Original Research Article

Study of the Pattern of Craniofacial Injuries in Victims of Fatal Road Traffic Accident Cases Autopsied in Midnapore Medical College

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Abstract

Background: The objective of this study was to investigate the pattern of craniofacial injuries in victims of fatal road traffic accidents, observed through autopsies conducted at Midnapore Medical College, West Midnapore from January 2021 to December 2023.

Methods: It is a retrospective, cross-sectional observational study. Data were collected through a comprehensive analysis of post-mortem reports documenting injuries in alleged road traffic accident cases where victims sustained craniofacial injuries. The study covered a period of three years, from January 1, 2021, to December 31, 2023. The data were analysed using Microsoft Excel.

Conclusion: The study underscores the need for context-specific interventions to address the unique injury patterns observed in road traffic accidents in West Midnapore. Enhancing road infrastructure, increasing traffic safety awareness, and promoting the use of protective measures like seat belts and helmets can significantly reduce the incidence of severe craniofacial injuries. The high prevalence of maxillofacial fractures highlights the vulnerability of the face, with substantial long-term physical and psychological repercussions.Effective prevention strategies, including stringent traffic regulations and awareness campaigns about the dangers of distracted or impaired driving, are essential. Despite its limitations, this study offers valuable insights into the patterns of craniofacial injuries in fatal accidents, emphasizing the need for improved road safety measures, stricter traffic laws, and enhanced post-accident care. Interdisciplinary collaboration among healthcare professionals, law enforcement, and policymakers is crucial for developing comprehensive strategies to manage and prevent these injuries. By analysing regional injury characteristics and comparing them with findings from other studies, this research contributes to a broader understanding of craniofacial trauma. The findings have significant implications for improving road safety, trauma care, and forensic practices.

Keywords: Craniofacial injuries, road traffic accidents, autopsy, fissure fractures, depressed comminuted fractures.

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Introduction

Road Traffic Accidents constitute a leading cause of death and disability worldwide, particularly among young adults aged 15 to 29 years[1]; according to the World Health Organization (WHO), approximately 1.35 million people die each year due to RTAs, with an additional 20 to 50 million sustaining non-fatal injuries, many of which result in long-term disabilities (World Health Organization, 2018). The burden of RTAs is disproportionately borne by low- and middle-income countries, where inadequate infrastructure, lax enforcement of traffic regulations, and limited access to emergency medical services contribute to heightened risks.[1]Cranial and facial injuries are among the most severe and potentially life-threatening consequences of RTAs. The high-speed, blunt-force trauma characteristic of these accidents often leads to a diverse array of injuries, ranging from superficial lacerations to catastrophic intracranial haemorrhages. Autopsy examinations play a pivotal role in elucidating the precise nature and extent of these injuries, facilitating an accurate determination of cause and manner of death.[2]Cranial and facial injuries encountered in RTAs encompass a spectrum of traumatic lesions affecting the bones, soft tissues, and neurovascular structures of the head and face. Common injuries include skull fractures, intracranial haemorrhages, facial fractures, and soft tissue contusions. The severity and distribution of these injuries are influenced by various factors, including the velocity of the impact, the nature of the collision, and the use of protective equipment such as helmets and seat belts.[3]Understanding the pattern and characteristics of these injuries is crucial for implementing effective preventative measures and improving post-accident care. The present study titled "Study of Pattern of Craniofacial Injuries in Road Traffic Accident Cases Autopsied in Midnapore Medical College, from 2021 to 2023" aims to contribute to the existing body of research by providing insights into the specific pattern and characteristics of craniofacial injuries in fatal road traffic accidents, focusing on Autopsy findings, identify various contributing factors of fatal cranio-facial injuries and measures to prevent these types of injuries.

