

Pattern of Facial Soft Tissue Injuries in Fatal Maxillofacial Trauma: An Autopsy-Based Study

Authors:

Dr. Parnita Raj¹, Dr. R K Punia², Dr. Mahesh Soni³

¹Postgraduate Resident, Department of Forensic Medicine & Toxicology, S.M.S Medical College & Attached Group of Hospitals, Jaipur. <https://orcid.org/0009-0007-0408-4917>

²Senior Professor and Former Head, Department of Forensic Medicine & Toxicology, S.M.S Medical College & Attached Group of Hospitals, Jaipur. <https://orcid.org/0009-0009-2723-1881>

³Postgraduate Resident, Department of Forensic Medicine & Toxicology, S.M.S Medical College & Attached Group of Hospitals, Jaipur. <https://orcid.org/0009-0003-6563-651X>

Corresponding Author:

Dr. R K Punia

Senior Professor and Former Head, Department of Forensic Medicine & Toxicology, S.M.S Medical College & Attached Group of Hospitals, Jaipur.

<https://doi.org/10.5281/zenodo.21543292>

Received: 05 July 2026, Accepted: 23 July 2026, Online First: 25 July 2026

ABSTRACT

Background: Soft tissue injuries of the maxillofacial region are common in fatal trauma and provide valuable information regarding the mechanism, direction, severity of impact, and medico-legal reconstruction of events. Although fractures have been extensively studied, limited literature exists regarding the distribution of external facial soft tissue injuries observed during medicolegal autopsy. The Aim of this study was to evaluate the pattern and distribution of soft tissue maxillofacial injuries among fatal trauma victims undergoing medicolegal autopsy. **Materials and Methods:** A descriptive cross-sectional autopsy-based observational study was conducted in the Department of Forensic Medicine and Toxicology, SMS Medical College, Jaipur. One hundred medicolegal autopsy cases with traumatic maxillofacial injuries were included. Information regarding demographics, injury characteristics and external facial soft tissue injuries was collected using a structured proforma. Data were analysed using descriptive statistics and expressed as frequencies and percentages. **Results:** Among the 100 cases, males constituted 89% while females accounted for 11%. Road traffic accidents were responsible for 90% of cases. Abrasion was the commonest external facial injury (73%), followed by laceration (33%), diffuse swelling (21%), stitched wounds (20%), bruises (6%) and crush injuries (5%). The maxillary region was the most frequently involved facial region (53%), followed by the mandibular (44%), zygomatic (41%), eyelids (37%), nose (34%), eyebrows (21%) and lips (9%). **Conclusion:** Soft tissue facial injuries demonstrate characteristic anatomical distribution in fatal trauma and may assist forensic experts in reconstructing injury mechanisms and identifying impact patterns. Documentation of these injuries has significant medico-legal importance.

Keywords: Maxillofacial trauma, Soft tissue injury, Facial injury, Autopsy, Abrasion, Medico-legal

INTRODUCTION

Maxillofacial trauma is a major public health concern and one of the most common injuries encountered in emergency departments and forensic practice. It includes injuries involving the soft tissues and bones of the face, resulting from road traffic accidents (RTAs), falls, assaults, sports injuries, occupational accidents, and other

traumatic events. Because of the anatomical prominence of the face and its close relationship with the brain and airway, maxillofacial injuries are associated with significant morbidity, mortality, cosmetic disfigurement, and functional impairment. In fatal trauma cases, detailed examination of facial soft tissue injuries during medicolegal autopsy provides valuable information

regarding the mechanism, severity, and direction of impact, thereby assisting in the reconstruction of events leading to death and correlating autopsy findings with antemortem clinical records and investigations.¹

Soft tissue injuries of the face include abrasions, contusions, lacerations, crush injuries, avulsions, and diffuse swelling. These injuries frequently accompany fractures of the facial skeleton but may also occur independently depending on the nature and force of trauma. The type, location, and extent of external injuries often reflect the mechanism of injury and provide important forensic evidence. For example, abrasions may indicate tangential impact or friction, contusions suggest blunt force trauma, while lacerations are commonly associated with high-energy impacts.^{2,3}

