Different Patterns and Distribution of Skull Fractures in Road Traffic Accidents

Zameeruddin Ahmed Hashmi[1], G Chandra Deepak[2], Mohammed Taqiuddin Khan[3]

[1]Assistant professor, Forensic Medicine And Toxicology, Government Medical College, Suryapet, [2]Senior Resident, ESIC Medical College, Hyderabad. [3]Professor and HOD, Department of Forensic Medicine, Osmania Medical College, Hyderabad. Telangana, India

Abstract

Background: The head is a common site of trauma in road accidents, and despite safety initiatives, the mortality rate for head injuries has not decreased. Despite the existence of a mandatory helmet law, both mortality and morbidity rates are on the rise. Head injuries are also associated with injuries to the neck, spine, stomach, abdomen, and pelvic cavity.

Objectives: To study different patterns and distribution of skull fractures in different kinds of road accidents.

Methods: In the Department of Forensic Medicine at Osmania General Hospital 4,213 post-mortem Examinations were carried out during the period (August 2019 to January 2021. In 784 cases, death was attributed to Road Traffic Accidents. Head injury was present in 634 cases. In 471 cases out of 784, skull fractures were found. The data has been collected from PME reports and inquest reports, relatives and friends of the deceased

Results: Most frequently noted type of fracture is fissured in 59.8% of the cases. Injuries in RTA's are almost always due to blunt force on cranial vault. Highest number of fractures are seen in temporal 100 (21%), Fractures occurring in cranial vault alone is 336(71.3%), BOS alone is 28(5.94%). Fractures extending into BOS are 308(65.3%). In the base of skull, overall highest frequency of fracture is found in MCF (alone in BOS) with 109 (23.1%), then in PCF (alone in BOS) is 71 (15%), least in ACF 39(8.28%). Only fracture MCF in all over skull is seen in 11(2.33%) cases, PCF 11(2.33%) cases

Conclusion: Commonest fracture of skull in road traffic accidents is the fissured fracture in the cranial vault, mostly in temporal bone. Fractures of cranial vault most frequently extend to middle cranial fossa and posterior cranial fossa till foramen magnum which are responsible for immediate deaths. Victims who survived till hospital admission are almost half in number. Strict enforcement of road safety regulations and improving emergency medical services may prevent untimely deaths and disabilities caused by RTAs.

Keyeords: *Road Traffic Accidents, RTA, Base of Skull, BOS, MCF, ACF, PCF*

Corresponding Author:
Dr. G Chandra Deepak,
Senior Resident, ESIC Medical College, Hyderabad
ORCID ID: 0000-0001-6150-9562

Introduction

The skull is an important part of the body because it protects the brain from external hazards. The skull prevents our brain from getting damaged every single

time we bump our heads. Thanks to the thickness of the bones of the skull and the skull's round shape, our brain is well protected. However, some times the skull will receive such a blow that it will break, just like the shell of an egg may crack, so the human skull. The head and brain are most vulnerable to injury in a variety of situations. A head injury is any injury that results in trauma to the skull or brain. The study of skull fractures is important as head being the most exposed and prominent part of the body; it becomes most susceptible to injuries, most commonly in road traffic accidents.

The history of trauma parallels the history of the evolution of man. Injury to brain without fracture of skull is not uncommon, though fracture of skull is usually accompanied by some degree of injury to the brain[1]. It has been truly said by Polson, that no injury to the head is too trivial to be ignored or so serious as to be despaired of.[1,2] Now – a- days cases of head injuries in road traffic accidents are increasing at an alarming rate in world communities, especially more densely populated areas with fast and heavy traffic flow along with rapid growth of industrialization. Hyderabad occupies the top position in highest vehicular density in India. Head injury is one of the leading causes of death and more than half of these deaths are as a result of road traffic accidents.

Expansion in road network, motorization and urbanization in the country has been accompanied by a rise in road accidents resulting in increased fatalities, disabilities and hospitalizations, mostly by head injuries with severe socio-economic costs across the country[1].

Poor road conditions such as missing guard rails, erosion, pot holes and faulty designs and dangerous conditions are significant contributors of road traffic accidents. While driver errors such as speeding, using mobile phone while driving, driving under the influence of alcohol etc are also other major factors.

