



RESEARCH ARTICLE

A SYSTEMATIC REVIEW OF ANALYSIS OF FRACTURE PATTERNS IN MAXILLOFACIAL ASSAULT RELATED INJURIES IN THE INDIAN SUB-CONTINENT AND SOUTH-EAST ASIA

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ABSTRACT

Maxillofacial assault related injuries are an etiological important factor in fracture of facial bones. Here we have carried out a systematic review of analysis of fracture patterns in maxillofacial assault related injuries in the Indian Sub-continent and South-east Asia. The review shows mandibular fracture being the most common fracture of facial bones in assault related injuries to the facial skeleton.

INTRODUCTION

Assault in Middle English comes from Old French *asaut* (noun), based on Latin *ad-* 'to' + *saltare*, frequentative of *salire* 'to leap'. Assault is one of the important causes of maxillofacial trauma world over and a growing menace in developing countries. Assault and interpersonal violence (IPV) can affect the entire population spectrum, from pubescent boys being beaten up by bullies to the elderly who are assaulted by their now-grown children. In western countries, inter personal violence is the commonest cause whereas in developing countries road traffic accidents result with more facial trauma than any other cause (Punjabi *et al.*, 2011). IPV was considered a personal matter in the past. However, the recognition that IPV occurs in all countries of the world irrespective of social, economic, cultural, or religious values, has made it a worldwide health and human rights issue. The prevalence and severity of IPV against women is substantial. An analysis of 48 population-based studies by the World Health Organization (WHO) indicated that 10% to 69% of women had been physically assaulted by an intimate partner at some point in their lives. Another multi-

country study indicated that the lifetime prevalence of IPV was 15% to 71% (Saddki *et al.*, 2010). Studies have shown that areas of the head, neck, and face were the most common sites of injury from IPV episodes with prevalence that ranged from 40% to 81%. It has also been noted that women who reported to an emergency department with head, neck, and facial injuries were 7.5 times more likely to be victims of violence than women whose injuries were limited to other areas of the body. Thus, an injury to the head, neck, and facial region of women may be an initial marker of IPV (Saddki, 2010). The reported findings in certain aspects of mandibular trauma have been widely substantiated, for example, a higher frequency of such fractures among males, whereas the results in other aspects have differed. Investigators in countries such as Jordan, Singapore, Nigeria, New Zealand, Denmark and Japan have found that motor vehicle accidents represent the most common cause of mandibular fractures in those countries, while others, in Finland Scotland and Sweden have reported assault as the most common etiological circumstance (Sirimaharaj *et al.*, 2008). Accidents constitute an important cause of preventable morbidity, mortality, and disability. Accidents resulting in deaths and disabilities are responsible for considerable loss of man-hours and also pose a threat to social, economic, and cultural development of any country. The road traffic accidents (RTAs) are now considered a public health hazard of primary magnitude and are likely to increase in the coming years owing to the rapid increase in the automobile users.

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Accidents are definitely on the increase in India. The country has a world's highest fatality rate in RTAs, 20 times that of developed countries. In India, eight people get killed for every 100 vehicles, whereas in developed countries like Britain, France, Germany, Italy, and USA, one person gets killed for every 1000 vehicles (Chandra Shekar, 2008). So with this in mind, we thought of systematically analyzing assault related injuries in the maxillofacial region as RTAs is already a well-established etiological factor in maxillofacial trauma set up.

Focused question

Is mandibular fracture more common than fractures of other bones of the facial region following assault related injury?

Objective

To analyze the fracture pattern in maxillofacial injuries following assault related injury in the Indian Sub-continent and South-east Asia.

METHODS

Eligibility Criteria

Inclusion criteria

- Studies published between 1st Jan 2000 to 31st December 2015.
- Articles in English or those having detailed summary in English.

Exclusion criteria

Non-availability of the full length articles despite communication with the authors. Information was collected from databases like PubMed and Google Scholar and cross references from the articles that were available from these two sources were also looked into.

PICO

P – Patients: Patients treated at the hospitals in the study
C – Comparison: Between mandibular fractures/ other facial bone fractures
O – Outcomes: Mandibular fractures are more common than other facial bone fractures
S – Study design: Clinical trials and randomized controlled trials.

