Changing Trends in Maxillofacial Trauma: A 15 Years Retrospective Study in the Southern Part of Haryana, India

Abstract

Objective: The aim is to analyze the pattern of maxillofacial injuries and treatment outcomes in the past 15 years (2002–2016). Materials and Methods: One thousand eight hundred and fifty patients from two tertiary referral center hospitals were studied retrospectively in which the age, sex, etiology, site of fracture, and treatment modality was recorded. Results: One thousand two hundred and twenty-eight males and 622 females were operated between 2002 and 2016. Mean age was 29 ± 17.2 years. Maximum incidence was seen in the age group of 16–30 years in males, whereas in females, the predominance of trauma was seen in both 16–30 and 31–45 age groups. Road traffic accidents were responsible for the majority of fractures (42.2%), followed by assaults (26.4), sports injuries (17.6%), and fall (10.7%). Maximum fractures were of the mandible (53.5%) followed by midface (25.6%) and panfacial trauma (20.8%). Nearly 53.6% of patients underwent open reduction, and internal fixation (ORIF), 34.2% managed by the closed method and 12.1% were kept under observation. Conclusion: This study verified a young male predominance, a shift toward more assault related fractures, especially in females. Mandibular fractures were the most common of all. Moreover, the changing trend toward ORIF in the past 15 years.

Keywords: Changing trends in trauma, facial fractures, fracture treatment, mandibular fractures

Introduction

Trauma is the leading cause of death in the first 40 years of human life.[1] According to the WHO statistics, around 1 million people die and nearly 15–20 million people are injured in road traffic accidents (RTAs) annually.[1] Many epidemiological studies on the pattern of maxillofacial injuries have been published from different countries, but the demographic data is difficult to evaluate due to many variables. Continuing audit of the etiology of maxillofacial trauma is important as the information reflects the effectiveness of preventive measures, such as the introduction of seat belt legislation since it suggests new ways in which injuries could be prevented as well as it is an important indicator of changing resource and training needs in oral and maxillofacial surgery.

The etiology of maxillofacial fracture has changed over the past three decades and continues to do so. The main causes in all the countries are usually RTAs, physical assaults, injuries from fall and sports.[2] Although Adi et al.[3] found that injuries from fall were the second most common cause of mandibular fractures, it is recognized that many assaulted patients report that their injuries are due to falls. Road accidents have in the past, been the most frequent cause of facial fractures in many countries including Nigeria,[4] Libya,[5] Europe,[6,7] and the US.[8] However, several studies show that physical assaults have now become the most common cause of maxillofacial fracture in many developed countries, even though the road accidents remain the most common cause of injury in many developing areas.[9,10] However, few large series of patients have been studied in India, and little information is available on their relative incidence and changing patterns in maxillofacial trauma over their 15 years.

Materials and Methods

During 2002–2016, 1850 patients with maxillofacial trauma were treated at trauma centers Sarvodaya Hospital, Faridabad, Haryana and Sudha Rustagi College of Dental Sciences and Research, Faridabad, Haryana, India. We retrospectively...
reviewed and analyzed the patient records using the hospital database. The characteristics of these fractures were analyzed. Information extracted from these patients’ case records included age at the time of injury, sex, cause, and site of fracture and the treatment modality used in the past 15 years of time span.

The etiology of injuries were classified as RTAs (two wheelers, four wheelers and pedestrians), assaults, falls, sports-related accidents and miscellaneous (including gunshot wounds, industrial accidents, etc.).

Overall fractures were classified as isolated mandible (single/multiple), mid face, pan facial and associated injuries (limbs and head).

Anatomically mandibular fractures were divided into eight regions (symphysis, parasympysis, canine region, body, angle, ramus, coronoid process, and condyle). Mid face fractures were classified into four groups (Le Fort I, Le Fort II, Le Fort III and ZMC). Treatment modalities were considered under three categories (open, closed, and observation). Data were processed using SPSS version 17 (SPSS Inc. Released 2008. SPSS Statistics for Windows, Version 17.0. Chicago: SPSS Inc.). The study was designed in accordance with the ethical guidelines of Helsinki.

Results

Patient demographics

The study population comprised of 1228 male and 622 female patients (ratio of 1.97:1) with a mean age of 29 ± 17.2 years. All throughout the 15 years, the gender distribution was seen dividing the age into five groups (0–15, 16–30, 31–45, 46–60, 61–75). The youngest patient was 1.5-year-old and the oldest patient was 75 years of age. Maximum trauma cases were belonging to the age group of 16–30 years in males, whereas in females, predominance of trauma was seen in both 16–30 and 31–45 age groups. Number of fractures in the age group 31–45 years has been declining since 2009, whereas the reverse pattern was seen in 16–30 years of the age group in the years from 2009. The rise in succeeding number of female trauma cases has been observed from 2002 to 2012 [Graph 1].