Road traffic accidents result in tremendous loss of lives and prolonged morbidity besides causing sufferings to relatives and friends. Loss of lives and useful working hours inflict heavy damage to nation's economic activity, loss of bread winner to family, and deprivation of family bond of love and security. Increasing traffic accidents and subsequent trauma creates heavy burden on our scarce funds and already overburdened hospitals. Road traffic accidents are one of the major causes of death and illness which is preventable. There is tremendous rise in RTAs due to increase in vehicular volumes on our roads, speeding of vehicles, poor driving skills, drunk-driving, bad roads, poor traffic controls and lack of public awareness, rampant indiscipline of road users in competent authorities and lack of implementation of existing laws to tackle the menace of disrespect to the laws and rules.

The main victims of RTAs are pedestrians, two wheeler riders, pillion riders and cyclists. The two wheeler riders in India rarely use protective and secure helmets. At times to escape the law, the riders merely use unsafe thin head gear. This group is called vulnerable road users.

As per the latest 2020 report last published on road accidents in India was for the year 2019, published by Transport Research Wing under Ministry of Road Transport and Highways, Government of India, the country recorded at least 4,49,002 accidents in 2019 leading to 1,51,113 deaths.[3]

Materials and Methods

In the Department of Forensic Medicine at Osmania General Hospital 4,213 post-mortem Examinations were carried out during the period (August 2019 to January 2021. In 784 cases, death was attributed to Road Traffic Accidents. Head injury was present in 634 cases. In 471 cases out of 784, skull fractures were found.

The data has been collected from PME reports and inquest reports, relatives and friends of the deceased during the period of August 2019 to January 2021

Inclusion criteria : All autopsy cases of road traffic accidents with a finding of skull fracture.

Exclusion criteria : All autopsy cases of road traffic accidents without skull fracture.

Place of study : Department of Forensic Medicine and Toxiclogy, Mortuary, Osmania General Hospital, Afzalgunj, Hyderabad.

Duration of study : 1.5 year (August 2019 to January 2021) (Since lockdown affected and extended the duration of our study)

Statistical Analysis: SPSS software version 22 has been used for statistical analysis. Data were presented as statistical tables and charts.

Results and Discussion

The study sample included 471 autopsy cases in one year duration. After analyzing inquest, PME reports of all the 471 cases with skull fractures in deaths due to road traffic accidents the results and discussion are described and depicted below.

The frequency distribution of all the variables of the study is depicted in tables here under.

GENDER and AGE WISE DISTRIBUTION

Table 1. Gender and Age group wise distribution of victims.

Gender	Frequency
Males	397
Females	74
Age Group	
0 to 10	14
11 to 20	39
21 to 30	119
31 to 40	103
41 to 50	90
51 to 60	55
61 to 70	42
71 to 80	8
81 to 90	1

Incidence of skull fractures is 397(84.3%) in males and 74 (15.7%)in females.

The M : F ratio is 5.36:1.

Majority of the cases were in the age group of 21 to 30 yrs with 119(25.2 %) cases and 31 to 40 yrs age group with 103(21%) in 31 to 40 yrs of age group, 90(19%) in 41 to 50 yrs of age group, 55(11.6 %) in 51 to 60 yrs of age group, 42(8.9%) in 61 to 70 yrs of age group, 8(1.69%) in 71 to 80 yrs of age group, 1(0.2%) in 81 to 90 yrs of age group.

Table 2: Distribution of different types of fractures single bone fracture

Fracture	Frequency
Fissured	282
Depressed	20
Sutural	8
Comminuted	42
Fissured, Depressed	14
Depressed, Comminuted	10
Fissured, Sutural	29
Sutural, Comminuted	1
Compound, Comminuted	34
Mosaic	9

Most frequently noted type of fracture is fissured in 282 (59.8%). Depressed fracture is found in 20 (8%), Comminuted fracture in 42 (8.9%), Sutural in 8 (1.6%).