INFORMATION SOURCES

Two Internet sources of evidence were used in the search of appropriate papers satisfying the study purpose: the National Library of Medicine (MEDLINE PubMed), Google Scholar and manual search using DPU college library resources. All cross reference lists of the selected studies were screened for additional papers that could meet the eligibility criteria of the study. Articles were screened if they were either clinical trials or randomized controlled trials and if the articles selected were available in their free full text format. In addition, only the studies that were carried out in humans from 1/1/2000 to 31/12/2015 were looked at.

SEARCH

KEYWORDS	SYNONYMS
Fractures	Injury
Maxillofacial trauma	Facial trauma
Assault	Interpersonal violence

Study selection: Preliminary screening consisted total of 611 articles out of which 3 articles were selected. Data was extracted independently by PS and the data extraction was confirmed by invigilators PW and SB. At first the papers were screened by title and abstract. As a second step, full text papers were obtained when they fulfilled the criteria of the study aim. Any disagreement between the two reviewers was resolved after additional discussion. For full-text screening, the following criteria were taken into consideration: randomized controlled trials, controlled clinical trials, and the key words in their various permutations and combinations. After the full text articles were reviewed, cross references were checked and a total of 13 articles were found and included in the study.

DATA COLLECTION PROCESS

A standard pilot form in excel sheet was initially used. Data extraction was done for one article and this form was reviewed by an expert and finalized. This was followed by data extraction for all the articles.

DATA ITEMS

The data items included were

- Author – The name of the author
- Location – The country in which the study took place
- Year of publication – The year in which the study was published.
- Study Design –Retrospective/ Prospective.\
- Sample size
- Setting –Hospital/ Maxillofacial Out Patient Department
- Time
- Population
- Age group
- Reason for injury and it's percentage
- Other reasons for injury with their percentages.
- Maxillofacial injuries due to assault
- Maxillofacial injuries due to other reasons.
- Conclusion
- Remarks

RESULTS

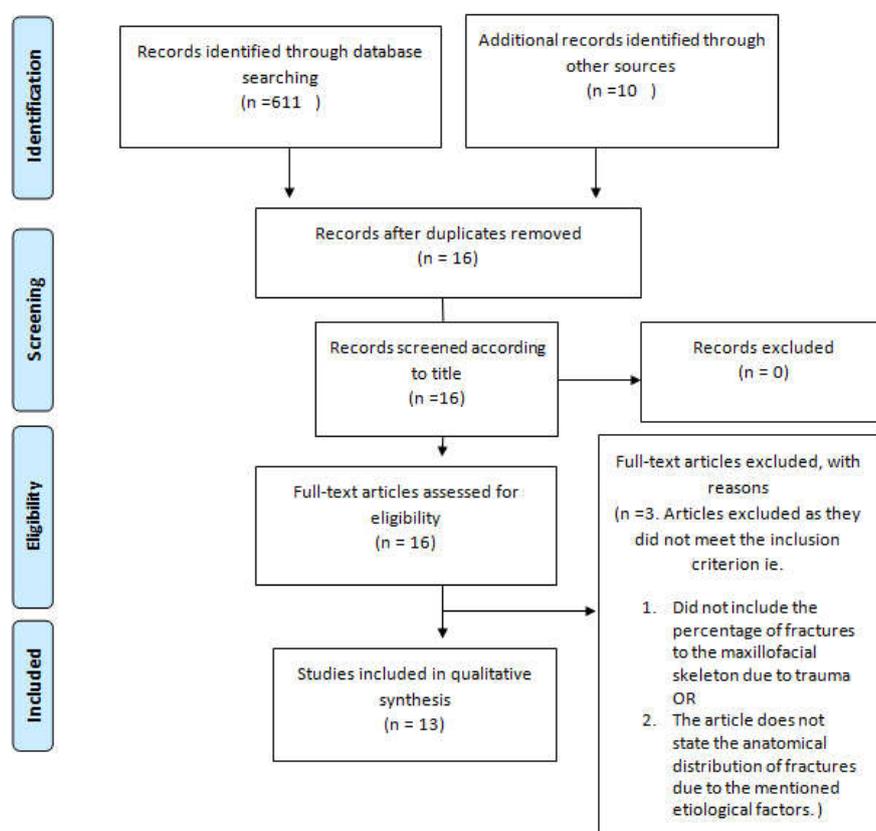
Study selection: Preliminary screening consisted total of 611 articles out of which 3 articles were selected. 10 additional records were identified from other sources including articles found via cross- referencing and a total of 13 articles were included in the study after excluding irrelevant and/or duplicate articles.

