Review Article

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Pattern of Maxillofacial Fractures in South Asian Countries: A Narrative Review
Running title: Maxillofacial fractures pattern in south Asian countries.

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ABSTRACT

Patterns of maxillofacial fractures vary by region, and they represent a general public health challenge, particularly in South Asia. This literature study examines data from South Asian nations, including Bangladesh, India, Pakistan, and Nepal, to comprehend the demographic trends, fracture sites, causes, and treatment procedures. The largest risk category for traffic accidents is men, primarily in the 20-30 age range. The frequent involvement of motorized two-wheelers highlights the need for increased helmet use and road safety. The most common site for fracture is the mandible, followed by the zygomaticomaxillary complex (ZMC) and maxilla. Treatment options might vary from conservative to open reduction and internal fixation, depending on the severity of the injury and the availability of resources. Data from underrepresented regions such as Sri Lanka, Bhutan, and the Maldives is still inadequate. The results of various treatment approaches, longitudinal trends, and gender differences would all be examined in future research to provide effective management and prevention methods.

Keywords: Mandible, maxillofacial fractures, pattern, road traffic accidents, South Asia, treatment modalities.

INTRODUCTION

Maxillofacial fractures represent a significant public health concern globally, and their patterns and etiologies vary considerably across different regions.[1-3] The face is particularly vulnerable to injury as it is the most prominent exposed part of the human body. The main causes worldwide include gunshot wounds, falls, assaults, sports, road traffic accidents (RTAs), and industrial trauma.[1,3] The predominant cause differs significantly across various countries and even among regions within the same country, attributable to variations in geographical reasons cultural, socioeconomic status and lifestyle characteristics.[4] Epidemiological research on maxillofacial trauma consistently indicate that young adult men represent the majority of those affected.[5] The mandible is the predominant fractured site within the maxillofacial areas.[6] The maxillary, nasal, naso-orbital-ethmoid (NOE), and zygomaticomaxillary complex (ZMC) represent various types of mid-face fractures. Complex midface fracture patterns caused by high-energy shocks are known as Le Fort fractures, and they are not very common.[6]

This narrative review considers the identified maxillofacial fracture patterns found in South Asian countries, with emphasis on Bangladesh, India, Pakistan, Nepal, and other provinces with available data.[1-25] Demographic trends, common causes of

injury, prevalent fracture sites, and treatment modalities will be reviewed with similarities and differences among the South Asian nations. The findings from the other nations offer helpful trends for the area despite the fact that the dataset presented contains insufficient data for Sri Lanka, Bhutan, and the Maldives.

SEARCH STRATEGIES

Google Scholar and PubMed were the main platforms for databases used for this review. This review covered both prospective and retrospective studies published in English within the preceding 10 years. The relevance and accessibility was guaranteed by this criterion. The search strategy implemented involved using of keywords like "Pattern", "Maxillofacial Fracture", "India, Bangladesh, Sri Lanka, Pakistan, Nepal, Bhutan and Maldives." We used Boolean operators (AND/OR) to narrow down search over the regional pattern of maxillofacial fractures.

RESULTS

A total of 25 articles[1-25] were found finally that met the inclusion criteria. The extracted data from previously published papers is tabulated in Table 1. A narrative review method was chosen in order to assemble available literature through a thorough and qualitative synthesis. It fills in the gaps in current knowledge by offering a comprehensive examination of regional patterns using an integrated approach across many different research conducted in South Asian countries.

Table 1: Extracted data from previously published papers.