Cont... **Table 3: Distribution of single bone fractures and Frequency of different bones fractured**

Single bone fractures in vault	Frequency
Frontal	19
Temporal	100
Parietal	9
Occipital	56
Orbit	3
SKULL BONE FRACTURE	
All facial bones	3
All cranial bones	5

Cont... **Table 3: Distribution of single bone fractures and Frequency of different bones fractured**

All skull bones	52
Frontal Alone	19
Frontal + Others	62
Temporal Alone	100
Temporal + Others	116
Parietal Alone	9
Parietal + Others	81
Occipital Alone	56
Occipital + Others	61
Orbital Alone	3
Orbital + Others	13
Nasal Alone	1
Nasal+ Others	12
Zygoma	2
Zygoma + Others	10

Injuries in RTA's are almost always due to blunt force on cranial vault. Highest number of fractures are seen in temporal 100 (21%), then in occipital 56 (11.9%), frontal 19 (4%), least single bone fracture is seen in 9 (1.9%) cases.

Table 4: Frequency of Fractures of BOS, frequency of involvement of BOS, Frequency in Vault and BOS.

Fractures of base of the skull	**Frequency**
ACF	39
ACF+	29
MCF	109
MCF+	22
PCF	71
PCF+	24
Entire	66

Cont... **Table 4: Frequency of Fractures of BOS, frequency of involvement of BOS, Frequency in Vault and BOS.**

Involvement of base of skull	
Extension into BOS	308
No BOS Involvement	135
BOS Alone	28
Frequency In Vault And Base	
Cranial Vault alone	336
BOS Alone	28

Fractures occurring in cranial vault alone is 336(71.3%), BOS alone is 28(5.94%). Fractures extending into BOS are 308(65.3%). In the base of skull, overall highest frequency of fracture is found in MCF (alone in BOS) with 109 (23.1%), then in PCF (alone in BOS) is 71 (15%), least in ACF 39(8.28%). Only fracture MCF in all over skull is seen in 11(2.33%) cases, PCF 11(2.33%) cases

Table 5: Frequency in different survival intervals

Survival Interval	**Frequency**
Brought Dead	40
Hospital Death	246
Spot Dead	185

246 (52.2%) cases survived for a duration in hospital and died in hospital, 185(39.2%) cases died on the spot, 40(8.5%) cases died on the way to hospital.

Discussion

Road traffic injuries are a major public safety issue. These not only result in death, but also in disabilities among survivors, who can become a burden to the society. India, as a developing nation, is undergoing a demographic, epidemiological, and economic transition that has had a significant impact on health outcomes. This change led to the rise of non-communicable disorders, such as road traffic accidents resulting in serious injuries, as a major health-care problem. Since road traffic collisions are a leading cause of morbidity and mortality.

Males are predominant as they are head of a family and go out for earning livelihood, whereas most females takes care of house hold chores. This finding matches with a similar study.[4] When compared to another study[5] female victims has an increase in number, this may be due to more number of females going out for earning livelihood supporting the family.

According to WHO estimates, The leading cause of death for children and young adults aged 5-29 years

are road traffic injuries account for 73% of global road traffic deaths and Males are about three times more likely than young females to be injured in a road traffic accident.[6]

Highest number of victims are seen in age group of 21 to 30 yrs, then 31 to 40 yrs of age. The simple explanation is that they are part of the mainstream working community and therefore are more vulnerable. This finding is in coherence with other studies.[7,8,9]

In a study done by Kanchan et al[10] in Manipal, 89.8% of the victims was 38.7 years. In another study done by Goyal et al[11] in Jaipur, maximum number of cases was in the age group of 21 – 40 years and 87.1% of the 69 victims were males. Janine jagger et al[12] in a study found that maximum occurrence of head injury occurred in the age group of 20-29 years. The age and gender distribution in our study match well with that of all the other studies

Most frequently noted type of fracture is fissured in 282 (59.8%). Depressed fracture is found in 20 (8%), Comminuted fracture in 42 (8.9%), Sutural in 8 (1.6%).