Road traffic accidents remain the leading cause of maxillofacial trauma worldwide, particularly in developing countries such as India. Rapid urbanization, increasing motor vehicle use, inadequate compliance with traffic safety measures, alcohol consumption, and excessive speed have contributed to the rising incidence of facial injuries. Young adult males are disproportionately affected because of greater occupational exposure, outdoor activities, and risk-taking behaviour. Other important causes include railway accidents, falls from height, interpersonal violence, and workplace injuries.⁴

Although numerous studies have described facial bone fractures and their management, relatively few autopsy-based studies have focused specifically on the pattern of external soft tissue maxillofacial injuries. Such injuries possess considerable medico-legal significance as they may indicate the site of impact, nature of the offending object, and sequence of traumatic events. Knowledge of their distribution also contributes to regional epidemiological data and helps formulate preventive strategies aimed at reducing trauma-related mortality.

Despite numerous hospital-based studies evaluating maxillofacial fractures, limited autopsy-based research has specifically focused on the distribution and forensic significance of facial soft tissue injuries in fatal trauma victims. Furthermore, published data from North-West India, particularly Rajasthan, remain scarce. Therefore, the present study was undertaken to evaluate the pattern and anatomical distribution of facial soft tissue injuries in fatal maxillofacial trauma and to assess their medico-legal significance.

Aim and Objectives

The present study aimed to evaluate the pattern and anatomical distribution of facial soft tissue injuries among fatal maxillofacial trauma victims undergoing medicolegal autopsy.

The specific objectives were:

- To determine the demographic profile of the victims.

- To identify the common causes of fatal maxillofacial trauma.
- To analyse the anatomical distribution of facial soft tissue injuries.
- To correlate injury patterns with their medico-legal significance.

MATERIALS AND METHODS

Study Design: This was a descriptive, cross-sectional, autopsy-based observational study.

This autopsy-based descriptive observational cross-sectional study was conducted in the Department of Forensic Medicine and Toxicology, SMS Medical College and Attached Hospitals, Jaipur, Rajasthan. The study was carried out from September 2024 to January 2025, after obtaining approval from the Institutional Ethics Committee and Research Review Board. A total of 100 medicolegal autopsy cases with traumatic maxillofacial injuries were included in the study. The sample size was calculated based on the reported prevalence of maxillofacial injuries in fatal road traffic accidents and was rounded to 100 to improve representation.

Inclusion Criteria

- All medicolegal autopsy cases presenting with traumatic maxillofacial soft tissue injuries.
- Availability of complete medico-social and demographic information.
- Written informed consent obtained from the legal representative or next of kin, wherever applicable.

Exclusion Criteria

- Cases with facial injuries resulting from non-traumatic causes such as congenital anomalies, diseases, or previous surgical procedures.
- Putrefied or decomposed bodies in which proper assessment of facial soft tissue injuries was not possible.

Sampling Technique: Consecutive sampling technique was used to include all eligible medicolegal autopsy cases during the study period.

Data were collected using a predesigned proforma. Demographic details, circumstances of injury, and medicolegal information were obtained from police inquest reports, hospital records, and relatives of the deceased. During autopsy, a meticulous external examination of the face was performed. Soft tissue injuries including abrasions, contusions (bruises), lacerations, diffuse swelling, crush injuries, and stitched wounds were identified and documented. The anatomical

distribution of injuries involving the eyelids, eyebrows, maxillary, zygomatic, mandibular, nasal, and lip regions was recorded. Cases with isolated skeletal fractures without associated external soft tissue injuries were not considered for detailed soft tissue analysis. Representative photographs were taken wherever appropriate for documentation. The collected data were entered into Microsoft Excel, cleaned, and analysed using descriptive statistical methods. The results were expressed as frequencies and percentages and presented in appropriate tables and figures.

RESULTS

A total of 100 medicolegal autopsy cases with traumatic maxillofacial injuries were included in the study. Males constituted the majority of the study population (89%), while females accounted for 11%, with a male-to-female ratio of approximately 9:1. The highest number of cases belonged to the 21–30 years age group (35%), followed by 31–40 years (23%) and 41–50 years (15%), indicating that young adults were the most affected population.

