

## Profile of Skeletal Injuries in Road Traffic Accidents Among Autopsies Conducted at A Tertiary Care Hospital Mortuary

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### Abstract

The present study was a prospective study conducted in tertiary hospital autopsy block (mortuary) of Raichur Institute of Medical Sciences Hospital (RIMS), Raichur during one-year period (01-12-2014 to 30-11-2015). During the study period a total of 125 victims of fatal Road Traffic Accident (RTA) with skeletal injury who died were autopsied in the autopsy block (mortuary) of RIMS Hospital, Raichur were studied. The purpose of the study was to know the pattern of skeletal injuries in victims of RTA. The results of this study have been concluded thus - Majority of the victims (51.2%) had skull fracture followed by ribs (26.4%), Femur (17.6%), Leg bones (17.6%), Pelvis (15.2%), Forearm bones (12.8%). Maximum number of victims had head injuries 36%. Skull fracture was predominant in all categories of road users except driver of motor vehicle in whom fracture of ribs was most common. Majority of the victims (51.2%) had skull fracture followed by ribs (26.4%), Femur (17.6%), Leg bones (17.6%), Pelvis (15.2%), Forearm bones (12.8%). Maximum number of victims who had head injuries was (36%). Skull fracture was predominant in all categories of road users except driver of motor vehicle in whom fracture of ribs was most common

**Key Words:** Skeletal injuries, RTA, Tertiary care hospital-mortuary

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### Introduction

The invention of the wheel and the automobiles has made great revolution in transportation and contributed immensely to the society but it has also brought misery and death with it. Injuries and fatalities occur in all forms of transportation but numerically road traffic accidents account for the great majority worldwide, causing more than 3000 deaths each day and killing more than a million people annually and injuring some 20–50 million. If the current trends continue, road traffic injuries are predicted to become

the fifth leading cause of death by 2030. Approximately 90 per cent of these deaths occur in low- and middle-income countries, where the road traffic fatality rates (21.5 and 19.5 per 100,000 populations, respectively) are higher than in high-income countries (10.3 per 100,000 population). In 2010 the United Nations General Assembly adopted resolution 64/255 which proclaimed the period 2011–2020 as the Decade of Action for Road Safety. The goal of the Decade is to stabilize and then reduce the forecast level of road traffic fatalities around the world by increasing activities conducted at national, regional and global levels.<sup>1</sup>

The increasing number of vehicles, poor adherence to traffic rules and regulations such as maintaining lane discipline, driving in zigzag patterns, poorly maintained and congested roads, abuse of alcohol, lack of awareness about helmets and need for

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implementing strict traffic rules are some of the causes of fatal RTA.

Oxford dictionary defines accident as an unfortunate incident that happens unexpectedly and unintentionally typically resulting in damage or injury.<sup>2</sup>

Road traffic accident is defined as accident which takes place on the road between two or more objects one of which must be any kind of moving vehicle.<sup>3</sup> In other words RTA occurs when a vehicle collides with another vehicle, pedestrian, animal, road debris, or other stationary barrier such as tree or utility pole.<sup>4</sup>

### Materials and Method

The present study was a Prospective study. The study material comprised of victims of RTA who died on spot or died in RIMS Hospital & autopsied in the autopsy block (mortuary) of RIMS Hospital, Raichur during the 1-year period from 01 December 2014 to 30 November 2015.

Ethical clearance for the present study was obtained from the Institutional Ethical Committee RIMS, Raichur. In each case, a thorough external and internal examination was done for fractures and other injuries and opinion as to the cause of death was made after the examination. The data thus obtained was recorded in the predesigned and pretested Proforma, which comprised relevant data and analysed.

Road Traffic Accident (RTA) is any vehicular accident occurring on the roadway (i.e. originating on, terminating on, or involving a vehicle partially on the roadway). This includes collision of an automobile with a pedestrian, another automobile or with a non-automobile on the roadway or fall from a moving vehicle causing injuries or death of involved individuals.

