Original Article

A Study on the Pattern and Distribution of Skull Fractures in Fatal Road Traffic Accidents

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Abstract

Introduction: Road traffic accidents (RTAs) are a leading cause of mortality and serious injury worldwide, with skull fractures frequently emerging as a significant consequence of such incidents. The pattern and distribution of skull fractures can provide valuable insights into the mechanisms of injury and the severity of accidents. Understanding these patterns is crucial for improving both preventive measures and clinical responses.

Materials and Methods: This is a retrospective cross- sectional study of one year duration**.** All the cases of road traffic accident death with skull fracture were included in the present study. A total of 342 cases of death due to fatal RTA were present and 140 cases had skull fractures.

Results: The commonest site of fracture was the vault, observed in (64.28%) of cases. In fractures involving single bones of vault, Frontal bone fractures were seen in the highest number of cases, in 29 cases (32.22%). In fractures involving the base of the skull, the highest number of fractures were seen in MCF, in (7.14%) of the cases.

Conclusion: A high number of fatalities due to road accidents occur in India every year. Its effect extends to the society at large. The financial burden produced on the family and healthcare system can be substantial. There can be adverse effect on the economic output of the country as well. Therefore, measures should be sought to reduce the road traffic accidents as a number of lives can be saved, as most of these are avoidable.

Keywords: skull fractures, road traffic accidents, two-wheelers

Introduction

Head injury is a morbid state resulting from gross or subtle structural changes in the scalp, skull, and/or the contents of the skull, produced by mechanical forces.[1] The head, being the most exposed part of the body, is often involved in incidents and is a major contributor to both morbidity and mortality in road

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traffic accidents.[2] RTAs are a leading cause of death among children and young adults aged 5-29 years, with around 1.3 million deaths annually.[3]These accidents also result in substantial economic losses for individuals, families, and nations.[3]

In 2021, Karnataka reported 34,647 road accidents, leading to 19,038 deaths and 40,754 injuries, marking a 1.37% increase in accidents and a 2.84% rise in fatalities compared to the previous year. Specifically, Kalaburagi reported 762 accidents, with 454 occurring in Kalaburagi city alone.[4] Accurate assessment of head injuries is crucial for forensic medicine to reconstruct events and provide reliable data to policymakers. Autopsy findings are essential for understanding head injuries and improving treatment by the medical community.[5]This study aims to investigate the pattern and distribution of skull fractures in fatal road traffic accidents, focusing on identifying common fracture types, their locations etc to enhance the understanding of injury patterns and support the formulation of strategies to mitigate the impact of such accidents on public health and safety.

Material and Methods

This was are trospective cross- sectional study, conducted in a one-year period from January 2023 to Dec 2023, at Gulbarga Institute of Medical Sciences**.** All the cases which satisfy the inclusion criteria will be included in the present study. The approval and clearance from the Institutional Ethics Committee was obtained, (ref no. GIMS/KLB/PHARMA/ IEC/223/2024-25, dated: 25-01-2024)and previous autopsy reports were screened for cases fulfilling the inclusion criteria. The reports of all the cases of RTA with head injury were collected and analysed. A total of 342 cases of death due to fatal RTA were present. 239 cases had head injuries, of which, 140 cases had skull fractures. Data from post mortem reports and police inquest were recorded in the proforma prepared. Convenience sampling technique will be used to collect the samples.

Skull fractures significantly increase the risk of death in road traffic accidents. Skull fractures with associated brain injuries have a higher mortality rate. In this study we aim to determine the pattern and distribution of skull fractures and to identify the potential risk factors and the high-risk group involved.

Inclusion criteria

- All the cases of road traffic accident death with skull fractures brought for medico-legal autopsy to Gulbarga Institute of Medical Sciences, Kalaburagi.

Exclusion criteria

- Cases of RTA deaths without skull fractures.
- Cases of skull fractures other than RTA-cases such as railway accidents, fall from height, operated cases etc.
- Bodies found in advanced stages of decomposition.
- Accidents with no definite history.

Assessment tools:

Microsoft office excel 2021. SPSS software version 22 has been used for statistical analysis. Data are presented as statistical tables and charts.

Results

The total number of autopsies conducted during the study period was 923. Out of which, 342 cases were of RTA's. Head injury was present in 239 cases (out of 342 cases) and 140 number of cases presented with skull fractures.

Age wise distribution of the victims

Majority of the victims were in the age group of 21-30 years,47 cases (33.58%), followed by 30 cases in the age group of 31-40 years (21.42%) and 26 cases in 41-50 years (18.58%). The least number of cases were seen in extremes of age group, 3 cases (2.14%) in 71-80 years and 04 cases (2.85%) in 0-10 years.