Materials and Methods

The study was conducted on victims of fatal road traffic accidents at the mortuary of Midnapore Medical College and Hospital. It encompassed a total of 863 cases from January 2021 to December 2023. The cases were systematically categorized based on factors such as age, gender, point of origin (PS) from where they were referred, and the specific patterns of craniofacial injuries and intracranial haemorrhage. Data were collected using a standardized format and analysed with Microsoft Excel.

Result and Discussion

Current study reveals that the majority of the victims were male, constituting 87%. The male-to-female ratio was found to be 7:1, which is supported by the study of World Health Organisations (WHO), though the ratio is somewhat lower than the present study, 3:1[4]. Study by Montazeri et al[5], Elvik et al[6], Bener et al[7] showing the similar pattern of male dominance. Young adults fell in the age group of 21 to 30 years, accounting for 22% of all cases, closely followed by the 31 to 40 years age group at 19.8%. The lowest incidence was observed in the age group of 0 to 10 years, with a mere 0.9%. Similar findings are reported by Reddy et al. (2021)[8]where young adults accounted for approximately 40% of RTA fatalities in their analysis of national data; though McGwin et al[9] found adults in the age group of 30-59 accounted for over 30% of RTA fatalities in their retrospective analysis.

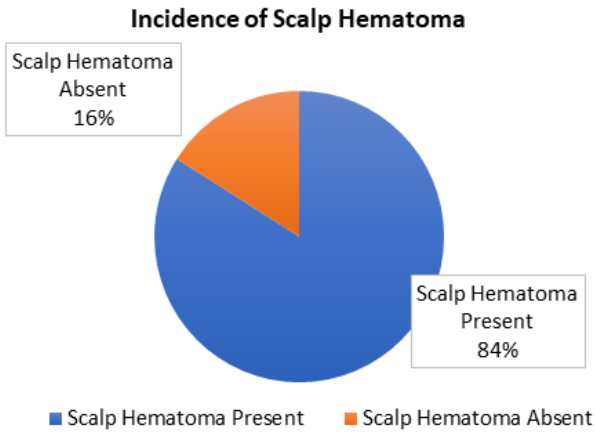

Figure No. 1

Pie chart 1 showing presence of scalp hematoma in 725 victims in current study, which accounts for

84% of the total.Horowitz R., et al.[10] depicted in their study that scalp hematoma is predominantly present in RTA cases subjected to cranio-facial injury, though they found the commonest area is the frontal region of the scalp[10].

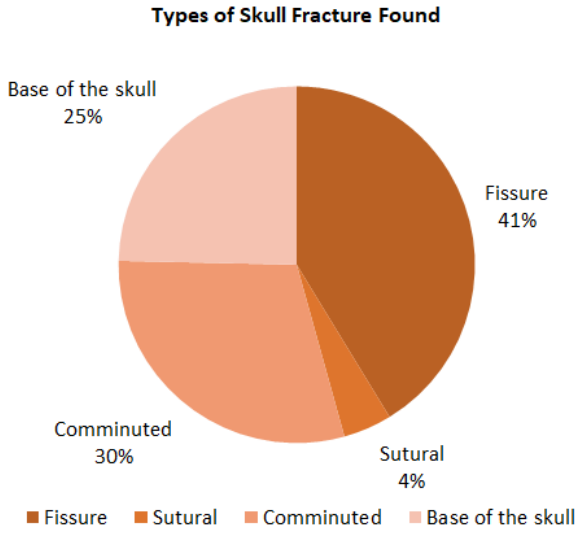

Figure No. 2

The current study reveals 38% of the victims were subjected to skull fracture, and among them the most prevalent skull fracture type was Fissure fracture also known as linear fractures, seen in 41% cases followed by Base of skull fracture and the least prevalent was sutural fracture, found in 4% cases (Pie Chart 2). A study by Nair et al.[11] found linear fractures to be prevalent in close to 60% of RTA fatalities examined during their investigation.Linear fractures are among the most common types of skull fractures observed in RTA fatalities. These fractures typically follow a linear trajectory along the cranial vault and may result from blunt force trauma to the head during the collision[12,13,14,15,16]. Barman et al. (2024) [17]documented basilar skull fractures in close to 25% of RTA fatalities included in their retrospective analysis.