Table 1: Gender and Age wise distribution of cases of Traumatic Maxillofacial Injuries

Age Group	Male Cases	Female Cases	Number of Cases (n=100)
1-10 years	01	02	03
11-20 years	11	00	11
21-30 years	35	00	35
31-40 years	22	01	23
41-50 years	12	03	15
51-60 years	05	02	07
More than 60 years	03	03	06
Total	89	11	100

Road traffic accidents were the predominant cause of maxillofacial trauma, accounting for 90% of cases, followed by train accidents (5%), assault (2%), fall from height (1%), heavy object fall (1%), and unknown causes (1%). Most incidents occurred during Night Hours 18:00–24:00 hours (40%), followed by Afternoon hours 12:00–18:00 hours (34%). Urban areas accounted for 65% of cases.

Among the external facial soft tissue injuries, abrasions were the most common finding, observed in 73% of cases, followed by lacerations (33%), diffuse swelling (21%), stitched wounds (20%), bruises (6%), and crush injuries (5%). No incised wounds were recorded.

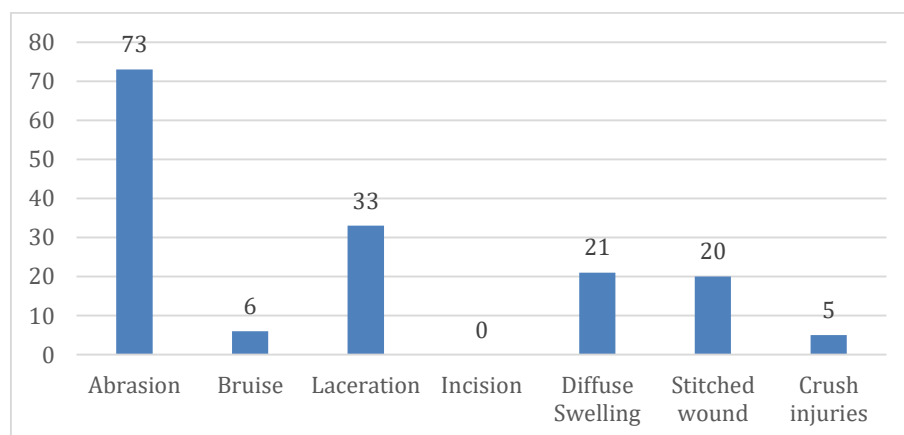


Figure 1: External Injury Type wise distribution of cases of Traumatic Maxillofacial Injuries



Image 1 Bilateral Periorbital Bruises

Analysis of the anatomical distribution of facial soft tissue injuries revealed that the **maxillary region** was the most frequently affected (53%), followed by the **mandibular region (44%)**, **zygomatic region (41%)**, **eyelids (37%)**, **nose (34%)**, **eyebrows (21%)**, and **lips (9%)**.

Table 2: Pattern of External Injury region on face in cases of Traumatic Maxillofacial Injuries

Face Region	Right	Left	Bilateral	No of Cases
Eyelid	15	16	06	37
Eyebrow	09	07	05	21
Maxillary	15	24	14	53
Zygomatic	12	17	12	41
Mandibular	12	11	21	44

Maxillary injuries were predominantly left-sided (24 cases), followed by right-sided (15 cases) and bilateral injuries (14 cases). Of the 44 mandibular injuries, 13 were bilateral, 12 right-sided, 11 left-sided, and 8 involved the midline. Among the 41 zygomatic injuries, 17 were left-sided, 12 right-sided, and 12 bilateral. Eyelid injuries were identified in 37 cases, with left-sided involvement in 16 cases, right-sided in 15 cases, and bilateral involvement in 6 cases. Eyebrow injuries were present in 21 cases, comprising 9 right-sided, 7 left-sided, and 5 bilateral injuries.