Table No.1: Age wise distribution of the victims

Age (in years)	Number	Percentage
0 – 10	04	2.85%
11-20	12	8.58%
21-30	47	33.58%
31-40	30	21.42%
41-50	26	18.58%
51-60	13	9.28%
61-70	05	3.57%
71-80	03	2.14%
Total	140	100%

Gender wise distribution of victims

Incidence of skull fractures in males was 121 (86.42%) and 19 (13.58%) in females. The male: female ratio is 6.36:1.

Table No. 2: Gender wise distribution of victims

Gender	Number	Percentage
Male	121	86.42%
Female	19	13.58%
Total	140	100%

Type of vehicle involved

Two wheelers were most commonly involved in the accidents, 102 cases (74.29%), followed by three wheelers in 07 cases(5%) and 4 wheelers in 06 cases (4.29%).

Table No.3: Type of vehicle involved

Vehicle	Number	Percentage
Two-wheeler	104	74.29%
Three-wheeler	07	5%
Four-wheeler	06	4.29%
Pedestrian	22	15.71%
Bus	01	0.71%
Total	140	100%

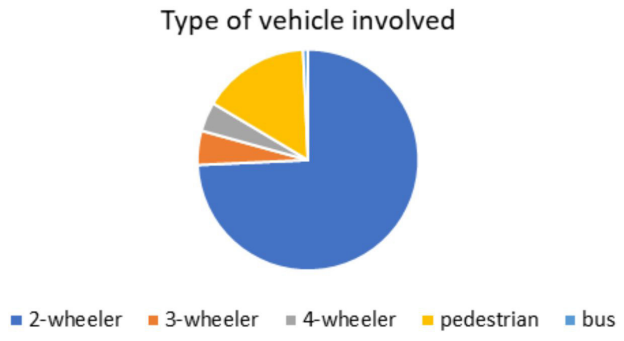

Figure No.1: Distribution of the type of vehicle

Type of victim involved

Most the victims were drivers, 74 cases (52.86%), followed by pillion riders in 35 cases (25%). 22 cases (15.72%) were pedestrians and 09 cases (6.42%) were occupants in 3 or 4 wheelers. It has been noticed that in all the cases involving two wheelers, helmets were not worn by the occupants.

Table No. 4: Type of victim involved

Victim	Number	Percentage
Driver	74	52.86%
Pedestrian	22	15.72%
Pillion rider	35	25%
Occupant	09	6.42%
Total	140	100%

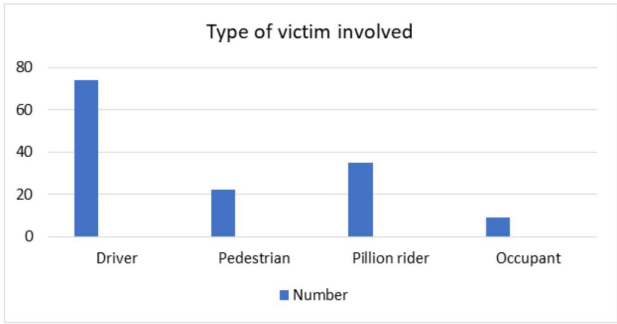

Figure No. 2: Distribution of the victims involved

Site of skull fractures

The commonest site of fracture was the vault, in 90 cases (64.28%), followed by the basal fracture seen in 16 cases (11.43%). Both vault and basal fractures were observed in 18 cases (12.86%).

Table No. 5: Site of skull fractures

Site	No.	Percentage
	90	64.28%
Base	16	11.43%
Facial bones	03	2.14%
Vault + base + facial	09	6.43%
Vault + facial	04	2.86%
Vault + base	18	12.86%
Total	140	100%

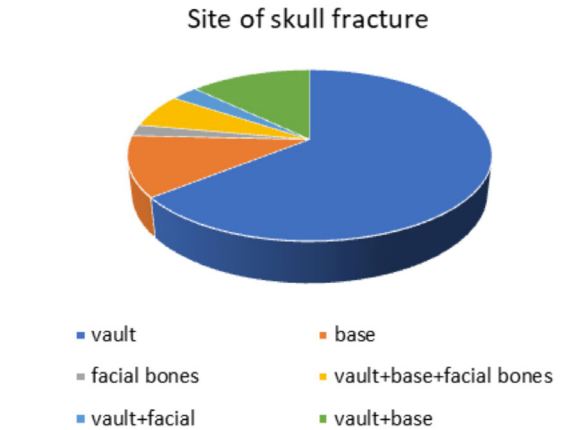

Figure No. 3: Distribution of site of skull fracture

Bone involved in cranial vault fractures

In fractures involving single bones of vault, Frontal bone fractures were seen in the highest number of cases, 29 cases (32.22%), followed by temporal bone in 15 cases (16.67%). The least number was seen in parietal bone, with 06 cases (6.67%).