### Results

During the present study a total of 425 medico legal autopsies were conducted out of which 125 cases were of RTA with skeletal injury. All the victims of RTA had fracture of one or the other bone. Deaths due to RTAs

accounted for (26.88 %) of the total medico legal autopsies conducted. (Table 1)

**Table 1: Profile of Medico legal autopsies conducted during the study period**

Type of Case	Number	Percentage
<b>RTA with Skeletal injury</b>	<b>125</b>	<b>26.88</b>
Poisoning	90	19.35
Burns	76	16.34
Drowning	17	3.7
Railways	47	10.1
Snake bite	11	2.3
Electrocution	10	2.1
Assault	8	1.7
Hanging	19	4.1
Natural Death	40	8.63
Others	22	4.8
	465	100

In the present study multiple bone fractures were observed in 55 cases out of 125 cases (44%). Skull fracture was present in maximum number of cases-59 (47.2%) followed by fracture of ribs-33 cases (26.4%) and fracture of femur-22 cases (17.6%), Leg bones 22 cases (17.6%), Fracture of the pelvic bones 19 cases (15.2%). (Table 2)

In our study the motor cycle riders had following fractures - there were 38 cases of skeletal fractures and 34 cases with skull fractures. The most common fracture was Skull fracture 32 cases (56.66%) followed with Ribs 10 cases (16.66%) and leg bones 10 cases (16.66%). (Table 3)

Most common type of fractures in pillion rider was skull fractures 4 (40%) followed by humerus, forearm bones, pelvis, femur 2 case each (20%), and ribs, leg bones 1 case each (10%). (Table 4)

Most common type of fracture in pedestrian was skull fracture 10 cases (38.46%) followed by pelvic fractures 7 cases (26.92%) and Ribs 6 cases (23.07%), Femur 4 cases (15.38%), Leg bones 2 cases (7.69%), Forearm bones 1 case (3.84%), Lumbar vertebra 1 case (3.84%). (Table 5)

Most common type of fracture in Drivers was Rib fractures 9 cases (64.28%), followed by

**Table: 2 Fracture of Bones**

Type of Bone Fractured	Motorcycle Riders	Pillion Riders	Pedestrians	Vehicle drivers	Front /rare seat occupant	Total	
						No.	%
Skull	34	4	10	6	6	59	47.2
Facial bones	4	0	1	0	0	5	4.0
Cervical vertebra	2	0	0	0	1	2	1.6
Hyoid bone	0	0	0	0	0	0	0
Thoracic vertebra	0	0	0	0	0	0	0
Sternum	0	0	0	1	0	1	0.8
Ribs	10	1	6	9	6	33	26.4
Clavicle	3	0	0	3	1	7	5.6
Scapulla	0	0	0	0	0	0	0
Humerus	1	2	3	3	1	9	7.2
Forearm bones	5	2	1	5	2	16	12.8
Wrist & Hand	0	0	0	0	0	0	0
Lumbar vertebra	1	0	1	0	0	2	1.6
Pelvis	3	2	7	3	4	19	15.2
Femur	10	2	4	4	3	22	17.6
Patella	0	0	0	0	0	2	1.6
Leg bones	13	1	2	1	3	22	17.6
Foot bones	1	0	0	1	1	4	3.2

**TABLE: 3 Fracture of Bones in Motorcycle Riders**

Type of Bone Fractured	Number of Cases	Percentage
Skull	34	56.66
Facial bones	4	6.66
Cervical vertebra	2	3.33
Hyoid bone	0	0
Thoracic vertebra	0	0
Sternum	0	0
Ribs	10	16.66
Clavicle	3	5
Scapulla	0	0
Humerus	1	1.66
Forearm bones	5	8.33
Wrist & Hand	0	0
Lumbar vertebra	1	1.66
Pelvis	3	5
Femur	10	16.66
Patella	0	0
Leg bones	13	20.66
Foot bones	1	1.66

skull fracture 6 cases (42.85%), fractures of Forearm bones 5 cases (35.71%), Femur 4 cases (28.57%), Clavicle 3 cases (21.42%), Humerus 3 (21.42%), Pelvis 3 (21.42%), Sternum 1 (7.14%), Leg bones 1 (7.14%), Foot bones 1 (7.14%). (Table 6)

Most common type of fractures in front seat/Rear seat passenger was Ribs 6 cases (40%), Skull 6 cases (40%), Pelvis 4 cases (26.66%), Femur and Leg bones 3 case each (20%), Forearm bones 2 cases (13.33%), Cervical vertebra, Clavicle, Foot bones 1 case each (6.66%). (Table 7)

Fracture of the skull was present in 64 cases out of 125 fatal RTA cases. Fractures of skull were grouped into linear fracture of vertex, Comminuted fracture of vertex, Depressed fracture of vertex, basal fracture, basal fracture plus linear fracture of vertex, crush fracture.

