

# Medico-Legal Update

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# MEDICO-LEGAL UPDATE

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# Suicidal Hanging Pattern: A Retrospective Review

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## ABSTRACT

Suicide is one of the ten leading causes of death in the world (> 400,000 deaths annually). The pattern of suicide and the incidence of suicide vary from country to country and cultural, religious and social values play important role in suicide. Our study's objective is to describe the epidemiology and pattern of suicide by hanging, in central region of Delhi. This five-year (1st January, 2006 to 31st December, 2010) retrospective study is carried out in the Department of Forensic Medicine, Lady Hardinge Medical College, New Delhi. Total 550 (19.89%) deaths of suicide by various means and out of total, 129 (23.45%) deaths were due to hanging. The highest number of suicide by hanging (n=45 cases, 34.88%) was in the age group of 21- to 30 years in both genders. The least number of hangings (n=7, 5.4%) deaths were in those over 50 years. Males (n= 96, 74.41%) outnumber females. The ratio of male to female suicide is 2.9:1. Peak hangings were in July and August (n= 33 cases, 25.58%) and least in May (5 cases, 3.8%). Maximum numbers of suicides were during morning hours (6-10 am) constituted 37 deaths (28.68%).

**Keywords:** Suicide, Hanging, Autopsy, Incidence.

## INTRODUCTION

Suicide represents a major health problem. Psychological autopsy study is always rewarding in providing vital information regarding the prevalent psychosocial and psychiatric risk factors associated with suicide. Globally, an estimated 815,000 people killed themselves in 2000, making suicide the 13th leading cause of death<sup>2</sup>. Suicide is now among the 3 leading causes of death of those aged 15–44 years. The WHO has estimated that each year over 1.6 million people lose their lives to violence. On the average, 2233 people commit suicide daily, roughly 1 person every 40 seconds<sup>31</sup>. The National Crime Record Bureau of India 2010 revealed the facts of suicides; the rate of committing suicide was 11.4 per lakh, in other-way total 15 people commit suicide every hour in India. Further, in the year 2009 total 1.35 lakh people committed suicide by various means, hangings constitute 31.5% of suicide in India. According to WHO report (2009) India stands on 41<sup>th</sup> position in suicide ranking worldwide.

## MATERIAL & METHOD

A retrospective review of all autopsies that were conducted at the Department of Forensic Medicine & Toxicology, Lady Hardinge Medical College (LHMC), New Delhi over the five-year period from 1<sup>st</sup> Jan. 2006 to 31<sup>st</sup> Dec. 2010 carried out. The suicidal hanging deaths further looked at in greater detail. The information was collected by the police and relatives, scene visits and autopsy findings. The selected cases were studied in detail as to the age, sex, marital status, ethnicity, social status, method employed for committing suicide and any possible underlying causes such as distressing life situations and psychiatric illnesses.

## RESULTS

A 5 years retrospective study from 1<sup>st</sup> Jan. 2006 to 31<sup>st</sup> Dec. 2010 is conducted in the Department of Forensic Medicine & Toxicology of Lady Hardinge Medical College, New Delhi. During this period total 2773 medico-legal autopsies were conducted in this college either dead body was brought directly from the scene of crime or admitted in associated hospitals of LHMC; Dr RML Hospital and Smt. Suchitra Kriplani Hospital.

Out of total 2773 autopsies, Out of these, 550 (19.89%) deaths were due to suicide by various means; out of total suicide deaths 129 (23.45%) deaths had committed suicide by hanging. Male were

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outnumbered, contributed 96 cases (74.41%) and 33 cases (25.58%) were females. The male and female ratio was 2.9:1. The maximum suicides by hanging were in age group of 21-30 years constituted 55 (42.63%) cases. In this age group males (n=40, 31.0%) were predominately committed suicide. There was only 15 cases (11.62%) were females. The age group 31-40 years was second to commit suicide by hanging that contributed 26 cases (20.15%), males were 24 cases (18.50%) and females 2 cases (1.55%) only. Third age group was 11-20 years whereas 24 cases (18.60%) including 12 males (9.30%) and 12 females (9.30%).

The overall young people (11-40 years) were vulnerable group to committing suicide by hanging. The committing suicide is a complex phenomenon; various factors are responsible to make person kill himself. Our findings suggest that maximum number of suicides were committed during morning hours between 6 am to 10 am constituted 37 cases (28.68%)

out of total 129 cases. In between 6 am to 12 noon it had contributed about 42% of total suicides by hanging and between after 12 noon and 6 pm contributed about 29%. Maximum suicides were committed between July to September i.e. 46 cases (35.65%).

Dribbling of saliva on angle of mouth was present in 33 (25.58%) cases while discharge of semen on tip of glans penis was seen in 10 (7.79%) cases. Eyes were opened in 67 (51.93%) cases and protrusion of tongue was seen in 56 (43.41%) cases. Hyoid bone was fractured in 6 (4.65%) cases and thyroid cartilage was fractured only in a single case. The ligature material was mostly duppta or wire and was present in 78 (60.46%) cases along with the body or in-situ. The most common site of knot was back (n=55, 42.63%) and minimum in front of neck (n=11, 8.52%) followed by right and left of the neck 24 (20.93%) and 39 (30.23%) respectively.

**Table 1: Distribution of Suicidal deaths by Hanging during period 2006 to 2010.**

| Year  | Male       |            |             |             |          |             | Female    |             |           |           |           |             | Grand Total | %     |
|-------|------------|------------|-------------|-------------|----------|-------------|-----------|-------------|-----------|-----------|-----------|-------------|-------------|-------|
| Age>  | 11-20 yrs  | 21-30 yrs  | 31-40 yrs   | 41-50 yrs   | >51 yrs  | Total       | 11-20 yrs | 21-30 yrs   | 31-40 yrs | 41-50 yrs | >51 yrs   | Total       |             |       |
| 2006  | 2          | 5          | 6           | 2           | 0        | 15          | 4         | 2           | 1         | 0         | 1         | 8           | 23          | 25.58 |
| 2007  | 1          | 6          | 5           | 4           | 0        | 16          | 2         | 2           | 0         | 1         | 1         | 6           | 22          | 17.05 |
| 2008  | 0          | 9          | 5           | 5           | 3        | 22          | 1         | 3           | 1         | 1         | 0         | 6           | 28          | 21.70 |
| 2009  | 4          | 12         | 3           | 1           | 1        | 21          | 2         | 4           | 0         | 0         | 0         | 6           | 27          | 20.93 |
| 2010  | 5          | 8          | 5           | 3           | 1        | 22          | 3         | 4           | 0         | 0         | 0         | 7           | 29          | 22.48 |
| Total | 12 (9.30%) | 40 (31.0%) | 24 (18.60%) | 15 (11.62%) | 5 (3.8%) | 96 (74.41%) | 12 (9.3%) | 15 (11.62%) | 2 (1.55%) | 2 (1.55%) | 2 (1.55%) | 33 (25.58%) | 129 (100%)  | 100   |

**Table 2: Year wise distribution of hanging cases with given findings**

| Year  | Total No. Of hanging | Discharge/ dribbling of saliva | Discharge of semen on glans | Fracture of Hyoid Bone | Fracture of thyroid cartilage |
|-------|----------------------|--------------------------------|-----------------------------|------------------------|-------------------------------|
| 2006  | 23                   | 3                              | 2                           | 2                      | 0                             |
| 2007  | 22                   | 10                             | 1                           | 1                      | 0                             |
| 2008  | 28                   | 9                              | 1                           | 0                      | 1                             |
| 2009  | 27                   | 5                              | 3                           | 2                      | 0                             |
| 2010  | 29                   | 6                              | 3                           | 1                      | 0                             |
| Total | 129                  | 33                             | 10                          | 6                      | 1                             |

**Table 3: Distribution of hanging deaths with findings of eye and tongue**

| Year  | Eyes opened | Protrusion of tongue |
|-------|-------------|----------------------|
| 2006  | 7           | 7                    |
| 2007  | 16          | 17                   |
| 2008  | 7           | 7                    |
| 2009  | 18          | 18                   |
| 2010  | 19          | 7                    |
| Total | 67          | 56                   |

**Table 4: Distribution of hanging deaths according to presence of ligature material along with dead body**

| Year  | Ligature material along with dead body | Percentage |
|-------|----------------------------------------|------------|
| 2006  | 16                                     |            |
| 2007  | 9                                      |            |
| 2008  | 9                                      |            |
| 2009  | 17                                     |            |
| 2010  | 27                                     |            |
| Total | 78                                     |            |

**Table 5: Distribution according to site of knot**

| Right    | Site of Knot |       |      | Total |
|----------|--------------|-------|------|-------|
|          | Left         | Front | Back |       |
| 1        | 4            | 3     | 6    | 14    |
| 3        | 7            | 1     | 9    | 20    |
| 4        | 6            | 0     | 7    | 17    |
| 4        | 8            | 2     | 12   | 26    |
| 4        | 6            | 1     | 12   | 23    |
| Total 16 | 31           | 7     | 46   | 100   |
| 24       | 39           | 11    | 55   | 129   |

**Table 6: Month-wise distribution of hanging deaths**

| Month     | Total No. of suicide by hanging | percentage |
|-----------|---------------------------------|------------|
| January   | 11                              |            |
| February  | 11                              |            |
| March     | 9                               |            |
| April     | 8                               |            |
| May       | 5                               |            |
| June      | 13                              |            |
| July      | 17                              |            |
| August    | 16                              |            |
| September | 13                              |            |
| October   | 10                              |            |
| November  | 9                               |            |
| December  | 7                               |            |
| Total     | 129                             |            |

**Table 7: distribution of hanging deaths as per time of incidence**

| Time          | No. of suicide | Percentage |
|---------------|----------------|------------|
| 6 - 10 am     | 37             | 28.68      |
| 10 am - 12    | 17             | 13.17      |
| 12+ 2 pm      | 21             | 16.27      |
| 2 - 6 pm      | 16             | 12.40      |
| 6 - 10 pm     | 22             | 17.05      |
| 10 pm - 12 pm | 11             | 8.52       |
| 12 - 6 m      | 5              | 3.87       |
| Total         | 129            | 100        |

## DISCUSSION

This study focuses only on hangings because it is the common method of suicide. Burn injuries and poisonings usually carry an element of doubt of whether it is suicide or homicide. The average annual incidence of medico-legal deaths in the Central region of New Delhi is 95.84 per 100000. Since there is stigma attached to suicide, there is a tendency to shy away from the truth in suicidal deaths. Furthermore, to establish a suicide by poisoning, laboratory findings are needed to confirm therefore real picture does not come out. Suicide is a complex phenomenon associated with

psychological, biologic, and social factors<sup>6</sup>. Some attempt to communicate pain, to reduce isolation, to avoid consequences of social status change, to seek revenge and convey a whole lot of other meanings that are essentially individualistic<sup>18,26,28</sup>. Hangings alone in Transkei<sup>19</sup> of South Africa are equivalent to the global suicide rate of 16 per 100,000. Rates per year are as high as 1 suicide per 1000 population (Falkland Islands) and 1 suicide per 1500 population (Hungary) are reported<sup>15</sup>. Hanging is 6.5 times more common in males than females<sup>19</sup> whereas in our study hanging is 2.90 times higher males than females. Men have a higher risk of suicide than women<sup>4,30</sup>. The trends noted in other areas of the world are in former socialist economies of Eastern Europe 4.3:1, United States 4.3:1, India 1.2:1, and China 0.9:1<sup>23</sup>. China is the only region where the rate of suicides was higher in females<sup>23</sup>. About 7% of men with a lifetime history of depression died by suicide, only 1% of women with a lifetime history of depression were died<sup>21</sup>. The predominance of suicide among males may be due to alcoholism and drug abuse and use violent methods<sup>16</sup>. Women usually use non-violent methods of suicides<sup>3</sup>. Women are more likely to ingest poisons than men<sup>21</sup>. Between 1994 and 1996, in most developed countries the male suicides under 35 years have increased disproportionately<sup>22</sup>. There is a 2-to 3-fold higher suicide among young males<sup>12</sup>. The young adults belonging to the age group 21 to 30 years were most prone to suicide (25.5%)<sup>24</sup> in concurrence to our study; 42.63% in the same age group. This is in contrast to the picture in some economically developed countries, where the incidence is highest in old age<sup>20</sup>. Financial hardship among young adults was the main underlying reason, identified in 87% victims of suicide<sup>19</sup>. The incidence of suicidal hanging was highest in May (43) and minimum in September (23) in Transkei of South Africa<sup>19</sup> contrast to our study whereas the highest hangings were in July (17) & August (16) and minimum in May (5). Depressive disorders are the fourth leading cause of disease and disability and are expected to rank second by 2020<sup>31</sup>.

The national suicidal incidence rate stands at 11 per 1 lakh per year according to a study conducted by NIMHANS, Bangalore<sup>13</sup>. Pattern of suicide in a region depends upon variety of factors, ranging from availability and access of the method, to the socio-economic status and the prevailing cultural and religious influences. Knowing the pattern of suicide in an area not only helps in early management of such cases but also suggests taking earliest preventive measures<sup>1</sup>. In a study, it was observed that 64% survived

the attempt of suicide and 36% succumbed death<sup>5</sup>. According to the study of Agarwal et.al<sup>2</sup> and Bhatia et al<sup>8</sup>, the common methods used for suicide were poisoning, hanging, drowning and burning. Insecticides such as malathion, paraquat and household items such as detergents, antiseptics were commonly used poisons<sup>27</sup>. Dode and Mohanty<sup>10</sup>, in their study of suicide in women, reports that menstruation related psyche could be held responsible for committing suicide. Even though, it is an accepted fact that no one single cause or a group of causes can give a complete explanation about the suicidal rate, certain factors like male sex, age, widowhood, single or divorced, childlessness, high density of population, a high standard of living, economic crisis, alcohol and addictive drug consumption, a broken home in childhood, mental disorders and physical illnesses have found to be positively correlated with a high suicide rate<sup>17</sup>. It is believed that suicide is a psychological term and should be supported by psychological evidence<sup>29</sup>.

Benett and Collins<sup>6</sup> reported, approximately 30,000 suicides each year and one suicide every twenty minutes occurred in the USA. Berman notes that the autopsy surgeon's responsibility for certifying the manner of death has important medical, legal, social, economical and research implications for the determination of criminal liability, payment of insurance benefits and establishment of public health records<sup>11</sup>. The psychological information, in the form of brief psychological autopsies would significantly affect the certifications in equivocal cases<sup>11</sup>. The instances of deliberate self-harm consists of suicide, parasuicide and suicidal gestures, the latter lacking the intention to kill though death may inadvertently ensue<sup>7</sup>. Differentiation between suicide, homicide, accident and other self-inflicted injuries merits paramount importance from medico legal standpoint. The opinion and decision of the autopsy surgeon about the manner of death may be crucial in initiating a homicide/suicide investigation.

### CONCLUSION

Hanging is the most common method of suicide all over the world. The high incidence of suicidal hanging among young adults, impose an enormous socio-economic burden on the society. Marital unhappiness, financial burdens, chronic non-curable illness, domestic violence, dowry harassment are the main causative factors of suicide. The Forensic investigator, to accurately assign the cause and manner of death in alleged suicides, he must be aware of the common methods of suicide, risk factors, socio-demographic

factors, cultural aspects and other established aetiologies in area.

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# Pattern of Head Injuries in Road Traffic Accidents in Imphal

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## ABSTRACT

This study was conducted at the mortuary of the Regional Institute of Medical Sciences during the period of September 2007 to August 2009 on 126 victims of road traffic accidents, who had sustained head injuries. It was observed that majority of the cases were in the age group of 21 - 30 years (28.57%) with the male: female ratio of 2:1. Pedestrians (38.89%) were the commonest victims and trucks were the frequent offending vehicles. Fissured fracture was observed in 54.72% followed by comminuted fracture in 33.96%. Temporal bone was the most frequent bone (33.96%) to be fractured. 43.42% of the victims had intracranial haemorrhage, of which 47.19% had subdural with subarachnoid haemorrhage. 77.5% had laceration of the brain and 31.25% had contre coup lesions. 38.10% died on the spot while another 38.10% died within 6 hours. The study highlights the need for implementation of stricter traffic rules and provision of emergency trauma services at the site of accidents.

**Keywords:** Road Traffic Accident, Head Injury, Pattern, Fracture, Intracranial Haemorrhage

## INTRODUCTION

In recent years, India witnessed a great increase in traffic density thereby putting a heavy burden on the country's already congested transport system. This in turn poses a great risk to the life of road users as is reflected by the increase incidence in mortalities and morbidities cause by Road traffic accidents (RTAs). According to the National Crime Record Bureau (2010)<sup>1</sup>, the number of vehicular accidents was 430600 resulting in 133938 deaths and 470600 injuries thereby accounting for 37.2% of all accidental deaths due to unnatural causes. Head injuries are the commonest in RTAs, head being the most vulnerable part of the body. Notwithstanding the vast improvements made in implementing the various road safety measures and the advancement in the field of medical sciences and technologies, head injury is still an area of great concern.

Therefore the present study was conducted to find out the pattern and distribution of head injuries due to RTAs and also the other associated factors.

## MATERIALS AND METHOD

The present study includes all cases of head injury due to RTAs brought for autopsy to the mortuary of Regional Institute of Medical Sciences, Imphal during the period of September 2007 to August 2009. Information regarding the particulars of the victim, type of offending vehicle, pattern of injuries etc was collected by examining the police papers, hospital records, interviewing the relatives of the victim and also the autopsy report.

## RESULTS

During the study period, 205 cases of RTAs were autopsied out of which head injury was noted in 126 cases. It was also observed that majority of the victims were in the age group of 21-30 yrs (28.57%) followed by 31-40 yrs (19.04%). Males (70.64%) outnumbered the females (29.36%) as shown in Table 1. Pedestrians (38.89%) were the victims in majority of the cases followed by two wheeler riders (23.81%) and occupants of vehicles (19.84%) as shown in Table 2.

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**Table 1: Age and sex distribution of victims**

| Age group (yrs) | Male | Female | Total | P.C % |
|-----------------|------|--------|-------|-------|
| 0-10            | 4    | 3      | 7     | 5.55  |
| 11-20           | 10   | 4      | 14    | 11.12 |
| 21-30           | 30   | 6      | 36    | 28.57 |
| 31-40           | 15   | 9      | 24    | 19.04 |
| 41-50           | 12   | 5      | 17    | 13.50 |
| 51-60           | 10   | 6      | 16    | 12.69 |
| >60             | 8    | 4      | 12    | 9.53  |
| Total           | 89   | 37     | 126   | 100   |

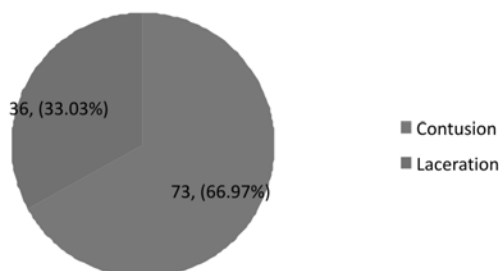
**Table 2: Type of victims with head injury**

| Victims           | No. | %     |
|-------------------|-----|-------|
| Pedestrian        | 49  | 38.89 |
| Two wheeler rider | 30  | 23.81 |
| Occupant          | 25  | 19.84 |
| Pedal cyclist     | 11  | 8.73  |
| Pillion rider     | 9   | 7.14  |
| Rickshaw puller   | 2   | 1.59  |
| Total             | 126 | 100   |
|                   | 126 | 100   |

In the present study, trucks were the offending vehicle in 34.13% of the cases followed by two wheelers (24.61%) as depicted in Table 3. Scalp was found to be injured in 109 cases, out of which haematoma was observed in 73 cases (66.97%) and scalp laceration in 36 cases (33.03%), as shown in Figure 1. There were 106 victims (84.12%) with skull fracture, as shown in Table 4, out of which fissured fracture and comminuted fracture were observed in 54.72% and 33.96% of the cases respectively.

**Table 3: Type of offending vehicle**

| Offending vehicle | No. of cases | %     |
|-------------------|--------------|-------|
| Truck             | 43           | 34.12 |
| Two wheeler       | 31           | 24.61 |
| LMV               | 26           | 20.64 |
| Bus               | 20           | 15.87 |
| Three wheeler     | 4            | 3.17  |
| Tractor           | 2            | 1.59  |
| Total             | 126          | 100   |

**Figure 1: Showing scalp injury****Table 4: Types of Skull Fracture**

| Type of Skull Fracture | No of cases | %     |
|------------------------|-------------|-------|
| Fissured               | 58          | 54.72 |
| Comminuted             | 36          | 33.96 |
| Suture                 | 4           | 3.77  |
| Combination            | 8           | 7.55  |
| Total                  | 106         | 100   |

In the present study, the most frequent cranial bone to be fractured was the temporal bone (33.96%) followed by parietal bone (26.42%) as illustrated in Table 5. As shown in Table 6, base of the skull was observed to be fractured in 65 cases and the middle cranial fossa (46.16%) was the most frequently involved followed by posterior cranial fossa (33.84%).

**Table 5: Type of cranial bone fractured**

| Type of Cranial bone | No. of cases | %     |
|----------------------|--------------|-------|
| Frontal              | 20           | 18.87 |
| Parietal             | 28           | 26.42 |
| Temporal             | 36           | 33.96 |
| Occipital            | 22           | 20.75 |
| Total                | 106          | 100   |

**Table 6: Distribution of fracture base of skull**

| Site of base fracture   | No. of cases | %     |
|-------------------------|--------------|-------|
| Anterior cranial fossa  | 13           | 20.00 |
| Middle cranial fossa    | 30           | 46.16 |
| Posterior cranial fossa | 22           | 33.84 |
| Total                   | 65           | 100   |

Intracranial haemorrhage was observed in 89 cases (43.42%). The commonest type was the combination of subdural and subarachnoid haemorrhages (47.19%) followed by subarachnoid haemorrhage (20.23%) as depicted in Table 7. In the present study, brain was found to be injured in 80 cases, out of which 77.5% were brain lacerations and 22.5% were brain contusions as depicted in Figure 2. Contrecoup brain lesions were observed 31.25% out of which 18 were lacerations and 7 were contusions.

**Table 7: Distribution of Intracranial haemorrhages**

| Intracranial haemorrhage | No of cases | %     |
|--------------------------|-------------|-------|
| Extradural (EDH)         | 2           | 2.25  |
| Subdural (SDH)           | 11          | 12.35 |
| Subarachnoid (SAH)       | 18          | 20.23 |
| Intracerebral (ICH)      | 2           | 2.25  |
| EDH + SAH                | 2           | 2.25  |
| EDH + SDH                | 8           | 8.99  |
| SDH +SAH                 | 42          | 47.19 |
| More than 2              | 4           | 4.49  |
| Total                    | 89          | 100   |

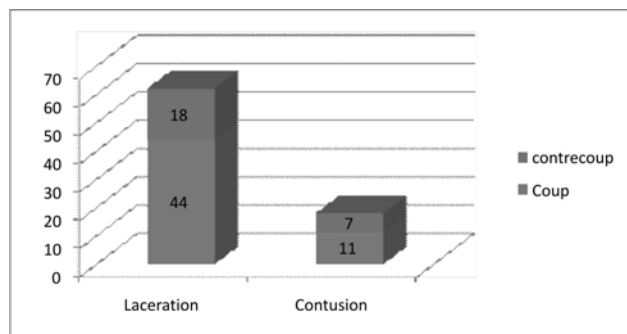


Fig. 2. Showing brain injury

As shown in Fig. 3, 101 (80.16%) cases died following head injuries while the remaining 25 cases (19.84%) had associated fatal injuries on the other parts of the body. 38.10% of these cases died on the spot while another 38.10% died within 6 hours (Table 8).

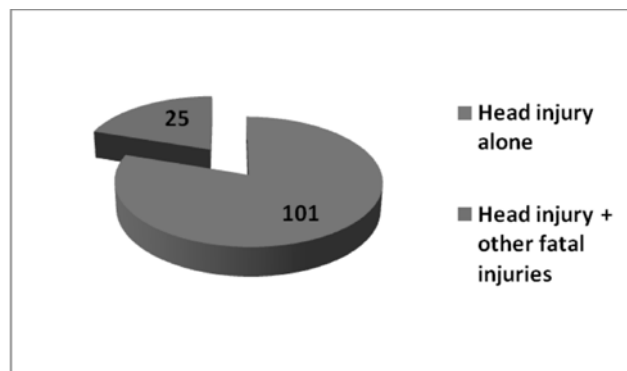


Fig. 3. Victims with the head injury alone and with other associated fatal injuries

Table 8: Survival period of the victims following injury

| Survival period | No of cases | %     |
|-----------------|-------------|-------|
| Spot            | 48          | 38.10 |
| <1 hr           | 25          | 19.85 |
| 1 – 6 hr        | 23          | 18.25 |
| 6 – 12 hr       | 11          | 8.74  |
| 12 – 24 hr      | 5           | 3.96  |
| 1 – 3 days      | 10          | 7.93  |
| 3 – 7 days      | 4           | 3.17  |
| Total           |             |       |

## DISCUSSION

Head injury was present in 61.46% of all cases of RTA which is consistent with the findings of Dhillon S et al. <sup>2</sup> (62%) and Sharma BR et al. <sup>3</sup> (58%). Majority of the victims were in the age group of 21-30yrs which correspond to the findings by Tripude BH et al. <sup>4</sup> and Menon A and Nagesh KR <sup>5</sup>. Similar findings of male preponderance in this study were observed by other workers <sup>4,5,6</sup>.

Pedestrians, two wheeler riders and occupant of vehicles were the frequent victims, which is in agreement with other studies <sup>4,5</sup>. Gupta S et al. <sup>7</sup> also reported pedestrians (44%) and two wheeler riders (19%) as the commonest victims. This shows the non compliance of traffic rules by pedestrians and reckless driving of vehicles on the roads, e.g. not using footpaths, ignoring zebra crossings, over speeding, etc. The increasing trend of people driving two wheelers, tendency to drive fast and not using helmets (which in the present study, none were using) could be the reasons for the increased incidence of head injury in two wheeler accidents.

According to Tandle RM and Keoliya AN <sup>8</sup> trucks were the frequent offending vehicle (59.81%) which was also observed in the present study. In the present study, scalp injury was not observed in 15.05% of the cases as similarly observed by Dhillon S et al. <sup>2</sup> (22%). This is significant as it indicates craniocerebral injuries could occur without any scalp injury. The common injuries to the scalp were contusions and lacerations as also reported by Gupta A et al. <sup>9</sup> and Sharma BR et al. <sup>3</sup>

Head injury is the commonest fatal injury in RTA. However, injury to the cranium alone is not much significant unless there are associated intracranial lesions. Very often severe and fatal head injuries are produced without any fracture to the skull. This is seen in the present study where no skull fracture occurred in 15.87% of the cases with head injuries. This is in conformation with Reddy KSN <sup>10</sup> who stated that severe and fatal brain injury may occur without fracture of the skull. Similarly, Pathak A et al. <sup>6</sup> found that skull fracture was absent in 22.78% of the cases. However, skull fracture was noted in 84.12% of the cases which is in agreement with Sharma BR et al. <sup>3</sup> (88.1%) and Gupta A et al. <sup>9</sup> (74%). Fissured fracture was the commonest type of skull fracture as similarly observed by Menon A and Nagesh KR <sup>5</sup>, Pathak A et al. <sup>6</sup>. The most frequent cranial bone to be fractured was temporal bone (33.96%) which may be compared with the findings of Kumar A et al. <sup>11</sup> (47.25%) and Gupta S et al <sup>7</sup> (45.45%). This could be explained by the fact that the thinnest area in the outer skull is the temporal bone (4 mm), followed by frontal bone (6 mm), parietal bone (10 mm) and occipital bone (15mm)<sup>12</sup>. Middle cranial fossa was the commonest part of the base of skull to be fractured which was also observed by other authors <sup>4,7</sup>.

Singh H and Dhattarwal SK <sup>13</sup>, Menon A and Nagesh KR <sup>5</sup> observed that subdural haemorrhage was the most frequent intracranial haemorrhage. In the present study, a combination of Subdural and Subarachnoid haemorrhages constituted the commonest intracranial haemorrhages.

In the present study, brain was injured in 63.49% of the cases which is consistent with Tripude BH et al.<sup>4</sup> (51%) and Gupta A et al.<sup>9</sup> (65%). Contrecoup lesions were noted in 31.25% of the cases with brain injuries. Kual A et al.<sup>14</sup> reported low incidence (9.03%) which may be because their study is not confined to head injuries only.

Kumar A et al.<sup>11</sup> also observed a pre-hospital mortality of 39.84% in head injury cases following RTA. Similarly, in the present study, 38.10% of the cases died on the spot while another 38.10% died within 6 hours. This emphasizes the need of emergency care in such cases. It is a known fact that, deaths have declined due to improved treatments and systems for managing trauma in societies wealthy enough to provide modern emergency and neurosurgical services<sup>15</sup>.

### CONCLUSION

Head injury is a serious and frequent type of trauma in road traffic accidents. From the present study, it may be concluded that stricter implementation of traffic rules and promotion of road safety measures by the concerned authority viz. the use of helmets and seatbelts, avoidance of over speeding, using footpaths, etc. is the need of the hour. It also highlights need of emergency trauma services at site of the occurrence for reducing morbidity and mortality in such cases.

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# Fatal Curling's Ulcer after Burns in a Child-A Case Report

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## ABSTRACT

Burns are the most frequently recognized severe form of trauma occurring in childhood. The association of acute gastrointestinal tract disease with burn injury is known since first half of the 19th century. Curling's ulcer is a recognized complication of burn shock which occurs in the gastrointestinal tract in burned patient. It manifest during the second week, when infection and toxic absorption from the separating sloughs is predominant. It will be diagnosed only in the event of haemorrhage, perforation, or at necropsy, and presumably these do not occur in every case. Prognosis in Curling's ulcer is always serious, especially in children, death occurring most often from haemorrhage or perforation.

A rare case of acute duodenal ulcer in a nine-month-old infant after deep burns of both lower extremities is described. It gives the impression that it is necessary to take into consideration the possibility of Curling's ulcer in every case of deep and extensive burns in children.

**Keywords:** Burns, Curling's Ulcer, Haemorrhage, Perforation.

## INTRODUCTION

Curling's duodenal ulcer a delayed complication of burns<sup>1,2</sup> associated with stress<sup>3</sup> is a rarity in children<sup>2</sup>. These ulcer can cause perforation and haemorrhage due to mucosal injury<sup>2,3</sup>. Manifestation of Gastric ulcers during the first three days in burn patients is due to initial hypotension, hypoxia and resultant mucosal ischemia which can bleed. Bleeding associated with the onset of sepsis usually occurs late, between 10days to 2 weeks following thermal injury<sup>3</sup>. Curling's ulcer by nature if found in stomach are multiple, superficial and if found in duodenum, are solitary, deeper and penetrating<sup>1</sup>. Gastrointestinal (G1) ulceration complicated by haemorrhage used to be potentially lethal after severe burn injury. In our case, the perforation of such Curling's ulcer has resulted in death of a child.

## CASE REPORT

A nine year old girl sustained burn injuries due to accidental fall of a burning kerosene lamp and sustained 47% of burns over the entire lower limbs (Fig. No: 1) and a part of abdomen and upper limbs. She was hospitalised in Kasturba Hospital, Manipal after first aid in a local hospital in a nearby village. Necessary treatment was initiated and continued to treat the patient. In due course the burn injuries got infected. Endoscopy was done during the treatment, which showed a duodenal ulcer which necessitated an exploratory laparotomy. Laparotomy revealed profuse arterial bleed due to perforation of the Curling's ulcer over the duodenal artery which is located at 2<sup>nd</sup> part of duodenum. Patient developed cardiac arrest and died subsequently. She survived for 11 days.



Fig. No. 1. Burn injury over the entire lower limbs

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At autopsy, the burn wounds showed greenish yellow slough at places indicative of infection. Internal examination revealed 100ml of blood in peritoneal cavity with a perforation of the duodenum in the posterior wall, measuring 1.5 X 1 cm at its 2<sup>nd</sup> part (Fig. No: 2). All the organs were pale.



Fig. No. 2. Perforation of the duodenum in the posterior wall

Cause of death: haemorrhage resulting from perforated duodenal ulcers secondary to burns.

## DISCUSSION

Stress ulcerations of the gastrointestinal tract are a common cohort of traumatic/surgical injury to the central nervous system, sepsis, shock, massive burns, long use of NSAID group of analgesics and steroids. Acute ulceration of the stomach or duodenum in a burn patient was first described by Swan in 1823.<sup>4</sup> Similar ulcers were found in 10 burn patients of Curling.<sup>5</sup> Pruitt et al. reported an 11.7% incidence of Curling's ulcer in 323 autopsies performed in 2772 burn patients treated in their unit. Pruitt's review reported that the incidence of haemorrhage was 64% and that of perforation 12%.<sup>6</sup> Gastric ulcers are first to appear, which are multiple, superficial and more common than duodenal.<sup>1,2,7</sup> Duodenal ulcers are deeper and mostly single and penetrating, resulting in haemorrhage.<sup>1,2</sup> Gastric mucosal ischemia caused by burns is thought to be a major causative factor in these ulceration of the upper gastrointestinal tract seen in association with burns.<sup>8-</sup>  
<sup>15</sup> Sepsis was identified as a contributing factor in the aetiology of stress ulcer complications. Yang et al<sup>16</sup> reported that 574 of 4684 patients developed burn wound sepsis and that 10.8% of this cohort manifested GI bleeding, compared with only 0.3% of the non-septic patients. Curling's ulcer is the most frequent life-threatening gastrointestinal impediment in burn patients because of its penetrating nature. It is most commonly encountered in patients with more than 50% of burnt body surface area.<sup>2,6</sup> It is usually recognised as

a late complication of burns, becoming manifest during the second week, when infection and toxic absorption from the separating sloughs is predominant.<sup>17</sup> Pre existing sepsis, hypotension and hypoxia increase the incidence of Curling's ulcer formation.<sup>6, 18</sup> The most common clinical finding is painless gastro-intestinal hemorrhage. Blood loss is usually minimal but may be substantial and life-threatening carrying mortality risk of 50%.<sup>19</sup> When massive, the onset of bleeding is typically 2 - 3 days after the trauma. Hemorrhagic gastritis, which frequently occurs in the early post burn period,<sup>20</sup> often associated with ileus, may be particularly prominent at post-mortem examination of patients with extensive burns who died early post burn. This hemorrhagic gastritis though not direct precursor lesion of Curling's ulcer, at least damages the mucosa and renders it more susceptible to ulceration as suggested by Goldman and Rosloff.<sup>21</sup> Any evidence of gastrointestinal bleeding later in the post burn period should suggest the diagnosis of Curling's ulcer. Bleeding from this entity is commonly trivial and ceases with resumption of gastrointestinal function.

## CONCLUSION

In case of burn patients with Curling's ulcer, the prognosis is poor, especially in children, death occurring most often from haemorrhage or perforation. So early detection and prompt management is essential in such cases. Early prophylaxis for stress ulcers in burn patients reduces GI complications, including bleeding. As successfully practised and endorsed by Fadaak H.A,<sup>22</sup> early enteral feeding in these patients as an additional measure for ulcer prophylaxis. If the conservative treatment of the ulcer and its complications maintained until the burns heal, the mortality and morbidity can be reduced significantly. As a forensic pathologist, we have to be familiar with the fact that Curling's ulcer though a rare complication, can be fatal in victim of burns, especially so in children.

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# Socio-demographic Profile of Electric Injuries at a Tertiary Care Mamata General Hospital Khammam, Andhra Pradesh

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## ABSTRACT

Socio-Demographic profile of electrical injuries is studied for a period of one year from October 2007 to September 2008. During this study period, 62 cases were admitted at Mamata General Hospital with history of electrical injuries. The most of the victims were males 57 [91.93%] and females 5 [08.06%] with a male to female ratio was 11.4:1. The peak incidence of electrical injuries was seen in the age group of 21 to 40 years in both sexes with male predominance [91.93%]. Majority of victims were married [62.90%] and Hindus [91.93%] with rural background [61.29%]. Highest number of victims were belong to low socio-economic group [64.52%]. Majority of victims were literate [49.10%] and the remaining were unskilled personnel [66.13%]. Majority of accidents were due to low voltage circuits [ $<1000$  v] [67.74%] as compared to accidents due to high voltage circuits [32.26%]. With reference to occupation 30.64% of electrical injuries occurred to labor class. Most of the victims were affected during day time [95.16%]. Majority of cases occurred during monsoon season [54.84%] with lowest number of cases occurring in rainy season. Majority of cases were involved with electrical injuries at work place [48.39%]. Domestic accidents were responsible in 59 cases [91.94%]. 5 cases succumbed to death due to accidental electrocution, all of which were males. All cases were accidental in nature. Suicidal and homicidal cases were not found in this study. The most common cause of death was cardiac arrest due to ventricular fibrillation.

**Keywords:** Socio, Demographic Profile, Electrical Injuries

## INTRODUCTION

Electricity is an integral part of modern society. It is a source of power, energy, and rhythm in today's life. Without electricity the existence of human life seems difficult in current scenario, it has the capacity to stand life as well as to destroy it. Most fatalities caused due to electricity are accidental and result from passage of an electric current, both low and high voltage, through the body. Suicides and homicides from electrocution are very rare but alternate current is the usual culprit. Lack of awareness, not operating as per standards and availability of cheap alternates at low cost are common causes of electrocution. This leads to penalty of lives and an increase in the electrical fatalities.

## MATERIALS AND METHOD

In present study, a total of 62 electrical injury cases were admitted in Mamata General Hospital, Khammam, Andhra Pradesh, during the study period of one year from October 2007 to September 2008. In this study

the cases were evaluated in reference to socio-demographic profile. Data was collected, statistically analyzed, compared with previous literature and conclusions were drawn.

## OBSERVATIONS

Data was analyzed observations are noted and tabulated. A total of 62 cases were admitted during the one year study period from October 2007 to September 2008. The majority of victims were male 57 [91.93%] as compared with female victims 5 [08.06%] and male to female ratio was 11.4:1.

The most common age group involved was 21 to 30 yrs [38.70%], followed by 31 to 40 yrs [22.58%] and 11-20 yrs [20.96%], next is 0-10 yrs [4.83%] and least were 51-60 yrs [3.23%]. While only one case was seen in 61-70 yrs. In present study victims age 70 years and over were not found. The mean age of males was 26.05 yrs and that of female was 28.04 yrs as depicted in table no.1.

**Table No. 1. age &gender**

| Year   | Male | Female | Total | %     |
|--------|------|--------|-------|-------|
| 0 -10  | 1    | 2      | 3     | 4.84  |
| 20-Nov | 13   | 0      | 13    | 20.97 |
| 21 -30 | 22   | 2      | 24    | 38.71 |
| 30 -40 | 14   | 0      | 14    | 22.58 |
| 41 -50 | 5    | 0      | 5     | 8.06  |
| 51 -60 | 1    | 1      | 2     | 3.23  |
| 61 -70 | 1    | 0      | 1     | 1.61  |
| Total  | 57   | 5      | 62    | 100   |

**Table No. 2. Educational status**

| Education   | Cases | %     |
|-------------|-------|-------|
| Primary     | 9     | 14.52 |
| High school | 5     | 8.06  |
| Secondary   | 22    | 33.87 |
| Graduate    | 8     | 12.09 |
| Illiterate  | 19    | 30.65 |
| Total       | 62    | 100   |

**Table No. 3. Marital status**

| Status     | Cases | %   |
|------------|-------|-----|
| Married    | 39    | 63  |
| Un married | 23    | 37  |
| Total      | 62    | 100 |

**Table No. 4. Socio economic status**

| SES    | Cases | %    |
|--------|-------|------|
| Lower  | 6     | 9.68 |
| Low    | 40    | 64.5 |
| Middle | 14    | 22.6 |
| Upper  | 2     | 3.23 |
| Total  | 62    | 100  |

**Table No. 5. Occupational wise**

| Occupation     | Cases | %    |
|----------------|-------|------|
| House wife     | 1     | 1.61 |
| Student        | 8     | 12.9 |
| Agriculture    | 10    | 16.1 |
| Laborer        | 19    | 30.6 |
| Govt. employee | 7     | 11.3 |
| Others         | 3     | 4.84 |
| Electrician    | 14    | 22.6 |
| Total          | 62    | 100  |

**Table No. 6. Seasonal variation**

| Season  | Months              | No. | %    |
|---------|---------------------|-----|------|
| Summer  | Mar,aprial,may,june | 10  | 16.1 |
| Monsoon | July,aug,sept,octo  | 34  | 54.8 |
| Winter  | Nov,dec,jan,feb     | 18  | 29   |
| Total   |                     | 62  |      |

Religion wise the majority of the victims were from the Hindu community [91.93%] followed by victims from the Muslim community [06.45%] and minimum victims were from the Christian community [01.61%].

Incidences of electrical injuries were higher in married people [69.90%] when compared to unmarried people [37.10%] as depicted in table no.3.

According to Region, the rural victims out-numbered [61.29%] the urban victims [38.10%].

According to educational level of victims, majority of the victims were secondary educated [33.87%] followed by illiterate victims [30.65%], then primary educated victims [14.52%], and lastly graduate group victims were minimum in number [12.90%] involved as depicted in table no.2.

Regarding to occupation, laborer class was top among the other occupations [30.64%], followed by Electricians [22.58%], Agriculturists 16.13%, students [12.90%], Government employees [11.29%], and house wife were least [01.61%] as depicted in table no.5.

We observed that the workplace [48.39%] is the most common place of incident, followed by at home [25.80%], next is regions surrounding electrical poles 20.97% and the minimum number of incidents were seen at factories [04.84%].

As per socioeconomic group, majority of the victims belong to a low class [74.19%] followed by victims in middle class 14 [22.58%] and minimum number of victims are from upper class 2 [03.28%] as depicted in table no.4.

According to source of current, majority of electrical accidents are due to low tension [<1000v] [67.74%] as compared to high tension electrical accidents [>1000v] [32.26%].

Most of the cases were due to domestic circuits [95.16%] as compared to industrial circuits [04.85%].

Majority cases were involved during monsoon season [54.84%] during the months of July, August, September, and October followed by winter season [29.03%], and summer season [16.13%] as depicted in table no.6.

The peak of incidences occurred during the day [95.16%] as compared to during the night [04.84%]. In our study, unskilled personnel were most commonly involved [66.13%] as compared to skilled personnel [33.87%].

The majority of victims have received treatment within one hour of sustained injury [69.35%] followed by victims receiving treatment within 1-2 hours [17.74%] and victims received treatment after more than 2 hours [04.84%]. As per hospital stay the majority of victims were admitted within 3 days [64.51%] followed by victims admitted within 3-10 days [25.80%] and victims admitted after than 10 days of injury [01.61%]. The results reveal that the maximum number of victims were discharged after treatment are [64.52%] followed by referred victims [16.13%], victims left against medical advice [11.29%], lastly victims who died [08.06%].

As for the manner of incident, we have found that all cases were accidental in nature and no suicidal or homicidal cases were reported.

## DISCUSSION

In India, death occurs mostly at the voltage between 220v-240v alternative current<sup>17,22</sup>, death due to low voltage had also been reported<sup>9,15</sup>. The rapid wide spread utilization of electricity is associated with increase of both non-fatal and fatal injury<sup>19</sup>. Deaths from electrocution are uncommon and are usually due to ventricular fibrillation<sup>1-23</sup> when heart is directly affected, or respiratory paralysis from the involvement of respiratory centers in the brain stem or directly due to burns or failure of viscera. The effects of electricity depends on the voltage, the type of current [direct / alternating], the area of contact, the duration of contact, the skin resistance and the path of current flow through the tissues and organs<sup>11,16</sup>. An electrical burn occurs only if the temperature of the skin is raised enough for a sufficiently long period to produce damage<sup>20</sup>. The skin resistance is an important factor in determining current flow and is influenced by the wetness or dryness of the skin and the region of the body in contact with an electrical conductor<sup>11,23</sup>. A glancing contact or fall against conductor results in a break in the circuit. In cases of high-tension supplies the victim is usually repelled violently. The fatal injuries may then be due to fall<sup>20</sup>. Nevertheless there can be enough current to make it difficult for a person to remove his body parts<sup>4</sup>. The analysis of medical literature confirms the rarity of suicide or homicide from electrocution<sup>4,14,16</sup>. In this study the most of the accidents are the result of accidental contact with electricity at domestic supply<sup>3,5,7,8</sup>. In our study these deaths are found to account for 0.811% of all medico-legal deaths in our region.

As expected, the highest number of electrical injuries is seen in males [91.93%] as compared to females [08.06%]. This male predominance was reported by other studies<sup>1-23</sup>. This is probably due to the fact that only males are involved in electrical works.

Most common age group involved was 21-30 yrs 24 [38.71%] followed by 31-40 yrs 14 [22.58%] and least were 11-20 yrs 13 [20.97%]. People of 21-30 yrs age group are more vulnerable to electrical injuries due to exposure to variety of electrical equipment in working place whereas at extreme ages the electrical fatality was rare. Similar findings are noted by previous studies<sup>13,18</sup>.

3 Children were got electrical burns, either due to playing, kite removal, and touching electrical equipment. This is consistent with<sup>8</sup>

Married people are usual victims 39 [62.90%] as compared to unmarried people [37.10%] because married people were continuously under strain and stress at occupation.

Majority of victims 57 [91.93%] were from Hindu religion because Hindus are in majority in our country compared to other religions.

Rural 38 [61.29%] victims out-numbered urban [38.70%] victims due to lack of proper education and knowledge about current motors and electrical appliances. The literates are more likely to experience electrical injuries including secondary 22 [33.87%] and primary educated people [14.52%] when compared to illiterates 19 [30.65%].

Laborer class were 19 [36.64%] top among the other occupations that were involved in electrical injuries. These are consistent with previous studies<sup>8,18</sup>.

Majority of victims belong to low socioeconomic group 40 [64.52%] these are consistent with previous studies<sup>8</sup>. Low and medium classes who are always under continuous work and occupational exposure are more susceptible to electrical injuries than people in upper socioeconomic class.

Domestic accidents are responsible for maximum cases 59 [95.16%]<sup>17,18,19-21</sup> whereas industrial accidents are responsible for 3 cases [4.83%]<sup>3,7,8</sup>. Ignorance faulty domestic appliances, frayed or broken flex of electric cables improper earthing accounts for many of the domestic accidents<sup>16</sup> WERE REPORTED

Most of the electrical accidents in this study 42 [62.74%] were due to low voltage<sup>6,7,9,10</sup>.

The general house hold electricity supply in India is 240volts of 50cycles per second, sothis domestic supply is classified as low [<1000v] and high [>1000v] voltage<sup>7,8,12,22</sup>

Whereas in death cases, 4 out of 5 deaths were due to high voltage <sup>11</sup> and only one case was due to low voltage

The majority of victims were unskilled personnel 41 [66.13%] when compared to skilled personnel 33.87%, in the previous studies it is ranged 65%.

Majority cases were involved during Monsoon season 34 [54.84%].This clearly explains that a large number of cases occur during rainy season and a lower number of cases occur during summer season. These are opposite to western studies<sup>1-6,16,18</sup> and similar to Indian studies <sup>8,12</sup>.

Reference to time of incident, the majority of 59 [95.16%] cases occurred during the day time<sup>7,17,18</sup> . Analyzing the place of occurrence, it reveals that the commonest place of occurrence is at the work place [48.39%].This is consistent with previous study <sup>8</sup>. This is because working people are more vulnerable for electrical injuries at work place. Underestimation of the danger of live circuits and carelessness plays a large part in work place incidents <sup>16</sup>.

Manner of incident, all 62 cases were accidental in nature, suicidal and homicidal cases were not reported. These are consistent with other studies <sup>3,7,12,17</sup>.

In death cases, out of 5 deaths, 4 cases were spot dead and 1 case was brought dead as a result of ventricular fibrillation which is the most common cause of death due to electrocution. These are consistent with previous studies <sup>16,17,20</sup>. The electric current is particularly dangerous when it is uses one of the circuits involving the heart muscles.

## CONCLUSIONS

In the present study, all cases are accidental in nature.

Young age and married men were found to be affected more.

Majority was from rural, Hindu community and belongs to low socioeconomic group

Literates slightly dominates illiterates

Laborerswere top among other occupations involved

The incidence was more at work place and during day time

Maximum cases encountered during monsoon season.

Domestic accidents were more common than industrial and most of victims were unskilled personnel, affected by low voltage.

From the present study we concluded that it is evident and important that electrocution deaths be through documented and investigated for safety, prevention and compensatory reasons.

while deaths due to electrical injuries are low [5cases out of 62 ] compared with deaths due to other injuries ,there is still scope for reduction in number by taking preventable measurements such as recent advances in electrical safety equipment in the home and update standards for electrical appliances at industries could be provided a degree of protection from electrical injury.

The main causes of electrocution is human negligence, faulty electrical equipment, poor connections, and lack of protective and safe measures

These injuries can be prevented with proper educational and training programs designed for the society and industry about the equipment.Precautions should be taken while working with electrical equipment and use of protective and safe measures can help one avoid accidental electrocution.

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# Blast Injuries and Explosive Material- A Review Article

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## ABSTRACT

The primary goal of writing this article is to focus on addressing blast knowledge gaps. Understanding what we know about blast injuries is just as important as understanding what we don't know. Bomb blast injuries to civilians in non-combat setting have become increasingly common over the last decade mainly as act of terrorism. Blast injuries are no longer confined to war fields but has concerned of civil life with the ever present threat of terrorism. We should always be prepared for bomb blasts. Bomb blast injuries tend to affect air containing organs more, as the blast waves tend to exert a shearing force on air tissues interfaces. Commonly injured organs include the tympanic membranes, the sinuses, the lungs and the bowel. Of these blast injuries lung injuries are most challenging to treat. It must be born in mind that bomb blast could also be used to disperse radiological and chemical agents. This comprehensive review of blast injuries, terrorists use whatever is available - illegally obtained manufactured weapons or improvised explosive devices (IEDs) that may be composed of HE (High order explosives) or LE (Low order explosive), or both. A manufactured and improvised bombs cause markedly different injury, which may provide the detail knowledge of blast materials.

**Keywords:** Blast Injury, Terrorism, High Order Explosive, Low Order Explosive, Improvised Explosive Device (IED).

## INTRODUCTION

The bomb is a container filled with an explosive mixture and missiles, which is fired either by detonator or a fuse<sup>3</sup>. Explosions have the capability to cause multisystem, life-threatening injuries in single or multiple victims simultaneously. These types of events present complex triage; diagnostic, and management challenges for the health care provider. Explosions can produce classic injury patterns from blunt and penetrating mechanisms to several organ systems, but they can also result in unique injury patterns to specific organs including the lungs and the central nervous system. Understanding these crucial differences is critical to managing and investigating these situations.

The extent and pattern of injuries produced by an explosion are a direct result of several factors including

the amount and composition of the explosive material (e.g. the presence of shrapnel or loose material that can be propelled, radiological or biological contamination), the surrounding environment (e.g. the presence of intervening protective barriers), the distance between the victim and the blast, the delivery method and any other environmental hazards<sup>2</sup>. No two events are identical and the spectrum and extent of injuries produced widely variable. Much of the challenge facing the care providers is the potential for the sudden creation of large numbers of patients who require extensive medical resources. This scenario can overwhelm Emergency Medical Service (EMS) and hospital resources. Emergency physicians must remain attentive to the possibility and consequences of blast injuries. The investigating agencies also must remain attentive and in contact to health service providers to enhance and find out the material type used in blast. Once notified of a possible bombing or explosion, hospital-based physicians should consider immediately activating hospital disaster and contingency plans, including preparations to care for anywhere from a handful to hundreds of victims.

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## **Historical prospective of Blasts in India<sup>7</sup>**

**March 12, 1993:** A series of thirteen explosions in Mumbai resulted in 257 deaths and over 700 injuries. The blasts were orchestrated by the organized crime syndicate called the D-Company, headed by Dawood Ibrahim.

**Feb. 14, 1998:** Coimbatore bombings: 46 deaths, 200 wounded as a result of 13 bomb attacks in 11 places.

**Oct. 1, 2001:** Militants attack Jammu & Kashmir Assembly complex in Srinagar, killing about 35. The Muslim extremist group Jaish-e-Mohammed was allegedly involved.

**Dec. 13, 2001:** Attack on the Indian Parliament complex in New Delhi led to the killing of a dozen people and 18 injured. Pakistan-based terror groups were blamed for the attack.

**Sept. 24, 2002:** Akshardham temple in Gujarat: 31 people were killed and another 79 wounded.

**May 14, 2002:** Militants attack on an Army camp near Jammu, killing more than 30 people.

**March 13, 2003:** A bomb attack on a commuter train in Mumbai killed 11.

**Aug. 25, 2003:** Twin car bombings in Mumbai killed at least 52 people and injured 150. Indian officials blamed a Pakistan-based terror outfit.

**Aug. 15, 2004:** An explosion in the north-eastern state of Assam killed 16 people, mostly victims were school children.

**July 5, 2005:** Militants attack the Ram Janmabhoomi complex, the site of the destroyed Babri Mosque at Ayodhya in Uttar Pradesh.

**Oct. 29, 2005:** Three powerful serial blasts rocked the busy shopping areas of south Delhi, two days before the Hindu festival of Diwali, killing 59 and injuring 200. A Pakistan-based terrorist outfit, the Islamic Inquilab Mahaz (believed to have links with Lashkar-e-Taiba) claimed responsibility.

**March 7, 2006:** A series of bombings in the holy city of Varanasi killed at least 28 and injured 101. Indian police put the blame on some Pakistan-based terror outfits.

**July 11, 2006:** Seven bomb blasts occurred at various places on the Mumbai Suburban Railway, killing 200. Investigations revealed that terror outfits with a base in Pakistan were behind the blasts.

**Sept. 8, 2006:** At least 37 people were killed and 125 were injured in a series of bomb blasts in the vicinity of a mosque in Malegaon, Maharashtra. The blasts were followed by an explosion and most of the people killed were Muslim pilgrims. The students Islamic Movement of India was allegedly responsible.

**February 19, 2007:** Two bombs explode in Samjhauta Express on board a train bound from India to Pakistan, burning to death at least 66 passengers, most of them were Pakistani.

**May 18, 2007:** A bombing during Friday prayers at Mecca Masjid, Hyderabad, killed 13 people.

**May 26, 2007:** Six people killed and 30 injured in a bomb blast in India's north-eastern city of Guwahati.

**June 10, 2007:** Gunmen killed 11 people in separate incidents of firing in Manipur's border town of Moreh.

**Aug. 25, 2007:** Forty-two people killed and 50 injured in twin explosions at a crowded park and a popular eatery in Hyderabad by Harkat-ul-Jehad-i-Islami (HuJI) activist.

**October 2007:** Two people were killed in blast inside Ajmer Sharif shrine in Rajasthan during Ramadan.

**May 13, 2008:** A series of six explosions tore through Jaipur, a popular tourist destination in the Rajasthan, killing 63 people and injuring more than 150.

**July 25, 2008:** Seven blasts in quick succession across the south Indian tech city of Bangalore killed one and injured more than 150 people.

**July 26, 2008:** Serial blasts in the western Indian city of Ahmedabad killed 57 people and injured more than 150, in 20 synchronised blasts in less than two hours. A group calling itself Indian Mujahideen claimed responsibility.

**Sept. 13, 2008:** Five bomb blasts in New Delhi's popular shopping centres, left 21 people dead and more than 100 injured. The Indian Mujahideen claimed responsibility.

**September 27, 2008:** Three people killed, after a crude bomb is thrown in a busy market in Mehrauli, New Delhi.

**September 29, 2008:** Five people killed after a bomb kept in a motorbike goes off in a crowded market Malegaon, Maharashtra.

**October 21, 2008:** 17 people killed in a powerful blast near Imphal, Manipur Police Commando complex.

**October 30, 2008:** At least 77 killed and over 100 injured in 18 bombings across Assam.

**November 26, 2008:** 166 people killed in coordinated serial explosions and indiscriminate firing across Mumbai including the crowded CST railway station and two five-star hotels - Oberoi and Taj.

**February 13, 2010:** 17 people killed and over 60 injured when a bomb rips out the famous German bakery in the Pune city.

**December 7, 2010:** Two-year-old girl killed and 25 others injured in a blast which takes place between the Dashashwamedh and Shitla ghats on the river Ganga, Varanasi.

**July 13, 2011:** Three bomb blasts in Mumbai; at least 20 people killed and more than 100 injured.

**September 7, 2011:** Terror struck Delhi, Wednesday, when a powerful bomb went off outside the Delhi High Court at 10.17 am. At least 13 persons were confirmed dead, while more than 76 others were injured.

## Classification of Explosives<sup>3,4</sup>

The explosives materials are classified in different categories based on contents of the explosive substance. Following are the categories:

### A. High Order Explosive (HE)

- Produce a supersonic high pressure oscillatory shock wave
- Examples include TNT, C-4, Semtex, dynamite Semtex, nitroglycerin, dynamite, and ammonium nitrate fuel oil (ANFO).

### B. Low Order Explosive (LE)

- LE creates a subsonic explosion and lacks HE's over-pressurization wave.
- Examples include pipe bombs, gunpowder, and most pure petroleum-based bombs such as Molotov cocktails or aircraft improvised as guided missiles.

### C. Manufactured Explosive

- Manufactured implies standard military-issued, mass produced, and quality-tested weapons.
- Manufactured (military) explosive weapons are exclusively HE-based.

### D. Improvised Explosive Device (IED)

- Use a device outside its intended purpose
- Commercial jet as a guided missile
- Loaded with metallic objects to inflict penetrating injury

High order explosive and Low order explosive cause different injuries. Terrorists use whatever is available – illegally obtained manufactured weapons or improvised explosive devices (IEDs) that may be composed of HE or LE, or both. Manufactured and improvised bombs cause markedly different injuries.

**Classification of blast injuries<sup>3</sup>**

| Category   | Characters                                                                                                                                                                                                                                                                      | Body part affected                                                                                                                                                                                                        | Type of Injury                                                                                                                                                                                                                                                                                                                                                                                                |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Primary    | <p>Unique to HE, results from the impact of the over pressurization wave with body surfaces.</p> <p>Body surface and internal organs are rapidly distorted because the body contains highly compressible tissues (air-containing organs) that undergo rapid volume changes.</p> | <p>- Gas filled structures are most susceptible</p> <p>-lungs, GI tract, and middle ear Internal distortions of air-containing organs cause distortion of neighboring solid organs heart, liver, spleen, and kidneys.</p> | <p>Blast lung(pulmonary baro-trauma)</p> <p>- TM rupture and middle ear damage</p> <p>-Abdominal hemorrhage &amp; perforation</p> <p>- Globe (eye) rupture</p> <p>Concussion (TBI without physical signs of head injury)</p> <p>Laceration of the liver, spleen and kidneys, Contusion to the heart.</p> <p>Distortion and rupture of the great vessels.</p> <p>Laceration, fracture, crush injuries etc.</p> |
| Secondary  | Results from flying debris and bomb fragments Depends on the speed, mass, and shape of the impacting object                                                                                                                                                                     | Any body part may be Affected                                                                                                                                                                                             | <p>Penetrating ballistic (fragmentation) or Blunt injuries</p> <p>-Eye penetration</p> <p>-Any injury associated with impact of high-speed</p>                                                                                                                                                                                                                                                                |
| Tertiary   | Results from individuals being thrown by the blast wind                                                                                                                                                                                                                         | <p>Any body part may be affected.</p> <p>Depends on the surface condition that the body impacts. Primarily head/neck and extremities</p>                                                                                  | <p>Any injury associated with whole-body motion and impact.</p> <p>Fracture and traumatic amputation.</p> <p>Closed and open brain damage</p>                                                                                                                                                                                                                                                                 |
| Quaternary | <p>Injuries, illnesses, or diseases not due to primary, secondary, or tertiary mechanisms.</p> <p>-Includes exacerbation or complications of existing conditions.</p>                                                                                                           | Any body part may be affected                                                                                                                                                                                             | <p>-Burns</p> <p>- Crush injuries</p> <p>- Closed and open brain injury</p> <p>- Asthma, COPD, or other breathing problems from dust, smoke, or toxic fumes</p> <p>- Angina</p> <p>- Hyperglycemia, hypertension</p>                                                                                                                                                                                          |

## Determination of Explosive material

- A. If possible, determine what material caused the explosion.
- I. High-order explosives (HEs) undergo detonation, an almost instantaneous transformation of the original explosive material into gases occupying the same volume of space under extremely high pressure. These high-pressure gases rapidly expand, compress the surrounding medium, and produce a defining supersonic, over-pressurization blast wave. Usually while explosive material is placed on ground, pressure waves are running parallel to ground causes maximum injuries over lower extremities like fracture of tibia and fibula. Examples of HEs include materials such as TNT, ammonium nitrate fuel oil, dynamite, and C-4 "plastic" explosives. In general, only HE explosions produce severe primary blast injury<sup>3,5</sup>.
- II. Low-order explosives (LEs) are composed of propellants, such as black powder, and pyrotechnics, such as fireworks. LEs undergo deflagration rather than detonation and release energy relatively slowly compared with HEs. This results in a subsonic explosion lacking the over-pressurization blast wave that characterizes HEs. Although LE explosions can be deadly, LE explosions very uncommonly cause the pulmonary and central nervous system injuries unique to primary blast injury<sup>3,5</sup>.
- B. If possible, determine the patient's location relative to the center of the explosion.
- I. An explosion that occurs in an enclosed space (including a building, a mine, or a relatively lightly constructed enclosed space such as a bus) or in water tends to cause more serious injury.
- II. Intensity of an explosion pressure wave declines with the cubed root of the distance from the explosion. A person 3 m (10 ft) from an explosion experiences 9 times more overpressure than a person 6 m (20 ft) away. Proximity of the person to the explosion is an important factor in a primary blast injury.
- III. Blast waves are reflected by solid surfaces; thus, a person standing next to a wall may suffer increased primary blast injury.

## What to do Emergency Medical Services

Emergency medical services provide a great role in dealing of such catastrophe and should always be in ready mode to extend all possible help in treating and prevent of mortality. There are following services that could be provided by EMS;

- I. Another ominous consideration is the tactic of setting dual explosions. The initial explosion is intended to injure civilians and to attract law enforcement and rescue personnel, followed by a delayed explosion designed to injure rescuers. Hospital disaster plans should include tight security at all hospital entrances in the event of a terrorist explosion in the community. All hospital personnel should be alert for unattended packages.
- II. In addition to protecting hospital patients and staff, sealing entrances helps control the chaotic flow of patients and visitors.
- III. Industrial accidents and terrorist explosions may be associated with the release of toxic and/or radioactive materials. The Central Bureau of Investigation (CBI) should particularly concerned about the possibility that a terrorist could attach a radioactive substance (e.g. a radiopharmaceutical or part of an old radiography machine) to a conventional explosive device, causing radiation contamination of the scene and casualties. In the 1993 attack on the World Trade Center, terrorists attached cyanide to a bomb placed in the underground parking garage. Fortunately, in that incident the cyanide was destroyed by the combustion. Physicians and EMS personnel must diligently search for evidence of radiation and/or chemical contamination in persons with blast injuries<sup>1</sup>.
- IV. EMS agencies should check for radiation contamination at the scene of a deliberately caused explosion. In addition, hospital personnel should screen persons who have been exposed to deliberate explosions for radioactivity with a Geiger counter or similar radiation dosimeter.

## Diagnostic features<sup>2,3,5</sup>

Judicious use of the laboratory is essential for accurate diagnosis in the mass-casualty situation.

- I. Most patients injured by significant explosions should have a screening urinalysis.
- II. If the explosion occurred in an enclosed space or was accompanied by fire, test carboxy-hemoglobin (HbCO) and electrolytes to assess acid/base status.
- III. Pulse oximetry readings may be misleading in cases of CO poisoning. When in doubt, apply 100% oxygen by tight-fitting face mask until CO levels can be measured.
- IV. Exposure to cyanide (CN), a product of incomplete combustion of plastics, is difficult to measure directly. CN exposure often accompanies CO poisoning. Consider CN poisoning in patients exposed to combustion in an enclosed space who have an anion gap metabolic acidosis. Treatment for CN poisoning should be started for significantly ill patients while awaiting confirmatory test results. Sodium thiosulfate or hydroxocobalamin are safe and appropriate empiric therapies.
- V. Victims of major trauma should have baseline hemoglobin determinations, cross-matching for potential blood transfusion, and screening for DIC.
- VI. If significant crush injury, compartment syndrome, or severe burns have occurred, emergency physicians should be attentive to the possibility of rhabdomyolysis with resulting hyperkalemia and myoglobinuric renal failure.
- VII. Useful tests for DIC include the following:
  - a. Activated partial thromboplastin time (aPTT)
  - b. Thrombin time
  - c. Fibrinogen & Fibrin split products
  - d. D-dimer levels
  - e. Serial CBC determinations, to include platelet counts
- VIII. Patients with burns from military white phosphorous (WP) munitions are at risk for hypocalcemia and hyperphosphatemia; follow

serial levels of these ions. White phosphorus is a metal that ignites on contact with air, creating intense heat and releasing phosphorous pentoxide, a severe pulmonary irritant. White phosphorus is a widely used component of military munitions, including hand grenades.

## CONCLUSION

Throughout the world, a paradigm shift has taken place in modern-day conflicts using more sophisticated and more devastating materials for explosions. The rise in urban warfare tactics by terrorist groups means that local health systems must be prepared to manage devastating explosion-related injuries. Acute care providers (i.e. physicians, nurses, and ancillary staff of emergency medicine, surgery, orthopaedics, and anaesthesiology), who are most likely to be the first receivers of injured people, have an urgent responsibility to know and understand the diagnostic and management issues unique to blast injuries. The forensic experts play a major role in identification of victim, reconstruction of dead bodies and preservation of evidence and also providing the detail autopsies finding which could be used in identification of material of explosion.

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# A Retrospective Study of Medico-Legal Cases at a Teaching Hospital in Shillong (January 2010 to December 2011)

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## ABSTRACT

A retrospective study of medico-legal cases presenting to the Casualty department of a teaching hospital in Shillong (north east India) was performed for the period January 2010 to December 2011. The parameters considered were type of cases, age and gender distribution, time of occurrence and manner of injury. It was observed that the majority of cases were road traffic accidents, followed by blunt injuries, fall from height and poisoning.

**Keywords:** Medico-Legal Cases, Road Traffic Accidents, Blunt Injuries, Fall From Height, Poisoning

## INTRODUCTION

In the past, the city of Shillong in north-east India was known for its natural beauty and tranquil surroundings. Not anymore. Of late, it has witnessed a rise in vehicular traffic and population, depletion of forest cover, climate change and a spate of crimes like never before. The statistics, according to records, are indeed alarming<sup>1</sup>.

A medico-legal case (MLC) is a case of injury or ailment where investigation by law enforcing agencies is required in order to fix responsibility for the said injury or ailment as per the law of the land<sup>2</sup>. It is the duty of the treating doctor to identify a medico-legal situation and register it accordingly. The common cases which can be labeled as MLC are road traffic accidents, fall from height, suspected or evident poisoning or intoxication, suspected criminal abortion, sexual assault and cases "brought dead" to Casualty where the cause of death is not clear.

The majority of medico-legal cases in the city are handled by the State Civil Hospital. The Casualty Department at our teaching hospital started functioning

as recently as July 2009. As the hospital is situated 12 km from the hub of Shillong, there are relatively fewer cases as compared to the centrally located ones. However, the number of patients attending Casualty are increasing steadily day by day, a good fraction of which fall under the category of MLC.

## MATERIAL AND METHOD

The present study was carried out retrospectively for the period January 2010 to December 2011. Data was taken from the MLC Registers which keep a record of such cases presenting to the Casualty Department of the hospital. The parameters considered were the type of cases, age and gender distribution, time of occurrence and manner of injury. A year-wise comparison of cases is also shown with the help of charts. Analysis of data was done using Microsoft Excel 2007.

## RESULTS

In the year 2009 (July to Dec), the total number of medico-legal cases was 219. However, this figure increased to 381 in the year 2010 (Jan to Dec) and 358 in the year 2011 (Jan to Dec).

For the study period (Jan 2010-Dec 2011), the majority of cases were road traffic accidents (RTAs), followed by blunt injuries, fall from height and poisoning. (Table 1)

Males in the age group 20-30 years were the most common victims. Females comprised 20.7% of the affected population. (Table 2)

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Most accidents and assaults occurred in the early evening and night hours (12 noon to 12 midnight), possibly under cover of darkness. (Table 3)

28.68% of cases were reported in the months of October to December, the festive season of eating, drinking and indulgence at the cost of life and limb. (Table 4)

The injuries were mostly accidental in nature, although homicidal and suicidal cases were also observed in this study. (Table 5)

**Table 1: Type of cases**

| Particulars          | 2010 | 2011 |
|----------------------|------|------|
| RTA                  | 193  | 179  |
| Blunt injury         | 94   | 62   |
| Fall from height     | 40   | 34   |
| Poisoning            | 17   | 24   |
| Sharp injury         | 18   | 13   |
| Brought Dead         | 1    | 20   |
| Electrocution        | 5    | 2    |
| Firearm              | 3    | 2    |
| Bomb Blast           | 0    | 2    |
| Hanging              | 1    | 2    |
| Strangulation        | 1    | 0    |
| Burns                | 1    | 2    |
| Sexual Assault       | 1    | 2    |
| Alcohol Intoxication | 1    | 9    |
| Others               | 5    | 5    |
| Total                | 381  | 358  |

**Table 2: Age and sex distribution**

| Age / sex | 2010 |        | 2011 |        | Total | %    |
|-----------|------|--------|------|--------|-------|------|
|           | Male | Female | Male | Female |       |      |
| 0-10 yrs  | 19   | 9      | 8    | 6      | 42    | 5.7  |
| 11-20 yrs | 55   | 18     | 58   | 18     | 149   | 20.2 |
| 21-30 yrs | 108  | 28     | 106  | 16     | 258   | 34.9 |
| 31-40 yrs | 65   | 12     | 50   | 17     | 144   | 19.5 |
| 41-50 yrs | 30   | 9      | 45   | 6      | 90    | 12.2 |
| 51-60 yrs | 14   | 4      | 19   | 3      | 40    | 5.4  |
| > 60 yrs  | 5    | 5      | 4    | 2      | 16    | 2.2  |
| Total     | 296  | 85     | 290  | 68     | 739   | 100  |

**Table 3: Time of occurrence**

| Time           | 2010        | 2011        | Total | %    |
|----------------|-------------|-------------|-------|------|
|                | No of cases | No of cases |       |      |
| 12 am – 6 am   | 24          | 22          | 46    | 6.2  |
| 6 am – 12 noon | 83          | 76          | 159   | 21.5 |
| 12 noon – 6 pm | 141         | 144         | 285   | 38.6 |
| 6 pm – 12 am   | 133         | 116         | 249   | 33.7 |
| Total          | 381         | 358         | 739   | 100  |

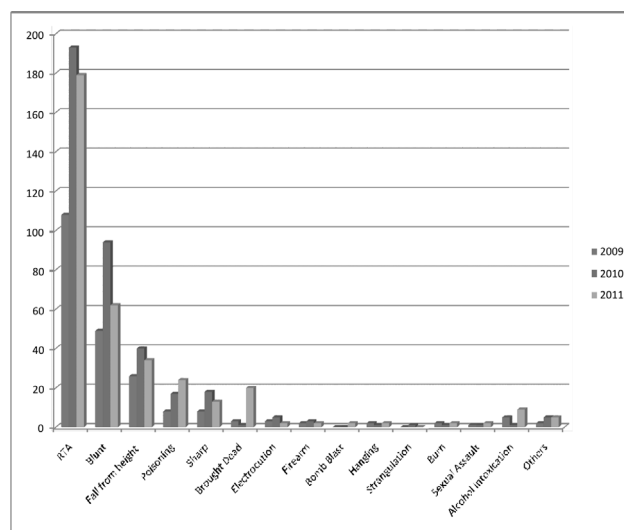
**Table 4: Month-wise distribution**

| Months             | 2010        | 2011        | Total | %    |
|--------------------|-------------|-------------|-------|------|
|                    | No of cases | No of cases |       |      |
| January – March    | 69          | 80          | 149   | 20.2 |
| April – June       | 107         | 92          | 199   | 26.9 |
| July - September   | 94          | 85          | 179   | 24.2 |
| October - December | 111         | 101         | 212   | 28.7 |
| Total              | 381         | 358         | 739   | 100  |

**Table 5: Manner of injury**

| Particulars      | 2010      |          |            | 2011      |          |            |
|------------------|-----------|----------|------------|-----------|----------|------------|
|                  | Homicidal | Suicidal | Accidental | Homicidal | Suicidal | Accidental |
| RTA              | 0         | 0        | 193        | 0         | 0        | 179        |
| Blunt injury     | 48        | 0        | 46         | 27        | 0        | 35         |
| Fall from height | 0         | 1        | 39         | 0         | 0        | 34         |
| Poisoning        | 0         | 15       | 2          | 0         | 16       | 8          |
| Sharp injury     | 9         | 3        | 6          | 7         | 1        | 5          |
| Brought Dead     | 0         | 0        | 0          | 0         | 0        | 0          |
| Electrocution    | 0         | 0        | 5          | 0         | 0        | 2          |
| Firearm          | 2         | 0        | 1          | 1         | 0        | 1          |
| Bomb Blast       | 0         | 0        | 0          | 0         | 0        | 2          |
| Hanging          | 0         | 1        | 0          | 0         | 2        | 0          |
| Strangulation    | 1         | 0        | 0          | 0         | 0        | 0          |
| Burns            | 0         | 0        | 1          | 0         | 0        | 2          |
| Total            | 60        | 20       | 293        | 35        | 19       | 268        |

**Fig 1. Year-wise comparison of cases**



## DISCUSSION

This study highlights the high incidence of motor vehicular accidents in the city of Shillong. Hence, proper safety measures and law enforcement are a must to prevent such occurrences. Men were more involved than women, probably due to their mobility and greater exposure to the environment at large. The findings are

consistent with those in other parts of the country, as shown by studies from Punjab<sup>3</sup> and Andhra Pradesh<sup>4</sup>.

The increased incidence of assault is a cause of concern in modern times. These result from street brawls and fights leading to blunt and sharp injuries depending on the weapon used. Self-inflicted sharp force injuries have also been observed. Of course, a good proportion of blunt and sharp injuries were purely accidental, such as a fall while working or playing, or occupational while handling tools, machines and masonry.

As regards poisoning, out of a total of 41 cases reporting to Casualty during the study period, 31 (75.6%) were suicidal and the rest (24.4%) accidental. This reflects the tendency towards self harm present in the study population which needs to be addressed by hospital authorities, psychiatrists, social workers and family members jointly.

Cases of alcohol intoxication witnessed a jump from a single case in 2010 to nine cases in 2011. This has happened as a natural consequence of police tightening the reins on drunken drivers and enforcing the law as per the Motor Vehicles Act 1988. Hence, these traffic violators are brought to book and sent for medical examination to the nearest hospital<sup>5</sup>.

Other medico-legal cases observed in this study were those of electrocution, burns, firearm injuries, bomb blast in coal mines/quarries, attempted hanging and strangulation. The contribution of these cases is low, which is comparable to the observations of Garg V et al (2007-09)<sup>3</sup>.

## CONCLUSION

Road traffic accidents form the bulk of medico-legal cases attending the Casualty Department of our hospital, followed by blunt injuries, fall from height

and poisoning. The spectrum of cases, as a whole, is similar to that seen in other parts of the country, such as Punjab and Andhra Pradesh.