Maximum frequency is of fissured type of fracture. This finding matches with other studies[13,14,15] not coherent with another study.[8]

Temporal bone is the bone that is fractured the most, individually in 100 cases, with extension to surrounding in only 16 cases, while parietal is fractured separately in only 9 cases, as an extension from surrounding bones(temporal or frontal or occipital) in 72 cases mostly from temporal(48 of 72) , the reason being for it may be due to anatomical location of these bones, thickness of bones[16-19]. Temporal bone (squamous portion) is present at sides of the skull (lateral cranial vault), parietal on top of skull, this anatomical presence makes the temporal bone most vulnerable, parietal the least. In RTA'S the victim may get hit by a vehicle or fall on the ground as a primary impact, but this scenario is most likely when the victim is either a pedestrian or two wheeler rider/pillion rider wherein he would fall on ground and vulnerable anatomical areas of skull come in contact with ground, and the likely regions i.e, the frontal, temporal or occipital rather than parietal get affected and then lead to casualty. Most frequently fractured bone is temporal, this finding is in coherence with other studies,[8,20] doesn't match with another study.[21]

Fractures occurring in cranial vault alone is 336(71.3%), BOS alone is 28(5.94%). Fractures extending into BOS are 308(65.3%). In the base of skull, overall highest frequency of fracture is found in MCF (alone in BOS) with 109 (23.1%), then in PCF (alone in BOS) is 71 (15%), least in ACF 39(8.28%). Only fracture MCF in all over skull is seen in 11(2.33%) cases, PCF 11(2.33%) cases – this might be as per reference.[7] Highest frequency is of cranial vault, this finding is similar to other study.[22]

This matches the findings of Jacobsen et al.[23] in Copenhagen, who found that linear fractures were the most frequent, accompanied by comminuted, depressed, ring, and spider web fractures. Linear fractures were the most frequent in the Jaipur study by Goyal et al,[11] followed by depressed and then comminuted fractures. Frontal and temporal fractures were much more frequent than parietal and occipital fractures when it came to the most common sites of skull fractures. This is due to the fact that most road traffic collisions involve the fronto-temporal region, which is more vulnerable to injuries than the parieto-occipital region.

There was a mix of fractures of the vault of the skull, intracranial hemorrhages, and fracture of the base of the skull in the majority of fatal head injury cases. This is due to the fact that fracture begins at the point of greatest contact and radiates downward to the base of the skull.

Devadiga and Jain et al[24] studied at 20 cases of fatal head injuries and found that 12 of them had fractures of both the vault and base of the skull. Six of the remaining cases had a base of the skull fracture

and eight had a vault of the skull fracture.

In a study by Davidson et al who discovered a combination of vault and base of the skull fractures.[25]

The current study's results are in accordance with the previous findings.

The time it takes for patients to be transported to the closest help station has an impact on their chances of surviving a head injury. The role of pre-hospital and in-hospital treatment in determining survival time is critical. The significant variation between the rate of mortality within 12 hours and instantaneous death may be due to the nature of rapid post-trauma care, the patient's physical ability to survive injury, and any pre-existing or related diseases and injuries.

According to Simon Sivett, 16% of RTA victims died on the spot, 44 % within 24 hours, 28% within 6 hours, 9 % within an hour, and 16 % between 6 and 24 hours.[26]

Conclusion

Commonest fracture of skull in road traffic accidents is the fissured fracture in the cranial vault, mostly in temporal bone. Fractures of cranial vault most frequently extend to middle cranial fossa and posterior cranial fossa till foramen magnum which are responsible for immediate deaths. Victims who survived till hospital admission are almost half in number.

Strict enforcement of road safety regulations and improving emergency medical services may prevent untimely deaths and disabilities caused by RTAs. Awareness campaigns concerning safety rules targeted at the high-risk groups and by improvement of the roads. The fact that the economically productive age-group were mostly involved an urgent public policy response with special reference to education, engineering, environment, and emergency care of road accident victims.

Ethical Clearance: Ethical clearance was obtained from the College institutional ethics committee of Osmania Medical College and General Hospital prior to the commencement of the study.

