Analysis of 1,545 Fractures of Facial Region—A Retrospective Study

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Abstract

Incidence and etiology of facial fractures vary from region to region due to various constituents. This study was carried to evaluate the patterns and distribution of fractures in the facial region among different age groups of patients in both males and females caused due to various etiologies. This is a retrospective epidemiological study, which was performed on patients with fractures in the maxillofacial region during a period of 2005 to 2013 at Mamata Dental College and Hospital, Khammam, India. A total of 1,015 patients with 1,545 fractures were referred for treatment to department of oral and maxillofacial injuries surgery, of Mamata Dental College and Hospital, with a mean age of 31.19. The ratio of males (859):females (156) is 5.5:1. Injuries caused by motorbike injuries (34.9%) are highest. The highest frequency of fractures caused by various reasons is seen more in third decade (39%). Mandible (43.81%) is the most common fracture site in the face. Among soft tissue injuries most commonly seen are lacerations (43%). This study differentiates the etiological factors causing facial trauma in several age groups. Results of this study suggest outcomes indicate that more reliance on individual transport on motor vehicles has increased the frequency of facial bone fractures. Regardless of age, motor vehicle accidents were high in all age groups except the first decade of life and above 60 years of age when traffic accidents dominated. Thus effectiveness of current preventive measures is to be assessed, followed by instituting new guidelines for prevention and inflexible traffic rules shall be levied. More epidemiological surveys can, if encouraged to measure the frequency of fractures, better the world.

Keywords

- facial fractures
- road traffic accidents
- mandible
- maxilla
- zygomatic complex
- facial fractures

Facial injuries influence a remarkable part of trauma patients, which occurs either in isolation or linked with other fractures of the bones of the body.¹ These fractures require early diagnosis and management if not commonly associated with functional, aesthetic, and psychological complications.²

A proper understanding of etiology, severity, and pattern of fractures assists in drawing a relation between clinical and research priorities for effective management. Extensive surveys have been done on fractures of maxillofacial bones in different regions of the globe. Withal, the incidence and

etiology of fractures vary from region to region due to factors such as population density, mode of transport, socioeconomic position, lack of modern technology in detecting the fractures of the face immediately after trauma, and severity of the wound.

This retrospective epidemiological study was performed to evaluate facial fracture patterns and distribution of fractures on different parts of the face among different age groups caused by various etiologies in patients referred to Mamata Dental College and hospital, Khammam, Andhra Pradesh, India.

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Materials and Methods

A retrospective epidemiological study was performed on 1,015 patients with fractures in the facial region during a period of 2005 to 2013 in Mamata Dental College and hospital, Khammam, Andhra Pradesh, India.

Fractures are divided into mandibular, maxillary + dentoalveolar fractures, palatal, zygomatic complex, Le Fort I, Le Fort II, Le Fort III, dentoalveolar fractures, nasal, orbital, and frontal. Mandibular fractures are further divided into symphysis, parasymphysis, angle, ramus, condyle, and coronoid. Fractures are further differentiated into each side as left and right.

Patients were classified based on etiological factors as road traffic accidents, falls on the same level, falls from elevation, sporting injuries, assault, and other causes (which include animal hit injuries, iatrogenic causes). Road traffic accidents are further sorted out as traffic accidents (which include fall from vehicles in motion) and pedestrian (vehicle accident, motorbike accident, bicycle accident, automobile accident, heavy-vehicle accident).

Qualitative variables were shown as frequencies, and quantitative variables were represented as means and standard deviation. The chi-square test was applied to evaluate the association between gender, traffic accidents, and facial region affected.

Results

During the period of 2005 to 2013, a total of 1,015 patients with facial injuries were brought up to the section of oral and maxillofacial surgery.

Age Distribution of Fractures

Patients' age ranged from 3 years to 85 years with a mean age of (31.19 ± 13.38) and median of 28. Highest numbers (39%) of fractures were sustained in the third decade of life and least (0.1%) in the ninth decade of life. The distribution of fractures in various age groups are shown in ► Fig. 1 (age-wise distribution of cases). Each patient had a mean of 1.5 fractures.