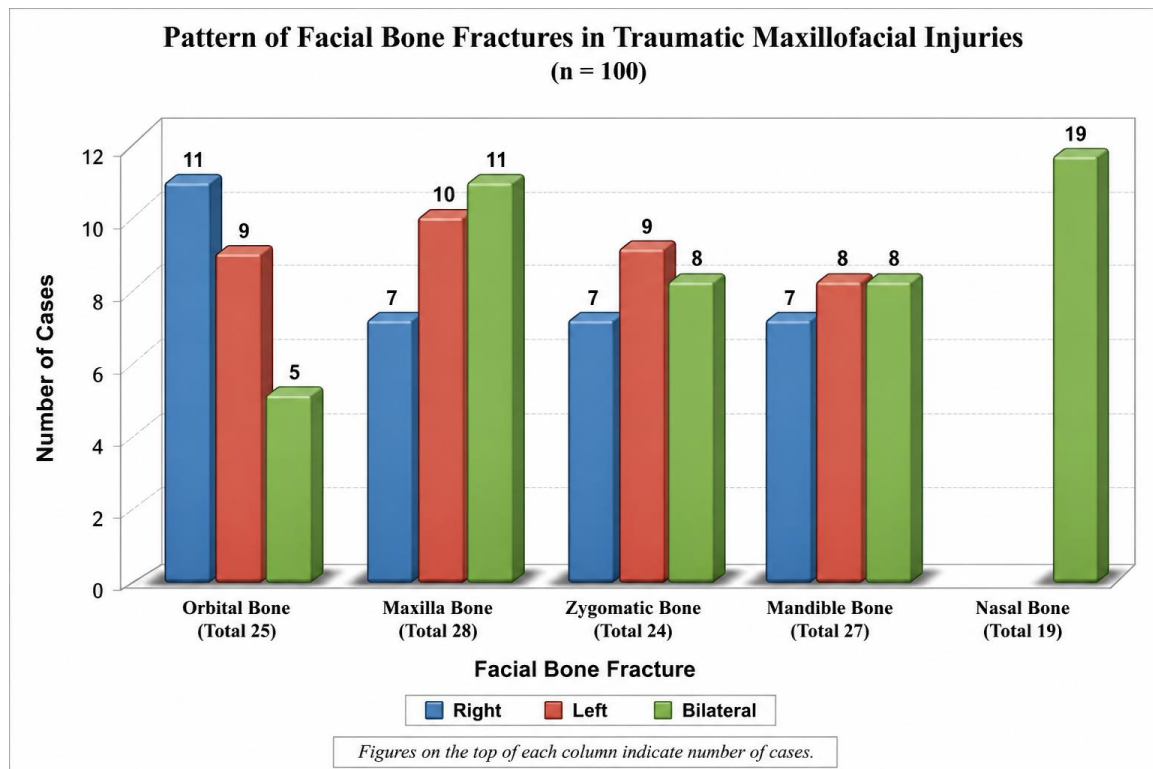


Figure 2: Pattern of Fractures of facial bones in cases of Traumatic Maxillofacial Injuries.

The most common fatal injury which lead to death was **head injury (63%)**, followed by **multiple bodily injuries (28%)**. Other fatal injuries included **spinal injuries (5%)**, **thoracic injuries (2%)**, and **abdominal injuries (2%)**. The cause of death was **coma in 60% of cases** and **shock in 40% of cases**.

DISCUSSION

The present autopsy-based observational study evaluated the pattern of soft tissue and bony maxillofacial injuries among 100 fatal trauma victims. The study demonstrated a marked male predominance (89%), with the highest incidence observed in the 21–30-year age group. Similar findings have been reported by Rupani et al., Abhinav et al., Kalathil et al., and Dalal et al., who observed that young adult males constitute the majority of victims sustaining maxillofacial trauma. This demographic pattern is largely attributed to greater outdoor activities, occupational exposure, risk-taking behaviour, and increased involvement in road traffic accidents among males. Young adults are also more likely to drive two-wheelers and engage in high-speed travel, thereby increasing their vulnerability to facial trauma.²⁻⁸

Road traffic accidents (90%) were identified as the predominant cause of fatal maxillofacial injuries in the present study. Comparable observations have been reported by Rupani et al. (56.75%), Abhinav et al., Khan et al., and Utkarsh Srivastava et al., all of whom identified road traffic accidents as the leading mechanism of maxillofacial trauma.^{1,2,5,6} The relatively higher proportion observed in the present study may be explained by the inclusion of only fatal autopsy cases, where high-energy vehicular collisions are more likely to

result in severe craniofacial injuries and death. These findings reinforce the urgent need for stricter enforcement of helmet and seat belt laws, improved road infrastructure, and public awareness regarding traffic safety.