Author's name, year	Country	Sample size (M:F)	Most common cause (%)	Most affected age group (%)	Fracture sites (%)	Key findings
Rahman A[1], 2021	Bangladesh	329 (4.98:1)	RTA (81) assault (8.51)	21-30 (31.3)	Mandible (61.7) ZMC (9.71) midface (9.42) panfacial (7) NOE (1.52) orbital (0.92)	The body was the most common site in the mandible, followed by the parasymphysis, angle, and condyle.
Singaram[2], 2016	India	267 (3:1)	RTA (73.8) Fall (18) assault (6.7)	20-40 (64.79)	Malar & maxillary (41.9) mandible (33) dentoalveolar (26.2) orbital floor (8.6) nasal bone (6.4)	Maxillofacial injuries are primarily caused by RTA, falls, and assaults, with motorized two-wheelers being the most common cause. Victims are young adult males aged 20-40 years, with fractures mainly affecting the malar bone and maxilla. Conservative management is common.
Hakim A[3], 2024	Bangladesh	213 (5.25:1)	RTA (65.26)	21-30 (31.31)	Mandible (62.92) midface (15.5) maxilla (4.7) ZMC (1.9) nasal (1.4) NOE (0.94)	The body was the most common fracture in the mandible, followed by the condyle, angle, and parasymphysis. Lefort I was the most frequent fracture among maxillary fractures. ORIF was preferred over closed reduction surgery.
Ragupathy K[4], 2023	India	277 (16.3:1)	RTA (62.1) fall (20.2) assault (14.4)	21-30 (41.16)	Mandible (52.3) ZMC (18.9) maxilla (7.9) orbit (6.7) dentoalveolar (4.2) palate (3.5) Lefort II (3.3) Le fort III (3.1) Lefort (2.4)	This study revealed a high male predominance. Mandible and ZMC were the most common. Mandibular parasymphysis was common followed by angle fracture. Most patients received ORIF treatment.
Liaquat A[5], 2014	Pakistan	214 (7.9:1)	RTA (58.4) fall (24.3)	20-29 (34.1)	Mandible (49.5) pan facial (15.4) ZMC (15.4) maxilla (3.3) nasal (1.4) zygomatic arch (1.4) frontal (0.5) NOE (0.5)	The mandible was the most common bone fractured facial bone. Employees and students were most affected, while falls were more common in younger age groups. Treatment methods included ORIF and MMF.
Rahman A[6], 2023	Bangladesh	90 (3.5:1)	RTA (75.56) fall (13.33) sports injuries (7.78)	13-18 (56.67)	Mandible (70) ZMC (14.44) midface (5.56)	RTAs were the most common cause of maxillofacial fractures, followed by accidental falls. Mandible fractures were prevalent, with the most common unilateral sites being the parasymphysis and body.

Subedi S[7], 2015	Nepal	328 (4:1)	RTA (88.1) IPV (7.6) fall (4.2)	20-29 (36.9)	Mandible (50.61) ZMC (20.43) nasal complex (7.62) dentoalveolar (4.27) midface (5.79)	The mandibular parasymphysis region is the most common in the mandible, followed by the symphysis, body, condyle, and angle. Road traffic accidents are the most common cause.
Shah A[8], 2016	India	102 (4:1)	RTA (42.2) fall (37.2) assault (11.8)	2nd - 4th decade (NR)	Mandible (73.5) Le Fort I (7.03) ZMC (5.47) panfacial (3.13) nasal (3.13) palate (3.13) zygomatic arch (2.34) Lefort II (1.56)	In mandible parasymphysis was the most common, followed by symphysis, condyle, angle, body and ramus. In 60.8% of cases, ORIF was the preferred treatment, while 79.4% of patients were treated under LA.
Gupta P[9], 2023	India	1674 (4.07:1)	RTA (53.5) fall (18.6) assault (16.1)	25-34 (27)	Mandible (32) ZMC (25) Lefort I (13) nasal bone (7) Lefort II (6) orbital (7) panfacial (4) dentoalveolar (2)	In mandible, the parasymphysis was the most common site, followed by the symphysis, condyle, angle, and body.
Khowaja S[10], 2020	Pakistan	224 (7.29:1)	RTA (73.21) fall (19.2) assault (3.57)	21-30 (34.38)	Mandible (85.65) maxillary (14.35)	Multiple fractures were the most frequent (31.39%). In mandible, para-symphyseal fracture was the commonest followed by coronoid, angle, and dentoalveolar fracture.
Kanala S[11], 2020	India	1112 (8:1)	RTA (70) fall (19)	21-30 (41)	Mandible (47.2) ZMC (17.4) maxilla (12.4) nasal (1.8) orbital and craniofacial (1.3) panfacial (1.1)	In mandible, the parasymphysis was the most common site, followed by the condyle, angle, symphysis, body and ramus.
Lokesh U[12], 2016	India	208 (6:1)	RTA (62.85)	21-30 (50)	Mandible (60.35) ZMC (24.85) maxilla (5.31)	RTAs are the primary cause of maxillofacial fractures, with non-helmet usage among two-wheeler users being the most common factor.
Awais S[13], 2022	Pakistan	263 (6.69:1)	RTA (68.44)	21-30 (47.14)	Mandible (57.27) ZMC (19.50) maxilla (19.10) frontal (1.7) nasal (2.29)	In mandible, the parasymphysis was the most common site, followed by the sub-condyle, body, angle, symphysis, and ramus.
Sinha V[14], 2021	India	315 (4:1)	RTA (61.90)	21-30 (31.42)	Mandible (39.52) nasal bone (20.95) ZMC (15.23) maxilla (12.38) NOE (4.76) panfacial (7.14)	In mandible, the parasymphysis was the most common site. Motorcycle accidents were the primary cause of RTAs, with ORIF by plating and screw being the preferred treatment for displaced, comminuted, and multiple face fractures.
Shah S[15], 2016	Pakistan	320 (5.25:1)	RTA (64.7) fall (18.8)	21-30 (32.8)	Mandible (69.7) midface (15.7) ZMC (8.4) nasal (1.2) NOE (0.8)	The most common site was body of the mandible, followed by condyle, angle, parasymphysis, dento alveolar, symphysis, ramus and the coronoid process. The most common mid face fracture Le Fort I, followed by Le Fort II, and Le Fort III.
Kansara A[16], 2023	India	75 (3:1)	RTA (48) fall (29.3) IPV (20)	21-30 (NR)	Nasal (30.34) mandible (23.45) maxilla (20) ZMC (16.55) orbit (9.65)	Nasal bone fractures are the most affected facial skeleton bone, followed by the mandible, with the mandibular body being the most common site for mandibular fractures.
Chaurasia N[17], 2021	Nepal	378 (4:1)	RTAs (53.7) fall (31.2)	31-40 (41.3)	Mandible (42.6) ZMC (27.9)	RTAs are the most common cause of maxillofacial fractures, with midface