Gender Distribution

The majority of patients who sustained trauma to face were males (84.6%). The ratio of males (859) to females (156) is 5.5:1 as shown in ► Fig. 2 (gender-wise distribution of cases). There is an almost fivefold risk in males when compared with females. Among males motorbike accidents are high in number followed by road traffic accidents. In females motorbike accidents are high followed by assault as shown in ► Fig. 3 (showing gender-wise distribution in accident types). This distribution of fractures is statistically significant ($p < 0.01$).

Etiology

Fractures were classified into various etiological factors, of which motorbike injuries (34.9%) are highest, followed by traffic accidents (18.2%). The least frequent were sporting injuries (1.2%). The distributions of fractures, according to

Fig. 1 Age-wise distribution of cases.

Fig. 2 Gender distribution of cases.

Fig. 3 Showing gender distribution in accident types.

various etiological factors, were shown in ► Fig. 4 (distribution of cases according to accident type).

Distribution in Various Trauma Reasons

A total of 1,015 patients with 1,545 fractures were studied of whom 769 patients were associated with soft tissue injuries. The highest frequency of fractures caused by various reasons is seen more in the third decade except for sporting injuries

Fig. 4 Distribution of cases according to accident type.

most commonly seen in the first and second decades as shown in ►Fig. 5 (distribution of fractures according to site).

Fracture Site

Of all facial bones, mandibular fractures are highest in number as shown in ►Fig. 6 (distribution of fractures in mandible) followed by zygomatic bones as shown in ►Fig. 7 (distribution of fractures in midface). The least were naso-orbitoethmoid (NOE) fractures (0.39%). The distributions of fractures due to various etiologies in various age groups are shown in ►Table 1 (distribution of trauma reasons in various age groups). In ►Table 2 (distribution of trauma reasons in

Fig. 5 Distribution of fractures according to site.

Fig. 6 Distribution of fractures in mandible.

Fig. 7 Distribution of fractures in midface.

various areas of face) and ►Table 3 (distribution of trauma reasons in bilateral region of midface) the distribution of fractures on face due to various etiologies was shown. Of all mandibular fractures, right parasymphysis fractures were highest in number followed by symphysis and left angle fractures as shown in ►Table 4 (distribution of fractures in mandible).

Soft Tissue Injuries

Among soft tissue injuries most commonly seen include lacerations (43%) followed by abrasions (36%) and contusions (21%) as indicated in ►Fig. 8 (distribution of cases according to soft tissue injuries).

Discussion

Trauma is one of the most significant causes of death occurring in first 40 years of life.³ One of the most common

Table 1 Distribution of trauma reasons in various age groups

	Age group									Total
	0–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	
1. Road traffic accidents	64.5%	78.9%	78.3%	78.7%	66.25	55.6%	62.6%	40%	100%	776
2. Sports	3.2%	3.0%	1.0%	0.5%	0.8%	0%	0%	0%	0%	12
3. Assault	0%	8.5%	10.6%	11.3%	17.3%	16.7%	8.3%	20.0%	0%	114
4. Fall	25.8%	4.8%	7.6%	7.1%	12.6%	20.9%	8.3%	20%	0%	75
5. Other causes	6.5%	4.2%	2.5%	2.4%	3.1%	7.4%	20.8%	20.0%	0%	38
										1,015

Table 2 Distribution of trauma reasons in various areas of face

	Nasal	Le Fort I	Le Fort II	Le Fort III	Frontal	NOE	Palate
1. Road traffic accident	84.9%	81.1%	88.1%	92.8%	73.6%	33.4%	67.9%
2. Sports accident	0%	0%	0%	0%	0.4%	0%	2.1%
3. Assault	9.4%	4.8%	4.7%	0%	11.5%	50%	14.8%
4. Fall from height	3.8%	4.8%	4.7%	7.1%	10.7%	0%	10.6%
5. Other causes	1.9%	9.5%	2.4%	0%	3.8%	16.7%	4.2%
Total	100%	100%	100%	100%	100%	100%	100%

Abbreviation: NOE, naso-orbitoethmoid.