Table 1: Prevalence of Base of Skull Fractures

Type of Base of the Skull Fracture found	Total number of cases seen
Type 1	82
Type 2	14
Type 3	10
Incomplete	17

As seen in Table 1, Base of the Skull fracture was seen in 123 victims, of which, most common Base of Skull fracture found was Type 1 and least common type was Incomplete Base of skull Fracture. Base of skull fractures in RTA victims often exhibit a characteristic pattern associated with the mechanism of injury. Studies by Johnson et al. (2022)[18] and Lee et al. (2021)[19] have reported that fractures commonly involve the anterior cranial fossa, middle cranial fossa, and posterior cranial fossa regions. Fractures may extend across multiple skull base compartments, resulting in complex patterns involving the petrous temporal bones, sphenoid bones, and occipital bones.

- Pattern of Fractures: Base of skull fractures in RTA victims often exhibit a characteristic pattern associated with the mechanism of injury. Studies by Johnson et al. (2022)[18] and Lee et al. (2021)[19] have reported that fractures commonly involve the anterior cranial fossa, middle cranial fossa, and posterior cranial fossa regions.
- Distribution by Location: Base of skull fractures in RTAs show a predilection for specific anatomical regions, influenced by the direction and severity of the impact forces. Research by Yang et al. (2020)[23] and Barman et al. (2024)[17] has indicated that fractures frequently occur at the skull base's weakest points, including the petrous temporal bone's thin squamous portion, the Sella turcica of the sphenoid bone, and the clivus of the occipital bone.
- Mechanisms of Injury: Base of skull fractures in RTAs typically result from blunt force trauma transmitted through the skull base during high-energy collisions. Acceleration-deceleration forces, combined with direct impacts or rotational forces, contribute to skull base fractures' severity and complexity. Studies by Garcia et al. (2019)[30] and Wiederholt WC et al. (2020)[20] have highlighted the role of head-on collisions, side impacts, and rollover events in producing skull base fractures, with differences in fracture patterns observed based on the vehicle's orientation and the occupants' positions.
- Association with Intracranial Injuries: Base of skull fractures in RTAs are frequently associated with intracranial injuries, including epidural hematomas, subdural hematomas, and intracerebral contusions. Research by Nair et al.[11] and Martinez

et al. (2021)[31] has shown that skull base fractures may serve as indicators of severe underlying brain injuries, particularly when accompanied with cerebrospinal fluid leaks or pneumocephalus.

- Prognostic Implications: The presence and severity of base of skull fractures in RTA victims have prognostic implications for outcomes and survival. Studies by Sharma et al. (2018)[26] and Lee et al. (2022)[19] have demonstrated an association between skull base fractures and increased mortality rates, particularly in cases involving extensive skull base involvement or associated intracranial injuries.