Source of Funding: Self

Conflict of Interest: Nil

References

1. SM.Sharma, Road Traffic accidents in India,IJAIMS,april-june 2016:1(2)57-64.
2. Vincent J Dimaio & Dominick Dimaio: Text Book of Forensic Pathology, 2nd Edition, CRC Press, New York, pg 149.
3. Road Accidents in India | Ministry of Road Transport & Highways, Government of India (morth.nic.in) 1-33.cdr (morth.nic.in) last accessed 20th February 2020.
4. Ramesh C. Patil , Mohammed Arifulla K. et al : Scenario of Pattern of Skull Fractures in the Victims of Unnatural Deaths Due to Head Injury Autopsied at Al-Ameen Medical College Hospital and District Hospital Mortuary, Vijaypur,I ndia.: International Journal of current Medical and Applied sciences; 2016, 10(2), 86-92.
5. Arvind Kumar, Sanjeev Lalwani , Deepak Agrawal , Ravi Rautji, TD Dogra Indian Journal of Neurotrauma (IJNT) 2008, Vol. 5, No. 2, pg. 63-67.
6. Road traffic injuries (who.int) last accessed 28th February 2020.
7. K.S. Narayan Reddy, The Essentials of Forensic Medicine and Toxicology, 33rd Edition, pg 247.
8. International Journal of Advanced & Integrated Medical Sciences, April-June 2016; 1(2):57.
9. Ranjana Singh, Hemant Kumar Singh, S C Gupta, and Yogesh Kumar ,Indian Journal of Community Medicine, 2014 Jan-Mar; 39(1):30-34.
10. Park Text Book of Social Preventive Medicine, 19th Edition 2007
11. Goel Mukesh Kumar, Rashmi, Kochar Shiv,

Fracture of the temporal bone: A tomographic v/s autopsy study, Journal of Indian Academy of Forensic Medicine. Year : 2007, Volume : 29, Issue : 4. Pg.no. 83 - 88

12. Trotter W. Concussion. Brit J Surg 1914;2:271–91.
13. Raja Rupani, Anoop Verma, Shiuli Rathore, Journal of Indian Academy of Forensic Medicine, October – December 2013, Vol.35, No. 4 , pg 336.
14. Singh B.K, Indian Journal of Forensic Medicine and Pathology, Vol 6, No.3, July – September 2013.
15. C.K. Parikh: Parikh's Text Book of Medical Jurisprudence, Forensic Medicine & Toxicology, 6th Edition 2000, CBS Publishers & Distributors, New Delhi.
16. Moreira –Gonzalez A, et al. Plast Reconstr Surg. 2006 May;117(6):1964-71.
17. Kennedy TA, Avey GD, Gentry LR. Imaging of temporal bone trauma. Neuroimaging Clin Am. 2014 Aug. 24 (3):467-86, viii.
18. Wennmo C, Spandow O. Fractures of the temporal bone--chain incongruencies. Am J Otolaryngol. 1993 Jan-Feb. 14(1):38-42.
19. Swartz JD. Temporal bone trauma. Semin Ultrasound CT MR. 2001 Jun. 22(3):219-28.
20. Arvind Kumar, Sanjeev Lalwani , Deepak Agrawal , Ravi Rautji, TD Dogra Indian Journal of Neurotrauma (IJNT) 2008, Vol. 5, No. 2, pg. 63-67.
21. Scholars Journal of Applied Medical Sciences (SJAMS) 2016:4(5f); 1819.
22. Tariq Azher, Arif Jamil Ansari, Zameer Ahmad, Journal of Migration and Human Security(JMHS), Jan-Mar 2017, Vol 11, No. 1,.
23. Jacobsen C, Lynnerup N. Cranial fractures caused by blunt trauma to the skull. A retrospective analysis of medico-legal autopsies in Denmark from 1999–2004. *Scand J Forensic Science* 2008;14(2):64–70
24. Devadiga KV, Jain SP. Mortality in head injury. J Ind Med Asso. 1969; 52(1): 22-26.
25. Kylie Davidson, Catriona Davies, And Dr. Patrick Randolph-quinney, Skeletal Trauma, Book - Forensic Anthropology, 1st Edition, 2011, Pages54, Ebook Isbn9780429251092
26. Simon Sivett, 1968: "Fatal road accidents" British Journal of Surgery, July Vol. 55, No.7: P.481-505.