Fracture of the vault of the skull was seen in 53 cases (82.81%) is more than the base of skull 6 cases (9.37%). Fracture of the facial bones was present in least number of victims 5 cases (7.8%). (Table 8)

**TABLE: 4 Fracture of Bones in Pillion Riders**

Type of bone fractured	Number of cases	Percentage
Skull	4	40
Facial bones	0	0
Cervical vertebra	0	0
Hyoid bone	0	0
Thoracic vertebra	0	0
Sternum	0	0
Ribs	1	10
Clavicle	0	0
Scapulla	0	0
Humerus	2	20
Forearm bones	2	20
Wrist & Hand	0	0
Lumbar vertebra	0	0
Pelvis	2	20
Femur	2	20
Patella	0	0
Leg bones	1	10
Foot bones	0	0

In our study many skeletal injuries were associated with either thoracic or abdominal visceral injuries which resulted in grave outcome of the case. Out 125 cases of RTA it was observed that in 33 cases ribs were fractured (26.4%) but out of 33 cases of ribs fractures 27 cases showed lung lacerations (81.81%). Out of 125 cases of RTA we observed fracture of pelvic bone and femur bone in 41 cases (32.8%) but out of 41 cases of pelvic and femur bone fracture, in 29 cases showed liver laceration (70.73%), spleen lacerated in 8 cases (19.51%), kidney was lacerated in 4 cases (9.75%) and in 8 cases (19.51%) other abdominal and thoracic viscera's were injured. (Table 9)

### Discussion:

#### Profile of Medico Legal Autopsies of Fatal RTA (Table No.1)

During the period of present study, it was observed that deaths due to RTA accounted for 26.88 % of total medico legal autopsies conducted i.e. more than 25% of unnatural deaths were due to RTAs. This result is less when compared with results of studies

conducted at, Government Medical College, Jammu (48.92%)<sup>5</sup> ; Government Medical College, Chandigarh (42.18%)<sup>6</sup> ; AIIMS, New Delhi (35.5%)<sup>7</sup> ; PGIMS, Rohtak (29.8%)<sup>8</sup> ; MLN Medical College, Allahabad (42.29%)<sup>9</sup> ; KMC, Manipal (36.50%)<sup>10</sup>; The results are more when compared with the results of studies conducted at RM College, Loni (24.1%)<sup>11</sup> Office of Judicial Medical Officer, Colombo (22.6%)<sup>12</sup>; P.D.U. Medical College and Associated Hospital, Rajkot (13.8%)<sup>13</sup>.

The difference in the number of RTA related deaths observed in different studies can be explained by the fact that RTA depends upon various epidemiological factors like geographical area, conditions prevailing in that region, category of road users, condition of road etc. Since Raichur is a very backward area High speed of driving by victims, bad road conditions with too many speed breakers with no proper signs, Improper enforcement by the traffic police might have contributed to this percentage of death.

#### Fractures of bones in victims (table no.2)

In the present study, numbers of skeletal injuries and internal organ injuries exceeded the total number of victims clearly indicating the multiplicity of injuries. As per our observations, Skull fracture was present in maximum number of victims (51.2%), followed by fracture of ribs (26.8%). Fracture of skull was most commonly observed in the study conducted at, Office of Judicial Medical Officer, Colombo (71.37%)<sup>12</sup>; Birmingham and Warwickshire (60%)<sup>14</sup>; Brisbane, Queensland (48.3%)<sup>15</sup>; PGIMS, Rohtak (51.6%)<sup>8</sup> ; and Birmingham Accident Hospital, Birmingham (52.18%)<sup>16</sup> . In our study the next most common fracture was of ribs and it is similar to the above mentioned last three studies. However contrary to our results leg bones fracture was common in the above mentioned first two studies.

#### Fractures of bones in motor cycle riders (table no.3)

Michael Fitzharris, Rakhi Dandona conducted a study on 378 motorised two wheeled vehicles (MTV) users were enrolled in a



study of whom open wounds and superficial injuries to the head (69.3%) and upper extremity (27%) and lower extremity (24%) were the most common injuries.

Skeletal injuries involving the skull were seen in majority of cases followed by clavicles and ribs.

A retrospective analysis was done by Sirathranont J, Kasantikul V in 3225 injured motorcyclists treated at Phra Chom Klao Hospital Phetchaburi province, Thailand between April 1, 1999 and March 31, 2000. The most fatal injuries to the motorcyclists were to the head, abdomen and chest in decreasing frequency.

An epidemiologic survey done by Ding SL et al of 2451 consecutive victims of traffic accidents, coming to or managed at, the emergency care department of a large Taipei metropolitan hospital in 1990. The results showed that the most common cause of head injury in traffic accidents was a motorcycle incident. Motorcycle accident injury patients were generally young males labourers or students.