## ACKNOWLEDGEMENT

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# Psychological Autopsy of Suicide Cases in Bhavnagar Region of Gujarat, India

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## ABSTRACT

Current study was undertaken at the Mortuary complex of Sir T. Hospital, Bhavnagar to evaluate, whether psychological autopsy is an important tool to unravel associated factors responsible for suicide and to know the underlying causes responsible for suicide, so that in future, any preventive strategy could be made on these factors to reduce the rate of suicide. . Out of all the cases brought for post-mortem examination during the period of 1st June 2010 to 31st May 2011, 110 cases were selected based on Inclusion-exclusion criteria. Proforma was filled by interviewing the Relatives and Friends of deceased, who accompany the dead body. And Data collected was subjected to analysis which revealed that 85% of suicide cases being in 15-44 yrs age group, 4. 93% Cases committed suicide at their Homes, Only 7% committed at other places, such as Workplace, Farm & Roadside, Illiterate - 8%, up to 7th standard - 40%, up to 12th standard - 44%, while education above graduation- only 8%, and None above/equal to post-graduation. So, Psychological Autopsy helps in determining the factors responsible for suicide.

**Keywords:** *Psychological Autopsy, Suicide*

## INTRODUCTION

Suicide has remained one of the major unsolved problems of mankind, as it is very difficult to understand anyone's nature, mind & thought process. Psychological Autopsy is an attempt to unravel such state of mind and Thought processes of the deceased. Psychological Autopsy is defined as "reconstruction of events leading to death; ascertainment of the circumstances of the death, including suicidal intent; and an in-depth exploration of other significant risk factors for suicide" [1] [2]

According to National Crime Records Bureau, in India every 5 minutes a person commits suicide, forming about 1,00,000 suicide deaths per year and about 7 attempt to kill themselves & Incidence of Suicide in India /lakh population/Year was 11.2 in 1999, and 10.3 in 2005 and 10.9 in 2009.<sup>[3]</sup> In spite of the magnitude of the problem, suicide continues to carry the stigma of shame, creating barriers to the promotion of knowledge and understanding about why people attempt suicide and how it can be prevented.

In our country, there is a paucity of studies regarding psychological autopsy of suicide victims. Various psycho-social characteristics of suicide victims in Gujarat, which had been witnessing a large number of suicides, are inadequately studied. Hence it is very much need of time that each case of suicide be studied

singly as well in comparison with others, and to study the various factors leading to suicide so that later on a preventive strategies can be formed. And this can be possible by carrying out study of Psychological Autopsies of Suicide cases.

## MATERIAL & METHOD

The current Study was undertaken at the Mortuary complex of Sir T. Hospital & Govt. Medical College, Bhavnagar. Out of all the cases brought for post-mortem examination during the period of 1<sup>st</sup> June 2010 to 31<sup>st</sup> May 2011, 110 cases were selected based on Inclusion-exclusion criteria.

### Inclusion criteria

1. Only those cases of Hanging, Poisoning and Burns were selected which proved to be of suicidal nature by circumstantial evidences and Post-mortem examination.
2. Cases having residence in Bhavnagar region of Gujarat (Bhavnagar & Amreli district only) were included for study.
3. Cases were included only if, reliable informants (i.e., spouse, parents, co-workers, close friends etc.) were present at the mortuary complex and willing to give written informed consent.

4. All age groups and both sexes were included for study.

### Exclusion Criteria

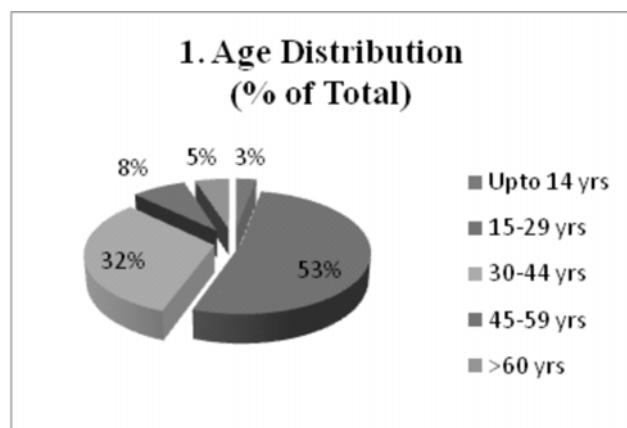
Cases not satisfying inclusion criteria & those not willing to give written informed consent were omitted from the study.

- In Such selected cases, a semi-structured interview was asked to spouse, parents, co-workers, and close friends etc., who were present with the dead bodies at mortuary.
- The Information sheet was given to the relatives and ample time was given to them to understand ask any questions arising there of.

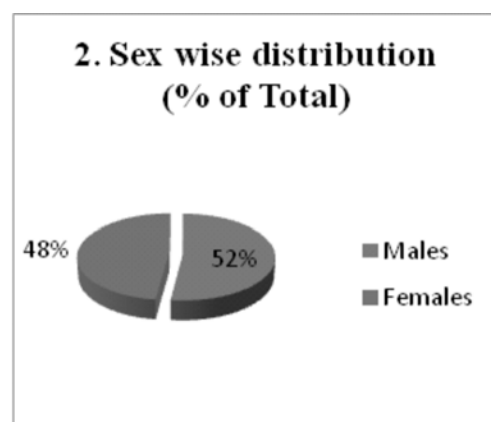
- Then Written consent is taken in Written Informed Consent form.
- Then prepared questionnaire was asked to them to obtain the details regarding the Deceased's Personal Information, DETAILS OF SUICIDAL EVENT, any PRE-SUICIDAL COMMUNICATION, Past Medical and Psychiatric history, Personal History, Family History with particular reference to suicidal events if any.
- And also the questions relating to the deceased's mental state were asked and an attempt was made to make a Retrospective diagnosis of psychiatric disorder.

## RESULTS

### 1. Age Distribution



### 2. Sex Distribution



### 3. Marital Status

| Sr. No. | Marital Status | Males (Total 49) |            | Females (Total 49) |            |
|---------|----------------|------------------|------------|--------------------|------------|
|         |                | No. of Cases     | % of Total | No. of Cases       | % of Total |
| 1.      | Married        | 30               | 61%        | 27                 | 55%        |
| 2.      | Unmarried      | 13               | 27%        | 18                 | 37%        |
| 3.      | Committed      | 4                | 8%         | 2                  | 4%         |
| 4.      | Divorced       | 1                | 2%         | 0                  | 0          |
| 5.      | Widowed        | 1                | 2%         | 2                  | 4%         |

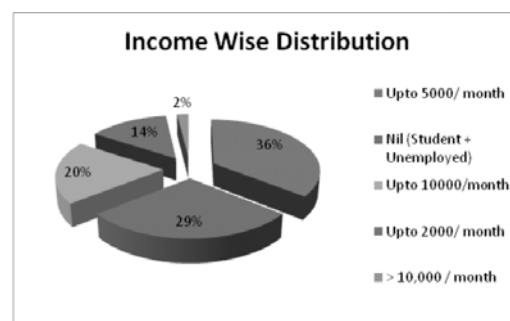
### 4. Education

| Sr No. | Education Level            | No. of Cases | Percentage of Total |
|--------|----------------------------|--------------|---------------------|
| 1.     | Illiterate                 | 9            | 8 %                 |
| 2.     | Upto 7 <sup>th</sup> Std.  | 46           | 40 %                |
| 3.     | Upto 12 <sup>th</sup> Std. | 50           | 44 %                |
| 4.     | Graduation                 | 9            | 8 %                 |
| 5.     | Post-grad. & Ph. D.        | 0            | 0 %                 |

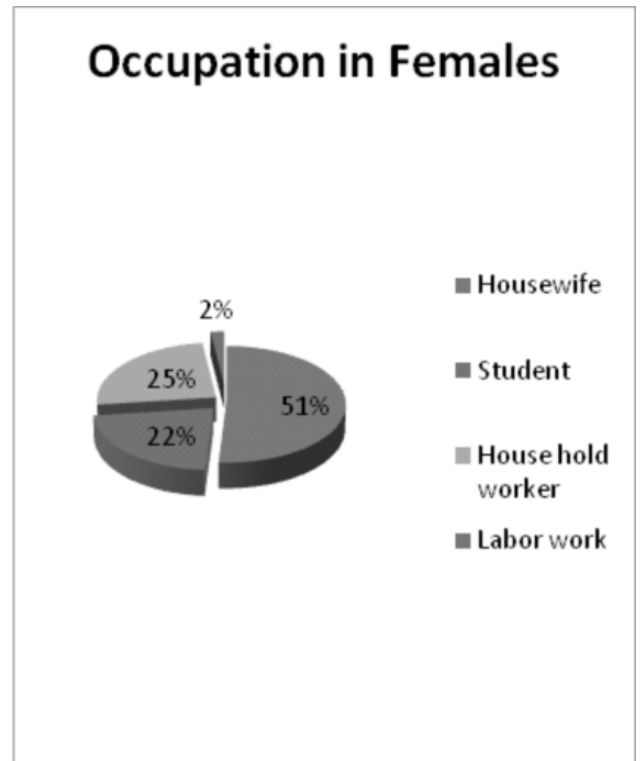
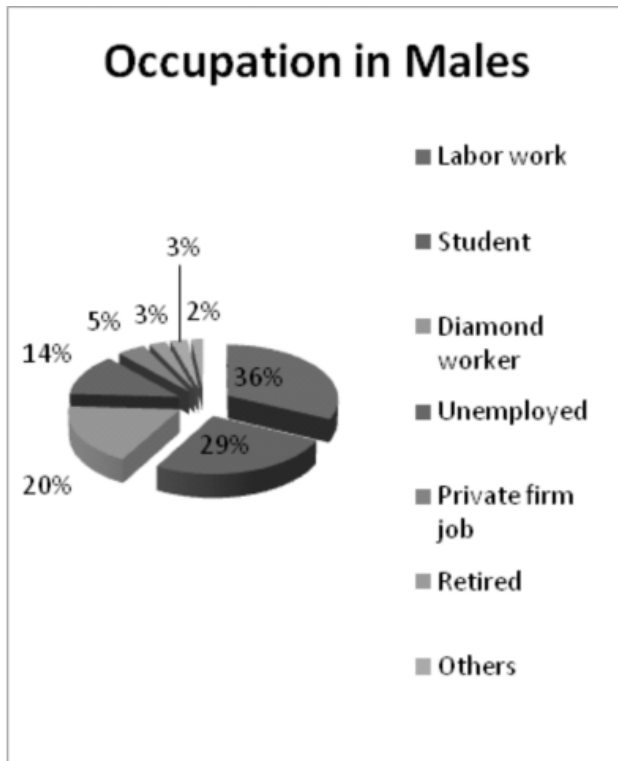
### 5. Time of Day

| Sr No. | Time of Day Level | No. of Cases | Percentage of Total |
|--------|-------------------|--------------|---------------------|
| 1.     | 12 Am – 6 Am      | 20           | 18 %                |
| 2.     | 6 Am – 12 Pm      | 39           | 39 %                |
| 3.     | 12 Pm – 6 Pm      | 34           | 30%                 |
| 4.     | 6 Pm – 12 Am      | 21           | 18 %                |

### 6. Income



## 7. Occupation



## 8. Place

1. Home – 106
2. Others – 8 (Farm, Hostel, work place, mandir, Road side)

## 9. Suicide Note

1. Present in 4 cases – 2 typical notes, 2 written on hand
2. No in 110 cases

## 10. Family type

1. Joint : 47
2. Nuclear : 67

## 11. Family History of Suicide

In 3 cases, Family History of Suicide is Positive. All three cases having F/H/O Suicide by mother, in the deceased's child hood.

## 12. Threats

1. Verbal Threats : 26 cases
2. Indirect Ideation : 1

## 13. Attempts

- 7 attempted suicide, 6 – by ingestion of poison & 1 by cutting vessels at wrist.
- Out of these 6, 2 again resorted to ingestion of poison, whereas 4 committed suicide by Hanging.

## 14. H/o Chronic / prolonged Illness

- 6 cases having H/o Chronic, prolonged painful Illness & committed suicide, as they were fed up by the morbidity of illness.

## 15. Psychiatric Disease

- 21 cases were diagnosed cases of Psychiatric diseases. Of which 19 were under treatment. However, 13 of them were drug defaulters.

### A. Psychotic Disease :12

### B. Depression : 9

## 16. Signs of Depression in Undiagnosed cases

- In 6 cases, H/o Sad mood, Reduced interaction with family, Reduced enjoyment of life, Hopelessness etc.

**17. Substance Abuse**

- 5 cases with H/o Alcohol addiction.
- 1 case addiction to ganja, afin and alcohol, where suicide resulted due to psychosis as a result of Addictive behavior.

**18. H/O Traumatic Childhood**

- 3 cases having history of death of mother at early age.

**19. Precipitating Factors**

| Sr. No. | Cause / Precipitating Factors         | No. of Cases | % of Total |
|---------|---------------------------------------|--------------|------------|
| 1       | Psychiatric Illness                   | 21           | 18.42      |
| 2       | Not known                             | 13           | 11.4       |
| 3       | Economic Constrains                   | 12           | 10.53      |
| 4       | Conflict with family for Love Affairs | 10           | 8.77       |
| 5       | Conflict with Spouse                  | 9            | 7.89       |
| 6       | Conflict with In-laws                 | 8            | 7.02       |
| 7       | Family Problems                       | 7            | 6.14       |
| 8       | Chronic / Prolonged Illness           | 6            | 5.26       |
| 9       | Conflict with Parents                 | 5            | 4.39       |
| 10      | Break up of relationship              | 4            | 3.51       |
| 11      | Love failure                          | 4            | 3.51       |
| 12      | Loneliness                            | 3            | 2.63       |
| 13      | Exam Pressure / Failure               | 3            | 2.63       |
| 14      | Moneylenders                          | 3            | 2.63       |
| 15      | Economic Loss                         | 2            | 1.75       |

Comparison of Precipitating Factors :

| Sr. No. | Causes                                                | % of Total |            |
|---------|-------------------------------------------------------|------------|------------|
|         |                                                       | In Males   | In Females |
| 1.      | Exam Pressure / Failure                               | 2%         | 1%         |
| 2.      | Family Problems                                       | 3%         | 3%         |
| 3.      | Conflict with Spouse, Parents & in laws               | 3%         | 33%        |
| 4.      | Chronic / Prolonged Illness                           | 5%         | 2%         |
| 5.      | Conflict with family for Love Affairs or Love Failure | 12%        | 16%        |
| 6.      | Other Causes                                          | 20%        | 4%         |
| 7.      | Economic Problems                                     | 27%        | 5%         |
| 8.      | Psychiatric Illness                                   | 19%        | 18%        |
| 9.      | Not known                                             | 9%         | 18%        |

**DISCUSSION**

1. The mean age for suicide was 29.50 yrs, with 85% of suicide cases being in 15-44 yrs age group,
- Venkoba Rao in his hospital based study on suicide attempts reported a preponderance of males and identified the vulnerable age group as being those from 15 to 25 years.<sup>[4]</sup>

- As per Study of B.S. Chauhan et al, Majority (59.4%) of suicide victims were in the age group of 20 to 29 years.<sup>[2]</sup>
2. Both the sex have equal prevalence and Hanging is preferred by males whereas burns in preferred by Females.
  3. Nearly 95 % of cases were Hindus. The sample was drawn from a predominant Hindu population and this may be the reason for this findings.
  - Various reasons have been cited in literature. It is claimed that monotheistic religions like Christianity and Islam prorogate suicide as a sin and that may be the reason for decreased number of people from those communities attempting suicide.
  4. 93% Cases committed suicide at their Homes; Only 7% committed at other places, such as Workplace, Farm & Roadside.
  5. 39% of cases committed Suicide during 6 in morning to 12 in Noon. 30% of cases committed suicide during 12 in noon to 6 in evening. These are the times, when most of the family members may have been busy in their work. So, during these timings more attention is needed to be given to persons with suicidal tendencies. While 18% committed suicide during 12 in night to 6 in morning, this period is also crucial as depression has highest influence in early mornings.
  6. Education has profound influence on suicide rate. Percentage distribution of Cases with education level : Illiterate – 8%, up to 7<sup>th</sup> standard – 40%, up to 12<sup>th</sup> standard – 44%, while education above graduation- only 8%, and None above/equal to post-graduation.
  - This shows that suicide is more prevalent in persons with low education level. So, raising the education level of society can have a significant role in prevention of suicide.
  7. Persons with Low Income and Unstable Jobs (Labor work, diamond workers, private firm jobs etc.) have more Prevalence of Suicide. In females, Housewives had the highest percentage for committing suicide.
  - According to the 2002 data of the Kerala State Mental Authority 19.8% of the suicide cases in the state were unemployed, 15.6% were farmers and 14.8% were those employed in the private sector.<sup>[5]</sup>

8. Suicide note was present in 4% cases. Where as Verbal threats of Suicide were present in 23% and Expression of Indirect ideation in 1%. And Verbal threats were more often given by females. So, the threats should not be ignored. And adequate counseling should be done.
  - Females had given more threats than the males.
  - Suicide ideas were expressed by more than 2/3 and clear intent was present in more than a third. Often warning was given to more than one person according to Robins et al, 1959).<sup>[6]</sup>
  - In a study comparing two cities it was noticed that in LA, 72% made direct reference as against 27% in Vienna. Indirect reference was made by 25% in LA and 2% in Vienna. So it is likely that cultural factors determine extent of signaling. (Farebrow and Simon, 1975).<sup>[7]</sup>
9. 59% cases lived in Nuclear Family, while 41% lived in Joint Family.
  - This shows that Joint families have protective effect on suicides.
10. 6% cases had history of previous attempts. Most of them attempted with ingestion of Poison, only 1 with cutting of wrist vessels. Only two of them again resorted to ingestion of Poison, while rest of them hanged themselves.
  - Our finding was different from the study conducted by Bennewith et al (2005) in which nearly half i.e. 44.7% of the suicides by hanging had previously self harmed.<sup>[8]</sup>
  - In a study conducted by Bhatia et al (2000), while studying a group of people comprising suicide ideators, attempters and completers, it was found that 6.9% 24.1% and 18.2% had past history of attempt, respectively.<sup>[8]</sup>
  - The importance of this parameter should be stressed, since patients with suicidal attempt need evaluation, early intervention and long term follow up.
11. Only 2.5% cases had Family History of Suicide/ Psychiatric illness.
12. Only 5% committed suicide as they were fed up with some hopelessly incurable or chronic painful conditions.
13. 18% of cases were diagnosed cases of Psychiatric Illness, of which 11% had Psychotic Disease while 7 % had Mood Disorder. So, It has to be stressed here that Psychiatric Patients with suicidal tendencies have to be handled with care & support and extra attention needs to be given to them.
  - 57% were found to have psychiatric illnesses; depression was the most prevalent (37.5%).<sup>[9]</sup>
  - In another study suicide ideators were studied in the general hospital set-up and it was found that 59.74% had depression, 9.74% had substance abuse, 9.74% had psychosis, 7.14% had neurotic disorders and 9.09% suffered from bipolar disorder.<sup>[10]</sup>
14. And also in 5% cases, History of Sad mood, Reduced interaction with family, Reduced enjoyment of life, Hopelessness etc. were elicited by the relatives. So, this unrecognized cases of Depression also alarming as they may have been saved, if diagnosed in time and adequately counseled.
15. Only 4% cases had significant history of Substance abuse. So, Direct relationship could not be established.
16. **STRESSOR TYPE**
  - In our study, Major Stress factor in Males was Economic Constrains (27%), followed by Love Failure/ Conflict over love affair (20%), Conflict with Spouse, Parents & in laws – 5%, Family Problems – 2%, Exam Pressure / Failure – 2%. And in 9% cases, Precipitating factor remained Unknown.
  - Whereas in Females, Major stress factor noted to be Conflict with Spouse, Parents & in laws (33%), followed by Conflict with family for Love Affairs or Love Failure (16%), Economic Problems (5%), Family Problems (3%), Chronic / Prolonged Illness (2%). And in 18% cases precipitating factor remained Unknown.
  - These figures show that women committed more suicides over acute stress and in impulsivity, where as Males committed suicide on more chronic stress & over prolonged adjustment problem to stress.
  - According to Khan et al (2006), Of the 47 deceased who had stressful life events, 22 had a single event and 25 had multiple stressful life events.<sup>[11]</sup>
  - According to Kar et al. attempters of suicide had more stressful life events within 6 months of the

attempt. Economic hardship and strained relations with family members are important stressors. Among young suicide committers, broken love affairs were common. Pressure to secure a seat in Medicine/Engineering tests is also one of the reasons for committing suicide. There are not many studies on educational burden and suicide in the teens which should be focused upon.<sup>[11]</sup>

- According to Richard et al (1999) Interpersonal problems as stressors for suicide have also been pointed out in a few studies.<sup>[12]</sup>

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# An Unusual Case of Railway Suicide

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## ABSTRACT

Injuries sustained due to railway mishaps are well documented. In these mishaps, ascertaining the cause of death is usually not difficult, but frequently circumstances do raise questions as to the manner of death.

Decapitation or complete severance of head from the body is imminently fatal condition without any exception. A case of decapitation in a railway accident is discussed. It stresses on the fact that there is an increasing number of such cases and there is always a question whether the death was a homicide or suicide or an accident. The combination of death scene findings and autopsy results will in most cases distinguish between homicidal and other modes of death.

**Keywords:** Railway Accident, Decapitation, Spinal Cord Transection.

## CASE REPORT

Body was of an adult age male individual. He was a student of Polytechnique College. He was found on the railway track 2000yard away from railway station. Body was found in two parts body and head. The head was present in between the track and the body was found just outside the track. The apparent cause given by police was suicide by railway track. First autopsy was conducted by doctors of general hospital. The board of doctors opined that the cause of death in this case is hemorrhagic shock due to injuries which are ante mortem in nature and sufficient to cause death in due course of events. Possibility of these injuries by railway accident cannot be ruled out. The injuries described by them were one completely amputated neck at level of just above thyroid cartilage and head lying aside on further exploration underlies vessels, muscles, fascia, tissue, bones, organs, crushed. Left clavicle and left ribs were found fractured. Left haemothorax was present. Fig 1 and 2.

Family members of the deceased were not satisfied because of presence of single injury that was decapitation injury causes suspicion of homicide than suicide. Another reason of suspicion was that the body was examined incompletely.

On post-mortem examination, length of the body measured 166 cm on alignment of the decapitated head. Dead body was of a young adult, moderately built and



Fig. 1. Decapitation injury showing ragged Margin of wound present over the upper Part of the neck.



Fig. 2. Decapitation injury present over the root of the neck region. Margins were irregular and contused.

well-nourished male individual wrapped in white cloth sheet. Body was wearing a red colour T-shirt and blue jeans pent. The T-shirt stained with grease stain on its posterior aspect. All clothes were smudged with dirt at places. Body was also smudged with dirt. Both eyes were partially open. Rigor mortis has passed off. Greenish discoloration present over the right iliac region of anterior abdominal wall. Post mortem bullae were present at places.

During first autopsy scalp was open partially, skull was not open and thorax and abdominal cavities were also not open completely. Fig 3.



Fig. 3. Incomplete incision given at time of first autopsy.

During second autopsy it is found that the following injuries were present over the body:

Complete transection of neck (Decapitation) at the level of cervical four and five vertebrae due to which head was separated, margins of wound were irregular, abraded & contused and stained with grease. Skin, Soft tissues, blood vessels, trachea at the level just below the cricoid cartilage level & adjacent muscles at the transection site were lacerated. All structures at the level



Fig. 4. Crushed fifth cervical vertebra and Fractured left clavicle

of injury were completely transected with crushing of edges. Cervical third and fourth vertebrae were found crushed. The fifth cervical vertebra, left clavicle and left first and left second ribs were found fractured. Fig 4.

No other external injuries were present on the body.

Membranes of brain were healthy, brain was slightly congested. Neck vessels were crushed. Left pleural cavity contain blood. Lungs were found congested. Stomach contains 150 gm. of semisolid food material in which pieces of rice were identifiable. Small intestine contains digested food material. Large intestine contains fecal matter and gases. Liver, spleen and kidney were pale. The viscera were sent to FSL for chemical analysis. No poison or alcohol was detected in viscera. The histopathological examination of marginal skin of decapitation injury shows congestion which is an ante-mortem phenomenon. Cause of death was opined as complete transection of the cervical spinal cord (Decapitation).

## DISCUSSION

Pedestrian–train collisions are usually accidental in nature, and occur after dusk when pedestrians cross the railway track to reach their destination through the nearest route or stroll along the railway tracks for leisure or recreation purposes.<sup>1-4</sup>

Railway suicides are usually committed by lying across the railway track, or walking or jumping in front of an approaching train, and are commonly seen during the daytime and in densely populated areas.<sup>3,5</sup> Although alcohol is an important risk factor in railway accidents, positive blood alcohol content and a psychiatric illness is often present in suicide victims.<sup>2,6,7</sup>

Extensive blunt force injuries, especially traumatic amputations of an upper or lower extremity are commonly seen in railway accidents.<sup>5,8,9</sup> Massive blunt force trauma with alcohol intoxication is highly suggestive of an accidental death.<sup>2,6</sup> Similar injuries can be encountered in suicides, which are committed by jumping in front of the train, whereas transverse sectioning of the body at the neck, trunk or extremities is commonly observed when the victim lies across the railway track. Decapitation with no other injury is considered typical of a suicide.<sup>1,2,10</sup> Classically, complete transections are associated with irregular, ragged and sharp-edged wound margins with a zone of skin abrasion and contusion. In incomplete transection, bridging of vascular and nervous pathways may be present at the depth of the wound<sup>11</sup>.

It is important to rule out homicide in all cases, which is often disguised as an accident or suicide. Railway homicides can be achieved by either pushing a person under a train, or leaving him or her unconscious on a railway track. Sometimes, dead bodies are disposed of on a railway track after killing by other means, to simulate a suicide or an accident<sup>5</sup>. Here, careful evaluation of the history, scene investigation, autopsy findings, and toxicological data help in deciding the manner of death.

Decapitation is an imminently fatal entity. Cases are on record where person have been killed by decapitation or else their head have been severed post-mortem.<sup>12</sup> Decapitation in vehicle assisted suicides and complete hanging have also been reported.<sup>13,14,15</sup> Railway fatalities have also resulted from suicidal or accidental decapitation<sup>16</sup>.

In the present case, complete transection of neck (Decapitation) at the level of cervical four and five vertebrae due to which head was separated, margins of wound were irregular, abraded & contused and stained with grease .which is typical of a railway mishap. The skin of the abraded margin and adjacent healthy area was sent for histopathological examination. The histopathological examination report showed that congestion was present in the injured area of skin. This indicates that the injury was ante-mortem in nature. The presence of ante-mortem decapitation injury and absence of other fatal injury over the body rule out the disposal of body on a railway track after killing by other means. No common poison or alcohol was detected in viscera, which rule out the leaving him unconscious on a railway track. These findings ruled out possibility of homicide by decapitation as well as post mortem decapitation.

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# A Study of Fingertip Patterns of Pulmonary Tuberculosis Patients

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## ABSTRACT

Dermatoglyphics is scientific study of epidermal ridges and their configuration on palmar and plantar region. Functional mutants of mannose binding protein are associated with pulmonary tuberculosis, which plays important role in inheritance. Epidermal ridge pattern is also determined by genetics. The study was undertaken to find out

1. Various Dermatoglyphic features in patients of pulmonary tuberculosis
2. To compare Dermatoglyphic features in normal and patients of pulmonary tuberculosis
3. To study the statistical significance of the difference found in patients and normal individuals. The study was undertaken with both arms from the age group between 20-45 yrs, one with 100 patients (72-males, 28-females) having pulmonary tuberculosis and the other with 100 healthy adult (72-males, 28-females). The study reveals increase in number of Whorls in Male Patients as compared to controls, increase in mean value of TFRC, AFRC in Male & Female patients as compared to controls. Dermatoglyphic analysis proven to have advantages as a diagnostic tool in certain diseases including pulmonary tuberculosis. It can be used as screening tools for pulmonary tuberculosis.

**Keywords:** Dermatoglyphics, Tuberculosis, Inheritance, Genetics

## INTRODUCTION

Harold Cummins coined the term Dermatoglyphics in 1926<sup>1</sup>. Dermatoglyphics literally means skin carvings. Ridges are genetically determined & influenced by environmental, physical & topographical factors. Dermatoglyphics is a scientific method for anthropological, medico legal & genetic studies. . The tuberculosis is partly genetic & partly environmental .So an attempt has been made, to study Dermatoglyphic patterns in tuberculosis, to compare them with normal individuals. The study of Dermatoglyphics was pioneered long back by Galton (1892)<sup>2</sup>. Tuberculosis caused by mycobacterium tuberculosis and is wide public health problem. The Dermatoglyphic science is based upon two major facts that the ridges are slightly different for fingers and no two persons, not even uniovular twins, show exactly similar finger print patterns. and the ridges are permanent throughout life and survive superficial injury and also environmental changes after 21st week of intrauterine life. The dermal ridge differentiation takes place early in fetal development. The resulting ridge patterns are

genetically determined and influenced by environmental factors. Patterns once established never change throughout life<sup>3</sup>. Functional mutants of mannose binding protein are associated with pulmonary tuberculosis, which plays important role in inheritance and epidermal ridge pattern is also determined by genetics.<sup>4</sup> Very little study has been conducted as far as Dermatoglyphics in pulmonary tuberculosis is concerned. Considering all above facts, the present study is under taken to find out various Dermatoglyphic features in pulmonary tuberculosis patients and compare them with normal individuals and to see differences found are statistically significant or not.

## Aims and objectives

1. To find out various Dermatoglyphic features in patients of pulmonary tuberculosis.
2. To compare Dermatoglyphic features in normal and patients of pulmonary tuberculosis.
3. To study the statistical significance of the difference found in patients and normal individuals.

## MATERIAL AND METHOD

The present study has been carried out on 200 individuals. Negative controlled study with two arms from the age group between 20-45 yrs, one with 100 patients (72-males; 28-females) having pulmonary tuberculosis and the other with 100 healthy adult (72-males; 28-females). As tuberculosis prevalence is more in males than females, more no. of male patient and control was selected than females. For all of whom written informed consent was obtained.

### Materials used for fingerprint are as follows

'Kores' duplicating ink, Porcelain tile, Wooden table of suitable height, Cotton gauge ball, Printing paper, Towel, Pressure pad, Spirit, Soap, Water, Disposable Mask

**Instruments used for qualitative and quantitative analysis for the study are:** Scale, Protractor, Pencil, Needle, Compound magnifying lens.

## COLLECTION OF DATA

The patients selected for the study are belonging to KIMS hospital Karad, Cottage Hospital Karad, SKNMC & hospital Pune, (West Maharashtra region). The patients selected were diagnosed clinically as having pulmonary tuberculosis and by doing investigations like sputum positive test. Controls are selected randomly without any respiratory problem or any symptoms related to pulmonary tuberculosis. Family history was taken to exclude other diseases as shown in proforma.

## METHOD

Standard ink method is used in present study<sup>5</sup>. The instruments cleaned before and after taking the prints. Fingers were cleaned with soap and water to remove oily dirt and sweat. Spirit was used to remove remaining oil and other dirt and keep the hand clean and dry. A dab of ink was applied on the porcelain tile and spread on slab evenly with the help of cotton gauge ball so that a thin layer of ink is formed on the tile surface. The hands were cleaned after taking the prints also.

## FINGER PRINTING

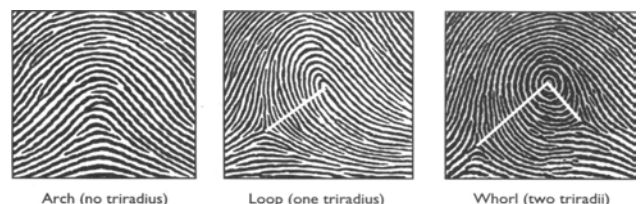
The distal phalanges of the individual's right hand were inked over the tile by firm pressure starting from thumb (ulnar to radial side). White crystal bond paper was kept on edge of the table for recording the finger print pattern. Rolled Fingerprints were obtained starting from thumb to little finger. The same procedure was

followed for recording the fingerprints of left hand.

**Following fingertip patterns were studied and analyzed in the present study (by Galton (1892)<sup>2</sup> – (Photograph no.1, 2&3).**

- 1) **Arch:** Ridges form a low curve and are parallel to each other
- 2) **Loop:** It is the most common pattern on the finger tips. In this configuration, a series of ridges enter the pattern area on the same side. If the ridge opens on the ulnar margin the resulting loop is termed as ulnar loop. If the ridge opens towards the radial margin the resulting loop is termed as radial loop. A loop has single triradius.
- 3) **Whorl:** A whorl is a ridge configuration with two or more triradii. One triradius is on the radial and the other on the ulnar side of the pattern. Henry ER. (1927)<sup>6</sup> limited the designation of whorl of those configurations having ridges that actually encircle a core. In whorl, ridges are commonly arranged as succession of spiral or ellipses or circle.
- 4) **Total Finger Ridge Count (TFRC):** It presents the sum of the ridge counts of all ten fingers, where only the larger count is used on those digits with more than one ridge count. (As shown in Photograph No. 1)
- 5) **Absolute Finger Ridge Count (AFRC):** Absolute finger ridge count (AFRC) represents the sum of the ridge counts of all ten fingers and it includes both ridge count values of whorl pattern

**Photograph No.1. Showing different finger tip patterns (line diagram)**



**Photograph No 2. Showing different finger tip patterns & TFRC, AFRC of right hand fingers**



**Photograph No 3. Showing different finger tip patterns & TFRC, AFRC of left hand fingers**

Data was tabulated and analyzed. Comparison of each study variable in patients and controls was done by applying student t-test in case of quantitative data. Qualitative data was analyzed by using Chi-square test. Student t-test was run on the data by Microsoft excel software. The difference is said to be significant if significance i.e. 'P' value is less than 0.05

**OBSERVATIONS****Table No.1. showing comparison of fingertip patterns between male Patients and Controls**

| Patterns     | Total Value (Pts.) | Total Value(Cont.) | Chi-square value | Statistical significant |
|--------------|--------------------|--------------------|------------------|-------------------------|
| Arches       | 27                 | 89                 | 36.041           | Very highly Significant |
| Ulnar Loops  | 366                | 458                | 24.021           | Very highly Significant |
| Radial Loops | 21                 | 25                 | 0.3593           | Not Significant         |
| Whorls       | 306                | 148                | 80.30            | Very highly Significant |

$$X^2=36.041, p(0.001) = 10.83$$

$$X^2=24.021, p(0.0001) = 10.83$$

$$X^2=0.3593, p(0.50) = 0.46$$

$$X^2=80.30, p(0.001) = 10.83$$

**Table No. 2. Showing comparison of fingertip patterns between female Patients and Controls**

| Patterns     | Total Value (Pts.) | Total Value(Cont.) | Chi-square value | Statistical significant |
|--------------|--------------------|--------------------|------------------|-------------------------|
| Whorls       | 115                | 87                 | 4.514            | Significant             |
| Radial Loops | 4                  | 6                  | 0.4028           | Not Significant         |
| Ulnar Loops  | 158                | 159                | 0.0040           | Not Significant         |
| Arches       | 3                  | 28                 | 20.605           | Very highly Significant |

$$X^2=4.514, p(0.05) = 3.84$$

$$X^2=0.4028, p(0.50) = 0.46$$

$$X^2=0.0040, p(0.50) = 0.46$$

$$X^2=20.605, p(0.001) = 10.83$$

**Table no.3. Showing comparison of TFRC & AFRC between male Patients and Controls**

| Count | Male Patients     | Male Controls     | 't' Value | Statistical Significance |
|-------|-------------------|-------------------|-----------|--------------------------|
|       | Mean $\pm$ S.D.   |                   |           |                          |
| AFRC  | 211.6 $\pm$ 89.55 | 129.5 $\pm$ 56.71 | 6.574     | Very highly Significant  |
| TFRC  | 156.2 $\pm$ 54.49 | 107.4 $\pm$ 37.81 | 6.240     | Very highly Significant  |

$$P(0.001) = 3.37$$

**Table no.4. Showing comparison of TFRC & AFRC between female Patients and Controls**

| Count | Female Patients   | Female Controls   | 't' Value | Statistical Significance |
|-------|-------------------|-------------------|-----------|--------------------------|
|       | Mean $\pm$ S.D.   |                   |           |                          |
| AFRC  | 222.6 $\pm$ 75.86 | 152.1 $\pm$ 62.34 | 3.795     | Very highly Significant  |
| TFRC  | 160.6 $\pm$ 29.72 | 120.9 $\pm$ 33.93 | 4.365     | Very highly Significant  |

$$P(0.001)=3.69$$

**RESULTS & DISCUSSION**

In the present study, among fingertip patterns there is decrease in number of total arches in both male & female patients as compared to Controls

(Table no1&2), decrease in number of Ulnar loops in Male patients as compared to Controls. (Table no.1), Increase in number of Whorls both in male & females patients as compared to controls.(Table no.1&2).

Among ridge count there is increase in mean value of TFRC, AFRC in Male & Female patients as compared to controls. (Table no.3&4).

There is very little study done in Dermatoglyphics in diseases like pulmonary tuberculosis. Sidhu LS<sup>7</sup> in 1977 and Nechaeva OB et al<sup>8</sup> in 1996 found statistical significant differences in distribution of various subtypes in index fingers of both hands and little finger of right hand. Sangita S Babu et al<sup>9</sup> in 2005 studied the whorl pattern significantly predominant with decrease in loop pattern, Difference in mean TFRC and AFRC of controls and study group was found to be highly significant. In the present study many Dermatoglyphic parameters were studied and found to be statistically significant.

### CONCLUSION

Genetic contribution is one of the causes of pulmonary tuberculosis. Some studies indicate that inherited susceptibility is important risk factor. Many Dermatoglyphic patterns seen in pulmonary tuberculosis patients are found to be statistically significant in comparison with controls. Qualitative and quantitative analysis of Dermatoglyphic patterns/traits can be safely and effectively performed using simple resources. Promising value in use as an adjunct to the already existing screening tools for pulmonary tuberculosis. Further validation using larger data sets warranted prior to applying this in clinical use.

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# Comparative Study of Finger Print Pattern in Thalassemic Population of Vidarbha Region of India

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## ABSTRACT

**Background:** Dermatoglyphics is the scientific study of epidermal ridges. Dermatoglyphics can be used in predictions of genetic disorders since epidermal ridge patterns are under genetic influence. This study attempts to analyze whether any specific pattern exist for thalassemic population of the region or not.

**Materials and Methods:** A total of 200 cases, 100 each of thalassemia and control were enrolled for the study. Dermatoglyphic prints were taken by "Ink method". Detailed dermatoglyphic analysis was done with the help of magnifying hand lens and ridge counting was done with the help of a sharp needle.

**Results:** Loop patterns are more in male thalasseemics in third and fifth digits. Whorls pattern, Furuhat's index, Dankmejer's index, total finger ridge count and absolute finger ridge count are higher in thalasseemics of both sexes.

**Conclusion:** There are specific differences in the dermatoglyphic patterns in thalassemic patients as compared with normal general population of the region.

**Keywords:** Dermatoglyphics, Thalassemia, Finger Ridge

## INTRODUCTION

Dermatoglyphics is the scientific study of epidermal ridges and their configurations on the palmar region of hand and fingers and plantar region of foot and toes. Dermatoglyphics depends upon the cornified layer of epidermis and dermal papillae. The epidermal ridges are differentiated in their definitive forms during third and fourth month of foetal life hence they are the significant indicators of conditions existing several months prior to the birth of individual. The original ridge characteristics are not disturbed unless the skin is damaged to a depth of about one millimeter<sup>1</sup>.

There are thousands of diseases known to be caused by abnormal genes. If there is any abnormality in the genetic make-up of parents it is inherited to the children and is reflected in dermatoglyphics pattern<sup>2</sup>.

Dermatoglyphics can be used in predictions of genetic disorders<sup>3</sup> since epidermal ridge patterns are under genetic influence<sup>4,5</sup>. Abnormal dermatoglyphics patterns are known to occur with genetic disorders like Mongolism, Turner's syndrome and Klinefelter's syndrome<sup>6,7,8</sup>. It indicates that dermatoglyphics shows definite diagnostic changes in those disorders which shows genetic basis. Moreover, characteristics of individual epidermal ridges are highly variable; they cannot be duplicated in a finger, palm or sole, in another region or in different individual which are permanent and unchanging.

Thalassemia infant is a haemoglobinopathy that is seen in early first three decades of life and is well determined by various factors like age, sex and caste. Calculated birth rate for homozygous thalasseemics in India is around 11,316 per year which are added each year to the existing load of homozygous thalasseemics<sup>9</sup>. In thalassemia the affected children are normal at birth but at about three months of age onset of anemia are seen in them. Then the physical growth is retarded. Characteristic bone changes like frontal bossing and prominent facial bones appear<sup>10</sup>. In various parts of the world dermatoglyphics studies in thalassemic

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patients were conducted and differences were observed in comparison to normal population of those regions <sup>11, 12</sup>. That is why the present study was undertaken with the aim of studying and comparing the pattern of dermatoglyphics in normal Vidarbhan people and thalassemic patients of the same region so that thalassemia can be predicted in early age and preventive measure can be taken. Moreover, the technique of dermatoglyphics is simple and cheapest in nature thus this study attempts to analyze whether any specific pattern, exist for thalassemia and whether that serve as an early diagnostic tool.

## MATERIAL AND METHOD

It was a prospective study which was conducted in government medical college Nagpur. Cases were included from various parts of Vidarbha region of Maharashtra India. A total of 200 cases, 100 each of thalassemia and control were enrolled for the study. In both the groups 60% male and 40% female were parts of the study. In thalassemia group, cases were diagnosed by clinician of respective departments of government medical college Nagpur depending upon clinical histories, family histories, clinical examinations, laboratories investigations and past medical records. In control group, normal healthy volunteers of Vidarbha region of Maharashtra were included after complete general, systemic examinations and laboratories investigation.

Dermatoglyphic prints were taken by "Ink method" <sup>1,3,6</sup>. In the method, subjects were asked to clean and dry their hands with some moisture on the hands. Thin film of ink was applied over the palm with the help of inked rubber roller taking care of uniformity on digits,

hollow of the palm and flexor crease of wrist. Then print was taken by placing the hand over a sheet of white paper from proximal to distal end which was kept over a pressure pad. Same procedure was adopted for another hand. Detailed dermatoglyphic analysis was done with the help of magnifying hand lens and ridge counting was done with the help of a sharp needle.

The dermatoglyphic patterns are analyzed according to sex and bi-hand. They are subjected to nonparametric statistical tests to evaluate significant pattern of identifiable differences between the thalassemia and control groups. For qualitative analysis chi-square test was used.

## RESULTS

The observed percentage of loops in thalassemic males was 58.33% on the third digit and 83.33% on the fifth digit, while in control males it was 40.83% on the third digit and 70.83% on the fifth digit indicating increased loops pattern on the third and fifth digits in male thalassemics (Table- 1). The percentage of arches on the first digit is significantly increased in female thalassemics (22.50%) than the control females (6.25%). It is also increased in male thalassemics on the first digit (11.66%) than the control males (6.66%). The percentage of whorls in thalassemic males on the second digit (66.66%) and fourth digit (76.66%) is significantly increased than the control males where it is 50% on the second digit and 60.83% on the fourth digit. The percentage of whorls in thalassemic females on the second digit (67.50%) and fourth digit (55.00%) is also increased significantly than control females on the second digit (42.50%) and fourth digit (35%) table-1.

Table 1: Digital distribution of finger tip patterns

| Digits          | Patterns | Males<br>Mean# (%) |            | Females<br>Mean# (%) |             |
|-----------------|----------|--------------------|------------|----------------------|-------------|
|                 |          | Thalassemics       | Control    | Thalassemics         | Control     |
| 1 <sup>st</sup> | Loops    | 51 (42.50)         | 58 (48.33) | 25 (31.25)           | 46 (57.55)  |
|                 | Whorls   | 55 (40.83)         | 54 (45.00) | 37 (46.25)           | 29 (36.25)  |
|                 | Arches   | 14 (11.66)         | 08 (06.66) | 18 (22.50)*          | 05 (06.25)  |
| 2 <sup>nd</sup> | Loops    | 33 (27.50)         | 50 (41.66) | 17 (23.75)           | 42 (52.50)  |
|                 | Whorls   | 80 (66.66)*        | 60 (50.00) | 56 (67.50)           | 34 (42.50)* |
|                 | Arches   | 07 (05.83)         | 12 (10.00) | 07 (08.75)           | 04 (05.00)  |
| 3 <sup>rd</sup> | Loops    | 70 (58.33)         | 49 (40.83) | 55 (68.75)           | 62 (77.50)  |
|                 | Whorls   | 43 (35.83)         | 61 (50.83) | 20 (25.00)           | 17 (21.25)  |
|                 | Arches   | 07 (05.83)         | 10 (08.33) | 05 (06.25)           | 01 (01.25)  |
| 4 <sup>th</sup> | Loops    | 28 (35.83)         | 43 (35.83) | 28 (42.50)           | 52 (65.00)  |
|                 | Whorls   | 92 (76.66)*        | 73 (60.83) | 50 (55.00)           | 28 (35.00)* |
|                 | Arches   | 00 (00.00)         | 04 (03.33) | 02 (02.50)           | 00 (00.00)  |
| 5 <sup>th</sup> | Loops    | 100 (83.33)        | 85 (70.83) | 69 (86.25)           | 66 (82.50)  |
|                 | Whorls   | 20 (16.66)         | 32 (26.66) | 09 (11.25)           | 12 (15.00)  |
|                 | Arches   | 00 (00.00)         | 03 (02.50) | 01 (01.25)           | 00 (00.00)  |

\* -  $p < 0.05$ , # - Mean of Right and Left Finger

Furuhata's index is 102.84 in thalassemic males and 85.26 in control males. It is 89.18 in thalassemic females and 46.51 in control females. The Furuhata's index in thalassemic patients (M+F) is 97.29 and that of controls (M+F) is 66.85. The Dankmejer's index is 9.66 in thalassemic males and 14.40 in control males. It is 19.08 in thalassemic females and 8.33 in control females. In (M+F) thalassemics the Dankmejer's index is 13.17 and in (M+F) controls it is 12.40 (Table- 2). Whorls are significantly increased in left hand of male thalassemics, right and left hands of female

thalassemics and both hands of males and females combined series as compared to that of controls. Arches are significantly increased in the right and left hands of female thalassemics as compared to control females. Loop patterns are significantly increased in the right and left hands of male thalassemics and males and females combined series as compared to that of controls indicating Furuhata's index and Dankmejer's index as higher in thalassemic patients than that of controls (Table-2).

**Table- 2: Frequency distribution of fingertip patterns**

| Subject | Sex | Side | Whorls (%)   | Arches (%) | Loops (%)    | Furuhata's Index | Dankmejer's Index |
|---------|-----|------|--------------|------------|--------------|------------------|-------------------|
| T Group | M   | R    | 146 (34.33)  | 15 (5.66)  | 139 (60.00)* | 105.04           | 10.27             |
|         |     | L    | 144 (34.66)* | 13 (5.00)  | 143 (60.33)* | 100.70           | 9.03              |
|         |     | R+L  | 290 (34.50)* | 28 (5.33)  | 282 (60.16)* | 102.84           | 09.66             |
|         | F   | R    | 84 (40.00)*  | 16 (8.00)* | 100 (52.00)  | 84.00            | 19.05             |
|         |     | L    | 89 (42.50)*  | 17 (8.50)* | 94 (49.00)*  | 94.68            | 19.10             |
|         |     | R+L  | 173 (41.25)* | 33 (8.25)* | 194 (51.00)* | 89.18            | 19.08             |
|         | M+F | R    | 230 (36.60)* | 31 (6.60)  | 239 (56.80)* | 96.23            | 13.48             |
|         |     | L    | 233 (37.80)* | 30 (6.40)  | 237 (55.80)  | 98.31            | 12.88             |
|         |     | R+L  | 463 (37.20)* | 61 (6.50)  | 476 (56.30)* | 97.27            | 13.17             |
| C Group | M   | R    | 139 (46.33)  | 18 (6.00)  | 143 (47.66)  | 97.20            | 12.95             |
|         |     | L    | 104 (34.66)  | 17 (5.66)  | 142 (47.33)  | 73.24            | 16.35             |
|         |     | R+L  | 243 (40.50)  | 35 (5.83)  | 285 (47.50)  | 85.26            | 14.40             |
|         | F   | R    | 59 (29.50)   | 0 (2.50)   | 124 (62.00)  | 47.58            | 8.48              |
|         |     | L    | 61 (30.50)   | 05 (2.50)  | 134 (67.00)  | 45.52            | 8.20              |
|         |     | R+L  | 12 (30.00)   | 10 (2.50)  | 258 (64.50)  | 46.51            | 08.33             |
|         | M+F | R    | 198 (39.60)  | 23 (4.60)  | 267 (53.40)  | 74.16            | 11.61             |
|         |     | L    | 165 (33.00)  | 22 (4.44)  | 276 (55.20)  | 59.78            | 13.33             |
|         |     | R+L  | 363 (36.50)  | 45 (4.50)  | 543 (54.30)  | 66.85            | 12.40             |

T- Thalassemia, C- Control, M- Male, F- Female, R- Right, L- Left

Percentage of ulnar loops in thalassemic males (60.16%) and males and females combined series (56.30%) is increased than that of control males (43.33%)

and males and females combined series (50.70%) table-3.

**Table 3: Frequency distribution of loop patterns on fingertips**

| Subject | Sex | Side | Ulnar Loops No. (%) | Radial Loops No. (%) | Total loops No. (%) |
|---------|-----|------|---------------------|----------------------|---------------------|
| T Group | M   | R    | 180 (60)            | 00 (0.00)            | 180 (60)            |
|         |     | L    | 181 (60.33)         | 00 (0.00)            | 181 (60.33)         |
|         |     | R+L  | 361 (60.16)         | 00 (0.00)            | 361 (60.16)         |
|         | F   | R    | 104 (52.00)         | 00 (0.00)            | 104 (52.00)         |
|         |     | L    | 98 (49.00)          | 00 (0.00)            | 98 (49.00)          |
|         |     | R+L  | 202 (50.50)         | 00 (0.00)            | 202 (50.50)         |
|         | M+F | R    | 284 (56.80)         | 00 (0.00)            | 284 (56.80)         |
|         |     | L    | 279 (55.8)          | 00 (0.00)            | 279 (55.8)          |
|         |     | R+L  | 563 (56.30)         | 00 (0.00)            | 563 (56.30)         |

**Table 3: Frequency distribution of loop patterns on fingertips (Cont.)**

| Subject | Sex | Side | Ulnar Loops<br>No. (%) | Radial Loops<br>No. (%) | Total loops<br>No. (%) |
|---------|-----|------|------------------------|-------------------------|------------------------|
| C Group | M   | R    | 126 (42.00)            | 15 (5.00)               | 141 (47.00)            |
|         |     | L    | 134 (44.66)            | 13 (4.33)               | 147 (49.00)            |
|         |     | R+L  | 260 (43.33)            | 28 (4.66)               | 288 (48.00)            |
|         | F   | R    | 123 (61.50)            | 12 (6.00)               | 135 (67.50)            |
|         |     | L    | 124 (62.00)            | 10 (5.00)               | 134 (67.00)            |
|         |     | R+L  | 247 (61.75)            | 22 (5.50)               | 269 (67.25)            |
|         | M+F | R    | 249 (49.80)            | 27 (5.40)               | 276 (55.20)            |
|         |     | L    | 258 (51.60)            | 23 (4.60)               | 281 (56.20)            |
|         |     | R+L  | 507 (50.70)            | 50 (5.00)               | 557 (55.70)            |

T- Thalassemia, C- Control, M- Male, F- Female, R- Right, L- Left

There is significant increase in the mean values of AFRC in thalassemic males and females and also in thalassemic male and female combined series when compared with the controls (Table- 4).

**Table- 4: Absolute Finger Ridge Count (AFRC)**

| Subject     | Sex         |  | Mean    | SD    | SEM  | CV %  |
|-------------|-------------|--|---------|-------|------|-------|
| Thalassemia | Male        |  | 163.58* | 30.75 | 3.97 | 18.80 |
|             | Female      |  | 163.12* | 35.68 | 5.65 | 21.87 |
|             | Male+Female |  | 163.35* | 33.22 | 3.32 | 20.33 |
| Control     | Male        |  | 117.35  | 53.38 | 6.90 | 45.49 |
|             | Female      |  | 136.82  | 51.34 | 8.12 | 37.52 |
|             | Male+Female |  | 127.08  | 52.36 | 5.24 | 41.20 |

\*-  $p < 0.05$ , SD- Standard Deviation, SEM- Standard Error of Mean, CV- Coefficient of Variation

There is statistically significant increase in the mean values of TFRC in thalassemic males and females and also in thalassemic male and female combined series when compared with the controls (Table- 5).

**Table- 5: Total Finger Ridge Count (TFRC)**

| Subject     | Sex         |  | Mean    | SD    | SEM  | CV%   |
|-------------|-------------|--|---------|-------|------|-------|
| Thalassemia | Male        |  | 140.36* | 30.25 | 3.91 | 21.55 |
|             | Female      |  | 135.10* | 25.01 | 3.96 | 18.51 |
|             | Male+Female |  | 137.73* | 27.63 | 2.76 | 20.06 |
| Control     | Male        |  | 103.60  | 46.67 | 6.03 | 45.05 |
|             | Female      |  | 115.82  | 38.18 | 6.04 | 32.96 |
|             | Male+Female |  | 109.71  | 42.42 | 4.24 | 38.67 |

\*-  $p < 0.05$ , SD- Standard Deviation, SEM- Standard Error of Mean,

CV- Coefficient of Variation

## DISCUSSION

Dermatoglyphics is used as diagnostic aid in number of diseases which have strong hereditary basis. Thalassemia is a genetic defect having at least 91 point mutations and several deletional mutations which were identified within and around the beta globin chain gene all affecting the expression of the beta globin chain gene resulting in defects in activation, initiation,

transcription and/or termination from this certain dermatoglyphic variations are to be expected in this disease. Thus dermatoglyphic patterns should help on expression of genes in thalassemia.

In this study thalassemics have fewer arches more than control group. However loop pattern is found to be significantly increased in male thalassemics mainly on third and fifth digits. Whorls are significantly

increased on second and fourth digits of both hands of male and female thalassemics, while arches are significantly increased on first digits of both hands of male and female patients.

Santosh Kumar et al <sup>13</sup> in their study which was conducted in 20 thalassemic and 200 control subjects observed preponderance of ulnar loops in 1<sup>st</sup>, 2<sup>nd</sup> and 5<sup>th</sup> digits while preponderance of whorls were observed in 2<sup>nd</sup> and 4<sup>th</sup> digit. Maximum arches were observed on the 1<sup>st</sup> digit, while radial loops were not seen in any case. Mutalimova AB and Kurdiumova TIU <sup>14</sup> found prevalence and amount of whorls more than other patterns on fingers in their study which was conducted in 39 cases which was compared with controls. Saha KC et al <sup>15</sup> in the school of Tropical Medicine in Kolkata studied 50 patients of thalassemia in which 30 were male and 20 were female observed increase frequency of whorls and decrease ulnar loop pattern. Rosener F and Spriggs HA <sup>11</sup> in their study which was conducted in Brooklyn on 76 females and 23 male patients with control group of the same race and sex found that the patients had an increased frequency of whorls and less ulnar loops than the controls, which was significant.

In this study, TFRC is significantly increased in thalassemic males and females and a significant difference is found in the count when thalassemic males and females combined series is compared with those of controls. AFRC is also significantly increased in both male and female thalassemics and male and female combined series than those of controls. Thus differences observed in TFRC and AFRC are found to be statistically significant. Rosener F and Spriggs HA <sup>11</sup> found that the mean total ridge count was significantly increased in thalassemics while Saha KC et al <sup>15</sup> observed higher values of total ridge count in males and lower values in female thalassemics. Thus above studies indicate diverse types of findings in various regions of the world. But all the study including ours shows difference in dermatoglyphic pattern as far as thalassemic and control of the respective regions are concerned.

### CONCLUSION

We conclude that loop patterns are significantly more in male thalassemics on third and fifth digits. Whorls pattern is higher in thalassemics of both sexes and it is predominant on second and fourth digits in male patients. Ulnar loops are less in female thalassemics while arches are significantly in more number in both male and female thalassemics on first digits. Furuhashi's index and Dankmeijer's index are

higher in thalassemics than controls and TFRC and AFRC both are significantly higher in male and female thalassemics than controls. Thus our study shows specific difference in the dermatoglyphic patterns in thalassemic patients as compared with normal general population and it will be helpful for early detection of thalassemia cases in the region.

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# Postmortem Study of Sudden and Unexpected Natural Deaths in Aurangabad Region, Maharashtra

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## ABSTRACT

The present study is a humble effort to determine the medico-legal and the epidemiological aspects of sudden natural deaths. Total of 2088 medico legal autopsies were performed between 1st January 2009 to 31st December 2009, out of which 221 (10.58%) were sudden natural deaths with male to female ratio 7.5:1. Most of the sudden natural deaths were in the age group of 41-50 years (28.05%). A majority of the patients were married (59.8%) Cardiovascular diseases were the most important cause contributing 51.59% principally maximum deaths due to coronary artery disease followed by respiratory diseases among all sudden natural deaths. All natural deaths occurring within 24hours (WHO) from the onset of signs and symptoms were considered. Cases involving trauma, drugs, poison, asphyxia, decomposition were excluded.

**Keywords:** Sudden Death, Natural Death, Unexpected Death, Autopsy

## INTRODUCTION

It is quite possible for a person to be in apparently perfect health but at the same time suffering from a serious disease of which he may not be aware. Sudden deaths are important from a medico-legal standpoint as they raise suspicion of foul play<sup>1</sup>.

Forensic pathologists deal not only with criminal, accidental and suicidal deaths, but also with a wide range of deaths from natural causes. Many of these deaths are sudden, unexpected, clinically unexplained or obscure, even though there need be no criminal element in their causation.<sup>2</sup>

The most widely accepted definition of sudden death is – A death which is not known to be caused by any trauma, poisoning or violent asphyxia and where death occurs all of a sudden or within twenty-four hours of the onset of terminal symptoms, which may be totally different from the symptoms which the patient was having so long. Thus, if the cause of death is known to be unnatural one, it can't be termed as sudden death.<sup>3</sup>

Not uncommonly, medico-legal autopsies are conducted in cases of sudden and unexpected deaths primarily to establish the cause of death in cases where such deaths have occurred in apparently healthy

individuals under suspicious circumstances. The situation may become very knotty where the trauma per se is not fatal and pathological lesion found at autopsy may have been compatible with continued life like chronic heart disease and these can create much more difficulties in determining the cause of death than in firearm wound or stab injury<sup>4</sup>.

Natural deaths undoubtedly constitute a significant portion of deaths which undergo autopsy for investigation of death. Therefore, the study of autopsies of individuals dying of sudden death is decided and to what extent this diagnosis rightly directs the process of death investigation.

## MATERIAL AND METHOD

The present study was conducted in the Department of Forensic Medicine and Toxicology, in Government Medical College and Hospital, Aurangabad, Maharashtra, during period from 1<sup>st</sup> January 2009 to 31<sup>st</sup> December 2009.

All cases, irrespective of age groups and sex, who died suddenly and/or unexpectedly within 24 hours of onset of terminal symptoms and brought to our institute for post-mortem examination, were studied.

Before starting the post-mortem examination, history about the onset of symptoms, their duration and habits, medical records if any were obtained from the relatives, friends and investigating officer.

The standard autopsy techniques were followed. Cavities opened and organs were examined in-situ before removal. Weight of all organs was taken before dissection. Gross examination and dissection of the organs was performed and wherever gross pathology found was sent in 10% formalin for histo-pathological examination. In few cases viscera was preserved for chemical analysis to rule out poisoning.

After the receipt of histo-pathological report and CA report, final opinion as to cause of death was given. The findings were recorded and analyzed statistically as per predesigned Pro-forma.

## RESULTS

In the present study, 2088 autopsies were conducted, out of which, 221 cases (10.58%) were of sudden natural death.

**Table 1: Age and sex distribution**

| Age (Yrs.) | Male death   | Female death | Total death |
|------------|--------------|--------------|-------------|
| 0-10       | 1            | 3            | 4           |
| 11-20      | 1            | 3            | 4           |
| 21-30      | 15           | 2            | 17          |
| 31-40      | 46           | 4            | 50          |
| 41-50      | 58           | 4            | 62          |
| 51-60      | 42           | 4            | 46          |
| 61-70      | 24           | 5            | 29          |
| > 70       | 8            | 1            | 9           |
| Total (%)  | 195 (88.24%) | 26 (11.76%)  | 221(100%)   |

Amongst these 221 cases, 195 cases (88.23%) were male and 26 (11.76%) were female. The male to female ratio was 7.5:1.

### Place of incidence

In the present study most of the cases of sudden death, i.e. 128 cases (57.92%) took place when the

deceased was in his/her home, followed by death on duty (14.48%).

**Table 2: Habits and relation of sudden natural death**

| No habits | Smk | Alc | Tob | Smk + Alc | Tob + Alc | NK | Total |
|-----------|-----|-----|-----|-----------|-----------|----|-------|
| 43        | 34  | 6   | 10  | 18        | 2         | 1  | 114   |

Smk - smoker, Alc - Alcohol, Tob - Tobacco, NK - Not known

In present study it was observed that the persons having habits of smoking, alcohol and/or tobacco outnumbered than those not having any habit.

### Time of onset of symptoms

In this study we observed the time of onset of symptoms was between 06 hrs to 12 hrs in 60 (27.15%) cases, followed by the 12 hrs to 18 hrs in 52 (23.53%) cases. The least number was seen in 00-06 hours.

### Period of survival

In the present study, out of 221 cases 127 (57.47%) cases died within 1 hour of onset of symptoms, followed by 35 (15.84%) died within 1 to 2 hour of onset of symptoms. Only 26 (11.76%) cases survived for 2-24 hours.

**Table 3: System-wise affection**

| System affected       | Male        | Female death | Total death | Percentage |
|-----------------------|-------------|--------------|-------------|------------|
| Cardiovascular system | 107         | 07           | 114         | 51.59      |
| Respiratory system    | 41          | 14           | 55          | 24.89      |
| GIS                   | 07          | 01           | 08          | 03.62      |
| CNS                   | 05          | 00           | 05          | 02.26      |
| Genitourinary         | 00          | 01           | 01          | 00.45      |
| Miscellaneous         | 02          | 00           | 02          | 00.90      |
| Multiple system       | 33          | 03           | 36          | 16.29      |
| Total (%)             | 195(88.23%) | 26(11.77%)   | 221         | 100.0      |

It is observed that cardiovascular system was the most vulnerable to sudden death contributing to 114 (51.59%) deaths & the least case of genitourinary system was 1 (00.45%).

Table 4: Showing diseases and sex-wise distribution of cases

| System & diseases        |                                               | Male death | Female death | Total death |
|--------------------------|-----------------------------------------------|------------|--------------|-------------|
| CVS                      | Coronary artery disease (CAD)§                | 72         | 05           | 77          |
|                          | CAD + OMI                                     | 29         | —            | 29          |
|                          | Acute myocardial infarction (AMI)§            | 04         | —            | 04          |
|                          | Mitral stenosis                               | 01         | 01           | 02          |
|                          | Ventricular septal defect §                   | —          | 01           | 01          |
|                          | Cardiac Tamponade                             |            |              |             |
| RS                       | Pulmonary tuberculosis                        | 30         | 07           | 37          |
|                          | Pneumonia                                     | 09         | 06           | 15          |
|                          | Bronchictasis + Lung abscess                  | —          | 01           | 01          |
|                          | Lung infract§                                 | 01         | —            | 01          |
|                          | CA Lung                                       | 01         | —            | 01          |
| GIT                      | Cirrhosis of liver                            | 04         | —            | 04          |
|                          | Rupture of esophageal varices                 | 01         | —            | 01          |
|                          | Intestinal infraction & obstruction§          | —          | 01           | 01          |
|                          | Acute pancreatitis with fatty liver           | 01         | —            | 01          |
|                          | Cirrhosis with gangrene of intestine§         | 01         | —            | 01          |
| CNS                      | Meningitis§                                   | 02         | —            | 02          |
|                          | Intracerebral hemorrhage                      | 02         | —            | 02          |
|                          | Subarachnoid hemorrhage                       | 01         | —            | 01          |
| GUT                      | polycystic kidney disease                     | —          | 01           | 01          |
| Miscel.                  | Sickle cell disease                           | 01         | —            | 01          |
|                          | Dengue fever                                  | 01         | —            | 01          |
| Multiple System Involve. | CAD/MI/OMI/AHD/Cardiom + Fat.liv. /cirrhosis  | 10         | 01           | 11          |
|                          | CAD/MI/AHD/Cardiom + Ben. nephro /cystic RCC  | 09         | —            | 09          |
|                          | Pneum/pul TB/Pl effusion + cirrhosis /fat liv | 08         | —            | 08          |
|                          | CAD/MI + Pneum/CA lung                        | 02         | —            | 02          |
|                          | CAD/MI + ICH/IVH                              | —          | 02           | 02          |
|                          | Pneumonia + Benign nephrosclerosis            | 01         | —            | 01          |
|                          | Meningitis + cirrhosis of liver               | 01         | —            | 01          |
|                          | ICH+ MI+ Benign nephrosclerosis               | 01         | —            | 01          |
|                          | MI+ Fatty liver+ Benign nephrosclerosis       | 01         | —            | 01          |
|                          | <b>Total</b>                                  | <b>195</b> | <b>26</b>    | <b>221</b>  |

From above table it is observed that heart is the most vulnerable organ in cases of sudden natural death with pathology in heart accounting for 114 cases (51.59%) followed by respiratory system 55 cases (24.89%). Male deaths (195) were in greater in number than female deaths (26)

## DISCUSSION

The duration of the death process has ranged from minutes to hours, but it is difficult to determine how long the fatal symptoms have been present, as death often occurs before the victim reaches hospital, in situation in which no data on the symptoms are available for want of eye witnesses. This study deals only with material from postmortem examinations, and

the cases were selected during the study period, with lack of proper registration of deaths, therefore statistical incidence of sudden death is not attempted.

## INCIDENCE

In the present study, it has been observed that incidence of sudden natural death was 221 cases out of 2088 total deaths (10.58%) amongst the medico legal autopsies conducted during the study period.

Thus the incidence of sudden natural death in the present study are consistent with the study of Nandy (2010)<sup>3</sup>, Reddy (2008)<sup>5</sup>, Zanjad et al (2006)<sup>6</sup>, Rao et al (2008)<sup>7</sup> and Ambade V.N. (2002)<sup>8</sup>.

## Age and sex distribution

As shown in the table no 1, in the age distribution for the present study, most of the cases (28.05%) belonged to 41 to 50 years age group and the minimum (1.81%) belonged to 0-10 years and 10-20 years of age groups each.

In the present study, most of the male deaths (29.74%) belonged to 41 to 50 years followed by 31-40 years (23.59%) and less deaths (0.51%) for 0-10 and 10-20 years of age. While maximum (19.23%) female death belonged to 61 to 70 years age group and minimum (3.85%) above 70 years of age group each.

The present study coincides with the studies by Kumar et al (2007)<sup>9</sup>, Sarkioja et al (1984)<sup>10</sup>, Zanjad et al (2006)<sup>6</sup>, Meina Singh et al (2002)<sup>11</sup> and Ambade V.N. (2002)<sup>8</sup>.

This may be due to westernization of Indian society, sedentary life style and increased smoking habit and alcohol drinking.

In the present study, out of 221 total sudden death, 195 (88.24%) were male and 26 cases (11.76%) were female with male to female ratio 7.5:1.

This is in accordance with the studies by Sarkioja et al (1984)<sup>10</sup>, Thomas et al (1988)<sup>12</sup>, Meina Singh et al (2002)<sup>11</sup>, Ambade V.N. (2002)<sup>8</sup>, Derya A. (2007)<sup>13</sup>, Kumar et al (2007)<sup>9</sup> and Rao et al (2008)<sup>7</sup>.

## MARITAL STATUS

It was observed that 175 (79.19%) victims were married followed by marital status not known 33 (14.93%) and the least reported 13 (5.88%) were unmarried. This coincides with study of Kumar et al (2007)<sup>9</sup> that majority of the patients were married (59.8%).

## PLACE OF INCIDANCE

It is observed that most of the sudden death occurred in home i.e. 128 cases (57.92%). It means that sudden deaths took place when the deceased may be resting in his/her home, followed by on duty 32 cases (14.48%) and road side 29 cases (13.12%).

The present study is consistent with kuller et al (1966)<sup>14</sup>, Fornes et al (1993)<sup>15</sup> and Durigon M. et al (2003)<sup>16</sup>.

## Habits and relation of coronary artery disease

Regarding the correlation between diseases leading to sudden natural death and chronic habits (alcoholism, smoking and tobacco chewing) in the present study it has been observed that out of 221 cases history regarding chronic habits was known in 114 (51.58%) cases. Out of this 70 (61.40%) were smoker, chronic alcoholic and tobacco chewer. The majority were smokers (34 cases), followed by smoker with alcoholic having 18 cases. Thus the present study is consistent with Rissanen et al (1978)<sup>17</sup>.

## Time of onset of symptoms

The time of onset of symptoms was between 06 hrs to 12 hrs in 60 (27.15%) cases, followed by the 12 hrs to 18 hrs in 52 (23.53%) cases. In the morning hours because there is more stress of daily schedule, transportation, fulfilment of duties etc. and that could explain the higher frequency. There are no other studies which mention such a time of onset of symptoms.

## Period of survival

Out of 221 cases 127 (57.47%) cases died within 1 hour of onset of symptoms, followed by 35 (15.84%) cases died within 1 to 24 hours of onset of symptoms, 33 (11.76%) cases period of survival were not known. It coincides with study of cases 118 (64.48%) whose final episode lasted less than 1 hour of Scott et al (1971)<sup>18</sup>.

## Cause of death

It was observed that maximum deaths were related to Cardiovascular system 114 (51.59%) cases, followed by Respiratory system 55 (24.89%) cases. In this study maximum deaths were due to coronary artery disease 110 cases (96.49% of CVS deaths), followed by pulmonary tuberculosis 37 cases. Preponderance to cardiovascular diseases is due to various risk factors, physical and mental stress and food habits, addictions and lack of exercise which affect the mostly cardiovascular system.

The present study coincides with studies of Luke et al (1968)<sup>19</sup>, Durigon et al (2003)<sup>16</sup>, Nandy A (2010)<sup>3</sup>, Reddy Narayan (2008)<sup>5</sup>, Zanjad et al (2006)<sup>6</sup>, Derya AA (2007)<sup>13</sup> and Rao et al (2008)<sup>7</sup>.

## Sex and System wise distribution

In CVS, RS, Gastrointestinal and CNS deaths male to female ratios were 15.28:1, 2.93:1, 7:1 and 5:1 respectively. In this study genitourinary system death was in only one case i.e. female.

Although there are numerous causes of sudden death, cardiovascular causes are the principle cause among sudden death in the present study. Out of 221 cases of sudden natural death, 114 cases (51.59%) were due to cardiovascular causes, of which 107 (93.86%) were male and 7 (6.14%) were female.

Findings in the studies by Sarkioja et al (1984)<sup>10</sup>, Thomas et al (1988)<sup>12</sup>, Zanjad et al (2006)<sup>6</sup>, Derya A A. (2007)<sup>13</sup> and Rao et al (2008)<sup>7</sup> are similar to this study. Thus from all above studies, it is seen that cardiovascular cause was the principle cause of death among sudden death and more common in males than females which is consistent with the present study.

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# Tooth for Truth-Dental DNA for Gender Determination: A Review

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## ABSTRACT

Forensic odontology occupies a primary niche in the total spectrum of methods applied to medico legal identification that cannot be underrated. While extensive work has led to the rapid development of the subject of forensic odontology in Western countries, there is a need for heightening the awareness about the importance of this specialty amongst Indian dental professionals. The enamel and dentin of human teeth act like an armor coating to protect the DNA rich inner aspect of the tooth, that is, the pulp tissue from various environmental conditions.

**Keywords:** Forensic Odontology, DNA Analysis, Gender Determination

## INTRODUCTION

Gender determination in forensic investigation utilizes craniofacial morphology, tooth dimensions and DNA analysis. Odontometrics plays an important role in sexing young individuals where secondary sexual characteristics are not developed.<sup>1</sup> Many researchers believe that measurements of tooth size or assessment of morphology are insufficiently accurate for forensic identification, particularly in the light of more objective methods.<sup>2</sup> These objective methods are the microscopic technique and the Polymerase Chain Reaction (PCR) analysis of DNA. In microscopic technique pulp tissue is examined for Barr bodies (present only in females). This technique has been shown to be of value in burnt and mummified remains and is highly accurate.<sup>3</sup> The second method is analysis of DNA sourced from the dental pulp and the amelogenin gene from tooth enamel by PCR.

## MICROSCOPIC METHOD

Determination of gender is difficult if the body is fragmented and sex chromatin diagnosis can be of great help in such situations. Tooth pulp tissue is sequestered in a hard tissue casing, where it may be buffered from the detrimental effects of impact trauma and heat.<sup>4</sup>

Gender can be determined by the presence & absence of X & Y chromosomes in the cells taken from buccal smears, skin biopsy, blood, cartilage, hair root sheath, and tooth pulp. A Barr Body is a hetero chromatic X chromosome found in the nucleus of an undividing

cell and it was first discovered by Barr and Bertam (1949). It is present as a mass usually lying against the nuclear membrane in the females<sup>5</sup>.

Seno & Ishizu in 1973<sup>6</sup> applied the above method for gender determination of pulp tissue of teeth which was later carried out by D.K. Whittker et al<sup>7</sup> to find the reliability of the method. According to him it was found to be possible to determine gender from necrotic pulp contents with a high degree of accuracy upto 5 weeks after cessation of blood supply, but the method became unreliable as putrefaction proceeded.<sup>7</sup>

Duffy JB et al in 1991 has found that sex chromatin is shown to be preserved in dehydrated human pulp upto one year and human pulp retains gender diagnostic characteristics when heated to 100 degrees for upto 1h.<sup>3</sup>

Adachi H in 1989 evaluated the appearance rate of Y chromatin in the dental pulp with the staining by quinacrine mustard, and was revealed that the pulp tissue could be well preserved for a long time because of the natural drying. A similar study by Johnson also showed that this method was more reliable in freshly extracted teeth than after a period of 3-6 months post extraction.<sup>8</sup> (unpublished data).

## ADVANCED METHOD

Gender identification by Polymerase Chain Reaction (PCR).

Gender determination is an important element in the analysis of biological evidence submitted to forensic laboratories.<sup>9</sup> Gender determination from teeth can provide an important means of personal identification in the event of a mass disaster. The enamel and dentin of human teeth protect the DNA rich inner aspect of the tooth from various postmortem insults. Despite exposure of the body to burial, mutilation, explosion, or incineration, it is usually possible to extract DNA of sufficient quality and quantity to conduct a PCR-based analysis.<sup>10</sup>

### DNA ANALYSIS

In 1944 Avery described Deoxyribonucleic acid (DNA) as the vehicle of generational transference of heritable unit.<sup>11</sup> Watson and Crick in 1953 revealed that the human DNA in its native form is double stranded and these two strands are joined together through a process called hybridization, which is the fundamental property of DNA.<sup>12</sup>

Nuclear DNA and mitochondrial DNA are the two types of human DNA and their characteristics make them attractive targets for forensic analysis. In cases where genomic DNA cannot be analyzed, possibly because it is too degraded, mitochondrial DNA may be present in sufficient quantity. Mitochondrial DNA sequences offer several unique advantages for the identification of human remains. Teeth present an excellent source of genomic DNA.<sup>13</sup> According to Yamada Y et al DNA extracted from dental pulp is useful for identification of individuals, paternity testing, and gender determination<sup>14</sup>.

The pulp tissue of tooth is an excellent source of DNA.<sup>15</sup> Developmental cells that have become trapped during mineralization of the tooth can be liberated from the dentin and predentin layers to provide additional source of DNA evidence.<sup>1</sup> When conventional dental identification methods fail, the DNA can provide the necessary link to prove identity.<sup>16</sup> I A Pretty & D Sweet in 2001<sup>17</sup> pointed out that comparison of DNA extracted from the teeth of an unidentified individual can be made to a known antemortem sample (stored blood, hairbrush, clothing, cervical smear, etc) or to a parent or sibling.