Summary of evidence: Assault is an important etiological factor for facial trauma. It can be easily controlled by means of proper education of the masses and restriction of assault inducing trigger factors like psychedelic drugs and alcohol. Here we look at the summary of the studies included in this systematic review. Chandra Shekar and Reddy in 2008 carried out a retrospective study in Mysore, India in which they included 546 patients from 2 hospitals. The study period was from 1st January 1998 to 31st December 2002 in an age group of 3-90 years. Assault related maxillofacial injuries accounted for 16.30% of all maxillofacial injuries. The increasing fights and assaults in the recent times, the authors claim, can be attributed to increasing interpersonal violence with alcohol consumption and unemployment.

Sr. No.	Search strategy	Number of articles	Number of selected articles	After Duplicate Removal
1	Fracture AND Maxillofacial trauma AND Assault	4	1	1
2	Maxillofacial trauma AND Assault	13	2	0
3	Fracture AND Interpersonal violence	13	0	0
4	Injury OR Facial trauma AND Interpersonal violence	120	0	0
5	Fracture OR Injury AND Maxillofacial trauma	409	3	2
6	Fractures AND Assault OR Interpersonal violence AND Maxillofacial trauma	19	1	0
7	Fractures AND Maxillofacial trauma AND Interpersonal violence	9	0	0
8	Fractures AND Facial trauma AND Assault	7	0	0
9	Injury AND Facial trauma AND Interpersonal violence	8	0	0
10	Injury AND Fractures AND Maxillofacial trauma AND Assault	6	1	0
	Other sources	10	10	10
	Total	621	18	13



PRISMA 2009 Flow Diagram



Alcohol consumption is considered a part of the life style of the present generation and the proportion of youth with this habit is increasing with time. Alcohol impairs driving ability and increases the risk of an accident as well as its consequences. Drugs such as barbiturates, amphetamines, and cannabis impair one's ability to drive safely. Alcoholics become more violent and this may be reason for higher incidence of fight and assault related maxillofacial injuries among male alcoholics. These authors in their study found that mandibular fractures to be more common than other fractures of facial skeleton (Chandra Shekar, 2008). In 2008 a prospective study was done in Thailand by Wimon Sirimaharaj and Kasemsak Pyungtanasup at the Chang Mai University on epidemiology of mandibular fractures. The authors carried out the study from 1st January 2005 to 30th June 2006 and included 198 patients in the age group ranging from 11- 80 years. In their study, assault was the second most common cause of mandibular fractures accounting for 13.63%.

This was presumably due to male aggression resulting from greater population density, competitiveness and hence lesser tolerance levels. In their study mandibular para-symphysis was found to be the most commonly fractured area with fractures comprising of 45.30% followed by angle of mandible at 19.51% of all cases of fractured mandibles. This was in accordance with the study carried out by Vetter *et al* but in contrast to Olsen *et al* and many others. In the present study, alcohol was associated with about 76% of jaw fractures, a proportion significantly higher than figures reported elsewhere. This discrepancy may be explained by under-reporting by hospital staff. It may also suggest that the neglected laws governing the sale and consumption of alcohol in Chiang Mai may be an important factor of alcohol related mandibular fracture (Sirimaharaj *et al.*, 2008). Subhashraj K, Ravindran C carried out a retrospective study in Chennai, India from October 2000 to September 2005. The study was published in 2008 and they included 185 patients.