					zygomatic arch (6.7) Lefort I (5) nasal (4.8) NOE (2.6) Lefort II (1.9)	fractures being more prevalent than mandible fractures.
Swain L[18], 2018	India	88 (7.8:1)	RTAs (82.9) IPV (6.8) fall (3.4)	21-30 (36.7)	Mandible (23.43) maxilla (16) ZMC (10.29) nasal (8) frontal (4.57) NOE (0.57) orbit (1.14)	The majority of patients have mandibular and maxilla fractures. Mandibular fractures occurred most commonly in the parasymphyseal region, followed by body, condyle, and angle.
Devakumari S[19], 2021	Nepal	163 (10.64:1)	RTAs (66.9) fall (19) assault (14.1)	31-40 (32.5)	Mandible (52.2) ZMC (10.4) zygomatic arch (27) Lefort II (6.1) Lefort III (2.5) Lefort I (1.8)	In mandible, the angle was the most common site, followed by the condyle, parasymphysis, body, symphysis, and ramus.
Agarwal P[20], 2016	India	1000 (8:1)	RTA (64.4) fall (25.1) assault (10.5)	21-30 (35.5)	ZMC (45.1) mandible (44.5)	The most common site of fracture was the mandibular body followed by parasymphysis, subcondyle, angle, symphysis, and dentoalveolar fractures.
Satpathy M[21], 2015	India	1268 (3.3:1)	RTA (67.67) fall (13.33) assault(13.09)	21-30 (33.52)	Mandible (44.58) temporal (11.75) ZMC (11.02) frontal (11) nasal (6.93) maxilla (7.65)	Parasymphysis region was the most common fractured site followed by body, condyle, and angle.
Kaul R[22], 2014	India	542 (3.7:1)	RTA (56.8) fall (22.3) assault (18.5)	31-40 (36.3)	Mandible (77.3) nasal (8.3) ZMC (6.28) Lefort II (3.27) Lefort I (1.76) Lefort III (0.75)	The mandibular body was the commonest fracture, followed by the angle, ramus, dentoalveolar, and symphysis. ORIF treated the majority of the patients. Orthopedic injuries made up the majority of concurrent injuries. Injuries to the head were also linked.
Hasnat A[23], 2017	Bangladesh	60 (7.57:1)	RTAs (60) fall (13.3) assault (8.3)	21-30 (51.7)	Mandible (36.67) ZMC (18.3) Lefort II (18.3) Lefort I (10) Lefort III (11.7) nasal (5)	Adult males are the most common victims of craniofacial trauma, with RTAs being the primary cause. Moderate head injuries are typically managed conservatively, with ORIF used for displaced facial bone fractures.
Malik S[24], 2017	India	784 (2.9:1)	RTA (72.7) assault (11.6) fall (8)	18-34 (34.94)	Mandible (71.27) Lefort fractur (7.18) nasal (7.18) ZMC (11.6) orbital (2.76)	Head/neck and limb injuries were prevalent, with surgical debridement and soft tissue suturing being common emergency procedures. Complications occurred in 6.88% of patients due to infection and malocclusion.
Kaura S[25], 2018	India	353 (4:1)	RTAs (61) assault (23) fall (15)	21-30 (47)	Mandible (90.36) ZMC (5.67)	The parasymphysis was the most common site in the mandible. The majority were males in their third decade; 73% received ORIF, 25.8% MMF.

M:F- male : female; RTA- road traffic accident; ZMC- zygomaticomaxillary complex fracture; NOE- naso-orbitoethmoid complex fracture; IPV- interpersonal violence; MMF- maxillomandibular fixation; ORIF- open reduction and internal fixation;;.