PCR technique is highly sensitive. It is possible to discriminate one individual from other with a high level of confidence by using 1ng or less of target DNA.<sup>15,25</sup>

According to Honda K et al (1990)<sup>18</sup> it is possible to

do DNA analysis by PCR method to determine the gender from hard tissues such as a piece of bone or a tooth, and old samples. PCR technique can be successfully applied both to recent and to ancient teeth in personal identification.<sup>19</sup> According to Yamamoto K (1996)<sup>20</sup> even after 21 months of extraction of teeth gender determination was possible from dental pulp tissue.

Akane A<sup>21,22</sup> quoted Saiki R.K (1988)<sup>23</sup> that even small samples of DNA can be analyzed easily by PCR method. A study done by Potsch L et al (1992)<sup>24</sup> also revealed that gender determination was possible by using as little as 50 – 100 ng target DNA. Sivagami and coworkers<sup>25</sup> (2000) prepared DNA from teeth by ultrasonication, and subsequent PCR amplification, they obtained 100 per cent success in determining the sex of the individual.

Researchers have shown that environmental conditions have more influence on DNA preservation than does time and there is no general correlation between the age of the sample and the preservation of DNA<sup>26,27,28</sup>.

According to J Burger et al & Chen L et al (1994)<sup>30</sup> DNA can be preserved for a long period of time if it is preserved in an environment with neutral or slightly alkaline pH and low temperature.<sup>29</sup> Lessig R & Edelmann J (1995)<sup>31</sup> pointed out that under the influence of high temperature the pulp degrades making DNA typing almost impossible. Urbani et al (1999)<sup>32</sup> evaluated the effect of temperature on sex determination using DNA – PCR analysis of dental pulp. PCR was shown to be 100% reliable when used to assess the gender of teeth, which had been heated at 100 degrees C for 15 minutes but less reliable when the teeth were heated at higher temperatures for longer periods of time. Murakami H et al (2000)<sup>33</sup> reported that sex could be determined by PCR of DNA extracted from the pulp of freshly extracted permanent teeth & freshly extracted milk teeth which were preserved at room temperature for 22 years. When teeth were heated for 30 min, sex determination from the pulp was possible in all teeth heated to 100, 150 and 200 degrees C, and even in some teeth heated to 250 degree C.

Komuro T et al (1998)<sup>34</sup> and Ovchinnikov IV et al (1998)<sup>35</sup> pointed out that the sex of infant's remains was possible from pulp tissue by PCR when it was not possible by anthropological methods.

Malaver P C & Yunis J J (2003)<sup>36</sup> extracted DNA from mineralized tissues of teeth after a short decalcification step with EDTA. PCR results showed that the pulp

yielded the strongest amplification signals. Hanaoka Y (1996)<sup>37</sup> and Stacks B (1996)<sup>38</sup> showed that sex determination from blood and teeth by PCR amplification of the alphoid satellite family was useful

There are many challenges for using this technique in the laboratory. Firstly this technique demands more expertise from the user than most of the older conventional techniques. Secondly, the extreme sensitivity of PCR and the problem of false positive and false negative results. Methodologic precautions are recommended to minimize this problem<sup>39,40,41</sup>.

### Gender determination from enamel

Amelogenin or AMEL is a major matrix proteins in developing tooth enamel. Developing enamel contains about 30% protein, and 90% of this is amelogenins. It has a different signature (or size and pattern of the nucleotide sequence) in male and female enamel.

The AMEL gene that encodes for female amelogenin is located on the X chromosome and AMEL gene that encodes for male amelogenin is located on the Y chromosome. The female has two identical AMEL genes or alleles, whereas the male has two different AMEL genes. This can be used to determine the gender of the remains with very small samples of DNA<sup>42</sup>

The gene for amelogenin can be used in gender determination of samples from unknown human origin through PCR method. The X chromosome gene, gives rise to a 106 bp amplification product (amplicon) and the Y chromosome gene, AMELY, a 112 bp amplicon.<sup>43</sup> Hence, the AMELX contains a 6 bp deletion in the intron 1. Therefore, when the amplicons are run on an agarose gel, samples from male sources (XY) will show two bands on an agarose gel (one for the 106 bp fragment and one for the 112 bp fragment), whereas females (XX) will show only one band. Thus, this process allows for gender determination of unknown samples.

However, mutations in the Y-derived fragment of the gene may result in amplification failure of the Y allele, causing misidentification of the biological sample as of a female<sup>44</sup>. The error rate is not much. In one study, amelogenin test was undertaken on 1224 individuals participating in a biomedical study and the concordance between referred sex in the database and amelogenin test was estimated. It was found that the overall concordance rate was 99.84% (1222/1224)<sup>45</sup>. Only two individuals were reported as having a different sex using amelogenin (than their actual sex).

In one study, Thangaraj and colleagues studied a total of 270 male samples, of which 5 males showed a deletion of Y chromosome specific amelogenin (1.85%). The authors proposed to call them "Deleted-Amelogenin Males" (DAMs), who but for the detection of the presence of other Y-specific markers (e.g. SRY, STR and 50f2) would have been identified as females. Considering the consequences of the result obtained only using the amelogenin marker, the authors suggested the use of additional Y chromosome markers for unambiguous gender identification<sup>46</sup>

### CONCLUSION

To conclude, because of the resistant nature of dental tissues to environmental assaults teeth present an excellent source of DNA material. When conventional dental identification methods fail, this biological material can provide the necessary link to identity. With the advent of PCR technique this source of evidence is becoming increasingly popular with investigators. Comparison of DNA preserved in and extracted from the teeth of an unidentified individual can be made to a known antemortem sample (stored blood, hairbrush, clothing, cervical smear, biopsy etc) or to a parent or sibling.

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# Self Autonomy and Informed Consent in Clinical Setup

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## ABSTRACT

A human being having intelligentsia of good personality or in simpler terms a personage is in full control of his body by the international convention. This is called as self autonomy. Therefore self autonomy of a patient should be respected in terms of medical treatment protocol also.

Informed consent should be encouraged in all the disciplines of medicine as we are entering the era of patient as a consumer and doctors as a service provider. The rising literacy in our community is esteeming the self respect in people. Therefore, all the procedures involving medical treatment, surgical operations, assisting reproductive technologies, treatment of mental disabled person and treatment of children should have proper consent in terms of age, mental capacity, free will and full disclosure.

**Keywords:** *Autonomy, Informed Consent, Personage, Procedure*

## INTRODUCTION

The concept of self autonomy revolves around the personhood of the person and this value has different meaning in different cultures. The fundamental principles of autonomy was first expressed in Nuremberg Code of 1947.<sup>1</sup> The principle of self autonomy of the person is the availability to think, decide and act on one's own deliberation and without coercion even if in the end the person involved decides to let someone else guide him / her. The constitution of India in Article 21 provides a right to life and personal liberty.<sup>2</sup> In its widest amplitude cover a wide variety of rights including the right to live in human dignity and all that goes along with it.<sup>3</sup> World Medical Association in Declaration of Helsinki (1964) emphasized upon the importance of informed consent for medical research by adequately informing the subject of the aims, methods, anticipated benefits, potential hazard & discomfort which the study may entail.<sup>4</sup> Thus concept of informed consent becomes the fundamental process in health care services. Therefore, informed consent should respect and protect the personal integrity of the person along with physical, mental, emotional and spiritual issues.

Another landmark judgment that laid the foundation of informed consent was by Justice Cardozo in 1914 i.e. "Every adult human being of sound mind has the right to determine as to what shall be done to his body. If the surgeon performs an operation without the patients consent, is considered to have committed

an assault for which he is liable pay the damages".<sup>5</sup> Medical Council of India (MCI) laid down the rules according to which surgical treatment without consent is considered as misconduct and is punishable.<sup>6</sup>

## CONSENT

Indian Contract Act 1872 defines when two or more person agree upon the same thing and same time in same sense provided the consent has been taken prior to coercion, not under the influence of fraud or misinterpretation and mistake.<sup>7</sup> A valid consent is one that, is given voluntarily without any element of duress; to be given by an individual who has the legal capacity, in terms of age and mental competence. Any decision relating to the giving or withholding of consent must be based on sufficient relevant information.<sup>8</sup> Consent should not be considered as a single stage process, rather it is continuous process and if after due information patient gives contradictory or doubtful signals in a particular procedure then he also has right to withhold consent at any point of time of the ongoing procedure.<sup>9</sup> The constitution of India in its penal code (IPC) provides protection to the doctors against legal actions in any misadventure that had happened during a procedure which is done in good faith after taking well informed consent of the patient or its relatives or legal guardian in case of minor or an insane (IPC 87, 88, 89).<sup>10</sup> For practical purpose we divide the consent of patient for examination, treatment prescription and a specific procedure into implied and expressed form.

## Implied Consent

The trust and empathy which a patient develops with his physician when he first comes in contact and due to this empathy he allows history and examination of himself. This empathy and trust forms the basis of implied consent is the most commonly employed type of consent in general and medical set up.

Implied consent is limited the examination up to inspection, palpation and auscultation excluding examination of intimate parts. The definition of intimate parts is not very clear, but in India generally the private parts are considered intimate parts where as several European countries has defined the intimate parts, which generally includes all the natural orifices of the body and genital parts including breast examination in females. In U.K. oral cavity has been excluded from the list of intimate parts as for the requirement of DNA sampling.<sup>11</sup>

## Expressed Consent (Informed)

Expressed consent can be given verbally or in writing.

### Verbal Consent

It is a type of informed consent in which a patient is informed about the procedure along with its risk and benefit. It is legally as effective as written consent if taken in presence of disinterested person (any of the supporting staff) of the hospital.

### Written Consent

Written consent is the consent of the patient for a procedure after obtaining due information regarding the correct procedure / treatment in totality. It is often wrongly equated with a patient's signature on a consent form. A signature on a form is evidence that the patient has given consent, but is not a proof of valid consent. If a patient is rushed for signing a form, on the basis of too little information, the consent may not be valid, despite the signature. Patients who may wish to withdraw their consent although they might have signed a consent form earlier. In such a case documentation in patient's medical record is important.

## Requirements for Valid Informed Consent

The requirements of consent dealt with in detail below, are

### Competence and Capacity

Competency is categorized in two broad terms—one

is mental capacity and other is legal age to give consent. Mental competency is assessed by various tests and one of them is Mac Arthur competence assessment tool –treatment (Mac CAT –T) which is based on understanding the information, reasoning the risk / benefits of their choice, consequence of their choice and experience of their choice.<sup>12</sup> The legal age for giving a competent consent in India is 18 years as per the Indian Majority Act.<sup>13</sup> Where as in children between 12-18 years consent for physical examination a child below 12 years cannot consent for treatment.<sup>10</sup>

## Sufficient Information (Disclosure, And Recommendation)

Delhi medical council defines adequate information that would enable patient to make a balance judgment to undergo the treatment or not. The sufficient information may include uncertainties about diagnosis, options for investigations prior to procedure, material or significant risk involved, common or serious side effects expected outcome including benefits and limitation of activities, alternatives to the procedure, consequences of not having the procedure and procedure will carried out by patients consultant or his / her team. Wherever it is required the help of supporting medical staff, language interpretations, counsellors, pamphlets, posters, charts, any audiovisual examples may be employed to obtain the informed consent. Such demonstrations or help may be of case to case basis but it is the duty of the clinician to get full disclosure to get informed consent.

Preferably the ideal timing of consent is at the time of admission for particular procedure.<sup>14</sup> Busy schedules of most health care centres impose problems of timing which can interfere with the processes important in gaining informed consent. Wherever possible, procedures should allow enough time to impart information to children, young people and families, so that they can understand and come to terms with information before they are asked to consent to a procedure. When clinical events (for example, immunisation and blood tests for new-born screening) are routinely anticipated, staff caring for someone whose consent is required should prepare the person, in the most appropriate manner, well ahead of the event. There are also situations where patient does not want disclosure, but authorize the treating doctor, such faith in the treating doctor is good but we as a clinician should abstain from over enthusiastic steps or take any undue advantage and misuse the situation.

## **Voluntarily (Understanding, Decision and Authorization)**

It should not be under fear of injury, or under a misconception of fact, and if the person doing the act knows, or has reason to believe, that the consent was given in consequence of such fear or misconception. (IPC sec 90 ).<sup>10</sup> The patient/client must agree of their own free will to clinical treatment or investigations and must not have been subjected to the will of a third party i.e. a relative, such as to vitiate their consent. This voluntarily should come after full disclosure of risk / benefit & understanding of treatment & procedure. Patient should also be made aware that this ongoing consent (voluntarily) can be withheld at any point of time, during treatment or procedure. The country like India has lot of cultural & family values. At some places persuasion through family members may help in apprehended patient. Some religious healing may also help in some respect but to any extent it should not come up to the level of coercion & stress.

## **Refusal of Consent**

Competent adults are entitled to refuse treatment. When this situation occurs it is important to consult and discuss all those who are concerned about the patient. Alternatives to the proposed treatment / procedure should be discussed with the patient. Advice should be sought from a senior colleague. In certain situations it may be necessary to apply for a court order in order to render treatment to a patient. When seeking the assistance of the court in such matters it is important to keep the patient informed and consult with them throughout the process. All discussions and actions taken should be documented in the patient's healthcare record. Court intervention may be sought when parents refuse treatment, which the health care professionals deem essential; however, post treatment rehabilitation needs to be offered to improve parent-child relationship.<sup>13</sup>

## **Exceptions to the Rule for Obtaining Consent**

It is generally acknowledged that there are two exceptions to the common law rule:

- Therapeutic Privilege
- Life-Threatening Situation.

**Therapeutic privilege** means that a Clinician can withhold information if he/she feels that it would be psychologically damaging to the patient to disclose.<sup>5</sup> It

is rare for a Clinician to rely on this particular privilege in justifying the reasons for not telling a patient certain facts in relation to the proposed treatment. This privilege should very rarely, if ever, be exercised. If a physician was conscious that an anxious man might refuse important treatment, if told of every single possible adverse outcome, the clinician might, according to his/her therapeutic privilege, be justified in withholding certain facts. The information to be withheld in therapeutic privilege if any how communicated in good interest of the patient & results in any misadventure is not punishable by law (IPC 93).<sup>10</sup>

In a life threatening situations or in an emergency where a patient is unable to consent or appreciate what is required, the clinician may administer the necessary medical treatment in the presence of expressed consent of the patient. This is known as doctrine of necessity. Indian law provides to treat such patients without consent provided the act should be in good faith or for the benefit of the patient (IPC 92). This doctrine also applied to the emergency situations in case of child who is presented to the hospital unattended. Article 21 of the Indian constitution imposes an obligation on the State to safeguard the life of every person, the government hospitals run by the State or bound by duty so extend medical assistance to preserve human life.

## **DISCUSSION**

Informed consent is required in all the surgical procedures along with separate consent for an anesthesia (local, regional or general) with explanations regarding the procedure of an anesthesia, its complications during the procedures and its after effects. If during the procedure any extension of the procedure is required which is not covered under the doctrine of necessity, fresh consent should be insisted instead of taking a paternal attitude and ones stepping the limitations of current procedures. The same is applied for a new procedure which has intervened in the ongoing procedures and needs intervention. Removal of any of tissue during the procedure should have prior consent or afterwards and should also have trust of the patient in further investigations or research purpose. Photography during the procedure should also be consented if it needs identity revelation.<sup>15</sup> Proper consent should be obtained for implants, prosthesis, shunts, clips, artificial or inert elements along with their durability, company, cost, decay, foreign body reaction technicalities of removal of the implant. All the transplants involving human tissue or organ should

have consent based upon the guidelines of Transplantation of the Human Organ Act 1994 and Transplantation of Human Organ (Amendment Bill 2011).<sup>16</sup> Separate cares should be taken in case of blood transfusion during the procedure and patient should have proper information about the amount of blood to be transfused.

For Cadaver Donor Transplants informed consent from next of kin should be taken. If prior consent for organ donation before death is given in the presence of two or more witnesses then transplantation of the organ should be presumed and permissible without seeking further consent.<sup>17</sup>

In Assisted Reproductive Technologies, that includes fertilization involving manipulation of gametes outside the human body and the transfer of gametes or embryos into the body. Informed consent should be taken from the spouses as well as the donor as the case may be. As per the Delhi Artificial Insemination Act 1995, written consent of both husband and wife seeking artificial insemination and also consent for single screen semen for HIV through ELISA.<sup>18</sup>

Mentally disabled person or the person who have diminished ability to consent for any of the medical procedure should be checked in terms of capacity and the capacity of the person who gives consent, they can be admitted or treated or discharged from a mental hospital as per the guidelines laid. Indian Mental Health Act 1987<sup>19</sup> but as far as the emergency is concerned they are supposed to be treated under the protection of IPC 92 and Article 21 of Indian constitution. None of such insane person could be operated as far as he is alive for the organ or tissue donation.<sup>20</sup>

Treatment of children is mainly under the consent of patient or guardian or under the doctrine of loco parents. When such conditions are not applicable or parental consent is being withheld then court's opinion could be sought. There are other situations like legally separated parents or sole custody authorized to one parent or unmarried mothers, the consent could be obtained from the mother or who is legally entitled. None of the child could be operated for organ transplant or tissue removal until he/she is minor (less than 18 yrs) as per the guidelines of Human Transplant Amendment Act 2011.<sup>20</sup>

## CONCLUSION

1. An individual's rights to bodily integrity and autonomy should be respected by allowing that person to determine what is done to him or her.
2. Consent must be freely given, informed and given by a person who is competent to do so.
3. It must be written in patient's understandable language & must not include too many medical terminologies.
4. Nature of the proposed procedure, its inherent risk (the risk known to be an adverse effect by mere performance of that procedure), sequelae, and potential benefits.
5. It must identify the attending physicians/ unit in-charge/ hospital name & address.
6. It must mention the date/time/place and number of witnesses.
7. An acknowledgment that no guarantee and promises has been made to the parents concerning the result of any procedure.

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# Calculation of Regression Equation for Estimation of Stature from Ulna Length

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## ABSTRACT

Many a times Forensic Experts are asked to identify the person from dismembered part of the body and skeletal remains by the Investigating Officer. If the whole skeleton is available it becomes easy for identification, but the problem arises when only dismembered part of the body, few bones or single bone is available. In identification stature is primary characteristic along with age and sex. The present study is carried out in J. J. M. Medical College, Davangere, Karnataka. Total 100 students (50 males and 50 females) are randomly selected. The height of the students and length of both right and left Ulna of each student is measured by the same observer and with the same instrument. In this study we formulated the Regression Equation for estimation of stature from percutaneous length of right and left Ulna for males and females separately. Co-efficient correlation of height with percutaneous Ulna length is also calculated. The results of the present study indicate that the percutaneous length of ulna can be efficiently used for estimation of stature.

**Keywords:** Regression Equation, Stature Estimation, Ulna length

## INTRODUCTION

Assessment of body height from different parts of body by anthropometric study of skeleton is an area of interest to Forensic Experts, Anatomists and Anthropologists. Many a times Forensic Experts are asked to identify the person from dismembered part of the body and skeletal remains by the Investigating Officer. If the whole skeleton is available it becomes easy for identification, but the problem arises when only dismembered part of the body, few bones or single bone is available.

In ancient time physician and surgeon like Charaka and Sushruta were well acquainted with the relation of different parts of body and height. According to Charaka, the height of an average man should be 84 anguls, thigh - 21 anguls, leg - 19 anguls, forearm- 15 anguls and arm- 16 anguls<sup>1</sup>.

In past many authors have studied on Stature estimation based on measurements of Ulna and other long bones. Several authors have offered regression equations based on the length of long bones; however it is well known that formulae that apply to one population do not always give accurate results for other populations. Pearson<sup>2</sup> stated that a regression formula derived for one population should be applied to other groups with caution. In 1929, Stevenson<sup>3</sup> confirmed the existence of inter population differences with respect to stature estimation.

And most studies have stressed that regression formula for stature estimation should be population specific. So there is a need to develop a separate regression formula for stature estimation from long bone measurement for a particular population.

Since Olecranon process and styloid process are easily felt through the skin, it becomes easy to measure the length of the Ulna bone. So the present study "Estimation of Stature from Percutaneous Ulna Length" is taken up.

## MATERIALS AND METHOD

The present study is carried out in J. J. M. Medical College, Davangere, Karnataka. Total 100 students (50

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males and 50 females) are randomly selected. The height of the students and length of both right and left Ulna of each student is measured by the same observer and with the same instrument.

The ulna length is measured as a straight distance from the most proximal point of the Olecranon process to the most distal point of the Styloid process, with forearm flexed 90° angle at the elbow joint by using spreading caliper. Height of the student is measured in erect position with barefoot. After collection of data, it is subjected to statistical analysis. Mean, Standard Deviation, Standard Error of Estimate and Range for Height, Right Ulna length and Left Ulna length is calculated separately for males and females.

Correlation of Height with Right Ulna length and Correlation of Height with Left Ulna length is calculated for males and females.

## RESULTS

The statistical data which are extracted from calculation are tabulated in Table-1 and Table-2 & Table-3.

**Table-1**

| All in centimeters | Mean   |        | Standard Deviation |        | Range     |           |
|--------------------|--------|--------|--------------------|--------|-----------|-----------|
|                    | Male   | Female | Male               | Female | Male      | Female    |
| Height             | 168.77 | 154.58 | 7.16               | 5.59   | 141-183   | 140-177   |
| Rt Ulna Length     | 27.15  | 24.46  | 1.45               | 1.22   | 22-29.5   | 22.5-28   |
| Lt Ulna Length     | 26.86  | 24.16  | 1.53               | 1.10   | 21.5-29.5 | 22.5-27.5 |

**Table-2**

|                                              | Male | Female |
|----------------------------------------------|------|--------|
| Correlation of Height with Right Ulna length | 0.79 | 0.71   |
| Correlation of Height with Left Ulna length  | 0.79 | 0.70   |

**Table-3**

|                            | Male              |                  | Female            |                  |
|----------------------------|-------------------|------------------|-------------------|------------------|
|                            | Right Ulna Length | Left Ulna Length | Right Ulna Length | Left Ulna Length |
| Standard Error of Estimate | 4.38              | 4.36             | 3.94              | 4.01             |

**Table - 1** shows Mean, Standard deviation and Range for Height, Right Ulna length and Left Ulna Length for male and female.

**Table -2** shows correlation co-efficient of Height with Right Ulna length and Left Ulna Length separately for male and female. For males, Correlation Co-efficient

of Height with Right Ulna Length and Left Ulna Length are 0.79 and 0.79 respectively which show significant positive correlation. Similarly for females Correlation Co-efficient of Height with Right Ulna Length and Left Ulna Length are 0.71 and 0.70 respectively which also show significant positive correlation.

**Table - 3** shows standard error of estimate for right Ulna length left Ulna length in males and females.

## Regression formulae for estimation of height;

### In males

Height from Right Ulna Length;  $Y_1 = 65.54 + 3.91X_1$

Height from Right Ulna Length;  $Y_2 = 68.79 + 3.72X_2$

### In Females

Height from Right Ulna Length;  $Y_3 = 75.54 + 3.23X_3$

Height from Right Ulna Length;  $Y_4 = 68.89 + 3.50X_4$

$X_1$  denotes right ulna length of male

$X_2$  denotes left ulna length of male

$X_3$  denotes right ulna length of female

$X_4$  denotes left ulna length of female

The standard error of estimate works out to be 4.38 for right ulna length and 4.36 for left ulna length in males, 3.94 for right ulna length and 4.01 for left ulna length in females.

Thus at 95% confidence level the estimated height of male and female are as follows:

### In males

$Y_1 = 65.54 + 3.91X_1 \pm 8.58$

$Y_2 = 68.79 + 3.72X_2 \pm 8.54$

### In Females

$Y_3 = 75.54 + 3.23X_3 \pm 7.72$

$Y_4 = 68.89 + 3.50X_4 \pm 7.85$

## DISCUSSION

Results of present study are in excellent agreement with study done by Mondal M.K. et. al.<sup>1</sup> (in his study

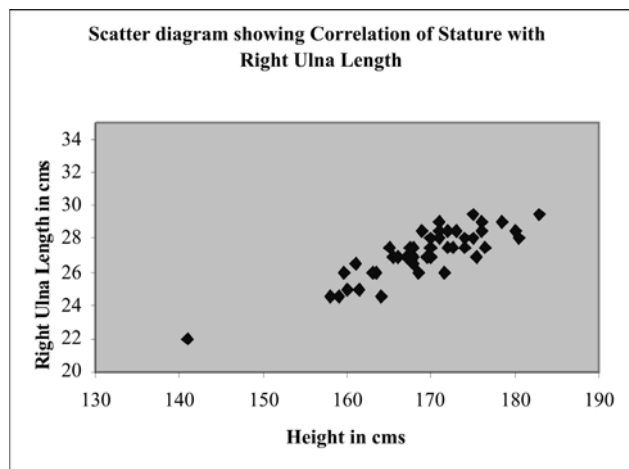


Fig. 1. Scatter diagram showing correlation of height with right Ulna length in Males.

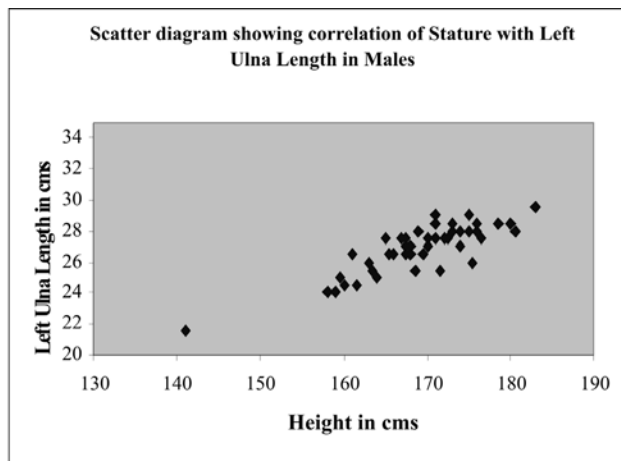


Fig. 2. Scatter diagram showing correlation of height with left Ulna length in Males.

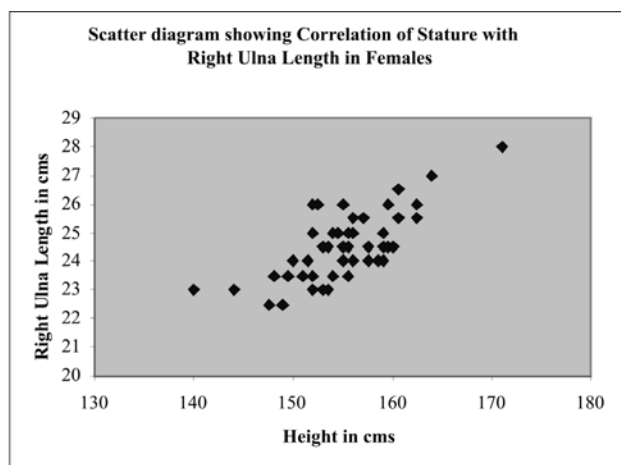


Fig. 3. Scatter diagram showing correlation of height with right Ulna length in Females.

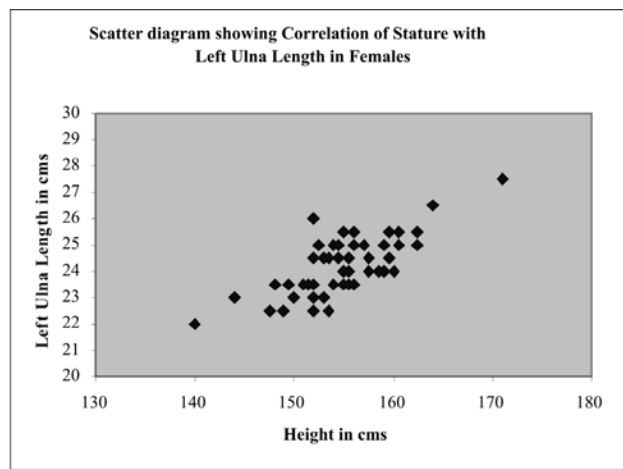


Fig. 4. Scatter diagram showing correlation of height with left Ulna length in Females.

correlation co-efficient (  $R$  ) of Height with Right Ulna length and Left Ulna Length are 0.78 and 0.68 respectively), Umesh S. R.<sup>4</sup> ( $R = 0.79$  for Male Rt Ulna Length,  $R = 0.77$  for Male Lt Ulna Length,  $R = 0.74$  for Female Rt Ulna Length,  $R = 0.83$  for Female Lt Ulna Length.) and Sorojini Devi et. al.<sup>5</sup> ( $R = 0.619$  for male and  $R = 0.584$  for female).

Duyar I et. al.<sup>6</sup> mentioned in his study, a need for separate regression equation to estimate stature depending upon length of Ulna (short, medium and tall) to have accurate results.

Allbrook D.<sup>7</sup> derived regression equation formulae for height estimation from ulna length as, Stature =  $88.94 + 3.06$  (ulna length)  $\pm 4.4$  (S.E.). He had not derived regression equation separately for male and female.

Agnihotri A. et. al.<sup>8</sup> are of the opinion that there is no need of separate regression formulae for right and left ulna and also no need of separate equation for male and female, but Mohanty<sup>9</sup> suggested a need for gender based different regression equations to predict the height.

Athawale MC<sup>10</sup> showed that there is definite correlation between stature of an individual and length of forearm bones. The regression equation derived for stature estimation from ulna length is; Stature =  $56.97 + 3.96 \times \text{Length of ulna} \pm 3.64$ . Here the author has taken average length of right and left ulna length for estimation of stature.

Lal and Lala<sup>11</sup> estimated height from surface anatomy of long bones like tibia & ulna. The ulnar multiplication factor was comparable in all series. They have claimed that ulnar multiplication factor is better guide for calculation of height when it is not definitely known to which part of the country the individual belongs.

In this study we have derived a separate regression equations for both Right and Left Ulna Length for males and females to estimate accurate stature of individual.

### CONCLUSION

The results of the present study indicate that the percutaneous length of ulna can be efficiently used for estimation of stature.

Most authors have underlined the need for population-specific stature estimation formulae. The main reason for this is, the ratio of various body parts differ from one population to another. In addition to ethnic differences, secular trend<sup>12</sup> and even environmental factors such as socioeconomic and nutritional status can influence body proportion<sup>13</sup>. So in this study we derived a separate regression equation to estimate stature from ulna length for Davangere region.

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# Down Syndrome: A Literature Review

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## ABSTRACT

Down Syndrome (DS) is a genetic condition caused by a chromosomal abnormality and results in a characteristic appearance, learning disability and a variety of physical and medical features. In India frequency of that occurrence is 2.2 per 1000 live births. Maternal age plays an important role in the frequency of Down syndrome. A wide variety of systemic (cardiovascular, hematopoietic, musculoskeletal, nervous) and oral anomalies (palate, oral opening, tongue, dental, periodontal and occlusion) are seen in Down syndrome children. Each individual may carry only limited anomalies which vary in its degree of severity and with age. These children require medical consultation and dentists do not need special skills or equipment to treat Down syndrome patients routinely in a dental office.

**Keywords:**

## INTRODUCTION

Down Syndrome (DS) is a genetic condition caused by a chromosomal abnormality and results in a characteristic appearance, learning disability and a variety of physical and medical features. It is also known as trisomy 21; trisomy G; mongolism.<sup>1</sup> First description of child who presumably has Down syndrome was provided by Esquirol in 1838.<sup>2</sup> Eight years later in 1846, Sequin gave description of the syndrome where he termed this condition "furfuraceous cretinism".<sup>3</sup> In 1866 John Lang Down<sup>4</sup> described a condition which he named "Mongolian Idiocy", later published an article accurately describing some of the characteristics of this syndrome that today bears his name. Later Lejuene<sup>5</sup> in 1959, demonstrated that the condition was associated with an extra G-group chromosome. In 1974 Nebuhr<sup>6</sup> suggested that the "Down syndrome phenotype" might be caused by the duplication of only a part of chromosome 21 band q22, which itself, represents about one half of the long arm.

In India, frequency of that occurrence is 2.2 per 1000 live births, which is higher than the average overall figure of 1 in 600 for all races.<sup>7</sup>

Approximately 95% of Down syndrome cases have extra chromosome 21, making the chromosome count 47 instead of the normal 46. The other 5% are accounted for by other chromosomal abnormalities including translocation (3%) and mosaicism (2%) or partial trisomy.<sup>8,9</sup> These anomalies are mild with intelligence approaching normal.<sup>8,9</sup> Maternal age plays an important role in the frequency of Down syndrome.<sup>8,9</sup> With increased maternal age, the incidence of occurrence increases as well. There appears to be no racial, social, and economic or gender predilection.<sup>8</sup>

People with disabilities have the right to equal standards of health and healthcare as the general population. However, there is evidence that they experience poorer oral health, have a greater unmet oral health need and less access to screening services than the general public. With the increase in ratio and trends towards deinstitutionalization, it is likely that most dental health care providers will encounter a Down syndrome patient. Dentists do not need special skills or equipment to treat Down syndrome patients routinely in a dental office.<sup>10</sup>

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## Diagnosis of Down Syndrome

### Before Birth

The sensitivity of multiple marker screening tests for Down syndrome is between 61 and 67 percent. Maternal serum levels of both alpha-fetoprotein and unconjugated estriol are often lower than normal for maternal and gestational age in women who are carrying a fetus with Down syndrome. In contrast, maternal serum levels of beta-human chorionic gonadotropin are often higher than normal. Testing for these three substances, performed in the second trimester, is often referred to as a "triple screen." In addition, an ultrasound examination done in the middle of the second trimester can identify some anomalies strongly associated with Down syndrome, such as nuchal translucency, short femurs, cardiac anomalies and duodenal atresia.

Chorionic villus sampling is performed between nine and 11 weeks of gestation, and amniocentesis is performed at 16 to 18 weeks of gestation. Either procedure yields fetal cells from which chromosomal abnormalities may be identified.<sup>11</sup>

### At Birth

Karyotyping of a newborn with suspected Down syndrome is important for two reasons. First, by confirming the diagnosis, karyotyping provides a degree of closure for the parents. Second, it gives the parents some guidance concerning their risk of having another child with Down syndrome.

Hypotonia is often the first characteristic of Down syndrome that is noticed. Referral to a medical geneticist for counseling is appropriate, because the risk of having a second child with Down syndrome varies with karyotype and maternal age.<sup>11</sup>

**Table I. Common Physical Characteristics in Neonates with Down Syndrome<sup>11</sup>**

| Characteristic                    | Range of occurrence (%) |
|-----------------------------------|-------------------------|
| Brachycephaly                     | 63-98                   |
| Oblique palpebral fissures        | 70-98                   |
| Gap between first and second toes | 44-97                   |
| Loose skin on nape of neck        | 17-94                   |
| Hyperflexibility                  | 47-92                   |
| Ear abnormalities                 | 28-91                   |
| Protruding tongue                 | 32-89                   |
| Flat nasal bridge                 | 57-87                   |
| Muscular hypotonia                | 21-85                   |
| Epicanthal folds                  | 28-79                   |

**Table I. Common Physical Characteristics in Neonates with Down Syndrome<sup>11</sup>**

| Characteristic                          | Range of occurrence (%) |
|-----------------------------------------|-------------------------|
| Brushfield spots                        | 35-78                   |
| Short fifth finger                      | 51-77                   |
| In-curved fifth finger                  | 43-77                   |
| Short broad hands                       | 38-75                   |
| High arched palate                      | 59-74                   |
| Single palmar crease                    | 42-64                   |
| Congenital cardiac defects              | 40-50                   |
| Transient myelodysplasia of the newborn | 10                      |
| Duodenal atresia                        | 5 to 8                  |

**Table II. Systemic conditions associated with Down syndrome<sup>12</sup>**

| Systems          | Conditions                                                                                                                                                                                                                                                                   |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Nervous          | Motor functions delayed; affects coordination Dementia analogous to Alzheimer's disease Speech Expressive language is delayed Phonation distorted as a result of imbalance of neuromuscular system.                                                                          |
| Behavior         | Natural spontaneity, genuine warmth, gentleness, patience and tolerance A few patients present anxiety and stubbornness.                                                                                                                                                     |
| Cardiovascular   | Ventricular septal defects Atrio-ventricular communis Patent ductus arteriosus Mitral valve prolapsed Tetralogy of Fallot.                                                                                                                                                   |
| Hematopoietic    | Impaired immunity Defective short-lived neutrophils Risk of lymphopenia Risk of eosinopenia Cell mediated immunity impaired Irregular serum immunoglobulin patterns Increased risk of leukemia Increased risk of hepatitis B carrier status if previously institutionalized. |
| Musculoskeletal  | Atlantoaxial Instability Midface is underdeveloped with relative prognathism Narrow and partially obstructed nasal air passages and thickening of mucosa. Mouth breathing Open mouth with tongue thrust.                                                                     |
| Gastrointestinal | Esophageal atresia Tracheoesophageal fistula Pyloric stenosis Duodenal atresia Meckel's diverticulum Hirschsprung's disease Imperforate anus.                                                                                                                                |
| Ophthalmologic   | Congenital and acquired cataracts Nystagmus Strabismus Dacryostenosis Blepharitis Keratoconus Refractive errors Amblyopia Increased retinal vasculature Glaucoma.                                                                                                            |
| ENT              | Otitis media Sinusitis Pharyngitis.                                                                                                                                                                                                                                          |

## DENTAL ANOMALIES

Microdontia: 35-55% of Down syndrome individuals present with microdontia in both the primary and secondary dentition. Kissling (1966) examined tooth diameters and found that all teeth,

except the upper first molars and lower incisors were reduced in size, but that the root formation was always complete.<sup>13</sup>

**Hypoplasia:** Johnson et.al. (1965) found the incremental lines exaggerated in Down syndrome population.<sup>15</sup> Hypoplastic defects are frequently the result of significant illnesses or prolonged fevers.<sup>16</sup>

**Partial anodontia:** Congenitally missing teeth are more common among individuals with Down syndrome (50%) when compared to the general population (2%), though the distribution of missing teeth is similar in both populations.<sup>13</sup> The only teeth not missing are first molars.<sup>13</sup>

**Taurodontism:** Taurodontism occurs more frequently ( $p < 0.001$ ) in persons with Down syndrome than in the general population. (Prevalence ranging from 0.54% to 5.6%.)<sup>17</sup> The mandibular second molar is the most frequently involved tooth in the dentition. If the diaphragm cells are altered and cell proliferation rates are slowed, as in Down syndrome, the invagination of the diaphragm is delayed.<sup>17, 18</sup>

**Crown variants:** Most crown variations are on the labial surfaces, incisal edges of anterior teeth, altered cuspal inclines on canines, missing or reduced distolingual cusps on maxillary molars and displaced distal cusp on mandibular molars.<sup>19</sup> Common variations of reduced size, agenesis and high frequency of crown irregularities are all interrelated and result from a decrease in mitotic activity of dental progenitor cells during embryogenesis.<sup>19</sup>

**Tooth Agenesis:** Agenesis is 10 times higher in Down syndrome patients than in the general population with a higher frequency in males than in females; higher in the mandible than in the maxilla, and higher on the left side than on the right.<sup>20</sup> Canines and first molars are rarely affected. The pattern of agenesis may be related to the peripheral nervous system, which either branches differently in Down syndrome patients or which contains fewer branches, or nerves that do not grow peripherally to the same extent as in the normal population.<sup>20</sup>

**Dental caries:** Orner's study<sup>21</sup> showed that Down syndrome individuals had a caries experience less than one-third that of their siblings. Shapira et al.<sup>22</sup> found that Down syndrome adults who were caries free had

significantly, lower *Streptococcus mutans* counts compared with the patients with dental caries. Several factors are considered responsible for the low prevalence of dental decay. Delayed eruption, reduced time of exposure to a cariogenic environment, congenitally missing teeth, higher salivary pH and bicarbonate levels (providing better buffering action), microdontia, spaced dentition, and shallow fissures of the teeth all contribute to this lower risk of dental caries.<sup>23</sup>

**Eruption of deciduous dentition:** Tooth eruption is delayed in timing and sequence, particularly in maxillary and mandibular anterior teeth and first molars. The first eruption is usually at age of 12 to 14 months but can be delayed up to 24 months.<sup>16</sup> By the time the primary dentition is completed the child may be 4-5 years of age.

**Eruption of the permanent dentition:** Like the primary dentition, first eruption in the permanent dentition is delayed. Six year old molars and mandibular incisors may not erupt till age of 8-9 years. The least affected teeth are upper and lower first molars and central and lateral incisors.<sup>24</sup> Alteration in eruption sequence timing and asymmetry seem to be less frequent between 7-9 years of age and more frequent between 10-14 years of age.<sup>24</sup>

### **Periodontal anomalies**

When compare with similar plaque levels, individuals with Down syndrome develop an earlier and more extensive gingivitis and exhibit rapid and generalized periodontal breakdown in adulthood.<sup>16</sup> Periodontal disease may start between the ages of six to fifteen. Common conditions seen in Down syndrome are, marginal gingivitis, acute and subacute necrotizing gingivitis, advanced periodontitis, gingival recession and pocket formation, horizontal and vertical bone loss with suppuration, bifurcation and trifurcation involvement in the molar area, marked mobility of posterior and anterior teeth, and frequent loss of teeth especially in the mandibular anterior area.<sup>22, 24</sup> An optional oral health preventive program can be started no later than eighteen months.<sup>25, 26</sup>

### **Occlusion anomalies**

The following are oral manifestations related to occlusion and may require orthodontic and/ or surgical

intervention.

**Malalignment:** A study by Ondarza et al.<sup>27</sup> analyzed patients with Down syndrome and showed a higher frequency of malalignments in both the deciduous and permanent dentition compared to a group without Down syndrome.

**Malocclusion:** The following factors play an important role in malocclusion: mouth breathing (96%), improper chewing (60%), evidence of bruxism (45%), tooth agenesis (12.7%), midline deviation in maxillary arch (80%), an anterior open bite (45%), dysfunction of temporomandibular joint (24%), delayed eruption and exfoliation of both primary and secondary dentition, characteristic tongue thrust, hypotonic ligamentary apparatus of mandibular joint, developmental disturbances of the mandible (platybsia) and maxilla (midfacial complex), and the jaw relationships.<sup>28</sup>

**Jaw Relationships:** Several findings in Down syndrome patients. They are as follows: (1) mandibular over jet, (69%); (2) anterior open bite (54%); (3) posterior cross bite (97%); (4) anterior cross bite (second largest category); (5) mesial molar occlusion (protruding mandible) (65%); (6) sagittal malocclusion (a result of relatively short maxilla and short middle cranial fossa).

**Midfacial complex:** The midface in Down syndrome patients is more deficient than the mandible.<sup>29</sup> The anterior cross bites are attributed primarily to an anteroposterior deficiency of the maxillary arch rather than a constriction in the transverse dimension. Since the mandible is not significantly affected, the apparent prognathism should be attributed primarily to the maxillary deficiency, rather than to enlargement of the mandible.<sup>29</sup>

**Platybsia:** Platybsia refers to the obtuse angle (NSBa: Nasion-Sella-Basion)<sup>29</sup> formed by the anterior cranial base segment to the posterior cranial base segment to such a degree that it appears as a straight line, indicating a flat cranial base.<sup>30</sup>

**Bruxism:** Bruxism is a common manifestation that starts early in life and sometimes persists throughout a person's life.<sup>16</sup> Initially bruxism eliminates some of the secondary and tertiary grooves and fissures found in newly erupted teeth. In young children, "transitory" bruxism is not uncommon.<sup>16</sup>

**Table III. Oral conditions associated with Down syndrome<sup>12</sup>**

| Systems      | Conditions                                                                                                                                                                                               |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Palate       | "Stair palate" with "v" shaped high vault<br>Soft palate insufficiency                                                                                                                                   |
| Oral opening | Angle of the mouth pulled down<br>Lower lip everted<br>Mouth breathing with drooling<br>Chapped lower lip<br>Angular cheilitis                                                                           |
| Tongue       | Scalloped, fissured<br>Protrusion and tongue thrusting<br>Macroglossia<br>Desiccated tongue                                                                                                              |
| Dental       | Microdontia Hypodontia Partial anodontia<br>Supernumerary teeth Spacing<br>Taurodontism Crown variants Agenesis<br>Hypoplasia and hypocalcification<br>Reduced risk of dental caries<br>Delayed eruption |
| Periodontal  | Increased risk of periodontal disease                                                                                                                                                                    |
| Occlusion    | Malalignment<br>Frequent malocclusions<br>Frequent temporomandibular joint dysfunction<br>Platybsia<br>Bruxism                                                                                           |

## CONCLUSION

This paper reviews diagnosis of Down syndrome as well as systemic (cardiovascular, hematopoietic, musculoskeletal, nervous) and oral anomalies (palate, oral opening, tongue, dental, periodontal and occlusion) and its' manifestations in Down syndrome with clinical recommendations. Each individual may carry only limited anomalies which vary in its degree of severity and with age. These children require medical consultation and dentists do not need special skills or equipment to treat Down syndrome patients routinely in a dental office.

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# A Study on Stapes Morphometry from Mangaolre, Karnataka

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## ABSTRACT

An anatomical detail of ossicular chain is of paramount importance in understanding the pathology and structural reconstruction of the ossicles. As stapes is located strategically between incus and fenestra vestibuli, its morphological aspects gains importance in all aspects of ossicular replacement surgeries, in electromagnetic middle ear implants and in ossiculoplasties. Study of variations of the stapes will help in understanding the diverse origin of its components. The present study attempts to provide morphometric detail of the stapes and also show light on the morphological variations. 25 human head specimens taken from the dissection hall, after removal of brain and duramater, subarcuate fossa and arcuate eminence of the petrous part of the temporal bone were chipped off with help of fine edged chisel and hammer. With help of bone cutter the tegmen tympani forming the remaining roof was removed, till the middle ear cavity and three ossicles are properly exposed and identified. Stapes showed maximum variations among ossicles. The mean height, width and length of stapes on both sides were found to be 3.22mm, 1.72 mm and 2.62mm respectively. The mean weight of stapes found to be 2.08mg. The weight of left sided stapes were more than the right sided stapes. Maximum variations of stapes proves its diverse embryological development.

**Keywords:** Stapes; Morphological Variations; Morphometry

## INTRODUCTION

The stapes is the smallest and lightest bone in the body.<sup>1</sup> The stapes is also known as the stirrup.<sup>2</sup> The head (caput) is directed laterally and has a small cartilaginous facet for articulation with the lenticular process of the incus. The neck is the constricted part supporting the head, and the tendon of stapedius is attached to its posterior surface. The processes diverge from the neck and are connected at their ends by a flattened oval plate, the base, which forms the footplate of the stapes. The footplate is attached to the margin of

the fenestra vestibuli by a ring of fibers (the annular ligament). The anterior process is shorter, thinner and less curved than the posterior.<sup>1</sup>

Stapes attached to incudostapedial joint (ball and socket articulation) with incus laterally and to oval window medially. The articular surfaces are covered with articular cartilage, and is enveloped by a capsule rich in elastic tissue and lined by synovial membrane. The stapes is stabilized by the stapedius muscle, which is innervated by the facial nerve. The vestibular surface and rim of the stapedial base are covered with hyaline cartilage. The cartilage encircling the base is attached to the margin of the fenestra vestibuli by a ring of elastic fibers, the annular ligament of the base of the stapes. The posterior part of this ligament is much narrower than the anterior part: it acts as a kind of hinge on which the stapedial base moves when stapedius contracts and

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during acoustic oscillation. The three bones together act as a bent lever so that the stapedial footplate does not move in the fenestra vestibuli like a piston, but rocks on a fulcrum at its anteroinferior border, where the annular ligament is thick.<sup>1</sup>

In non-mammalian tetrapods, the bone homologous to the stirrup is usually called the *columella*; however, in reptiles, either term may be used. In fish, the homologous bone is called the hyomandibular, and is part of the gill arch supporting either the spiracle or the jaw, depending on species.<sup>3</sup> As the stapes first develops embryologically from the 6th to 8th week of life, it surrounds the stapedial artery, which supplies the majority of the vasculature of the embryonic head. After that period, the external carotid artery is generated and takes over for the stapedial artery, which subsequently involutes, leaving the stapes with a windowframe-like structure.<sup>1</sup>

Ossicular replacements and ossiculoplasties have advanced the deafness related surgical treatment to a great extent in last 5-6 decades. For such complex surgeries the ENT surgeon must be thorough in navigating a closed, small area of middle ear – and handling the structures without damaging the vital structures. Procedures involving complete or partial removal of ossicles, especially stapes – commands a comprehensive anatomical knowledge of the middle ear.<sup>4</sup> The technical issues regarding the design and placement of electromagnetic middle ear implants can be better understood by anatomy of stapes and incudo-stapedial joint.<sup>5</sup> The development of Krauss-modified Schusing ossicle cup prosthesis, used in incus replacement is intimately dependent upon detailed information of the stapes superstructure.<sup>6</sup> Stapedial otosclerosis causing stapes fixation and conductive deafness is the most common variety of otosclerosis. Here the lesion starts in front of oval window in an area called 'fissula ante fenestrum'. This is the site of predilection (anterior focus). Lesions may start behind the oval window (posterior focus), around the margin of the stapes footplate (circumferential), in the footplate but annular ligament being free (biscuit type).<sup>7</sup> In order to develop anatomically-based mathematical models, which are needed to improve our understanding of stapes dynamics, detailed morphometry of the stapes is required.<sup>8</sup>

The current study was taken up to address the relative lack of data on the morphometry and variations of the stapes in Indian scenario.

## MATERIALS AND METHOD

25 human head specimens taken from the dissection hall of A J Institute of Medical Sciences, were used for the study. The cranial cavity and its middle cranial fossa were properly exposed after removal of brain and duramater. Portion above the internal acoustic meatus, sub arcuate fossa and arcuate eminence of the petrous part of the temporal bone were chipped off with help of fine edged chisel and hammer. Care was taken so that chipped off portion from exceeding 1 cm from the surface of the middle cranial fossa. With help of bone cutter the tegmen tympani forming the remaining roof was removed, till the middle ear cavity and three ossicles are properly exposed and identified.

With help of magnifying lens - observations were made in exposed part. Malleus identified easily by its globular head and incus by its body. Following the body and long process of the lower end of incus the head of the stapes was reached and gently pulled with help of a pointed forceps. Stapes foot plate was separated from the oval window and stapes in toto delivered out of the middle ear cavity.

By using ECG recording paper, having a scale of 1mm, the length and width of the stapes foot plate was noted by noticing the distance between the crura of the stapes. Height of the stapes was recorded by noting the distance between the head and the footplate.

Using electronic weighing machine – the weights of the stapes bone thus extracted noted after it was completely dried.

The measurements were tabulated for evaluation, comparison and interpretation. Morphological variations – if any were noted. Variations of the individual stapes bones noted and photographed after fixing the bone thin paraffin base.

## RESULTS AND OBSERVATIONS

Stapes height ranged from 2.5mm to 4mm on both sides with average of 3.22mm. Width ranged from 1mm to 3mm on both sides, with average of 1.76mm. Length ranged from 2mm to 3.5mm with an average of 2.62mm

on both sides. Weight ranged from 0.4mg to 4 mg with average of 2.08mg on both sides. Stapes obtained from fetus had 3mm (ht), 1.5mm (width) and 2.5mm (length) and weighed 1mg.

Stapes showed maximum variations in comparison to other ossicles. Variations ranged from symmetrically thick crura, symmetrically thin crura to rudimentary head and neck, absent neck. Other variations noted are – anterior crus is very thin and not reaching the footplate, circular obturator foramen, small bony projection from the anterior end of footplate, footplate having midline ridge, equally thick neck and head. One stapes bone looked like a hollow tube. Incudotapedial joint facets showed small variations in terms of shape, size and depths. The right sided stapes showed dominance in all the aspects except the weight which was observed to more in left sided stapes.

**Table 1: Showing Morphometric data of Left sided stapes**

| Sl. No  | Height<br>In mm | Width<br>In mm | Length<br>In mm | Weight<br>In mg |
|---------|-----------------|----------------|-----------------|-----------------|
| 1       | 4               | 2              | 3               | 3               |
| 2       | 3.5             | 2              | 2               | 2               |
| 3       | 3               | 2              | 2.5             | 2               |
| 4       | 3               | 1.5            | 2.5             | 1               |
| 5       | 3               | 1.5            | 3               | 2               |
| 6       | 3               | 2              | 2.5             | 2               |
| 7       | 3.5             | 1.5            | 2               | 0.9             |
| 8       | 3.5             | 1.5            | 3               | 3               |
| 9       | 3.5             | 1.5            | 2.5             | 2               |
| 10      | 3               | 1.5            | 2.5             | 0.8             |
| 11      | 3.5             | 1.5            | 3               | 3               |
| 12      | 3               | 1.5            | 2               | 0.4             |
| 13      | 3               | 1.5            | 2               | 3               |
| 14      | 3.5             | 1              | 2.5             | 3               |
| 15      | 3.5             | 1.5            | 2               | 1.2             |
| 16      | 3               | 1.5            | 3               | 2               |
| 17      | 3.5             | 2              | 3               | 3               |
| 18      | 3.5             | 2              | 3               | 3               |
| 19      | 3               | 2              | 2.5             | 3               |
| 20      | 3               | 2              | 2.5             | 2               |
| 21      | 3               | 2              | 2.5             | 2               |
| 22      | 3               | 2              | 3               | 2               |
| 23      | 3               | 1.5            | 2.5             | 2               |
| 24      | 3               | 2              | 2.5             | 2               |
| 25      | 3               | 2              | 2.5             | 2               |
| mean    | 3.22            | 1.72           | 2.56            | 2.092           |
| std dev | 0.29            | 0.29           | 0.36            | 0.78            |

**Table 2: Showing Morphometric data of Right sided stapes**

| Sl. No  | Height<br>In mm | Width<br>In mm | Length<br>In mm | Weight<br>In mg |
|---------|-----------------|----------------|-----------------|-----------------|
| 1       | 3.5             | 1.5            | 3               | 2               |
| 2       | 3.5             | 2              | 3               | 2               |
| 3       | 2.5             | 1.5            | 2.5             | 2               |
| 4       | 3               | 1.5            | 2               | 1               |
| 5       | 3               | 1              | 2               | 1.1             |
| 6       | 3.5             | 1.5            | 2.5             | 2               |
| 7       | 3.5             | 1              | 2               | 4               |
| 8       | 3.5             | 2              | 2.5             | 2               |
| 9       | 3.5             | 2              | 3               | 3               |
| 10      | 3               | 2              | 3               | 3               |
| 11      | 3.5             | 2              | 2.5             | 1               |
| 12      | 3               | 1.5            | 2               | 1               |
| 13      | 3.5             | 2              | 3               | 3               |
| 14      | 3               | 2.5            | 3               | 1.2             |
| 15      | 2.5             | 1.5            | 3               | 3               |
| 16      | 3.5             | 2              | 3               | 3               |
| 17      | 3               | 1.5            | 2.5             | 2               |
| 18      | 3               | 2              | 2.5             | 1.5             |
| 19      | 3.5             | 2              | 3               | 3               |
| 20      | 3               | 2              | 2.5             | 1.2             |
| 21      | 3               | 3              | 3.5             | 2               |
| 22      | 3.5             | 1.5            | 3               | 2               |
| 23      | 3.5             | 1.5            | 2               | 2               |
| 24      | 3.5             | 2              | 3               | 2               |
| 25      | 3               | 2              | 3               | 2               |
| mean    | 3.22            | 1.8            | 2.68            | 2.08            |
| std dev | 0.32            | 0.43           | 0.43            | 0.79            |

**Table 3: Analysis of data collected**

| Sl. No             | Height<br>In mm | Width<br>In mm | Length<br>In mm | Weight<br>In mg |
|--------------------|-----------------|----------------|-----------------|-----------------|
| Mean               | 3.22            | 1.76           | 2.62            | 2.086           |
| Standard deviation | 0.30            | 0.36           | 0.39            | 0.78            |
| Maximum            | 4               | 3              | 3.5             | 4               |
| Minimum            | 2.5             | 1              | 2               | 0.4             |
| Range              |                 |                |                 |                 |
| n                  | 50              | 50             | 50              | 50              |
| t                  | 1               | 0.447          | 0.291           | 0.957           |
| Pearsons           | 0.12            | 0.03           | -0.005          | -0.13           |

## DISCUSSION

Anatomy of the ossicle of tympanic cavity has unfortunately remained as an area of peripheral interest. Scant data exists on individual features and variations in each bone. The multiplicity of the contributing developmental sources only serves to add

to the range and frequency of the variations in the stapes. This is well evidenced by the amount of variations noted in this study of 25 sets of the stapes. Not surprisingly, the bones and their anomalies are definitive components of many congenital head and neck defects such as Treacher- Collins syndrome and Pierre Robin syndrome. In many such syndromes of first and second arch involvement, obvious auditory defects have been identified in newborns. Stapes in the course of growth from a chondral annulet to a stirrup shaped bone retains plates of primordial cartilage on the foveate head and the flattened surface of the base. Periosteal bone after forming a collar for the crura spreads to the neck of ossicle and across lateral surface of the base and then soon to be resorbed on the entire obturator aspect, circumferentially along the crura and across the neck and the base.

The study from Indian subcontinent though had done on stapes morphometry, westerners have done the study using more morphometric parameters. Ten human stapes from fresh temporal bones were studied by aWengen DF, Nishihara S, Kurokawa H and Goode RL and measurements regarding stapes superstructure were carried out.<sup>9</sup> The dimensions of the parts of the superstructure are as follows: 1) stapes head 1.14 mm (range, 0.91 to 1.49) in diameter parallel to the axis of the footplate and 0.83 mm (range, 0.65 to 1.08) perpendicular to it; 2) stapes head to shoulders 0.93 mm (range, 0.81 to 1.07), head to foramen 1.26 mm (range, 1.15 to 1.39), and head to lateral surface of stapes footplate 3.19 mm (range, 2.91 to 3.45); 3) neck width parallel to the axis of the footplate 1.18 mm (range, 0.88 to 1.47) and 0.64 mm (range, 0.48 to 0.88) perpendicular to it; 4) anterior crus 0.58 mm wide (range, 0.41 to 0.74) at the shoulder of the arch and 0.51 mm (range, 0.39 to 0.65) closer to the stapes footplate; 5) posterior crus 0.65 mm wide (range, 0.46 to 0.77) at the shoulder of the arch and 0.55 mm (range, 0.38 to 0.75) closer to the stapes footplate; and 6) maximum width of entire superstructure near footplate 2.48 mm (range, 2.06 to 2.98).

According to our study the average height is 3.22mm and Wadhwa S, Kaul J.M and Agarwal A.K<sup>10</sup> the anatomical height of the stapes measured an average of 3.41mm, ranging from a minimum of 3.06 mm to a maximum of 3.71 mm. Similar values have been reported by Urbantschitsch, (average - 3.70 mm; min-3.02; max-4.50 mm), Bast et al. (mean - 3.06 mm ; min-2.50; max-3.78 mm) and Dass et al. (mean -3.29mm; min - 2.80; max-3.93 mm).<sup>11</sup>

Clinically, the height of the stapes superstructure is of greater significance in stapedia reconstruction. Wengen et al. reported this distance to be 3.19 mm (2.91-3.45 mm).<sup>9</sup> In our study it was found to be 3.22 mm (2.50-3.50 mm). Partial ossicular replacement requires implants which fit onto the head of the stapes alone, thus necessitating the knowledge of the dimensions of the stapedia head.<sup>12</sup>

Twelve human stapes from temporal bones were studied by Reza Masteri Farahani and Mehrdad Nooranipour.<sup>13</sup> Different dimensions were measured by an electronic microscope with an accuracy of  $\mu\text{m}$ . The dimensions were (1) maximum diameter of stapes head parallel to the axis of footplate, 1088  $\mu\text{m}$  (range, 857–1277  $\mu\text{m}$ ); (2) distance of main nutritional foramen to head surface, 398  $\mu\text{m}$  (range, 250–833  $\mu\text{m}$ ); (3) stapes head to shoulders, 757  $\mu\text{m}$  (range, 571–1000  $\mu\text{m}$ ), head to foramen, 1047  $\mu\text{m}$  (range, 785–1500  $\mu\text{m}$ ), and head to lateral surface of footplate, 2612  $\mu\text{m}$  (range, 1892–3400  $\mu\text{m}$ ); (4) anterior crus width at shoulder, 398  $\mu\text{m}$  (range, 333–500  $\mu\text{m}$ ); minimum width of anterior crus, 251  $\mu\text{m}$  (range, 214–350  $\mu\text{m}$ ); (5) posterior crus width at shoulders, 386  $\mu\text{m}$  (range, 285–600  $\mu\text{m}$ ); minimum width of posterior crus, 191  $\mu\text{m}$  (range, 142–300  $\mu\text{m}$ ); (6) maximum width of footplate near anterior crus, 371  $\mu\text{m}$  (range, 321–500  $\mu\text{m}$ ), maximum width of footplate near the posterior crus, 411  $\mu\text{m}$  (range, 357–611  $\mu\text{m}$ ), minimum width of footplate, 228  $\mu\text{m}$  (range, 178–388  $\mu\text{m}$ ); (7) maximum width of ossicle, 2298  $\mu\text{m}$  (range, 1928–3050  $\mu\text{m}$ ); (8) angle between crura, 19.5° (range, 15–24°); and (9) diameter of foramen at the end of curve, 1343  $\mu\text{m}$  (range, 1071–1888  $\mu\text{m}$ )

According to Olszewski J the weight of the stapes increases by 11.57% during the fetal life and there is similar increase in overall dimensions in correlation with its weight increment.<sup>14</sup> Morphometry of the stapes is also studied by Varela et al. who have also tabulated a similar morphometric data.<sup>15</sup> Naujoks et al. have studied the ossicles of ear both morphometrically and histologically concluded that ossicles have different osteogenesis.<sup>16</sup> In autogenetic ossicles, angiogenetic and appositional osteogenesis could be seen; in allogenic ones, angiogenesis was predominant. Connective tissue prevailed in allogenic ossicles. The histological findings were in accordance with morphometric results and with statements from other literature.

## CONCLUSIONS

Morphologically stapes showed maximum variations in all its parts, among the ossicles. The right sided stapes dominated the left sided ones in all the

parameters except weight of left stapes dominated over the right. Neck of the stapes is identified in all the specimens except in one (which is in contrast to some earlier literature which denies the very existence of it). Anterior and posterior crura are thick at shoulder and thin at the junction of footplate. Posterior crura are generally found to be either symmetrically thick or thin. Obturator foramen is like an isosceles triangle in most of the specimens, in few it was circular. Footplate showed some exostoses from its anterior end in 2 specimens. Stapes as a whole appeared very thin and looked like a hollow tube in one specimen.

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# Estimating Stature from Percutaneous Length of Ulna in South Indian Population

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## ABSTRACT

Stature estimation from percutaneous body measurements forms part of forensic anthropological analysis for the purpose of identification. However, there is a great void in such norms for south Indian population. This study is aimed at modeling the stature on the basis of percutaneous ulnar length in human subjects comprising of south Indian population. The study was conducted in the Department of Anatomy in collaboration with the Department of Forensic Medicine, A.J. Institute of Medical Sciences, Mangalore on 200 young and healthy students comprising of 100 males and 100 females in the age group ranging from 20 to 22 years. The measurements were taken by using standard anthropometric instruments. It is remarked that ulnar length show a linear relationship with the stature, where stature is normally distributed.

**Keywords:** Forensic Science, Forensic Anthropology, Stature, Ulnar Length

## INTRODUCTION

Estimating individuality on the mutilated part of a dead body is a difficult task in Forensic Medicine. The dilemma of identification mainly arises when unknown human remains are brought to forensic pathologists for examination. The stature of an individual is an innate characteristic. It is considered as one of the important parameters for personal identification. There is a reputable relationship between stature and dimensions of various body parts, which allows forensic pathologists to estimate stature from different parts of the body. Many studies have been carried out to estimate stature from percutaneous body measurements.<sup>1-7</sup> A linear association between the length of bones and body height exists since stature is determined mostly by the length.<sup>8, 9</sup> The most comprehensive description of stature estimation from skeletal remains was compiled by Krogman and Iscan, Rollet, Dupertuis and Hadden, Pearson, Trotter and

Gleser.<sup>7, 10-12</sup> Various long bones have been employed for stature estimation using variety of methodologies.<sup>13-16</sup> Although many formulae for stature estimation from long bones have been proposed, there is concern regarding the accuracy of the use of population specific formulae on other human populations.<sup>17, 18</sup>

The ulna is a long bone on the medial side of the forearm. Proximally the ulna has a bony process called the olecranon process which articulates with the humerus. Distally the ulna bears a styloid process. The olecranon is subcutaneous and easily palpable. Its position depends on the angle of flexion-extension of the elbow joint. In extension, its tip is in line with the epicondyles of the humerus and in full flexion three bony points make an equilateral triangle. The whole length of the subcutaneous border of the ulna is palpable down to the styloid process.<sup>17, 19</sup> Ossification of the ulna begins at the 8th week of fetal life. The proximal epiphysis fuses with the shaft in 16th year and the distal epiphysis unites with the shaft in 20th year.<sup>17</sup>

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The ulna length has been shown to be a reliable and precise means in predicting the stature of an individual.<sup>20, 21</sup> Despite its significance and practical use, there is a great void in such norms for south Indian population, and hence, this study was designed to

investigate the relationship and to propose a specific regression formula between the percutaneous ulna length and height of an individual.

## MATERIAL AND METHOD

The study was conducted in the Department of Forensic Medicine in collaboration with the Department of Anatomy, A.J. Institute of Medical Sciences, Mangalore on 200 young and healthy students comprising of 100 males and 100 females in the age group ranging from 20 to 22 years. The subjects were apparently healthy and without any physical deformity. They were from different parts of the south India belonging to different socio-economic status. The ulna length was defined as the direct distance between the tip of the olecranon process and the styloid process while the elbow in full flexion. The length of both right and left Ulna of each student is measured with the help of spreading caliper. The height of the individual was measured between vertex and the floor, when the person is standing erect, in anatomical position and the head in the Frankfort plane, using a standing height measuring instrument. Height was measured to the nearest 0.1 cm. All the measurements were taken at a fixed time between 2.00 pm to 4:30 pm to eliminate discrepancies due to diurnal variation. Furthermore, the measurements were recorded by the same person to minimize the errors in methodology. Each measurement was taken thrice and the mean was taken for further analysis. Results were expressed as mean  $\pm$  SD and analyzed using a statistical package SPSS (15th version).

## RESULTS AND OBSERVATIONS

There was no significant differences were observed in the lengths of right and left sides of ulna in both males (mean difference = 0.0170, p-value = 0.123) and females (mean difference = 0.007, p-value = 0.540). Hence we have used right ulnar length for the construction of stature formulae. Regression analysis was performed for estimation of stature using the ulna length as an independent variable. Various important parameters of the study subjects are summarized in Table I. Gender differences in mean height and ulna length were found to be highly significant ( $P < 0.0001$ ) (Table 1). Mean ulna lengths of the male were significantly larger than that of the females for all ages ( $P < 0.0001$ ) (Fig. 1). Pearson's correlation coefficient was used to examine the relationship between ulna length and height according to the gender. Correlation coefficient between total height and ulna length was

found to be statistically significant and positive in both males and females (Figs. 2 and 3). Regression equations for stature estimation were derived as follows:

For male: Height =  $80.492 + 3.255$  (ulna length)

For females: Height =  $42.070 + 4.520$  (ulna length)

For both male and female (combined):  
Height =  $43.853 + 4.504$  (ulna length)

**Table I. Height, ulna length, correlation coefficient, regression coefficient and value of constant in males and females.**

\*  $P < 0.0001$  when compared with the females.

| Parameter               | Male             | Female           |
|-------------------------|------------------|------------------|
| Total Number            | 100              | 100              |
| Mean Age                | 18.18 $\pm$ 1.20 | 18.27 $\pm$ 0.65 |
| Height Range (cm)       | 157-183          | 150-178          |
| Mean Height (cm)        | 172.45 *         | 159.34           |
| Ulna Length Range (cm)  | 25.6-31.4        | 24-29            |
| Mean Ulna Length (cm)   | 28.25 *          | 25.94            |
| Correlation Coefficient | 0.79             | 0.66             |
| Regression Coefficient  | 3.255            | 4.520            |
| Value of Constant       | 80.492           | 42.070           |

## DISCUSSION

In forensic examinations and anthropological studies, prediction of stature from incomplete and decomposing skeletal remains is fundamental in establishing the identity of an unknown individual.<sup>10,21</sup> This can be accomplished using bones such as entire skeleton, long bones, vertebrae, cranium, clavicle, scapula and sacrum.<sup>9,12,22</sup> In the majority cases skeletal collections were used in such studies. Studies showed that long bones are the most appropriate specimens to evaluate stature.<sup>10</sup> Since there is dearth of literature for south Indian population regarding stature from long bones we proposed to investigate the relationship and to propose a specific regression formula between the percutaneous ulna length and height of an individual.

The average stature of adult males within a population is significantly higher than that of adult females.<sup>17,21,24</sup> The results obtained in our study are in agreement with the above statement. There was distinct sexual dimorphism in the ulna length in our study group where it was significantly longer in males than in females, a result that reinforces the previous observations.<sup>21</sup> Studies on secular change and allometry have established differential limb size between genders and among populace.<sup>25,26</sup> The need for gender specific formulae is proved as the rate of skeletal maturity in males and females tend to vary during the course of

development.<sup>17</sup> Furthermore, racial variation in the relationship between ulna length and height has been clearly demonstrated by comparative studies between Black, White and Asian subjects.<sup>27</sup>

The ulna length was proven to be superior to arm span measurement and hand length in predicting height.<sup>20,24</sup> Furthermore, linear regression equation of stature based on ulna length has definitive advantage over that of lower limb bone lengths, as it can be useful in cases where the lower extremities are distorted along with the deformities of the trunk.<sup>15</sup> Height estimation has also been attempted using the ratio between height and ulna length.<sup>21</sup> Results obtained from a study that attempted to reconstruct stature from ulna length in Hindu population in Gujarat demonstrated a regression coefficient between height and ulna length to be +3.506 for males.<sup>15</sup> The present study shows a regression coefficient of +3.255 for males and +4.520 for females. Variety of factors such as, age, race, gender and nutritional status affect human development and growth and therefore, different nomograms are required for different populations.<sup>15, 17</sup> The present study documents norms for height and ulna length and presents gender specific linear regression models for stature prediction in adult south Indian population. The formulae are valid for the age group (20- 22 years) of the subjects. Since the height is shown to progressively decrease with advancing age due to spinal cord shrinkage, it is recommended that similar studies on different age groups should be carried out to complement the results of the present study.<sup>17</sup> The regression models proposed will be of immense practical use in clinical practice, medico-legal, anthropological and archeological studies where the total height of a subject can be calculated if the ulna length is known. It is concluded that the stature of a deceased person for whom only mutilated forearms are available, can be determined with fair degree of accuracy by using the model equations derived from the present study.

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# Dentigerous Cyst in the Left Maxillary Sinus - A Case Report

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## ABSTRACT

Dentigerous or follicular cysts are the second most common type of odontogenic cyst. The cyst develops from the proliferation of the enamel organ remnant or reduced enamel epithelium. It is attached to the tooth cervix (cemento-enamel junction) and encloses the crown of the unerupted tooth. The most common sites of this cyst are the mandibular and maxillary third molars and maxillary cuspid areas, since these are the most common impacted teeth. We report a case of dentigerous cyst in a 12 year old female associated with left maxillary canine which was impacted in the maxillary sinus, with a retained deciduous maxillary canine.

**Keywords:** Dentigerous Cyst, Impacted Maxillary Canine, Maxillary Sinus

## INTRODUCTION

Dentigerous cyst is one of the most common type of developmental odontogenic cyst, estimated to be 20% of all jaw cysts. It is estimated that about 10% of all impacted teeth have formed a dentigerous cyst. It is always involved or associated with the crown of a normal permanent tooth. Seldom is a deciduous tooth involved. By definition, dentigerous cyst is an odontogenic cyst that surrounds the crown of an impacted tooth, caused by fluid accumulation between reduced enamel epithelium and the enamel surface, resulting in a cyst in which the crown is located within the lumen<sup>1</sup>. The cyst develops from proliferation of the enamel organ remnant or reduced enamel epithelium. Expansion of the cyst is related to epithelial proliferation, release of bone resorbing factor and an increase in cyst fluid osmolality<sup>2</sup>. There is no reproducible genetic defect has been identified. Loss of heterozygosity in the region of the PTCH on chromosome 9q has been claimed in sporadic cyst and dentigerous cysts can also be associated with various syndromes. Some of them appear to be induced by inflammation<sup>3</sup>. The highest incidence of this cyst occurs during the second & third decade. There is a greater incidence in males with a ratio of 1.6 to 1 reported<sup>2</sup>. The cyst is potentially capable of becoming an aggressive lesion. In case of a cyst associated with impacted maxillary cuspid, expansion of anterior maxilla often occurs<sup>1</sup>. Extension of the cyst into the maxillary sinus

or to the orbital floor may be noted. Resorption of the roots of the adjacent erupted teeth may occasionally be seen<sup>2,4</sup>.

A variant of dentigerous cyst arising at the bifurcation of molar teeth is the paradental cyst or buccal bifurcation cyst. Originally the cyst was considered along the buccal root surface of partially erupted mandibular third molar, teeth but later involvement of other mandibular teeth was recognized. In these later circumstances, mandibular molars are fully erupted<sup>5,6,2</sup>. There are some cases of the cyst that appear to have an inflammatory pathogenesis. It has been suggested that, on occasion, a dentigerous cyst may develop around the crown of an unerupted permanent tooth as a result of periapical inflammation from an overlying primary tooth<sup>6</sup>.

## CASE REPORT

A 12 year old female patient presented with the swelling of the left side of the face, since 3 months. Swelling started as a small lesion and gradually increased to involve the left side of the face. On clinical examination, no marked facial asymmetry of the face was observed, no lymph nodes were palpable and no significant colour change of the swelling was observed. Intraorally, the affected side showed over-retained deciduous canine which was mobile. The swelling was 5cm × 4cm, Extending from 22 - 25. Marked expansion

of buccal cortex was noted. The swelling was soft in consistency and compressible. No signs of inflammation or draining sinus were observed (Fig-1).



Fig-1:- Clinical picture of the patient

**FNAC:-** Fluid was aspirated. On aspiration clear yellow coloured fluid was observed.

**RADIOGRAPHIC EXAMINATION:** Paranasal sinus view revealed a unilocular radiolucent lesion with sclerotic border involving the left maxillary sinus. 23 was in the sinus around which a large lesion was observed. The lesion being large gave the impression of multilocular process because of persistence of bone trabeculae within the radiolucency (Fig-2). The lesion was planned for enucleation.

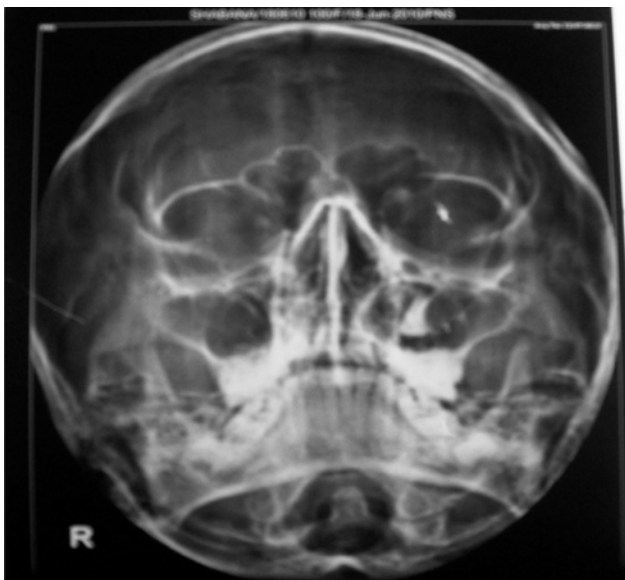


Fig-2:- Para nasal sinus radiograph

A vestibular incision was placed from 22-24 and mucoperiosteal flap raised, buccal window was created and expanded to gain access (Fig-3). The cystic lining was separated from surrounding bone and the entire lining was enucleated along with the 23 tooth (Fig-4). The cavity was irrigated with betadine and saline and packed with antiseptic packing. The tissue was prepared for histopathological examination. Serial sections were made.