Table 3 Distribution of trauma reasons in bilateral region of midface

	Maxilla + dentoalveolar			Orbit		ZMC		
	Right	Left	B/L	Right	Left	Right	Left	B/L
1. Road traffic accident	75%	81.9%	75%	85%	63.7%	85.6%	75.5%	66.6%
2. Sports accident	0%	0%	0%	0%	0%	0.7%	0%	0%
3. Assault	20.8%	18.2%	0%	5.0%	18.2%	6.8%	10.2%	0%
4. Fall from height	0%	0%	0%	10.0%	0%	2%	7.9%	33.3%
5. Other causes	4.2%	0%	25.0%	0%	18.2%	4.8%	6.3%	0%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Abbreviations: B/L, bilateral; ZMC, zygomaticomaxillary.

components of multiple trauma caused by road traffic accidents, falls, and sporting injuries is facial trauma.³ Girotto et al⁴ in 2001 studied functional outcomes of facial trauma in which he stated that these injuries should not be neglected and to be treated at the earliest possible time as severity of injury holds a direct relationship with work disabilities such as visual problems, difficulty in mastication, alterations in sensation of smell, paresthesia, and malocclusion.

This epidemiological study was performed at the Mamata Dental College and the hospital, which is a level I trauma center located at district headquarters in Khammam that has a population of more than 2 million. A respectable bit of research studies have been taken out on the pattern of maxillofacial trauma. The mean age of fracture incidence in our study was 31.19 years, which was on par with other study conducted by Meyer et al⁵ in which he concluded that the mean age is 30.7 years. Nevertheless, this value is slightly higher when compared with the value reported in the study

by Gassner et al³ in which mean age is 25.8 years. The activity of life is high in second and third decades of life due to which the mean age of fracture lies in the early third decade. The balance of males and females sustaining fractures in this region are 5.5:1 that is higher than studies conducted in other regions by Mesgarzadeh et al⁶ in Iran, whose value is 3.8:1, and Ugboko et al⁷ in Nigeria, whose value is 4.1:1. Although many explanations can be prepared for this variation, trends of increased male aggressiveness in driving, increasing assault rates, and personal competitiveness reason for this deviation.² In men third decade of life is very dynamic as they engage in extraneous activities, drive vehicles carelessly, and commonly get indulged in physical violence, which is in comparison with the study of Tanaka et al⁸ in which 10 to 29 years of males are usually involved.

Various studies^{9–11} concluded that road traffic accidents are a common cause of facial fractures as victims are commonly traveling in motorbike and bicycles without any

Table 4 Distribution of fractures in mandible

	Parasymphysis			Angle			Body			Condyle symphysis			Ramus			Coronoid		
	Right	Left	B/L	Right	Left	B/L	Right	Left	B/L	Right	Left	B/L	Right	Left	B/L	Right	Left	B/L
1. Road traffic accident	74.6%	68.3%	81.5%	63.1%	62.5%	75%	58.4%	65.1%	57.2%	82.1%	74.5%	62.5%	74.4%	100%	60%	50%	71.5	33.33%
2. Sports accident	0.9%	3.8%	0%	2.6%	0%	0%	0%	0%	0%	2.2%	0%	6.3%	2.3%	0%	0%	0%	0%	0%
3. Assault	9.1%	15.4%	0%	23.7%	17.9%	25.0%	16.7%	17.4%	14.3%	2.2%	13.7%	3.1%	7.0%	0%	0%	0%	14.3%	0%
4. Fall from height	12.7%	7.7%	12.5%	5.3%	16.1%	0%	16.7%	17.4%	28.6%	13.3	7.8%	28.1%	11.6%	0%	0%	0%	14.3%	0%
5. Other causes	2.7%	3.8%	6.3%	5.3%	3.6%	0%	8.3%	0%	0%	0%	3.9%	0%	4.7%	0%	40%	50%	0%	66.66%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Abbreviation: B/L, bilateral.

Fig. 8 Distribution of cases according to soft tissue injuries.

proper protection contributing to a major percentage of road traffic accidents. In our study road traffic accident (74.9%) account for major etiology of fractures. Among males (84.6%), motorbike accidents (31.56%) occupy the most common reason for fracture, which is more eminent than the study of Yokoyama et al (26.9%)¹² followed by traffic accidents (15.8%). Among road traffic accidents, car accidents (1.7%) are least of all which clearly reflects the socioeconomic status of the great unwashed. The least etiological factor causing facial trauma is sporting injuries (1.1%), which is in contrast to studies conducted in developed countries by Iida et al, (9.7%)¹¹; In the study by Gassner et al (31%),³ encouragement by media for active participation in sports for achieving benefits in health and beauty contributed to this rise when compared with producing nations.¹³ Other studies, especially in developed countries (Australia [Allan and Daly 38.1%],¹⁴ Bulgaria [Bakardjiev and Pechalova 61%],¹⁵ and the United States [King et al 50%])¹⁶ concluded assault as a usual reason as the availability of weapons has eased and increasing aggressive behavior has replaced road traffic accidents with these wounds. In our study this value is 8.3% due to less availability of weapons. These statistical data are highly significant (χ^2 value = 46.764; df = 1; $p < 0.001$).