Etiology

RTAs were responsible for the majority of the fractures (42.2%) [Table 1]. Maximum incidences were seen in patients on two wheelers followed by four wheelers and then pedestrians. Four wheeler accidents coincided with two wheeler accidents in the year 2013. 2006 and 2009 reported minimal incidences with four wheelers and maximum RTAs were seen in the year 2012 [Graph 2].

Assaults were the second leading cause for the maxillofacial trauma (26.4%) increasing progressively from the year 2002 to 2012 and the slight decline has been observed from 2012 to 2016. Sports injuries contributed to 17.6% of the trauma mostly affecting males. Maximum sports injuries were seen in the year 2013. Injuries from falls were 10.7% of the total trauma cases mostly affecting the children belonging to the age group 0–15 years. Miscellaneous group (1.8%) included gunshot wounds, industrial accidents, etc., [Graph 3].

| Year | 2 wheelers | 4 wheelers | Pedestrians | Total | Assault | Fall | Sports | Miscellaneous |
|------|------------|------------|-------------|-------|--------|------|--------|---------------|
| 2002 | 18         | 9          | 8           | 35    | 9      | 7    | 3      | 1             |
| 2003 | 33         | 19         | 5           | 57    | 39     | 3    | 4      | 1             |
| 2004 | 39         | 11         | 12          | 62    | 7      | 14   | 27     | 2             |
| 2005 | 24         | 6          | 11          | 41    | 27     | 18   | 10     | 4             |
| 2006 | 35         | 3          | 22          | 60    | 29     | 3    | 25     | 5             |
| 2007 | 21         | 10         | 7           | 38    | 35     | 8    | 12     | 4             |
| 2008 | 34         | 23         | 10          | 67    | 22     | 15   | 29     | 3             |
| 2009 | 30         | 3          | 19          | 62    | 37     | 8    | 33     | 0             |
| 2010 | 24         | 16         | 4           | 44    | 38     | 18   | 26     | 4             |
| 2011 | 16         | 14         | 8           | 38    | 42     | 30   | 37     | 0             |
| 2012 | 32         | 18         | 27          | 77    | 63     | 18   | 12     | 2             |
| 2013 | 24         | 24         | 16          | 68    | 28     | 11   | 39     | 1             |
| 2014 | 29         | 17         | 5           | 51    | 30     | 16   | 34     | 6             |
| 2015 | 24         | 19         | 4           | 47    | 44     | 14   | 15     | 0             |
| 2016 | 19         | 8          | 7           | 34    | 39     | 16   | 20     | 1             |

RTA=Road traffic accident

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Graph 1: Overall distribution

Table 1: Etiology
Fracture site

The site distribution of the fractures showed that 53.5% occurred in the mandible, 25.6% occurred in midface including zygomatic complex fractures and 20.8% presented with panfacial trauma. Of the 991 fractures that occurred in the mandible, 785 fractures (79.2%) were multiple (maximum belonging to symphysis/parasymphysis and condylar fractures) and 206 (20.7%) were isolated fractures (mostly being located in the angle region) [Graph 4 and Table 2].

Of the 474 middle third fractures, the most common were Le Fort III fractures (39%), followed by Le Fort II fractures (39%) and Le Fort I amounted to 20.2%. Zygomatic complex fractures were seen in 67 (14.1%) patients out of 1850, 385 (20.8%) patients had panfacial trauma [Graph 5]. In 410 patients, associated head and limb injuries were present. 172 patients had limb injuries, whereas 238 patients had associated head injuries [Graph 6].

Treatment modalities

With regard to treatment methods, approximately 41.1% of all patients with mandibular fractures were treated by closed reduction [Table 3]. Open reduction and internal fixation (ORIF) was carried out in 48.1% of the cases. Active jaw exercises and observation were recommended for 10.6% of the patients mostly sustaining exclusively condylar fractures [Graph 7]. Most of the cases seen with middle third fractures were treated by ORIF (54.4%). Nearly 30.1% of the patients were treated by closed reduction and the use of metal arch bars and only 15.4% of the middle third injuries were left for observation. The most common surgical technique used in the treatment of zygomatic fractures in this study was Gillie’s temporal approach [Graph 8]. Even in panfacial trauma cases, similar results were seen with 67% undergoing open method treatment. Nearly 21.2% of patients were treated using the closed method, and only 11.6% of patients were kept under observation [Graph 9].