Fig-3:- 23 seen from the buccal window

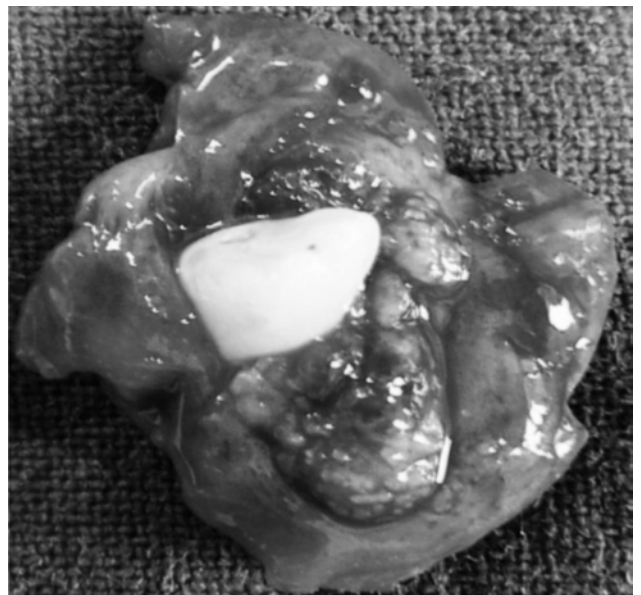


Fig-4:- Enucleated cyst along with 23

**HISTOPATHOLOGICAL EXAMINATION:-** The lesional tissue showed a dense loose fibrous connective tissue wall. The lumen was lined by 4-6 layers of stratified squamous epithelium. The junction between epithelium and connective tissue was flat. A few mucous cells were noted in the epithelial lining (Fig-5). Epithelial odontogenic rests were seen in the connective tissue wall.

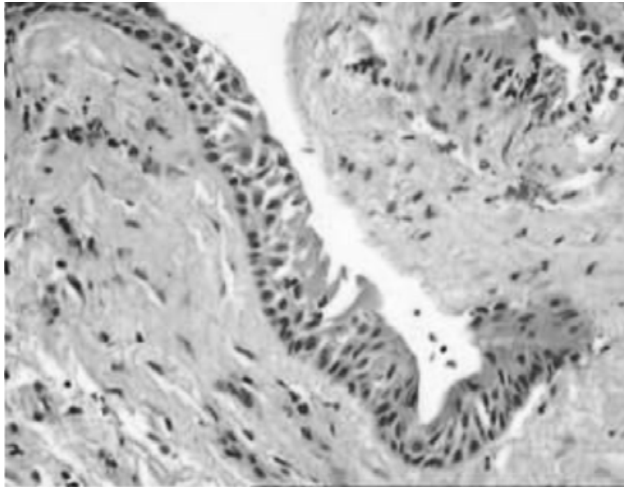


Fig-5:- Histopathological identification

## DISCUSSION

Dentigerous cysts may occur in association with any unerupted tooth. In this case, unerupted left maxillary canine was involved, the tooth was pushed into the sinus.

Serious potential complications can stem from dentigerous cysts.

- The cysts have to be differentially diagnosed from ameloblastoma developing either from lining epithelium or from the rests of odontogenic epithelium in the wall of the cyst. The formation of such a tumor manifests itself as a nodular thickening in the cyst wall, mural ameloblastoma, but this is seldom obvious clinically and thorough histopathologic study is important<sup>7,8</sup>.
- The development of epidermoid carcinoma from the same two sources of epithelium has been noted. Epidermoid carcinoma arising from the lining epithelium of dentigerous cyst has been reported by Gardner<sup>9</sup>. Browne and Gough also reported cases of malignant transformation and suggested that keratin metaplasia in long standing cyst lining appears to precede the development of carcinomatous change<sup>9</sup>. Carcinomas arising in the cyst may have wide age range (51-61yrs) and are encountered in older patients<sup>6</sup>.

- The development of mucoepidermoid carcinoma is also documented, considering the frequency with which mucus secreting cells are found in the lining epithelium indicative of pleuripotentiality of this epithelium. This very distinct possibility has to be considered<sup>11</sup>. However, mucoepidermoid carcinoma is most common in middle aged adults and three times more common in mandible than in the maxilla in the molar- ramus area<sup>6</sup>.
- In the anterior maxilla, AOT was considered because of its association with the crown of an impacted tooth<sup>2</sup>.
- Also ameloblastic fibroma in younger teenagers and children was also considered but mandibular molar- ramus area is favoured location for this lesion<sup>6</sup>.

The histopathological section was thoroughly examined, no complications were observed.

A clinico - pathologic correlation was considered to rule out potential complications.

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# A Study on Eruption of Third Molar of Libyan Individual and its Comparison with the Egyptian

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## ABSTRACT

The aim of the present investigation was to reconstruct the chronological age bases on third molar eruption and to compare between Libyan and Egyptian. A total of 200 cases both Libyan (100) and Egyptian (100) were assembled from the school and university of Libya between 15 and 25 years of age. A strong agreement was found between eruptions time of third molar and chronological age. The statistical analysis revealed that earliest third molar eruption was in the female at 16 year which has completed at 24 years in both the sexes. It also erupted earlier in lower jaw in both the sexes. The spaces for third molar also appear earliest in female at 15 year of age with early preponderance in lower jaw. This study has shown no differences in eruption between Libyan and Egyptian.

**Keywords:** Dental Age Estimation, Third Molar, Chronological Age, Forensic Odontology

## INTRODUCTION

Age estimation is an important activity that is frequently required to be carried out by a medico legal expert. An individual is often referred to a medical man by the court or investigating authority in criminal as well as in civil cases to give the opinion regarding his or her age. Assessment of age of the individual by dental examination is one of the commonly employed methods.

Forensic age estimation in living subjects has gained increasing significance in recent years. In dental age estimation, tooth eruption is a parameter of developmental morphology that can be analyzed by either clinical examination or by evaluation of dental X-rays<sup>1</sup>.

It is known that chronology of dental development is less variable than bone development and the method applied for this particular period of life is a reliable indicator of age. The eruption times for deciduous and permanent teeth are fairly constant. Eruption of teeth is one of the changes observed easily among the various dynamic changes that occur from formation of teeth to the final shedding of the teeth<sup>2</sup>. Geographically Libya and Egypt are belongs to North African nation. Their food habits, environment and culture are almost same. Hence this study was undertaken to compare the TME between the Libyan and Egyptian with the chronological age. With the increase number of criminals and crimes, improved and rapid method of age estimation is required. Clinical method of dental

age estimation found suitable since it does not require any special equipment, expertise and is more economical.

## MATERIAL AND METHOD

This study was conducted between Aug'09 and Aug'10 with the materials that consists 100 of each Libyan and Egyptian apparently healthy males and females belong to age group 15-25 years irrespective of their caste; religion and socio-economic status. Only those cases with known date of birth supported with documentary evidence were examined with consent. The selected cases were grouped as shown in **Table 01**. The clinical method used in this study to assess dental age is based on emergence of third molar tooth in the oral cavity.

**Table 1. Division of age group of cases**

| Age groups | Starting at  | Ending at  |
|------------|--------------|------------|
| 15 years   | Age 15 years | + 364 days |
| 16 years   | Age 16 years | + 364 days |
| 17 years   | Age 17 years | + 364 days |
| 18 years   | Age 18 years | + 364 days |
| 19 years   | Age 19 years | + 364 days |
| 20 years   | Age 20 years | + 364 days |
| 21 years   | Age 21 years | + 364 days |
| 22 years   | Age 22 years | + 364 days |
| 23 years   | Age 23 years | + 364 days |
| 24 years   | Age 24 years | + 364 days |

The various landmarks considered were: Height; weight; general body built and dental examination. The various instruments, viz. weight machine, standard steel made anthropic meter, measuring tape, torch, dental mirror, photographic equipment and computer and related softwares were used for the analysis of these cases.

## RESULTS

1. **Number of cases of TME (third molar eruption):** Out of 200 selected cases only 118 cases in both the sexes amongst all age group has shown either partial or complete third molar eruption (**Figure 01**). Hence, the analysis was done only against 118 cases of TME.

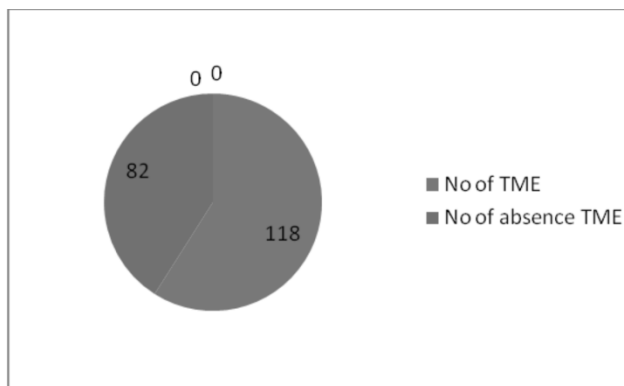


Fig. 1. Showing cases of TME

2. **Sex wise distribution of TME (Table 02):** The eruption of third molar found earliest in female in lower jaw in 16 years of age and one year later in male that has completed in both the sexes by 24 years and its frequency is almost same in both Libyan and Egyptian.

Table 2. TME in both male and female against different age group

| Age [yr] | Male             |             | Female           |             |
|----------|------------------|-------------|------------------|-------------|
|          | Libyan           | Egyptian    | Libyan           | Egyptian    |
| 15       | 0                | 0           | 0                | 0           |
| 16       | 0                | 0           | LJ-1             | 0           |
| 17       | LJ-1             | LJ-1        | CE-1; LJ-1       | LJ-1        |
| 18       | LJ-2             | CE-1; LJ-1  | CE-1; LJ-2       | LJ-3        |
| 19       | CE-1; LJ-1       | LJ-2        | CE-1; LJ-2       | CE-2; LJ-2  |
| 20       | CE-2; LJ-2       | CE-2; LJ-2  | CE-2; LJ-2       | CE-3; LJ-2  |
| 21       | CE-2; LJ-3       | CE-2; LJ-3  | CE-3; LJ-1       | CE-3; LJ-1  |
| 22       | CE-2; UJ-1; LJ-1 | CE-2; LJ-2  | CE-2; UJ-1; LJ-1 | CE-3; LJ-1  |
| 23       | CE-3; LJ-2       | CE-4; LJ-1  | CE-5; LJ-1       | CE-4        |
| 24       | CE-5             | CE-5        | CE-5             | CE-5        |
| Total    | CE-15 UJ-1 LJ-12 | CE-16 LJ-12 | CE-20 UJ-1 LJ-1  | CE-20 LJ-10 |
|          | Total: 28        | Total: 28   | Total: 32        | Total: 30   |

CE-Complete Eruption, LJ-Lower Jaw, UJ-Upper Jaw

3. **TME against marital status:** It has no impact over the marital status in this study.
4. **Location wise distribution:** Urban predominant rural in regard to TME amongst all age groups in both the sex. A total of 92 cases comprising 77.97% belong to urban against 22 cases of rural comprising 22.03%.
5. **Nutritional status of the cases:** A total of 50 (42.37%) case of TME belongs to the well-built category, followed by moderate built for 42 (35.6%) cases and poor built for only 26 (22.03%) cases as shown in Table 03.

Table 3. Showing distribution of cases of TME according to built

| Age in year | Poor built  | Moderate built | Well-built  | Total |
|-------------|-------------|----------------|-------------|-------|
| 15          | 0           | 0              | 0           | 0     |
| 16          | 0           | 0              | 1           | 1     |
| 17          | 2           | 1              | 3           | 6     |
| 18          | 3           | 4              | 3           | 10    |
| 19          | 3           | 4              | 4           | 11    |
| 20          |             | 7              | 6           | 4 17  |
| 21          | 3           | 6              | 9           | 18    |
| 22          | 3           | 5              | 8           | 16    |
| 23          | 3           | 8              | 8           | 19    |
| 24          | 2           | 8              | 10          | 20    |
| Total       | 26 (22.03%) | 42 (35.6%)     | 50 (42.37%) | 118   |

6. **Relation with height:** The distributions of TME cases are almost same, i.e. 27.11% belong to both (150-160) cm and (160-170) cm group followed by 28% to (170-180) cm and 26% to (140-150) cm group.
7. **TME vs. body weight (Table 04):** The mean age of complete TME in male in all the quadrants, upper jaw and in lower jaw are 22.2581 years (with standard deviation of 1.73143), 22.5 years and 20.25 years (with standard deviation of 1.82376) respectively.

In female, the mean age of complete TME in all the quadrants, upper jaw and in lower jaw are 21.8750 years (with standard deviation of 1.91067), 22.5 years and 19.2857 years (with standard deviation of 1.82052) respectively. In both the sexes eruptions are earlier in lower jaw than upper jaw.

**Table 4. TME of cases against their body weight**

| Wt. (kg) | 40-50 | 50-60 | 60-70 | 70-80 | >80 | Total |
|----------|-------|-------|-------|-------|-----|-------|
| 15       | 0     | 0     | 0     | 0     | 0   | 0     |
| 16       | 0     | 0     | 1     | 0     | 0   | 1     |
| 17       | 1     | 1     | 2     | 1     | 0   | 5     |
| 18       | 1     | 2     | 2     | 3     | 2   | 10    |
| 19       | 2     | 2     | 2     | 2     | 1   | 9     |
| 20       | 2     | 3     | 3     | 2     | 3   | 13    |
| 21       | 3     | 4     | 4     | 4     | 3   | 18    |
| 22       | 4     | 4     | 4     | 5     | 4   | 21    |
| 23       | 4     | 4     | 4     | 4     | 4   | 20    |
| 24       | 5     | 4     | 4     | 4     | 5   | 21    |
| Total    | 22    | 24    | 26    | 25    | 21  | 118   |

8. **Space for third molar (SPM3):** The analysis for spaces for third molar was done amongst all the 200 cases irrespective of TME. In all age group SPM3 is more in upper jaw in comparison to the lower jaw. The space appeared earliest in female at the age of 15 year in the lower jaw and one year later in male, i.e. in 16 year. It is more in numbers in lower jaw in the earlier years and gets reversed in the later years.

## DISCUSSION

**Sexual Dimorphism in TME:** Third molar erupted earliest in 16 years in female and one year later in male that has completed by 24 years in both the sexes. This findings of TME in between 16-25 years are well tallied with the findings of Gordon et al<sup>3</sup>, Scott DB<sup>4</sup>, Polson CJ<sup>5</sup>, Smith S<sup>6</sup>, Kerr D.J.A<sup>7</sup>, Grewal R.S<sup>8</sup>, Savara BS, Steen JC<sup>9</sup>, Tedeschi C.G, Eckert WG and Tedeschi LG<sup>10</sup>, Hassanali J<sup>11</sup>, Hagg U, Taranger J<sup>12</sup>, Pathak SK, Mathur PN, Jain S. and Saini O.P<sup>13</sup>, Rao N<sup>14</sup>, Vij K<sup>15</sup>, Korhonen M, Larmas M<sup>16</sup>, and Chaurasia BD<sup>17</sup>. Studies published to date agree that sexual dimorphism contrary to the rest of the dental maturation processes can be observed, with females reaching the different development stages earlier than males, independently of their ethnic origin. Perhaps because that a good part of the third molar formation process occurs once puberty is reached. The early eruption in females than males is also supported by Savara BS, Steen JC<sup>9</sup>, Hassanali J<sup>11</sup>, Hagg U, Taranger J<sup>12</sup>, Korhonen M, Larmas M<sup>16</sup>, Billewicz W.Z, McGregor I A<sup>18</sup>, Upender Kishore, SK Verma, and G K Sharma<sup>19</sup>.

**Location wise distribution of TME:** A total of 92 cases comprising 77.97% belong to urban, against the very less number of 22 cases of rural involvement comprising only 22.03%. This findings of urban predominance over rural amongst all the age groups in both the sexes has no special significance as the cases

for the present study were taken from urban only where the population was dense.

**Marital status:** It has no impact on third molar eruption in this present study as cases studied here were unmarried; however this aspect needs to be analyzed further for a conclusive opinion by studying a reasonably large group comprising both married and single.

**TME against anthropometric measurements:** The TME shows little or no variation in the same age group irrespective of body height and weight. Though eruption of teeth may be effected by dietary, climatic, racial and geographical variation, the eruption time for deciduous and permanent teeth are fairly constant. The similar findings were reported by Reddy V<sup>2</sup>, **James H. Shaw**<sup>20</sup>. Shuper A, Shohat M, Sarnat H, Varsano I, Mimouni M<sup>21</sup> support the view of this study that teeth eruption is an independent process, unrelated to other anthropometric measurements. Every child has their own rate of growth and maturation, and this is not merely a reflection of their chronological age. Fortunately, the temporal variability of development stages is limited due to the genetic control of odontogenesis.

**Third molar eruption (TME):** In both the sex eruptions of third molar found most common in lower jaw in comparison to upper jaw. This finding of TME is well tallied with the findings of Smith S<sup>6</sup>, Vij K<sup>15</sup>, Billewicz W.Z, McGregor I A<sup>18</sup>, Subrahmanyam BV<sup>22</sup>, JS Wedl, S Danias, R. Schmelzle and R.E.Friedrich<sup>23</sup>. Moreover in this present study TME was found proportionate of homologous teeth on the left and the right side of the same jaw tallied with the findings of Billewicz W.Z, McGregor I A<sup>18</sup>.

**Space for third molar (SPM3):** Both in Libyan and Egyptian SPM3 appear earliest in lower jaw in female at the age of 15 years and in 16 years in male. In the earlier age group it mostly presents in lower jaw in both the sexes, but as the age progresses its frequencies are more in upper jaw. This may be explained that in the later age group SPM3 are replaced by eruption in lower jaw in both the sexes.

## CONCLUSION

In both Libyan and Egyptian TME is earlier in female than male. The mean age of complete TME in all the quadrants, upper jaw and in lower jaw in female are 21.8750 years, 22.5 years and 19.2857 years and in male

are 22.2581 years, 22.5 years and 20.25 years respectively. Teeth eruption is an independent process, unrelated to other anthropometric measurements. There exists a co-relation between the third molar eruptions with chronological age. This result also highlighted that there exist no difference in eruption of third molar in both the Libyan and Egyptian; however it needs a large group to analyze to draw an accurate conclusion.

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# Early Detection of Snake Bite - A Case Report

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## ABSTRACT

Snakebites can be deadly if not treated immediately. Snake envenomations are frequently encountered in medical emergencies. Some snake venoms contain hemotoxins that can result in widespread bleeding, disseminated intravascular coagulation (DIC) and a rapid death. This can be prevented by giving polyvalent antsnake venom within hours.

A three & half years old male child was admitted to Pediatrics I.C.U. of T.N.M.C. & B.Y.L. Nair Ch. Hospital, Mumbai with history of unknown bite. Initially Pediatricians were confused to diagnose the bite and called forensic experts for evaluation. On detailed examination and investigations by Forensic Medicine personnel and Pediatricians it was observed that the child was having two puncture wounds, 1cm apart from each other along with swelling of left foot and leg, multiple ecchymotic patches over the body and laboratory parameters revealed state of disseminated intravascular coagulation. On these findings, we diagnosed a case of vasculotoxic snake bite which help the Pediatrician for starting polyvalent antsnake venom therapy that proved to be beneficial in prevention of development of compartment syndrome and advancement of DIC. Here we report a case of snakebite who presented with vasculotoxic manifestation, showed full recovery after effective treatment.

**Keywords:** Snake Bite, Coagulation Profile, Polyvalent Antsnake Venom

## INTRODUCTION

Snake bite is common health problem in India, particularly rural and farming areas. Of the 52 poisonous species in India, majority of bites and consequent mortality is attributable to 5 species viz. *Ophiophagus hannah* (king cobra), *Naja Naja* (common cobra), *Daboia russellii* (Russell's viper), *Bungarus caeruleus* (krait) and *Echis carinatae* (saw-scaled viper)<sup>1</sup>.

Common vasculotoxic snakes in India include *Daboia russellii* (Russell's viper), *Echis carinatae* (saw-scaled viper). Vasculotoxic envenomation have the potency to cause a broad spectrum of presentations varying from swelling and bleeding manifestation to disseminated intravascular coagulation which present

as acute medical emergencies and show a good response if effective treatment is given in time.

Children are at higher risk of serious complications or death due to snakebites because of their smaller body size. Getting to an emergency room as quickly as possible is very important. If properly treated, many snakebites will not have any serious effects. The clinical features of the snakebite reflect the effects of the venom components. These include local tissue damage, ranging from swelling of the bitten limb to necrosis of the skin and muscle, abnormal blood clotting and bleeding, hypotension and shock, neurotoxicity that can lead to paralysis of respiratory muscles requiring assisted ventilation, and renal toxicity<sup>2</sup>. Symptoms and signs vary according to the species of snake involved in the bite and the amount of venom injected. Sometimes the identity of the biting snake can be confirmed by examining the dead snake; it may be strongly suspected from the patient's description or the circumstances of the bite or from knowledge of the clinical effects of the venom of that species. This information will enable the doctor to choose appropriate antivenom, anticipate the likely complications and therefore take appropriate action. If the biting species is unknown, recognition of

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the emerging pattern of symptoms, signs and results of laboratory tests may suggest which species was responsible.

### OBSERVATION

A three & half years old male child brought by his father, presented to the emergency department of our hospital with history of unidentified bite on the lateral region of dorsal aspect of left foot of 12 hours duration. The child was bitten by unidentified animal at 9.30pm while he was playing with some friends outside his house. Initially it was not associated with any parasthesia or bleeding at local site. So the child went off to sleep but after a brief interruption during late night period, his father noticed swelling of left lower limb below the level of knee joint. So, the child was taken to some private hospital where the doctor had given some injection (details not known) and sent home. But the next morning his father noticed swelling of left lower limb associated with intense pain & bluish discolouration, so he brought him to hospital.

On general examination patient was conscious, agitated & afebrile, having heart rate 110 per min, blood pressure 108/64 mm hg and respiratory rate of 28 per min with no evidence of pallor, icterus, cyanosis, clubbing, and lymphadenopathy. But ecchymotic patches were seen at multiple regions of the body i.e. over palate, chin, flexor aspect of lower 1/3<sup>rd</sup> of left forearm, upper 1/3<sup>rd</sup> of inner aspect of left thigh, upper 1/3<sup>rd</sup> of outer aspect of left thigh and middle 1/3<sup>rd</sup> of right leg.

On systemic examination, cardiovascular, respiratory and abdominal examinations were essentially normal. Central nervous system examination revealed normal higher functions; tone, power & reflexes were normal. There were no findings suggestive of increased intracranial tension, meningitis, cerebellar involvement, focal neurological deficit and cranial nerve palsy respectively. Pupils were bilaterally equal & reacting to light.

On local examination, there was swelling of left whole foot reaching upto left knee joint involving left leg associated with tenderness and the bite mark was seen as two puncture wounds, roughly circular shaped, of size 0.2cm each, 1cm apart from each other, reddish coloured, seen over lateral region of dorsal aspect of left foot, 2.5cm anterior to left lateral malleolus.

Laboratory investigations revealed a haemoglobin of 10.7 gm/dl, total leukocyte count of 10,420/ mm<sup>3</sup>,

platelet counts 1.18 lacs/mm<sup>3</sup>, and peripheral blood smear was normal. Urine analysis showed minimal albuminuria and 1-2 red blood cells/HPF. Coagulation profile showed bleeding time-14 minutes (normal – upto 9 minutes), clotting time-18 minutes (normal – upto 8 minutes), prothrombin time (PT) 14 seconds (Control = 11 seconds) with INR 1.5, partial thromboplastin time (PTT) was 40 seconds (Control = 35 seconds), and fibrinogen degradation products - 2.68 mg/L (Normal < 0.20 mg/L). All the biochemical investigations including plasma glucose, blood urea, serum creatinine, serum bilirubin, AST, ALT, serum total protein, and albumin/globulin ratio were within normal limits.

A possible diagnosis of vasculotoxic snake envenomation was made.

### The diagnosis was based on the following features

1. Two puncture wounds (snake bite), 1 cm apart from each other, seen over dorsal aspect of left foot.
2. Ecchymotic patches were seen over multiple regions of the body.
3. Laboratory parameters revealed state of DIC (elevated levels of bleeding time, clotting time, prothrombin time, partial thromboplastin time)

Patient was given polyvalent antsnake venom after sensitivity testing, in addition to antibiotics. Dramatic improvement of the patient's clinical condition was noted. The circumference of the left leg normalized as compared to the unaffected side within 12 hours of treatment. The patient's coagulation profile came back to normal values. The patient was discharged home after four days in a good general condition with no residual functional loss or disability.

### DISCUSSION

Snake bite is relatively uncommon in urban areas. Tertiary care centre in metropolitan cities like Mumbai get these patients from adjoining semi-urban areas as referred cases. Common vasculotoxic snakes in India include *Daboia russellii* (Russell's viper), *Echis carinatae* (saw-scaled viper).

Snakebites are very common in the third world countries. World health organization (WHO), in a recent adopted study, estimated that at least 421,000 envenomations and 20,000 deaths occurred worldwide from snakebite every year, but warned that these figures might be as high as 1,841,000 envenomations and



Fig. 1. Showing two puncture wounds indicative of snake bite along with swelling of left foot and leg.



Fig. 4. Showing ecchymotic patches over medial aspect of left thigh.

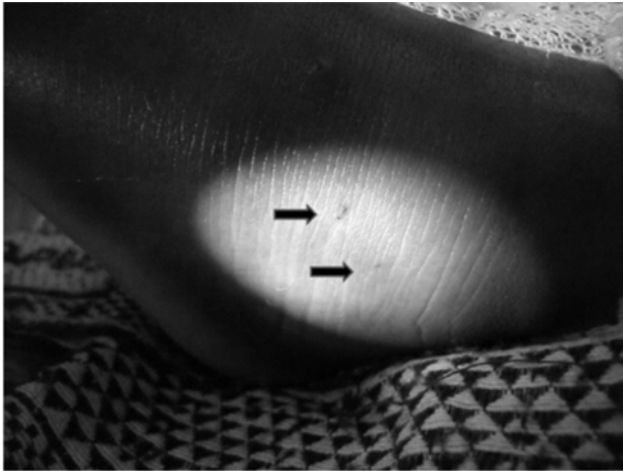


Fig. 2. Showing two puncture wounds (snake bite marks) viewed under torch light.



Fig. 5. Showing ecchymotic patches over flexor aspect of left forearm.



Fig. 3. Showing two puncture wounds (snake bite marks) 1 cm apart from each other.

94,000 deaths. Snake envenomation is associated with a mortality rate of 10-20%, if effective treatment is not initiated early. The major cause of mortality is due to increased bleeding tendency caused by the venom. Venom of viper is a mixture of multiple enzymes and low molecular weight peptides, some of which are responsible for the bleeding manifestations. Multiple mechanisms have been suggested for the bleeding occurring after envenomation. These include disseminated intravascular coagulation (DIC) due to spontaneous activation of factor V and factor X by pro-coagulants present in the venom<sup>3</sup>. It has also been suggested that the small dose of venom, as typically injected in humans, leads to continuous activation of fibrinogen, producing a fragile fibrin more susceptible to lysis than ordinary fibrin, leading to bleeding manifestations<sup>4</sup>. Vascular endothelial damage caused

by the haemorrhagin present in the venom also contributes to bleeding manifestations<sup>5</sup>. Antivenom therapy is the key to the medical management of snakebite<sup>6</sup>. The literature and the manufacturers of the snake antivenom recommend its early administration; within 6 hours in case of appearance of any local or systemic signs after snakebite, repeated every 4 to 6 hours until definitive improvement of the signs<sup>7,8</sup>. If compartment syndrome develops later (usually 52 hours after envenomations), antivenom therapy is an alternative to fasciotomy<sup>9</sup>.

Disseminated intravascular coagulation is the most common cause of mortality and morbidity in victims bitten by snakes. A prompt recognition of disseminated intravascular coagulation and timely given fresh frozen plasma can decrease morbidity and mortality.

### CONCLUSIONS

In our patient, an increase in bleeding and clotting time, marginal increase of prothrombin time, and a marked increase in fibrinogen degradation products suggest that disseminated intravascular coagulation (DIC) is the possible cause of bleeding manifestations. The bite marks along swelling of left foot and leg, ecchymotic patches over multiple regions of the body and laboratory parameters were indicative of vasculotoxic (viperine) bite.

The positive results of the present case report confirm an empirical concept: early diagnosis and early administration of polyvalent antsnake venom, proved to be beneficial in prevention of development of compartment syndrome, advancement of DIC renal toxicity and subsequently death.

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# Morphology and Multi-elemental Analysis Leading to Detection of Gunshot Wounds

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## ABSTRACT

Present authors report the morphology and elemental analysis of gunshot wounds. Scanning electron microscopy has been used to study the morphology of the samples and compared with the control. The scanning electron micrographs (SEM) of gunshot entry wounds show coagulation of skin tissues. Energy dispersive X-ray fluorescence spectrometry (EDX) has been used to carry out multi-elemental analysis of gunshot residues. Using EDX, lead, barium and some other metallic elements were detected in skin samples from a gunshot entry wound. Lead and barium were not identified in control samples from non-injured cases. These findings indicate that EDX is a useful method for rapid non-destructive elemental analysis of gunshot residues. This technique can provide scientific evidence for identification of a firearm wounds even after storing the sample for a long time in formalin.

**Keywords:** Scanning Electron Microscopy, Energy Dispersive X-Ray Fluorescence Spectrometry, Multi-Elemental Analysis, Gunshot Wounds

## INTRODUCTION

In the field of forensic medicine, identification of the weapon used to inflict a wound is an important subject. Such identification is usually performed according to the morphology and characteristics of the wound. However, metallic residues adhered to the surface of the wound should also be investigated<sup>1</sup>. The fundamentals of scanning electron microscopy were first described by von Ardenne in 1938<sup>2</sup>. SEM together with EDX is used in toxicology and pathology for determining exogenic and endogenic toxic substances<sup>3-5</sup>. Scanning electron microscopy (SEM) has been used in a variety of forensic science applications, including examination of bite and tooth marks, hair analysis, determination of direction of travel of bullets in bone, and examination of seminal stains. One of the most striking properties of SEM is its ability to combine imaging with elemental analysis together with its suitability for digitalization and automation of complete tasks. Forensic applications of SEM are found mostly in areas where there is a need for good imaging at relatively high magnifications in combination with elemental analysis. This is the case in areas where small particles of relatively heterogenic character and with a complex composition play a major part, for example

gunshot residue and pyrotechnical post-explosion residues. It is used in medicine began later on. Scanning electron microscopy (SEM) together with energy dispersing microanalyzer (EDX) was used by Raso et al in 1999, to examine the bioreactivity of silicon implants<sup>6</sup>. In forensic medicine, Kim et. al used both SEM and EDX in 2000 to analyze remains after bullet wounds<sup>7</sup>.

A bullet has several components, each with its own peculiar elemental composition. Bullets generally have the following composition

- Casing = casing proper + primer cap + anvil
- Jacket = Copper + zinc
- Lead; lead with varying amounts of antimony depending on the manufacturer and type of bullet
- Primer powder: barium, lead, antimony in varying mixture
- Propellant: single base/ double base/ triple base.
- Gunshot residues: primer residues, propellant residues, jacket residues, projectile residues, cartridge casing residues.

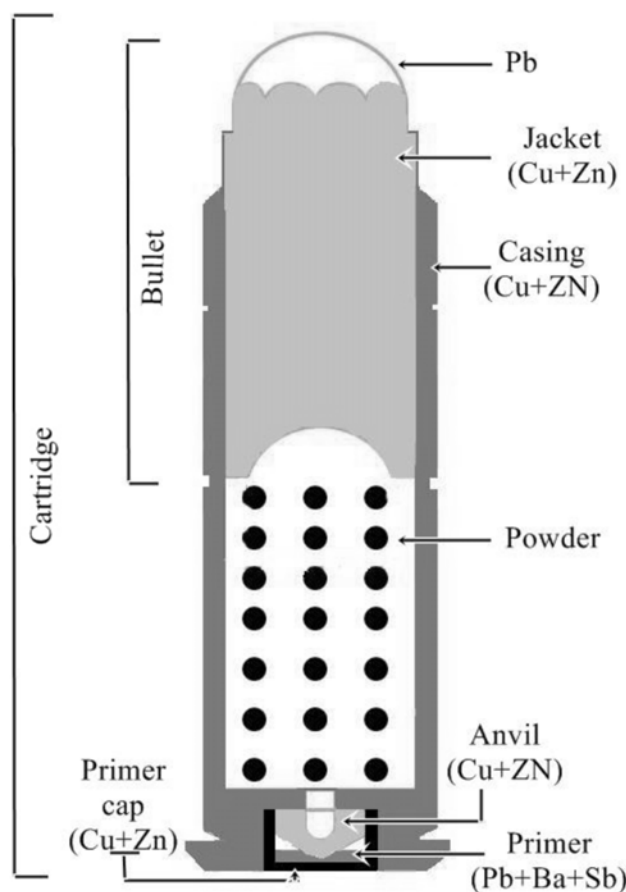


Fig.1. Schematic diagram of a bullet

Most primers today contain lead, barium and antimony. Samples from suspect shooters are searched for particles that contain these elements. However in the near future primers will become increasingly free of lead and other heavy elements and this will put forward a new challenge to the automated detection of GSR by SEM-EDX. In 1976, Nesbitt et al presented the first paper on the detection of gunshot residues by scanning electron microscopy. They conducted test firings in the Aerospace Corporation with seven different guns and collected the residue for morphological and elemental analysis<sup>8</sup>. Similar approach was followed by Matricardi et al. in FBI laboratory in 1977<sup>9</sup>. The detection and analysis of GSR was reviewed in 2001 by Romolo et.al<sup>10</sup>. In the last five years a lot of effort has been put into quality assurance, which is the standardization of sets to sample shooters hands and the development of proficiency tests to validate the laboratory specific methods for the detection and classification of GSR.

Primer and propellant, jacket, lead, and even particles of casing material are found in contact or close

range gunshot wounds. Bits and pieces of the material from the inside of the cartridge is scraped off by the exiting bullet and carried along into the wound<sup>11</sup>.

The data from careful quantitative analysis of the elemental compositions of the various bullet particles and residues found in a wound can be used to define the precise composition of the bullet that caused the wound. Where more than one individual was involved in a shooting incident resulting in death, such analysis may assist in pinpointing the source of the fatal shot in cases where bullets of different compositions were used. Any cartridge or bullet with any portion made of an unusual alloy of metals not commonly found or used in the locality may also be readily identified<sup>11</sup>.

After a bullet is recovered from a body or crime scene, most pathologists wash the blood, tissue, and foreign material from it, make a cursory examination to determine its construction and approximate caliber, engrave a number or initials on it, and seal it in a labeled container to be subsequently handed over to a firearms examiner. This process may destroy valuable evidence. If a lead or lead-tipped bullet perforates an intermediary target, fragments of this material may be found embedded in or adherent to the bullet. Foreign material, such as powder, cloth, glass, wood, or paint, is often readily visible if the bullet is examined with a dissecting microscope before cleaning. Once recognized, this material can be subjected to nondestructive tests, including SEM-EDX. In the present study, we examined the usefulness of SEM-EDX to detect morphology and metallic elements in samples from a gunshot wound.

## MATERIALS AND METHOD

### Case history

A male committed suicide by gunshot. In autopsy, two bullet holes were found, one below the chin (contact entry wound) and other at the frontal region (exit). Total three samples were collected from the dead body, one from entry wound, one from tract of the bullet and one control sample (taken from chest of the victim). All the three samples were kept in Formal saline for one month, and prepared for SEM-EDX using carbon tap with platinum coating.



Fig. 2a. Entry wound

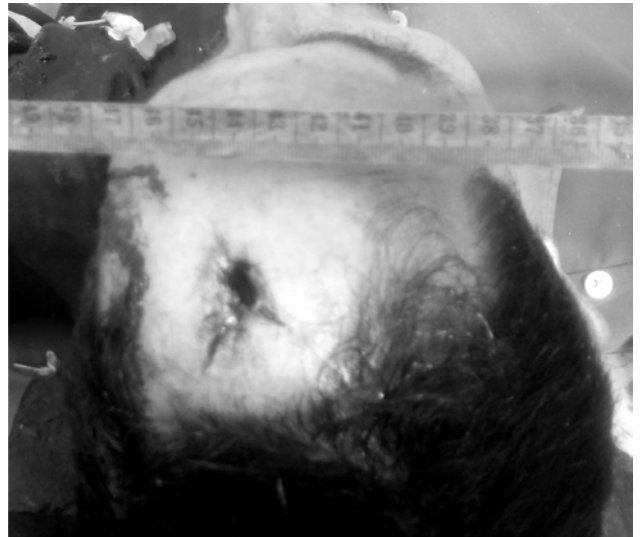


Fig. 2b. Exit wound

### EXPERIMENTAL TECHNIQUES

JEOL JSM LV 6390 scanning electron microscope attached with energy dispersive spectroscope was used to study the samples. The instrument was operated with rhodium target at 15 kV. The samples were prepared on carbon tape with coatings of platinum to prevent charge accumulation.

### RESULTS AND DISCUSSIONS

#### Morphological analysis

Fig.3a, 3b and 3c show the scanning electron

micrographs of control, gunshot entry wound and tract of the bullet. It is evident from the Scanning Electron Micrographs (SEM) that gunshot entry wound and tract show coagulation of tissues because of production of heat by firing of the bullet at contact range. Entry wound also shows honey-comb appearance at 1000x magnification. The amount of coagulation seen at the entry wound is greater than that of the tract, because production of heat was more at the contact entry wound. The control sample shows aligned tissues of the human skin. In gunshot entry wound and tract, some foreign particles are found in the surface of the skin tissues.

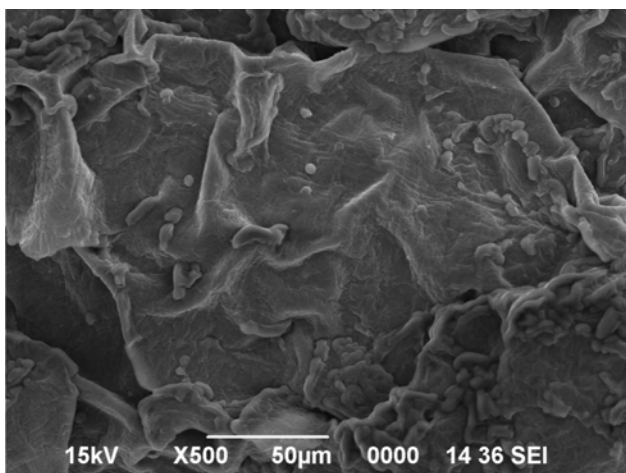
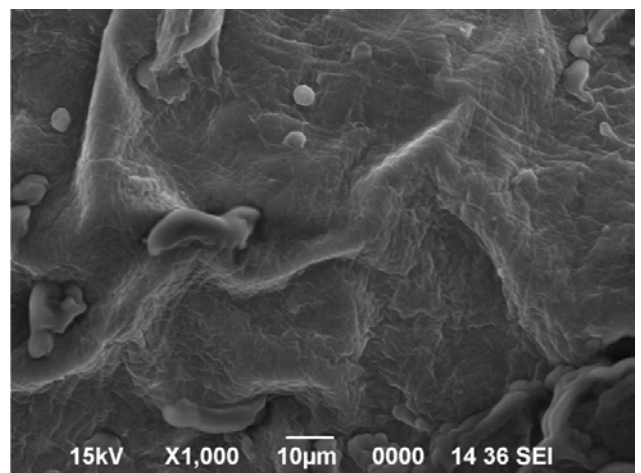


Fig. 3a. Normal skin (500 &amp; 1000 magnification)



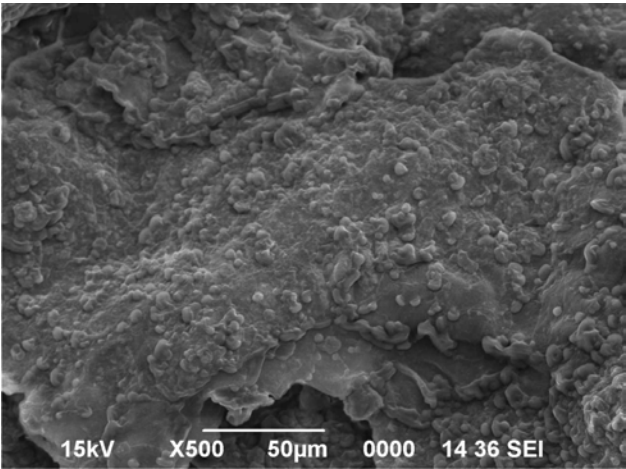


Fig. 3b. Entry wound (500 & 1000 magnification)

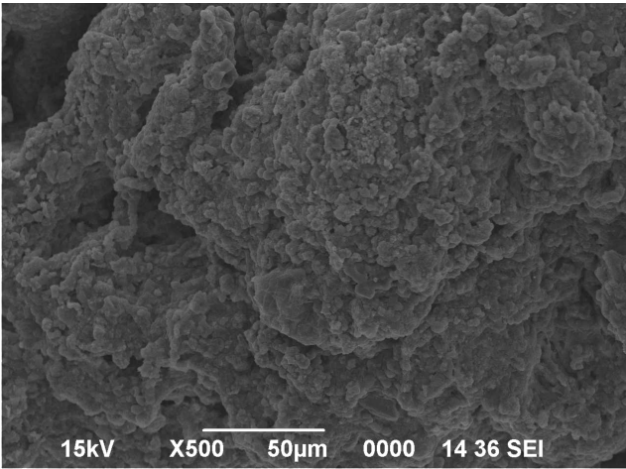
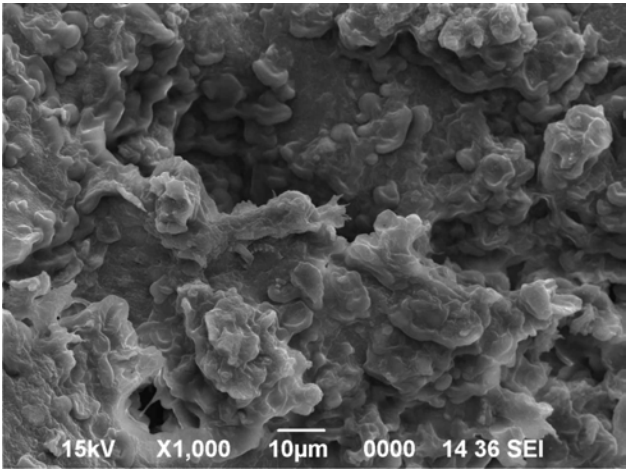
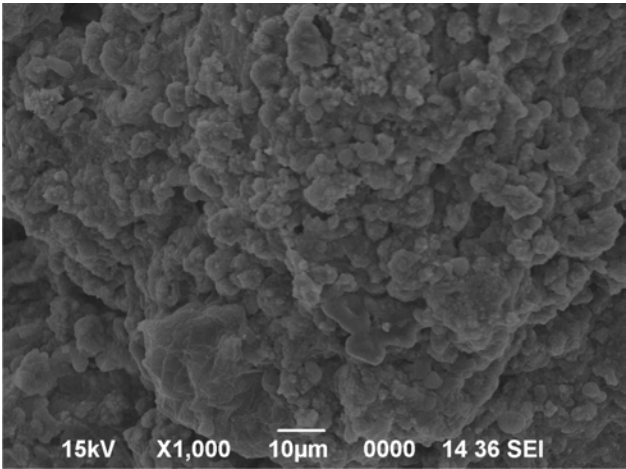


Fig. 3c. Tract of the bullet (500 & 1000 magnification)



Brazeau, Wong and Havel<sup>12,13</sup> described the potentialities of the use of SEM together with EDX analysis for characterizing the bullet wound site. They found that analyzing the presence of firearm residue around the wound site can assist in more accurate interpretation of the events.

**Multi-elemental analysis**

Firearms usually contain lead, antimony and barium in the primer, and copper and zinc in the metal jacket. Iron may come from the barrel of the firearm or from the bullet if it had a European- type metallic jacket. For positive identification of a gunshot wound it is necessary to detect lead and at least one other element out of antimony or barium. In this study, skin samples were examined by EDX. Normal skin shows presence of carbon, oxygen, sulphur and calcium. Peaks for some metallic elements, such as lead and barium were identified in the skin samples from the gunshot wounds.

Lead concentrations around entrance holes are reported to be higher than those around the corresponding exit holes from which entry and exit holes can be identified. From the analysis of the bullet entry wound site, and the tract, we deduce that the presence of microparticles is most expressive at the wound site than that of the tract as evident from the Fig.4 (a)-(c).

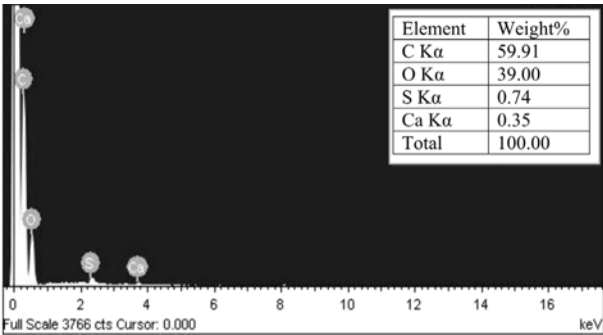


Fig. 4a. EDX of Normal Skin

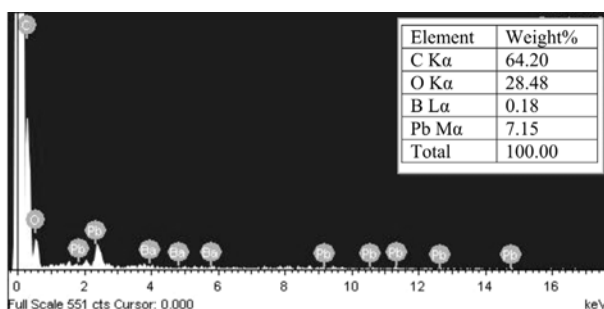


Fig. 4b. EDX of Bullet Entry wound

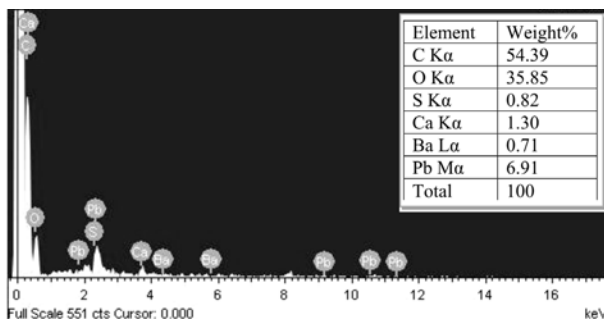


Fig. 4c. EDX of Bullet tract

(Insets of Fig.4a, 4b and 4c show the amount of elements present in the samples)

Dubrovin and Dubrovina (2003) described a significant increase in the size of the bullet wound depending on the distance of the firearm<sup>14</sup>. It would be possible to calculate the distance of the firearm by measuring the size of the bullet wound. Brozek-Mucha et al. (2003) described the presence of lead, barium and antimony on the surface of examined tissues<sup>15,16</sup>. Moreover presence of barium in the entry wound indicates that the bullet was fired from a very short range<sup>17-19</sup>.

## CONCLUSIONS

On the basis of morphological and microstructural analysis we can differentiate between a pseudo-gunshot wound and a true gunshot wound. For positive identification of a gunshot wound it is necessary to detect lead and at least one other element out of antimony or barium, and we found both lead and barium in the gunshot wounds. With the help of morphology of gunshot wounds (SEM), we can differentiate between the entry and exit wounds, as production of heat in cases of close range fires coagulates the tissue more at its entry. As the features are well preserved for one month, we can use these tools for the diagnosis of gunshot wounds in cases of decomposed bodies. On the basis of detection of barium

we can also comment regarding the range, that the bullet was fired from a close range.

## ACKNOWLEDGEMENT

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# A Two Years Retrospective Study of Pattern of Railway Fatalities Cases Brought to Sion Hospital, Mumbai

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## ABSTRACT

The present study was undertaken in the Department of Forensic Medicine & Toxicology at Lokmanya Tilak Municipal Medical College & Lokmanya Tilak Municipal General Hospital, Sion Mumbai and total 763 cases collected for this study purpose from calendar year 1st Jan 2010 to 31st Dec 2011. The present study demonstrated preponderance of male 699 (91.62%) victims over female 64 (8.38%) victims. The age group of 21-30 years 347(45.47%) was most commonly affected followed by age group of 11-20 years 142(18.62%). The maximum no of cases were reported between time of 6pm-10pm 241(31.58%) followed by 6am-10am 203 (26.61%). The most common cause of railway accident was Knocked down while crossing 453(59.37%) followed by fall from train 119 (15.59%). The most common body region involved was Head, Face & Neck 715(93.70%) followed by Upper limbs 591(77.45%). Brain 547(71.69%) was most common internal organ involved and Laceration 627(82.17%) was most commonly reported injury over victims body. Head injury 349(45.74%) was most common death and most common manner of death was accidental 680(89.12%) in this study.

**Keywords:** Railway Fatalities, Railway Accident, Fall from Running Train, Railway Safety

## INTRODUCTION

Mumbai is one of the metro city of India having dense population and daily many people from all parts of the country came to Mumbai in search of job. Mumbai city had three railways line namely Western railway, Central railway and Harbour railway. Sion hospital receiving railway accident cases mainly from police stations Dadar Railway, Wadala Railway, Kurla Railway, MCT Railway, Vashi Railway etc. As the growth of Mumbai had limitation so people chose to stay away from proper Mumbai and they had to daily travel from their home to office in Mumbai and back. The present study was undertaken to find out any pattern of railway accident and causes of these accident.

## MATERIAL AND METHOD

The present study was undertaken in the Department of Forensic Medicine & Toxicology at Lokmanya Tilak Municipal Medical College & Lokmanya Tilak Municipal General Hospital, Sion Mumbai. Total 763 cases collected for this study purpose

from calendar year 1<sup>st</sup> Jan 2010 to 31<sup>st</sup> Dec 2011 in a predetermined proforma from post mortem reports, inquest panchnama and statement of relatives of deceased. The detail history was taken about the occurrence of railway accidents was taken into account.

### Inclusion criteria of cases

- 1) All cases of railway accident where victim died due to railway injuries.

### Exclusion criteria of cases

- 1) Cases where data was incomplete.

## OBSERVATIONS & RESULTS

The present study demonstrated preponderance of male 699 (91.62%) victims over female 64 (8.38%) victims with male victims to female victims ratio of 10.92:1. The age group of 21-30 years 347(45.47%) was most commonly affected followed by age group of 11-20 years 142(18.62%).

**Table No. 1: Age group and Sex wise distribution of cases**

| Age(years) | 0-10 | 11-20 | 21-30 | 31-40 | 41-50 | 51-60 | >60  | TOTAL |
|------------|------|-------|-------|-------|-------|-------|------|-------|
| Male       | 2    | 131   | 321   | 121   | 47    | 69    | 8    | 699   |
| Female     | 0    | 11    | 26    | 8     | 11    | 5     | 3    | 64    |
| Total      | 2    | 142   | 347   | 129   | 58    | 74    | 11   | 763   |
| %          | 0.26 | 18.62 | 45.47 | 16.91 | 7.61  | 9.69  | 1.44 | 100   |

**Table No. 2: Month and year wise distribution of cases**

| Month     | 2010 | 2011 | Total |
|-----------|------|------|-------|
| January   | 38   | 34   | 72    |
| February  | 32   | 31   | 63    |
| March     | 37   | 28   | 65    |
| April     | 29   | 30   | 59    |
| May       | 30   | 32   | 62    |
| June      | 33   | 29   | 62    |
| July      | 31   | 25   | 56    |
| August    | 26   | 34   | 60    |
| September | 34   | 31   | 65    |
| October   | 42   | 37   | 79    |
| November  | 29   | 27   | 56    |
| December  | 34   | 30   | 64    |
| Total     | 395  | 368  | 763   |

**Table No. 3: Time distribution of occurrence of railway accidents**

| Time of railway accident | No of cases | Percentage |
|--------------------------|-------------|------------|
| 06am -10am               | 203         | 26.61      |
| 10am -02pm               | 98          | 12.84      |
| 02pm -06pm               | 82          | 10.75      |
| 06pm -10pm               | 241         | 31.58      |
| 10pm -02am               | 117         | 15.34      |
| 02am -06am               | 22          | 2.88       |
| Total                    | 763         | 100        |

The maximum no of cases were reported between time of 6pm-10pm 241(31.58%) followed by 6am-10am 203 (26.61%). The reason was that these were peak hours of travelling and local trains were overcrowded during this period.

**Table No. 4: Pattern of railway fatalities in relation to railway station**

| Railway station                                     | Dadar | Matunga | Wadala | Chunabhatti | Kurla | Chembur | Mankhurd | Govandi | Total |
|-----------------------------------------------------|-------|---------|--------|-------------|-------|---------|----------|---------|-------|
| <b>Pattern</b>                                      |       |         |        |             |       |         |          |         |       |
| Knocked down while crossing                         | 121   | 17      | 79     | 31          | 127   | 29      | 21       | 28      | 453   |
| Fall from train                                     | 26    | 2       | 10     | 14          | 21    | 19      | 16       | 11      | 119   |
| Lying on track for suicide                          | 8     | 1       | 7      | 10          | 16    | 11      | 3        | 13      | 69    |
| Fall in gap between boarding or alighting           | 7     | 0       | 5      | 3           | 7     | 4       | 3        | 2       | 31    |
| Knocked down while standing at the edge of platform | 4     | 1       | 2      | 3           | 7     | 4       | 5        | 1       | 27    |
| Electrocution                                       | 3     | 0       | 0      | 1           | 4     | 2       | 0        | 1       | 11    |
| Not known                                           | 13    | 4       | 7      | 3           | 20    | 1       | 2        | 3       | 53    |
| Total                                               | 182   | 25      | 110    | 65          | 202   | 70      | 50       | 59      | 763   |

The most common cause of railway accident was Knocked down while crossing 453(59.37%) followed by fall from train 119 (15.59%).

**Table No. 5: Region wise involvement of body in railway accident**

| Body region involved | No of cases | Percentage |
|----------------------|-------------|------------|
| Head, Face & Neck    | 715         | 93.70      |
| Trunk                | 458         | 60.02      |
| Pelvic region        | 269         | 35.25      |
| Upper limbs          | 591         | 77.45      |
| Lower limbs          | 451         | 59.10      |

Total exceeds 100% as different body regions of same victim sustained different injuries.

The most common body region involved was Head, Face & Neck 715(93.70%) followed by Upper limbs 591(77.45%).

**Table No. 6: Involvement of internal organs of body**

| Organ                 | No of cases | Percentage |
|-----------------------|-------------|------------|
| Brain                 | 547         | 71.69      |
| Spine and spinal cord | 139         | 18.21      |
| Lungs                 | 291         | 38.13      |
| Heart                 | 57          | 7.47       |
| Liver                 | 209         | 27.39      |
| Spleen                | 131         | 17.16      |
| Kidneys               | 69          | 9.04       |

Total exceeds 100% as same victim sustained injuries to multiple organs.

Brain 547(71.69%) was most common internal organ involved in railway fatalities.

**Table No. 7: Nature of injuries present over body**

| Type of injuries sustained   | Number of cases | Percentage |
|------------------------------|-----------------|------------|
| Abrasions                    | 489             | 64.08      |
| Contusions                   | 147             | 19.26      |
| Laceration                   | 627             | 82.17      |
| Crush/Amputations            | 379             | 49.67      |
| Decapitation                 | 69              | 9.04       |
| Transection of trunk         | 78              | 10.22      |
| Closed fractures/Dislocation | 321             | 42.07      |
| Electrocution                | 11              | 1.44       |

Total exceeds 100% as same victim sustained multiple injuries.

Laceration 627(82.17%) was most commonly reported injury over victims body.

**Table No. 8: Cause of death in railway accident cases**

| Cause of death                           | Number of cases | Percentage |
|------------------------------------------|-----------------|------------|
| Head injury                              | 349             | 45.74      |
| Injuries to vital organs                 | 172             | 22.54      |
| Decapitation                             | 69              | 9.04       |
| Transection of trunk                     | 57              | 7.47       |
| Crush amputation of limb/limbs           | 76              | 9.96       |
| Multiple injuries, haemorrhage and shock | 29              | 3.81       |
| Electrocution                            | 11              | 1.44       |
| Total                                    | 763             | 100        |

Head injury 349(45.74%) was most common cause of death in this study.

**Table No. 9: Manner of death**

| Manner of death | Number of cases | Percentage |
|-----------------|-----------------|------------|
| Accidental      | 680             | 89.12      |
| Suicidal        | 79              | 10.35      |
| Homicidal       | 4               | 0.53       |
| Total           | 763             | 100        |

## DISCUSSION

The present study demonstrated preponderance of male 699 (91.62%) victims over female 64 (8.38%) victims with male victims to female victims ratio of 10.92:1. The age group of 21-30 years 347(45.47%) was most commonly affected this was consistent with studies of Amit M Patil et al<sup>1</sup>, Lere LB et al<sup>3</sup>, Mohanty MK et al<sup>4</sup>, Pawan Sable et al<sup>5</sup> and Rautji R et al<sup>6</sup>.

The maximum no of cases were reported between time of 6pm-10pm 241(31.58%) followed by 6am-10am 203 (26.61%) this was consistent with the study of Pawan Sable et al<sup>5</sup>. The most common cause of railway accident was knocked down while crossing 453(59.37%) this was consistent with the study of Pawan Sable et al<sup>5</sup>.

The most common body region involved was Head, Face & Neck 715(93.70%) this was also reported by Mohanty MK et al<sup>4</sup>, Pawan Sable et al<sup>5</sup> and Rautji R et al<sup>6</sup>. The most commonly involved internal organ was Brain 547(71.69%) and most common of cause death in this study was Head injury 349(45.74%) this was consistent with the study of Pawan Sable et al<sup>5</sup>.

The most common manner of death was Accidental 680(89.12%) followed by suicidal victims 79 (10.35%) and homicidal incidence was 4 (0.53%) cases this was consistent with the study of Pawan Sable et al<sup>5</sup>.

## SUMMARY AND CONCLUSION

The most railway accident occurred due to knocked down while crossing the railway lines so these will be preventable by taking various steps mentioned below:

- Tack crossing will be prevented by putting the barriers between the two tracks so that those passengers don't have any option except to use over head bridge.
- Mass media should be used to educate passengers regarding the track crossing and deaths occurring due to it.
- Young male in age group of 21-30 yrs should be counselled about railway stunts they performing.

- The railway should take care to prevent the passengers from travelling on the roof of train.
- Public awareness by involving various social groups like NGO's to create awareness about the railway fatalities.

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# Correlation of Splenic Length with the Height of an Individual - A Cross Sectional Study

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## ABSTRACT

**Objective:** To estimate splenic length in correlation with the height of an individual.

**Background:** The normal length of the Spleen varies from 12 -14 cm. Various text books describe the measurement of splenic length but not it's correlation with the height of an individual. As per the data available there are few studies done, correlating the splenic length and height of an individual. Clinically length of the spleen is more significant. Hence this study has been taken up with the criteria of ultrasonographic measurement of splenic length and it's correlation with height of an individual.

**Method:** The study was conducted in department of radio diagnosis, M.S.Ramaiah teaching hospital. 500 individuals were selected for the study based on inclusion and exclusion criteria. Splenic length was measured with the help of Ultrasound. Height of the individual was measured in centimeters and statistical analysis was done.

**Result:** The length of the Spleen increases proportionately with increase in height of individual

(Males:  $F=10.832$  and  $P<0.01$ ) , ( Females:  $F=3.052$  and  $p=0.029$  ).

**Conclusion:** The relation between Splenic length and height of an individual is significantly positive.

**Keywords:** Height, Splenic length, Ultrasound

## INTRODUCTION

The spleen is a large encapsulated mass of vascular and lymphoid tissue, situated in the upper left quadrant of abdominal cavity between the fundus of stomach and diaphragm. Its shape varies from curved wedge to a domed tetrahedron. The relations of the neighboring structures determine the shape of spleen during the development.<sup>1</sup>

The size and weight of the spleen vary with age and between the sexes. It also varies slightly in same individuals under different conditions. It is comparatively large in the young child and although weight increases during the puberty, by the adulthood it is relatively smaller in comparison with neighboring organs. It tends to diminish in size and weight as age advances. Its average adult weight is about 150gms, although the normal range is wide between 80gms to 300gms.<sup>1</sup> Splenomegaly is an important clinical sign for diagnosis and evaluation of various conditions in the Indian subcontinent, be it malaria, kala- azar, malignancies of hematopoietic system or conditions

related to portal hypertension. However determination of spleen size especially of unpalpable spleens, based on the percussion is not always reliable. Therefore splenomegaly, in reports of clinical studies, often represents only palpable spleens, and accuracy of such a diagnosis in each is often unknown.<sup>2</sup>

In case where there is only mild splenomegaly or mild enlargement, making decision about size can be difficult. It is very important to have a set of standard normal sonographic values showing upper and lower limits.<sup>3</sup> Gerspcher et al, who compared ultrasonographic and clinical palpation of spleen and evaluated size changes, concluded that abdominal palpation was a poor method for estimation of splenomegaly.<sup>4</sup> Sonographic measurements, allow accurate determination of splenic weight. Estimating splenic weight with formula  $0.43 \times \text{length} \times \text{width} \times \text{thickness}$ , Downey provides the greatest overall accuracy.<sup>5</sup>

A study conducted on Hong Kong based Chinese population, show a rapid growth in splenic length up to age 20 years, followed by a mild decrease. A

statistically significant difference is seen between male and female subjects from about 15 to 40 years with spleens of men being about 0.5 cm longer.<sup>6</sup>

Assessment of splenic size by physical examination is subjective and known to be inaccurate. Therefore evaluation with radiological imaging is common. Sonography is quick, simple, and relatively inexpensive modality that carries no risk of ionizing radiation.<sup>7</sup>

Spleen length is correlated with age, height, weight and BSA. Multiple regression analysis indicate that age, height, and either weight or BSA have significant positive association with spleen length.<sup>8</sup> Statistically significant differences between splenic dimension and weight in both sexes have been established in Nigerian adult population by Okoye et al.

In pediatric populations, there is a significant correlation between spleen size and height, weight, and body surface area.<sup>8,9</sup> The previous studies done by different people namely Rosenberg, Dittrich, Konus, Frank, Niderau, Loftus, Hosey on the Splenic dimensions and their correlation with the physical data of the individual have given the significant values.

Normal spleen size has been found to vary significantly depending on age and sex.<sup>9-15</sup> Therefore Ultrasonographic measurement of Splenic length and its correlation with height of an individual has been taken up in this study.

## MATERIALS AND METHOD

### Source of data

During the period of November 2007 to May 2009, about 2054 apparently healthy subjects visited M.S. Ramaiah Memorial hospital for health check-ups, among them 500 healthy subjects were selected for the study based on inclusion and exclusion criteria.

The men and women with no apparent diseases and who had no fever were included in the study. Individuals with the signs and symptoms of cirrhosis of Liver or Portal hypertension, Hepatobiliary or pancreatic disorder (Congenital or acquired), haematological disorders, febrile illness or trauma, women with recent history of abortion and pregnant women were excluded from the study.

**Ultrasound examination:** Each subject was scanned using a voluson 750 pro ultrasound machine with a sector probe of 3.5 MHZ frequency with an electronic caliper. The length is measured in longitudinal images,

the maximum length measured as the greatest overall dimension.

The height of the individuals was measured in centimeters with the help of tape.

Descriptive statistical analysis was used in the present study. Pearson correlation was used to find the relationship of splenic length with height of the individual. Student-t test was used to find the significance of correlation.

## RESULTS

Among the 500 subjects with the age more than 18 years taken for the study, the total number of male subjects was 278 (57.6%) and the number of female was 222 (44.4%). The height of the 500 subjects taken for the study ranged from 140 to 189 cms. The splenic length of 500 individuals was obtained by using Ultrasound machine. Statistical analysis was done with the parameters using Student-t test to find correlation between splenic length and height of the individual.

**Table-1: Mean Splenic length in male and female subjects according to height**

| Height in centimeters | Splenic length     |                   |
|-----------------------|--------------------|-------------------|
|                       | Male               | Female            |
| 140-149               | 8.5+/_0.14         | 8.72+/_1.01       |
| 150-159               | 9.21+/_1.22        | 9.17+/_1.07       |
| 160-169               | 9.59+/_1.20        | 9.62+/_1.39       |
| 170-179               | 10.18+/_1.07       | 9.16+/_1.07       |
| 180-189               | 10.81+/_1.21       | 9.2+/_1.14        |
| Significance          | F=10.832 ; P<0.001 | F=3.052 ; P=0.029 |

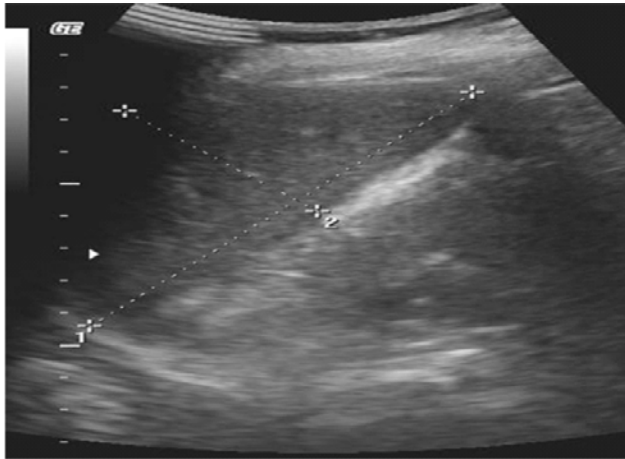
The table shows relationship between height and splenic length in an individual. A moderate correlation of  $r = 0.386$  was noted between height of the individual and splenic length.  $Spl = 1.2 + 0.051H$ . The splenic length increases as height of male subjects increase from  $8.50 \pm 0.14$  to  $10.81 \pm 1.21$ . The splenic length increases as height of female subjects increase from  $8.72 \pm 1.01$  to  $9.16 \pm 1.07$ . This shows statistically significant between height of subjects and the splenic length. ( $p < 0.001$  for males) and ( $p = 0.029$  in females).

## DISCUSSION

Normally splenic length varies from 12 to 14cm. In case where there is mild splenomegaly making decision about size can be difficult. It is very important to have a set of standard normal sonographic values showing upper and lower limits.<sup>3</sup>

Photograph showing measurement of Spleen in Longitudinal Scan.

(1-Measuring the length of the Spleen.)



Conventional sonography is a well-established, widely used, and relatively inexpensive means of assessing the spleen without ionizing radiation. A study by Rosenberg<sup>9</sup> et, al. found that a simple measurement of length was accurate as a guide to the spleen size. The authors proposed setting the upper limit of splenic length at 12cm for girls 15 years or older and at 13cm for boys 15 years and older. This study Rosenberg<sup>9</sup> et, al. and another by Dittrich<sup>10</sup> et al found that there was an approximately linear increase in spleen size, as measured on sonography, in the course of development in pediatric population and that spleen size correlated best with body height. A third study of pediatric population by Konus<sup>11</sup> et al, with 307 subjects also found that height correlated best with spleen length ( $r=0.88$ ), although their tallest individual was only 68 inches (173cm), which is shorter than that of our study population. In a study of adults, Frank<sup>12</sup> et al used conventional sonography to evaluate 793 healthy patients (17-82 years) and found that 95% of patients had splenic length of less than 11cm, a width (transverse diameter) of less than 7cm and a thickness of less than 5cm. Niederau<sup>13</sup> et al studied 915 healthy subjects using sonography and found the mean longitudinal and transverse diameters of the spleen to be  $5.8 \pm 1.8$  and  $5.5 \pm 1.4$ cm, respectively in male and female. In all these previous studies it was concluded that splenic length varies directly with height of an individual. Statistical analysis of the present study showed that, both in males and females, splenic length varies directly with height of the individual and hence it was concluded that a significant correlation does exists between splenic length and height of the individual.

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# Epidemiological Study of Drowning in Yavatmal

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## ABSTRACT

**Introduction:** Drowning is a form of death in which atmospheric air is prevented from entering the lungs due to submersion of body in water or any other fluid medium.

**Methodology :** The present study is a retrospective research undertaken to study the fatal cases of drowning at the mortuary of department of Forensic Medicine, Shri V.N. Govt Medical College, Yavatmal. The duration of the study is 5 years (January 2006 to December 2010). The aim of this study was to know the incidence, trends according to sex and residency and season, characteristics of drowning cases, and the manner of death.

**Results :** Total of 3560 cases were autopsied during the five year period, 2006 to 2010, of which 178 deaths i.e. 5% were due to drowning. Male victims predominated. Age group commonly involved was 20-29 years. Married were more in number. Suicidal drowning(57.3%) was the most common form of drowning followed by accidental(37.1%) and homicidal(3.4%).

**Keywords:** Drowning, Suicide, Yavatmal, Retrospective Study

## INTRODUCTION

Drowning is a preventable cause of morbidity and mortality. The World Health Organization (WHO) appraises the annual global incidence of death by drowning to be about 400,000.<sup>1</sup> Drowning is the 3rd leading cause of unintentional injury death worldwide, accounting for 7% of all injury related deaths.<sup>2</sup>

The global burden and death from drowning is found in all economies and regions, however:

- low- and middle-income countries account for 96% of unintentional drowning deaths;
- over 60% of the world's drowning occurs in the WHO Western Pacific Region and WHO South-East Asia Region;
- Drowning death rates are highest in the WHO African Region, and are more than eight times higher than in Australia or the United States of America (USA).

China and India have particularly high drowning mortality rates and together contribute 43% of the world's drowning deaths and 41% of the total global DALYs (disability-adjusted life years) lost related to drowning.<sup>2</sup>

Research in Asia has shown that in many countries

drowning kills more children annually than pertussis, measles, diphtheria, plague, cholera, dengue fever, and typhoid combined and is the leading cause of death in children after infancy.<sup>3</sup> This counting is apparently a gross underestimate because of under reporting.<sup>4</sup> The major un-natural causes of Accidental Deaths reported in 2009 in India were

- (i) Road Accidents (37.9%),
- (ii) Railway Accidents and Rail-Road Accidents (7.8%),
- (iii) Poisoning (8.0%),
- (iv) Drowning (7.7%),
- (v) Sudden Deaths (7.4%) and
- (vi) Fire Accidents (7.0%).

Amongst un-natural causes of suicidal deaths 33.6% of the suicide victims consumed poison; 31.5% of the victims died by hanging, 9.2% by Fire/Self-Immolation and 6.1% by Drowning.<sup>5</sup> In the developed countries, the highest incidence of drowning is seen in children under 5 years of age and young adults between 15 to 24 years old.<sup>6,4</sup> In some countries, drowning is the first or second leading cause of death in children.<sup>7</sup>

In 2009, 7749 (7.7%) drowning deaths occurred in India with highest death in Lakshadweep (62.5%) &

Maharashtra was at 14<sup>th</sup> place(8.1%).<sup>5</sup> Accidental immersing is a mainly preventable cause of death. Water safety unions, the general public and lawmakers need suitable data about the conditions of drowning to plan for effective preventive action. Effective avoidance measures require itemized understanding of the specific epidemiology of drowning incidents. Despite the big number, facts and figure by WHO of deaths due to drowning, relatively few epidemiologic studies have examined drowning.

The aim of this study was to examine the incidence, demographic trends and characteristics of drowning cases with special consideration to the type of activity the victims were involved in and the manner of death.

## METHOD

### Study Design

Retrospective analysis was done on all drowning cases that were brought & died at Shri V.N.G.M.C Yavatmal over a period of 5 years (from January 2006 to December 2010). The Data were obtained from Department of Forensic medicine & Toxicology, Shri V.N.G.M.C, Yavatmal.

### Data Collection

Drowning deaths were identified by reviewing death certificates and autopsy reports that listed drowning as a possible primary or contributing cause of death in accordance with the International Classification of Disease (ICD-10). Demographic data included age, sex, residence, season and manner of death.

## RESULTS

Total of 3560 cases were autopsied during the five year period, 2006 to 2010, of which 178 cases i.e. 5% were of drowning deaths. Among 178 drowning cases 54.5% were male while rest were female. 36 % deaths in age group of 20- 40 yrs out of which 54.68% fall in 20-30yrs. Among the less than 20 yrs of age group 29.54% fall below 10 yrs. 66.3% were married and 57.9% were from rural area. From table 2 it is evident that Male drowning rate has declined from 3.5:1 in 2006 to 1.2:1 in 2010 while rural urban is showing the inconsistent trend with sudden rise in year 2007 in rural area and falling to 1.07: 1 in 2010.

From Fig. 1 its evident that most cases of drowning (70, 39.3% were in rainy season followed by winter(55,31%) and summer (53,29.77%) Fig 2 shows

manner of deaths in most cases were suicide (102, 57.3%) followe by accident (66, 37%) .

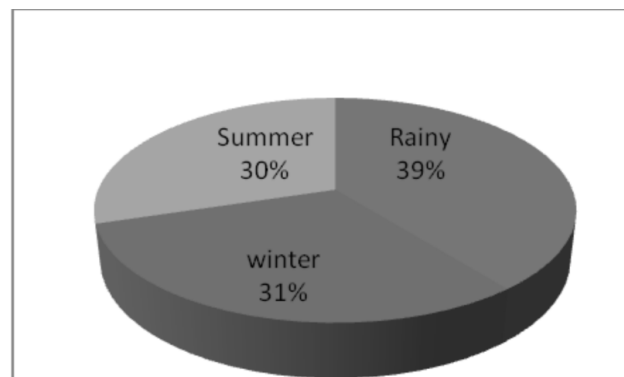


Fig. 1. Distribution of drowning victims according to the season

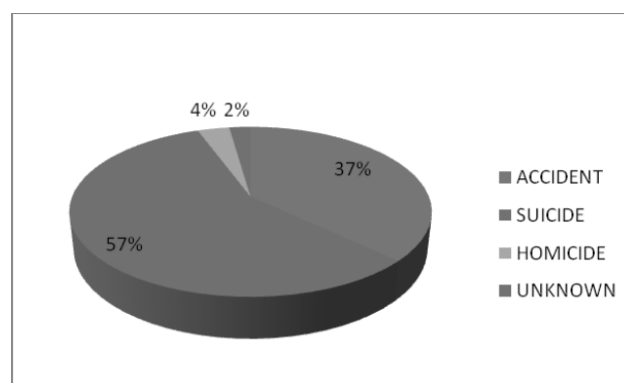


Fig. 2. Distribution of drowning victims according to manner of death

## DISCUSSION

The data collected in the present study reveals several interesting facts about the drowning situation in Yavatmal. In 5 year period from 2006 to 2010, 178 drowning cases were submitted for medico-legal autopsy at Government Medical College, Yavatmal.

The study data shows that in all years under consideration, the male to female ratio ranged from a high of 3.5:1 in 2005 to low of 1.2:1 in 2009. This proportion is similar to 4.16 males for every female by Wintemute et al in USA, during the period 1974 to 1985<sup>8</sup> similar result was shown by Shetty Mahabalesh,<sup>9</sup> Other Studies shows the following results 2.31 males to every female in Denmark for the period 1987-1989.<sup>10</sup> and 5.3 males for every female in Minnesota forth period 1980-1985.<sup>11</sup> Financial burden (37%) and marital disharmony (35%) were the principal reasons for the suicide<sup>12</sup>.