This study was unique in that the authors included only the elderly with the age group ranging from 60- 81 years. Of the 25 assault victims, 11 were male and 14 were female. This again is a rare finding, where-in more women are affected than men. Assault accounted for 13.5% of the maxillofacial injuries and among the 185 patients with maxillofacial fractures, the mandible was found to be more commonly involved than the mid-face (Subhashraj, 2008). Norkhafizah Saddki, Adlin A Suhaimi and Razak Daud in 2010 published a retrospective study in the One-Stop Crisis Centre in Kelantan, Malaysia on maxillofacial injuries associated with intimate partner violence (Saddki, 2010). This study was carried out from 1st January 2005 to 31st December 2006 and it was exclusively done amongst women in the age group of 15- 59 years. Assault accounted for 74% of maxillofacial injuries and middle third of the face was the most commonly involved. The majority of victims of inter personal violence in this study (50.4%) sustained maxillofacial injuries. This is in agreement with previous studies which found that the head, neck, and facial regions were the most common sites of IPV injuries (Bhandari *et al.*, 2006; Muelleman, 1996; Ochs, 1996). In this study, the most common mechanism of assault for maxillofacial injuries was being hit or punched by a fist. The common use of fist as a means of assault was reported in other studies (Muelleman, 1996; Le *et al.*, 2001; Shepherd *et al.*, 1990). A previous investigation linked the mechanism of assault with the type of injury, and suggested that attacks with the fist can generate enough forces to cause fractures, particularly if more than three punches were delivered at any one site (Shepherd, 1990). Soft tissue injuries were also highly prevalent with contusions accounting for as much as 66.4% of all soft tissue injuries. The prevalence of soft tissue injuries in this study may be attributed to the impact of falls following punches or kicks. Abusive behavior, they found occurs repetitively. For the vast majority of the women in this study (85.5%), the reported IPV incident was not the first episode of abuse.

There were instances in which the victims themselves refused admission, possibly due to fear that their partners would discover them or due to worries about the safety and well-being of their children. This underscores that it may be difficult for a victim to leave an abusive relationship (Landenburger, 1998). A retrospective study of 82 patients carried out by Suneel Kumar Punjabi *et al* from 1st Jan 2007 to 31st December 2008 in Karachi and published in 2011 evaluated zygomatic fractures. The age group included in the study was from 11- 60 years. Males were more commonly affected 84.14% and females were involved in 15.85% of cases. This 5.30:1 ratio of male preponderance can be explained by the fact that the majority of such fractures result from road traffic accidents, assault, falls, sports injuries etc. where men are more commonly involved. This ratio is comparable to similar studies done in other countries (Wahab *et al.*, 2008; Zachariades *et al.*, 1990; Adekeye, 1980; WHO, 1992). Assault resulted in 23.17% of maxillofacial fractures. Injury to the left side of the face showed more predominance in the cases of trauma due to assaults. This may be due to the fact that majority of the population is right handed (Punjabi, 2011). Pranav Kapoor and Namita Kalra in 2012 published a retrospective analysis of 1000 patients studied from March 2008 to February 2009. The population group was patients reporting to Guru Teg Bahadur Hospital, East Delhi with the age group being 0- 80 years the peak incidence was, however, observed in the age group of 21-30 years. The third decade is perhaps the most active period of life in which people tend to

remain outdoors in search of their livelihood and are thus more vulnerable to vehicular accidents, falls, and assault-related injuries. Individuals in the extremes of life were found to be least affected and most of the injuries (75.7%) were observed in persons of working age group (21-60 years). The gender distribution revealed a male preponderance in all the age groups. Interpersonal violence accounted for 54% of maxillofacial injuries and mandibular fractures were found to be the most common (Kapoor, 2012).