Table No. 6: Bone involved in cranial vault fractures

Bone fractures in vault	No.	Percentage
Frontal	29	32.22%
Parietal	12	13.33%
Temporal	15	16.67%
Occipital	06	6.67%
Multiple bones	19	21.11%
All cranial vault bones	09	10%
Total	90	100%

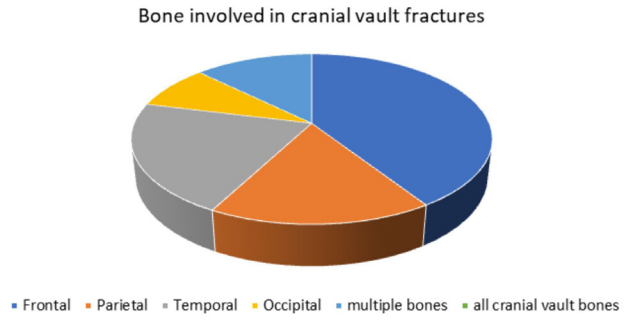

Figure No. 4: Distribution of cranial bones involved in fracture

Base of skull fracture

In fractures involving the base of the skull, the highest number of fractures were seen in MCF,10 cases (7.14%), followed by ACF, 03 cases (2.14%).

Table No. 7: Base of skull fractures

BOS fracture	No.	Percentage
ACF	03	18.75%
MCF	10	62.5%
PCF	00	0
Multiple	02	12.5%
All	01	6.25%
Total	16	100%

Types of skull fractures

The most common type of fracture noticed was linear fracture in 86 cases (63.23%), followed by comminuted fracture in 15 cases (11.02%). A combination of fractures was seen in 27 cases (19.86%).

Table No. 8:Types of skull fractures

Type of fracture	No.	Percentage
Linear	86	61.42%
Depressed	02	1.42%
Comminuted	19	13.59%
Elevated	01	0.73%
Hinge	01	0.73%
Crush	04	2.85%
Combination	27	19.28%
Total	140	100%

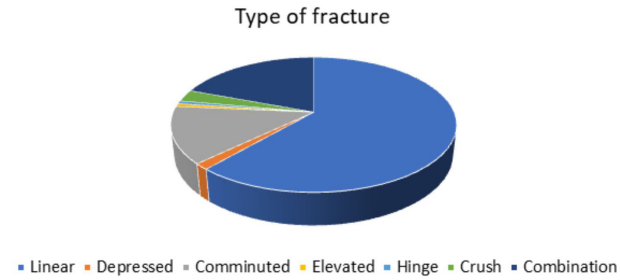

Figure No. 5: Distribution of type of fracture

Discussion

In our study, out of the 923 autopsy cases conducted during the study period, 342cases were of fatal RTA cases. Skull fracture was noted in 140 cases (58.57%), among 239 cases of head injuries. This is similar to the findings, in studies done by Shribhagwan et al[2] where in 150 RTA victims of death due to head injury, skull fracture was found in 59% of the cases. In a study conducted by Raza et al[6], skull fractures were present in 62% of the cases. The occurrence of skull fractures depends on a number of factors like speed of the vehicle involved, type of collision, use of safety features like helmets, seatbelts etc.

Majority of the victims were in the age group of 21-30 years,47 cases (33.58%), followed by 30 cases in the age group of 31-40 years (21.42%). These findings are consistent with the findings of many other studies. In the study conducted by Hashmi ZA et al[7], the 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%).Also, in studies conducted by Gopal B K et al[8] and by Shribhagwan et al[2] on victims with head injuries, the most affected age group was 21-30 years with 30% and 30.6% respectively. Inexperience, distracted driving, lack of safety precautions like use

of helmet, alcohol and drug use are some the factors contributing to the many causes. But in studies conducted by Nair SS et al[9] and by Shetty VB et al[10], the most commonly affected age group was between 30-40 years.

The incidence of skull fractures in males was 121 (86.42%) and 19 (13.58%) in females. The male: female ratio is 6.36:1. Similar finding was also observed in the study conducted by Hashmi ZA et al[7], wherethe incidence of skull fractures was 397 (84.3%) in males and 74 (15.7%)in females with a ratio of 5.36:1.Male preponderance is observed in almost all studies on fatal RTA deaths. Men tend to travel more frequently and widely for work or business, making them more likely to be involved in accidents. Additionally, factors such as higher risk-taking behaviour, alcohol consumption, aggression, and overconfidence contribute to the higher incidence of accidents among men compared to women.