The age group of 20-40 years had the largest number of drowning victims in this study with almost equal

victims between 20-30yrs and 31-40 yrs . Similar observation was made by R M K Tan of Singapore.<sup>13</sup> Unlike a study conducted in Karnataka (Mangalore) where largest number of drowning victims were in the age group of 30-41yrs .<sup>9</sup> Western countries where drowning of children below the age of 15 years were generally higher.<sup>14,15</sup> In present study married are more in than unmarried ones. These findings are in accordance with study by Dr R K Gorea & Dr Amandeep Singh in which Marital status of 96 persons was known out of which 61.45% were married and 38.5% were unmarried.<sup>16</sup> There are more no of deaths from drowning in rural areas (57.9%) as compared to urban areas (39.3%). Findings of present study corresponds with study by Dr R K Gorea & Dr Amandeep Singh i.e.(54cases) in rural areas as compared to urban areas (42cases)<sup>16</sup>

According to climatological factors or season wise distribution, this study confirms that the majority of death took place during rainy season i.e. 70 victims in five years, when water level is high in the river,well,pond and lakes. <sup>11,,17,18</sup>

Taking into consideration the manner of death, in our study, suicidal (57.3%) drowning was the commonest while according to some authors such as Wintemute et al<sup>8</sup> ,Giersten<sup>19</sup>, number of deaths due to accidental submersion ranged between 80-90% of the total number of death due to submersion. The difference may be due to high suicidal rates in India.

**Table 1. Distribution of drowning victims according to demographic data**

| Age (yrs)      |           | No of deaths | Percentage |
|----------------|-----------|--------------|------------|
|                | <20       | 44           | 24.7       |
|                | 20- 40    | 64           | 36         |
|                | >40       | 39           | 26.7       |
| Sex            | Male      | 97           | 54.49      |
|                | Female    | 81           | 45.5       |
| Marital status | Married   | 118          | 66.3       |
|                | Unmarried | 55           | 30.9       |
| Residency      | Rural     | 103          | 57.9       |
|                | Urban     | 70           | 39.3       |

**Table 2. Trend of drowning deaths over last five yrs**

| YEARS       | 2006   | 2007  | 2008  | 2009  | 2010   |
|-------------|--------|-------|-------|-------|--------|
| Male:Female | 3.5:1  | 1.9:1 | 1.5:1 | 2.4:1 | 1.2:1  |
| Rural:Urban | 1.25:1 | 3:1   | 1.1:1 | 1.1:1 | 1.07:1 |

## CONCLUSION

A retrospective 5 year study, from 2006 to 2010, 5% of total medico-legal autopsies were due to drowning. As the death rate due to drowning is more among the young people, males mostly due to suicides life skill education be taught to youths for facing stress in life and various ways for generating the income. Drowning Deaths in rainy season can be prevented by good disaster management skills.

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# Dermatoglyphics and ABO Blood Groups, an Observational Study

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## ABSTRACT

**Objectives:** (a) To study distribution of finger print pattern among the subjects having different ABO and Rh blood group and (b) Identify any relation between their characters and blood groups.

**Methods:** 313 students at PIMS&RC were selected over a period of 6 months, their blood groups were ascertained and their finger prints studied. Fingerprints were grouped under 3 major categories, i.e. loops, whorls and arches. Association was assessed statistically using chi-square test.

**Results:** Male: female ratio was 1.8:1. Majority of the subjects (35.78%) in the study were of blood group O Positive followed by blood group B Positive, A Positive, AB Positive, O Negative, B Negative, A Negative and finally AB Negative, of whom 93.93% were Rh-positive. The general distribution of pattern of finger print showed high frequency (61.35%) of loops whereas whorls were moderate (35.14%) and arches were least (3.51%) in frequency. Almost same order was noticed in both Rh-positive and Rh-negative individuals or A, B, AB and O blood groups. Blood group O Positive showed more loops (62.86%) while, blood group B Negative had more whorls (55%) and blood group O Negative had more chances of having arches (6.67%) as compared to other blood groups. The ring finger more often has whorls (52.72%), where as the little finger more often has loops (79.23), both cases true irrespective of the blood group.

**Conclusion:** The study suggests an association between finger print pattern and blood group. The distribution of different pattern of finger prints in individual fingers also showed some peculiarities in relation to blood group.

**Keywords:** Finger Print, Dermatoglyphic, Dactylography, Identification

## INTRODUCTION

It was around the early 1900's that the concept of finger prints (dactylography / dermatoglyphic) as a method of identification came into view. A person's blood group is like a bar code permanently etched into his life, it never changes, just like one's finger print.

This study was done to find a relationship between a person's finger print and his/her blood group. If such a relationship were to exist, it would help immensely, not only in forensic medicine, it would be of use in various walks of science and would help us to better understand the complexity of the human body.

**Dermatoglyphics:** The word dermatoglyphics comes from two Greek words (derma meaning skin and glyph meaning carving)<sup>1</sup> and refers to the friction ridge formations which appear on the palms of the hands

and soles of the feet. They remain absolutely constant and persist throughout life, from infancy to old age, and the patterns of no two hands resemble each other, not even those of identical twins<sup>1</sup>.

The scientific work on dermatoglyphics began with Joannes Purkinje<sup>3</sup>. In 1880, Henry Faulds<sup>4</sup> and W. J. Herschel<sup>5</sup> recommended the use of fingerprints for personal identification. Herschel<sup>5</sup> reported actually using this method of identification in India. Cummin<sup>6</sup> is popularly called the father of dermatoglyphics, whereas Galton<sup>7</sup> is the "inventor". He classified finger prints as arch, loop and whorl. His system was further modified and is now used practically all over the world.

**Blood Grouping:** Blood grouping was introduced in 1900 by Karl Landsteiner<sup>8</sup>, for which he was awarded a Nobel Prize in 1930. Blood grouping system is divided into major and minor blood group system. The

major blood group system consists of ABO and Rh systems. Other blood group systems include the MN system, K system etc.

## OBJECTIVES

### The study was carried with two objectives

- (a) To study distribution of finger print pattern among the subjects having different ABO and Rh blood group and
- (b) Identify any relation between their characters and blood groups.

## MATERIALS AND METHOD

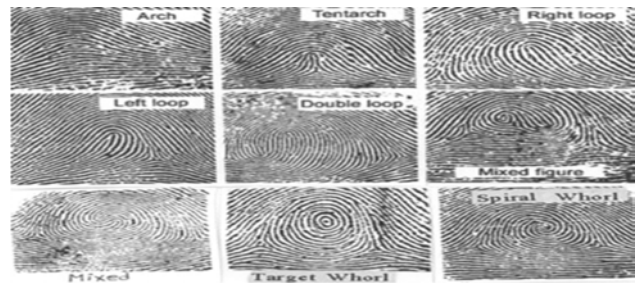
### Selection of Subjects

This study was conducted from December 2009 to May 2010. For the study, 313 medical students were selected from PIMS&RC, Tiruvalla, Kerala, in the age group of 18-23 years.

### METHOD OF STUDY

The subjects were explained the procedure and consent from each one was taken before the start of recording data. A proforma was prepared, onto which the subject could state their name, age, sex and blood group. Columns were prepared for the recording of finger prints, the first column for the left little finger, followed by the left ring finger and so on, till we reach the last column, for the right little finger.

- For taking dermatoglyphics, Ink Method<sup>9</sup> was used.
1. Fingers are to be thoroughly washed and rubbed clean and dry, as the slightest perspiration will cause blotches and blur the print.
  2. Ink the bulb surface of the finger or thumb between nail boundaries. Only one finger at a time should be inked. Roll the finger across the ink pad in one continuous motion.
  3. Once the finger has been inked, check to see that the ink covers the entire pattern area (to the first crease on the tip of your finger), then transfer the ink to a strip of paper by placing the paper on the edge of a flat surface and rolling the finger across it (using the same continuous motion).



4. As each finger is rolled, check to see that the entire pattern has been printed. This usually can be ensured if the finger is rolled from one margin to the other, making contact with all the areas that were inked.
5. Label the strip by side and each digit using Roman numerals (customarily the thumb = I and the little finger = V).
6. For all practical purposes, finger prints were classified into 3 major groups, i.e. loops, whorls, arches.
  - a. The sub-groups of composites and compound patterns were classified under "Whorls"
  - b. Right loop and left loop patterns were grouped under "Loops"
  - c. Tented Arches and Simple arches were grouped under the category "Arches"

Finger prints which were deemed unreadable even after careful scrutiny were excluded from the study

- For assessing the blood group of the subject, Antigen-Antibody Agglutination Test<sup>8</sup> was performed.
1. Blood typing is performed by mixing an individual's red blood cells with antisera containing the various agglutinins on a slide and seeing whether agglutination occurs.

## STATISTICAL METHOD

The data were analysed comparing sex to blood groups, Rh Positive to Rh Negative groups, general distribution of finger prints in all fingers with blood groups and distribution of finger print patterns in different fingers. Statistical analysis was done by applying Chi-square test. A *p* value of  $\leq 0.05$  was considered statistically significant.

**Observations and Results (Findings)****Table 1: Distribution of cases according to sex and blood groups**

| Sex    | Blood group |          |            |          |           |       |             |          | Total        |
|--------|-------------|----------|------------|----------|-----------|-------|-------------|----------|--------------|
|        | A +         | A -      | B +        | B -      | AB +      | AB -  | O +         | O -      |              |
| Male   | 27          | 0        | 32         | 3        | 5         | 0     | 44          | 0        | 111 (35.64%) |
| Female | 50          | 2        | 56         | 5        | 12        | 0     | 68          | 9        | 202 (64.54%) |
| Total  | 77(24.60%)  | 2(0.64%) | 88(28.12%) | 8(2.56%) | 17(5.44%) | 0(0%) | 112(35.78%) | 9(2.86%) | 313 (100%)   |

**Impression:** Male female ratio is ~ 1.82:1. Irrespective of gender, people with blood group O Positive predominated, followed by those with blood group B Positive, then A Positive, AB Positive, O Negative, B Negative, A negative. In the study, a subject with the blood group AB Negative was not found.

**Table 2: Distribution of cases according to Rh blood groups.**

| Blood group | Rh positive  | Rh negative |
|-------------|--------------|-------------|
| A           | 77 (24.60%)  | 02 (0.64%)  |
| B           | 88 (28.12%)  | 08 (2.55%)  |
| AB          | 17 (5.43%)   | 0 (0%)      |
| O           | 112 (35.78%) | 09 (2.88%)  |
| Total (n)   | 294 (93.93%) | 19 (6.07%)  |

**Impression:** Rh-Positive subjects far outnumber their Rh-Negative counterparts.

**Table 3: General distributions of finger print patterns in all fingers and among subjects of A, B, O and Rh blood groups (n = 3130)**

|        | A+           | A-         | B+           | B-         | AB+        | AB-    | O+           | O-         | Total         |
|--------|--------------|------------|--------------|------------|------------|--------|--------------|------------|---------------|
| Loops  | 468 (24.38%) | 19 (0.99%) | 551 (28.69%) | 36 (1.88%) | 86 (4.48%) | 0 (0%) | 704 (36.67%) | 56 (2.91%) | 1920 (61.35%) |
| Whorls | 269 (24.45%) | 0 (0%)     | 291 (26.45%) | 44 (4%)    | 83 (7.55%) | 0 (0%) | 385 (35%)    | 28 (2.55%) | 1100 (35.14%) |
| Arches | 33 (30%)     | 1 (0.91%)  | 38 (34.52%)  | 0(0%)      | 1 (0.91%)  | 0 (0%) | 31 (28.14%)  | 6 (5.52%)  | 110 (3.51%)   |
| Total  | 770          | 20         | 880          | 80         | 170        | 0      | 1120         | 90         | 3130(100%)    |

**Table 3- Impression:** Loops predominate in most people, followed by whorls and finally arches, except those with blood group B Negative, who showed to have a slightly higher occurrence of whorls than loops and finally arches.

O Negative subjects have more chances of having arches as compares to their Rh positive counterparts

Arches are more common among people with blood group O and least common among those with blood group AB.

**Table 5. Distribution of pattern of finger prints in different fingers of both hands of subjects (n = 313 x 2); L = loops, W = whorls and A = arches**

| Fingers | Individual blood groups |        |       |           |   |   |              |        |       |            |        |        |              |        |        |        |     |     |               |        |        |            |        |        |        |        |        |        |
|---------|-------------------------|--------|-------|-----------|---|---|--------------|--------|-------|------------|--------|--------|--------------|--------|--------|--------|-----|-----|---------------|--------|--------|------------|--------|--------|--------|--------|--------|--------|
|         | A+(77x2=154)            |        |       | A-(2x2=4) |   |   | B+(88x2=176) |        |       | B-(8x2=16) |        |        | AB+(17x2=34) |        |        | AB-(0) |     |     | O+(112x2=224) |        |        | O-(9x2=18) |        |        |        |        |        |        |
|         | L                       | W      | A     | L         | W | A | L            | W      | A     | L          | W      | A      | L            | W      | A      | L      | W   | A   | L             | W      | A      | L          | W      | A      |        |        |        |        |
| Thumb   | 85                      | 62     | 7     | 4         | 0 | 0 | 98           | 73     | 5     | 8          | 8      | 0      | 16           | 18     | 0      | 0      | 0   | 0   | 110           | 111    | 3      | 11         | 6      | 1      |        |        |        |        |
|         | 55.20%                  | 40.30% | 4.50% | 100%      |   |   | 55.70%       | 41.50% | 2.80% | 50%        | 50%    |        | 47%          | 53%    |        |        |     |     | 49.10%        | 49.60% | 1.30%  | 61.10%     | 33.30% | 5.60%  |        |        |        |        |
| Index   | 77                      | 70     | 7     | 3         | 0 | 1 | 100          | 58     | 18    | 7          | 9      | 0      | 17           | 16     | 1      | 0      | 0   | 0   | 120           | 85     | 19     | 9          | 7      | 2      |        |        |        |        |
|         | 50%                     | 45.50% | 4.50% | 75%       |   |   | 25%          |        |       | 56.80%     | 33%    | 10.20% |              | 43.80% | 56.20% |        | 50% | 47% | 3%            |        |        |            | 53.60% | 37.90% | 8.50%  | 50%    | 38.90% | 11.10% |
| Middle  | 117                     | 29     | 8     | 4         | 0 | 0 | 138          | 30     | 8     | 9          | 7      | 0      | 20           | 14     | 0      | 0      | 0   | 0   | 170           | 46     | 8      | 14         | 2      | 2      |        |        |        |        |
|         | 76%                     | 18.80% | 5.20% | 100%      |   |   | 78.50%       | 17%    |       | 4.50%      |        | 56.20% | 43.80%       |        | 58.80% | 41.20% |     |     |               |        | 75.90% | 20.50%     | 3.60%  |        | 77.80% | 11.10% | 11.10% |        |
| Ring    | 72                      | 77     | 5     | 4         | 0 | 0 | 75           | 98     | 3     | 3          | 13     | 0      | 12           | 22     | 0      | 0      | 0   | 0   | 114           | 110    | 0      | 7          | 10     | 1      |        |        |        |        |
|         | 46.80%                  | 50%    | 3.20% | 100%      |   |   | 42.60%       | 55.70% | 1.70% | 18.80%     | 81.20% |        | 35.30%       | 67.70% |        |        |     |     | 50.90%        | 49.10% |        |            |        | 38.90% | 55.50% | 5.60%  |        |        |
| Little  | 117                     | 31     | 6     | 4         | 0 | 0 | 140          | 32     | 4     | 9          | 7      | 0      | 21           | 13     | 0      | 0      | 0   | 0   | 190           | 33     | 1      | 15         | 3      | 0      |        |        |        |        |
|         | 76%                     | 20.10% | 3.90% | 100%      |   |   | 79.50%       | 18.20% | 2.30% | 56.20%     | 43.80% |        | 61.80%       | 38.20% |        |        |     |     | 84.80%        | 14.70% | 0.50%  | 83.30%     | 16.70% |        |        |        |        |        |

| Fingers | Total(n=313x2) |             |           |
|---------|----------------|-------------|-----------|
|         | Loops          | Whorls      | Arches    |
| Thumb   | 332(53%)       | 278(44%)    | 16(3%)    |
| Index   | 333(53.19%)    | 245(39.14%) | 48(7.67%) |
| Middle  | 472(75.40%)    | 128(20.45%) | 26(4.15%) |
| Ring    | 287(45.85%)    | 330(52.72%) | 9(1.43%)  |
| Little  | 496(79.23%)    | 119(19.01%) | 11(1.76%) |

**Impression:** the ring finger more often has whorls than loops or arches, where as the little finger more often has loops than any other pattern, both cases true irrespective of the blood group.

### CONCLUSION

- Irrespective of gender, people with blood group O Positive predominated, followed by those with blood group B Positive, then A Positive, AB Positive, O Negative, B Negative, A negative. In the study, a subject with the blood group AB Negative was not found.
- Rh-Positive subjects far outnumber their Rh-Negative counterparts.
- Loops predominate in most people, followed by whorls and finally arches, except those with blood group B Negative, who showed to have a slightly higher occurrence of whorls than loops and finally arches.
- O Negative subjects have more chances of having arches as compares to their Rh positive counterparts
- Arches are more common among people with blood group O and least common among those with blood group AB.
- The ring finger more often has whorls than loops or arches, where as the little finger more often has loops than any other pattern, both cases true irrespective of the blood group.

### DISCUSSION

Bloterogel and Bloterogel<sup>10</sup> expressed a correlation between physical characters and blood groups. Hahne<sup>11</sup>, in his study, asserted that blood group O is associated with more loops and less whorls than blood group A, which is similar to the findings of this study. Herch<sup>12</sup> found high frequency of loops in blood group A. Gowda and Rao<sup>13</sup> in their study reported high

frequency of loops with moderate whorls and low arches in individuals of blood group A, B and O. They also found a significantly greater number of loops in Rh-Positive and whorls in Rh—Negative subjects. Bharadwaja A, Saraswat PK, Aggarwal SK, Banerji P, Bharadwaja S<sup>14</sup> in their study on students at J.L.N. Medical College, Ajmer, found that there is an association between distribution of finger print (dermatoglyphic) pattern and blood groups. They found the general distribution pattern of the primary finger print was of the same order in individuals with A, B, AB and O blood group i.e. high frequency of loops, moderate of whorls and low of arches, the same findings were seen in Rh-positive and Rh-negative individuals of ABO blood group. They found that the correlation was more consistent for blood group A and loops, arches were more in blood group AB. The distribution pattern in individual fingers had high frequency of loops in thumb and little finger whereas ring fingers had more whorls and index and middle fingers presented higher incidences of arches in subjects of A, B and O blood groups. Individuals of blood group AB had high frequency of whorl in thumb, index and ring fingers while middle and little fingers showed more number of loops. In the present study, we found statistics similar to Bharadwaja's<sup>14</sup> study in terms of general distribution of fingerprints (i.e. loops > whorls > arches), except in blood group B Negative, who showed whorls > loops > arches. Arches were more often found in individuals with blood group O Negative. The ring finger more often has whorls than loops or arches, where as the middle and the little finger more often has loops than any other pattern, both cases true irrespective of the blood group. Individual with blood group B Negative and O Positive showed almost an equal chance of having loops or whorls on their index fingers.

## ACKNOWLEDGEMENT

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# Estimation of Stature from Foot Print Length

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## ABSTRACT

Though there are several parameters which help in identifying a person, stature of an individual is one of the important parameter, as it is an inherent characteristic. There is an established relationship between stature and dimensions of various parts of the body allowing the investigators to estimate the stature from available data. In the present study right footprint length, left footprint length and heights of 200 students (100 males and 100 females) studying in M.R. Medical College belonging to Gulbarga region are recorded for stature estimation. Significant and positive correlation coefficient has been shown to exist between stature and measurements of foot prints. The present study shows a significant correlation of stature with right and left foot print length ( $P < 0.01$ ). The results show that males are taller and their mean foot length is larger than that of females. There is no statistically significant difference in right and left footprint length in both the sexes ( $P > 0.05$ ). Either right or left footprint length may be used to predict the stature by regression formula. Regression equations are derived separately for individual foot length in both the sexes.

**Keywords:** Stature, Foot Length and Correlation Coefficient

## INTRODUCTION

The stature of an individual is an inherent characteristic and is considered as one of the important parameters for personal identification.<sup>1</sup> The term stature originated from the Latin word *statura* meaning 'height' or size of the body and from the Latin verb *stare*, meaning to 'stand'.<sup>2</sup> Examination of footprint provides important evidence in a crime scene investigation as it helps in the estimation of stature of a criminal. Significant and positive correlation coefficient has been shown to exist between stature and measurements of foot prints. Ossification of bones of foot occurs earlier than that of long bones of lower extremities. Even during adolescent age, the height can be predicted more accurately from foot measurements than long bones of lower limb. Taken together, evidences suggest that relationship between foot length and stature is of practical use for medico legal experts, anthropologists, anatomists and archaeologists; when such evidence is provided to the investigator, it helps to establish the individual's physical description. Footprints are also used for identifying newborn babies in hospitals.<sup>3</sup> Foot prints and shoe prints are different forms of physical evidence which have tremendous values in tropical country like India. Footprints have been accepted as evidence of identification in courts of many countries.<sup>4</sup>

Despite of the relationships between different body parameters that have been determined, it has been emphasized that these vary from population to population and ethnic origin due to differences in effects of heredity, nutrition, living style and levels of physical activity<sup>5</sup>. A good correlation between foot length and the height of an individual could be established. As such a study has not been done in Gulbarga region, Hence present study is under taken to confirm that foot length is useful to determine the height of an individual.

## MATERIALS AND METHOD

The present study was carried out on 200 Students of both sexes (100 males & 100 females) of M.R. Medical College, from Gulbarga region. The aims and objectives of the intended study were properly explained to all the students and consent is taken on the proforma.

A glass plate of 24x24 inches is cleaned and uniformly smeared with a thin layer of black painters ink by using a roller. Individual student's footprint and stature are taken separately. Each student is asked to wash and dry his/her feet to remove the dirt. Then he/she is asked to stand on the smeared glass plate and then to walk casually on two separate white sheets so that prints of right and left foot are transferred on two

separate sheets. The length of footprint is measured from outer most margin of heel to the tip of extension of longest toe in the footprint with the help of a scale and it is recorded in centimetres. All the measurements are taken at a fixed time between 2:00 pm to 4:00 pm to eliminate diurnal variation in the height and by the same observer to avoid personal error in the methodology. Height of the subjects is recorded using staturemeter.

## OBSERVATIONS AND RESULTS

The data obtained was subjected to Regression analysis to find out the strength of relationship between the right footprint length, left foot print length and the stature using spss 11.5 package software. Using linear regression analysis, a constant (a) and a regression coefficient (b) were estimated with height as the dependent variable and right foot print length and left foot print length as explanatory or independent variable.

**Table 1: Correlation between Right Foot Print Length, Left Foot Print Length and Stature in Male Students:**

| Variable       | N      | Mean $\pm$ SD                     | Range              | Cor. Coeff. r-value | Reg. Coeff. b-value | Reg. Equation           |
|----------------|--------|-----------------------------------|--------------------|---------------------|---------------------|-------------------------|
| RFPL Actual Ht | 100100 | 25.13 $\pm$ 1.42172.34 $\pm$ 4.72 | 22.2–27.8159 - 184 | + 0.82              | 3.40                | Ht = 86.9 + 3.40 (RFPL) |
| LFPL Actual Ht | 100100 | 24.96 $\pm$ 1.47172.34 $\pm$ 4.72 | 22–27.8159 – 184   | + 0.80              | 2.41                | Ht =112 + 2.41 (LFPL)   |

RFPL = Right Footprint Length. LFPL = Left Footprint Length. Ht =

The difference in correlation coefficient is statistically significant ( $P < 0.01$ ). Stature could be predicted from the right footprint length in Males by

using regression equation:  $Ht = 86.9 + 3.40(RFPL)$  and from left footprint length by using regression equation:  $Ht = 112 + 2.41(LFPL)$ .

**Table-2: Correlation between Right Foot Print Length, Left Foot Print Length and Stature in Female Students:**

| Variable       | N      | Mean $\pm$ SD                     | Range        | Cor. Coeff. r-value | Reg. Coeff. b-value | Reg. Equation          |
|----------------|--------|-----------------------------------|--------------|---------------------|---------------------|------------------------|
| RFPL Actual Ht | 100100 | 22.61 $\pm$ 1.51163.29 $\pm$ 5.45 | 20-25148-176 | +0.88               | 4.10                | Ht = 70.60+4.10 (RFPL) |
| LFPL Actual Ht | 100100 | 22.59 $\pm$ 1.62163.29 $\pm$ 5.45 | 20-25148-176 | +0.88               | 3.12                | Ht = 92.8+3.12 (LFPL)  |

RFPL = Right Footprint Length. LFPL = Left Footprint Length. Ht = Height.

The difference in correlation coefficient is statistically significant ( $P < 0.01$ ). Stature could be predicted from right footprint length in Females by using regression equation:  $Ht = 70.6 + 4.10(RFPL)$  and from left footprint length by using regression equation:  $Ht = 92.8 + 3.12(LFPL)$ .

Following points are observed from the present study:

Male students are taller than female students. Mean footprint length is more in males than females. There is no statistically significant difference in right and left foot length in both the sexes. Stature can be determined by right or left footprint length separately in both the sexes. There is no statistically significant difference in stature estimated by right footprint length and left footprint length. ( $P > 0.05$ )

## DISCUSSION AND CONCLUSION

Human foot is a complex structure adopted to allow orthograde bipedal stance and locomotion and is the

only part of the body which is in regular contact with ground. There are 28 separate bones in human foot and 31 joints including ankle joint. Functionally the skeleton of the foot may be divided into tarsus, metatarsus and phalanges.<sup>6</sup>

Human foot is classified as T – Type (Tibial type) – first toe is longer than the second, F – Type (Fibular type) – second toe is longer than the first toe, O – Type (Transitional type) – when both first and second toe are equal in length and M – Type – Where 3<sup>rd</sup> toe is taller.<sup>7</sup> The present study is statistically significant ( $P < 0.01$ ) and shows that height can be predicted by regression equation by known footprint lengths separately in both the sexes. Where as Devesh V<sup>5</sup>, Danborn B<sup>8</sup> and Vidya CS<sup>9</sup> observed that mean foot length is more in males than in females. The findings are similar to present study. Theodoros B Grivas<sup>10</sup> stated that right foot length and left foot length are independent predictor of stature. These findings are supported by the present study.

Agnihotri Arun Kumar<sup>11</sup> in his study included 125 male and 125 females students for estimation of stature

by left foot length. General multiple linear regression model was highly significant ( $P < 0.001$ ) and multiple correlation coefficient was ( $r$ ) 0.87. In a study by Devesh V (2006)<sup>5</sup> correlation coefficient ( $r$ ) of 0.698 for males, 0.738 in females and 0.848 in combined group was obtained between stature and left foot length. Raju M<sup>12</sup> (2009) obtained a statistically significant relation between bare foot length while walking and stature ( $P < 0.001$ ). In his study he included only male individuals.

The results of the present study are quite encouraging and would ultimately help the investigating officer to estimate stature of a person if foot print length is available at the scene of crime. Estimation of stature from foot print length is easy, economical and convenient. No specialised equipment or training is required. Anthropologists, anatomists, forensic experts and investigating officers may use this method to their added advantage. Thus this study is able to add another method to estimate stature from foot print length in the individuals from Gulbarga region.

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# Carbon Monoxide Poisoning in Burn - A Case Report

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## ABSTRACT

Carbon monoxide poisoning is an important aspect of most fires - indeed it is the major or even sole cause of death in many victims of conflagrations, especially in house fire. When any combustible material burns in air, most of the carbon in organic material, such as timber, fabric and furnishings, is converted to carbon dioxide. Carbon monoxide is also produced, however, and, where the access of oxygen is limited or exhausted by the ongoing combustion, larger volumes of the carbon monoxide are produced. Slow, smouldering fires with little flame are likely to produce more monoxide, as with burning bedclothes and mattresses.

Here one case of burn is discussed, where thirty five year old person was found dead in his closed room. On crime scene visit it was found that only mattress is burnt, rest of the room is normal. On examination the deceased was sustained only 18% superficial burns. The samples were preserved for chemical analysis. Chemical analysis of blood reveals 46% carboxyl haemoglobin.

**Keywords:** Carbon Monoxide Poisoning, Thermal Burn

## INTRODUCTION

The actual cause of death from burns is complex and results from the interplay of many factors. In rapid deaths, the directly destructive effects of heat on the respiratory tract leading to asphyxia, the combined toxic effects of carbon monoxide, cyanide and the multitude of other noxious gases (oxides of nitrogen, phosgene etc.) that are inhaled, the release of toxic material from the extensive tissue destruction, and 'shock' due to pain all cause or contribute to death.<sup>1</sup>

Carbon monoxide poisoning is an important aspect of most fires - indeed it is the major or even sole cause of death in many victims of conflagrations, especially in house fire. When any combustible material burns in air, most of the carbon in organic material, such as timber, fabric and furnishings, is converted to carbon dioxide. Carbon monoxide is also produced, however, and, where the access of oxygen is limited or exhausted by the ongoing combustion, larger volumes of the carbon monoxide are produced. Slow, smouldering fires with little flame are likely to produce more monoxide, as with burning bedclothes and mattresses. At the other extreme, rapid flash fires with flames fanned by moving draughts and those involving volatile fuels, such as petrol or kerosene, produce relatively little monoxide - though much depends upon the free access of air. In

many house fires, where the seat of the fire is originally remote from the victim, death may occur from carbon monoxide poisoning long before the flames reach the body.<sup>2</sup>

Carbon monoxide is a colourless, odourless gas produced by incomplete combustion of material containing carbon. The most common sources of Carbon Monoxide Poisoning today are motor vehicle exhaust, smoke from fires, engine fumes, and nonelectric heaters.<sup>3</sup>

## CASE HISTORY

As per police inquest, accidental death report and statement of witness, the neighbours of deceased noticed large amount of smoke is coming through the partially opened window of his room. They also noticed that the room was locked from inside and accordingly called fire brigade personnel.

The fire brigade personnel broke the door and stopped the fire. At the scene incidence it was noticed that the mattress which was left side of the deceased was completely burnt. The mattress on which deceased was slept was not burnt. The deceased was in supine position with left upper and lower limbs, lateral aspect of trunk and face were on the left burnt mattress. The burn injuries were present over left side of body

including left upper and lower limb. The deceased was brought to hospital where he was declared dead before admission and the body was sent for autopsy. As per statement of sister of deceased he was unmarried, chronic smoker and alcoholic. He was alone in the room at the time of incidence.

### OBSERVATIONS

**Scene of incidence:** the door was opened from outside. One window was partially opened. The left mattress of double bed was burnt but the wooden bed was not burnt. We also noticed 4-5 butts of cigarettes and same number of unused cigarettes, partially empty whisky bottle and empty glass. There was no smell and evidence of any inflammatory material.

### AUTOPSY FINDINGS

The deceased was 35 years old, averagely built and nourished.

#### On external examination,

1. The post mortem lividity was present over back and cherry red in colour.
2. Cyanosis of fingernails of right hand.
3. Oozing of reddish colored fluid through the nose and mouth.
4. There were superficial burns with blackening of skin and singeing of left eye brows, left eye lashes and left side of scalp and facial hairs.
5. On the left upper limb there was superficial to deep burn with peeling of skin over arm and forearm, subcutaneous tissue was exposed over extensor aspect of left forearm, 4 cm below the elbow joint and multiple blisters were present over extensor aspect left hand over radial aspect of wrist and base of left thumb, margins of blisters were reddish coloured.
6. The middle and distal phalynx of index and middle fingers of left hand were exposed; medial aspect of the nail of index finger was burnt, blackish coloured.
7. There were superficial burns with blackening of skin and singeing of hairs of lateral aspect of left thigh and subcutaneous tissue was exposed .
8. There was a patch of superficial burn was present over flexor aspect of left leg, 5cm below the popliteal fossa, reddish coloured.

**Table-1 Percentage and distribution of burns**

| Sr. No. | Area                | Percentage |
|---------|---------------------|------------|
| 1       | Head, neck, face    | 2 %        |
| 2       | Right Upper limb    | 0 %        |
| 3       | Left Upper limb     | 9 %        |
| 4       | Anterior Trunk      | 4%         |
| 5       | Right Lower limbs   | 0%         |
| 6       | Left Lower limbs    | 3%         |
| 7       | Total area of burns | 18 %       |

#### On internal examination

1. On opening trachea and laryngeal mucosa were congested and soot particles were seen admixed with the mucus.
2. Blood was in fluidity in consistency and cherry red in color.
3. Both lungs were congested and edematous.
4. All organs were severely congested on cut section.

#### Material preserved

1. Routine viscera for chemical analysis
2. Blood with layer of liquid paraffin in air tight container for carboxy haemoglobin.
3. Scalp hairs and piece of skin for detection of inflammatory material.
4. Tissue for histopathology examination

#### Results of chemical analysis

1. Chemical analysis examination of blood under paraffin showed 46% carboxy haemoglobin.
2. General and specific chemical testing for blood reveal 90 mg% alcohol
3. Test for detection of inflammatory material (petroleum hydrocarbons) were negative in skin and scalp hairs.

On the basis of autopsy, history, scene of incidence, chemical analysis and histopathological examination report the final cause of death was given as "Asphyxia due to suffocation as result of carbon monoxide poisoning in a case of 18% superficial thermal burns."

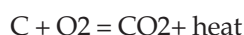
### DISCUSSION

For the victim of a fire whose body shows no or minimum evidence of thermal injuries, the cause of

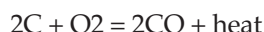
death is often attributed to "smoke inhalation. This is often used synonymously with carbon monoxide poisoning. Examination of individuals overcome by smoke inhalation will usually reveal soot in the nostrils and mouth as well as coating the larynx, trachea, and bronchi. At autopsy, it is usually relatively easy to determine whether the individual died of carbon monoxide intoxication. The livor mortis, the muscles, and internal organs, as well as the blood, will have a cherry-red coloration<sup>4</sup>

In house-fire victims, carbon monoxide and hydrogen cyanide, singly or combined, are probably not solely responsible for the deaths that occur in badly burned victims (a minority of fire victims). In fact, the significantly higher carboxy-haemoglobin in unburned or scarcely burned victims (most fire victims) indicates that carbon monoxide alone or combined with hydrogen cyanide plays a major role in the cause of death. Carbon monoxide levels of 30% or 40% and even 20% may cause death if the victim suffers from an underlying disease such as severe coronary atherosclerosis.

In a typical fire the complete exothermic reaction is:



If the conditions of the fire are altered such that there is an overabundance of fuel (increased carbon) and/or a relative/absolute lack of oxygen, incomplete combustion results:



The latter is the typical scenario in most fires; therefore most fire-related deaths are directly attributed to smoke inhalation, primarily from the contained CO therein<sup>5</sup>

Carboxy haemoglobin detection from the victim's blood is the most important laboratory finding to differentiate ante mortem and post mortem incidence of burning. More than 10% blood haemoglobin saturation with carbon monoxide in bodies recovered from fire usually indicates that the victim inhaled smoke and hence was alive at the time of fire<sup>6</sup>

The combustion reaction in the fire may sometimes be incomplete, resulting in the production of a great deal of smoke, composed of gases and of condensed and solid products. Carbon particles, by-products of sulphurous compounds, and carbon monoxide, together with other toxic gases, are also present in smoke.<sup>7</sup>

Similarly in this case the deceased sustained less burns (18%) due to slow smouldering fires with little flame. It produced more carbon monoxide due to burning of bedclothes and mattresses. The room was closed and there is no space for escaping the smoke which resulted asphyxia due to carbon monoxide. The deceased was under the influence of alcohol and smoking cigarette. He slept with burning cigarette in the left hand which resulted into the burning of left



Fig. 1. Showing burnt and unburnt cigarettes.



Fig. 2. Showing left burnt and right unburnt mattress.



Fig. 3. showing cherry red pm lividity on back.



Fig. 4. minimum burn on left lower limb and upper limbs.



Fig. 5. showing burnt nail of left index finger, at typical position of cigarette holding.

mattress. The middle and distal phalynx of index and middle fingers of left hand were severely burnt. The type of fire was accidental and the manner of death was the same.

## CONCLUSIONS

The type of fire provides valuable information regarding how a case should be worked up. A fire that begins in bedding or clothing in a case with a history of alcohol and/or drug use in a cigarette smoker may suggest an accidental origin.

In this case of burns was less hence the investing authorities were in dilemma regarding the cause and manner of death. It was very important to visit the scene of incidence, proper history, meticulous autopsy, collection evidences. This was very helpful in this case to conclude the cause and manner of death. The cause of death was "Asphyxia due to suffocation as result of carbon monoxide poisoning in a case of 18% superficial thermal burns." The manner of death and type of fire were accidental.

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# A Study of Pattern of Asphyxial Deaths in Shimla Hills

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## ABSTRACT

This is a retrospective analytical study of violent asphyxial deaths reported to Department of Forensic Medicine, IGMCS Shimla from January -December 2005. Out of 218 postmortems conducted in department 12 (5.5 %) cases were of violent asphyxial deaths. The present study emphasis on demographic variables, type of asphyxia, pattern of injuries in such cases.

**Keywords:**

## INTRODUCTION

Violent asphyxia is one of the known causes of suicidal and homicidal deaths. While hanging and drowning are commonly observed in suicidal cases, strangulation including throttling is usually homicidal. Asphyxia refers to a state in which there is lack of oxygen in body because of some mechanical interference with the process of breathing.

With the rising level of stress and tensions in our day to day life more and more people are being pushed towards unnatural deaths by committing suicides, homicides and accidents. This fact is very much evident from daily news through different channels of media that is television, radio, internet etc.

## MATERIAL AND METHOD

In the present study we retrospectively analyzed the records of all 218 postmortem cases which were conducted in the Department of Forensic Medicine and Toxicology during January-December, 2005. All the cases of violent asphyxial deaths during the aforementioned period were segregated and necessary case details such as demographic variables, types of asphyxia and pattern of injuries were obtained from the records which are being maintained in the department.

## Month wise distribution of cases

| sex     | month  | hanging |              | ligature strangulation |              | Total |              |
|---------|--------|---------|--------------|------------------------|--------------|-------|--------------|
|         |        | N       | % of Total N | N                      | % of Total N | N     | % of Total N |
| males   | march  | 2       | 16.7%        |                        |              | 2     | 16.7%        |
|         | july   | 2       | 16.7%        |                        |              | 2     | 16.7%        |
|         | nov    |         |              | 1                      | 8.3%         | 1     | 8.3%         |
|         | dec    | 1       | 8.3%         |                        |              | 1     | 8.3%         |
|         | Total  | 5       | 41.7%        | 1                      | 8.3%         | 6     | 50.0%        |
| Females | April  | 1       | 8.3%         |                        |              | 1     | 8.3%         |
|         | may    | 1       | 8.3%         |                        |              | 1     | 8.3%         |
|         | July   |         |              | 1                      | 8.3%         | 1     | 8.3%         |
|         | august |         |              | 1                      | 8.3%         | 1     | 8.3%         |
|         | sep    | 1       | 8.3%         |                        |              | 1     | 8.3%         |
|         | dec    | 1       | 8.3%         |                        |              | 1     | 8.3%         |
|         | Total  | 4       | 33.3%        | 2                      | 16.7%        | 6     | 50.0%        |
| Total   | march  | 2       | 16.7%        |                        |              | 2     | 16.7%        |
|         | April  | 1       | 8.3%         |                        |              | 1     | 8.3%         |
|         | may    | 1       | 8.3%         |                        |              | 1     | 8.3%         |
|         | July   | 2       | 16.7%        | 1                      | 8.3%         | 3     | 25.0%        |
|         | august |         |              | 1                      | 8.3%         | 1     | 8.3%         |
|         | sep    | 1       | 8.3%         |                        |              | 1     | 8.3%         |
|         | nov    |         |              | 1                      | 8.3%         | 1     | 8.3%         |
|         | dec    | 2       | 16.7%        |                        |              | 2     | 16.7%        |
|         | Total  | 9       | 75.0%        | 3                      | 25.0%        | 12    | 100.0%       |

Out of total 12 cases, 9 cases were found to be of hanging, 2 cases were of ligature strangulation and 1 case of ligature strangulation along with gagging.

Out of total 9 cases of hanging 5 were males and 4 were females. Out of total 3 cases of ligature strangulation, 1 case was a male in whose case death was found out to be due to ligature strangulation along with gagging and 2 cases of ligature strangulation were of females.

### Age distribution of cases

| sex     | type           |         |                        |        |
|---------|----------------|---------|------------------------|--------|
|         |                | hanging | ligature strangulation | Total  |
| males   | N              | 5       | 1                      | 6      |
|         | Mean           | 32.40   | 25.00                  | 31.17  |
|         | Std. Deviation | 21.173  | .                      | 19.177 |
| Females | N              | 4       | 2                      | 6      |
|         | Mean           | 33.50   | 37.50                  | 34.83  |
|         | Std. Deviation | 11.818  | 10.607                 | 10.515 |
| Total   | N              | 9       | 3                      | 12     |
|         | Mean           | 32.89   | 33.33                  | 33.00  |
|         | Std. Deviation | 16.639  | 10.408                 | 14.869 |

The mean age of males and females in case of hanging was  $32.89 \pm 16.63$  years. The mean age of males and females in case of ligature strangulation was  $33.33 \pm 10.40$  years.

### Time of day at time of death of cases

| sex       | type    |                        |        |
|-----------|---------|------------------------|--------|
|           | hanging | ligature strangulation | Total  |
| not known | 4       | 2                      | 6      |
|           | 33.3%   | 16.7%                  | 50.0%  |
| morning   | 2       |                        | 2      |
|           | 16.7%   |                        | 16.7%  |
| evening   | 1       |                        | 1      |
|           | 8.3%    |                        | 8.3%   |
| night     | 2       | 1                      | 3      |
|           | 16.7%   | 8.3%                   | 25.0%  |
| Total     | 9       | 3                      | 12     |
|           | 75.0%   | 25.0%                  | 100.0% |

In 50% of cases the time of death was not known. In 25% of cases death occurred during night, in 16.7 % cases death was found out to be in the morning and 8.3 % of cases death occurred during evening. Out of 12 cases in one case death was instantaneous, 9 cases were of immediate death and in 2 cases time of death was not mentioned.

### Cause of death in the cases

| sex                 | type    |                        |        |
|---------------------|---------|------------------------|--------|
|                     | hanging | ligature strangulation | Total  |
| cerebral congestion | 2       |                        | 2      |
|                     | 16.7%   |                        | 16.7%  |
| asphyxia            | 4       | 3                      | 7      |
|                     | 33.3%   | 25.0%                  | 58.3%  |
| both                | 2       |                        | 2      |
|                     | 16.7%   |                        | 16.7%  |
| not mentioned       | 1       |                        | 1      |
|                     | 8.3%    |                        | 8.3%   |
| Total               | 9       | 3                      | 12     |
|                     | 75.0%   | 25.0%                  | 100.0% |

In 7 cases the cause of death was asphyxia while in 2 cases death was due to cerebral congestion and there was a combination (cerebral congestion and asphyxia) in other 2 cases.

### Chest and limb injuries

| sex         | type    |                        |        |
|-------------|---------|------------------------|--------|
|             | hanging | ligature strangulation | Total  |
| injuries    |         | 2                      | 2      |
|             |         | 16.7%                  | 16.7%  |
| no injuries | 9       | 1                      | 10     |
|             | 75.0%   | 8.3%                   | 83.3%  |
| Total       | 9       | 3                      | 12     |
|             | 75.0%   | 25.0%                  | 100.0% |

In all the 9 cases of hanging there were no chest and limb injuries.

### Face injuries

| sex         | type    |                        |        |
|-------------|---------|------------------------|--------|
|             | hanging | ligature strangulation | Total  |
| injuries    | 1       | 2                      | 3      |
|             | 8.3%    | 16.7%                  | 25.0%  |
| no injuries | 8       | 1                      | 9      |
|             | 66.7%   | 8.3%                   | 75.0%  |
| Total       | 9       | 3                      | 12     |
|             | 75.0%   | 25.0%                  | 100.0% |

In 9 cases of hanging 8 cases did not have any face injury.

### Hyoid injuries

| sex         | type    |                        |        |
|-------------|---------|------------------------|--------|
|             | hanging | ligature strangulation | Total  |
| injuries    | 2       |                        | 2      |
|             | 16.7%   |                        | 16.7%  |
| no injuries | 7       | 3                      | 10     |
|             | 58.3%   | 25.0%                  | 83.3%  |
| Total       | 9       | 3                      | 12     |
|             | 75.0%   | 25.0%                  | 100.0% |

In the present study 2 cases of hanging were having fracture of hyoid bone, while in 1 case there was inward fracture of left cornua and in other case there was fracture of cornua of right side.

### Thyroid injuries

| sex         | type    |                        |        |
|-------------|---------|------------------------|--------|
|             | hanging | ligature strangulation | Total  |
| Injuries    |         | 2                      | 2      |
|             |         | 16.7%                  | 16.7%  |
| no injuries | 9       | 1                      | 10     |
|             | 75.0%   | 8.3%                   | 83.3%  |
| Total       | 9       | 3                      | 12     |
|             | 75.0%   | 25.0%                  | 100.0% |

There was no thyroid injury in hanging cases while in ligature strangulation of 3 cases in total 1 case had hemorrhage in thyroid gland and the other had laceration in the area.

In the case of ligature strangulation along with gagging there was an abrasion and contusion of muscle along with intimal rupture of carotid vessels.

### Skin changes

| sex         | type    |                        |        |
|-------------|---------|------------------------|--------|
|             | hanging | ligature strangulation | Total  |
| contusion   | 1       | 2                      | 3      |
|             | 8.3%    | 16.7%                  | 25.0%  |
| no findings | 8       | 1                      | 9      |
|             | 66.7%   | 8.3%                   | 75.0%  |
| Total       | 9       | 3                      | 12     |
|             | 75.0%   | 25.0%                  | 100.0% |

### Details of ligatures in cases

| sex           | type    |                        |        |
|---------------|---------|------------------------|--------|
|               | hanging | ligature strangulation | Total  |
| typical       | 2       |                        | 2      |
|               | 16.7%   |                        | 16.7%  |
| atypical      | 5       | 1                      | 6      |
|               | 41.7%   | 8.3%                   | 50.0%  |
| not mentioned | 2       | 2                      | 4      |
|               | 16.7%   | 16.7%                  | 33.3%  |
| Total         | 9       | 3                      | 12     |
|               | 75.0%   | 25.0%                  | 100.0% |

### Types of Knots in cases

| sex           | type    |                        |        |
|---------------|---------|------------------------|--------|
|               | hanging | ligature strangulation | Total  |
| fixed         | 4       | .0%                    | 4      |
|               | 33.3%   |                        | 33.3%  |
| slip          | 2       |                        | 2      |
|               | 16.7%   |                        | 16.7%  |
| not present   | 1       | 1                      | 2      |
|               | 8.3%    | 8.3%                   | 16.7%  |
| not mentioned | 2       | 2                      | 4      |
|               | 16.7%   | 16.7%                  | 33.3%  |
| Total         | 9       | 3                      | 12     |
|               | 75.0%   | 25.0%                  | 100.0% |

There were 5 cases of atypical hanging. There were 2 rounds of ligature material in the case of ligature strangulation with gagging.

### Position of tongue in cases

| sex           | type    |                        |        |
|---------------|---------|------------------------|--------|
|               | hanging | ligature strangulation | Total  |
| protruded     | 1       | 1                      | 2      |
|               | 8.3%    | 8.3%                   | 16.7%  |
| not protruded | 6       |                        | 6      |
|               | 50.0%   |                        | 50.0%  |
| not mentioned | 2       | 2                      | 4      |
|               | 16.7%   | 16.7%                  | 33.3%  |
| Total         | 9       | 3                      | 12     |
|               | 75.0%   | 25.0%                  | 100.0% |

In 6 cases of hanging the tongue was not protruded. The ligature material used was jute rope in 2 cases, while sleeve of shirt in 1 case, dupatta in 2 cases, nylon rope in 3 cases and in 4 cases the ligature material was not mentioned. The bodies were found in the forest in 2 cases, in 4 cases inside the house, in 1 case at the back of house, in 1 case under the bridge, in 1 case in the cowshed, 1 in toilet, 1 in dharamshala and 1 in hotel room. In ligature strangulation in the case of body found in hotel room the ligature material was dupatta, in the case of body found below the bridge the material was not known while in case of body found at the back of house a jute rope was used.

## DISCUSSION

The total incidence of death due to violent asphyxia found in this study is (5.5%) which is same as that of study of Amandeep S. et al that is (5.26%). Among the different type of asphyxial deaths highest incidence was seen that of hanging that was 75% which is at variance from the study conducted by Amandeep et al where drowning was recorded as the main cause of death that is 59.4%. The difference in incidence of death due to hanging in this study from the study done by Amandeep et al 59.4% can be attributed to the difference in terrain of the area and absence of canals in the region. There was not much difference of age between males (32.4years) and females(33.5years) in hanging cases . This is in contrast to the study done by Amandeep et al where the 59.24% of hanging cases were in the age group of 15-25 years. Out of 3 cases of ligature strangulation 2 cases were females and the mean age of females was 37.5 in comparison to 1 case of male death due to ligature strangulation in whose case the mean

age is 25 years. The ratio of hanging to strangulation cases is 3:1. Out of total 6 males the ratio of hanging to strangulation is 5:1. Out of total 6 females the ratio of hanging to strangulation is 2: 1. Though there is equal male to female ratio that is 1:1 in present study of violent asphyxial deaths yet the ratio of hanging to strangulation is 3:1 which shows that the predominant cause of violent asphyxial deaths is hanging.

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# An Autopsy Study of Paediatric Fatalities in Central Kolkata, India

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## ABSTRACT

Childhood deaths are a curse to the society. Every effort should be made to prevent such deaths. During the period 2008 to 2010, 230 autopsies were conducted on subjects up to the age of 18 years at the Kolkata Police Morgue. Majority (52.2%) of them were between 13-18 years and males marginally exceeded the females. Un natural deaths accounted for 80.8% of the fatalities and burn was the leading cause of death followed by road traffic accidents and drowning. The residence of the victims (38.3%) was the commonest place of incidence and most of the events occurred during day time. Increase in the general awareness, level of education and counseling of the parents and children need to be done to prevent such un intentional deaths

**Keywords:** Paediatrics, Autopsy, Fatality

## INTRODUCTION

Children are the future of any nation. It is the duty of the state to protect its future and nurture its children to the best of its ability. Death of children, be it natural or un natural, is un wanted under any circumstances. The infant mortality rate reflects the overall health of any state<sup>1</sup>. Autopsies conducted on individuals in the paediatric age group give some idea regarding the fatalities in this age. A study conducted in Pune during 1997-99 showed that 30.5% of the total autopsies were in the paediatric age group<sup>2</sup>. In Kuala Lumpur<sup>3</sup> majority of the paediatric deaths on which autopsies were conducted were of non traumatic origin while among the traumatic deaths accidents accounted for the maximum number. In Manipal<sup>4</sup> among the childhood fatalities due to trauma, most were due to road traffic accidents. No reported autopsy study on paediatric fatalities exists in our state. Hence the present study was undertaken to highlight the different factors leading to such deaths in Kolkata and suggest the remedial measures.

## METHOD

The present study is a retrospective study conducted at the Kolkata Police Morgue attached with the Department of Forensic Medicine, Medical College Kolkata, during the period 2008-2010. All the subjects below the age of 18 years on whom medico-legal autopsy was conducted during the said period were included in the study. Still born cases were excluded from the study. Details regarding the cases were

collected from the police inquest report, autopsy report and other relevant hospital records. The data so collected were analyzed and presented in the form of charts and tables.

## RESULTS

A total of 3688 autopsies were conducted during the 3 – year period of study out of which 230 (6.3%) were in the paediatric age group.

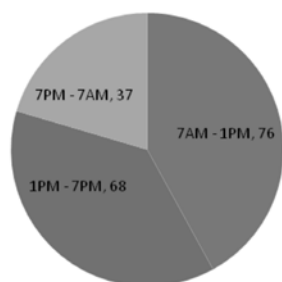
Majority of the subjects (52.2%) were in the age group of 13 – 18 years where as infants comprised 6.9% of the cases. Table 1.

**Table 1. Age and sex distribution of the victims.**

| Age group in years | Male        | Female      | Total       |
|--------------------|-------------|-------------|-------------|
| Less than 1        | 10          | 6           | 16 (6.9%)   |
| 1-5                | 14          | 10          | 24 (10.5%)  |
| 6-12               | 39          | 31          | 70 (30.4%)  |
| 13-18              | 56          | 64          | 120 (52.2%) |
| Total              | 119 (51.7%) | 111 (48.3%) | 230         |
|                    |             | 230         | 100%        |

Overall male victims (51.7%) marginally exceeded the females (48.3%). In children below the age of 12 years, males and females were 57.2% and 42.8% respectively (n=110). On the other hand in the 13-18 years age group female victims (53.4%) were more compared to the males (46.6%) (n=120). Table 1.

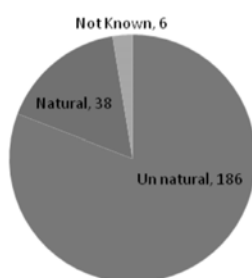
One third (33.1%) of the incidences occurred between 7AM and 1PM followed by 29.5% between 1PM to 7PM. Least number of cases 37 (16.1%) occurred during the night time of 7PM to 7AM. Fig 1.

**Time of incidence**

The residence (38.3%) of the victims was the most common place of incidence while 16.9% occurred on the road and 14% in water bodies comprising of river (11.3%) and pond (2.7%). Table 2.

**Table 2. Place of incidence.**

| Place     | Cases | Percentage |
|-----------|-------|------------|
| Home      | 88    | 38.3%      |
| Field     | 15    | 6.5%       |
| River     | 26    | 11.3%      |
| Pond      | 6     | 2.7%       |
| Road      | 39    | 16.9%      |
| Hospital  | 20    | 8.7%       |
| Others    | 13    | 5.6%       |
| Not Known | 23    | 10%        |

**Nature of death**

Majority of the deaths were un natural (80.8%). Fig 2. Among them 70.4% and 10.2% (n=186) were accidental and suicidal respectively. All the suicidal deaths were in the age group of 13-18 years. Table 3.

**Table 3. Manner of death. (n=186)**

| Manner of death | Cases | Percentage |
|-----------------|-------|------------|
| Homicidal       | 15    | 8.1%       |
| Suicidal        | 19    | 10.2%      |
| Accidental      | 131   | 70.4%      |
| Not Known       | 21    | 11.3%      |
| Total           | 186   | 100%       |

Burns (18.2%) were the leading cause of fatality among the un natural deaths followed by road traffic accidents (16.9%), drowning (13.9%) and fall from height (8.2%). Natural cause due to diseases was responsible for 16.5% of the total fatalities. Table 4.

**Table 4. Cause of death.**

| Cause of death        | Cases | Percentage |
|-----------------------|-------|------------|
| Road traffic accident | 39    | 16.9%      |
| Burn                  | 42    | 18.2%      |
| Drowning              | 32    | 13.9%      |
| Fall from height      | 19    | 8.2%       |
| Disease               | 38    | 16.5%      |
| Poisoning             | 14    | 6.1%       |
| Strangulation         | 8     | 3.4%       |
| Smothering            | 5     | 2.2%       |
| Snake bite            | 5     | 2.2%       |
| Hanging               | 4     | 1.7%       |
| Assault               | 2     | 1%         |
| Electrocution         | 5     | 2.2%       |
| Others                | 5     | 2.2%       |
| Not Known             | 12    | 5.3%       |
| Total                 |       |            |

## DISCUSSION

Only 6.3% of the total 3688 autopsies were in the paediatric age group. Paediatric deaths are unwanted for and reflect the status of the society. Preventive measures need to be framed to reduce such deaths. In Kuala Lumpur<sup>3</sup> 143 cases of paediatric deaths were reported on autopsy during 2000-2004 out of which 32.9% were still born. An autopsy study of natural deaths in Pune<sup>2</sup> revealed that 30.5% of all the autopsies were in the paediatric age group.

A gradual increase in the number of victims was noted with increasing age. Infants comprised 6.9% of the cases where as more than half (52.2%) were between the age of 13-18 years. This is due to the fact that at an early age the children are more protected by their parents and family members. As they grow older they tend to set themselves free from parental bindings and restrictions and venture into the unknown. Similar findings were noted in Manipal<sup>4</sup> where 13-18 years was the commonest age group to be involved in traumatic deaths. However in studies conducted in Surat<sup>5</sup> and South Africa<sup>6</sup> the commonest age group was 11-15 years.

Males (51.7%) were more common victims as compared to females (48.3%). This trend was also noted in children below 12 years. Surprisingly in the 13-18 years age where maximum fatalities were noted, females were the common victims. This fact reflects the sociological background of our society, which is male dominated. As the child starts to grow the care and

protection inclines towards the male where as the girl child is neglected. In this age in the lower socio economic class the females are sent to earn livelihood and are thus exposed to the dangers of the society.

Out of the total 144 incidents occurred during the day time hours between 7AM to 7PM with peak 76 cases (33.1%) between 7AM to 1PM. It is obvious that during the daytime the children may go outdoor and get involved in some mishap while after dark they usually remain indoor with their parents. Thus the incidence is less during night. Palimar<sup>4</sup> in his study found that 74.7% of the events occurred during day time. Similar findings were reported by Meiers<sup>7</sup> and Rivara<sup>8</sup>.

The most common place of incidence was the residence of the victims itself (38.3%). Among the outdoor locations 16.9% on the road due to road traffic accidents and 14% in water bodies due to drowning. Most of the incidents at home were due to burns. Mukherji<sup>9</sup> in his study of paediatric burns in Indore has reported that 95% of the incidents occurred at home. Gupta<sup>10</sup> also pointed out that majority of the burns in paediatric age occurred at home. Contrary to our findings of drowning, Xin Ong<sup>11</sup> from Singapore reported that in 63.3% cases of drowning occurred in swimming pools.

In our study majority of the deaths were un natural (80.8%) out of which 70.4% (n=186) were accidental. Only 19 cases of suicidal deaths were found all of which were in the 13-18 years age. This can be explained by the fact that only after a certain mental maturity suicides were committed. Hence no case of suicide was found in the lower age. Homicidal deaths in the form strangulation (8 cases), smothering (5 cases) and assault (2 cases) were detected in 8.1% of all un natural deaths. Collins<sup>12</sup> in his study found that 45% of childhood homicides were by head trauma and 25% by asphyxia. In Switzerland the most common manner as reported from Lausanne<sup>13</sup> was by cranio cerebral trauma due to battering or shaken baby syndrome. In contrast to the western countries in India asphyxia was the common mode of homicide among children. Verma<sup>14</sup> reported 28 cases of strangulation in paediatric and adolescent age in New Delhi from 1993-2004. In relation to head injuries Agarwal<sup>5</sup> reported that 96.9% of head injuries in children were accidental in nature.

Natural deaths due to disease or pathological conditions were found in 16.5% cases which reflect the poor health condition of the victims. Overall burns (18.2%) were the leading cause of death in our study, which confirms the finding that most on the incidents occurred at home. In Canada<sup>15</sup> 33.4% of all burn inpatients were in the 0-18 years age, most of which occurred indoor. Enescu<sup>16</sup> reported 4327 cases of paediatric burns over a 5 year period from 1988.

Morrow<sup>17</sup> in his study pointed out that infants and young children have the highest risk of death from burn injury. Similar findings were reported from Mumbai<sup>18</sup>, Vellore<sup>19</sup> and Manipal<sup>20</sup>. In our society from the adolescent age females are involved in cooking activities. Due to their in experience and lack of preventive knowledge often the fall victims of burns.

Road traffic accidents and drowning accounted for 16.9% and 13.9% of deaths. Both these occurred during the day time when the children were free of their parental protection unaware of the dangers. In Spain motor vehicular accidents contributed significantly to multi trauma cases in paediatric population<sup>21</sup>. In Canada drowning is the second leading cause of un intentional deaths among children and accounts for 11% of such deaths<sup>22</sup>. In the year 2000 over 1400 children below the age of 20 years drowned in USA<sup>23</sup>. In Bangladesh drowning was the leading cause of death in children aged 1-17 years and 85% of which occurred during daytime<sup>24</sup>.

## CONCLUSION

Most of the deaths in paediatric age are preventable. Appropriate measures must be taken to ensure that such deaths are prevented. Awareness among the general population, counselling of the parents and children need to be increased. Apart from this education level of the parents and health status of children must also be taken care of. Only then can the child mortality due to un intentional cause be reduced and the future generation can breathe safe.

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# Bilateral Asymmetry of the Intracranial Vertebral Artery in the Indian Population

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## ABSTRACT

Vertebral artery (VA), one of the feeder vessels to the brain is responsible for blood flow to posterior circulation of the brain. Reduction in the dimensions of the vessel because of atherosclerosis, or compression or stretching, may lead to hindbrain hypoxia with serious clinical manifestations. Because normative data for the intracranial vertebral artery in Indians are not readily available, it was the aim of the present study to measure the dimensions of these distal parts of the VA, to inform professional practice of the possible influence of different vessel dimensions on blood flow to the hindbrain. The length and outer diameter of intracranial vertebral arteries was measured in human bodies during routine autopsies from 100 bodies of both sexes and all age groups. The cases were grouped, Group I: Less than 20 years, Group II: 20 to 40 years and Group III: More than 40 years. Intracranial parts of the vertebral arteries obtained from the cranial cavity of 30 specimens were processed for light microscopic study and the left and right luminal and outer diameters were measured and compared by use of t-tests. The length of vertebral artery on the left side was significantly more in group II and group III. The outer diameter of the vertebral artery is significantly more on the left side in group II.

**Keywords:** Human Intracranial Vertebral artery, cerebral circulation, hindbrain, vertebrobasilar insufficiency

## INTRODUCTION

Vertebral arteries, one of the feeder vessels to the brain are responsible for vascular supply to the posterior parts of the brain. The vertebral artery is vulnerable to mechanical injury with resultant thrombus or embolus formation, often found at the vertebro-basilar junction. These vascular injuries and resultant neurological insults have been associated repeatedly with cervical spine manipulation.

Reduction in the dimensions of the vertebral arteries because of atherosclerosis, or compression or stretching, may lead to hindbrain hypoxia with serious clinical manifestations. Such effects may be more pronounced in VAs that are naturally smaller than the norm. Because normative data for the intracranial vertebral artery in the Indian population are not readily available, it was the aim of the present study to measure the dimensions of these distal parts of the VA, to inform professional practice of the possible influence of different vessel dimensions on blood flow to the hindbrain.

## MATERIAL AND METHOD

Intracranial vertebral arteries were studied in human bodies during routine autopsies. Arteries from

100 bodies of both sexes and all age groups were studied. Gross measurements of the arteries were made on all autopsies irrespective of age, sex and cause of death.

The cases were grouped according to age as follows;

**Group I:** Less than 20 years

**Group II:** 20 to 40 years

**Group III:** More than 40 years.

The cranial cavity was exposed and following measurements were taken (in situ):

- The length of the intracranial part of the vertebral arteries from the point of entrance of the artery through the foramen magnum to the basilovertbral junction, with a measuring tape.
- The external diameter of the vertebral arteries on both sides was measured using a vernier caliper at the middle of their length.

The length and the diameter of both the sides in each pair were compared and the results were statistically analyzed.

The intracranial parts of the vertebral arteries were removed from the cranial cavity of 30 adult cadavers who had succumbed due to road side accidents and preserved in 10% formal saline. 2 mm pieces of right and left vertebral arteries were taken from the center of their length and processed for paraffin sectioning. Seven micron transverse sections were cut on a rotary microtome. Every fifth slide was stained with Hematoxylin and eosin staining (Harris1990). The stained slides were observed under light microscope and various layers of the arteries of both the sides were made with the help of ocular and stage micrometer.<sup>1</sup>

The following measurements were taken under 3.2X

1. Measurement of the luminal diameter. The measurements were taken along the maximum and minimum diameter of the vessels. The mean of the two readings was taken.
2. Measurements of external diameters: The external diameter of the vessels in histological sections was calculated using the formula – [luminal diameter / 2 + (thickness of tunica intima + tunica media + tunica adventitia) × 2].

The length and the diameter of both the sides in each pair were compared and the results were statistically analyzed. Five measurements were taken at random from every fifth section and their mean calculated.

## FINDINGS

All the vertebral arteries are found to run straight in their course, running medially from the margin of the foramen magnum to the junction of the pons and medulla oblongata where they join to form the basilar artery. In a 35 years old male, the right vertebral artery was markedly narrow throughout its course.

The age and sex distribution of the 100 case is given in Table 1.

**Table 1: Age and Sex distribution of postmortem cases studied**

| Groups with age                | Males | Females | Total |
|--------------------------------|-------|---------|-------|
| Group I (less than 20 years)   | 3     | 0       | 3     |
| Group II (20-40 years)         | 67    | 7       | 74    |
| Group III (more than 40 years) | 20    | 3       | 23    |

The mean length and outer diameters of the vessels in the three groups recorded are given in tables 2 and 3.

**Table 2: Mean Length of the vertebral artery**

| Groups with age                | Right (mm)  | Left (mm)   | p-value |
|--------------------------------|-------------|-------------|---------|
| Group I (less than 20 years)   | 27.33 ±3.51 | 29.33 ±4.04 |         |
| Group II (20-40 years)         | 27.45 ±3.43 | 28.15 ±3.20 | p=0.000 |
| Group III (more than 40 years) | 28.39 ±3.98 | 29.43 ±3.72 | p=0.05  |

The length of vertebral artery on the left side is significantly more in group II (p=0.000) and group III (p=0.05) (Table 2)

**Table 3: Mean Outer Diameter of the vertebral artery**

| Groups with age                | Right       | Left       | p-value |
|--------------------------------|-------------|------------|---------|
| Group I (less than 20 years)   | 2.33 ± 0.31 | 2.43 ±0.25 |         |
| Group II (20-40 years)         | 2.48 ±0.38  | 2.55 ±0.34 | p=0.016 |
| Group III (more than 40 years) | 2.93 ±0.33  | 2.96 ±0.30 |         |

The outer diameter of the vertebral artery is significantly more on the left side (p=0.016) in group II.

The following measurements were made after staining the paraffin sections of vessels and observing under stage and ocular micrometer.

**TABLE 4: Outer and luminal diameter of vertebral arteries in 30 individuals**

| S. No.m | Vahodr (mm) | Valur (mm) | Vahodl (mm) | Valul (mm) |
|---------|-------------|------------|-------------|------------|
| 1.      | 2.21        | 1.70       | 1.85        | 1.46       |
| 2.      | 0.98        | 0.73       | 2.06        | 1.78       |
| 3.      | 2.36        | 1.95       | 2.48        | 2.18       |
| 4.      | 2.84        | 2.45       | 2.76        | 2.42       |
| 5.      | 2.55        | 2.22       | 2.67        | 2.35       |
| 6.      | 2.41        | 1.90       | 2.30        | 2.05       |
| 7.      | 2.19        | 1.90       | 2.18        | 1.90       |
| 8.      | 1.66        | 1.40       | 2.15        | 1.88       |
| 9.      | 2.38        | 2.01       | 2.28        | 1.94       |
| 10.     | 2.36        | 2.09       | 2.48        | 2.04       |
| 11.     | 2.88        | 2.42       | 2.93        | 2.54       |
| 12.     | 2.28        | 2.04       | 2.38        | 2.05       |
| 13.     | 2.86        | 2.55       | 2.88        | 2.48       |
| 14.     | 2.57        | 2.25       | 2.57        | 2.22       |
| 15.     | 2.87        | 2.46       | 2.88        | 2.48       |
| 16.     | 2.58        | 2.25       | 2.54        | 2.10       |
| 17.     | 2.77        | 2.40       | 2.85        | 2.38       |
| 18.     | 2.08        | 1.78       | 2.12        | 1.80       |
| 19.     | 2.15        | 1.85       | 2.35        | 2.05       |
| 20.     | 2.38        | 2.04       | 2.55        | 2.16       |
| 21.     | 2.66        | 2.25       | 2.49        | 2.11       |
| 22.     | 2.16        | 1.85       | 2.57        | 2.16       |
| 23.     | 2.74        | 2.30       | 3.08        | 2.45       |
| 24.     | 2.88        | 2.45       | 2.66        | 2.26       |
| 25.     | 2.97        | 2.50       | 3.17        | 2.70       |
| 26.     | 2.48        | 2.13       | 2.57        | 2.16       |
| 27.     | 2.36        | 2.08       | 2.45        | 2.10       |
| 28.     | 2.58        | 2.25       | 2.68        | 2.32       |
| 29.     | 2.78        | 2.42       | 2.56        | 2.15       |
| 30.     | 2.88        | 2.48       | 2.61        | 2.16       |
| Mean    | 2.46±0.42   | 2.10 ±0.38 | 2.54±0.30   | 2.16 ±0.25 |

VAHODR= Vertebral artery histological outer diameter right side;

VALUR=Vertebral artery luminal diameter right side;

VAHODL=Vertebral artery histological outer diameter left side;

VALUL=Vertebral of carotid artery intima media left side.

The mean luminal diameter of the vertebral artery on the right side is  $2.10 \pm 0.38$  mm and on the left side is  $2.16 \pm 0.25$  mm. The difference was not statistically significant with  $p=0.494$ .

The mean histological outer diameter of the vertebral artery on the right side is  $2.46 \pm 0.42$  mm and on the left side is  $2.54 \pm 0.30$  mm. The difference was not statistically significant with  $p=0.426$ .

## DISCUSSION

The vertebral arteries in their intracranial course are seen to be running obliquely towards their union to form the basilar artery with no tortuosities in their course in all the cases observed. Wilkinson et al<sup>2</sup>, Shrontz et al<sup>3</sup> and Akar et al<sup>4</sup> have described the course of the intracranial vertebral artery but they have not mentioned about any curve in the vessels. However Bauer et al<sup>5</sup> found tortuous vertebral arteries in 9% of cases in the extracranial part in patients of atherosclerosis. The present study suggests that in normal individuals the vertebral arteries run straight in their course in a medial direction to their union to form the basilar artery.

The outer diameter is found to be more on the left side in all the three groups observed. An increased diameter of the left sided arteries is seen by Stopford<sup>8</sup> Brown et al<sup>6</sup>, Fast et al<sup>9</sup>, Shrontz et al<sup>3</sup>, Mitchell and McKay<sup>10</sup>. Stopford<sup>8</sup> reported unequal vertebral arteries in 92% of cases with an excessively small right vertebral artery in five of the 150 cases he studied. The artery is considered to be hypoplastic if it is less than half the diameter of the other side as documented by Brown et al<sup>6</sup>.

In the present study unequal diameters were recorded in 87% of the cases studied with a right sided vertebral artery seen in one case. Fisher et al<sup>11</sup> recorded a hypoplastic vertebral artery in 10% of cases studied.

Similar left sided dominance has been reported by Pai et al<sup>7</sup> who documented mean diameter 3.4 mm on the left and 2.9 mm on right side. However they studied only 25 specimens.

Macchi et al<sup>12</sup> observed increased diameter of left artery than that of the right in most subjects (58%); the mean left/right difference was statistically significant ( $p < 0.05$ ). The vertebral artery diameter had a tendency

to increase with age that reached significance only for the left vertebral one. This is in accordance with the present study with increased diameter on the left side in 63% of our cases.

Brown et al<sup>6</sup> recorded outer diameter to be 3.5 mm in the right vertebral, 3.7 mm in the left. Shrontz et al<sup>3</sup> found it to be  $2.9 \pm 0.1$  mm on the left side and  $2.6 \pm 0.1$  mm on the right side. Akar et al<sup>4</sup> recorded average outer diameter 3.5 mm on the right side and 3.2 mm on the left. The present study is in accordance with those of Brown et al<sup>6</sup> and Shrontz et al<sup>3</sup>. However, Akar et al<sup>4</sup> recorded larger right sided vessels probably because of racial difference and the small sample size in their study.

The mean histological outer diameter of the vertebral artery on the right side is  $2.46 \pm 0.42$  mm and on the left side is  $2.54 \pm 0.3$  mm. The mean histological outer diameter for both the vessels was more on the left side corresponding with our readings of the gross outer diameter. Mitchell and McKay<sup>10</sup> found the microscopic outer diameter of the vertebral artery to measure  $2.04 \pm 0.55$  mm on the left side and  $2.03 \pm 0.52$  mm on the right side in formalin fixed cadavers. The slightly lower readings in their study are because they did not include the tunica adventitia in calculating the outer diameter. Moreover their study included 45 Blacks and 13 Whites.

In the eight white females in their study they recorded the outer diameter  $2.13 \pm 0.34$  mm on the right side and  $2.42 \pm 0.39$  mm on the left side which were significantly more in size. They concluded that the females in the white ethnic group may be more at risk as regards vascular accidents after cervical spine manipulation. Based on his conclusion in the present study we can presume that the larger left sided vertebral arteries recorded could make the Indian population more at risk of ischemic events.

The mean luminal diameter of the vertebral artery on the right side is  $2.10 \pm 0.38$  mm and on the left side is  $2.16 \pm 0.25$  mm. Mitchell and McKay<sup>10</sup> recorded it to be  $1.73 \pm 0.51$  mm on the right side and  $1.74 \pm 0.50$  mm on the left side. The slightly lower readings in their study could be because of the different population they studied.

The length is found to be significantly more on the left in individuals 20-40 years of age. ( $27.45 \pm 3.43$  right side and  $28.15 \pm 3.20$  left side)

Akar et al<sup>4</sup> found it to be 30.2 mm on the right side and 29.8 mm on the left side. The longer arteries they recorded on the right side could be because of racial difference. Moreover their sample size comprised of only eleven individuals.

Du Bin et al<sup>13</sup> recorded the length of the intracranial branch of vertebral artery on the left and right sides as  $32.7 \pm 1.2$  mm and  $32.7 \pm 1.1$  mm respectively. But they observed only 25 specimens as opposed to the 100 specimens in our study.

### CONCLUSION

The intracranial part of vertebral artery was studied in 100 autopsy cases. The arteries have a straight course from the foramen magnum to their union to form the basilar artery.

A normative reference standard has been established for the intracranial vertebral artery in the Indian Population. These values assume great significance in surgical and radiological practice. The mean length is  $27.45 \pm 3.43$  mm and  $28.15 \pm 3.20$  mm on right and left sides respectively in individuals 20-40 years of age. The mean length is  $28.39 \pm 3.97$  mm and  $29.43 \pm 3.72$  mm on right and left sides respectively in individuals 40-60 years of age.

The mean outer diameter is  $2.48 \pm 0.38$  mm and  $2.55 \pm 0.34$  mm on right and left sides respectively in individuals 20-40 years of age. The mean outer diameter is  $2.93 \pm 0.33$  mm and  $2.96 \pm 0.30$  mm on right and left sides respectively in individuals 40-60 years of age.

The length and the outer diameter of the vessel were found to be significantly more on the left side in individuals 20-40 years of age. The length was found to be significantly more on the left side in individuals 40-60 years of age. This left sided dominance suggests the dominant left lobe circulation which assumes significance in narrowing of these vessels in cerebrovascular involvement.

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# A Study of Foot Anthropometry in the Right Footed Indian Population

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## ABSTRACT

Quantitative analysis of foot anthropometry is important to the study of ergonomics, forensic science and anthropology. The present study is aimed at providing anthropometric values for foot length, width and height in right footed individuals and establishing a reference standard for 300 young adults. The study was carried out in Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Ambala, India on 300 medical students (150 male and 150 female) age 18 and above using an osteometric board and vernier callipers. Footedness was analyzed by using the criterion, kicking the ball. Of the 300 subjects, 90% (270) were found to be right footed. Of the 150 males 93.33% (140) and of the 150 females 86.67% (130) preferred their right foot to kick the ball. Left foot measurements of right foot preference group were interestingly higher than those of the right side. The mean foot height and mean foot length were significantly higher on left side in right footed males. The mean foot breadth was significantly more on the left side in right footed females.