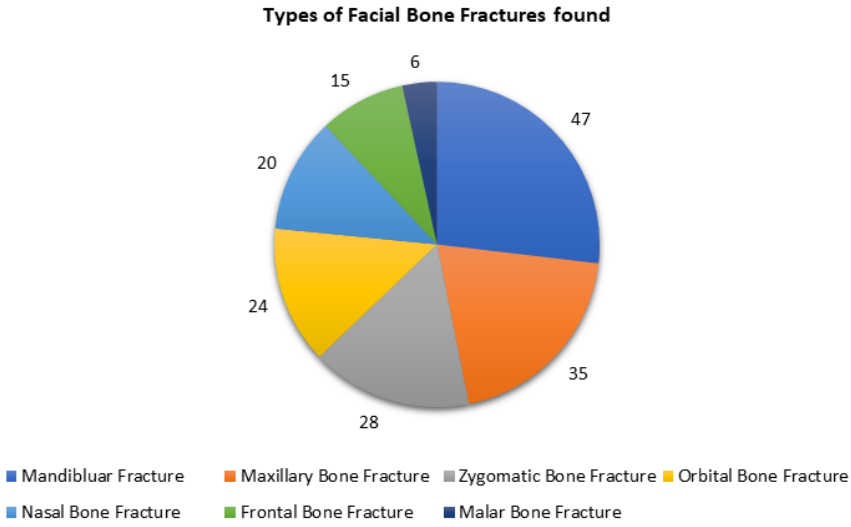

Figure No.3

In the present study, we found 20% of victims were subjected to facial bone fractures (n=175), mandible fracture (vide Pie Chart 3) being the most common type of facial bone to be fractured, and most of time it's also associated with other facial bones like maxilla, zygomatics. A comprehensive analysis by Barman et al.[17] found that facial fractures were present in nearly 65% of fatal cases studied. Correspondingly, a study conducted by Johnson and colleagues (2023)[18] reported a slightly lower but still substantial incidence of facial bone fractures, accounting for 58% of fatal road traffic accidents examined. Several scientific studies investigating facial fractures in fatal road traffic accidents consistently identify fractures of the mandible as the most common. Patel et al.[20], Kumar et al.[24], Sharma et al.[25], and Gupta et al.[26] conducted autopsy-based or retrospective analyses, confirming the predominance of mandibular fractures in such cases. These studies underscore the critical impact of facial trauma in fatal road incidents, emphasizing the importance of preventative measures and improved safety regulations in minimizing such injuries.

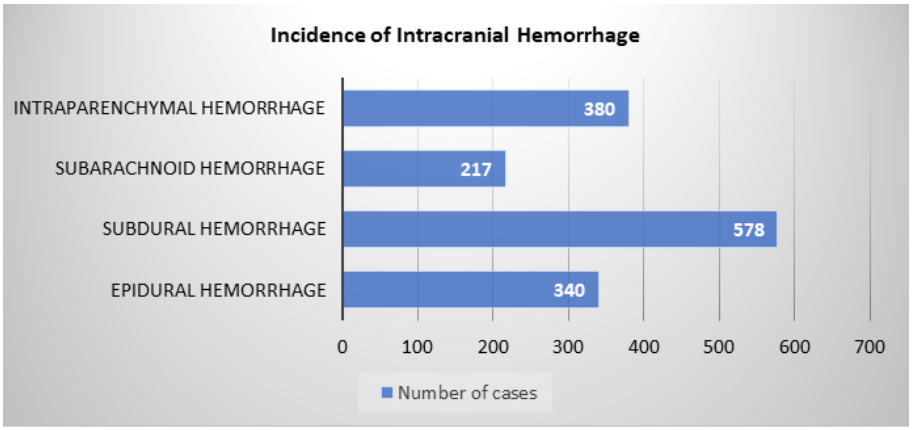

Figure No. 4

Total 688 cases of Intracranial haemorrhages were found in our study. A single individual often showed multiple types of intracranial haemorrhages. The most common type of intracranial haemorrhage seen in fatal road traffic accidents (RTAs) was subdural haemorrhage, seen in 578 cases. Many RTA-related intracranial haemorrhages exhibit multifocal distribution, involving several regions of the brain. This pattern reflects the diffuse nature of head trauma in RTAs, with widespread injury to various brain structures[20].A study by Barman et al.[17] revealed that ICH was present in 70% of fatal RTA cases, almost all located in the subdural and subarachnoid spaces. Similarly, Jones and colleagues[11] reported a higher incidence of ICH in traumatic brain injury cases associated with RTAs compared to other causes of head trauma. Studies by MG Rajkumar et al. (2023)[27], Chiu WT et al. (2000)[28] and Mekonnen D et al. (2012)[29] have arrived at similar conclusions regarding distribution of intracranial haemorrhages in victims of fatal road traffic accidents.