Two wheelers were most commonly involved in the accidents, 102 cases (74.29%), followed by three wheelers in 07 cases(5%) and 4 wheelers in 06 cases (4.29%). In the study done by Pateria S et al[11], two-wheel riders accounted for 65.38%, followed by 4-wheeler in 14.46% of cases. Similar observation was also made in the study by Raza S et al[6], where two-wheeler accounted for 46% of the cases. Road accidents involving two-wheelers are a significant concern worldwide due to their high frequency and potential severity. Two wheelers have increased vulnerability in crashes as they lack safety features and protection offered by four wheelers. But in a study done by Malik Y et al[5], four wheelers were the most commonly involved vehicle, in 49.39% of the cases, followed by six wheelers (24.85%) and two wheelers in 23.03% of the cases.

Most the victims were drivers, involving 74 cases (52.86%), followed by pillion riders in 35 cases (25%). 22 cases (15.72%) were pedestrians. Also, in the study conducted by Pateria S et al[11] on fatal cases with head injuries, 48.31% of the victims were drivers. In contrast to our study, most of the victims involved in fatal RTAs were pedestrians in studies conducted by Gopal BK et al[8] (38%), Raza S et al[6] (37.3%), Shetty VB et al[10] (42.72%) etc.

In our study the commonest site of fracture was the vault, in 90 cases (64.28%), followed by the basal fracture seen in 16 cases (11.43%). Both vault and basal fractures were observed in 18 cases (12.86%). This is similar to the findings, observed by Hashmi ZA et al[7], in which fractures occurring in cranial vault alone was 71.3%, BOS alone was involved in 5.94% and both were involved in 65.43%. Also, in the study conducted by Das NK et al[12], fracture of the vault was seen in 56.5%, only base was fractured in 10% and both vault and base were fractured in 24.5% of the cases. However, vault with base fracture was seen in 42.85% of cases, in a study conducted by Devi M et al[13], followed by only vault fractures in 19.54% and only base fractures in 8.27%. Also, in study by Bharathi MO et al[14] combined vault and base fractures were seen in 48.23% of the cases.

Frontal bone fractures were seen in the highest number of cases, in 29 cases (32.22%), followed by temporal bone in 15 cases (16.67%). Shribagwan et al[2] too observed similar findings, frontal bone being involved in 44.32%, followed by temporal bone fractures in 30.68% of cases. Also, in a study by Soni SK et al[15], most of the fractures were present on frontal bone in 23% of the cases. Findings in contrast to our study was found in studies done by Hashmi ZA et al[7], Rajshekar V et al[16], in which temporal bone was the most commonly fractured bone seen in 21% and 53.3% of cases respectively.

In fractures involving the base of the skull, the highest number of fractures were seen in MCF,10 cases (7.14%), followed by ACF, 03 cases (2.14%). Our finding is in accordance with the study by Das NK et al[13], wherein MCF was most commonly fractured region involving the base, in 20% of the cases. Similar results were also noted in studies done by Bharathi MO et al[4], Hashmi ZA et al[7] and by Nair SS et al[9].

In our study the most common type of fracture noticed was linear fracture in 86 cases (63.23%), followed by comminuted fracture in 15 cases (11.02%). These findings are consistent with study conducted by Hashmi ZA et al[7], where linear fracture was observed in 59.8% of cases. It is also consistent with the studies done by Shribhagwan et al[2] and Nair SS et al[9], with 54.4% and 67.4% of cases respectively were observed with linear fractures. This was in contrast to the study conducted by Devi M et al[13], in which comminuted fracture was observed in maximum number of cases, constituting 31.5% of the cases.

Conclusion

In our study the majority of the victims were aged 21-30 years, comprising 47 cases (33.58%). Skull fractures were observed in 121 males (86.42%) and 19 females (13.58%), resulting in a male-to-female ratio of 6.36:1. Most of the victims were drivers, with 74 cases (52.86%), followed by pillion riders, who accounted for 35 cases (25%).A high number of fatalities due to road accidents occur in India every year. Its effect extends to the society at large. The financial burden produced on the family and healthcare system can be substantial. There can be adverse effect on the economic output of the country as well. Therefore, measures should be sought to reduce the road traffic accidents as a number of lives can be saved, as most of these are avoidable. For that, strict enforcement of traffic laws and regulations are crucial. Road infrastructures like road designs, signage, road markings should be enhanced. The public should be educated about road safety, responsible driving and about the consequences of violating traffic rules.

Ethical clearance: Ethical clearance was obtained from the institutional ethical committee prior to the commencement of the study. (ref no. GIMS/KLB/PHARMA/IEC/223/2024-25, dated:25-01-2024)

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Conflict of interest: Nil

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