**Keywords:** Foot parameters, footedness, foot anthropometry

## INTRODUCTION

Motoric dominance, the preferential usage of an upper limb or lower limb based on its primary or dominant use in motor functions in specific situations, is a universal, uniform and unique characteristic of all human beings; one parameter used to test of motoric dominance is footedness. Typically footedness for a particular task is characterized by its stabilizing and mobilizing {or manipulating} features. That is one limb is used to manipulate an object or lead out {example; kicking a ball}, whereas the other foot has the role of lending postural support. So, the foot use to mobilize limb is the preferred foot and the foot use for support is non preferred foot.<sup>1</sup>

Homo sapiens are one footed species and like hand preference foot preference is overwhelmingly right sided.<sup>2</sup> Footedness has been implicated as a risk factor for the development of pathology in the lower extremity because most individuals place a greater mechanical demand on their preferred foot during voluntary motor acts. Thus long term mechanical stress acting in homogenously on the preferred lower limb particularly during high demand activities may cause injuries and hazards to that limb.<sup>1</sup>

Quantitative analysis of foot anthropometry is important to the study of ergonomics, forensic science and anthropology. Basically foot anthropometry is the measurement of the size and proportion of the foot. The parameters often measured include foot length and foot breadth.<sup>3</sup>

Research scholars have examined the anthropometry of foot and relationship with other aspects of the body. Although sex differences in foot morphology have been studied by many of these investigators one issue that rarely examined in depth is the possibility of foot measurements in relation to footedness.<sup>4</sup>

This present study is aimed at providing anthropometric values for foot length, width and height in right footed individuals and establishing a reference standard for the 300 young adults belonging to the Indian Population.

## MATERIAL AND METHOD

The present study was conducted in the department of anatomy M.M.I.M.S.R Mullana (Ambala) on 300 medical students chosen randomly from M.M. Institute of medical sciences and research Mullana, Ambala including 150 males and 150 females of age 18

years or above. Prior informed consent for the study was obtained in English and vernacular language. Subjects with apparent physical foot anomalies, inflammation, trauma, deformities and surgery (if any) were excluded because of their unsuitability for the investigation.

The following anthropometric measurements of right and left foot of each subject were taken with the subjects standing erect and placing alternate foot on the calibrated **osteometric board**.

1. **Foot length:-** It was the distance measured from acropodion ( the most forwardly projecting point on the head of the first or second toe whichever is larger when the subject stands erect ) to pternion ( the most backwardly projecting point on the heel when the subject stands upright with equal pressure on both the feet).
2. **Foot Breadth:-** The foot breadth was measured as the distance between medial margin of the head of the first metatarsal and lateral margin of the head of fifth metatarsal.

**Foot Height** was measured using **Vernier callipers** in the following way:

**Foot Height:-** It was the distance from the floor to the point where the top of the foot meets the front of the leg as defined by "Pheasant" (1994).

**FOOTEDNESS** is one's preference to put one's left or right foot forward in surfing and completing a task. Footedness was analysed by a) By kicking the ball (using Waterloo Footedness Questionnaire-Revised criteria)<sup>5</sup>

The objectivity of data was ensured by taking measurements directly from the subject. The subjects were grouped as right foot preference and left foot preference groups as assessed by footedness criteria.

The somatometric measurements of right and left feet of the right foot preference subjects were statistically analyzed using students t-test, tabulated and co-related with each other.

## FINDINGS

Present study was conducted on 300 medical students of age 18 years and above. Foot anthropometric measurements and footedness of each foot of subject were measured and checked by using the criteria given. Mean age of males in the study was 19.14 years and that of female was 18.90 years, while mean age of all 300 subjects was 19.02 years.

**Table 1: Foot Preference in 300 Medical Students**

| Sex     | Right-foot preference(N) | Left foot preference (N) |
|---------|--------------------------|--------------------------|
| Males   | 140                      | 10                       |
| Females | 130                      | 20                       |
| Total   | 270                      | 30                       |

Table-1 shows that out of 300 subjects' 140 (93.33%) males and 130 females (86.67%) preferred their right foot to kick the ball. The remaining 10 males (6.67%) and 20 females (13.3%) preferred their left foot to kick the ball. All the subjects had tendency to use their dominant foot and no subject was found to be mixed footed.

**Table 2: Mean Foot Parameters in Right Footed Males (N=140)**

| Parameter (cm)    | Right Foot Mean± SD | Left foot Mean± SD | p-value |
|-------------------|---------------------|--------------------|---------|
| Foot height (FH)  | 7.07±0.75           | 7.22±0.73          | 0.004   |
| Foot breadth (FB) | 9.48±0.55           | 9.53±0.53          | 0.138   |
| Foot length (FL)  | 25.86±1.33          | 26.06±1.53         | 0.012   |

**Foot Height-** The left foot height was found to be significantly more than that of right foot height (p=0.004).

**Foot Breadth-** No significant difference was observed in foot breadth.

**Foot Length-** The left foot length was found to be significantly more than that of right foot length (p=0.012).

**Table 3: Mean Foot Parameters in Right Footed Females (N=130)**

| Parameter (cm)    | Right Foot Mean± SD | Left foot Mean± SD | p-value |
|-------------------|---------------------|--------------------|---------|
| Foot height (FH)  | 6.45±0.75           | 6.47±0.81          | 0.771   |
| Foot breadth (FB) | 8.38±0.52           | 8.52±0.50          | 0.000   |
| Foot length (FL)  | 23.32±1.18          | 23.27±1.13         | 0.456   |

**Foot Height-** The mean left foot height was found to be more than that of right foot height. But no significant difference was observed.

**Foot Breadth-** The left foot breadth was found to be significantly more than that of right foot breadth (p=0.000).

**Foot Length-** The mean right foot length was found to be more than that of left foot length but the difference was not significant.

**Table 4: Comparison of Mean Right Foot parameters of Right Footed Males (N=140) and Right Footed Females (N=130)**

| Parameter (cm)    | Male (RF)<br>Mean± SD | Female (RF)<br>Mean± SD | p-value (RF) |
|-------------------|-----------------------|-------------------------|--------------|
| Foot height (FH)  | 7.07±0.75             | 6.45±0.75               | 0.0001       |
| Foot breadth (FB) | 9.48±0.55             | 8.38±0.52               | 0.0001       |
| Foot length (FL)  | 25.86±1.33            | 23.32±1.18              | 0.0001       |

**Foot Height-** The right footed males have significantly more right foot height than that of right footed females (p=0.0001).

**Foot Breadth-** The mean right foot breadth of males was significantly more than the mean right foot breadth of females (p=0.0001).

**Foot Length-** The mean right foot length in males was significantly more than that of females (p=0.0001).

**Table 5: Comparison of Mean Left Foot parameters of Right Footed Males (N=140) and Right Footed Females (N=130)**

| Parameter (cm)    | Male (LF)<br>Mean± SD | Female (LF)<br>Mean± SD | p-value |
|-------------------|-----------------------|-------------------------|---------|
| Foot height (FH)  | 7.22±0.73             | 6.47±0.81               | 0.0001  |
| Foot breadth (FB) | 9.53±0.53             | 8.52±0.50               | 0.0001  |
| Foot length (FL)  | 26.06±1.53            | 23.27±1.13              | 0.0001  |

**Foot Height-** The right footed males have significantly more left foot height than that of right footed females (p=0.0001).

**Foot Breadth-** The mean left foot breadth of males was significantly more than that of mean left foot breadth of females (p=0.0001).

**Foot Length-** The mean left foot length in the right footed males was significantly more than that of right footed females (P=0.0001).

## DISCUSSION

Out of the 300 individuals in our study 270 (90%) were right footed and 30 (10%) were left footed. All the subjects have tendency to use their dominant foot and no subject was found to be mixed footed. Of the 150 males studied 140 (93.33%) were right footed and 10 out of 150 were found to be left footed (6.67%). Of the 150 females studied 130 (86.67%) were right footed and 10 out of 150 were found to be left footed (13.33%). Yamaner et al<sup>1</sup> have documented 328 of 407 male football players to be right footed and 79 to be left footed. Carey et al<sup>2</sup> found 79% right footed and 21% left footed out of 236 players they studied in France World Cup 1998. However Zverev et al<sup>5</sup> and Spry et al<sup>6</sup> have reported a mixed footed group of 10.7% and 9.21% respectively. Zverev et al<sup>5</sup> reported 81% right footed and 8.3% left footed of the 205 (112 males and 93 females) cases studied and Spry et al<sup>6</sup> documented 39 right leg dominant and 30 left leg dominant of 76 cases studied. In comparison to all these studies mentioned we have observed higher preponderance of right sided individuals (90%). We can infer that the Indian population is predominantly right footed.

In the right foot preference group all the right foot parameters (table 4) and the left foot parameters (table 5) were significantly more in the males as compared to females. Our findings are similar to earlier studies conducted on different population by Ozden H et al<sup>7</sup> on Turkey population, Kewal Krishan et al<sup>8</sup> on North Indian Himachal population, Agnihotri et al<sup>9</sup> on Mauritius population, Barnabas et al<sup>10</sup> on Nigerians, and Oladipo et al<sup>11</sup> on Nigerians, Jaydip Sen et al<sup>12</sup> on Bengali Rajbhanshi, Mukta rani et al<sup>13</sup> on students of Delhi colleges, However all these studies conducted were on the general population whereas we have considered the right foot preference group. It can be documented that men have significantly longer, wider and higher feet than their female counterparts.

**Table 6: Comparison of Mean Foot Dimensions of Right Foot Preference Group in Males**

| Author                           | No                        | Side     | Foot Height                        | Foot Breadth                         | Foot Length                          |
|----------------------------------|---------------------------|----------|------------------------------------|--------------------------------------|--------------------------------------|
| Present study                    | 140<br>(right footed)     | RF<br>LF | 7.07±0.75<br>7.22±0.73<br>(P<0.05) | 9.48±0.55<br>9.53±0.52               | 25.85±1.33<br>26.05±1.53<br>(P<0.05) |
| Yamaner et al <sup>1</sup>       | 328<br>(right footed)     | RF<br>LF | 6.17±0.59<br>6.19±0.64             | 10.14±0.47<br>10.20±0.58<br>(p<0.05) | 26.77±1.08<br>26.84±1.12<br>(p<0.05) |
| Mukta rani et al <sup>13</sup>   | 150<br>(total population) | RF<br>LF |                                    | 8.52±0.67<br>8.66±0.68               | 23.34±1.58<br>23.46±1.59             |
| Jaydip sen et al <sup>12</sup>   | 175 (total population)    | RF<br>LF |                                    | 9.89±0.50<br>9.90±0.50               | 23.95±1.10<br>24.01±1.10             |
| Agnihotri et al <sup>9</sup>     | 125 (total population)    | RF<br>LF |                                    | 9.63±0.54<br>9.62±0.54               | 26.17±1.05<br>26.14±1.06             |
| Kewal Krishan et al <sup>8</sup> | 123 (total population)    | RF<br>LF |                                    | 9.52±0.61<br>9.50±0.61               | 24.72±1.19<br>24.70±1.1              |
| Manna et al <sup>14</sup>        | 200 (total population)    | RF<br>LF | 8.00±0.81<br>7.96±0.84<br>p>0.05   |                                      |                                      |
| Manna et al <sup>14</sup>        | 200 (total population)    | RF<br>LF | 8.00±0.81<br>7.96±0.84<br>p>0.05   |                                      |                                      |

In the present study all the dimensions of left foot were more than that of right foot in the right foot preference group in males. These results are in accordance with Yamaner et al<sup>1</sup> in which left foot parameters were more in males. Similar findings have also been reported by Jaydip Sen et al<sup>12</sup> and Mukta Rani et al<sup>13</sup> who have documented longer and larger feet on the left side. In variance to these Agnihotri et al<sup>9</sup> and Kewal Krishnan et al<sup>8</sup> have reported longer and broader right sided feet. However the dimensions in the above mentioned studies except those of Yamaner et al<sup>1</sup> were of the total population and not those of the right footed population.

Manna et al<sup>14</sup> have documented significantly more right foot height as compared to the higher left foot height of our study. But their sample group was 200 males of total population whereas our subjects were

140 right footed males. This could be the reason for the variance in our observations.

The left sided feet were significantly longer than the right sided feet in males in the subjects of our study. In accordance with our findings Yamaner et al<sup>1</sup> have also reported significantly longer left sided feet. However the actual length was more than ours. We observe significantly more left foot height whereas Yamaner et al<sup>1</sup> observed significantly more left foot breadth. The right and left foot height of present study group were higher than that of Yamaner et al<sup>1</sup> on Turkish foot ball players. But measurements of right and left foot breadth and foot length of present study group were less than that of Yamaner et al<sup>1</sup> group. This may be because of racial and sample differences. So, it can be observed that Turkish players have much wider and longer feet than right footed Indians.

**Table7: Comparison of Mean Foot Dimensions of Right Foot Preference Group in Females**

| Author              | No                        | Side     | Foot Height                      | Foot Breadth                       | Foot Length              |
|---------------------|---------------------------|----------|----------------------------------|------------------------------------|--------------------------|
| Present study       | 130<br>(right footed)     | RF<br>LF | 6.45±0.75<br>6.47±0.81           | 8.38±0.52<br>8.52±0.50<br>(P<0.05) | 23.32±1.18<br>23.27±1.13 |
| Mukta rani et al 13 | 150<br>(total population) | RF<br>LF |                                  | 7.81±0.77<br>7.90±0.79             | 20.59±1.41<br>20.69±1.44 |
| Jaydip sen et al12  | 175<br>(total population) | RF<br>LF |                                  | 8.99±0.50<br>9.01±0.50             | 22.23±1.10<br>22.26±1.10 |
| Agnihotri et al9    | 125(total population)     | RF<br>LF |                                  | 8.74±0.50<br>8.75±0.52             | 23.33±1.08<br>23.28±1.09 |
| Manna et al 14      | 100(total population)     | RF<br>LF | 6.87±0.53<br>6.77±0.56<br>p>0.05 |                                    |                          |

We have not come across any available literature documenting foot parameters in relation to foot preference groups in females. In the present study mean foot breadth was found to be significantly more in the right footed females on the left side. Similar findings have also been reported by Mukta Rani et al<sup>13</sup> and Jaydip Sen<sup>12</sup> et al who have documented broader feet on the left side. However the dimensions in their studies were not related to footedness.

Manna et al<sup>14</sup> have documented significantly higher right feet in variance to our left. But their sample group was 100 females of total population whereas our subjects were 130 right footed females.

Our observations are in concordance with those of Agnihotri et al<sup>9</sup> in measurements as well as side dominance, the sample size being almost equal. It can be summarized that the Mauritian female subjects observed by Agnihotri et al<sup>9</sup> were closest in findings to our right footed females.

## SUMMARY

The foot preference was observed in 300 young individuals (150 males and 150 females) using WFQ-R criteria, kicking a ball and anthropometric foot measurements (foot height, foot breadth foot length) were studied and statistically analyzed in the right foot preference group.

All foot parameters were found to significantly more in males than females on both right and left side sides in the right footed individuals.

Of the 300 subjects 90% were right footed, 10% were left footed. Of the 150 males, 93.33% were right footed and 6.67% left footed. Of the 150 females 86.67% were right footed, 13.33% were left footed.

The mean foot height and mean foot length were significantly higher on left side in right footed males. The mean foot breadth was significantly higher on left side in both right footed and left footed females. The

asymmetry in right foot preference group is important in the present study. The predominantly right footed Indian population have been found to have higher left foot parameters indicating the non preferred feet to be used more for supportive purpose and the preferred foot used for manipulative tasks. The results of this study may bring insight to the morphology of adult Indian population. These findings are useful for shoe designing in shoe industries for the Indian population.

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# Ectodermal Dysplasia- A Case Report, Management and Review

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## ABSTRACT

Ectodermal Dysplasia is a rare group of inherited disorders. The disorders arise from disturbances in one or more ectodermal structures and their accessory appendages. The absence of, or deficient function of, at least two derivatives of the ectoderm constitutes a form of ED. The purpose of this article is to review ectodermal dysplasia (ED) and management.

**Keywords:** Ectodermal Dysplasia, Accessory Appendages

## INTRODUCTION

A 4-year boy reported to the pediatric department in Bharati Vidyapeeth Deemed University Dental College & Hospital, Pune with the chief complaint of multiple missing teeth. Patient does not give a history of eating discomfort but complains of intolerance to heat and absence of sweating. Patient does not give any family history. On extra oral examination, patient had a soft, smooth, thin and dry skin. The hair of the scalp & eyebrows tends to be fine & scanty .

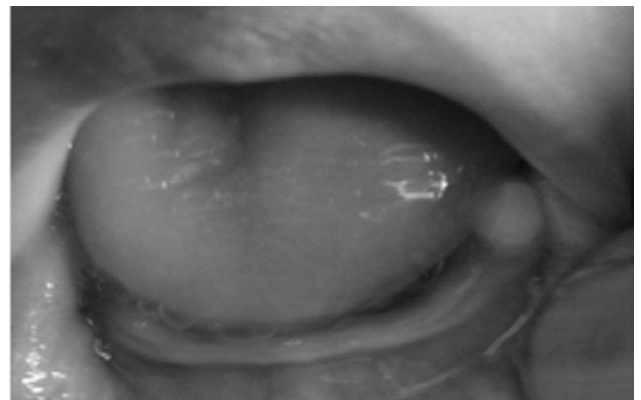


The bridge of the nose is depressed; the supraorbital ridges and frontal bosses are pronounced with protuberant lips.



Toe nails appear dystrophic and brittle.

Intra oral examination shows multiple missing teeth (anadontia) in both the jaws.

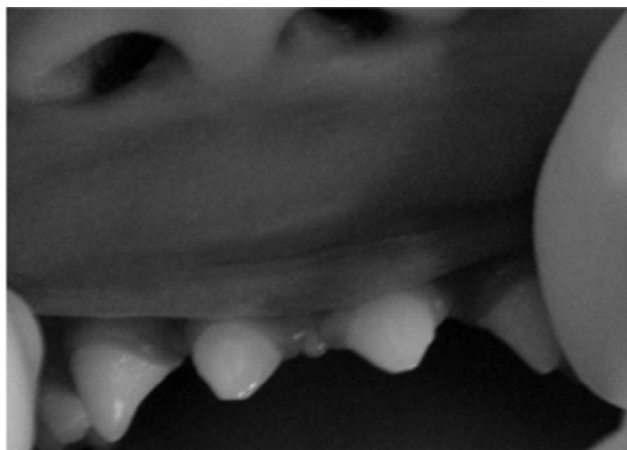


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Maxillary anterior teeth were conical in shape.

The orthopantomograph radiograph shows multiple missing teeth.



The final diagnosis was given as ectodermal dysplasia (ED).

## DISCUSSION

The ectodermal dysplasias (EDs) comprise a large, heterogeneous group of inherited disorders that are defined by primary defects in the development of 2 or more tissues derived from embryonic ectoderm. The tissues primarily involved are the skin, hair, nails, eccrine glands, and teeth. Although Thurnam published the first report of a patient with ectodermal dysplasia in 1848, the term ectodermal dysplasia was not coined until 1929 by Weech.<sup>1</sup>

The ectodermal dysplasias are congenital, diffuse, and nonprogressive. To date, more than 192 distinct

disorders have been described. The most common ectodermal dysplasias are X-linked recessive hypohidrotic ectodermal dysplasia (Christ-Siemens-Touraine syndrome), and hidrotic ectodermal dysplasia (Clouston syndrome).

Current classification of ectodermal dysplasias is based on clinical features. Pure ectodermal dysplasias are manifested by defects in ectodermal structures alone, while ectodermal dysplasia syndromes are defined by the combination of ectodermal defects in association with other anomalies.

Freire-Maia and Pinheiro proposed the first classification system of the ectodermal dysplasias in 1982,<sup>3</sup> with additional updates in 1994 and 2001. Their original classification system stratified the ectodermal dysplasias into different subgroups according to the presence or absence of (1) hair anomalies or trichodysplasias, (2) dental abnormalities, (3) nail abnormalities or onychodysplasias, and (4) eccrine gland dysfunction or dyshidrosis.<sup>2,3,4</sup>

## PATHOPHYSIOLOGY

Ectodermal dysplasia results from the abnormal morphogenesis of cutaneous or oral embryonal ectoderm (ie, hair, nails, teeth, eccrine glands). Note the following:

- **Hair defects:** A reduction in the number of hair follicles in conjunction with structural hair shaft abnormalities may be seen. Structural hair shaft abnormalities may result from aberrations in hair bulb formation and include longitudinal grooving, hair shaft torsion, and cuticle ruffling. Hair bulbs may be distorted, bifid, or small.<sup>10</sup>
- **Eccrine defects:** Eccrine sweat glands may be absent or sparse and rudimentary, particularly in patients with hypohidrotic ectodermal dysplasia
- **Other secretory gland defects:** Hypoplasia of the salivary and lacrimal glands may occur. In some patients, mucous glands may be absent in the upper respiratory tract and in the bronchi, esophagus, and duodenum.
- **Dental defects:** Abnormal morphogenesis or absence of teeth may occur. Nail dystrophy: Abnormal nail plate formation may result in brittle, thin, ridged, or grossly deformed nails.<sup>4,5,6</sup>

## SEX

X-linked recessive hypohidrotic ectodermal dysplasia has full expression only in males. Female carriers outnumber affected men, but females show little or no signs of the condition.<sup>7</sup>

## AGE

Clinical recognition of ectodermal dysplasia varies from birth to childhood depending on the severity of symptoms and the recognition of associated complications. Many patients are not diagnosed until infancy or childhood, when dental anomalies, nail abnormalities, or alopecia become apparent.

## HISTORY

Individuals affected by ectodermal dysplasia have abnormalities in different ectodermal structures. Some ectodermal dysplasia types are mild, while others are devastating. Obvious manifestations of the disorders are not clinically apparent in most newborns. Dental, hair, and nail anomalies usually become evident during infancy or childhood. A family history of similar clinical features is helpful.

Other signs and symptoms are as follows:<sup>8,9,10</sup>

- Hyperthermia with fever and seizures
- Xerophthalmia (decreased tears) and conjunctivitis
- Deficient hearing or vision
- Xerostomia (decreased saliva) and frequent dental caries
- Developmental delay or mental retardation
- Dysphagia
- Growth failure
- Frequent pharyngitis, otitis, and rhinitis

Following are several of the well-defined ectodermal dysplasias:

X-linked hypohidrotic ectodermal dysplasia (EDA or Christ-Siemens-Touraine syndrome)

X-linked hypohidrotic ectodermal dysplasia (EDA or Christ-Siemens-Touraine syndrome) is the most common ectodermal dysplasia. The typical facies, which is often not recognized until infancy, is

characterized by frontal bossing; sunken cheeks; saddle nose; thick, everted lips; wrinkled, hyperpigmented periorbital skin; and large, low-set ears. Wrinkled, hyperpigmented skin around the eyes and everted lips are typical characteristics of anhidrotic/hypohidrotic ectodermal dysplasia syndrome.

Dental manifestations include conical or pegged teeth, hypodontia or complete anodontia, and delayed eruption of permanent teeth. Most patients have fine, sparse, lusterless, fair hair; therefore, little pigmentation in the hair shaft is observed microscopically and the medulla is often discontinuous. When medullation is present, a "bar code" appearance is often seen.<sup>17</sup>

Hidrotic ectodermal dysplasia (Clouston syndrome)

Hidrotic ectodermal dysplasia (Clouston syndrome) is inherited in an autosomal dominant manner; the homozygous state may be lethal. It is more common in persons of French-Canadian ancestry.<sup>18, 19, 20</sup> Scalp hair is very sparse, fine, and brittle and alopecia is common. Eyebrows are thinned or absent. Nail dystrophy is common. Persistent paronychia infections are frequent. Polydactyly, syndactyly, and bulbous fingertips may be present. Patients have normal facies, no specific dental defects, and normal sweating. Other reported findings include reticulate hyperpigmentation of the knees, elbows, and fingers; palmoplantar keratoderma; and eccrine poromatosis.<sup>9</sup>

## IMAGING STUDIES

Perform orthopantomography at an early age if hypodontia or dental abnormalities are present. X-ray films of hands, feet, or both may demonstrate specific skeletal deformities. Renal ultrasonography, voiding cystourethrography, and intravenous pyelography may be helpful in evaluating children with ectodermal dysplasia in association with cleft lip and/or palate for underlying genitourinary tract anomalies.

## MEDICAL CARE

The care of affected patients depends on which ectodermal structures are involved. Note the following:

<sup>11, 13</sup>

- For patients with anhidrosis/hypohidrosis, advise air conditioning for home, school, and work. Encourage frequent consumption of cool liquids to

maintain adequate hydration and thermoregulation. Finally, advise patients to wear cool clothing.

- For patients with dental defects, advise early dental evaluation and intervention and encourage routine dental hygiene. Dentures may be indicated as early as age 2 years. Multiple replacements may be needed as the child grows, and dental implants may eventually be required. Advise orthodontic treatment for cosmetic reasons and to ensure adequate nutritional intake.
- Patients with xerosis or eczematous dermatitis may benefit from the use of topical emollients.
- Patients with severe alopecia can wear wigs to improve their appearance.
- Patients with scalp erosions should be treated with topical and systemic antibiotics as needed. General scalp care may involve the use of weekly dilute bleach baths or acetic acid soaks to minimize bacterial colonization of the scalp. Application of special scalp dressings may be helpful.
- Use artificial tears to prevent damage to the cornea in patients with reduced lacrimation.
- Protect nasal mucosa with saline sprays followed by the application of petrolatum.
- Patients with ectodermal dysplasia with immunodeficiency should be monitored for infection and treated with therapeutic and/or prophylactic antibiotics when appropriate.
- Allogeneic stem cell transplantation has been performed in a small number of patients with autosomal dominant ectodermal dysplasia with immunodeficiency (EDA-ID); poor engraftment and post-transplant complications were common.

### **SURGICAL CARE**

Early repair of cleft lip or palate may lessen facial deformities and improve speech. Other midfacial defects or hand/foot deformities may be surgically corrected in order to improve function and reduce physical disfigurement.<sup>12</sup>

### **CONSULTATIONS**

Consultation with the following specialists may be necessary:

- Dermatologists can assist in the diagnosis of ectodermal dysplasia and in the management of patients with chronic eczematous dermatitis or scalp erosions.
- General dentists or periodontal dentists can provide regular preventative dental care and restorative service as indicated.
- Plastic surgeons can provide evaluation and management of cleft lip and/or palate defects, other facial defects, and hand and foot defects.
- Speech and physical or occupational therapists can assist patients with cleft lip and/or palate with feeding and speech difficulties and can provide therapy to assist patients with hand and foot defects.
- Genetic counselors can provide patients and families with assistance in diagnosis and genetic analysis.
- Immunologists can help with the evaluation for suspected immunodeficiency.

### **ACTIVITY**

Instruct patients with hypohidrosis to avoid vigorous physical activities and to maintain adequate hydration. Advise on the importance of light clothing, a cool-water spray bottle, and restriction of overexposure to warm temperatures. Recommend swimming or sedentary sports (eg, archery). Educate parents that antipyretics are not effective in the treatment of hyperpyrexia.<sup>13</sup>

### **PROGNOSIS**

The prognosis for most patients with ectodermal dysplasia is very good.

If hypohidrosis is recognized in the neonatal period and managed appropriately, no evidence indicates that the life span for a person diagnosed with one of the common types of ectodermal dysplasia is shorter than average.

Life span can be affected in some rare types of ectodermal dysplasia. For example, patients with ectodermal dysplasia with immunodeficiency are at risk for significant morbidity and mortality related to recurrent infections and failure to thrive.

## PATIENT EDUCATION

Provide early guidance about temperature regulation, acceptable activities, and the risk of hyperpyrexia from febrile illnesses. Inform patients and families that antipyretics are not effective in treating hyperpyrexia associated with hypohidrosis. Instruct caregivers on proper skin care and monitoring for signs of infection in patients with chronic scalp dermatitis and erosions.

## ACKNOWLEDGEMENT

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**Conflict of Interest :** Nil

**Source of funding:** Own

**Ethical clearance:** Signed informed consent was obtained from the patient and the case was cleared by the institutional ethical committee, Bharati Vidyapeeth University Dental College & Hospital, Katraj, Dankawadi, Pune.

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# A Study of Neural Tube Defects in a Perinatal Autopsy Series

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## ABSTRACT

The literature on neural tube defect is exhaustive but only few autopsy studies are reported in India about neural tube defects.

**Objective:** The purpose of this study was to explore the incidence and characteristics of NTDs in a perinatal autopsy series and to describe the frequency of associated morphologic anomalies.

**Material & Methods:** It was a prospective study done in India where 125 perinatal autopsies performed during the period from July 2010 to Oct 2011 after taking written consent from parents out of which 60 came out as having NTDs.

### The result emerged as:-

NTD types: Spina Bifida type- 58.33%, Cranioschisis type- 41.67%.

NTD location: Lumbosacral-40%, cranium-33.33%, lumbar-11.67%, occipital-8.34%, sacral-5%, Thoracolumbar- 1.66%.

NTD in relation to maternal age: <20 yrs- 51.67%, 20 to 40yrs-41.67%, >40yrs-6.66%.

NTD in relation to maternal parity: Gravida 1-50%, Gravida 2-25%, Gravida >2- 25%.

NTD in relation to gestational age: <32 wks- 75%, >32wks- 25%.

NTD in relation to degree of consanguinity: 0-66.66%, 1- 1.68%, 2- 25%, 3- 6.66%.

NTD in relation to sex of the baby: Female-58.33%, Male-41.67%.

NTD with associated morphological anomalies: Most common anomaly was of CNS. Most common non-CNS anomaly was of skeletal system followed by urogenital system.

**Conclusion:** Incidence of neural tube defect much higher in India than other developing countries which need national intervention. To know the chance of recurrence in future pregnancy and for genetic counselling, autopsy is must for those babies who die due to NTD.

**Keywords:** Neural tube Defect, Perinatal Autopsy, Morphologic Anomalies

## INTRODUCTION

A Wide variety of CNS and other organ system anomalies associated with Neural Tube Defects has long been of great fascination to embryologists, teratologists and clinicians. NTDs are congenital malformation of CNS secondary to abnormal closure of the neural tube during embryonic development. <sup>(1)</sup> Congenital malformations account for 25% to 30% of perinatal deaths in western countries <sup>(2)</sup> and 10.5% in India. <sup>(3)</sup> The reported incidence of NTD in India varies from 0.5 to 11/ 1000 births while the incidence in the USA & Europe is reportedly below 1/ 1000 due to periconceptional folate fortification. <sup>(4)</sup> NTDs may be classified according to location as spinal NTD (spina

bifida) and cranial NTD (cranioschisis) and may be sub classified according to the external appearance and the structural composition of the defect and confirmed by microscopic examination. In anencephaly there is failure of fusion of cephalic part of neural tube. In cranioschisis closure defect of flattened neural tube extends along the spinal cord. Etiology of NTD is considered multifactorial, with genetic, environmental and nutritional factors all playing some role. Literature on NTD is extensive, but few studies provide information on NTD rates and associated morphologic anomalies in fetal and perinatal autopsy series in India.

NTDs may be associated with some syndromes that are usually missed by USG for that need complete

autopsy. The prenatal diagnosis confirmed by autopsy makes it possible for the geneticist to assess the chances of repetition of the malformation in the question, such information is essential before a new pregnancy is conceived. <sup>(5)</sup>

## OBJECTIVES

The purposes of this study were (a) To determine the rate and distribution of NTDs in an Indian fetal and perinatal autopsy series. (b) To describe the frequency of associated morphologic anomalies.

## MATERIALS & METHOD

This study is a prospective, non interventional, conducted in a medical college in India, between July 2010 to Oct 2011. This study includes critical analysis of all the NTDs in a perinatal autopsy case series. After the delivery, written consent was taken from the parents or guardian, for a fetal autopsy procedure. They were told that such a procedure will help diagnose the cause of fetal death, and also will be useful in assessing the risk of recurrence. Detailed maternal medical and obstetric history including the laboratory and ultrasonographic reports were reviewed. In each case the autopsy was done according to the Standard Protocol in the following order: - Anthropometry, External examination, Internal examination, Examination of the placenta and umbilical cord, Tissue taken for histopathological study. In case of suspected skeletal dysplasia radiologic study was done. After autopsy completed all the organs were returned into the respective body cavities and the incision lines were sutured. The bodies were then properly disposed.

## RESULTS

Total 125 perinatal autopsies were performed out of which 60 came out as having NTDs.

**Table-1 Types of Neural tube defect (N= 60)**

| Location                                                       | Morphology            | No |
|----------------------------------------------------------------|-----------------------|----|
| SPINA BIFIDA<br>(Total No. 35 and total percentage is 58.33%)  | Occulta               | 1  |
|                                                                | Cystica               |    |
|                                                                | Cutaneous cyst.....   | 2  |
|                                                                | Meningocele.....      | 2  |
|                                                                | Myelomeningocele..... | 26 |
| CRANIOSCHISIS<br>(Total No- 25 and total percentage is 41.67%) | Aperta                |    |
|                                                                | Myelocele.....        | 4  |
|                                                                | Cephalocele           |    |
|                                                                | Meningocele.....      | 2  |
|                                                                | Encephalocele.....    | 2  |
| Total                                                          | Unspecified.....      | 1  |
|                                                                | Anencephaly           | 20 |
|                                                                |                       | 60 |

**Table 2. Location of NTDs (N= 60)**

| Location      | Location                     | No         |
|---------------|------------------------------|------------|
| Spina Bifida  | Lumbosacral.....             | 24(40%)    |
|               | Lumbar.....                  | 7(11.67%)  |
|               | Sacral.....                  | 3(5%)      |
|               | Thoracolumbar.....           | 1(1.66%)   |
| Cranioschisis | Cephalocele (Occipital)..... | 5(8.34%)   |
|               | Anencephaly (Cranium).....   | 20(33.33%) |
| Total         |                              | 60         |

**Table 3. Relationship of NTDs with that of Maternal Age (N=60)**

| Maternal age in Yrs | Spina Bifida | Cranioschisis |
|---------------------|--------------|---------------|
| < 20 yrs            | 17(28.33%)   | 14(23.34%)    |
| 20 to 40 yrs        | 16(26.67%)   | 9(15.0%)      |
| >40 yrs             | 2(3.33%)     | 2(3.33%)      |
| Total               | 35(58.33%)   | 25(41.67%)    |

**TABLE 4. NTDs in relation to Maternal Parity (N=60)**

| Gravida   | Spina Bifida | Cranioschisis |
|-----------|--------------|---------------|
| 1         | 18(30%)      | 12(20%)       |
| 2         | 10(16.67%)   | 5(8.33%)      |
| >2        | 7(11.67%)    | 8(13.33%)     |
| Total =60 | 35(58.33%)   | 25(41.67%)    |

**Table 5. NTDs in relation to gestational age (N=60)**

| Gestational Age | Spina Bifida | Cranioschisis |
|-----------------|--------------|---------------|
| 20 to 32 wks    | 27(45%)      | 18(30%)       |
| >32 wks         | 8(13.33%)    | 7(11.67%)     |
| Total = 60      | 35(58.33%)   | 25(41.67%)    |

**Table 6. NTDs in relation to consanguinity(N=60)**

| Degree of Consanguinity | Spina Bifida | Cranioschisis |
|-------------------------|--------------|---------------|
| 0                       | 20(33.33%)   | 20(33.33%)    |
| 1                       | 1(1.68%)     | 0             |
| 2                       | 12(20%)      | 3(5%)         |
| 3                       | 2(3.33%)     | 2(3.33%)      |
| Total number            | 35(58.33%)   | 25(41.67%)    |

**Table 7. Distribution of sex among NTDs (N=60)**

| Sex        | Spina Bifida | Cranioschisis |
|------------|--------------|---------------|
| Female     | 20(33.33%)   | 15(25%)       |
| Male       | 15(25%)      | 10(16.67%)    |
| Total = 60 | 35(58.33%)   | 25(41.67%)    |

**Table 8. NTD cases with associated morphologic anomalies**

| System     | Spina Bifida | Cranioschisis |
|------------|--------------|---------------|
| CNS        | 25(71.42%)   | 20(80%)       |
| GI         | 7(20%)       | 3(12%)        |
| Urogenital | 9(25.71%)    | 7(28%)        |
| Skeletal   | 12(34.29%)   | 8(32%)        |
| Diaphragm  | -            | 1(4%)         |
| Orofacial  | 2(5.71%)     | 1(4%)         |
| CVS        | -            | 1(4%)         |

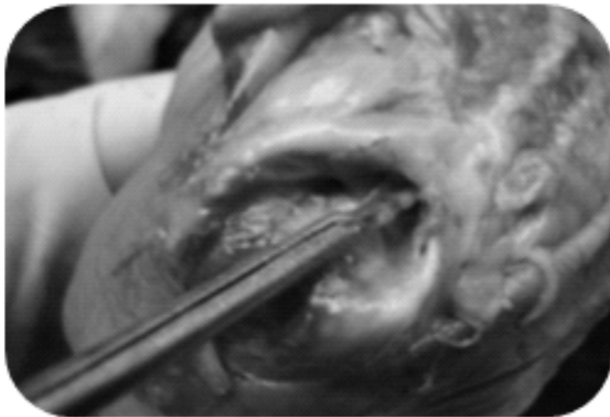


Fig. 1. Spinal cord identified through the defect

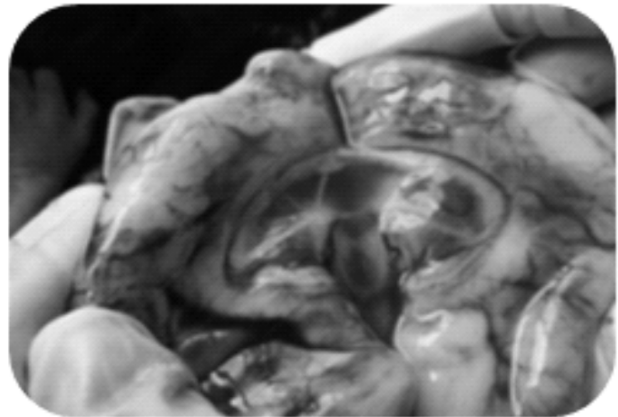


Fig. 2. Associated with Hydrocephalus



Fig. 3. Spina bifida continious with cranial defect (cranioschisis)



Fig. 4. Neural tube defect with intracranial mass

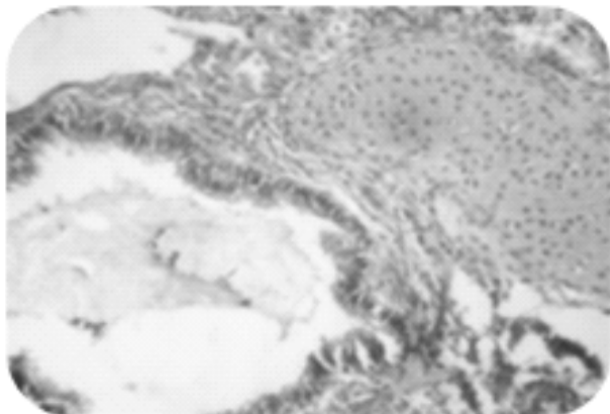


Fig. 5. Intracranial mass is mature teratoma- 40x 10



Fig. 6. Anencephaly with spina biafida

## DISCUSSION

Comparison of the present results with those of other studies is complicated not only by geographic and temporal variations in the prevalence of NTDs <sup>(6)</sup>, but also by differences in the composition of autopsy series and by possible differences in practices of prenatal diagnostic measures.

In the present study NTD cases represent 48% of all the autopsies performed. Incidence of NTD in this study is 8.2/ 1000 live birth. A wide range of frequency has been quoted from different parts of India ie. 5.7/1000 in Pondicherry, 7/1000 in east Delhi and 11.4/1000 in Davangereb. <sup>(7)</sup> The reason for wide geographical variation of frequency is exactly not known because the etiology of NTDs is multifactorial & has genetic

predisposition and the fact that very few large intricate study performed in India.

In the present study incidence of NTD is 48% of all autopsy performed. This is much higher than the study of Ljudmilla et al <sup>(6)</sup> or of American study from Rhode Island Hospital reporting a rate of 3.9% NTDs in a large peri- and neonatal autopsy series from 1958– 1995 <sup>(7)</sup> where percentage of NTDs were 4.9% and 3.9%. Reason is that to get consent from parents in Indian scenario is a mammoth job and we got consent mostly from obvious congenitally malformed baby.

The proportion of spina bifida in NTDs in the present study (58.3%) is quite higher to the proportion found by Pinar in 1998 (37%). However, the present study has a similar proportion of cephalocele (8.34%) and a lower proportion of cases with anencephaly (33.33%) than Pinar's study (10% and 53%, respectively) <sup>(8)</sup>. The lower proportion of anencephaly in the present study compared to spina bifida and cephalocele might reflect improved prenatal diagnosis of spina bifida and cephalocele in the last decades. In the present study the most common location of spina bifida was lumbosacral (40% of cases). This is similar to the rate of 42% lumbosacral cases reported by LJUDMILLA <sup>(9)</sup>.

Most of the cases of NTDs found with the mothers having age < 20 yrs (51.67%) and between 20- 40 yrs of age (41.67%) and least number of cases (6.66%) with mothers > 40 yrs of age. This is similar to Indian study of Sharada et al where maximum number of NTD cases were <40 yrs of age and no case found above 40 yrs of age. <sup>(10)</sup>

Maximum no of NTDs observed in first gravida (50%) which is similar to study of Sharada et al. <sup>(10)</sup>

All the NTD cases identified after 20 wks as prenatal USG done in every case after 20 wks and in 25% of cases first USG done after 32 wks reflecting poor prenatal care and poor socio-economic status. Scenario is quite similar to another Indian study of Sharada et al. <sup>(10)</sup>

Consanguinity have very little role in this study as in the study of Sharada et al. <sup>(10)</sup>

Both spina bifida and cranioschisis seen to be more common in female (58.33%) unlike to study of sharada et al where there is female predominance in anencephaly and male predominance in hydrocephalus. <sup>(10)</sup>

In 45(75%) cases out of 60 cases of NTD had associated morphological anomalies. This is similar to study of Nielsen et al where associated morphological anomalies seen in 63% of cases. <sup>(9)</sup> Most common anomaly in spina bifida was of CNS system seen in 25 cases (71.42%) out of 35 cases. Most common CNS anomaly was hydrocephalus. Others were Arnold-Chiari malformation and atresia of Aqueduct of Sylvius. Most common non CNS anomaly was of skeletal system affecting 12 cases (34.29%) followed by urogenital system (9 cases, 25.71%). One case of spina bifida had association with congenital intracranial teratoma.

In 20 out of 25 cases of cranioschisis (80%) associated morphological anomalies were found. Most common anomaly was hydrocephalus. Most common non-CNS anomaly was of skeletal system (8 cases, 32%) followed by urogenital system (7 cases, 28%).

## CONCLUSION

Autopsy study have shown that antenatal diagnosis by ultrasound is fairly accurate, though associated anomalies are often missed and these anomalies are very important as they dictate future recurrence rate, need of genetic counselling and better antenatal diagnosis in next pregnancy. So in every perinatal death due to NTD, autopsy should be done. This is exemplified by a study where a follow up of pregnancies detected to have malformed fetuses by ultrasound showed the presence of additional malformations in 37%-44 % of cases. <sup>(11)</sup> This led to a revision of the diagnosis in 25 % -40 % of cases. <sup>(11)</sup> High incidence of NTDs indirectly indicates poor perinatal care in that part of India. This study also confirms well known association of NTD with specific morphologic anomalies. In spite of mounting incidence of NTDs in India, very few studies still date have been done and mostly those are epidemiological studies. This is one of the very few studies in India where autopsy was performed in babies with NTDs who died during perinatal period.

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# Current Trends of Fatal Poisoning in Metropolitan Hospital, Mumbai

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## ABSTRACT

Prospective two year study period, from 1st August, 2008 to 31st July, 2010, a total of 1,374 autopsies were performed at the centre, 70 cases were suspected cases or confirmed poisoning and those persons declared dead on arrival in the causality and suspected to be a case of poisoning. Incidence of deaths due to poisoning was 5.09 %. Peak incidence was observed in the age group of 21-30 years. Male to female ratio was 2.33:1. Insecticide was commonest poison (22 or 31.42%), followed by alcohol intoxication (16 or 22.85%). Maximum deaths were due to cerebral edema 18 (30.50%) cases including insecticide and alcohol poisoning.

**Keywords:** Poisoning, Death, Insecticide, Current Trends, Autopsy

## INTRODUCTION

According to World Health Organization, three million acute poisoning cases with 2,20,000 deaths occur annually. Of these 99% of fatal poisonings occur in developing countries, particularly among agriculture workers<sup>1</sup>. The exact incidence of this problem in India is uncertain, but it is estimated that about 7 to 10 million cases of poisoning are reported every year, of which about 10,000 happen to die<sup>2</sup>.

The pattern of poisoning varies from region to region depending on variety of factors such as availability of the poisons, socioeconomic status of the population, religious and cultural influences. At present Aluminium phosphide tops the list in northern part of India while insecticide heads the list in southern part of India<sup>3</sup>.

Acute poisoning is one of the most common causes for emergency hospital admissions. The patients of poisoning need careful thorough assessment, early diagnosis, monitoring and aggressive supportive management in the intensive care setting<sup>4</sup>. Knowing the pattern of poisoning in a region not only helps in early diagnosis and treatment but also helps to take preventive measures. In metro cities like Mumbai the pattern of poisoning may differ considerably due to its cosmopolitan and urban nature. Hence there is need for such study. Considering this the present study was undertaken to evaluate poisoning cases in Mumbai

City and adjoining suburban and rural part in relation to age, sex, cause of death, pattern and manner of death. The epidemiology of this study will help in up-gradation of the academics and autopsy surgeons will also take the help of this study in difficult or suspected cases.

## MATERIAL AND METHOD

This prospective study was carried out in departments of Forensic Medicine, Pathology and Postmortem Center attached to T.N.M.C & B.Y.L. Nair hospital, Mumbai, Maharashtra. All deaths with history of suspected or confirmed poisoning & those persons declared dead on arrival in the causality and suspected to be a case of poisoning were included in the study. Seventy (5.09 %) such cases out of a total number of 1,374 autopsies during a 2 year period i.e. from 1<sup>st</sup> August 2008 to 31<sup>st</sup> July 2010 were selected for the present study except deaths due to natural causes and undetermined causes (Negative autopsy).

Viscera for the chemical analysis were collected during postmortem examination and sent to Forensic Science Laboratory, Kalina, Mumbai. Each poisoning case has been studied in detail using specific proforma. The primary data in each case were collected from different sources. All data were documented and statistically analyzed. After evaluation of brief history, causal factors, indoor paper finding, post mortem examination, chemical analysis report,

histopathological examination report, the final cause of death was ascertained. The socioeconomic status was assessed by using Modified Kuppuswamy Scale.

## RESULTS

In the present study, incidence of deaths due to poisoning was 5.09 %. It was observed that most of the victims 22(31.42%) were in the 21-30 of age group; the youngest victim was 1 year old and the eldest was 83 years old. It was noted that male (n = 49, 70%) outnumbered female (n=21, 30%) with male to female ratio being 2.33:1 (Table 1). Most of the victims were Hindus (n= 54, 77.14%) followed by Muslims (n= 13,

18.57%). Most of the victims (n = 48, 68.57%) were from urban area followed by suburban area (n = 16, 22.85%) and rural area (n=6,8.57%) (Table 2). It was observed that 36 (51.42%) victims were married, 25 (35.71%) were unmarried and in 5 (7.14%) victims marital status was not known. Manual labourer constituted highest number of cases (n = 22, 31.42%) followed by unemployed (n = 12, 17.14%) ones. Considering the socio-educational status, it was observed that 14(20%) victims were illiterate, 6(8.57%) were having higher secondary education and 6(8.57%) were graduates. Most of the victims were from the lower middle class (n = 36 ,51.43%), followed by the lower class (n = 20, 28.57%).

**Table 1: Distribution of cases according to age and sex**

| Age GroupSex | 0-10 years | 11-20 years | 21-30 years | 31-40 years | 41-50 years | 51-60 years | 61-70 years | 71-80 years | More than 81 | Total |
|--------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------|
| Male%        | 0          | 2           | 17          | 10          | 6           | 10          | 3           | 0           | 1            | 49    |
|              | 0          | 2.85        | 24.28       | 14.28       | 8.87        | 14.28       | 4.28        | 0           | 1.42         | 70    |
| Female%      | 2          | 4           | 5           | 4           | 3           | 3           | 0           | 0           | 0            | 21    |
|              | 2.85       | 5.71        | 7.14        | 5.71        | 4.28        | 4.28        | 0           | 0           | 0            | 30    |
| Total%       | 2          | 6           | 22          | 14          | 9           | 13          | 3           | 0           | 1            | 70    |
|              | 2.85       | 8.87        | 31.42       | 20          | 12.85       | 18.57       | 4.28        | 0           | 1.42         | 100   |

**Table 2: Locality of the victims**

| Locality | Number of cases | Percentage |
|----------|-----------------|------------|
| Urban    | 48              | 68.57      |
| Suburban | 16              | 22.85      |
| Rural    | 6               | 8.57       |
| Total    | 70              | 100        |

While evaluation the reasons for consumption of poisoning, it was found that maximum were (n= 24 or 32.85%) in depression due to unknown cause and in 11(15.71%) it was mistaken for medicine. Probable manner of poisoning was suicidal 31 (44.28%), followed by accidental 22(31.43%) and no case of homicide was observed.(Table-3). It was observed that 35 (50%) cases were declared dead on arrival, 32(45.71%) cases were admitted to hospital and 3 (4.28%) were found dead or declared dead at spot.

**Table 3 : Manner of poisoning and Sex**

| Manner of poisoning | Male | Female | Total |
|---------------------|------|--------|-------|
| Suicidal            | 19   | 12     | 31    |
| Accidental          | 15   | 7      | 22    |
| Homicidal           | 0    | 0      | 0     |
| Not known           | 15   | 2      | 17    |
| Total               | 49   | 21     | 70    |

Maximum number (22 or 31.42%) of cases were due to insecticides followed by alcohol intoxication 16(22.85%). Deaths due to unknown poisoning were 8(11.42%) and due to rodenticides were 4(5.71%).Carbolic acid, alcohol and phenobarbitone, chloroquine, sedative overdose and snake bite poisoning were seen as a one case of each. Cause of death was pending in 11(15.71%)cases.(Fig.1) Maximum deaths were due to cerebral edema 18(30.50%) and includes insecticide and alcohol poisoning.

## DISCUSSION

In the present study, incidence of deaths due to poisoning was 5.09 % which coincides with the studies of Gargi et al<sup>5</sup>, Khagawat et al<sup>6</sup>. It does not coincide with studies of Aggarwal N.K.et al<sup>2</sup>, Gupta B.D. et al<sup>7</sup> and Dalal et al<sup>8</sup> and Harish et al<sup>9</sup>. This could possibly

be due to different geographical areas and different constitution and life styles of people. The main reason for low incidence of deaths due to poisoning is the good quality treatment received by the victims admitted in this tertiary hospital in metropolitan area.

In our study, males outnumbered the females and the peak incidence of deaths due to poisoning was in the age group of 21-30 years with (31.42%). This particular age group is the most active phase of life for men who are involved mentally, physically and socially and exposed to maximum hazards. They are exposed to day to day stresses of life than females and the peak coincides with the studies of Aggarwal N.K. et al<sup>2</sup>, Kiran et al<sup>10</sup>. It does not coincide with the studies of Singh K et al<sup>11</sup>, Gupta B.D. et al<sup>7</sup>.

In this study, it was observed that most of the victims were from Hindu religion with 54(77.14%) cases followed by Muslim 13 (18.57%) cases. Most of the victims were Hindu, which can be explained by the fact that major population is Hindu. In our study as well as most of the other studies Hindus are more common than others.

Most of the victims (59 or 84.28%) were from urban area, followed by suburban area (16 or 22.85%) and rural area (8.57%). This coincides with study of Gargi et al.<sup>5</sup> In most of the studies poisoning in rural area was common. The preponderance to urban area is because this hospital is located in the metropolitan area (Mumbai city district)

It was observed that 36 (51.42%) victims were married. The married person more often becomes victim of poisoning which was found similar with Gupta B.D. et al<sup>7</sup>. The reason of fact could be that the amount of stress carried by the married people on their day to day life is more than the single males or females which makes them more vulnerable to the poisoning.

Manual laborers constituted highest number of cases i.e. 22 (31.42%). The preponderance in this group is possibly due to low socioeconomic status, physical and mental stress etc. One of the main reason for involvement of this population is due to hectic construction activity in the city. This coincides with study of Kiran et al<sup>10</sup> and Gupta S.K. et al<sup>12</sup>. In this study 14(20%) victims were illiterate, however educational status could not be ascertained in 41(58.57%) cases. This coincides with study of B.D.Gupta et al<sup>7</sup>. Due to illiteracy they are not aware of methods of bursting stress or availing the services from a psychiatrist.

It was observed that the three groups on the lower side of the scale (The lower, lower middle class, upper lower together) contribute to the majority (63 cases or 90%). The more preponderance in lower middle class and lower class is due to poverty. This coincides with study of Shetty et al<sup>13</sup>. This does not coincide with Dhatarwal et al.<sup>14</sup> (Middle class).

In this study depression of unknown origin as a reasons for consumption of poison were seen in maximum 23 (32.85%) cases and in 11(15.71%) victims had consumed the poison in mistake of medicine. This coincides with Kiran N. et al<sup>10</sup>. In this study probable manner of poisoning was suicidal in 31 (44.28%), followed by accidental in 22(31.43%), not known in 17(24.28%) cases. Persons not able to sustain stressful situations were the major victims of suicidal poisonings. This endorses the view that the inability to cope up with the demands put forth by the standards set by the materialistic modern society is the major culprit. This study coincides with Zine et al<sup>1</sup>. It was observed that 35 (50%) cases were declared dead on arrival, 32(45.71%) cases were admitted to hospital. This may be due to distance between place of incidence and hospital, a strong desire to commit suicide and unnoticed by nearby people. This coincides with study of Sonar<sup>15</sup>.

It was observed that maximum number (22 or 31.42%) of cases were due to insecticides followed by alcohol intoxication 16(22.85%). Owing to easy availability, low cost and high toxicity, comparatively painless death than other violent methods, insecticides have always been extremely popular in India for committing suicide. This coincides with the study of Zine et al<sup>1</sup>, Kiran et al<sup>10</sup>, Dash et al<sup>16</sup>.

Maximum deaths were due to cerebral edema in 18 (30.50%) cases of insecticide and alcohol poisoning. cases. This coincides with study of Gupta S.K. et al<sup>12</sup>.

## CONCLUSION

The present study helps to interpret the trends of poisons used.

In this study, there is an increasing frequency of insecticide poisoning in urban population including younger age group and male sex. Suicidal was most common manner of poisoning. Maximum victim were married. Most of the victims were from the lower middle class. Highest number of deaths were in manual labours. Cerebral edema was most common immediate cause of death due to poisoning.

Most important in the management in order to have a good outcome is rapid transport to hospital, early diagnosis and treatment.

Enlightenment through educating young people about harmful effects of drugs, promoting poisoning information centers, introducing separate toxicological units in the hospitals will be helpful to reduce mortality of poisoning cases.

- The high incidence of suicide in young married couples can be checked by developing satisfactory interpersonal relationships and tackling effectively their social and psychological problems.
- There is an urgent need for strict implementation of Pesticide Act so that it could strengthen the legislature on available of drugs and poisons substance in the market. This can regulate the import, manufacture, sale, transport, distribution and use of pesticides with a view to prevent risk to human beings.
- It is also further suggested to find out causes and nature of poisoning and design appropriate health education programme for prevention of both suicidal and accidental poisoning for the benefit of the public at large.

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# Phenytoin Induced Gingival Overgrowth - A Case Report

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## ABSTRACT

Gingival overgrowth is a rare disorder characterized by the proliferative fibrous over growth of the gingival tissue. It usually develops as an isolated disorder but can be a feature of a syndrome. Anticonvulsants, immune-suppressant drugs and calcium channel blockers have been known to produce similar gingival overgrowths in susceptible patients.

Phenytoin, an anti epileptic has been frequently used in the management of all forms of epilepsy except petit-mal. The potential of phenytoin to induce gingival hyperplasia has been well-established.

This article documents a severe gingival enlargement in a patient under anti-epileptic therapy and provides a rational model for its clinical management

A case of 15 year old male is reported who presented a generalized severe gingival overgrowth, involving the maxillary and mandibular arches and covering all teeth. Treatment included phase 1 therapy, substitution of the drug, and surgical excision of the excessive gingival tissue, maintenance and supportive therapy resulting in excellent clinical outcome. Post surgical follow up demonstrated no recurrence.

**Keywords:** Phenytoin, Antiepileptic, Gingival Over Growth, Gingivectomy

## INTRODUCTION

Gingival enlargement or gingival overgrowth is one of the most important clinical features of gingival pathology.<sup>1</sup> Gingival hyperplasia due to the concomitant unesthetic appearance and the formation of new niches for the periopathogenic bacteria is considered a serious adverse drug reaction.<sup>2</sup>

There are many factors (causal or modifying) involved in gingival overgrowth. Plaque accumulation on teeth causes gingival inflammation and its resultant enlargement. Gingival hyperplasia can be seen in patients with familial gingival enlargement, pregnancy and leukemia.<sup>3</sup>

Gingival overgrowth or gingival enlargement, is consequence of the administration of three groups of medicaments which are broadly classified as- anti-convulsants, calcium channel blockers and immunosuppressants.<sup>4</sup> An increasing number of medications are associated with gingival over growth. Currently there are more than 20 prescription medications associated with gingival enlargement.<sup>5</sup>

Epilepsy is a disease where a person has recurrent seizures due to a chronic underlying process.<sup>6</sup> Anti-epileptic drugs are among the most commonly prescribed centrally active agents. They are used widely to treat conditions other than epilepsy, including migraine, neuropathic pain, anxiety, and bipolar disorder.<sup>7</sup>

The currently available anti-epileptic drugs act either by depressing the neuronal activity at the focus of origin, or by blocking the spreading mechanisms.<sup>6</sup> The tolerability of available anti-epileptic drugs differs substantially and the likelihood of specific adverse effects is the most important consideration when selecting a drug for a given patient. These adverse effects can be broadly classified into those that are reversible and dose-dependent (such as ataxia, sedation, dizziness, and cognitive dysfunction) and those that are chronic and not rapidly reversible (such as changes in body weight, hirsutism, and gingival hyperplasia).<sup>7</sup>

Phenytoin (PHT 5, 5 -diphenylhydantoin), first introduced as an antiepileptic drug in 1938<sup>8</sup>, is

commonly used as a therapeutic agent in patients with epilepsy, either alone or in combination with other anticonvulsant drugs. It is slowly absorbed from the gastrointestinal tract, extensively metabolized in the liver by microsomal enzymes, with major metabolite being 5-(p-hydroxyphenyl)-5-phenylhydantoin.<sup>9</sup> This metabolite is implicated in the pathogenesis of gingival overgrowth.<sup>6</sup>

The drug acts via stabilization of neuronal cell membranes and through suppression of synaptic transmission. At the cellular level it acts by affecting the (Na<sup>+</sup>K<sup>+</sup>) pump, Ca<sup>++</sup> transport or the sodium influx.<sup>10</sup>

Advantages of phenytoin include its effectiveness, low cost, availability, and frequency of administration (once a day). Among the side effects of phenytoin therapy, gingival hyperplasia is a well-recognized adverse effect, occurring on average among approximately 50% of patients receiving this drug. The first case of phenytoin induced gingival overgrowth was first reported in 1939.<sup>10</sup>

Although several studies have been conducted regarding phenytoin-induced enlargement, the pathogenesis of this gingival lesion still is not understood. The literature has suggested an association between phenytoin-induced gingival enlargement and a variety of conditions, including multiple anti-epileptic therapies, plaque accumulation, host genetic predisposition, and reduced serum folate levels.<sup>10</sup>

High levels of dental plaque and calculus also have been reported to be a critical co-factor. Risk factors associated with phenytoin-induced gingival enlargement may have a synergistic effect.<sup>10</sup>

This article describes the clinical history and management of a case of gingival hyperplasia in a patient under anti-epileptic therapy (phenytoin). This report demonstrates the value of consultative planning between oral care practitioners and physicians for the prevention and treatment of gingival lesions in these medically compromised patients.

### CASE REPORT

A 15 year old male presented himself at the Department of Periodontics, A.B. Shetty Memorial Institute of Dental Sciences, Mangalore with a chief complaint of swelling of gums all over his mouth. The swelling caused difficulties in speech, mastication, and it also had obvious implications for his aesthetic appearance.

He reported that the enlargement had begun with the eruption of permanent teeth, when he noticed a small bead like nodular enlargement of the gums which

gradually progressed to the present state covering almost the entire crowns of the teeth. The intraoral examination revealed generalized, severe gingival overgrowth involving both the mandibular and maxillary arches, covering the entire crowns. (Figure 1 and 2) (GOI=3 according to Angelopoulos & Goaz index) local factors were consistent with the size of the lesion.



Fig. 1. Gingival enlargement in maxillary & mandibular region.



Fig. 2. Gingival enlargement in both arches.

The gingiva was pink, with a firm and dense consistency. No acute inflammatory signs were present.

The extra oral examination revealed that the patient was unable to close his lips because of the protrusion of the enlarged tissues

Panoramic radiograph examination did not reveal any evidence of bone loss indicating absence of periodontitis and an outward growth rather than a vertical enlargement of gingiva.

The patient's medical history revealed that he had suffered epilepsy attacks, with variable intervals since the age of 5 years. He had been administered phenytoin (100mg once daily) He reported that the enlargement had begun with the eruption of permanent teeth, with a slow progression.

Histopathological investigations after excisional biopsy revealed hyperparakeratinised hyperplastic stratified squamous epithelium with elongated rete pegs and dense fibro collagenous tissue, with a few sparse inflammatory cells.(Figure 3)

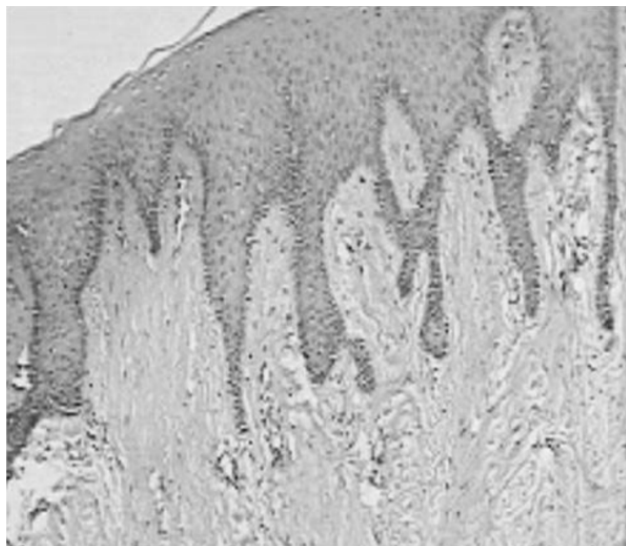


Fig. 3. Histopathological photograph.

Routine hematological laboratory investigations did not reveal any abnormality. On the basis of medical, family, drug histories and clinical findings it was diagnosed as Phenytoin induced gingival overgrowth.

### CASE MANAGEMENT

#### 1. Drug substitution / withdrawal

The most effective treatment related to drug enlargement is withdrawal or substitution of the medication. Hence prior to local management, the patient was thoroughly assessed by a neurologist and a suitable drug substitution therapy was instituted. The neurologist substituted the drug with carbamazepine

#### 2. Non surgical treatment

Professional debridement with scaling and root planning was performed. Patient was instructed to maintain good oral hygiene with chlorhexidine rinses. The patient response to nonsurgical treatment was moderate hence surgical approach was the preferred line of treatment.

#### 3. Surgical treatment

The treatment consisted of external bevel gingivectomy( Figure 4) of all quadrants with a Krikland's gingivectomy knife (Hu-Friedy). The surgical intervention was carried out quadrant wise under local anaesthesia. After the surgical

intervention periodontal pack (Coepack) was placed. The periodontal pack was removed after 7 days and the postoperative course was uneventful. The post surgical follow up till 6 months did not show any recurrence. (Figure 5 and 6)



Fig. 4. External bevel gingivectomy



Fig. 5. Post operative photograph



Fig. 6. Post operative photograph

### DISCUSSION:

**Gingival** overgrowth is a common feature of gingival diseases. There includes various kinds of gingival overgrowth, varying according to the etiological factors and the pathological processes producing them.<sup>1,2,3</sup>

Drug induced gingival overgrowth is known as an adverse effect with three types of drugs namely: phenytoin, an antiepileptic; cyclosporine A, an

immunosuppressant; and calcium channel blockers such as dihydropyridines (nifedipine), verapamil, and diltiazem, which are widely prescribed for the treatment of various cardiovascular diseases.<sup>4</sup>

Although the pharmaceutical effect and primary target tissues of an antiepileptic, an immunosuppressant, and calcium channel blocker are different, they act similarly on gingival connective tissue, causing fibrous gingival overgrowth.<sup>10</sup>

## PATHOGENESIS

### 1. Accumulation of Type I Collagen in Gingival Connective Tissue<sup>10</sup>

Drug-induced gingival overgrowth, previously termed as gingival hypertrophy or gingival hyperplasia by finding an increased number of fibroblasts in gingival connective tissue with histological analysis. However, these earlier terms, "hypertrophy" or "hyperplasia" did not accurately reflect the histologic composition of enlarged gingiva. Not increase proliferation of gingival fibroblasts, but the severe accumulation of extracellular matrix within the gingival connective tissue, particularly collagenous components, was observed in human gingival overgrowth. These disorders are therefore suitable to be considered as fibrosis in gingival connective tissue. "Gingival overgrowth" or "gingival enlargement" is the preferred term for all drug-related gingival lesions

### 2. Synthesis and Degradation of Type I Collagen<sup>10</sup>

The metabolism of collagen is precisely balanced by collagen synthesis and degradation to maintain tissue volume. Generally, fibrosis is caused by the loss of homeostasis of the synthesis and degradation of collagen fibers, resulting in the excess accumulation of collagen fibers

Collagen may be degraded *via* an extracellular pathway involving the secretion of collagenase and *via* an intracellular pathway involving phagocytosis by fibroblasts.

McCulloch and Knowles showed decreased collagen phagocytosis of fibroblast isolated from human phenytoin-induced gingival overgrowth than healthy gingiva, type I collagen and collagenase mRNA expressions were significantly suppressed by, phenytoin administration in these rat experimental models. Hence it can be concluded that drug-induced gingival

overgrowth is not due to the increased synthesis of type I collagen but the decreased degradation through the reduction of collagen phagocytosis of fibroblasts.

### 3. Role of $\alpha$ -2 Integrin<sup>10</sup>

Integrins are a large family of heterodimeric transmembrane receptors for extracellular matrix molecules, and acts as the principle mediators of the molecular dialogue between a cell and its extracellular matrix environment. Each heterodimer consists of an  $\alpha$  and  $\beta$  subunit. There are approximately 17  $\alpha$  and 8  $\beta$  subunits in mammals.

$\alpha$ 2 $\beta$ 1 integrins have been shown to serve as specific receptors of type I collagen in fibroblasts.

One etiological factor of drug-induced gingival overgrowth may be the inhibition of collagen phagocytosis by reducing a 2 integrin expression or decrease of the binding activity in

gingival fibroblasts. It has been hypothesized that subjects with the 807 C genotype of a 2 integrin express less a 2b 1 integrin on the gingival fibroblasts surface, leading to the decreased potential of fibroblast binding to type I collagen and collagen phagocytosis by administered drugs, and, hence, an increased the risk.

### 4. Role of Calcium in Collagen Phagocytosis<sup>10</sup>

Phenytoin is known to act as a calcium channel antagonist and inhibit calcium ion flux. Intracellular calcium signaling participate in a positive feedback loop that enables

integrin-mediated cell adhesion by altering integrin-binding affinity. Drug-induced gingival overgrowth may be induced through the reduction of a 2b 1 integrin-binding affinity in collagen phagocytosis in fibroblasts by disturbing the intracellular calcium flux

The clinical appearance of phenytoin induced gingival overgrowth is usually characteristic, although variants are seen depending on the location of lesions, the irritants involved and the extent of inflammation. Gingival hyperplasia with its potential cosmetic implications and also providing new niches for the growth of microorganisms is a serious concern for both the patients and clinician.

Gingival overgrowth usually begins in the interdental papilla region of the labial surfaces of the anterior region. As the condition progresses, the marginal and papillary gingiva may develop into a massive tissue and may interfere with speech, mastication and aesthetics. With time the untreated case may develop into more severe periodontitis with future loss of periodontal attachment and bone loss.

In the present case the patient noticed the enlargement corresponding with the eruption of permanent teeth with gradual progression. Phenytoin

induced gingival enlargement began as a painless bead like enlargement of the interdental papilla which gradually progressed into a massive tissue fold covering considerable portions of the crown. Patient had difficulties in mastication, in opposing his lips together, in speech and to maintain the oral hygiene. This resulted in psychological stress to the patient.

The histological features of the excised biopsy tissue showed the typical appearance of gingival lesions in drug induced gingival enlargement. The epithelium was stratified squamous, parakeratinized. The rete ridges were narrow and elongated extending deeply into connective tissue. The connective tissue consisted of hypo cellular collagenous tissue which formed numerous interlacing bundles running in various directions and mild inflammatory cell infiltrate of lymphocytes arranged in foci between the collagen bundles.

Based on the family, medical & drug histories to this case, it was termed as phenytoin induced gingival enlargement

The presence of overgrowth makes plaque control difficult, resulting in secondary inflammatory process complicating the gingival hyperplasia induced by the drug. Although the exact role played by dental plaque in the pathogenesis of drug induced gingival enlargement is unclear. Evidence indicates that the elimination of local factors and maintenance of good oral hygiene reduces the severity of gingival enlargement.

The suggested treatment varies according to the degree of severity and on medication being used.

When the enlargement is minimal, scaling of the teeth and home care may be sufficient to maintain good oral health. As the excess tissue increases, appearance and functional impairment dictate the need for surgical intervention.

An initial single episode of crown and root debridement was performed under local anesthesia using ultrasonic scaling and root planing. This first treatment protocol also integrated oral hygiene instruction, including the Bass technique of brushing and interdental cleaning with dental floss and interdental brushes. In addition, 0.12% chlorhexidine gluconate rinses were prescribed twice a day as an adjunctive antimicrobial.

The neurologist was consulted to change the ongoing anticonvulsant program, establishing a level of seizure management without sacrificing attentiveness and mood control. The physician was willing to adjust the therapy and the patient started to take carbamazepine (Tegretol). and phase 1 therapy

was performed.

Because of the severity of the involvement of the gingiva and absence of bone loss in this case, an external bevel gingivectomy followed by gingivoplasty was the favored treatment which was performed quadrant wise under local anaesthesia. The post surgical follow up did not show any signs of recurrence.

Treatment relieved the problems of speech, mastication, esthetics. Maintenance of oral hygiene was also much easier. This boosted the psychological condition of the patient

## CONCLUSION

Drug induced gingival enlargement is characterized by the proliferative fibrous overgrowth of the gingival tissues, with varying degrees of involvement. Among the old and relatively new pharmacologic agents involved in gingival enlargement, phenytoin still has the highest prevalence rate (approximately 50%), with calcium channel blockers and Cyclosporine associated enlargements about half as prevalent. Ideally, patients receiving anti-epileptic medications should expect multidisciplinary treatment care and more rational anti-epileptic therapies.

Current studies on the pathogenetic mechanism of drug associated enlargement are focusing on the direct and indirect effects of these drugs on gingival fibroblast metabolism.

Newer molecular approaches are needed to clearly establish the pathogenesis of gingival overgrowth and to provide novel information for the design of future preventative and therapeutic modalities.

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# Jatropha Curcas Poisoning in a Group of Agricultural Labourer

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## ABSTRACT

*Jatropha curcas* belongs to the Euphorbiaceae family and is found in the coastal areas of tropics. There are few reported cases of its poisoning in pediatric and in adults; we have not come across mass accidental poisoning among the agricultural farmers in literature. However, we found a group of 18 agricultural labourers affected by the poisoning of its seeds, who presented with complaints of vomiting, colicky abdominal pain, giddiness and diarrhea with in few minutes and reported to the casualty in a couple of hours. Illness was self-limiting without any complications during the entire hospital stay and follow up.

**Keywords:** *Jatropha*, *Curcin*, *Neutrophilic Leukocytosis*, *Mydriasis*

## INTRODUCTION

**Jatropha curcas** grows well in poor soil and drought resistant. *Jatropha curcas*, commonly called as “Adavi amadam or Pepalam” in Andhra Pradesh, and is known as Jamalgutta in Hyderabad. The seeds (Fig.2) of this plant contain 37% of oil and are grown in many parts of India for bio-diesel. It is a small tree or shrub with smooth gray bark, which exudes whitish colored watery latex when cut. Normally, it grows between three and five meters in height, but can attain a height of up to eight or ten meters under favorable Conditions.



Fig. 1. *Jatropha* Plant

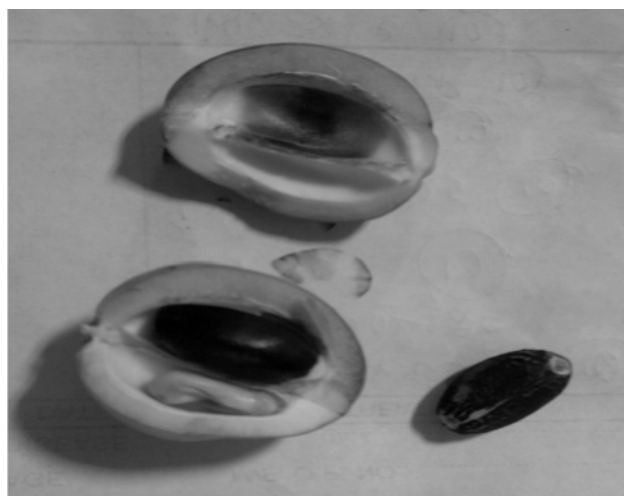


Fig. 2. Seeds&Fruits of *Jatropha*

**Chemistry** per 100 g, the seed is reported to contain 6.6 g H<sub>2</sub>O, 18.2 g protein, 38.0 g fat, 33.5 g carbohydrate, and 15.5 g fiber<sup>1</sup>. Leaves, which show antileukemic activity, contain  $\alpha$ -amyrin,  $\beta$ -sitosterol, stigma sterol, and campesterol, 7-keto- $\beta$ -sitosterol, stigmast-5-ene-3- $\beta$ , 7- $\alpha$ -diol, and stigmast-5-ene-3  $\beta$ , 7  $\beta$ -diol<sup>2</sup>. Leaves contain isovitexin and vitexin. From the kernal saccharose, raffinose, stachyose, glucose, fructose, galactose, protein, and oil, largely of oleic- and linoleic-acids<sup>4</sup>, curcasin, arachidic-acid, linoleic-acid, myristic-acid, oleic-acid, palmitic-acid, and stearic-acids are also reported<sup>3</sup>.

## Toxicity

The poisoning manifests with acute abdominal pain and nausea within 1/2 hour following ingestion. The initial symptoms are followed by diarrhea and nausea, which are not usually serious. Depression and collapse may occur, especially in children. Two seeds are strong purgative. Four to five seeds are said to have caused death, but the roasted seed is said to be nearly innocuous. Bark, fruit, leaf, root, and wood are all reported to contain HCN<sup>5</sup>. Seeds contain the dangerous tox-albumin curcin, rendering them potentially toxic.