Discussion

Factors such as geographic area, population density, socioeconomic status, and cultural variances have always been the point of concern to influence the causes and incidence of maxillofacial fractures.[11-14] To optimize treatment modalities and improve patients’ quality of life, changing trends of oral and maxillofacial injuries in the past 15 years and their comparison from different states and countries is indispensable.[11,14,15] Some consistent

| Year | Isolated mandible | Mid face | Associated injuries | Pan facial |
|------|-------------------|----------|---------------------|-----------|
|      | Single | Multiple | Total | Lefort I | Lefort II | Lefort III | ZMC | Total | Limbs | Head |        |
| 2002 | 13     | 28       | 41    | 5        | 3        | 4        | 2    | 14    | 2     | 3     | 2       |
| 2003 | 14     | 66       | 80    | 7        | 10       | 2        | 2    | 21    | 1     | 2     | 5       |
| 2004 | 18     | 48       | 66    | 8        | 5        | 24       | 3    | 40    | 5     | 3     | 8       |
| 2005 | 07     | 43       | 50    | 3        | 15       | 12       | 7    | 37    | 17    | 9     | 15      |
| 2006 | 13     | 68       | 81    | 2        | 2        | 10       | 4    | 18    | 12    | 15    | 25      |
| 2007 | 15     | 45       | 60    | 6        | 7        | 5        | 3    | 21    | 9     | 14    | 18      |
| 2008 | 12     | 59       | 71    | 4        | 15       | 12       | 7    | 38    | 21    | 17    | 29      |
| 2009 | 11     | 75       | 86    | 12       | 6        | 7        | 5    | 30    | 18    | 24    | 26      |
| 2010 | 12     | 48       | 60    | 6        | 9        | 25       | 4    | 44    | 8     | 16    | 28      |
| 2011 | 19     | 51       | 70    | 3        | 7        | 9        | 2    | 21    | 22    | 18    | 38      |
| 2012 | 20     | 69       | 89    | 10       | 16       | 26       | 3    | 46    | 11    | 17    | 39      |
| 2013 | 20     | 49       | 69    | 9        | 8        | 14       | 8    | 39    | 12    | 29    | 41      |
| 2014 | 14     | 47       | 61    | 7        | 11       | 12       | 6    | 36    | 21    | 32    | 44      |
| 2015 | 8      | 43       | 51    | 6        | 7        | 14       | 7    | 34    | 6     | 27    | 37      |
| 2016 | 10     | 46       | 56    | 8        | 5        | 9        | 4    | 26    | 7     | 12    | 30      |

ZMC=Zygomaticomaxillary complex
findings are the predominance of men and people in the 16–30-year-old age group. The incidence of fracture among men is consistently higher than among women, the ratio range being 1.97:1 that is similar to the preceding studies.\textsuperscript{[16,17]} Although slight increase in the incidences with women have been seen from the year 2011 to 2013 which may be attributed to rise in domestic violence or bandit assault. Children represent a special group of patients (0–15 years) having a small size of the bones, the small volume of paranasal sinuses, the growth potential, mixed dentition, quicker healing process, as well as difficulty in cooperation.\textsuperscript{[18,19]} A predilection for mandibular fractures, especially the condylar and symphysis fractures was seen in children which is similar to the findings by Kyrgidis \textit{et al.}\textsuperscript{[20]} The injuries were mostly caused by RTAs followed by assault, sports injuries, and then fall. We found that 42.2% of the patients were injured in road accidents out of which maximum trauma was with 2 wheelers followed by 4 wheelers and then the pedestrians. Similar studies have shown that the incidence of motorcycle crashes in other developing countries amounting to 45%–65%.\textsuperscript{[21,22]}

Although the number of incidences increased in 2012, the increase was with a similar pattern. The progressive increase is seen in a number of assault cases from 2002 to 2012 which has slightly decreased progressively from 2012-2016, which can be attributed to improved law and order. More fractures were seen in males than females, the ratio being similar to that obtained in other studies.\textsuperscript{[21]}