Demographic Trends

The provided data from the previously published articles showed a consistent pattern as far as the demographics of maxillofacial fracture victims across the South Asian countries. There is always a widespread male predominance in studies.[1-27] Although it varies, the male-to-female ratio often falls between 3:1 and more than 8:1. This difference is due to several factors, such as increased engagement in risky behaviors, exposure to workplace hazards, and differences in culture on gender, roles, and sensitivity to trauma. The most prevalent cases are generally young adults, with ages between 20 and 30 years of age.[1-27] A scoping review between low- and middle-income countries, including South Asian countries, revealed that the mean for peak age was 30.8 years, ranging from 20-40 years, which also supports the observed pattern.[27] These studies show that outdoor activities that result in maxillofacial injuries mostly affect young males.[1, 3, 6, 27]

Etiology

Road traffic accidents (RTAs) are always found to be the main cause of maxillofacial fractures in all the studied South Asian countries.[1-27] A high proportion of RTAs is attributed to the factor calling for enhanced traffic safety measures and enhanced compliance with standard legal requirements.[1-5] Motorized two-wheelers are often affected and the helmet use is crucial.[2,12-14,20,21] Other important contributing factors are falls, assaults, and sports injuries depending on the study done and the geographical area.[1-27] The degree of each of these causes may be different across the various sub regions in South Asian countries.

Fracture sites distribution

The mandible[1-15, 17-25] has been found to be the most often fractured bone in the maxillofacial region, followed by the ZMC and maxilla.[1-19, 22, 23, 25] However, the precise percentages of each fracture type fluctuate throughout the studies, which may be due to regional variances in the types of traumas experienced as well as methodological inconsistencies.[1-5] Within the mandible, the body[1,3,15,16,22] and parasymphysis[4,6-11,13,14,18] are frequently cited as the most common sites of fracture. This may be attributable to the anatomical structure and force distribution during trauma. The ZMC is also frequently involved, often in conjunction with other midface fractures.[1-25]

Treatment modalities

Management of maxillofacial fractures can be surgical or non-surgical depending on the extent of the fracture and the area involved and the capability of the center practicing.[1-27] The use of open reduction and internal fixation (ORIF) is more common in fracture cases that are displaced or comminuted as this approach enables a precise restoration of the anatomy and stable fixation.[3,4,8,11,15,20,22,26] Closed reduction methods, including maxillomandibular fixation (MMF) are employed in cases with less severe levels of displacement.[9,15,26] For some extra-articular or minimally displaced fractures, conservative treatment could be justified.[2] However, the type of treatment modality depends on many factors such as the experience of the surgeon, the resources available, and the general health condition of the patient.[16, 22] A transition toward the use of more operative and reconstructive techniques like ORIF, evident in many of the described studies[3,4,8,11,15,20,22,26] may be attributed to refinements in surgical practices and wider availability of subsequent technology.

Challenges

Specialist health care, especially in remote or poorly staffed regions of South Asian countries, remains limited.[27] These issues include delays in diagnosis and ultimately in treatment, which in turn can worsen the rate of complications and subsequent untoward outcomes. For instance, a scoping review of cranio-maxillofacial injuries in low- and middle-income nations, including South Asian countries, found that most patients (77.8%) had their treatment delayed due to either a lack of fixation materials (54.8%) or surgeon unavailability (35.7%).[27] The regional maxillofacial fracture care in South Asian countries is further complicated by a lack of human resources, surgically trained people, advanced technology, and supplies.[27]

Research gaps and future directions

Nevertheless, the present review is incomplete in terms of the following aspects. Baseline data from other underrepresented South Asian countries[1-25], particularly Sri Lanka, Bhutan, and the Maldives, is reported inadequately, necessitating additional research in order to further improve the regional patterns. Subsequent studies should aim at investigating other socially and behaviorally related unsatisfactory gender differences.[1-27] More future research should be longitudinal to identify shifts in the pattern of fractures and evaluate the efficiency of preventive measures.[26,27] More studies should also observe the functional and cosmetic real-life results after implementing various management strategies and should also consider the possibility of removing the obstacles to receiving prompt, appropriate care in the severely depleted areas.[16,22]

CONCLUSIONS

An analysis of the current literature presented in this paper also reveals a high rate of maxillofacial fractures in South Asian countries. As demonstrated and emphasized in this paper, there is a continued presence of RTAs as the leading cause, though the patterns of the fractures and treatment that is offered differ with the region. That male participants dominated across the studies raises implications that more research is required in exploring the social and behavioral cause of such differences. To sum up, the existing situation underlines the requirement for

better road safety measures, competent application of laws and rules of the road, growing popularity of safety awareness programs, and the creation of moto-oriented prevention programs with regard to the South Asian experience of maxillofacial fractures treatment. Reduction of the burden of maxillofacial fracture in South Asian countries can be achieved by safe measures and equitable access to health care. Additional larger-scale and longitudinal studies conducted in populations not well represented in the literature are important to guide prevention and management.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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DATA AVAILABILITY STATEMENT

The data presented in this study are available on reasonable request from the corresponding author.

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