## CASE REPORT

Middle-aged male agricultural daily labourers went to paddy fields in Khammam district of Andhra Pradesh in the morning hours. They found almond-shaped fruit over the tree. One of them in the group motivated others that the seeds of this plant could be eaten. Nearby farmers warned them that the seeds were poisonous and should not be eaten. Due to curiosity, few of the farm labourer obtained the fruit from the trees. As the seeds tasted like that of ground nuts, other labors also joined the process of eating. The number of seeds consumed varied from 1 to 16. The minimum time for the onset of symptoms was 2 minutes and the maximum time of the onset of symptoms was 30 minutes. In few of them, the first symptom was giddiness followed by vague epigastric pain, vomiting, colicky abdominal pain followed by diarrhea. However, this sequence varied in some

individuals. Vomiting was projectile and initially consisted of ingested food; there was no evidence of any blood stains. Two of them could observe the ingested seeds in the vomitus. Diarrhea was watery, colorless, and non-sticky, with no foul smell and was a constant feature reported by all the individuals. Colicky pain was intermittent in nature and was relieved with the passage of stools. All of them were brought to the hospital at around 1:15 PM. The details of cases are given in Table 1. We had not tested any vomitus or stool for toxicological analysis considering the clear history and availability of seeds and fruits with patients. All the patients recovered without any complications.

## OBSERVATION

A total of 18 male patients admitted to the casualty with a history of consumption of *Jatropha* kernels. The identification of the poison was based on observation of plant stem along with leaves, flowers and fruits (Fig No 1). Many of the patients were having seeds in their pockets. The average weight of the fruit was 6.12 grams, seed 0.75 grams and kernel 0.30 grams. The time taken for the onset of symptoms ranged from 2 min to 2 hours irrespective of the kernels consumed. Minimum kernels consumed were ½ and the maximum was 16. The symptoms were not influenced by the age, weight, height and the number of kernels consumed. Vitals of all the individuals were normal except for 4 subjects, who were known hypertensive. Refer to table No 1.

**Table1. General particulars of the victims of *Jatropha* poisoning**

| Pt I.D | Age (years) | Body Weight (Kgs) | Height (Cms) | No.of Seeds Consumed | Time taken for onset of symptoms (In Min) | Vitals At Admission |             |        |                 |
|--------|-------------|-------------------|--------------|----------------------|-------------------------------------------|---------------------|-------------|--------|-----------------|
|        |             |                   |              |                      |                                           | P.R (/min)          | B.P (mm.Hg) | T (°F) | RR (per minute) |
| 1      | 22          | 53                | 163          | 16                   | 5                                         | 88                  | 100/80      | 98.6   | 20              |
| 2      | 25          | 54                | 178          | 8                    | 15                                        | 72                  | 100/80      | 98.6   | 22              |
| 3      | 37          | 65                | 169          | 10                   | 30                                        | 86                  | 140/80      | 98.6   | 22              |
| 4      | 19          | 49                | 163          | 6                    | 15                                        | 80                  | 120/70      | 98.6   | 22              |
| 5      | 25          | 50                | 175          | 6                    | 2                                         | 80                  | 100/70      | 98.6   | 24              |
| 6      | 30          | 55                | 153          | 5                    | 30                                        | 68                  | 100/80      | 98.2   | 22              |
| 7      | 45          | 49                | 153          | 1                    | 15                                        | 64                  | 150/90      | 98.6   | 24              |
| 8      | 20          | 56                | 158          | 4                    | 30                                        | 69                  | 120/80      | 99     | 22              |
| 9      | 45          | 57                | 162          | 5                    | 30                                        | 76                  | 120/80      | 98.6   | 22              |
| 10     | 30          | 64                | 164          | 4                    | 30                                        | 85                  | 110/70      | 99     | 22              |
| 11     | 50          | 52                | 175          | 10                   | 15                                        | 72                  | 190/110     | 98.6   | 22              |
| 12     | 15          | 56                | 150          | 1                    | 120                                       | 96                  | 120/90      | 99     | 24              |
| 13     | 40          | 50                | 152          | 1                    | 15                                        | 80                  | 120/80      | 98.4   | 24              |
| 14     | 50          | 55                | 155          | 1                    | 15                                        | 100                 | 160/110     | 98.4   | 28              |
| 15     | 47          | 51                | 153          | 1                    | 10                                        | 86                  | 150/100     | 98.4   | 24              |
| 16     | 23          | 56                | 158          | 1                    | 10                                        | 100                 | 150/100     | 98.4   | 20              |
| 17     | 25          | 44                | 145          | 0.5                  | 30                                        | 100                 | 130/90      | 98.4   | 25              |
| 18     | 30          | 82                | 152          | 2                    | 5                                         | 65                  | 130/90      | 98.4   | 22              |

On clinical examination the chief symptoms manifested were giddiness, pain abdomen, vomiting and diarrhea. The maximum number of vomiting episode was 6 and that of diarrhea was 7. The typical history of colicky abdominal pain, which was relieved after passage of stools, was a consistent finding. Vomiting and diarrhea were totally absent in 7 patients

who have consumed 1/2 to 2 kernels. Pupils were normal in size and reacting to light except in two patients who manifested with mid dilated pupils. The core body temperatures of all the patients were normal however 3 of the patients' skin surface were cold to touch. Refer to table No 2.

**Table:2. Clinical features presented by the victims of Jatropha poisoning**

| Patient I.D | Pupils* | Skin Surface** | Giddiness | Pain abdomen | Vomiting |      | Diarrhea |    |
|-------------|---------|----------------|-----------|--------------|----------|------|----------|----|
|             |         |                |           |              | BA#      | AA## | BA       | AA |
| 1           | MDRL    | cold           | Present   | Present      | 6        | 0    | 4        | 3  |
| 2           | NSRL    | warm           | Present   | Present      | 4        | 0    | 4        | 0  |
| 3           | NSRL    | warm           | Present   | Present      | 4        | 1    | 4        | 2  |
| 4           | NSRL    | warm           | Present   | Present      | 3        | 0    | 3        | 0  |
| 5           | NSRL    | warm           | Present   | Present      | 4        | 0    | 0        | 2  |
| 6           | NSRL    | warm           | Present   | Present      | 2        | 0    | 2        | 0  |
| 7           | NSRL    | cold           | Present   | Present      | 5        | 0    | 0        | 0  |
| 8           | NSRL    | cold           | Present   | Present      | 3        | 0    | 3        | 1  |
| 9           | NSRL    | warm           | Present   | Present      | 2        | 0    | 2        | 1  |
| 10          | NSRL    | warm           | Present   | Present      | 2        | 0    | 2        | 0  |
| 11          | MDRL    | warm           | Present   | Present      | 2        | 0    | 2        | 1  |
| 12          | NSRL    | warm           | Present   | Present      | 0        | 0    | 0        | 0  |
| 13          | NSRL    | warm           | Present   | Present      | 0        | 0    | 0        | 0  |
| 14          | NSRL    | warm           | Present   | Present      | 0        | 0    | 0        | 0  |
| 15          | NSRL    | warm           | Present   | Present      | 0        | 0    | 0        | 0  |
| 16          | NSRL    | warm           | Present   | Present      | 0        | 0    | 0        | 0  |
| 17          | NSRL    | warm           | Present   | Present      | 0        | 0    | 0        | 0  |
| 18          | NSRL    | warm           | Present   | Present      | 0        | 0    | 0        | 0  |

\*Note: MDRL: Mid dilated and reacting to light; NSRL: Normal in size and reacting to light

\*\*Skin Surface: warm/cold is a subjective feeling

#-Before Admission; ##-After Admission

Lab investigations revealed significant neutrophilic leukocytosis, and no changes in renal function test, random blood sugar and Hb%. We have observed that

there is rise in urine albumin levels in 4 cases irrespective of number of seeds consumed. There were no ECG changes in any of the patients. Refer to Table No3.

**Table 3. Laboratory parameters observed among the victims of Jathropa poisoning**

| Pt.Id | Blood Investigations |     |      |      |                           |                         |    |   |    | Urine Routine# | ECG## |
|-------|----------------------|-----|------|------|---------------------------|-------------------------|----|---|----|----------------|-------|
|       | RFT                  |     | RBS* | Hb%  | Total Count (cells/cu.mm) | Differential Count**(%) |    |   |    |                |       |
|       | Urea                 | Cr  |      |      |                           | N                       | E  | M | L  |                |       |
| 1     | 37                   | 1.2 | 100  | 16.9 | 19,100                    | 90                      | 3  | 2 | 5  | alb++          | WNL   |
| 2     | 23                   | 0.9 | 0    | 14.7 | 13,800                    | 93                      | 2  | 1 | 4  | N              | WNL   |
| 3     | 26                   | 0.7 | 98   | 12   | 9,900                     | 85                      | 1  | 1 | 13 | N              | WNL   |
| 4     | 24                   | 0.9 | 96   | 8    | 16,600                    | 90                      | 3  | 2 | 5  | N              | WNL   |
| 5     | 26                   | 0.7 | 106  | 12.3 | 13,300                    | 86                      | 2  | 2 | 10 | N              | WNL   |
| 6     | 34                   | 1   | 96   | 13.9 | 17,700                    | 92                      | 2  | 1 | 5  | alb+           | WNL   |
| 7     | 27                   | 0.8 | 94   | 11.7 | 6,400                     | 65                      | 8  | 2 | 25 | N              | WNL   |
| 8     | 24                   | 0.8 | 98   | 11.4 | 7,300                     | 50                      | 18 | 2 | 30 | N              | WNL   |

**Table 3. Laboratory parameters observed among the victims of Jatropha poisoning**

| Pt.Id | Blood Investigations |     |      |      |                           |                         |    |   |    | Urine Routine# | ECG## |
|-------|----------------------|-----|------|------|---------------------------|-------------------------|----|---|----|----------------|-------|
|       | RFT                  |     | RBS* | Hb%  | Total Count (cells/cu.mm) | Differential Count**(%) |    |   |    |                |       |
|       | Urea                 | Cr  |      |      |                           |                         |    | N | E  |                |       |
| 9     | 31                   | 0.9 | 88   | 9.5  | 4,900                     | 66                      | 8  | 2 | 24 | N              | WNL   |
| 10    | 28                   | 0.9 | 94   | 11.7 | 7,400                     | 68                      | 3  | 2 | 27 | N              | WNL   |
| 11    | 28                   | 0.9 | 108  | 13.2 | 13,300                    | 90                      | 4  | 2 | 4  | alb+           | LVH   |
| 12    | 35                   | 1   | 100  | 10.2 | 6,600                     | 63                      | 13 | 2 | 22 | N              | WNL   |
| 13    | 24                   | 0.7 | 102  | 12.0 | 7,900                     | 65                      | 12 | 1 | 22 | N              | WNL   |
| 14    | 23                   | 0.9 | 86   | 13.6 | 12,800                    | 80                      | 8  | 2 | 10 | N              | WNL   |
| 15    | 24                   | 0.8 | 90   | 10.0 | 16,400                    | 50                      | 18 | 2 | 30 | N              | WNL   |
| 16    | 28                   | 0.9 | 100  | 12.4 | 8,400                     | 90                      | 6  | 1 | 3  | alb+           | WNL   |
| 17    | 28                   | 0.7 | 80   | 11.0 | 9,400                     | 65                      | 8  | 2 | 25 | N              | WNL   |
| 18    | 31                   | 0.8 | 103  | 8.6  | 10,600                    | 88                      | 2  | 2 | 8  | N              | WNL   |

\*RBS: Random Blood Sugar in mg/dL

\*\*Differential count: N-Neutrophils; E-Eosinophils; M-Monocytes; L-Lymphocytes

#alb+-high albumin content; Alb+-albumin in traces

##ECG-WNL-within normal limits; LVH- Left Ventricular Hypertrophy

RFT: Renal Function Tests; Cr-Creatinine

All the patients in our hospital were treated symptomatically with rehydration salts and intravenous fluids. The recovery was fast and patients were discharged within 48 hours. The order of recovery was vomiting followed by abdominal pain and loose motions. No complications were observed. The symptomology is inconsistent with the number of seeds consumed.

## DISCUSSION

Sporadic cases and cases of small groups of *Jatropha* poisoning were reported from various parts of the world. Most of the literature related to the subject discusses about the *Jatropha* poisoning in pediatric age group in small numbers. We have encountered a large group of 18 adult males. Most of the studies pointed out the time of onset of symptoms as 15 min to 2 hours, but our study has shown that the onset of symptoms are as rapid as 2 min and as late as 2 hours.

Some of the authors<sup>6</sup>, pointed out about the pupillary constriction in cases of *Jatropha* poisoning. But in our study we could appreciate mydriasis in two cases. This finding is consistent with the findings of some authors<sup>7</sup>. Giddiness was a constant finding seen in all the patients and it was not reported in the previous studies. Neutrophilic leukocytosis was a common finding in 10 patients, but this was not reported in previous studies. As the seeds, fruit and the signs and symptoms

resemble the *Croton tiglium*, the *Jatropha* poisoning should be considered as differential diagnosis for the same.

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# Palatal Rugae Pattern as an Aid for Personal Identification: A Review

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## ABSTRACT

In forensic dentistry, the oral cavity plays an important role because of unique anatomy of teeth, rugae pattern and other oral structures. The palatine rugae have interested forensic odontologists not only because of their typical pattern of orientation but also usefulness as reference landmark in human identification. Due to its internal position, rugae pattern is not damaged by trauma; it can be recorded and photographed both in living or dead. The common methods used in forensic sciences for confirming the person's identity are fingerprint, DNA analysis and dental comparisons. In certain situations, where fingerprints and teeth are lost due to any reason, the use of human palatal rugae has been suggested as an alternative method for human identification. The present review emphasizes the use of rugoscopy as a new dimension in forensic odontology.

**Keywords:** *Palatine rugae, Rugoscopy, Forensic Odontology*

## INTRODUCTION

The main objective of forensic science is to establish the person's identity which is a very complex process. The analysis of the teeth, fingerprints and DNA comparison, are probably the most commonly used techniques in the context allowing fast and secure identification. However these techniques cannot always be applied, in some cases hence, it is necessary to apply different and less known techniques such as palatoscopy. "Palatoscopy or palatal rugoscopy," is the name given to the study of the palatal rugae in order to establish the person's identity for differentiating the sex and in order to determine the age of an individual.

Transverse palatine folds or palatal rugae (palatine rugae) are asymmetrical and irregular elevations of mucosa located in the anterior third of the palate made from the lateral membrane of the incisive papilla, arranged in transverse directions from the palatine raphae located in the midsagittal plane. The development of palatal rugae appears towards the third month of intrauterine life once they are formed may experience changes in their size due to the growth of the palate but its shape remains same throughout the life time. <sup>(1, 2, 3, 4)</sup>

Palatal rugae have been equated with fingerprints and are unique to an individual. Palatal rugae can be

of special interest in edentulous cases and also in certain conditions where there are no fingerprints to be studied such as burned bodies or bodies that underwent decomposition, as in mass disasters like Tsunamis, Earthquakes and Airplane accidents. <sup>(1 - 3)</sup>

The palatine rugae appear to pose the features which are unique, post mortem resistant and stable and hence, these parameters are ideal for forensic identification. Many criminal investigations and victims of aircraft accidents have been identified by their dentition. The use of human palatal rugae was suggested as an alternative method of identification because rugae are protected from trauma by their internal position in the head by tongue and buccal fat pads. <sup>(1)</sup>

## HISTORICAL REVIEW

Kuppler, in 1897, was the first person to study palatal anatomy to identify racial anatomic features. Palatal rugoscopy was first proposed in 1932 by a Spanish investigator called Trobo Hermosa. In 1937, Carrea developed a detailed study and established a way to classify palatal rugae. One year later, Da Silva proposed another classification based on rugae pattern. Later these classifications have been modified. Lyell's classification in 1955 is considered the most important and it has been widely used in research involving orthodontics. In forensic odontology the most widely

used classification is as given by Thomas et al in 1983<sup>(8)</sup>

### Thomas's Classification (palatine rugae)

According to size, shape and unification of palatine rugae is as under and as shown in fig1, fig 2 & fig 3.

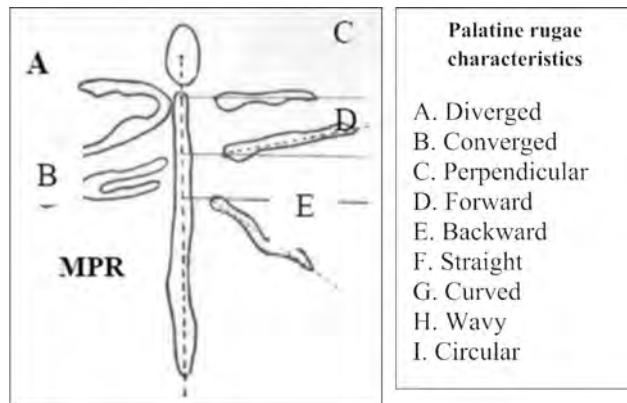


Fig. 1. shows different types of unifications of rugae.

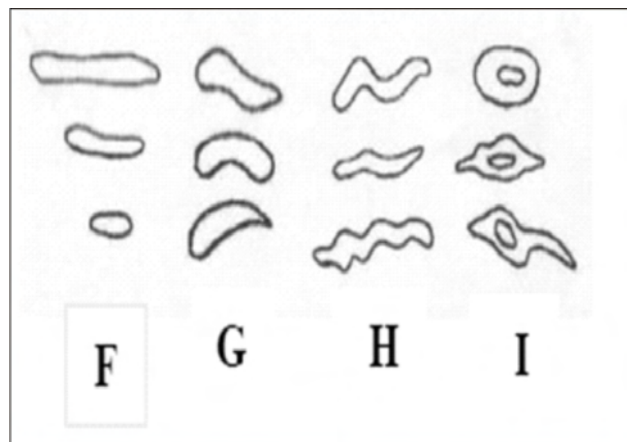


Fig. 2. Shows different shapes of rugae.

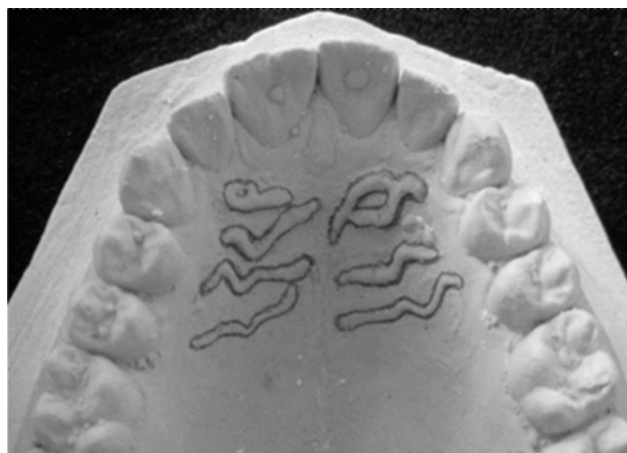


Fig. 3. Rugal pattern delineated by rugoscopy.

### According to Thomas et al

#### 1) Size:

- a) Primary rugae (5-10 mm)
- b) Secondary rugae (3-5 mm)
- c) Fragmentary rugae (less than 3 mm)

#### 2) Shape:

- a) Straight.
- b) Curve
- c) Wavy
- d) Circular

#### 3) Number: Total no of rugae present in primary and secondary rugae.

#### 4) Unification:

- a) Diverged
- b) Converged
- c) Perpendicular
- d) Forward
- e) Straight<sup>(5-7)</sup>

### DISCUSSION

Palatal rugae have shown to be highly individualistic and consistent in shape throughout the life. It is well established fact that the palatal rugae pattern is unique to human beings as fingerprints. Once rugae are formed they do not undergo any change except in length due to normal growth and remain in the same position throughout a person's life time. Diseases, chemical aggression, or trauma do not change the palatal rugae form. It is also concluded that changes that occur from the orthodontic movement, extraction, aging and palatal expansion do not modify the rugae enough to hamper identification. Palatal rugae are used in human identification not only due to their singularity and unchangeable nature, but also due to other advantages, namely their low utilization costs<sup>(7)</sup>

A study was carried out by Sunita et al in 1996 to determine age related changes in rugal pattern and to compare the number and pattern of rugae in Australian Aborigines with those of Caucasians. They concluded that length of rugae increased significantly with age but the total number of rugae remained constant. They

also observed statistically significant association between rugae and ethnicity. Straight forms being more common in Caucasians, where as wavy forms were more common in Aborigines. <sup>(8)</sup>

Kamla R et al, in 2011, compared rugae patterns of males and females in lucknow city, including twins, siblings and their parents. Effects of various dental treatments were also assessed. A uniqueness of palatal rugae as an aid for personal identification was the sole objective of the study. They concluded that no two palates are alike in their configuration and once formed, they do not undergo any changes except in length due to normal growth. They remain in the same position throughout the person's entire life. Thus, palatal rugae appear to possess the features of an ideal forensic identification parameter, i.e. uniqueness, postmortem resistance and stability, provided ante mortem record exists. <sup>(9)</sup>

Numerous studies have been reported by various authors from 2007-2011, to study the rugal pattern in different age groups in both sexes. According to their results, there was no significant gender difference in the total number of rugae. But there was a significant difference in the Shape, Size, and Unification. The females showed variations in converge type, while males showed variations in circular type. The incidence of curved, straight and forwardly directed rugae was more among females. While wavy, perpendicular and backwardly directed rugae were more among males. The females showed significant difference in sinus type, where as males showed significant difference in unification. The predominant direction of the rugae was found to be forward relative to backward. Hence it is observed that rugae pattern can be used as an additional method of identification in forensic odontology. <sup>(7,8,10-19)</sup>

Shwetha.K.S. et al, in 2005 did a study to compare palatine rugae pattern of Mysorean and Tibetan subjects, to assess the predominant palatine rugae pattern in these two populations, and to determine the uniqueness of palatine rugae pattern in an individual. They concluded that rugae are unique to an individual and are sufficiently characteristic to distinguish between individuals are subtle but definite and this indicates that the genes have originated from different quarters and pattern cannot change throughout the life. <sup>(20)</sup>

A study was carried out by P.M. Jibi et al, in 2011, to compare the rugae pattern between males and females of two different communities in the city of Davangere, Karnataka, India, this may be an additional method of

identification in cases of crimes or communal riots. The method of identification of rugae pattern followed was that of Lysell and Thomas and Kotze, which includes the number, shape, direction, and unification of rugae. The study revealed no significant difference in the total number or length of rugae between the two communities and sexes. However, with regard to shape and unification, females showed a significantly higher diverging rugae type while males had a significant number of circular and converging type of rugae. Also, discrimination function analysis allowed a moderate differentiation of the population. Hence, the rugae pattern can be an additional method of differentiation in conjunction with the other methods such as visual, fingerprints, and dental characteristics in forensic sciences. <sup>(21)</sup>

Aichi Gakuin. D.S.S. in 1990 did a study to compare the palatal rugae and shape of the hard palate in Japanese and Indian children. The materials for study were serial upper jaw plaster casts of 58 Japanese (29 boys and 29 girls) aged 3 to 7 years, and 93 Indians (46 boys and 47 girls) aged 5 to 8 years. They Observed and measured the palatal rugae, the incisive papilla and the shape of the hard palate using the method of Yamazaki, following Lysell's and Hauser's. The differences according to population, palatal findings and sex are summarized as the number of primary rugae of Japanese children was more than those of Indian children, but the numbers of transverse palatal rugae were the same. There were differences between Japanese and Indian children in the primary rugae shapes, the posterior limit of the rugae zone, the number and position of the secondary rugae and fragmentary rugae. The incisive papilla of the Japanese children was a little larger than those of the Indians. Generally the incisive papillas of the two populations were pear-shaped, but the Indians showed more variability. The palatal raphe of the Japanese was wider than those of the Indians. The number of children with no palatal raphe branch was large for Indian children, but small for Japanese. The frontal view of the hard palate of Japanese children was broad and that of Indian children was narrower than the Japanese. The palatal shape of the two populations was almost trapezoidal. The occlusal view of the two populations was broad and U-shaped. There were many transverse palatal rugae in the two populations at the left side. The posterior limit of the rugae zone of the left side was shifted further back than the right side. Hence it was concluded that there are obvious differences in the rugal pattern of various races. <sup>(22)</sup>

Muthusubramaniam et al, in 2005, conducted a study to examine the extent of palatine rugae preservation for use as identification tool to burn victims and cadavers, thus simulating forensic cases of incineration and decomposition. Patients with pan facial third-degree burns were examined within 72 hours of their accident. In addition human cadavers stored in mortuary at 5 degree centigrade's at 30-40 % humidity and kept for 7 days and assessed for the condition of palatine rugae. The author took the photographs of the palatine rugae using palatine mirror. The study results showed that among the subjects with third-degree pan facial burns, 93 percent of palatal rugae were normal. The authors observed no changes in the color or surface anatomy of the palatine rugae in 77 % of human cadavers. They concluded that the palatine rugae could be used as a reference landmark during forensic identification of the individual.<sup>(23)</sup>

Thomas and Van Wyk in 1987 described the identification of severely charred edentulous body with the help of dentures in the victims mouth, that were compared with another set found in the persons home , plaster casts of tissue surfaces of both sets of maxillary dentures were made. The investigators delineated and photographed the rugae and midpalatal raphae. They made tracings of each set of rugae on acetate paper and superimposed them on the photograph of the other cast. The tracings established a concordance between the two sets of dentures.<sup>(2)</sup>

Palatoscopy has its own advantages and disadvantages. Palatoscopy might not be so useful in ante mortem data collection procedures. Another aspect of palatoscopy that one must consider is the possibility of rugae pattern forgery. In a case report, Gitto et al, in year 1999, described a method where palatal rugae were added to a complete denture in order to improve speech patterns in some patients. This process can lead to false identity exclusion due to misleading ante mortem data.<sup>(5)</sup>

## CONCLUSION

Personal identification is a difficult issue, involving different disciplines, from forensic odontology to genetics in forensic medicine: however, sometimes forensic pathologists and anthropologists immediately opt for genetic methods which may be more time consuming and expensive and ignore the potential of

odontological methods: among these palatal rugae are less expensive and very easy to observe.

Rugoscopy was absolutely individually and could be used as a personal print for identification especially that, it is completely sex and age independent. The presence or absence of teeth never affect rugae pattern and longitudinal study's for the same person showed its stability. Rugoscopy could be a definite means of personal identification in the forensic odontostomatology and is of great importance and value in medico-legal aspects. To give rugoscopy such importance, previous recording, scanning and preservation through dental casts and computer records are essential.

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# Profile of Medicolegal Cases at Sri Siddhartha Medical College and Hospital, Tumkur

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## ABSTRACT

Drawing a public attention and awareness towards casualties is important to prevent unnatural deaths; this possibly could reduce the incidence of such cases. This is a retrospective study (3 years & 11 months) conducted to understand the magnitude & pattern of medicolegal cases in this region of the state.

In this study revealed that road traffic accidents (64.6%) constituted the majority of medicolegal cases out of 1300, followed by assault and poisoning (10.3% and 8.4% respectively). Male predominance is quite evident. The affected age group is 21-30 years (30.5%) followed by 31-40 years and were more prone to such casualties

**Keywords:** Medicolegal case, Injury, RTA, Fall from height, Poisoning

## INTRODUCTION

A medicolegal case is a case of injury or illness where the attending doctor, after eliciting history and examining the patient, thinks that some investigation by law enforcement agencies is essential to establish and fix responsibility for the case in accordance with the law of land.<sup>1</sup>

Injury is defined under section 44 IPC as “any harm whatever illegally caused any person, in body, mind, reputation or property”.<sup>2</sup>

In spite of recent advancement of technology in the field of medical sciences, death and deformities due to all causes, are yet to be controlled successfully; rather incidences of road traffic accidents has been increasing at an alarming rate in our country and also throughout the world.<sup>3</sup>

By the year 2020 it is estimated that in countries like India, mortality from injury will be more than those from communicable diseases. Despite this documentation, injuries are still not well recognized as major public health problem in this country.<sup>4</sup>

Road traffic injuries account for 2.1% of global mortality. The developing countries bear a large share of burden and account for about 85% of the deaths as a

result of road traffic crashes.<sup>5</sup> India account for about 10% of road accident fatalities worldwide.<sup>6</sup>

The present study is an attempt to address this deficit in this zone by providing epidemiological profile of medicolegal cases. The accidental causes from major part of this study, more attention has been given to their evaluation and prevention.

## MATERIAL AND METHOD

The study was retrospective analysis from 1<sup>st</sup> Jan 2008 to November 30<sup>th</sup> 2011 of all medicolegal cases admitted in emergency department of Sri Siddhartha Medical College & Hospital, Tumkur. This institute is situated in the rural area of Karnataka along the side of national highway (NH-206). The collected data were analyzed and compared with other studies.

## OBJECTIVES

1. To analyze pattern of medicolegal cases.
2. To draw public attention and awareness towards traumatic casualties.
3. To suggest preventive measures, this possibly could reduce incidence of these cases.

**OBSERVATIONS AND RESULTS:****Table No. 1: Gender wise distribution.**

| Sex    | 2008 | 2009 | 2010 | 2011 | Total | Percentage |
|--------|------|------|------|------|-------|------------|
| Male   | 324  | 244  | 279  | 177  | 1024  | 78.76%     |
| Female | 71   | 69   | 81   | 55   | 276   | 21.24%     |
| Total  | 395  | 313  | 360  | 232  | 1300  | 100%       |

**Table No. 2: Age wise distribution.**

| Age in years | 2008 | 2009 | 2010 | 2011 till Nov. | Total | Percentage |
|--------------|------|------|------|----------------|-------|------------|
| 0-10         | 21   | 23   | 14   | 7              | 65    | 5%         |
| 11-20        | 56   | 37   | 56   | 21             | 170   | 13%        |
| 21-30        | 150  | 96   | 85   | 66             | 397   | 30.5%      |
| 31-40        | 76   | 66   | 85   | 64             | 291   | 22.6%      |
| 41-50        | 46   | 39   | 51   | 38             | 174   | 13.5%      |
| 51-60        | 26   | 28   | 40   | 17             | 111   | 8.5%       |
| 61-70        | 12   | 13   | 20   | 13             | 58    | 4.4%       |
| 71-80        | 5    | 11   | 8    | 4              | 28    | 2%         |
| >80          | 3    | 0    | 1    | 2              | 6     | 0.5%       |
| Total        | 395  | 313  | 360  | 232            | 1300  | 100%       |

**Table. No 3: Year wise distribution of cases.**

| Sl. No | Type of cases           | 2008 |        |       |            | 2009 |        |       |            |
|--------|-------------------------|------|--------|-------|------------|------|--------|-------|------------|
|        |                         | Male | Female | Total | Percentage | Male | Female | Total | Percentage |
| 1      | RTA                     | 230  | 28     | 258   | 65%        | 162  | 45     | 207   | 66%        |
| 2      | Poisoning               | 26   | 22     | 48    | 12%        | 18   | 9      | 27    | 8.6%       |
| 3      | H/o Fall                | 7    | 0      | 7     | 1.7%       | 10   | 0      | 10    | 3.1%       |
| 4      | Snake bite              | 9    | 2      | 11    | 2%         | 3    | 0      | 3     | 0.9%       |
| 5      | Animal injuries         | 4    | 0      | 4     | 1%         | 2    | 0      | 2     | 0.6%       |
| 6      | Railway accidents       | 0    | 0      | 0     | 0%         | 1    | 0      | 1     | 0.3%       |
| 7      | Assault                 | 30   | 10     | 40    | 10%        | 22   | 6      | 28    | 8.5%       |
| 8      | Brought dead            | 10   | 3      | 13    | 3%         | 14   | 6      | 20    | 6.2%       |
| 9      | Burns                   | 0    | 1      | 1     | 0.25%      | 3    | 1      | 4     | 1.2%       |
| 10     | Industrial accidents    | 2    | 2      | 4     | 1%         | 1    | 0      | 1     | 0.3%       |
| 11     | Hanging                 | 1    | 2      | 3     | 0.75%      | 0    | 1      | 1     | 0.3%       |
| 12     | Electrical injuries     | 3    | 1      | 4     | 1%         | 4    | 0      | 4     | 1.2%       |
| 13     | Insect bite             | 1    | 0      | 1     | 0.25%      | 2    | 1      | 3     | 0.9%       |
| 14     | Self inflicted injuries | 1    | 0      | 1     | 0.25%      | 1    | 0      | 1     | 0.3%       |
| 15     | Alcohol case            | 0    | 0      | 0     | 0%         | 1    | 0      | 1     | 0.3%       |
|        | Total                   | 324  | 71     | 395   | 100%       | 244  | 69     | 313   | 100%       |

**Table. No 4: Year wise distribution of cases.**

| Sl. No | Type of cases        | 2010 |        |       |            | 2011 Till November |        |       |            |
|--------|----------------------|------|--------|-------|------------|--------------------|--------|-------|------------|
|        |                      | Male | Female | Total | Percentage | Male               | Female | Total | Percentage |
| 1      | RTA                  | 185  | 47     | 232   | 64.4%      | 116                | 27     | 143   | 59%        |
| 2      | Poisoning            | 12   | 9      | 21    | 5.8%       | 5                  | 9      | 14    | 5.7%       |
| 3      | H/o Fall             | 12   | 0      | 12    | 3.3%       | 12                 | 1      | 13    | 5.3%       |
| 4      | Snake bite           | 3    | 0      | 3     | 0.8%       | 0                  | 0      | 0     | 0%         |
| 5      | Animal injuries      | 1    | 1      | 2     | 0.5%       | 1                  | 0      | 1     | 0.4%       |
| 6      | Railway accidents    | 0    | 0      | 0     | 0%         | 1                  | 0      | 1     | 0.4%       |
| 7      | Assault              | 28   | 11     | 39    | 10.8%      | 18                 | 9      | 27    | 11.1%      |
| 8      | Brought dead         | 21   | 3      | 24    | 6.6%       | 9                  | 18     | 27    | 11.1%      |
| 9      | Burns                | 1    | 5      | 6     | 1.6%       | 0                  | 0      | 0     | 0%         |
| 10     | Industrial accidents | 9    | 1      | 10    | 2.7%       | 5                  | 0      | 5     | 2%         |
| 11     | Hanging              | 1    | 3      | 4     | 1.1%       | 1                  | 0      | 1     | 0.4%       |
| 12     | Electrical injuries  | 4    | 0      | 4     | 1.1%       | 3                  | 1      | 4     | 1.6%       |
| 13     | Insect bite          | 2    | 0      | 2     | 0.5%       | 4                  | 0      | 4     | 1.6%       |
| 14     | Self inflicted       | 0    | 1      | 1     | 0.2%       | 2                  | 0      | 2     | 0.8%       |
|        | injuries             |      |        |       |            |                    |        |       |            |
|        | Total                | 279  | 81     | 360   | 100%       | 177                | 65     | 242   | 100%       |

**Table No.5: Total year wise (2008 to 2011 till November) distribution of cases.**

| Sl. No | Type of cases        | Males | Females | Total | Percentage |
|--------|----------------------|-------|---------|-------|------------|
| 1      | RTA                  | 693   | 147     | 840   | 64.6%      |
| 2      | Poisoning            | 61    | 49      | 110   | 8.4%       |
| 3      | H/o fall             | 41    | 1       | 42    | 3.2%       |
| 4      | Snake bite           | 15    | 2       | 17    | 1.3%       |
| 5      | Animal injuries      | 8     | 1       | 9     | 0.6%       |
| 6      | Railways             | 2     | 0       | 2     | 0.14%      |
| 7      | Assault              | 98    | 36      | 134   | 10.3%      |
| 8      | Brought dead         | 54    | 20      | 74    | 5.6%       |
| 9      | Burns                | 4     | 7       | 11    | 0.8%       |
| 10     | Hanging              | 3     | 6       | 9     | 0.6%       |
| 11     | Electrical injuries  | 14    | 2       | 16    | 1.2%       |
| 12     | Industrial accidents | 17    | 3       | 20    | 1.5%       |
| 13     | Insect bite          | 9     | 1       | 10    | 0.7%       |
| 14     | Self inflicted       | 4     | 1       | 5     | 0.38%      |
| 15     | Alcohol abuse        | 1     | 0       | 1     | 0.07%      |
|        | Total No. of cases   | 1024  | 276     | 1300  | 100%       |

## DISCUSSION

In the present study 1300 medicolegal cases were admitted in emergency department of Sri Siddhartha Medical College and Hospital, Tumkur during the period of 3 years and 11 months (1<sup>st</sup> Jan 2008 to 30<sup>th</sup> November 2011). Road traffic accidents comprised of maximum number of cases 840 (64.6%) followed by assault 134 (10.3%) and poisoning 110 (8.4%). A study

by Garg V and Verma SK had findings with RTA followed by poisoning and fall from height.

There is overwhelming majority of the male victims 1024 (78.76%), consistent with other studies.<sup>5-10</sup> It is due to greater male exposure on roads, construction area and farms.

The most common age group affected was 21-30 years, included 397 (30.5%) and next age is 31-40 years

291(22.6%). This is consistent with the studies available in India and other countries.<sup>8-13</sup> except 31- 40 years. Males between 10 to 39 years of age are most likely to be victims.<sup>14</sup> A study by Agnihotri the commonest age group was 16-30 years and most common cause was road traffic accident followed by acts of violence.<sup>15</sup> It is consistent with our findings. This age group is the most active phase of life, physically and socially and hence outnumbers the other age groups.

### CONCLUSION

The present study shows that road traffic accidents, assault and poisoning were maximum when compared to other cases. This is continue to be a growing menace, incurring heavy loss of valuable man power and human resources in the form of death and disability along with a corresponding drain of potential economic growth.

The basic principles of injury prevention are education, engineering, uniform enforcement of law and order, pre-hospital care and evaluation. Proper education, training for safety standards and behavior modification are interlinked; and are required to be implemented in the community to prevent all kinds of injuries including domestic violence. In our opinion, the above considerations certainly are result oriented and will be extremely helpful to manage the health of all communities.

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# A Study of Poisoning Cases at Harsha Hospital Nelamangala, Bangalore Rural

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## ABSTRACT

Acute poisoning with various substance is common everywhere. The earlier initial resuscitations, gastric decontamination and use of specific antidotes, better the outcome. The aim of this study was to characterize the poisoning cases admitted to the Harsha Hospital, Nelamangala, Bangalore rural. The cases admitted to the emergency department of Harsha Hospital during the period of 3 years and 3 months (1st January 2009 to 31st March 2012) were evaluated retrospectively. We reviewed data obtained from the hospital medical records. This study highlighted the need to establish a poison information center for the better management and prevention of poisoning cases.

**Keywords:** Poisoning, Organophosphorous compound, Carbamates, Rat poison

## INTRODUCTION

Death due to poisoning has been known since time immemorial. Poisoning is a major problem all over the world, although its type and the associated morbidity and mortality vary from country to country. According to the legal system of our country, all poisoning death cases are recorded as unnatural death and a medico-legal autopsy is routine. Toxicology is defined as the study of the effects of chemical agents on biological materials. Modern toxicology is a multidisciplinary science and forensic toxicology is required to determine any exogenous chemical agent present in biological specimens made available in connection with medico-investigations.<sup>1</sup>

Organophosphorous poisoning occurs very commonly in southern India, where farmers form a significant proportion of the population who commonly use organophosphorous compounds like parathion as insecticides. Thus, due to the easy accessibility of these compounds, a large number of suicidal cases are encountered in this region.<sup>2</sup>

## MATERIAL AND METHOD

These retrospective studies were done on medico-legal cases admitted to the emergency department of Harsha Hospital during the period of 3 years and 3 months (1<sup>st</sup> January 2009 to 31<sup>st</sup> March 2012).

## OBSERVATIONS AND RESULTS

In the study following results were found. There was total of 1510 cases during this period 149 (9.84%) cases were due to poisoning.

**Table No. 1** shows age and sex wise distribution of poisoning cases. Among the 149 cases 97 (65.10%) were seen in males and 52 (34.90%) were seen in females with a ratio of 2:1. The incidence was more in the age groups of 21 – 30 years 87 (58.3%) followed by 11 – 20 years 25 (16.7%) and 31 – 40 years 18 (12.32%). In case of males incidence were more in males in age group 21 – 30 years followed by 31 – 40 years but in females the incidence is more in 21 – 30 years followed by 11 – 20 years.

**Table No. 1. Age and sex wise distribution of poisoning deaths**

| Age        | Male | Female | Total | %age   |
|------------|------|--------|-------|--------|
| 0 – 10yrs  | 0    | 1      | 1     | 0.67%  |
| 11 – 20yrs | 14   | 11     | 25    | 16.7%  |
| 21 – 30yrs | 56   | 31     | 87    | 58.3%  |
| 31 – 40yrs | 14   | 4      | 18    | 12.32% |
| 41 – 50yrs | 9    | 4      | 13    | 8.7%   |
| 51 – 60yrs | 3    | 0      | 3     | 2.01%  |
| 61 – 70yrs | 1    | 1      | 2     | 1.3%   |
| Total      | 97   | 52     | 149   | 100%   |

**Table No.2: Type of poisons.**

| Poison            | Male | Female | Total | Percentage |
|-------------------|------|--------|-------|------------|
| Organophosphorous | 48   | 18     | 66    | 44.29%     |
| Organochloride    | 30   | 24     | 54    | 36.24%     |
| Carbamates        | 13   | 8      | 21    | 14.09%     |
| Rat poison        | 4    | 2      | 6     | 4.02%      |
| Unknown           | 2    | 0      | 2     | 1.36%      |
| Total             | 97   | 52     | 149   | 100%       |

**Table No. 2.** Shows the type of poison used. The organophosphorous poisoning was most commonly used poison in both males 48 (32.22%) and females 18 (12.08%). The other types of poisoning cases were as follows, organochloride in males (30) and females (24), carbamates poisoning in males (13) and females (8), Rat poison in males (4) and females (2) respectively.

**Table No. 3. Manner of poisoning**

| Manner of death | Male | Female | Total | %age   |
|-----------------|------|--------|-------|--------|
| Suicidal        | 68   | 40     | 108   | 72.48% |
| Accidental      | 29   | 11     | 40    | 26.84% |
| Homicidal       | 0    | 1      | 1     | 0.68%  |
| Total           | 97   | 52     | 149   | 100%   |

**Table No. 3.** Show manner of poisoning. The deaths due to suicidal poisoning 108 (72.48%) were more in both sexes compared to death due to accidental 40 (26.84%) or homicidal poisoning 1 (0.68%).

## DISCUSSION

Poisoning exposure was grouped into 15 toxic substances. Pharmaceutical or medicinal drug use, recreational drug use and chemical exposure were also captured and categorized into intended groups, which included suicide abuse, misuse, unintentional exposure, therapeutic use and adverse drug events (ADE). During the study it was found that occurrence of poisoning was more in males 97 (65.10%) than females 52 (34.90%) in the ratio of 2:1<sup>3,4,5,6,7,9 - 16</sup>. The incidence was more in 21-30 years age group<sup>2,5,9,14,15</sup> followed by 11 -20 years and 31 – 40 years. In study by Sang Ki Lee et al<sup>12</sup> age group of poisoning was more in 50 – 59 years followed by 40 – 49, 60 – 69 and 70- 79 years respectively.

The common type of poisoning was organophosphorous compound<sup>5,10,14</sup> followed by poisoning organochloride compound<sup>8</sup> and carbamates. But in study by others<sup>1,2</sup> pesticides poisoning was followed by carbon monoxide and drugs. In study by Ismail Birincioglu et al<sup>4</sup> carbon monoxide poisoning was first followed by prescription and narcotic drugs. In study by Kanchan T et al studied males preferred organophosphorous compound and females were zinc phosphide and carbamates to commit suicide, but there was no such differentiation seen in our study.

In the study it was found that suicidal poisoning 108 (72.48%) was more than the incidence of accidental 40 (26.84%) or homicidal poisoning 1 (0.68%). The suicidal poisoning occurred more in males 68 (45.63%) than females 40 (26.84%). The suicidal poisoning was more than accidental or homicidal poisoning in our and other studies<sup>3,5,12,15</sup>, but in study by others<sup>1,2,7</sup> accidental poisoning was more than suicidal followed by homicidal poisoning. In study by Vougiouklakis T et al<sup>7</sup> substance of abuse was more in accidental poisoning. The incidence of homicidal poisoning was low 1 (0.68%)<sup>1,2</sup> and among this, incidence was more in children than adults.

## CONCLUSION

This study highlighted the lacunae in the services of tertiary care hospitals and the need to establish a poison information center for the better management and prevention of poisoning cases. To reduce deaths from self poisoning, it require interventions to reduce the incidence of this harmful behavior by detecting cause, by providing psychiatric counseling and provide quick medical help in management of acute poisoning. The more stringent legislation and enforcement regarding the sale and distribution of the toxic substance is needed and substitution of the pesticide with safer agents is necessary.

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# Accidental Hanging - A Case Report

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## ABSTRACT

An interesting case of fatal accidental hanging of a habitual burglar is presented in the present case report which poses a controversy in diagnosis whether it is to be included under accidental hanging or in positional asphyxia. This case report stresses on the importance of crime scene visit, police record verification and meticulous autopsy so as to come to an appropriate conclusion regarding the cause of death

**Keywords:** *Accidental Hanging, Positional Asphyxia*

## INTRODUCTION

Accidental hanging is uncommon among the adult population; however it is commonly reported among the children, old people, drug addicts, and alcoholics and in mentally retarded group. Most of the times burglars try to get into the house through small opening like windows, ventilators and digging holes into the walls, during this process there is a high possibility of miss judgment about the entry dimensions of these structures. In the process of doing so, there is a high risk of victim to suffer from positional asphyxia/ accidental hanging. Here we are presenting an interesting case where in a burglar succumbed to death because of accidental hanging. This case reiterates the importance of crime scene investigation, police record verification and meticulous autopsy to come to a conclusion regarding the cause of death.

## CASE REPORT

A 30-year-old male of height 160 cms was found suspending from a window of a locked house, which is situated at about 240 cms from the ground on early hours. Neighbors informed the nearest police station about the incident. The police along with the team of forensic medicine experts visited crime scene. The person was identified to be a habitual burglar in that locality from the police records. On examination, the person was trapped between two window bars as seen in photograph No 1 with feet not touching the ground, while upper limbs and head was inside the house. Right hand was firmly holding the window bar. The body was compressed between the iron bar in front over the neck fig No 2, and by window on the back at the level of T6 as seen in fig No 3. The body was shifted to mortuary for autopsy.



Fig. 1. Position of the victim as seen from the front



Fig. 2. Compression of the neck by window bar



Fig. 3. Position of victim as seen from behind

Individual was found to be well nourished and moderately built. Rigor mortis was found in upper and lower limbs; postmortem hypostasis was found in the lower limbs and fixed. Intense cyanosis was noticed in both the hands. On examination of neck, a linear contusion measuring 12.0 cms x 2.5 cms was present over front of neck from the right extending to the left angle of mandible. On dissection there was petechial hemorrhages and muscular contusions underneath it. Another linear contusion was noted on the posterior aspect of the chest at the level of T6 vertebrae placed horizontally and was measuring about 25.0 cms x 2.0 cms and on dissection underlying muscles were contused.

Dark-red liquid blood, diffuse visceral congestion, sub-pleural petechial hemorrhages were the other positive findings noticed at the internal examination. No poisonous substance/alcohol was found in the viscera.

### DISCUSSION

In accidental hanging, a person gets hanged to death accidentally and unintentionally. This can occur in a person, while at work, play, show performance as in circus party, while imitating judicial hanging or exhibiting hanging exercises and also during autoerotic masochistic performances<sup>1</sup>. A person can also get hanged accidentally, when the neck compressed below the chin by getting suspended by the steering wheel of a motor car, tail board of a lorry or cart, edge of a sofa or arm of a chair. Positional asphyxia, also known as postural asphyxia, on the other hand is a form of

asphyxia which occurs when someone's position prevents them from breathing adequately. The cases of positional asphyxia<sup>2</sup>, include those in which subjects fall into confined spaces and are unable to get out. The present case demonstrates the features of both the entities. The diagnosis of positional asphyxia is essentially based on three criteria: body position obstructing normal breathable air exchange, impossibility to move to another position and exclusion of other causes of natural or violent death. positional asphyxia can occur in various ways, some of which are better defined and more easily characterized from a pathophysiologic perspective (such as the head-down position), whereas in others, the forced position of the head, neck, or rib cage in restricted spaces can trigger asphyxiating mechanisms (blocking of the respiratory orifices, atypical compression of the neck, compression or immobilization of the thorax)<sup>3</sup>. Incomplex situations in which it is difficult, if not impossible, to identify the precise mode of asphyxiation can be included among cases of positional asphyxia in the widest sense of the term. According to these authors, not only cases in which body posture leads to restricted or confined positions but also those in which it causes hyperflexion of the head and neck, with partial or complete obstruction of the respiratory tract, or atypical compression of the neck, must be included under the heading of positional asphyxia<sup>4</sup>. For positional asphyxia as a means of death must be taken into account in cases featuring the following conditions: the position of the body must hinder the normal exchange of respiratory gases; there must be a reason why it was impossible to change this position; other causes of natural or violent death must be excluded. Positional asphyxia can explain the cause of death in various circumstances when autopsy does not reveal significant findings. It must be taken into account not only in suspected cases of death caused by alcohol or drug abuse or in subjects afflicted by psychiatric diseases but also in vehicle crashes and accidents at work<sup>3</sup>. The present case poses a problem in diagnosis in that the findings such as accidental occurrence, suspension of the body at the neck, constricting force being the weight of the body as indicated by the feet not touching the ground and hypostasis seen in the dependent parts of the body goes in favour of accidental hanging. However, absence of the ligature material takes the case diagnosis away from

hanging. Other findings such as the body position obstructing the normal breathing, inability of the person to change the position of the body and absence of the natural diseases as depicted at autopsy moves the cases diagnosis towards the entity of positional asphyxia. Absence of elements such as intoxication of the person by alcohol or other agents and absence of psychiatric illness in the victim makes the cases difficult to be included under the diagnosis of positional asphyxia. Based on the findings of the case, opinion expressed by various authors would it be appropriate to include such cases under the purview of the term positional asphyxia?

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# Relationship of Palatoradicular Groove and Localized Periodontitis: Three Case Reports

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## ABSTRACT

The clinical significance of Palatoradicular Groove (PRG) is related to the incidence of localized periodontitis with or without pulpal pathosis, depending on the depth, extent and complexity of the groove. This report describes the various treatment modalities in the management of chronic localized periodontitis associated with PRG on maxillary lateral incisors. From eliminating the groove to placement of bone graft and platelet rich fibrin in the osseous defect, resulted in an uneventful healing and the tooth continued to serve well.

**Keywords:** Palatoradicular Groove, Lateral Incisors, Platelet Rich Fibrin

## INTRODUCTION

Palato-radicular grooves (palato-gingival grooves, distolingual grooves, radicular lingual grooves, coronoradicular grooves) are developmental morphological defects affecting maxillary incisors. Developmentally, this is thought to represent an infolding of the enamel organ and Hertwig's epithelial root sheath.<sup>[1]</sup> It was first described in the literature by Oehlers in 1958 as a radicular invagination of an upper lateral incisor in a Chinese female.<sup>[2]</sup> Prichard was the first to state that, lingual grooves on maxillary teeth are a predisposing factor to localized severe periodontal destruction.<sup>[3]</sup> Plaque and calculus may accumulate in the depth of the groove, making proper oral hygiene at this site difficult, if not impossible for the patient. The reported prevalence of palato-radicular groove varies from 2.8 to 8.5%. Out of these, the maxillary lateral incisors are affected up to 90% of the times.<sup>[4,5]</sup>

This report includes three cases involving PRG and describes the relationship between the PRG, its affects on the periodontium, and the clinical management of such situations.

## CASE 1

A 24 year old male reported to the Dept. of Periodontology and Oral Implantology, Rural Dental College and Hospital, Loni, with a chief complaint of pain and swelling in the upper left palatal region since 15 days. Detail dental history revealed that 2 months back, the patient had taken some over the counter medication from a pharmacist after which the swelling

subsided. But, again after 15 days he noticed a swelling in the same region and hence had come for the treatment of the same. Clinically, a periodontal abscess with a probing depth of 10 mm was evident palatally (Fig 1). Further exploration revealed a palatoradicular groove in association with 22. Radiograph showed bone loss along the mesial aspect of 22 approaching the periapical area. Medical and family history was non-contributory. After evaluation of the detail case history and consultation with the endodontist, root canal therapy was planned followed by elimination of the groove. 1 month following the endodontic treatment, a full thickness mucoperiosteal flap was reflected which

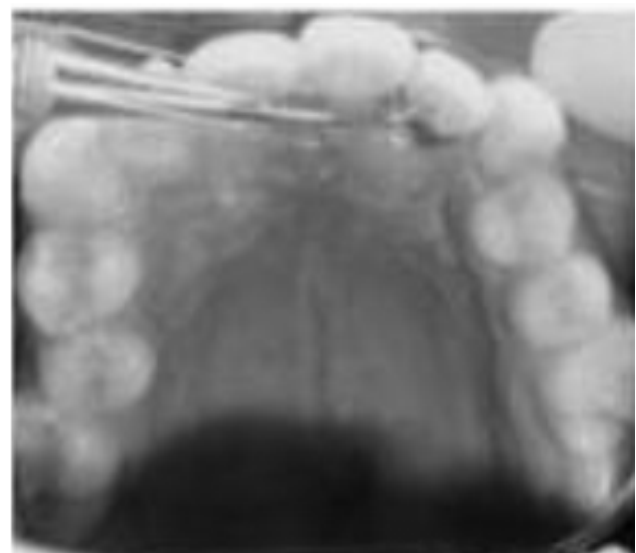


Fig. 1. Probing depth of 10 mm with 22

revealed a shallow groove of 4 mm in length associated with mild bone loss in the vicinity of the groove. After thorough debridement, the groove was eliminated by radiculoplasty, (Fig 2) followed by sutures. Postoperatively, the patient was prescribed analgesics and antibiotics along with 10 ml of 0.2 % Chlorhexidine mouthrinse. The periodontal dressing and sutures were removed after one week and the post surgical healing period was uneventful.



Fig. 2. Shallow groove being eliminated by radiculoplasty

After 6 months, the probing depth had reduced from 10 mm to 2 mm (Fig.3) with a satisfactory bone fill on the radiograph.

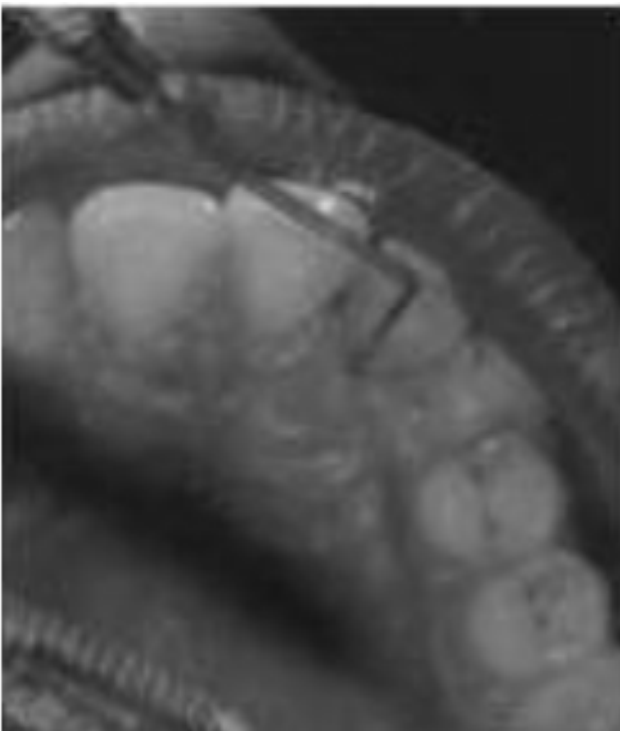


Fig. 3. Probing of 2mm at 6 months

## CASE 2

A 27 year old female was referred to the Department of Periodontics with a chief complaint of pus discharge from the labial vestibule in the region of 11 since 1 month. Her medical and dental history was non-contributory. Clinical examination disclosed a localized periodontal pocket of 4mm at the palatal surface of 11 (Fig.4) and concomitantly, a palatoradicular groove running lateral to the cingulum was appreciated. The surrounding palatal gingiva appeared slightly reddish and the oral hygiene was fair. Radiographic investigation showed mild bone loss along the mesial aspect of 11. Thermal and electric pulp testing gave delayed response and hence endodontic treatment was initiated on the same day. After 2 weeks of endodontic treatment, a full thickness mucoperiosteal flap was raised from 13 to 23. A shallow palatoradicular groove extending 3 mm from the cemento enamel junction was noticed associated with mild bone loss along the mesial and marginal region. Thorough sub gingival scaling, root planning and curettage was done. The groove was eliminated with long thin tapered fissure medium grit diamond point. Cavity was etched & bonded with Xeno III & restored with resin modified glass ionomer cement (RMGI) (Fig.5). Flap was sutured followed by placement of periodontal dressing for 1 week along with the prescribed antibiotics and analgesics.



Fig. 4. Periodontal pocket of 4 mm at the palatal surface of 11



Fig. 5. Saucerization of the groove.

Re-examination at 6 months after the periodontal surgery revealed reduction in probing pocket depth from 4 mm to 1 mm with no signs of bleeding on probing (Fig.6) and a significant radiographic bone formation in the periodontal intrabony defect.

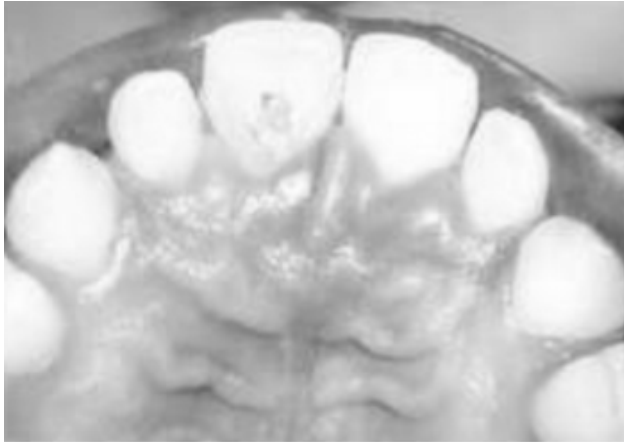


Fig. 6. Healthy sulcus at 6 months.

### CASE 3

A 35 year old male patient reported to the department with a chief complaint of pus discharge in the upper right anterior region since one month. Dental history revealed that the patient had undergone endodontic treatment and repeated oral prophylaxis sessions in association with 12 in a private clinic 5 months back. On further examination, pus exudation was evident from the palatal surface of 12. No significant medical or family history was elicited. Careful periodontal probing revealed the presence of palatoradicular groove, with a probing depth of >7mm, associated with grade II mobility in relation to 12 (Fig.7). The periodontal pocket was present only along the groove and other surfaces showed minimal probing depth. Radiographic examination revealed advanced bone loss on the distal aspect of 12 reaching the apex (Fig.8).

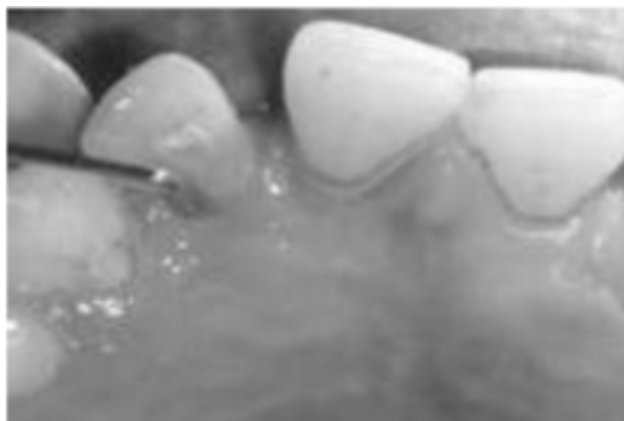


Fig. 7. Pus exudation and Periodontal pocket along the groove.



Fig. 8. Advanced bone loss on the distal aspect reaching the apex

After the initial phase of thorough scaling and root planning, occlusal interferences on the incisor was eliminated by coronoplasty. It was then decided to raise a flap to gain access for the elimination of the groove. Following local anesthesia, a full thickness mucoperiosteal flap was reflected on the palatal aspect of the affected tooth. Flap reflection and debridement revealed a deep groove that extended beyond the middle third of the root. "Saucerization" of the groove (grinding it out to its depth using a small round diamond bur) was accomplished followed by sealing the groove with resin modified glass ionomer cement (RMGI) (Fig.9). Root conditioning was done with citric acid and platelet rich fibrin along with the bone graft (Fig.10) was placed in the advanced circumferential bony defect (Fig.11) associated with and the flaps approximated with sutures.

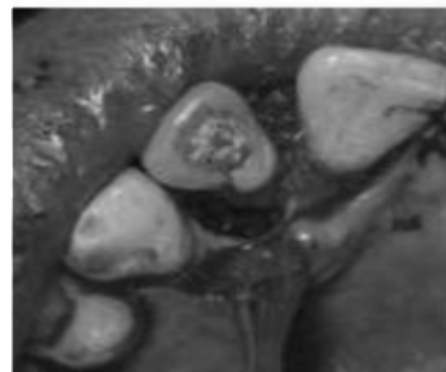


Fig. 9. Groove and the associated circumferential defect

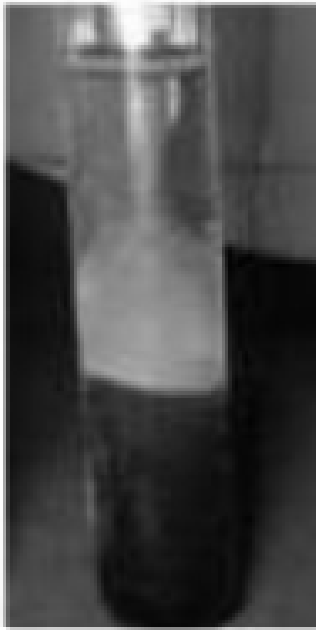


**Fig. 10.** Platelet rich fibrin along with bone graft

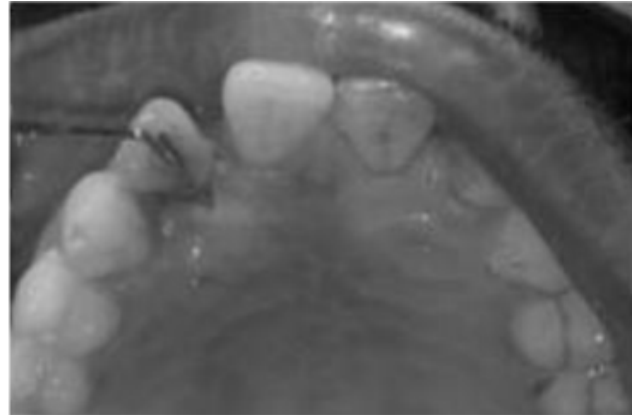


**Fig. 12.** At 6 months, asymptomatic, 2 mm non bleeding sulcus.



**Fig. 11.** Plateletrich fibrin and bone graft placed in the advanced circumferntial bony defect

Review after 6 months showed complete resolution and reduction in the pocket depth of 6 mm in 6 months and resulted in the patient being asymptomatic with a 2 mm non bleeding sulcus present on the palatal aspect (Fig.12) . Radiographically, reduction in the extension of the defect with marked bone fill was evident (Fig.13).

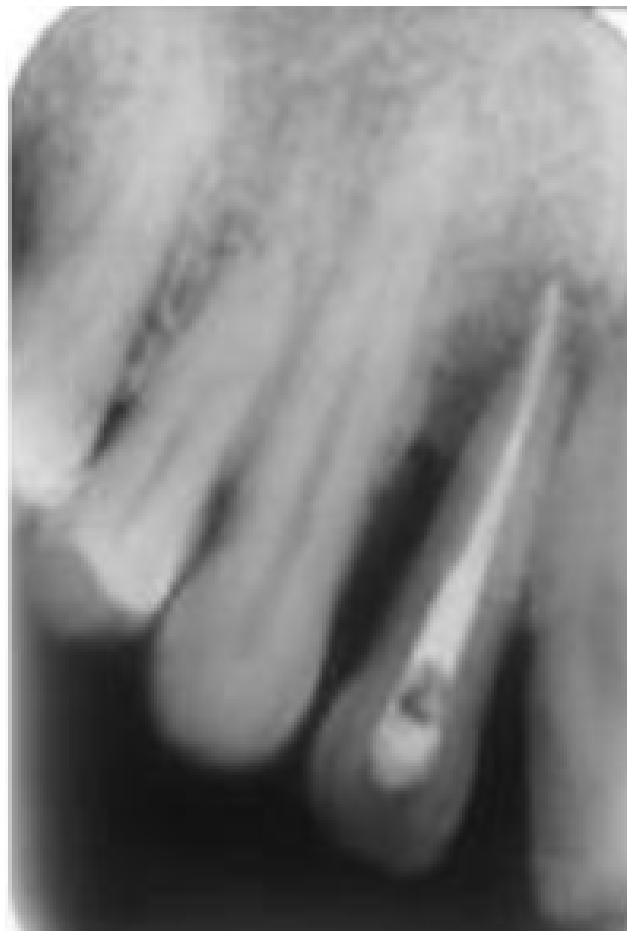


**Fig. 13.** Prgression of hard tissue healing at 6 months.

## DISCUSSION

The presence of a palatogingival groove is considered to be an important contributing factor to the development of localized chronic periodontitis, for it favors the accumulation and proliferation of bacterial plaque deep into the periodontium. It is a developmental anamoly of variable extent and depth that may or may

not involve a communication between the pulp cavity and the periodontal tissue. These defects usually occur on the lingual surface of the midpalatal, mesial, or distal region of the tooth. The groove is more likely to form on the lateral surfaces

(60 percent) than in the mid-palatal region (40 percent).<sup>[6]</sup> However, Kogon<sup>[4]</sup> found the groove to be more frequently found on the mid-palatal regions. Goon *et al.* suggested a classification, which represents two types of Radiculo lingual Grooves (RLG's), simple and complex.<sup>[7]</sup> The simple RLGs do not communicate with the pulp and represents a partial unfolding of Hertwig's epithelial root sheath, while complex RLGs communicate directly with the pulp and groove that extend the length of the root. In rare cases, the groove may lead to minor accessory root, which may contain a root canal.

This report presents three cases of PRG's demonstrating variations in the depth, extent of involvement of the pulp, attachment apparatus, the amount of bone loss and various treatment modalities applied in their management.

In the first case, the patient was a young male with severe periodontal pocket depth, moderate destruction of the attachment apparatus, and a mild groove, which was managed by radiculoplasty. Such mild grooves are not always associated with tremendous bone loss and hence its elimination resulted in the complete gain of the attachment apparatus and gave an excellent prognosis. The second case involved a moderate pocket depth with a mild bone loss in which the groove was restored with RMGI cement. Glass ionomer cement has been used as it has an antibacterial effect, chemical adhesion to the tooth structure, and good sealing ability.<sup>[8]</sup> Clinical and histological studies have shown that there is an epithelial and connective tissue adherence to the glass ionomer cement during the healing process. When a sealant of some type is used, it prevents the formation of a dead space between the gingival flap and the depressed groove.<sup>[9]</sup> The third case had a complex groove with moderate bone loss which was then treated with a periodontal flap surgery along with bone graft and PRF. Conditioning of the groove has been done as it removes the surface debris, increases the wettability, and increases the bond strength of the glass ionomer cement.<sup>[9]</sup> The PRF was prepared in accordance with the protocol developed by Choukroun *et al.*<sup>[10]</sup> PRF is a second generation platelet concentrate widely used to accelerate soft and hard tissue healing. PRF would be able to progressively release cytokines during fibrin matrix remodelling and such a mechanism might explain the clinically observed healing properties of PRF. It is also found that PRF causes slow release of growth factors (such as transforming growth factor-1 $\beta$ ,

PDGF-AB, and vascular endothelial growth factor) and glycoproteins (such as thrombospondin-1) during  $\geq 7$  days.

Various treatment modalities have been suggested that depend on the severity of the periodontal defect and type of groove (deep or shallow). Ramirez,<sup>[11]</sup> Holem,<sup>[12]</sup> and Everett and Kramer<sup>[13]</sup> suggested a curettage procedure with or without a flap and odontoplasty for shallow grooves. Lee *et al.*<sup>[1]</sup> recommended doing an apically repositioned flap and placing amalgam in the groove. Rankow and Krasner<sup>[14]</sup> advocated surgical exposure of the defect and flattening of the groove by grinding with a high-speed diamond bur or fine stone, with or without application of the guided tissue regeneration (GTR) technique. Everett and Kramer<sup>[13]</sup> advised that if the groove is very deep, the prognosis is usually hopeless. Holem suggested that conservative treatment by eliminating the groove with a restorative material, or orthodontic extrusion of the tooth but, there is a general consensus that these usually have predictable failures. Perhaps the best technique or treatment option can be the use of GTR or enamel matrix derivatives, which usually show true regeneration of the lost attachment apparatus. In spite of all these treatment procedures, if periodontal maintenance at regular intervals is not carried out following any or all of these treatments, there is a greater likelihood of failure.<sup>[14]</sup> A combination of endodontic, intentional replantation and Emdogain therapy was used to successfully treat a maxillary lateral incisor that had a palatogingival groove by Al-Hezaimi K *et al* in 2004.<sup>[15]</sup>

The prognosis of the teeth with radicular grooves depends on the severity of the periodontal

problem, accessibility and the type of groove (shallow, deep or long, short).

In the last decades, with extensive knowledge of bone grafts, guided tissue regeneration, mechanical barriers, growth factors, we decided to treat the groove and the associated bony defect using various treatment modalities mentioned in the literature.

The present case series reflected a significant gain in the attachment and a appreciable radiographic bone formation in the circumferential defect as in case three, supporting the role of various growth factors present in the PRF in accelerating the soft and hard tissue healing. Also, as it was a circumferential defect, it provided the best spatial relationship for defect bridging by vascular and cellular elements from the periodontal ligament and adjacent osseous wall. Space maintenance is provided by the defect walls providing protection and retention of the grafts.

However, after 6 months all the three cases depicted marked reduction in the probing depth, with adequate bone fill and a healthy non-bleeding sulcus which resulted in the longevity of the tooth.

### CONCLUSION

We found excellent prognosis with teeth having palatoradicular groove provided that the etiology is eliminated followed by precise selection of the method employed and regular follow ups.

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# A Two Year Study of Pattern of Fatal Childhood Burns in V.S. General Hospital, Ahmedabad

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## ABSTRACT

Burns - the second leading cause of death in children. This study investigates the distribution and pattern of childhood burns in autopsies coming to mortuary of VS General hospital, Ahmedabad. The study was conducted at mortuary of VS General hospital from November 2009 to October 2011. Only children < 18 years of age have been included in the study. Total 2246 autopsies including 345 of burns injury were conducted in study period of which 50 cases were of < 18 years of age. Residence area did not make much difference in incidence of burns. The commonest manner of death due to burns was accidental followed by suicidal and homicidal, where flame burns were found to be the commonest type of burns.

**Keywords:** Accidental, Childhood burns, Flame burns

## INTRODUCTION

Burns - the second leading cause of death in children under the age of five and the commonest cause of accidental deaths in the home setting.<sup>1</sup>

In recent years, there has been an increase in the attention directed at the epidemiology of childhood injuries.<sup>2,3</sup> In children, males have regularly been associated with an excess risk of burn injuries compared to females<sup>3,4</sup>, although some studies have reported that in certain societies females may be at a higher risk because of their involvement in domestic activities near open fires and because of clothing styles.<sup>5,6</sup>

## MATERIAL AND METHODS

V S general hospital is a tertiary care hospital with one of the renowned teaching institutes of Ahmedabad where the study regarding the pattern of childhood burns has been undertaken retrospectively in the duration of Nov 2009 to Oct 2011. All the data regarding age, sex, socio economic status, residential area, type of burns, manner of burns, total body surface area involved and the survival period was gathered from the hospital records. All the gathered data of the deceased < 18 years of age due to burns was analyzed and tabulated properly.

## RESULTS

### Age of the deceased (TABLE I)

Among all 50 cases, 14 (28%) aged 0-4 years, 2(4%) aged 5-8 years, 8 (16%) aged 9-12 years, and 26 (52 %) aged 13-18 years.

TABLE I : Age of the deceased

| Age group   | No. of Cases | Percentage |
|-------------|--------------|------------|
| 0-4 years   | 14           | 28 %       |
| 5-8 years   | 2            | 4 %        |
| 9-12 years  | 8            | 16 %       |
| 13-18 years | 26           | 52 %       |
| Total       | 50           | 100 %      |

### Sex of the deceased (TABLE II)

Among all 50 cases included 13 (26%) males and 37 (74%) females with (female-to-male ratio: 2.84 to 1).

TABLE II : Sex of the deceased

| Sex     | No. of cases | Percentage |
|---------|--------------|------------|
| Males   | 13           | 26 %       |
| Females | 37           | 74 %       |
| Total   | 50           | 100 %      |

### Socio economic status of the deceased (TABLE III):

Among all 50 cases, maximum number of cases 43 (86%) were coming from low socio economic class while 7 (14%) were from middle socio economic class.

**TABLE III : Socio economic status of the deceased**

| Socioeconomic status | No. of cases | Percentage |
|----------------------|--------------|------------|
| Low                  | 43           | 86 %       |
| Middle               | 7            | 14 %       |
| High                 | 0            | 0 %        |
| Total                | 50           | 100 %      |

#### **Residence of the deceased (TABLE IV):**

Among all 50 cases, 19 females and 8 male, total 27 (54%) of them were having the residence in urban areas while 18 females and 5 males, total 23 (46%) were from rural areas.

**TABLE IV : Residence of the deceased**

|         | Urban        |            | Rural        |            |
|---------|--------------|------------|--------------|------------|
|         | No. of cases | Percentage | No. of cases | Percentage |
| Males   | 8            | 16 %       | 5            | 10 %       |
| Females | 19           | 38 %       | 18           | 36 %       |
| Total   | 27           | 54 %       | 23           | 46 %       |

#### **Type of burn of the deceased (TABLE V):**

Among all the 50 case flame burns (66%) were the commonest type of burns, followed by Scald burns (22%), (12%) had electric burns.

**TABLE V : Type of burn of the deceased**

| Type of Burns | Male         |            | Female       |            | Total        |            |
|---------------|--------------|------------|--------------|------------|--------------|------------|
|               | No. of cases | Percentage | No. of cases | Percentage | No. of cases | Percentage |
| FLAME         | 4            | 8 %        | 29           | 58 %       | 33           | 66 %       |
| SCALD         | 5            | 10 %       | 6            | 12 %       | 11           | 22 %       |
| ELECTRICAL    | 4            | 8 %        | 2            | 4 %        | 6            | 12 %       |
| CHEMICAL      | 0            | 0 %        | 0            | 0 %        | 0            | 0 %        |

#### **Manner of burns of the deceased (TABLE VI)**

Accidental burns were the commonest with 45 (90%) cases followed by suicidal 3 (6%) and homicidal 2 (4%). Both the homicidal cases have the residence in urban area.

**TABLE VI : Manner of burns of the deceased**

| Manner     | No. of Cases | Percentage |
|------------|--------------|------------|
| Accidental | 45           | 90 %       |
| Suicidal   | 3            | 6 %        |
| Homicidal  | 2            | 4 %        |
| Total      | 50           | 100 %      |

#### **Body surface area involved of the deceased (TABLE VII)**

**TABLE VII : Body surface area involved of the deceased**

| Body surface area involved | No. of cases | Percentage |
|----------------------------|--------------|------------|
| ≤ 30%                      | 7            | 14 %       |
| 31-40 %                    | 6            | 12 %       |
| 41-50 %                    | 4            | 8 %        |
| 51-60 %                    | 9            | 18 %       |
| 61-70 %                    | 5            | 10 %       |
| 71-80 %                    | 2            | 4 %        |
| 81-90%                     | 4            | 8 %        |
| ≥ 90 %                     | 13           | 26 %       |
| Total                      | 50           | 100 %      |

Among all the cases, maximum number of cases 13 (26%) were having > 90 % of their body surface area involved in burns.