In Aurangabad, Maharashtra, a retrospective study was carried out by Monali Ghodke, Subhash Bhojar and Seemit Shah in C.S.M.S.S Dental College. The study was carried out from February 2008 to September 2009 and was published in 2013. Age group included was from 1-70 years. Out of 35 patients included in the study 31 were males and 4 were females. Young adults aged 21-30 years were the most commonly involved. Given that mandible is the only mobile facial bone, and the remaining portion is a part of the fixed facial axis, the fracture is never left unnoticed as it is extremely painful with the pain worsening with speech and mastication. This study assessed only mandibular fractures and condyle was the most commonly involved region following maxillofacial trauma (Ghodke *et al.*, 2008). In the Northern Indian state of Haryana, a prospective study was published in 2013 by Sunita Malik and Singh Gurdarshan from Government Medical College, Sonapat. In this study as well, a predominance of injured males in the age group of 17-34 years was found. Males were proposed to be at a greater risk due to their greater participation in high risk activities which increases their exposure to risk factors such as driving vehicles, sports that involve physical contact, an active social life and drug use, including alcohol.

In the author's study, alcohol consumption prior to the injury was recorded in 49.4% of cases. Alcohol impairs judgment, brings out aggression, often leads to interpersonal violence, and it is also a major factor in motor vehicle accidents. Sunita Malik *et al.* (2012) also founded parasymphysis as the most common site of fracture in the mandible. But this study was not consistent with the findings of the study conducted by Adekeye (Adekeye, 1980), Nair (1986) and Adebayo (Chalya, 2003) who reported the body as the most prominent site. Van Beek (Van Beek, 1999) found condyle as the most common site. Chalya *et al.* (2011) found angle as the most prominent site of fracture. With these findings in view, soft tissue injuries were the most frequently occurring type of injury and mandibular fracture was the most frequent type of bony injury in this study.

From Madhya Pradesh, a state in Central India, Amit Agnihotri and Dhanaram *et al* carried out an epidemiological study in 153 patients on the pattern and etiology of mandibular fractures. The study was carried out from 15th June 2011 to 31st March 2013 in the Department of Oral and Maxillofacial Surgery. The age group that the study comprised of ranged from 1 year to over 60 years. Persons in the 3rd decade of life were found to be most vulnerable to not only road traffic accidents but also assaults and incidences of inter-personal violence. Males comprised of 82.3% of the 153 patients, with a male: female ratio of 4.6:1. The author suggested that the relatively high number of male to female ratio is because in Indian society males mostly bear the burden of earning and therefore are more prone to accidents due to increased bread-winning activity.

The cage is only rattled even more by the younger generation who use a plethora of drugs, sometimes with an amalgamation of alcohol which plays an important role in maxillofacial fractures. In this study, assaults accounted for 4.5% of all maxillofacial fractures with the mandibular para-symphysis being the most commonly affected region (Agnihotri *et al.*, 2013). Information Technology has changed the face of urban India, and the southern India city of Bangalore was quick to jump the band-wagon in 2000s. So in 2014, Yadavalli Guruprasad, Hemavathy, Girish Giraddi and Jayaprasad N Shetty from Government Dental College Bangalore published a retrospective study of 689 patients wherein they assessed the etiological factors and injury characteristics for maxillofacial trauma. In their study inter-personal violence was responsible for 15% of injuries. The majority of adults were yet again, in the 3rd decade of their life and alcohol consumption was found in 41.6% prior to the injury. Mandible was seen as the most commonly fractured bone in our study accounting for 50.3% of the fractures and the most common site was angle of mandible accounting for 38.9% (Guruprasad *et al.*, 2014). This finding is consistent in a similar study from Bulgaria whereas the percentage of mandibular fracture in a study from Pakistan and UAE was 51%. Among the maxillary fractures the most common was Lefort II 54%, similar to findings from other studies (Wasiu, 2005; Leles, 2010; Al Khateeb, 2007). In another cross-sectional study of 120 patients published in 2014 by Adhikari RB, Karmacharya A and Mallya N from Nepal, patterns of mandibular fractures were assessed. The age group selected was 3- 80 years and yet again, patients were mostly affected in the 3rd decade of life ie. 21- 30 years. Male to female ratio was found to be 1:0.69 reflecting that males are more commonly affected than females.