Studies conducted by Adebayo et al¹⁷ revealed that 18% of wounds are sustained in females. In our survey, 15.4% of females sustained facial injuries, which reflects the dynamic part played by females in society. Motorbike injuries (21.8%) are the most common reason whose value is lower than the study of Thorn et al (36%),¹⁸ indicating the social changes in exposing women to similar conditions like men and none of the sport injury cases were reported reflecting the least measure of encouragement given to the females in this particular sphere of activity. Assaults (18.6%) are the next common etiology of fractures reflecting the influence of domestic violence on females. Thorn et al¹⁸ in his study showed that in more than half of the cases the assailants and the victims are linked up. Approximately 75% of females are ill-treated by their spouses and influence of alcohol contributes for this factor.

In the first two decades of life the most common understanding of fractures has been accredited to road traffic accident (64.5%) in which motorbike accidents were high followed by a fall from a bicycle as children set about riding at this age. Fall from height occupies 25.8% of fractures, which is in contrast to studies conducted by Güven and Keskin¹⁹ in

which they have reported falls as the major cause accounting for 50% of cases where sleeping on house tops has been reasoned followed by traffic accidents (28%).¹⁹ Lack of parental supervision can be assigned to be the prime cause for these hurts in our study. The proportion of fractures caused by assaults in this particular age group is none which is on par with the study by Zimmermann et al²⁰ as the motor activity is less in this age group.

The frequencies of fractures peaked in the third decade of life, which is in agreement with Iida et al (52%).¹¹ Motorbike accidents are high in number (41.7% in third decade) followed by traffic accidents (15.9% in third decade) indicating the highest activity of individuals in these age groups. According to Subhashraj et al,²¹ socioeconomic conditions, poor road conservation, not wearing a helmet or safety equipment, disrespect toward traffic rules, and alcohol influence play a major role in these accidents.

In the fourth decade of life motorbike (34%) and traffic accidents (19.8%) were amplified in a numeral followed by heavy-vehicle accidents (11.3%) that were higher when compared with all other age groups, indicating the dependence of people on these vehicles for their sustenance and also consumption of alcohol during driving. Assaults account for 11.3%, which was less than the study of Iida et al²² in which assaults occupy the prime position in this age group (30.1%). Above the fifth decade (17.3%) of life the proportions of individuals occupied by assault injuries were peaked when compared with all other age groups, which recon that injuries caused by assault in this particular age group are more eminent due to behavioral changes and under alcohol influence. This is comparable to study of Maliska et al (37.5%)²³ in which similar effects are reported as this age group is more prone to robbery, resulting in increased incidence of assaults.

Among all the etiological agents, motorbike injuries (34.9%) were high in number followed by other traffic accidents (18.2%). If all the fractures such as traffic accidents, pedestrian-vehicle accidents, motorbike accidents, bicycle fall, three-wheeler accidents, heavy-vehicle accidents, and car accidents are included under road traffic accidents, 74.9% of individuals are included whose value is higher than Iida et al¹¹ study in which 52% of fractures are caused by road traffic accidents where reason is attributed to lack of wearing seat belts. Extension of road lanes, strict traffic rules are levied, wearing seat belts, separate tracks for heavy vehicles on highways, and alcohol detectors are brought into enforcement to prevent these accidents. The least number of fractures is due to fall (9%) whose value lies in the range of 7.1 to 22.4% (Simsek et al²⁴). In our study, 43.8% of fractures were due to road traffic accidents seen in mandible followed by 39.3% in the midface area and 16.9% of fractures in the frontal bone region. In mandible, condyle (right side, 3.02%; left side, 3.1%) is more susceptible, followed by parasymphysis (right side, 3.70%; left side, 3.2%) and symphysis (2.70%) fracture, which suggests that during accidents most patients experienced a direct fall on the chin region leading to a combination of fractures involving symphysis or parasymphysis and condyle region. Impact over anterior portion of

mandible gets transferred to the condylar regions, causing indirect fractures of these areas. This is in contrast to the work performed by Subhashraj et al,²¹ which shows less the proportions of condylar fractures.