Higher occurrence of skull fracture can be explained by the fact that in motorcyclists whatever may be the site of primary impact, secondary impact and secondary injuries are invariably to the head.

#### **Fractures of bones in pillion riders (table no.4)**

In our study it constitutes 11.2% of total RTA death cases.

#### **Fracture of bones in pedestrians (table no.5)**

In the present study, majority of the pedestrians had skull fractures in 38.46% of cases, followed by fracture of pelvis (26.92%).

Skull fracture was most commonly observed in the study conducted at, Birmingham and Warwickshire (57.92%)<sup>14</sup>; Brisbane, Queensland (53.9%)<sup>15</sup> and Office of Judicial Medical Officer, Colombo (69.5%)<sup>12</sup>.

In the study conducted at Brisbane, Queensland<sup>15</sup> and Office of Judicial Medical Officer, Colombo<sup>12</sup>, ribs fracture formed the commonest group next to skull fracture and is

**TABLE: 5 Fracture of Bones in Pedestrians**

Type of bone fractured	Number of cases	Percentage
Skull	10	38.46
Facial bones	1	3.84
Cervical vertebra	0	0
Hyoid bone	0	0
Thoracic vertebra	0	0
Sternum	0	0
Ribs	6	23.07
Clavicle	0	0
Scapula	0	0
Humerus	3	11.23
Forearm bones	1	3.84
Wrist & Hand	0	0
Lumbar vertebra	1	3.84
Pelvis	7	26.92
Femur	4	15.38
Patella	0	0
Leg bones	2	7.69
Foot bones	0	0

similar to our result. But in the study done at Birmingham and Warwickshire<sup>14</sup>, the next most common fracture was of leg bones and is contrary to our result.

#### **Fracture of bones in drivers: (table no.6)**

In the drivers of motor vehicle, fracture of ribs was most common (64.28%), followed by skull (42.85%) and femur (28.57%). The higher percentage of fracture of ribs and in drivers can be explained by the fact that the unrestrained drivers move forward after collision and chest strikes the steering wheel and horn boss.

The impact of chest with rigid steering wheel and horn boss can result in fracture of bones of thoracic cage. The skull fractures may be due to the impact of head against the windscreen or upper screen rim or the side pillar because of forward movement of the victim after collision. The relatively lesser percentage of skull fracture among drivers may be due to the slight protection offered by the steering wheel to the drivers and thus reducing the collision of head against windscreen. Another factor may be that the driver gives his attention constantly to the

**TABLE: 6 Fracture of Bones in Drivers**

Type of bone fractured	Number of cases	Percentage
Skull	6	42.85
Facial bones	0	0
Vertebra	0	0
Hyoid bone	0	0
Sternum	1	7.14
Ribs	9	64.28
Clavicle	3	21.42
Scapulla	0	0
Humerus	3	21.42
Forearm bones	5	35.71
Wrist & Hand	0	0
Pelvis	3	21.42
Femur	4	28.57
Patella	0	0
Leg bones	1	7.14
Foot bones	1	7.14

road and so has momentary warning of an impending crash, compared with the front seat passenger who may be oblivious of imminent disaster and fail to “brace up” ready for the impact. In the present study it was observed that occurrence of fracture of bones was higher in collision with heavy motor vehicles. This may be because of greater degree of force of impact due to large mass and more speed of heavy motor vehicles. Study carried out at Brisbane, Queensland<sup>15</sup>, fracture of ribs was more common in car drivers (47.4%) than car passengers (22.7%). In another Study conducted at Colombo, Sri Lanka<sup>12</sup>, in drivers’ skull fracture was present in maximum number of cases (76.9%). In another study done by Keith Mant as mentioned in the Knight’s Forensic Pathology, 42% of drivers had skull fracture this finding is contrary to our study.

Pelvic fractures were observed mostly in drivers of three or four wheelers.

#### **Fracture of bones in front seat passenger / rear seat passenger: (table no.7)**

In front seat passengers of motor vehicle, most common fracture was skull fracture (40%), and ribs (40%) followed by pelvic bone (26.66%), Forearm bones (13.33%). The higher percentage of fracture of ribs to

**TABLE: 7 Fracture of Bones in vehicle occupants**

Type of bone fractured	Number of cases	Percentage
Skull	6	40
Facial bones	0	0
Cervical vertebra	1	6.66
Ribs	6	40
Clavicle	1	6.66
Humerus	1	6.66
Forearm bones	2	13.33
Pelvis	4	26.66
Femur	3	20
Patella	0	0
Leg bones	3	20
Foot bones	1	6.66

the front seat passengers can be explained by the fact that the unrestrained passenger move forward after collision and chest strikes the dash board or side rim. In our study, fracture of leg bones was seen in (20%) of front seat occupants. This may be due to the violent impact of legs against the dashboard due to the forward movement of occupant of front seat.