Abrasions were the most common external soft tissue injury, occurring in 73% of cases, followed by lacerations (33%), diffuse swelling (21%), stitched wounds (20%), bruises (6%), and crush injuries (5%). Similar observations were reported by Amit Kumar et al., who found superficial soft tissue injuries to be the predominant facial lesions in fatal trauma victims.⁹ Abrasions usually result from friction between the facial skin and rough surfaces such as roads during vehicular collisions, while lacerations generally indicate high-energy blunt force impacts against hard objects. The predominance of abrasions in the present study reflects the mechanism of road traffic accidents, where victims frequently sustain sliding injuries after impact.

The anatomical distribution of facial soft tissue injuries revealed that the maxillary region (53%) was the most commonly affected site, followed by the mandibular (44%), zygomatic (41%), eyelids (37%), nasal (34%), eyebrow (21%), and lip (9%) regions. Although many hospital-based studies have reported mandibular fractures as the most common facial injury, autopsy-based studies often demonstrate extensive injuries involving multiple

facial regions due to the higher magnitude of force involved in fatal trauma.^{3,4} The predominance of maxillary injuries observed in the present study may be attributed to direct frontal impacts sustained during high-speed collisions, where the midface frequently strikes the steering wheel, dashboard, windshield, or road surface.

Laterality analysis showed that left-sided injuries were marginally more frequent than right-sided injuries in the maxillary, zygomatic, and eyelid regions. Bilateral involvement was common in mandibular and zygomatic injuries, suggesting severe blunt force trauma involving multiple impact sites. Such injury patterns indicate that fatal facial trauma often results from complex mechanisms rather than isolated direct blows. Similar observations have been described in studies evaluating fatal craniofacial injuries, where bilateral facial involvement reflects higher energy transfer and greater injury severity.^{4,8}

Among facial bone fractures, maxillary fractures (28%) and mandibular fractures (27%) were slightly more frequent than orbital (25%) and zygomatic fractures (24%), while nasal bone fractures were observed in 19% of cases. Rupani et al. reported that combined fractures involving the mandible, maxilla, and zygomatic complex were the commonest skeletal injuries in fatal maxillofacial trauma.¹ Likewise, Dalal et al. demonstrated that mandibular fractures commonly coexist with fractures of other facial bones in victims of fatal road traffic accidents.⁴ The coexistence of multiple facial fractures in the present study indicates exposure to high-energy impacts and supports the concept that fatal facial trauma is rarely confined to a single anatomical structure. Head injury was the leading fatal injury in the present study (63%), followed by multiple bodily injuries (28%). Coma was the commonest cause of death (60%), whereas shock accounted for 40% of fatalities. Similar observations have been reported by Prathigudupu Satish et al., who emphasized that facial trauma alone seldom causes death but frequently coexists with severe traumatic brain injury, cervical spine injury, or thoracoabdominal trauma.⁹ Facial injuries therefore serve as important indicators of the magnitude of force transmitted to the head and should prompt careful examination for associated intracranial injuries during medicolegal autopsy.

From a forensic perspective, detailed documentation of facial soft tissue injuries provides valuable evidence regarding the mechanism, direction, and severity of trauma. The distribution of abrasions, lacerations, bruises, and associated fractures assists in reconstructing the sequence of events, differentiating accidental from homicidal injuries, correlating autopsy findings with scene investigations, and interpreting injury causation. Comprehensive recording of these injuries also facilitates

comparison with clinical records and strengthens medico-legal opinion during judicial proceedings.

Overall, the findings of the present study highlight the predominance of road traffic accidents and young adult males in fatal maxillofacial trauma. The characteristic distribution of soft tissue injuries and associated facial fractures provides important epidemiological and forensic information that may contribute to improved trauma prevention strategies and more accurate medico-legal interpretation of fatal injuries.