Prevalent Patterns:

The patterns of intracranial haemorrhages observed during autopsy examinations of RTA victims may vary depending on the mechanism and severity of the injury. However, certain prevalent patterns can be identified:

- Multifocal Haemorrhages: Many RTA-related intracranial haemorrhages exhibit multifocal distribution, involving multiple regions of the brain. This pattern reflects the diffuse nature of head trauma in RTAs, with widespread injury to various brain structures.
- Frontotemporal and Temporoparietal Haemorrhages: Haemorrhages involving the frontotemporal and temporoparietal regions of the brain are commonly observed in fatal RTAs, particularly in cases of lateral impacts or rotational injuries. These regions are susceptible to injury due to their proximity to the skull base and vulnerability to shearing forces.
- Haemorrhagic Contusions: Haemorrhagic contusions, characterized by areas of haemorrhage within the brain parenchyma, are prevalent in RTA-related head trauma. These contusions often occur at points of impact or deceleration, such as the cerebral cortex or deep white matter tracts, and may be associated with skull fractures or focal brain injuries[20].

Summary

This retrospective, cross-sectional observational study reviewed 863 cases of road traffic accidents with craniofacial injuries autopsied in the Department of Forensic Medicine and Toxicology at Midnapore Medical College and Hospital from 2021 to 2023. Most victims were male, aged between 21 and 40 years. The most common injury was scalp hematoma, observed in 84% of cases, followed by skull fractures, which were present in 38% of cases. The most frequent type of skull fracture was a fissured fracture. Many cases exhibited multiple concurrent fractures and scalp hematomas. Intracranial haemorrhage was reported in 80% of cases, with subdural haemorrhage being the most prevalent, accounting for 84% of all intracranial haemorrhages. Mandibular fractures were the most common type of facial bone fractures.

Conclusion

These variations in injury patterns emphasize the importance of context-specific interventions and preventative measures to address the specific challenges faced in the West Midnapore region. For instance, focusing on improving road infrastructure, increasing awareness about traffic safety, and encouraging the use of protective measures like seat belts and helmets can mitigate the risk of severe craniofacial injuries in road traffic accidents.

The observed prevalence of maxillofacial fractures in the present study highlights the vulnerability of the face to traumatic injuries. Maxillofacial fractures not only have immediate consequences but also impact long-term physical and psychological well-being. Therefore, interventions targeting the prevention of facial injuries, such as promoting compliance with traffic regulations and raising awareness about the risks associated with distracted driving or driving under the influence, are crucial to reduce the burden of craniofacial injuries sustained in road traffic accidents.

Despite the limitations of this study, it provides valuable insights into the pattern of craniofacial

injuries in fatal road traffic accidents in West Midnapore. The findings underscore the need for ongoing efforts to improve road safety awareness, strengthen traffic regulations, and enhance post-accident care services. Furthermore, the study highlights the importance of interdisciplinary collaborations between healthcare professionals, law enforcement agencies, and policymakers to develop and implement comprehensive strategies to prevent and manage craniofacial injuries sustained in road traffic accidents effectively.

In conclusion, the present study contributes to the existing literature by examining the pattern and characteristics of craniofacial injuries in fatal road traffic accidents in West Midnapore. The findings emphasize the significance of skull fractures, maxillofacial fractures, and intracranial haemorrhages and provide insights into the unique regional aspects of these injuries. Cross-referencing with previous studies conducted in India and other countries enhances our understanding of the variations in injury patterns. The study's outcomes have important implications for road safety interventions, trauma care protocols, and forensic investigations to reduce the burden of craniofacial injuries, mitigate their long-term consequences, and ultimately improve the overall well-being of road traffic accident victims.

Ethical Clearance: This is a retrospective non-interventional data based cross sectional observational study and thus ethical clearance was not required.

Source of Funding: Self

Conflict of Interest: Nil

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