Assaults made up 15% of mandibular fractures and mandibular para- symphysis was the most commonly involved site (Adhikari *et al.*, 2012). Fareed iMukram Ali *et al* in February 2015 analyzed retrospectively 115 patients in SMBT Dental College in Ahmednagar District of Maharashtra. The study was carried out from January 2011 to November 2013 in the age group of 1- 60 years. Interpersonal violence accounted for 13.04% and mandibular fracture was the most commonly found facial bone fracture. This study showed that the maxillofacial fractures predominantly occurred in the age group of 21- 40 years. These findings are similar to the previous studies. High prevalence of injuries may be due to the fact that people in this age group are active and are more involved in daily activities as compared to the other age groups. The male to female ratio in the author's study was 1.87:1. Male dominance in this study is in agreement with various other studies which have reported the same. According to the authors of this study, youth of lower socioeconomic group consume alcohol due to frustration of unemployment and end up in arguments brawls leading to violence. Other causes of interpersonal injuries includes the domestic violence mostly the females are the victims of such episodes it is also quite common in rural areas (Ali *et al.*, 2015). And as recently as December 2015, R K Jain and Mathura Prasad Agarwal from Jaipur in Rajasthan published a retrospective analysis of 729 patients who presented to the emergency or out-patient department of SMS Hospital. The study was carried out from November 2013 to January 2015 and persons from 4- 62 years were assessed. Assault resulted in 3.5% of all maxillofacial injuries and zygomatico-maxillary complex fractures were found to be more common than mandibular fractures. Because of its prominent position, zygomatico-maxillary complex is

frequently fractured either alone or in combination with other bony structures such as the maxilla or nasal complex. The pattern of age distribution in maxillofacial injuries reflected that no age was exempted for these injuries but the most common age group affected was 21-30 years. This finding is in accordance with a number of previous studies. The possible reasons for the higher frequency of maxillofacial injuries in third decade may be attributed to the fact that people in this period of life are more active regarding sports, fights, violent activities, industry and high speed transportation. The low frequencies in the very young and old age groups are due to the low activities of these age groups (Jain *et al.*, 2015).

Location

Our systematic review showed studies from varying locations across South-east Asia. 4 out of 13 studies were carried out abroad and the remaining in India. 3 studies were carried out in southern part of India while the rest were scattered in other parts of the country. Closer home, Kiran Gadre and Rajshekharan Halli from Pune published a review of 6872 patients over 22 years in 2013. They found assault to be responsible for only 1.8% of their study patients which is a relatively small number given the sample size the study had.³² This study was included in the review but the article was not a part of the search strategy.

Year of publication

It is interesting to note that before 2008 there were limited number of articles in the literature relating to assault. We feel that since the economy opened up roughly around 10 years ago and advances in telecommunication opened up avenues for clinical research.

Study design

Out of 13 studies, 1 was a cross-sectional study, 1 was epidemiological and 2 were prospective. All other studies were retrospective. There is scope of carrying out a multi-centric prospective longitudinal study.

Sample size: Sample sizes in all the studies combined ranged from 35- 1000.

Setting: All studies were carried out in a hospital setting or in the department of oral and maxillofacial surgery and plastic surgery.

Time: Studies were carried out between 1998 and 2015 with most studies in mid-2000s. The minimum duration of the study was 1 year and the maximum duration was 6 years.

Age group: Age group ranged from 0-80 years amongst all the studies and the most commonly affected age group was 21-30 years.

Reason for injury: The percentage of assault related injury ranged from 3.5%- 74% with an average of 20.37% amongst all the causes of facial trauma.

RTAs on an average account for 53.37% of all facial trauma cases with the range being from 43% to 88%. Injuries due to falls ranged from 1.5 to 27 % while sports injuries ranged from 1.1% to 10 %.

Limitations

As with any study, this systematic review also comes with a few limitations. One of the limitation of this review is that no article described exclusively, maxillofacial injuries due to assault. This is due to the fact that majority of facial injuries are due to road traffic accidents in a developing country like India.

Conclusion

This systematic review shows that mandibular fractures are more common than other facial bone fractures. However more studies need to focus on assault as the only cause of facial trauma. Road traffic accident, although is probably the most common cause of facial trauma, assault and interpersonal violence is a growing menace in a developing country like India and more studies need to focus on the same.

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