#### **Distribution according to survival period of deceased (TABLE VIII):**

**TABLE VIII : Distribution according to survival period of deceased**

| Survival period | No. of cases | Percentage |
|-----------------|--------------|------------|
| SPOT DEAD       | 2            | 4 %        |
| 1 TO 6 HRS      | 5            | 10 %       |
| 6 TO 12 HRS     | 3            | 6 %        |
| 12 TO 24 HRS    | 1            | 2 %        |
| 24 TO 36 HRS    | 1            | 2 %        |
| 36 TO 72 HRS    | 2            | 4 %        |
| 3 TO 7 DAYS     | 16           | 32 %       |
| > 7 DAYS        | 20           | 40 %       |
| Total           | 50           | 100 %      |

## **DISCUSSION**

In the present study, number of female children affected is more than male children because of the involvement of the female children in the kitchen and also maximum cases were seen in low socio economic status because of poverty. Due to low socio economic status and more members per family, there is need of more earning. Father and mother both go to work and female children of the family are supposed to take care of the kitchen and other small children of the family. In the present study majority of the burn deaths were due to flame burns followed by scalds and electric burns, similar to other studies.<sup>7, 9,10</sup> Most of the studies like Ghuliani KK<sup>7</sup>, Gupta RK et al<sup>8</sup> and Sharma BK et al<sup>11</sup> including this study show that majority of the cases

were accidental deaths followed by suicidal deaths. This inference of manner of death is based on history given either by police or and relatives, circumstantial evidences and post-mortem findings. The higher number of accidental burns especially in female children is due to their involvement in domestic cooking work and low quality of cooking appliances due to poverty responsible for accidental cases. In majority of the victims more than 50 % of the body surface area was burnt.

### CONCLUSION

Pattern of childhood burns in present study are more or less similar to the pattern found in most of the other Indian studies. The observations also indicate that patients with lesser percent burns or with lesser risk of death are not able to survive even at the tertiary level of our health care system. It can be a result of either poor approach or negligence or improper up gradation of the so-called ICU's and burn-units with today's techniques and advanced mode of facilities. This study also identified specific patterns and risk factors of childhood burns in Ahmedabad. Burn prevention efforts should be directed towards mitigating these risk factors as well as educating parents and keeping cooking appliances away from children

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# Identification by Sim Cards - A Case Report

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## ABSTRACT

Identification is crucial in any criminal investigation particularly in a murder case. In this particular case the police failed to search, the pocket contents of the dead body, and missed an important clue which would have helped them in saving time and prevention of decomposition of the body. As the time passes, because of the decomposition changes there is possibility of important medical evidences. Though the body was kept in cold storage, because of frequent power failures and lack of generator back up, body being in the cold storage for almost more than six days, it started already decomposition. If the doctor is not skilled there is every chance of missing important findings on the body.

This case narrates the importance of searching pocket contents which is simple and easy.

**Keywords:** *Unidentified Body, Pocket Contents, SIM Cards, Strangulation, Homicide*

## INTRODUCTION

The objectives of post mortem examination are to determine the identity of the deceased. Accurate identification is mandatory because unclaimed bodies, portions of the dead body or bones, etc, may sometimes be brought for examination to support false charge. In a charge of homicide, the two essential requirements are: Positive identification of the victim and the proof of death by the criminal act of the accused. This is collectively termed as corpus delecti<sup>1</sup>.

Identification of the living is usually carried out by the police. However, where medical knowledge is needed for elucidation of disputed facts, a medical person is consulted.

A medical person is mainly concerned with the identification of a dead body. It is required when an unknown dead body is found on/along the road or field, or in a railway compartment or in water. Identification in cases of decomposed /mutilated bodies and of skeletal remains is another problem encountered

by the medical person. Accurate identification is mandatory for the establishment of corpus delecti after homicide since unclaimed bodies, portions of dead body or bones are sometimes brought to the doctor to support a false charge.

The term 'Corpus Delecti' means the body of offence or the body of crime. In a charge of homicide, it includes:

1. Positive identification of the dead body (victim) and
2. Proof of its death by criminal act of the accused.

The interest of the community in the scene of death, after the discovery of remains or after a mass disaster, is often overwhelming. The disturbance of the scene by curiosity seekers or by ill-trained police personnel may prelude not only accurate identification of the dead bodies but also complete collection of physical evidence. This invites the 'Law of Multiplicity of Evidence' to play its role wherever called for. The Supreme Court has laid down that in law, a conviction for an offence does not necessarily depend upon the 'corpus delecti' being proved<sup>1</sup>.

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**Brief history of the case;** One female aged about 20 years left the house because of frustration, she was having health problem related to her menstruation, after the medical checkups doctors told her that she is having problems with the sex organs like- small uterus, absent ovary on one side and cystic ovary on other side, and advised her to undergo "sex change operation" she

had asked her father to arrange for the said surgery & the father was postponing it, this was frustrating her, she informed to one of her relative / friend about the surgery and non cooperation in the family, he promised her that he knows the doctors, and will accompany her to Chennai, and asked her to bring cash and gold ornaments to meet the expenses, she collected the amount and gold from her house and kept one note saying that she is leaving the house permanently, and requesting not to make any attempt to trace her, she followed him in his four wheeler, On the way he strangulated her, collected the amount and gold, threw the body on the road side, and fled the scene.

On 26/10/2006 the police found the body as an “UNKNOWN FEMALE”, aged 20 years, kept in cold storage of Mysore Medical College mortuary up to 31/10/2006, during these six days the police tried to identify the address of the deceased, when all their attempts failed, finally brought requisition to conduct post mortem examination.

Before conducting autopsy on any UNKNOWN BODY it is usual practice to note down, all the clothes and articles present on the body, and hand over the same to the concerned police after duly recording it in the post mortem report while examining the clothes two SIM cards were found, in one of the pockets of the pant, immediately these were given to the concerned police and asked them to contact the stored numbers in those SIM cards, the call went to one of her friend the address was traced, the autopsy was stopped at that stage (the body was not yet opened) the parents came in the same evening and identified the body, after identification post mortem examination revealed the homicidal strangulation, the suspect was arrested, gold was recovered, was booked under homicidal section, court punished him with a term of life imprisonment, very recently.

SIM CARDS of the mobile helped in identification and solving the murder case.

**Post mortem examination:** Length of the body was 158cms, moderately built with light brown complexion, body is cold being refrigerated, rigor mortis had passed off, body was distended, discolored in the face and chest, marbling present over the chest, post mortem peeling of skin present at places; and post mortem blebs were seen at places.

### External injuries

1. Abrasion of 3 X 1cms present on the right upper eye lid.
2. Abrasion of 2 X 1cms present on the lower eye lid – right sided.
3. Abrasion of 2 X 1cms present 3cms below injury No. 2
4. Irregular abrasion in an area of 25 X 24cms present on the right sided abdomen.
5. Horizontally placed ligature mark of 19 X 2cms, extending from left sided upper part of the neck, and running backwards to the back of the neck. The skin over the neck was dark brown and hard.
6. Abrasion of 3 X 3cms present on the right knee.
7. Abrasion of 2 X 1cms present 10cms below external injury No. 6
8. Abrasion of 6 X 2cms present on the front of outer aspect of left wrist.
9. Abrasion of 28cms extending from back of right thumb running to front of wrist and towards the elbow, present intermittently in its course.
10. Abrasion of 1.5 X 1cms present on the left cheek.

All the injuries numbering 1 to 10 are ante mortem. Ligature mark is ante mortem caused due to flexible ligature material.

### Clothes and articles present on the body

- i. Denim Colored jeans pant.
- ii. Grey colored full sleeved shirt.



Fig. 1. Unknown Body found on 26/10/2006

- iii. Yellow colored under wear.
  - iv. Black colored "T" shirt.
  - v. Black colored sacred thread around the neck.
  - vi. Two SIM cards found in the pant Pockets.
- All were handed over to the concerned police.



Fig. 2. Same Body on 31/10/2006 in spite of being kept in cold storage



Fig. 3. Strangulation mark



Fig. 4. Showing abrasions and marbling

## Internal examination

1. Head –scalp and skull, membranes, and brain; on reflection of the scalp, extra-vasation of blood (contusion) present over occipital area and also over both temporal areas. Skull-intact; brain covered by sub arachnoid hemorrhage over the cerebellum. Brain was softened; white matter showed multiple petechial hemorrhages.



Fig. 5. Contusion over the back of head

2. Thorax- walls and ribs, pleura and cavity, larynx and trachea, lungs, pericardium and heart, large vessels; Ribs and sternum intact, remaining things were softened, discolored and decomposed.
3. Abdomen –walls were intact, stomach contained rice meals-150ml, smells normal, partially digested; all organs were softened discolored and decomposed.
4. Genitourinary system, uterus normal in size, empty, on right side ovary was missing and left side was small and cystic.

On dissection of the neck, the tissues around the ligature mark showed extravasation (contusion) of blood. Thyroid cartilage and hyoid bone were intact.

Final opinion as to cause of death: Death was due to asphyxia consequent to ligature strangulation with the presence of external injuries and head injury.

## DISCUSSION

1. The post-mortem examination is a legal requirement when the cause of death is not known. The objectives of a post-mortem examination are:
  1. To establish the identity of an individual
  2. To know the cause of death
- 3 In case of fetus to determine whether it was viable or not.

2. During external examination, the clothes on the body should be examined carefully for stains and tears as these may indicate struggle before death. The pockets of the clothes should be checked and any item found should be noted in the post-mortem report<sup>2</sup>.
3. The main part of corpus delicti is the establishment of identity of the dead body, and infliction of violence in a particular way, at a particular time and place, by the person or persons with the crime and none other. The case against the accused cannot be established unless there is convincing proof of these points. If the victim's identity is not known, it becomes difficult for the police to solve the crime. The identification of a dead body and proof of corpus delicti is essential before a sentence is passed in murder trials, as unclaimed, decomposed bodies, or portions of a dead body, or bones are sometimes produced to support false charge. However, cases have occurred where the death sentence was passed even when body was not found or was not identified<sup>3</sup>.
4. In the dead unknown medico legal cases, police plays an important role in the matter of identification. Police official has to investigate the case and advertise the details including identifying features of the unknown person in the news papers and media etc. For this purpose he has to photographs and finger prints. He has to find out the relatives who identify the person before conduction of medico legal postmortem<sup>4</sup>.
5. Clothing may also provide a clue to the social status and occupation of the individual. Pocket contents

like papers, letters, keys, Driving license / identity card, diary, passport etc often provide identification.

However, a person might have been clothed in borrowed garments or second hand clothes and rarely a body may be deliberately clothed in another's attire and documents / articles, etc. placed in the pockets in order to mislead the investigative agencies<sup>1</sup>.

## CONCLUSION

Unidentified dead bodies are to be given 'at most care' during post mortem examination. All parameters should be used to identify the dead body. Sometimes they may be murder cases.

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# Estimation of Stature from Head Length in Hyderabad Karnataka Region

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## ABSTRACT

Estimation of stature from various measurements of the body is vital to medicolegal investigations. Correlation coefficients and formulae derived for regression equation to estimate the approximate height are age and race specific. It is a cross-sectional study carried out to estimate stature from head length on 100 students of M.R. Medical College, Gulbarga aged above 21 years hailing from Hyderabad Karnataka region and also to evaluate the correlation of body height and head length. A Positive and statistically significant correlation between total height and other cranial parameters like head height, head length & head breadth was observed in both the sexes ( $P < 0.01$ ). The correlation coefficient between head length and stature is 0.664 in males, 0.661 in females, The results indicate that the cranial dimension like head length provides an important means in estimating the stature of an unknown individual. Regression equations derived -  $Ht = (a) + (b) \times \text{Head length}$  can be used to estimate the stature, in this Hyderabad Karnataka region.

**Keywords:** Stature, Head length, Correlation Coefficient

## INTRODUCTION

The stature of an individual is an inherent characteristic and is considered as one of the important parameters for personal identification<sup>1</sup>. Identification is necessary in living persons, recently dead persons, decomposed bodies, mutilated bodies and skeleton<sup>2</sup>. The term stature originated from the Latin word *statura* meaning 'height' or size of the body and from the Latin verb *stare*, meaning to 'stand'. Stature relates the natural standing height of the living individual<sup>3</sup>. Estimation of stature is an important tool in forensic examination especially in unknown, highly decomposed, fragmentary and mutilated human remains. In such cases while conducting a medicolegal autopsy, forensic pathologist is often asked to opine about the identity of the deceased. Stature being one of the criteria of personal identification helps in narrowing down the investigation process, and thus provides useful clues to the investigating agency. Stature has a definite and proportional biological relationship with each and every part of the human body<sup>4</sup>. Anthropometric measurements differ in different races, sex and age groups. Many workers have attempted to estimate the stature of the individuals belonging to different races and age groups using different measurements of the body. In the

present study an attempt has been made to find out the correlation and derive a regression formula between head length and stature in a sample of population of this region.

## MATERIALS AND METHOD

The present study was carried out on randomly selected 100 Students (50 Boys & 50 Girls) of M.R. Medical College, Gulbarga hailing from Hyderabad Karnataka region. The study was carried out in the Department of Forensic Medicine & Toxicology, M.R. Medical College Gulbarga. The aims and objectives of the intended study were properly explained to all the students and consent is taken on the proforma.

Head length is measured by the spreading caliper as the straight distance between glabella and opisthocranium and height is measured as the vertical distance from floor to the vertex by staturimeter on subjects standing erect against the wall with their head resting in Frankfurt plane.

Data for the present study comprises of students who are above 21 years of age. Subjects with any congenital abnormality affecting the head, any spinal abnormality, other than Hyderabad-Karnataka regions and less than 21 years of age were excluded from the



Fig. 1. Showing measurement of head length.

study.

## OBSERVATIONS & RESULTS

Age and sex wise distribution of all the cases involved in the study are shown in table No 1, whereas height wise and head length wise distribution of all the cases are shown in table no 2 & 3. Regression analysis is carried out to find the strength of relationship between the height and the head length using the Statistical Package for Social Sciences (SPSS) 11.5 package. Results were expressed as Mean  $\pm$  SD. A comparison of the mean values between the genders was performed using the t-test. P value  $< 0.05$  was considered statistically significant.

It can be observed from the table no 4 that the independent variable (head length) is strongly related to the dependent variable (height). Mean and Standard deviation of height and head length in Boys, Girls and combined cases is also shown in the table. The correlation coefficient between head length and stature is 0.664 in Boys, 0.661 in Girls and 0.671 in general population (combined). Height v/s head length is a positive correlation and is statistically highly significant as  $P < 0.01$ .

Regression Equations to estimate Stature from Head length: ( $Y = a + bx$ ): where  $Y$  = Total height and  $x$  = head length.

For Boys:  $Y = 73.85 + 5.25 x$ .

For Girls:  $Y = 72.01 + 4.94 x$ .

For Combined Boys and Girls:  $Y = 66.25 + 5.46 x$ .

Table No. 1: Age and sex wise distribution of data in all the cases

| Age       | Boys |        | Girls |        | Total |
|-----------|------|--------|-------|--------|-------|
|           | No.  | %      | No.   | %      |       |
| 21-22     | 8    | 16.00  | 29    | 58.00  | 37    |
| 23-24     | 28   | 56.00  | 17    | 34.00  | 45    |
| 25-26     | 11   | 22.00  | 4     | 8.00   | 15    |
| $\geq 27$ | 3    | 6.00   | 0     | 0.00   | 3     |
| Total     | 50   | 100.00 | 50    | 100.00 | 100   |

Table No.2: Total height wise distribution of cases:

| Height(cms) | Boys |        | Girls |        | Total |
|-------------|------|--------|-------|--------|-------|
|             | No.  | %      | No.   | %      |       |
| 155-159     | 0    | 0.00   | 12    | 24.00  | 12    |
| 160-164     | 0    | 0.00   | 35    | 70.00  | 35    |
| 165-169     | 13   | 26.00  | 3     | 6.00   | 16    |
| 170-174     | 19   | 38.00  | 0     | 0.00   | 19    |
| 175-179     | 16   | 32.00  | 0     | 0.00   | 16    |
| 180-184     | 2    | 4.00   | 0     | 0.00   | 2     |
| Total:      | 50   | 100.00 | 50    | 100.00 | 100   |

Table No.3: Head length wise distribution of cases:

| Head Length (cms) | Boys |        | Girls |        | Total |
|-------------------|------|--------|-------|--------|-------|
|                   | No.  | %      | No.   | %      |       |
| 17.0-17.9         | 0    | 0.00   | 15    | 30.00  | 15    |
| 18.0-18.9         | 25   | 50.00  | 30    | 60.00  | 55    |
| 19.0-19.9         | 20   | 40.00  | 5     | 10.00  | 25    |
| 20.0-20.9         | 5    | 10.00  | 0     | 0.00   | 5     |
| Total             | 50   | 100.00 | 50    | 100.00 | 100   |

Table No. 4: Comparison between height and head length in Boys, Girls & combined cases:

| Parameters             | No: of cases | Mean $\pm$ S.D.  | Correlation between height and head length and P-value                                             |
|------------------------|--------------|------------------|----------------------------------------------------------------------------------------------------|
| Height                 | 100          | 167 $\pm$ 6.32   |                                                                                                    |
| Head Length (Boys)     | 50           | 18.98 $\pm$ 0.67 | $r = 0.664$ , $t = 6.20P < 0.01$ . Hence positive correlation is highly significant.               |
| Head Length (Girls)    | 50           | 18.06 $\pm$ 0.81 | $r = 0.661$ , $t = 6.12P < 0.01$ . Hence positive correlation is highly significant.               |
| Head length (Combined) | 100          | 18.52 $\pm$ 0.79 | $r = 0.671$ , $t = 8.93P < 0.01$ . Boys & Girls) Hence positive correlation is highly significant. |

## DISCUSSION AND CONCLUSION

The present study provides valuable new data pertaining to the head length and its correlation with the stature in a sample of population belonging to Hyderabad Karnataka region. Correlation coefficients between the total height and the head length among the subjects involved in the present study were found to be statistically significant and positive indicating a

strong relationship between the two parameters. Dimensional relationships between body segments and the whole body have been of interest to artists, scientists, anatomists, anthropologists and forensic experts for long time<sup>5</sup> and hence attracted many workers to derive formulae to estimate stature from various cranial dimensions.

Saxena et al<sup>6</sup> derived a regression equation between head length and height in Uttar Pradesh. Their correlation coefficient between head length and height was +0.2048. This was cephalometric study on males aged between 25-30 years where head length measurements were taken from nasion to inion. Similarly Jadhav et al<sup>7</sup> have showed positive correlation between head length and height with correlation coefficient +0.53. This study included both sexes aged between 17-22 years and head length measurements were taken between glabella and inion, where as in the present study head length is calculated from glabella to opisthocranium.

Isurani Ilayperuma (2010)<sup>8</sup> also estimated stature from the cranial dimensions like head length and found that Height v/s head length is a positive correlation and is highly statistically significant. M Chiba & K Terazawa<sup>9</sup> have estimated stature with head diameter in 124 Japanese cadavers (77 males & 47 females) with correlation coefficient of +0.39 in males and +0.003 in females. Patil and Mody<sup>10</sup> assessed the usefulness of maximum length of the skull in the estimation of stature in Indian sample. They derived regression equations but the measured parameter (maximum length of the skull) used by Patil and Mody differ from the maximum length of the head taken in present study. Patil and Mody took measurements from radiographs where as in present study measurements are directly taken on living.

The availability of the head or part of the head or even a dry skull is enough to assess the stature of the individual from the formula derived in this study. If either of the measurement (head length or total height) is known, the other can be calculated. This fact will be of practical use in medico legal investigations and in anthropometry. The method outlined above is simple, practical and gives reliable results and therefore it must be utilised and encouraged in day to day work in

forensic investigation. It is a non invasive, non time consuming and non expansive method with no specialized equipment or training required.

In forensic examinations and anthropological studies, prediction of stature from incomplete and decomposing cranial remains is vital in establishing the identity of an unknown individual. Therefore, formulae based on the cranial dimension like head length provides an alternative stature predictor under such circumstances. The cranium has easily identifiable surface landmarks making the measurements possible even in compromised conditions.

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# Myoepithelioma a Rare Salivary Gland Tumor - A Case Report

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## ABSTRACT

Myoepithelioma is a rare benign tumor of the myoepithelial cells, constituting 1.5% of the salivary gland tumors with equal frequency in men and women. It occurs in the range of 9-85 years. It is most common in the parotid gland and the hard and soft palate. It may contain acellular mucoid or hyalinized stroma and the tumor cells are unable to form ducts (None, <5-10% or <1 duct/HPF). A case of myoepithelioma has been reported.

**Keywords:** Myoepithelioma, Mucoid or Hyalinized Stroma, S-100, Plasmacytoid

## INTRODUCTION

Myoepithelial cells are epithelial in origin, contractile in nature and have some features of smooth muscle cells, including parallel arrays of actin filaments with multi-potential properties. They are an important component of some tumors, in particular, pleomorphic adenoma & myoepithelioma, where the characteristic myxoid or mucoid stroma is of myoepithelial origin. They support secretory cells, contract & widen the diameter of the intercalated ducts and aid in rupture of acinar cells packed with mucous secretion. Myoepithelioma is a rare benign neoplasm that occurs at any age, 48 % in parotid gland and 52 % in minor salivary glands. It does not have a potentially aggressive behavior<sup>1</sup>.

## CASE REPORT

A 49 year old male patient reported to the Department of Oral and Maxillofacial Pathology, Bharati Vidyapeeth Deemed University, Dental College and Hospital-Pune with a chief complaint of swelling on the soft palate since the last 8 years and difficulty in eating and swallowing since the last 3 months. On intraoral examination a slow growing swelling on the soft palate and oro-nasopharynx, with a non-ulcerated surface and firm consistency was noted.

**Investigations:** Patient was advised a PA view and lateral view.

It could not be differentiated whether there was a growth in the maxillary sinus or a nasal polyp. So a C T scan of the hard palate was advised which showed well defined soft tissue mass with mild enhancement in relation to posterior aspect of hard palate on right side extending into the soft palate. Compression over the oropharynx and nasopharynx due to the mass was seen. There was no evidence of lymphadenopathy or bony erosion. These features were highly suggestive of a benign lesion. Evidence of bilateral maxillary sinusitis was also noted.

Soft tissue lesions are better seen on M R I. So to determine the accurate extension of the lesion an MRI was advised, which showed a well-defined mass measuring 30mm x 27mm x 20mm, arising on the posterior end of the hard palate on the right side with the involvement of entire soft palate. The mass was causing indentation on the pharyngeal air column. Margins were well defined with no extension into surrounding tissue, no other bony involvement. Overall picture was suggestive of a well defined right sided hard & soft palate mass mostly benign or of a low grade malignancy as seen in figure 1.

**Figure1: MRI showing a well-defined mass measuring 30mm x 27mm x 20mm**

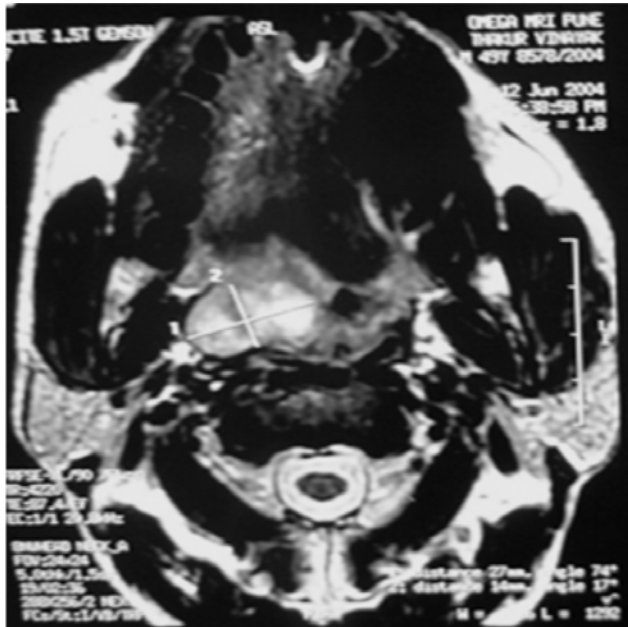


Figure 2: 4X showing encapsulated mass of tumor cells

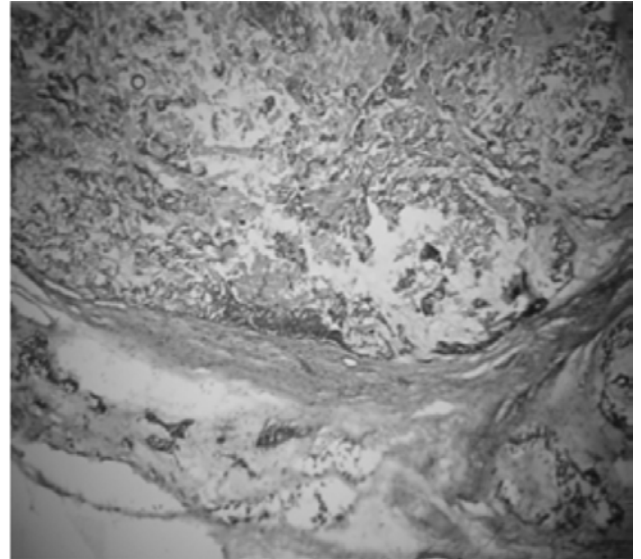
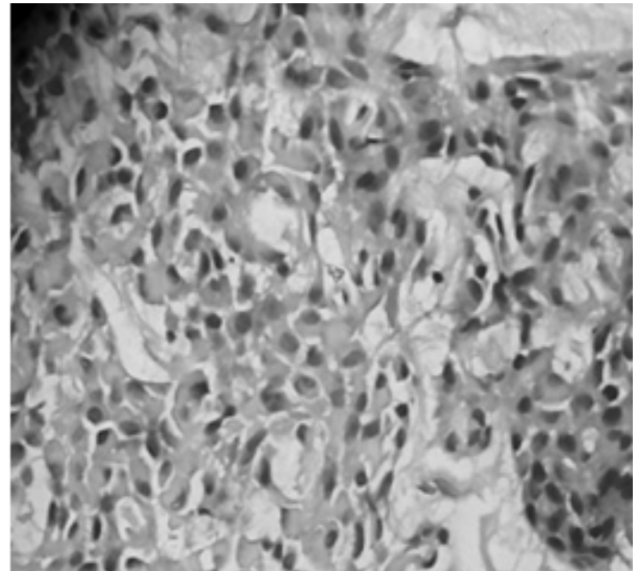


**Figure 3: 10 X showing plasmacytoid monomorphic tumor cells**



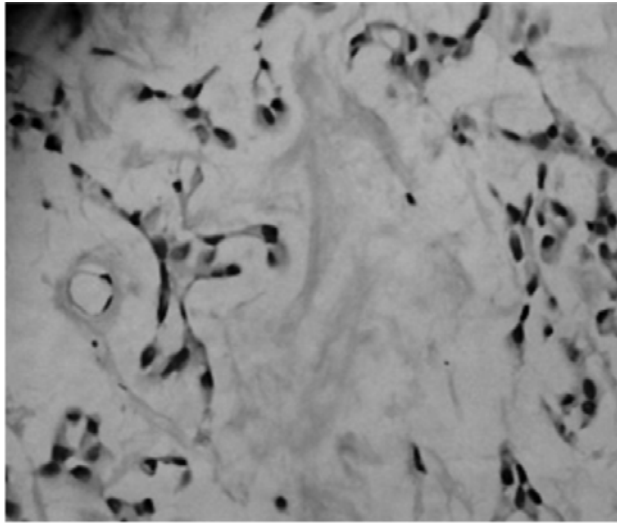
### Gross description of the biopsy specimen

The specimen consisted of a 3 x 2.5 x 2 cm in size soft tissue mass with smooth surface, firm in consistency & grayish white in color. The cut surface consisted of varying proportions of firm tan, gelatinous & granular areas. The tumor was enclosed by a thin rim of capsule.

## HISTOPATHOLOGY

The incisional biopsy section showed a mass composed of nests & cords of tumor cells in a collagenized stroma with a capsule, the tumor cells were plasmacytoid, monomorphic with abundant, dense glassy eosinophilic cytoplasm and eccentric nuclei. The cells lacked pleomorphism / atypia. Ductal differentiation was not seen. There was no evidence of a carcinomatous / sarcomatous transformation. Overall picture was suggestive of Plasmacytoid variant of myoepithelioma, as evident from figures 2, 3 and 4.

**Figure 4: 40 X showing tumor cells in a collagenized stroma**



To confirm the tissue of origin immunohistochemistry was done

The typical double staining of myoepithelial cells with markers particularly-S-100 was seen as seen in figures 5 and 6.

**Figure 5: IHC showing S100 POSITIVE**

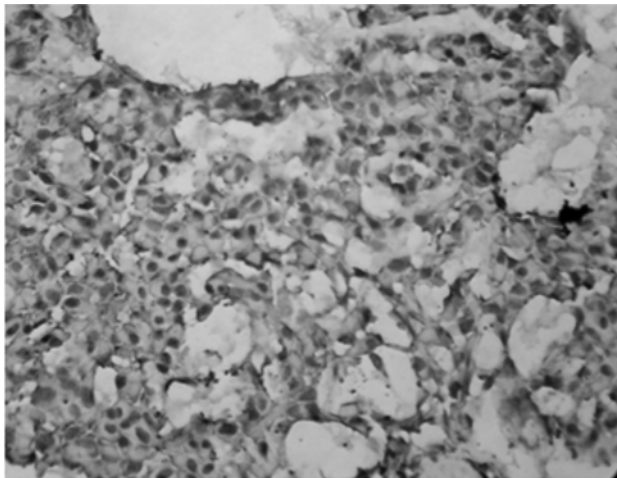
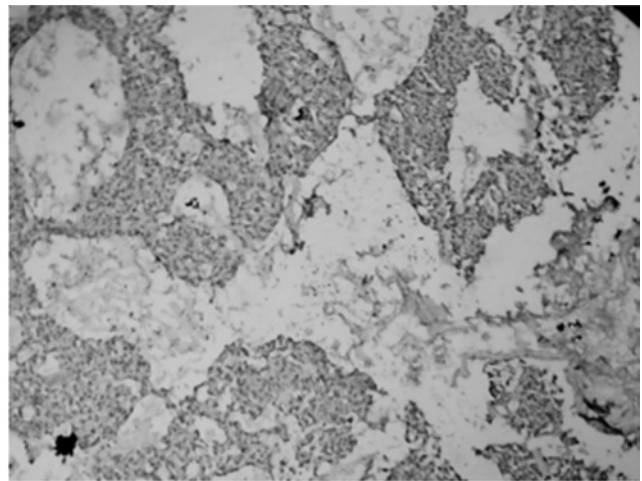


**Figure 6: IHC showing S100 POSITIVE**



## DISCUSSION

Tumours composed entirely or almost exclusively of myoepithelial cells are uncommon, accounting for less than 1 percent of all salivary gland tumours. The term myoepithelioma was apparently used first by Sheldon in 1943 who reported that 3 of 54 cases of so-called mixed salivary gland tumours were primarily composed of basket (myoepithelial) cells. The taxonomy of these cells is somewhat controversial. Some investigators prefer to classify these tumours as a separate type of monomorphic adenoma of the salivary gland and designate them as myoepithelioma. We and other pathologists use the designation of myoepithelioma but acknowledge that these adenomas represent one end of the spectrum of mixed tumour. Since occasional ductal elements may be present in an otherwise predominantly myoepithelial tumour, the designation of myoepithliomas opposed to mixed tumour with myoepithelial predominance is largely a matter of personal preference. Barnes and associates suggest that such a tumour is best designated as mixed tumour with a high content of myoepithelial cells if one or more ductal structures are noted in every 200X magnification field or if more than one small cluster of ducts is present within the tumour<sup>1,2</sup>.

## CLINICAL FEATURES

A review in 1985 by Barnes and associates noted 40 previously reported cases to which the authors added one new case. Twenty one (51 percent) of myoepitheliomas were located in the parotid gland, 11 (27 percent) were found on the palate and 5 (12 percent) were located in the submandibular gland. Two cases were present in the lip and cheek, and the gingival and retromolar area accounted for one case each. A review of 33 cases of myoepithelioma from the files of the AFIP showed that 21 percent were located in the parotid gland, 12 percent in the submandibular gland and 67 percent arose in the minor salivary glands with slightly over half of these being located on the palate. The age and sex distribution of myoepitheliomas is similar to that of mixed tumours. There are no distinctive clinical features and similar to most other salivary gland tumours, myoepitheliomas present as asymptomatic, slowly growing masses.

### Gross and microscopic features

Macroscopically, myoepitheliomas appear as well-circumscribed, frequently encapsulated tumours that show no features distinct from mixed tumours except for the absence of grossly myxoid or chondroid areas. Parotid myoepitheliomas are usually encapsulated, whereas those arising in the minor salivary glands may not demonstrate a capsule. Microscopically, they show three morphologic patterns. The spindle cell pattern is the most common and consists of a proliferation of spindle shaped cells with eosinophilic cytoplasm. These may be arranged in diffuse sheets or interlacing fascicles. Little intercellular fibrous stroma or ground substance is present. The plasmacytoid pattern shows groups of round cells with eccentric nuclei and eosinophilic, often hyaline appearing cytoplasm. Some authors have referred these cells as hyaline cells. These may be present in sheets of closely packed cells or in groups of cells separated by a loose, myxoid stroma. The third and least common pattern shows a combination of plasmacytoid and spindle shaped cells. The spindle cell pattern is most common in parotid tumours, whereas plasmacytoid is common in palatal tumours. The uncommon myoepitheliomas of the tongue tend to show a myxoid pattern. Lesions designated as myoepithelioma do not contain the characteristic myxochondroid stroma of the mixed tumour.

### Immunohistochemistry and ultrastructure

Neoplastic myoepithelial cells show immunoreactivity for cytokeratin, s-100 protein, glial

fibrillary acidic protein, vimentin and actin. Ultrastructurally, myoepithelial cells demonstrate desmosomes, cytoplasmic myofilaments and basal lamina<sup>3,4,6</sup>.

### Behaviour and treatment

Treatment of myoepitheliomas is similar to that of mixed tumours and consists of complete surgical removal. Most myoepitheliomas pursue a benign course with minimal tendency for recurrence. A few examples of malignant myoepitheliomas have been reported. According to several investigators there is some indication that the behaviour of spindle cell myoepitheliomas is correlated with the degree of cellular differentiation. Well differentiated lesions behave in a benign fashion, whereas less differentiated tumours with a myoepithelial nature that may be uncertain as visualized by light microscopy tend to behave in an aggressive or malignant manner. Plasmacytoid myoepitheliomas tend to follow a benign course.

## CONCLUSION

The rarity of myoepitheliomas and the varied phenotypic expression of myoepithelial cells may cause problem in diagnosis. Sciubba and Brannon noted that 7 of the 23 cases accessioned at the AFIP at the time of their study were initially mistaken for a malignant epithelial or mesenchymal lesion. Tumours consisting predominantly of spindle shaped myoepithelial cells may be difficult to differentiate from mesenchymal lesions such as fibrous histiocytoma, leiomyoma, or schwannoma. Use of immunohistochemical methods to demonstrate positive staining for immunoreactive cytokeratin, S-100 protein and glial fibrillary acidic protein helps to confirm the myoepithelial nature of the tumour. Similarly, a mixed tumour composed predominantly or entirely of plasmacytoid myoepithelial cells might be confused with a plasmacytoma. In such cases, immunohistochemical or ultrastructural studies may be used to confirm the diagnosis. Immunohistochemical or electron-microscopic studies may be necessary to establish the correct diagnosis<sup>4,6,7</sup>.

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**Conflict of interest:** Nil

**Source of support:** Self

**Ethical clearance:** The case was cleared by the institutional ethical committee headed by Dean of the faculty, Bharati Vidyapeeth Deemed University, Dental College and Hospital-Pune.

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# Variations in the Circle of Willis by MR Angiography

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## ABSTRACT

The arterial Circle of Willis at the base of the brain serves as a potential collateral pathway, which will maintain adequate cerebral perfusion in the case of diminished afferent blood supply through internal carotid and basilar arteries<sup>1</sup>.

In the present study, Circle of Willis of 100 healthy persons were examined with the help of 3D-TOF MR Angiography of brain. (74 individuals aged 18-60 years and 26 aged above 60 years of either sex.) All component vessels of the circle were assessed by measuring the diameter. Sections of the vessels that were visualized as continuous segment for at least 0.8mm in diameter were considered to be normal and those smaller than 0.8mm in diameter were considered hypoplastic.

Variations most commonly found in communicating arteries, less commonly in cerebral arteries and very rarely noted in internal carotid artery. Most common type of variation found in vessels is hypoplasia and absence. The present study is an observational study; the data of this study will be helpful to the neurosurgeon in the selection of patient as well as assessing the feasibility of shunt operation.

**Keywords:** Circle of Willis, 3D TOF MR Angiography, Shunt Operation

## INTRODUCTION

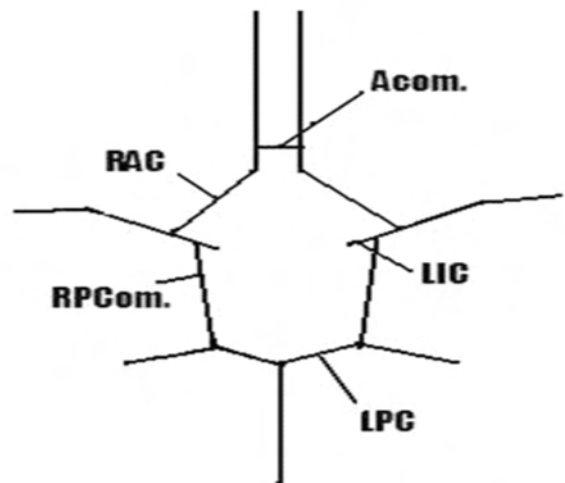
Brain is highly metabolic organ; it requires constant supply of blood. The major arteries supplying the cerebrum are joined to one another at the base of the brain in the form of an arterial circle or circle of Willis. The arteries which form the circle of Willis are the branches of internal carotid artery and the basilar artery. The cerebral arterial circle is an arterial wreath encircling the optic chiasma, the tuber cinereum in the cistern interpeduncularis. The arterial circle is formed by

- Anteriorly – anterior communicating artery
- Anterolaterally – right and left anterior cerebral arteries
- Laterally – proximal segment of right and left internal carotid arteries
- Posterolaterally – right and left posterior communicating arteries
- Posteriorly – proximal segment of right and left posterior cerebral arteries, which are derived from the bifurcating terminals of the basilar artery

The cerebral arterial circle is set to equalize the blood flow to various parts of the brain, but normally there is

little exchange of blood between right and left sides of arterial circles because of the equality of blood pressure.<sup>2,3</sup>

Magnetic Resonance Angiography {MRA} has been evaluated into an attractive and non radiation dependant alternative for imaging of the intracranial vasculature.<sup>1,4</sup> An attempt has been made to study the variations in the Circle of Willis by MR Angiography.



**SCHEMATIC DIAGRAM OF CIRCLE OF WILLIS**

## MATERIALS AND METHOD

MR Angiography images of 74 adult individuals of age Group 18-60 years and 26 adult individuals aged above 60 years of either sex attending department of Radio-diagnosis for brain MRA were analyzed.

Brain MR Angiography images required for this study were obtained from the Radiodiagnosis department of General Municipal Hospital.

The permission of the Head of Department of Radio-diagnosis as well as consent from the patients was taken.

Approval from Ethical Committee was obtained.

### Inclusion Criteria

- Normal individuals in the age group of 18 to 90 years of either sex attending the department of Radio-diagnosis.

### Exclusion Criteria:

- Individuals younger than 18 years.
- Any history of cerebral infarction due to atherosclerosis or embolism.
- Any history of accidental head injury.
- Previous history of intracranial surgery.
- Abnormal brain MR findings, such as aneurysm or tumor.

### Material

MR Angiography machine "PHILIPS MRACHIEVA (1.5T)".

### Analysis of image

As MR Angiography was being performed, all the images were transferred to a dedicated workstation.

All component vessels of the circle were assessed by measuring their diameter. The section of vessels that were visualized as continuous segment for at least 0.8mm in diameter were considered normal, those smaller than 0.8mm in diameter were considered hypoplastic and those segments, which were not visualized, were considered as absent.<sup>5</sup>

Fig. 1. Complete Circle of Willis

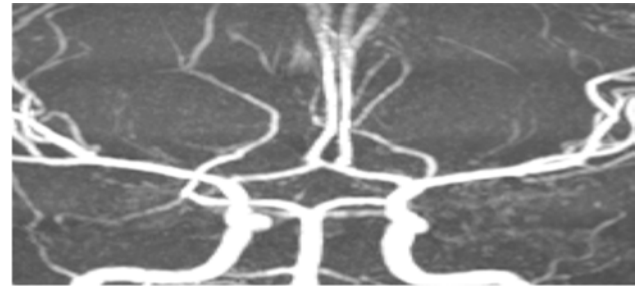


Fig. 2. Arrow denotes variations in the circle of willis - hypoplastic right posterior cerebral artery (rpc) and anterior communicating artery (acom) with absence of left posterior communicating artery (lpcom)



Fig.3 Arrow denotes variations in the circle of willis -triplicated anterior communicating artery (acom), hypoplastic right posterior communicating artery (rpcom) and absence of left posterior communicating artery (lpcom )

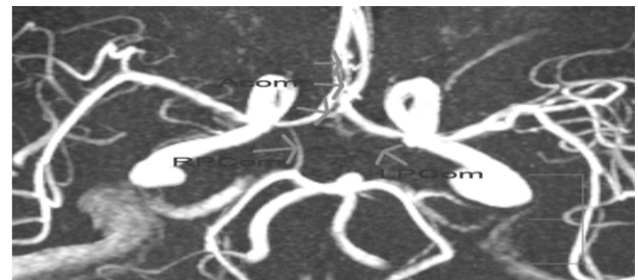
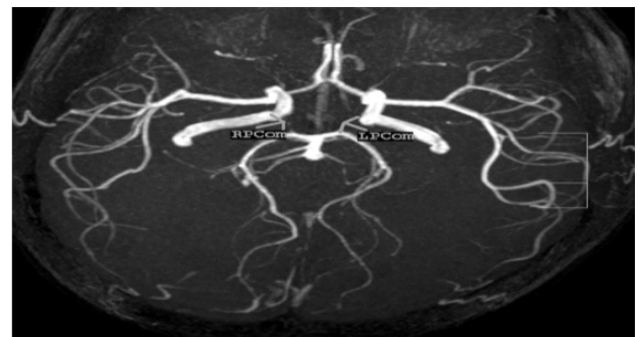


Fig.4 Arrow denotes variations in the circle of willis - absence of both right (rpcom) and left (lpcom) posterior communicating artery



## RESULT

**Table No. 1. Number and percentage of variations of vessels in the circle of study group.**

| No. | Description                                               | Number | Percentage |
|-----|-----------------------------------------------------------|--------|------------|
| 1   | No. of observed circles                                   | 100    | 100%       |
| 2   | Circle with variation                                     | 86     | 86%        |
| 3   | Circle with variation only in communicating Artery        | 59     | 59%        |
| 4   | Circle with variation only in main Artery                 | 1      | 1%         |
| 5   | Circle with variation in both main & communicating Artery | 26     | 26%        |

The total numbers of observed circles were 100 (100%) (This included complete, incomplete and partially complete circles). Out of these 86% of circles showed variations (like incomplete, partially complete, because of the hypoplasia or absence of one or more of the vessels), 59% of circles showed variations only in communicating arteries, 1% of the circles showed variations only in main arteries and 26% of circles showed variations in both main and communicating arteries.

**Table 2. Type of variations observed in main arteries of study population**

| Vessel |           | Normal | Hypoplastic | Absent | Total |
|--------|-----------|--------|-------------|--------|-------|
| RAC    | No.       | 95     | 5           | -      | 100   |
|        | Percent   | 95%    | 5%          | -      | 100%  |
| LAC    | No.       | 92     | 5           | 3      | 100   |
|        | Percent   | 92%    | 5%          | 3%     | 100%  |
| ACA    | Total No. | 187    | 10          | 3      | 200   |
|        | percent   | 93.50% | 5%          | 1.50%  | 100%  |

Two types of variations were found in major vessels which form the circle of Willis

a) hypoplasia

b) absence

- Right anterior cerebral artery (RAC) was hypoplastic in 5% of the study sample.
- Left anterior cerebral artery (LAC) was hypoplastic in 5% and absent in 3% of the study sample.
- Anterior cerebral arteries (ACA) (including both right and left side) were hypoplastic in 5% and absent in 1.5% of the study sample.

| Vessel |           | Normal | Hypoplastic | Absent | Total |
|--------|-----------|--------|-------------|--------|-------|
| RPC    | No.       | 88     | 7           | 5      | 100   |
|        | Percent   | 88%    | 7%          | 5%     | 100%  |
| LPC    | No.       | 90     | 7           | 3      | 100   |
|        | Percent   | 90%    | 7%          | 3%     | 100%  |
| PCA    | Total No. | 178    | 14          | 8      | 200   |
|        | percent   | 89%    | 7%          | 4%     | 100%  |

- Right posterior cerebral artery (RPC) was hypoplastic in 7% and absent in 5% of the study sample.
- Left posterior cerebral artery (LPC) was hypoplastic in 7% and absent in 3% of the study sample.
- Posterior cerebral arteries (PCA) (including both right and left side) were hypoplastic in 7% and absent in 4% of the study sample.

| Vessel |           | Normal | Hypoplastic | Absent | Total |
|--------|-----------|--------|-------------|--------|-------|
| RIC    | No.       | 99     | -           | 1      | 100   |
|        | Percent   | 99%    | -           | 1%     | 100%  |
| LIC    | No.       | 100    | -           | -      | 100   |
|        | Percent   | 100%   | -           | -      | 100%  |
| ICA    | Total no. | 199    | -           | 1      | 200   |
|        | percent   | 99.50% | -           | 0.50%  | 100%  |

- Right internal carotid artery (RIC) was absent in 1% of the study sample.
- No variations were observed in left internal carotid artery (LIC).
- Internal carotid artery (ICA) (including both right and left side) was absent in 0.5% of the study sample.

**Table 3. Type of variations observed in communicating arteries of study population.**

| Vessel |         | Normal | Hypoplastic | Absent | Total |
|--------|---------|--------|-------------|--------|-------|
| RPCom. | No.     | 28     | 32          | 40     | 100   |
|        | Percent | 28%    | 32%         | 40%    | 100%  |
| LPCom. | No.     | 33     | 30          | 37     | 100   |
|        | Percent | 33%    | 30%         | 37%    | 100%  |
| PCom   | No.     | 61     | 62          | 77     | 200   |
|        | percent | 30.5%  | 31%         | 38.5%  | 100%  |

| vessel |         | Normal | Hypoplastic | Absent | Duplication | Triplification | Total |
|--------|---------|--------|-------------|--------|-------------|----------------|-------|
| Acom.  | No.     | 59     | 28          | 8      | 3           | 2              | 100   |
|        | Percent | 59%    | 28%         | 8%     | 3%          | 2%             | 100%  |

Following types of variations were found in the communicating vessels which form the circle of Willis

- a) hypoplasia
- b) absence
- c) duplication
- d) triplication

Right posterior communicating and left posterior communicating vessels showed first two types of variations but anterior communicating vessel showed all the four types of variation.

- Right posterior communicating vessels (RCom.) were hypoplastic in 32% and absent in 40% of the study sample.
- Left posterior communicating vessels (LCom.) were hypoplastic in 30% and absent in 37% of the study sample.
- Posterior communicating arteries (PCom) (including both right and left side) were hypoplastic in 31% and absent in 38.5% of the study sample.
- Anterior communicating vessels (Acom.) were hypoplastic in 28%, absent in 8%, duplicated in 3% and triplicates in 2% of the study sample.

## DISCUSSION

|                                                                 | Puchades-orts<br>A et al <sup>6</sup> (1975)<br>by autopsy method | Alper BJ et al <sup>7</sup><br>(1959) by<br>autopsy method | Present<br>study |
|-----------------------------------------------------------------|-------------------------------------------------------------------|------------------------------------------------------------|------------------|
| No. of observed circles                                         | 62                                                                | 350                                                        | 100              |
| Circles with variations                                         | 87%                                                               | 65.4%                                                      | 86%              |
| Circles with variations only in communicating arteries          | 58%                                                               | -                                                          | 59%              |
| Circles with variations only in main arteries                   | 0%                                                                | -                                                          | 1%               |
| Circles with variations in both main and communicating arteries | 29%                                                               | -                                                          | 26%              |

Puchades-orts A et al<sup>6</sup> (1975) observed 62 circles of Willis by autopsy method and found 87% of circles with variations. Alper BJ et al<sup>7</sup> (1959) observed 350 circles of Willis by autopsy method and found 65.4% of circles with variations, and the present study observed 100 circles of Willis and 86% of circles showed variations. The percentage of variations of the circle of Willis in the present study is in close agreement with Puchades-orts A et al<sup>6</sup> (autopsy method) and is greater than the Alper BJ et al<sup>7</sup> (autopsy method).

Circles with variations only in the communicating arteries were observed by Puchades-orts A et al<sup>6</sup> (1975) with autopsy method in 58% cases and in the present study in 59% cases. The percentage of circles with variations only in communicating arteries in the present study is in close agreement with Puchades-orts A et al<sup>6</sup> autopsy study.

Circles with variations only in the main arteries were not found in Puchades-orts A et al<sup>6</sup> (1975) with autopsy study but in the present study it is found in 1% case. The percentage of circles with variations only in main arteries in the present study is slightly greater than the Puchades-orts A et al<sup>6</sup> autopsy study.

Circles with variations in both main and communicating arteries were observed by Puchades-orts A et al<sup>6</sup> (1975) with autopsy method in 29% cases

and in the present study in 26% cases. The percentage of circles with variations in both main and communicating arteries in the Puchades-orts A et al<sup>6</sup> autopsy study is greater than present study.

### Embryological basis

Puchades-orts A et al<sup>6</sup> (1975) found that the most favoured artery in the ontogeny of the circle is the middle cerebral artery. There is no literature showing variations in this artery in the normal brains.

The second most favoured is the anterior cerebral artery, its variation is compensated by hypertrophy of the anterior communicating artery. The least favoured artery is the posterior cerebral artery. The caliber of the anterior communicating artery is usually in inverse relation with that of anterior cerebral artery. However if the anterior cerebral arteries are normal, anterior communicating artery may be of any shape or even be absent.

Anterior communicating artery first appears in human embryos of 18 mm (CRL) as a reticulated anastomosis between the two anterior cerebral arteries. In embryos of 24 mm (44 days) they fuse to form a single trunk. During the fetal period this artery acquires great proportions, equal to those of anterior cerebral and this pattern of growth explains the rarity of its absence. On the other hand it is far more frequent to find this vessel

to be either dilated or equal in size to the anterior cerebral artery<sup>6</sup>.

The posterior communicating artery attains its highest degree of fetal development by the time that the primitive trigeminal artery disappears. It becomes smaller when the vertebral artery forms, and in cases where the trigeminal artery remains, it diminishes even further. In these cases the posterior communicating arteries can be extremely thin or even disappear. This explains why hypoplasia is, by far, the most frequently found variation in the posterior communicating arteries<sup>6</sup>.

During the development of the frontal lobe subsequent growth of anterior cerebral artery occurs, which by twelfth week is well formed. The development of the occipital and temporal lobes, specially in their basal portion, follows that of the frontal. This in turn conditions the growth of the posterior cerebral arteries. These vessels are the last to form. Since in the early stages these lobes are still poorly developed the posterior cerebral arteries appear as collateral branches of a large arterial trunk. From this trunk also originate the mesencephalic, quadrigeminal and diencephalic arteries and the posterior choroidal branch. All these vessels become collateral branches of the posterior cerebral artery as this one grows (orts Liorca<sup>8</sup>). This complicated ontogenic process is the reason why in the adult the posterior cerebral arteries are the most variable of all the great cerebral vessels (anterior, middle and posterior) with respect to origin, morphology and caliber<sup>6</sup>.

### CONCLUSION

Variations most commonly found in communicating arteries, less commonly in cerebral arteries and very rarely found in internal carotid artery. Most common type of variations found in vessels were hypoplasia and absence.

The present study was an observational study; the data of this study can be helpful to the neurosurgeons

in the selection of patient as well as assessing the feasibility of shunt operation.

### ACKNOWLEDGEMENTS

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# Multiple Sutural Bones at the Lamboid Suture- A Case Report

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## ABSTRACT

The variation in the frequency of occurrence of sutural bones (wormian bones) was observed in majority of human populations around the world. These bones rest along sutures and/or fill the fontanelles of neonatal skull. The occurrence of wormian bones is quite common in Indian population. We found ten wormian bones in adult Indian skull. Knowledge of its presence is very important for anthropologist, radiologists, autopsy surgeon, orthopedic and neurosurgeons.

## INTRODUCTION

Wormian bones<sup>1</sup> / supernumary ossicles / os inca / sutural bones are those accidental or intercalated bones found in the cranium having no regular relation to their normal ossification centre. They are commonly found in relation to the occipital bone. The mechanism of their formation is not been entirely known. Some authors claim that the bones are developed from external influences<sup>2</sup>. However, presence of such phenomenon in medico-legal practice such as examination of skull for osteological purpose or examination of head during autopsy may create confusion to concerned Doctor. In view of this we are reporting a case of multiple sutural bones at the lamboid suture and discuss the various issues thereupon.

## CASE REPORT

During our routine osteology demonstration classes, we found series of sutural bones in the lamboid suture in an adult Indian skull (Fig 1). All the ten bone were arranged along lamboid suture. The largest bone among them was at lambda and the sizes of remaining bones were smaller we move towards the asterion except the last bone labeled as number 10 on the left side. All the bones were irregular in shape.



Fig 1 showing multiple sutural bones at lamboid suture (the bones are label from 1 to 10)

## DISCUSSION

First specific description of wormian bones was written by Olaus Worm, a Dutch anatomist (1588-1654) in a letter to Thomas Bartholin, who described them as small, irregular bones, are found in the cranial sutures. In turn Bartholin named them Ossa Wormiana<sup>1</sup>.

According to Bregman et al nearly 40% of skulls have sutural bones in the vicinity of lamboid suture<sup>3</sup>. Various workers as Bergman R.A.(1988)<sup>3</sup>, Malhotra VK<sup>4</sup> (1978), Saxena SK<sup>5</sup> (1986) Pal GP<sup>6</sup>(1987) Gopinath, K<sup>7</sup> (1992) reported the presence of inca bone at the lambda.

The squamous occipital part consist of two parts i.e. supraoccipital and and interparietal. The interparietal bone lying above the highest nuchal lines develops in membrane by 2 pairs of centers, 1 pair for the lateral plate and the other for the medial plate. Each centre consists of 2 nuclei. Failure of fusion between these centers or their nuclei with each other and the supraoccipital may give rise to various anomalies in the interparietal region which leads to the formation of sutural bones<sup>8</sup>.

The presence of sutural bones is usually associated with cranial and central nervous system anomalies<sup>9</sup>. But there are many cases where no any associated embryological anomalies were found. Jeanty et al<sup>10</sup> reported the presence of sutural bones in four fetuses without any associated anomalies.

In general, the relationship between mechanical factors (such as cranial deformations), skull morphogenesis, and Wormian ossicles, is rather supported, and quite relevant for the studies on functional craniology<sup>11</sup>. Therefore, these sutural bones must be considered as the result of a lack of complete balance between cranial changes in size (growth) and shape (development) during ontogenesis<sup>12</sup>.

Presence of such multiple bones at labmoid suture is of considerable importance and may have potential forensic implications such as:

1. The sutural bones may be mistaken for fracture of skull in the region of occipital bone to an inexperienced eye.
2. It may affect age estimation as lambdoid sutures start to close on their inner table of skull at about the age of 25 years and outer table starts closing near the lambda and union is often completed at about 45 years<sup>13</sup>. Presence of such bones may retard the fusion and thence affect the opinion on gross or radiological examination.

3. Due to presence of such bones, the force required for causing injury to head may be less and therefore a critical question may be raised by legal authorities regarding the culpability of the accused. Under such circumstances, due precaution should be exercised by the forensic pathologist while furnishing an opinion. The opinion should be based on the established principle – whether the injury is suuficient in ordinary course of nature to cause death in normal individual or due to presence of such deformity, the said injury is likely to cause death.
4. Due to presence of such bones, the sutures may be weak and easily fractured especially in children and young adults; a linear fracture may pass in to a suture line and cause a 'diastasis' or opening of the weaker seam between the bones<sup>14</sup>.

In conclusion we have reported this unusual presentation and discuss the various medico-legal issues regarding presence of such bones. This case report may be useful for the radiologists, autopsy surgeons, anthropologists and neurosurgeons for proper interpretation and delivering opinion.

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# A Study of Post-Mortem Histo-pathological Findings in Snake Bite Poisoning

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## ABSTRACT

Snake bite remains an underestimated cause of accidental death in modern India. The snakes most commonly associated with human mortality in India are cobra (*Naja naja naja*), krait (*Bungarus caeruleus*), Russell's viper (*Vipera russelli*) and saw scaled viper (*Echis carinatus*). With approximately 45900 deaths occurring annually in India, a large proportion of snake bites occur when people work barefoot in the fields or while walking at night or early morning through fields or along roads. The study was carried out over a period of 2-year (January 2010-December 2011), where 1,637 autopsies were performed. Out of these forty three autopsies (2.62%) performed were deaths due to snake bite. The male to female ratio was 1.5:1. Males succumbed to snake bites twice frequently (60.46%) when compared to females (39.53%). The age ranged between 01-61 years (16.27% of them belonged to the 1-12 years of age-group, 69.76% belonged to 13-40 years of age group and 13.95% belonged to 41-61 years of age group). The fang marks were seen in 28 cases on the lower extremities. There was congestion of lungs, intestine, cardiac tissue and especially kidneys. The major cause of death was renal failure

**Keywords:** Autopsy, Acute renal failure, Envenomation, Histopathology, Ophitoxaemia

## INTRODUCTION

Since ages, India has remained notorious for its venomous snakes and the effects of their bites. With its surrounding seas, India is inhabited by more than 60 species of venomous snakes—some of which are abundant and can cause severe envenoming. Spectacled cobra (*Naja naja*), common Krait (*Bungarus caeruleus*), saw-scaled viper (*Echis carinatus*) and Russell's viper (*Dabvia russelli*) have long been recognized as the most important species causing fatal snakebites<sup>1</sup>. It has been estimated that 5 million snake-bite cases occur worldwide every year, causing about 100,000 deaths<sup>2</sup>. Government of India hospitals from all but six states reported only 1,364 snakebite deaths in 2008<sup>3</sup>, but this is widely believed to be an under-report as many victims of snakebite choose village-based traditional therapists and most die outside government hospitals. But a retrospective snakebite mortality survey in India<sup>4</sup> estimated a total of 45,900 (95% CI 40,900-50,900) national snakebite deaths in 2005 which constitutes about 5% of all injury deaths and nearly 0.5% of all deaths in India.

In 2009, snake bite was recognized for the time by WHO as a neglected tropical disease. In tropical

countries, it is largely an occupational disease for agricultural workers, and as a result, can affect food production. Snake bite causes substantial human mortality and disability—physical and psychological, but its recognition as an important international public health issue has been hindered by insufficient epidemiological data<sup>6</sup>. Snake bite incidences vary from region to region and depend upon:

- The natural habitat of particular species of snake in the region; and
- Probability of human being coming in contact.<sup>6</sup>

However, there have been no epidemiological studies related to snake-bite incidence from the Bellary District in Karnataka. Approximately 800 medicolegal autopsies are performed annually at Vijaynagar Institute of Medical Sciences (VIMS), Bellary. In view of the monetary benefits given by the Government of Karnataka, India, under the Yeshasvini Cooperative Farmers Health Care Scheme" (Yeshasvini Scheme) to the dependants of those who die due to snake-bite, several false cases of snakebite have also been reported for claiming the compensation. Hence, it is also of

immense importance for the forensic experts to detect snakebite victims at autopsy so as to ascertain the exact cause of death and to prevent false claims.

## MATERIALS AND METHOD

We considered 43 reports specifying the findings of autopsies of victims of snake bite performed at the Vijayanagar Institute of Medical Sciences, Bellary, Karnataka, during the period Jan 2010-Dec 2011. In India snakebites are unnatural deaths that need to be examined at autopsy (medico-legal) according to statutory rules. All the cases were from the surrounding area under the jurisdiction of the local police administration. Thirty two cases were known deaths due to cobra bite and eleven deaths due to viper snake bite. The subjects were from those admitted to the hospital and received treatment at Emergency ward. The snake type was retrieved from records, police inquest, history or the offending snake captured /killed and examined. At complete autopsy all findings were recorded in a standard protocol. The site of snake bite on the body was noted. The changes in the internal organs were noted down with special concentration on the morphological changes in the kidneys. Specimens of lungs, Kidneys, heart and section of the skin with snake bite marks were sent for histopathological examination.

## RESULTS AND DISCUSSION

A total of 43 cases (2.62%) of snake-bite were recorded during the period 2010 to 2011. The snake bite victims were 26 males and 17 females; average age was  $27.18 \pm 14.82$  years, the youngest subject was 1 year old and the oldest 61 years old. Majority of the snake-bite cases were in the age group of 13-40 yr (69.76%; n=30), followed by the age group of 1-12 yr (16.27%, n=7) and 41 -61yr (13.95%, n=6). Interestingly, it was observed that there was a preponderant male dominance in all age groups. Also, out of 43 snakebite cases, 60.46 per cent (n=26) of the cases were males. Male to female ratio was found to be 1.5:1. In the previous studies reported from Ambajogai (Maharashtra)<sup>7</sup> and Karnataka<sup>8</sup>, the male to female ratio was found to be 3.2:1 and 2:1, respectively. Studies from other countries also indicate male victim preponderance; male: Female ratio was reported as 1.9:1 in Thailand<sup>9</sup> and 1.3:1 in Pakistan<sup>10</sup>. The predominance of male victims suggests a special risk of outdoor activity. The commonly affected age groups were observed to be 15-44 yr in Pakistan<sup>10</sup> and 6-40 yr in Zimbabwe<sup>11</sup>. Rainy season (June to September) accounted for 53.48% (n=23)

of the cases reported, 25.58% (n=11) during October to January, 20.93% (n=9) during February to May. A study from Pondicherry also reported highest number of bites during June to September<sup>12</sup>. The possible reason for majority of the snake-bites in rainy season may be attributed to the flooding of rain water in the dwelling places of snakes, thus causing their dislodgment. Consequently, human population becomes accidental victim to the snake-bite. Further, the situation is aggravated by the propinquity of rodents near the human habitat, thus increasing the risk of snake-bite.

The two fang marks of <0.1 cm which were 1cm apart were seen in 34 cases on the lower extremities and no fang marks were detectable in the remaining 9 cases. Thirty two cases (74.41%) were known deaths due to cobra bite and eleven deaths (25.58%) due to viper snake bite. In ten cases at the site of snake bite, there were blood stains, swelling and cellulitis around the bite site. Previous reports have established that the order of distribution of snake venom in different organs of the body as, site of injection or skin >heart/liver > kidneys > lungs > spleen<sup>8</sup>. At autopsy there was extensive hemorrhage and congestion of lungs, cardiac tissue and kidneys. The regional lymph nodes were swollen and hemorrhagic.

On histo-pathological examination sections from the skin area of snake bite showed keratinising stratified squamous epithelium and dermis showed fibrocollagenous tissue with dilated and congested blood vessels and were infiltrated with polymorphonuclear leucocytes. In ten cases the section of the heart showed features of myocarditis with left ventricular hemorrhage. In one of these cases, the right coronary and left circumflex arteries were patent, left anterior descending artery showed a calcified atheromatous plaque for about 4 cm from its origin with 90% obliteration of lumen. In twenty cases the lungs showed extensive hemorrhage, thickened alveolar septa, congested capillaries, obliteration of alveolar spaces and the airways were filled with proteinaceous fluid devoid of inflammatory cells, features suggestive of Pulmonary edema.

The following are the few examples of such cases:

### 1. VIMS, Bellary: MLC-30/2011

- **Kidney: Gross:** One kidney measuring 9 X 6 X 3cm. On cut section-haemorrhagic areas seen. Other kidney measuring 9 X 5 X 3.5cm. On cut section-hemorrhagic areas seen. Micro (Fig.1): The section

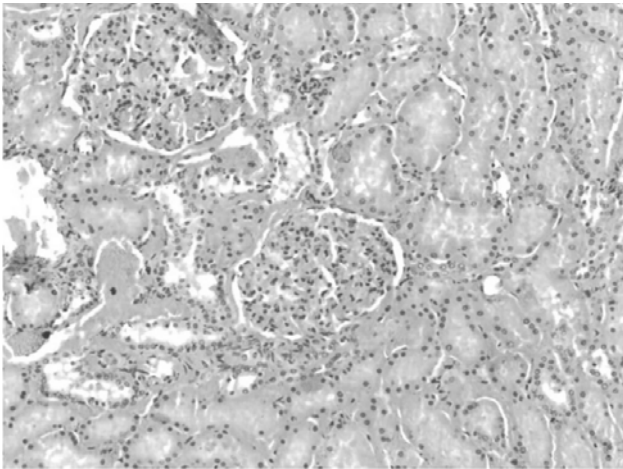


Fig. 1

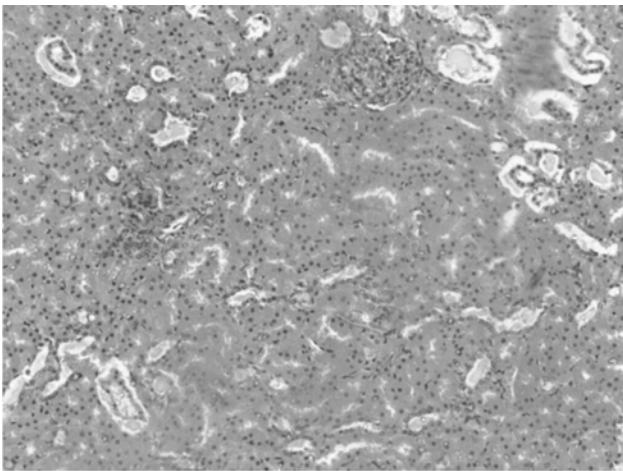


Fig. 3

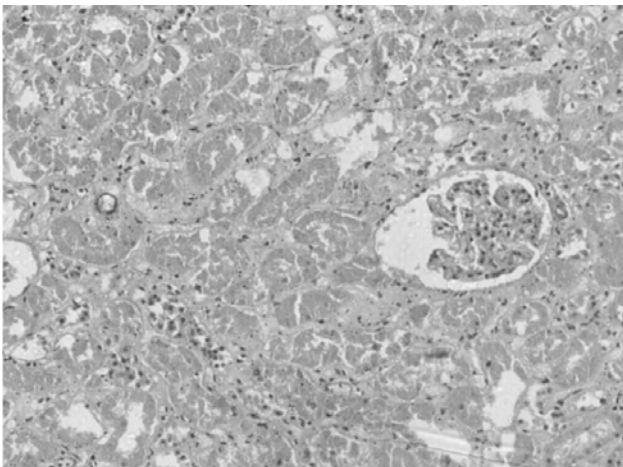


Fig. 1, 2 & 3. Microscopy of kidney showing multifocal necrosis of the tubules and hypercellular Glomeruli (Acute tubular necrosis)

studied from both the kidneys show multifocal necrosis of the tubules, both in the cortex and medulla. The glomeruli appear to be hypercellular. The interstitium shows multifocal areas of hemorrhage. Some of the degenerated tubules show red blood cell cast formation.

- **Lungs: Gross:** Right lung measuring 13 X 9 X 4.5cm. On cut section-Spongy & hemorrhagic. Left lung measuring 13.5 X 11 X 4.5cm. On cut section-Spongy & hemorrhagic. Micro (Fig.4): The section studied from both the lungs show focal areas of alveolar damage with increased proliferation of alveolar macrophages. The alveolar septa and the interstitium show areas of hemorrhage. Some of the alveoli are filled with eosinophilic material.

- **Final impression:** ARDS like change in lungs associated with tubular necrosis & interstitial hemorrhage of kidneys.

## 2. VIMS, Bellary: MLC-35/2011

- **Kidney: Gross:** One portion of kidney measuring 8.5 X 4 X 0.6cm. On cut section-unremarkable. Other portion of kidney measuring 8.4 X 4 X 0.5cm. On cut section- unremarkable. Micro (Fig.2): The multiple sections studied from both the kidneys show extensive necrosis of the tubules, both in the cortex and medulla. The glomeruli appear to be hypercellular with prominent congested capillaries. The interstitium appears oedematous with congested blood vessels and focal areas of hemorrhage. However the interstitium shows no inflammatory cells.
- **Lungs: Gross:** One portion of lung measuring 9 X 8 X 1cm. On cut section-Grey brown hemorrhagic areas noted. Another portion of the lung measuring 11 X 7.5 X 1.4cm. On cut section- Grey brown hemorrhagic areas noted. Micro (Fig.5): The multiple sections studied from both the lungs show most of the alveoli filled with proteinaceous like material. The alveolar septa appear edematous and the interstitium shows multifocal areas of hemorrhage associated with haemosiderin laden macrophages.
- **Final impression:** Acute tubular necrosis of the kidney associated with ARDS like features of lung.

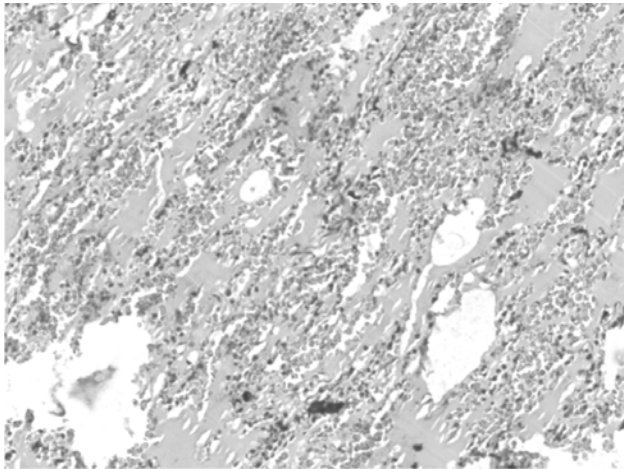


Fig. 4

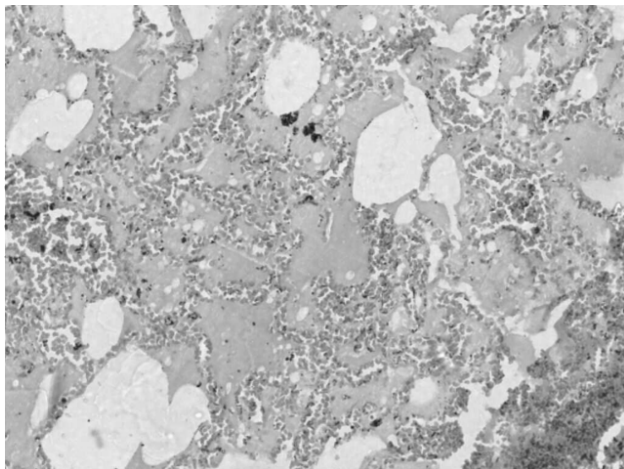


Fig. 5

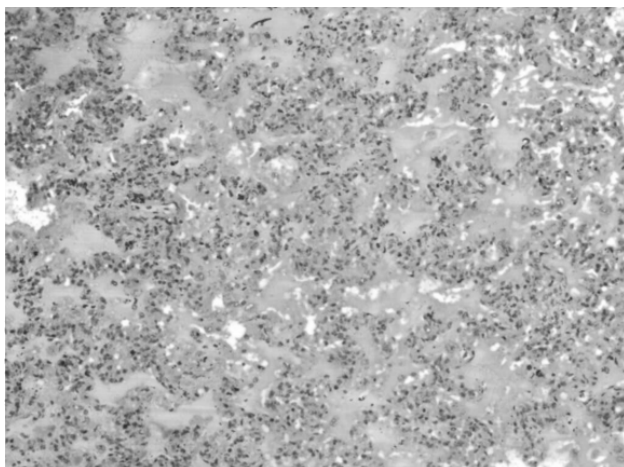


Fig. 4, 5 & 6. Microscopy of lungs showing focal areas of alveolar damage with increased proliferation of alveolar macrophages(ARDS)

### 3. VIMS, Bellary: MLC-38/2011

- Kidney: Gross:** One kidney measuring 8.5 X 5 X 2cm. On cut section- unremarkable. Other portion of kidney measuring 8 X 5 X 1.5cm. On cut section- unremarkable. Micro (Fig.3): The sections studied from both the kidneys show mainly the features of tubular necrosis with desquamation of epithelial cells into the lumen. Some of the tubular cells show degenerative changes. The interstitium appears oedematous, shows passive congestion and multifocal areas of haemorrhage with haemosiderin laden macrophages. Most of the glomeruli appear normal except for few of them which show hypercellularity, dilatation of the capillaries associated with passive congestion.
- Lungs: Gross:** One portion of lung measuring 11 X 8 X 2cm. On cut section- Anthrotic pigments noted. Another portion of the lung measuring 11 X 9 X 5cm. On cut section- Appears haemorrhagic. Micro (Fig.6): The section studied from lungs show predominantly oedematous change with many of the alveoli filled with oedematous fluid. Some of the alveoli show intraalveolar haemorrhage with haemosiderin laden macrophages. The septa appears thickened and the interstitium show oedematous change with passive congestion and focal infiltration of lymphocytes. Some of the alveoli are collapsed and show proliferation of the alveolar epithelial cells. The bronchi and the bronchioles appear to be normal.
- Final Impression:** Acute tubular necrosis of the kidney associated with ARDS like features of lung.

There were renal lesions in 28 cases. The macroscopic examination of the kidneys showed bilateral congestion. On section all the kidneys showed congestion of cortex and medulla, dilated capillaries with haemorrhagic areas, infiltrated by acute and chronic inflammatory cells. Twenty two cases showed features of interstitial nephritis with dilated and congested blood vessels. In six cases sections from the kidney showed extensive necrosis of the tubular epithelium with oedema and mixed

inflammatory cell infiltrate in the interstitium. Many of the glomeruli showed microthrombi (acute tubular necrosis secondary to ischemia). In eight cases, spleen showed vast areas of interstitial hemorrhage and congestion of sinusoids.

Out of the 43 cases of snake bite studied, 28 cases (65.11%) showed distinct renal lesions. This shows that renal failure is the common cause of death in snakebite. The classification of snakes as neurotoxic (Cobra, krait), hemotoxic (Vipers) and myotoxic (sea snakes) is an oversimplification since mixed features are commonly seen. Similar findings were reported in previous published works<sup>13,14,15,16</sup>. This study shows that renal involvement is also seen in cobra bite cases contrary to the known fact that these are mainly neurotoxic. This observation can be explained by two possible mechanisms. Firstly all snake venoms are mixed toxins that have intrinsic activity on the kidneys. Secondly there is a high possibility of immunologically mediated nephropathy in snakebite. Another mechanism of renal involvement in common neurotoxic bites is ischaemia induced nephropathy especially cortical and tubular lesions. This fact is worth giving due consideration during management and monitoring of cases of envenomation by cobra<sup>16</sup>.

### CONCLUSION

Snake bite is a common and frequently devastating environmental and occupational disease, especially in rural areas of tropical developing countries. Its public health importance has been largely ignored by medical science. Snake venoms are rich in protein and peptide toxins that have specificity for a wide range of tissue receptors, making them clinically challenging and scientifically fascinating, especially for drug design. Although the full burden of human suffering attributable to snake bite remains obscure, hundreds of thousands of people are known to be envenomed and tens of thousands are killed or maimed by snakes every year. Preventive efforts should be aimed towards education of affected communities to use proper footwear and to reduce the risk of contact with snakes to a minimum through understanding of snakes' behavior. To treat envenoming, the production and clinical use of antivenom must be improved. Increased collaboration between clinicians, epidemiologists, and laboratory toxinologists should enhance the understanding and treatment of envenoming.

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