Strengths of the Study

- This is one of the few autopsy-based studies from Rajasthan focusing specifically on the pattern and distribution of facial soft tissue injuries in fatal maxillofacial trauma.
- All cases were examined using a standardized medico-legal autopsy protocol, ensuring uniform documentation of injuries.
- The study provides detailed anatomical mapping of facial soft tissue injuries, which has important forensic and medico-legal applications.
- The findings contribute valuable regional epidemiological data that may assist forensic experts, trauma surgeons, and policy makers in injury prevention and medico-legal reconstruction.

CONCLUSION

The present autopsy-based observational study demonstrated that traumatic maxillofacial injuries predominantly affected young adult males, with road traffic accidents being the leading cause of fatal facial trauma. Abrasions were the most frequent soft tissue injury, while the maxillary region was the most commonly involved anatomical site, followed by the mandibular and zygomatic regions. Multiple facial bone fractures were frequently associated with severe head injuries, which constituted the principal cause of death. The characteristic pattern and distribution of soft tissue injuries observed during autopsy provide valuable information regarding the mechanism, direction, and severity of trauma and play an important role in medicolegal reconstruction. Detailed documentation of facial injuries should therefore be considered an essential component of every medicolegal autopsy, as it contributes to accurate determination of the cause and manner of death and supports judicial investigations.

Study Limitations

- The study was conducted at a single tertiary care centre, limiting the generalizability of the findings to other regions.
- The sample size was limited to 100 autopsy cases, which may not represent the complete epidemiological spectrum of fatal maxillofacial trauma.
- Only fatal cases were included; therefore, the findings cannot be extrapolated to survivors or hospital-based patients.
- The study primarily employed descriptive statistical analysis, and associations between injury patterns and demographic or etiological variables were not statistically evaluated.
- Detailed information regarding helmet use, seat belt use, alcohol intoxication, vehicle type, collision mechanism, and injury severity scores was not consistently available for all cases.

Future Directions

Future multicentric studies involving larger sample sizes should be undertaken to establish regional and national epidemiological trends of fatal maxillofacial trauma. Comparative studies including both fatal and non-fatal cases would provide a more comprehensive understanding of injury patterns and outcomes. Advanced imaging modalities such as postmortem computed tomography (PMCT) may be integrated with conventional autopsy to improve the detection of facial fractures and associated injuries. Further analytical studies evaluating the influence of helmet use, alcohol consumption, vehicle type, impact direction, and injury severity on maxillofacial trauma are also warranted. Development of standardized autopsy documentation protocols for facial injuries may further improve the quality of forensic investigations.

Recommendations

- A systematic examination and documentation of all facial soft tissue and skeletal injuries should be incorporated into every medicolegal autopsy.
- Greater emphasis should be placed on high-quality forensic photography and standardized recording of injury characteristics to facilitate medicolegal interpretation.
- Strict enforcement of helmet and seat belt legislation, along with improved road safety education and traffic law compliance, is essential to reduce the burden of fatal maxillofacial trauma.
- Collaboration between forensic experts, trauma surgeons, neurosurgeons, and law enforcement

agencies should be encouraged to improve injury reconstruction and medicolegal investigations.

- Establishment of a regional trauma registry documenting detailed maxillofacial injuries would help formulate evidence-based preventive strategies and strengthen future forensic research.

Ethics Approval:

The study was approved by the Institutional Ethics Committee (IEC) and Research Review Board of S.M.S. Medical College, Jaipur, Rajasthan, India. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and applicable national ethical guidelines.

Acknowledgement

The authors sincerely acknowledge the Department of Forensic Medicine & Toxicology, S.M.S. Medical College and Attached Group of Hospitals, Jaipur, Rajasthan, for providing the facilities and institutional support required to conduct this study. The authors are also grateful to all faculty members, technical staff, and medico-legal personnel for their valuable cooperation during data collection.

Data Availability Statement

The datasets generated and/or analysed during the current study are available from the corresponding author upon reasonable request. The data are not publicly available due to medico-legal and institutional confidentiality restrictions.