| Year | Mandible fractures | Middle 3rd fractures | Pan facial |
|------|--------------------|----------------------|------------|
|      | Closed | Open | Observation | Closed | Open | Observation | Closed | Open | Observation |
| 2002 | 32     | 4     | 6           | 9      | 4     | 2           | 1      | 1    | 0           |
| 2003 | 42     | 31    | 8           | 16     | 2     | 4           | 1      | 2    | 2           |
| 2004 | 36     | 21    | 10          | 26     | 10    | 5           | 1      | 4    | 3           |
| 2005 | 30     | 14    | 7           | 13     | 17    | 8           | 4      | 8    | 3           |
| 2006 | 52     | 19    | 8           | 4      | 12    | 3           | 2      | 22   | 1           |
| 2007 | 24     | 20    | 14          | 8      | 12    | 3           | 5      | 8    | 5           |
| 2008 | 37     | 28    | 4           | 12     | 18    | 8           | 16     | 15   | 4           |
| 2009 | 35     | 38    | 12          | 7      | 21    | 2           | 9      | 12   | 5           |
| 2010 | 28     | 33    | 8           | 3      | 28    | 13          | 7      | 13   | 8           |
| 2011 | 26     | 40    | 5           | 4      | 11    | 5           | 8      | 24   | 6           |
| 2012 | 31     | 44    | 13          | 17     | 24    | 5           | 5      | 30   | 3           |
| 2013 | 18     | 45    | 4           | 11     | 22    | 6           | 4      | 33   | 2           |
| 2014 | 7      | 48    | 4           | 5      | 24    | 7           | 6      | 35   | 2           |
| 2015 | 7      | 42    | 2           | 4      | 29    | 1           | 7      | 28   | 1           |
| 2016 | 3      | 50    | 1           | 4      | 24    | 1           | 6      | 23   | 0           |
The incidence of maxillofacial trauma in females has been on the rise as increasing number of women are being engaged in numerous activities outside the home in a bid to render financial assistance to their families, thus exposing them to various hazards.

When the maxillofacial region is injured, the mandible is vulnerable than zygomaticomaxillary complex, probably because the mandible is mobile and has less bony support than the maxilla. The majority fractures occurred in the 16–30-year-old age group, thus confirming the published reports. This coincides with the period when young men and women complete their secondary education and make numerous journeys in search of employment.

As expected, the majority of the fractures were seen in the mandible, a figure comparable to other published reports. Isolated single mandibular fractures accounting for 20.7% and isolated multiple mandibular fractures accounting for 79.2% of all mandibular fractures were observed.

Of 1,850 patients, 25.6% had mid face fractures, which is similar to those reported by Hussain et al., who reported that the overall number of middle third fracture in road crashes was 20%. 54.4% of patients were treated with ORIF, 30.1% with closed reduction and the rest were kept under observation.

Among 474 patients with mid face fractures, maximum incidences were reported in Le Fort III region (39%) followed by Le Fort II (26.5%), Le Fort I (20.2%) and least incidences were seen with zygomaticomaxillary complex fractures (14.1%). This is contradicted by Rowe and Killey which states zygomaticomaxillary complex fractures to be most common ones. Associated head injury (12.8%) accounted for the greater majority of associated injuries, similar to findings from preceding several studies, whereas limb injuries accounted for 9.2%. Manson has shown this high incidence of head, maxillofacial, and cervical spine injuries in about 75% of RTA victims.

In the past 10 years, plate osteosynthesis has become popular in the management of facial fracture and in the treatment of mandibular fractures. This technique offers advantages to both surgeons and patients. It offers stable anatomic reduction of the fragments, decreases the risk of post-operative displacement of the fractured fragments and eliminates the need of maxillomandibular fixation (MMF) in the postoperative period.

ORIF is also the patients’ choice because it allows immediate recovery of function, cuts down the period of bone remodelling and consolidation of the fracture site and decreases the healing period.

Despite these advantages, existing incidence suggest similar long-term results using either technique.

Arch bar fixation is a simple economic method used for treating maxillary and mandibular fractures which can be performed in 20–30 min without creating stress for the patient and yields satisfactory clinical results provided that it is indicated. Adverse effects are obvious on the patients’ social and professional life due to speech difficulty. Finally, dental and periodontal complications may be caused by difficulty in maintaining oral hygiene.

In this study, we observed that there has been a progressive increase in the number of patients being treated by ORIF in mandibular, middle third, and panfacial fractures, whereas a progressive decline has been seen in the patients kept under observation, especially in mandibular fractures in the past 15 years.

**Conclusion**

In this retrospective study that analyzed a sample of 1850 maxillofacial trauma patients, we verified a young male predominance, a shift toward more assault related fractures which is more evident in females and a major transition to ORIF from MMF modalities, especially in mandibular fractures. In the past 15 years as ORIF allows for diminishing or eliminating intermaxillary fixation times, its use may be justified. Further studies are required to better establish other potential advantages of ORIF over MMF. Management of injured patient should also be aimed at reducing the incidences of maxillofacial injuries by using preventive and interventional programs. There is need to ensure strict compliance of traffic rules and regulations, implement improved safety devices in automobiles, use of helmets by motorcyclists, separation of pedestrians from motor vehicles and educating people to obey traffic rules, especially at the school level and in rural areas could reduce the number of maxillofacial trauma. Injuries elsewhere may exist in patients with maxillofacial trauma, and conversely,
maxillofacial trauma may coexist with other injuries in a high proportion of cases. This inter-relationship makes it necessary for the maxillofacial surgeon to be part of a multidisciplinary trauma team.

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Conflicts of interest
There are no conflicts of interest.

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