In the study conducted at Birmingham and Warwickshire, England<sup>14</sup>, most common fracture seen in motor vehicle occupants was skull fracture (52.30%), followed by fracture of ribs and clavicle (36.92%) which is very similar to our study. In another study conducted at Colombo, Sri Lanka<sup>12</sup>, skull was the most commonly fractured bone among the passengers of motor vehicle (57.6%)

#### **Distribution of skull fractures: (table no.8)**

In the present study, skull fracture was present in 64 cases out of 125 cases (51.27%) of total victims of RTA. Therefore, fracture of skull was further analysed and our observations showed that fracture of the vault of skull alone was seen in 46 cases (71.87%), fracture of the base of the skull alone seen in 2 cases (3.125%). Whereas, fractures involving both vault and base of the skull accounted for 4 cases (6.25%). Fracture of facial bones was present in 5 cases (7.81%). The skull was crushed in 7 cases (10.35%).

**TABLE: 8 Distributions of Skull Fractures**

Site	No of cases	%
Vault alone	46	71.875
Base alone	2	3.125
Vault and Base	4	6.25
Crushed	7	10.9375
Facial bones	5	7.8125
Total	64	100

Commonest type of fractures present in the skull vault was linear / fissured fracture (50%), followed by Comminuted fracture being (18.25%).

In a study conducted at Maulana Azad Medical College, New Delhi, out of 104 cases, fracture of skull was present in 78 victims (75%). The combination of both vault and base of skull was commonest (44.8%), followed by fracture of the vault of skull alone (39.74%) and fracture of base of skull alone (10.2%). The commonest type of fracture seen in the skull vault was linear fracture (62%), followed by comminuted fractures (28%), the above findings are in line with observations made in our study.

In the base of skull, Linear fracture was the most common fracture (77%) and maximum number of fractures was seen in middle cranial fossa (51%).

In a retrospective study done at Istanbul, Turkey, a total of 501 victims of fatal RTAs with skull fracture were analysed. Linear fracture was found to be the most common type of skull fracture (46.56%).

In another study carried out at AIIMS, New Delhi<sup>7</sup>, in 79.87% of victim's skull fracture was present. Fracture of the vault of skull was more common than the base of the skull and most common type of fracture was linear. These results are similar to the results of our study.

In analysis done by Kumar lalwani et al of 2472 medicolegal autopsies of vehicular accident fatalities, the most commonly injury was to the head (69.63%) followed by chest (33.62%) Out of total number of 1699 cases (68.73%) who sustained head injury, skull

fractures were found in 1183 cases (69.63%) were head injury. The most common bone involved was the temporal bone 559 (47.25%) followed by parietal bone (45.47%) occipital bone (41.0%) and frontal bone (33.64%) most commonly found intracranial hemorrhage was subdural hemorrhage (89.11%).

#### **Associated visceral injuries (table no.9)**

In any RTA cases, skeletal injuries associated with visceral injuries the out will be highly complicated. Chances of Survival depend on type and severity of skeletal as well as visceral organ. The vital period available for treating doctor in such cases is too less and outcome will be fatal one.

**TABLE: 9 Associated Visceral Injuries**

Type of Bone Injury	No of cases	Viscera	No of cases	%
Ribs fracture	33	Lungs	27	81.81
Pelvis + Femur fracture	41	Liver	29	70.73
		Spleen	8	19.51
		Kidney	4	9.75
		Others	8	19.51

In the study done at Birmingham accident Hospital, Birmingham<sup>16</sup> Victims with major chest injury had multiple rib fracture in 87% of cases and all the cases of lung injury were associated with ribs fracture.

In the study conducted at GTB Hospital, Shahadra, New Delhi, during 1992-1994, lung injuries were associated with fracture of ribs in 75.8% of cases. The results of above studies are similar to the results of our study.

#### **Conclusion**

The mechanical forces & biophysical motion that occurs during accidents are responsible for the patterns of injuries in specific conditions or state through which the human body passes during the traumatic events.

Despite this massive and largely preventable human and economic toll, action to combat this global challenge has been insufficient.

Setting a goal of reducing road traffic deaths and injuries by 50% by 2020 as part of this agenda is a reflection of the growing recognition of the contribution of road safety to health, development and broader environmental objectives, and the potential for action.

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