Consent for Publication

As this study involved medicolegal autopsy cases, individual informed consent for publication was waived by the Institutional Ethics Committee. Confidentiality of all study participants was maintained.

Funding

The authors received no financial support for the research, authorship, or publication of this article.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this study.

Author Contributions

Dr. Parnita Raj: Conceptualization, Data Collection, Autopsy Examination, Literature Review, Data Analysis, Manuscript Preparation.

Dr. R. K. Punia: Study Design, Methodology, Supervision, Interpretation of Results, Critical Review and Final Approval of the Manuscript.

Dr. Mahesh Soni: Data Collection, Statistical Analysis, Literature Review, Manuscript Editing, and Final Review.

All authors have read and approved the final version of the manuscript.

Abbreviations

RTA – Road Traffic Accident

IEC – Institutional Ethics Committee

PMCT – Postmortem Computed Tomography

FMT – Forensic Medicine and Toxicology

SMS – Sawai Man Singh

REFERENCES

1. Boffano P, Kommers SC, Karagozoglou KH, Forouzanfar T. Aetiology of maxillofacial fractures: A review of published studies during the last 30 years. *Br J Oral Maxillofac Surg.* 2014;52(10):901-906.
2. Gassner R, Tuli T, Hächl O, Rudisch A, Ulmer H. Cranio-maxillofacial trauma: A 10-year review of 9543 cases with 21067 injuries. *J Craniomaxillofac Surg.* 2003;31(1):51-61.
3. Abhinav RP, Selvarasu K, Maheswari GU, Taltia AA. The patterns and etiology of maxillofacial trauma in South India. *Ann Maxillofac Surg.* 2019;9(1):114-117.
4. Rupani R, Singh M, Kumar V, Singh R, Kumar S, Yadav P. The maxillofacial injuries: A postmortem study. *Natl J Maxillofac Surg.* 2018;9(1):48-51.
5. Yadollahi M, Arfaatabar M, Paydar S, et al. Pattern of maxillofacial injuries and determinants of outcome in a large series of patients admitted to a Level-I trauma center. *Bull Emerg Trauma.* 2019;7(4):400-408.
6. Khan TU, Khan MA, Ahmad M, Khitab U, Khan MT, Jan A. Etiology and pattern of maxillofacial trauma presenting to a tertiary care hospital. *J Ayub Med Coll Abbottabad.* 2022;34(1):52-57.
7. Kalathil LSM, Mangalath U, Roshni A, Aslam S, Thomas T, Nair RB. Study of patterns of maxillofacial injuries: An institution-based observational study. *J Pharm Bioallied Sci.* 2021;13(Suppl 2):S1019-S1023.
8. Dalal D, Saha S, Sinha PK, Ejaz A, Bhaduri M, Basu P, Haldar S. Study of the Pattern of Craniofacial Injuries in Victims of Fatal Road Traffic Accident Cases Autopsied in Midnapore Medical College. *Indian J Forensic Med Toxicol.* 2024;18(4):48-54.
9. Kumar A, Tandon S, Sharma GASK, Yadav A. Study of facial injuries sustained in cases of fatal accidents and intentional violence. *J Indian Acad Forensic Med.* 2020;42(2):114-119.
10. Srivastava U, Haobijam N, Palin K. Patterns, aetiology and associated complications of maxillofacial fractures at a tertiary care centre: A cross-sectional observational study. *Int Surg J.* 2025;12(9):1502-1507.
11. Saukko P, Knight B. *Knight's Forensic Pathology.* 4th ed. Boca Raton: CRC Press; 2016.
12. Payne-James J, Byard RW, Corey TS, Henderson C. *Simpson's Forensic Medicine.* 14th ed. Boca Raton: CRC Press; 2019.
13. Fonseca RJ, Marciani RD, Turvey TA, editors. *Oral and Maxillofacial Trauma.* 5th ed. St Louis: Elsevier; 2020.
14. Hupp JR, Ellis E, Tucker MR, editors. *Contemporary Oral and Maxillofacial Surgery.* 7th ed. St Louis: Elsevier; 2019.