In case of heavy-vehicle accidents compared with lower face (27.05%), midfacial fractures (49.41%) were in high proportion that was in distinction to the sketch published by Gopalakrishna et al²⁵ according to which midfacial fractures were accounted more in motorcyclist accidents. The cause of this alteration may be due to deficiency of air bags in heavy vehicles leading to midfacial injuries.

The next higher numbers of fractures were due to assault (9.7%). This is in contrast to the work conducted in Western countries where assault is the prime cause of fractures.²⁶⁻²⁸ Of these, mandible fractures (49.33%) were high in this particular type followed by midface (30.67%) and upper face (20%). The left side of mandible is most commonly involved during assault due to use of the right hand most times, and because greater numbers of right-handed individuals exist, fractures are usually seen on the odd side of the expression. Midfacial fractures are relatively less compared with lower third of the face as the most amount of force is required for fractures. Nevertheless, when the weapon is used, the proportion of fractures are more in midfacial and upper facial region as frontal and zygomatic bones are more prominent and aggressors commonly target these areas.²⁹

Fall injuries account for 9.25%, which is less than the number reported in studies conducted by various authors.^{11,30,31} The number of fractures was greater when an individual breaks down from height either under the influence of alcohol or due to active participation in activities,³⁰ resulting in transfer of greater amounts of impact to bones causing fractures. The bigger numbers of fractures were seen in frontal bone (16.7%). Mandible fractures account for 53.1% in falls from height and 9.7% in fall from same level, which was far less than the number reported in the study by Yamamoto et al³⁰ (fall from height, 64.6%; fall from same level, 70.6%). Of these, 31.5% of fractures are seen in condylar region and in the symphysis region (28.9%). Most of these fractures are a combination of symphysis or parasymphysis and condylar regions. Because of heavy impact on symphysis or parasymphysis region, forces are transmitted indirectly to condyles leading to fracture. The percentage of fractures due to fall from the same level (9.7%) was far less when compared with fall from a height with symphysis and condyle occupying 14.2%, which is in contrast to studies of Yamamoto et al³⁰ in which symphysis fractures occupied 11.9% and condylar fractures occupied 64.5%. This lower incidence of fractures was due to less impact of violence being brought forth. Nonetheless, both symphysis and condyles occupy equal proportion of incidence because, during the fall, most times chin is the part that adds up in direct contact associated with dispersion of forces toward the condyle, resulting in indirect breaks. Midfacial fractures (17.4%) are less as smaller amounts of impact is transmitted to these bones. This variation is in contrast to studies of Yamamoto et al³⁰ in which no significant dispute is picked up between midfacial and lower facial fractures.

The mandible is the most common site of the facial skeleton prone to fracture (43.81%) that is in contrast to studies.^{13,29,31,32} In contrast to study by Adebayo et al¹⁷ in which body fractures (51%) are eminent, our study stated the highest frequency of cracks in the parasymphysis region (right, 18.6%; left, 17.72%) with mild variation between right and left that was due to motorbike accidents. This is followed by condylar fractures (right, 11.3%; left, 12.2%), which is far less than that reported in the study by Marker et al³³ (41%). Assault is considered to be the contributing factor in this variation. However, Ellis et al³⁴ indicated that motor vehicle accidents and fall injuries contribute to one-third of fractures compared with assaults that contribute for less than one-fourth. This reason holds in effect in our work also that shows motor vehicle accidents were higher compared with assaults. Angle fractures in our studies account for 15%, which was less than the number revealed in study conducted by Ogundare² (36.32%) in which assaults were more common during which aggressors try to reach this region. In cases of panfacial trauma, a combination of midfacial fractures and mandibular fractures account for 15.2% and zygomatic complex and mandibular fractures account for 9.3%. This is far less than the number revealed in studied conducted by Obuekwe et al.³⁵ The compounding of the midface and upper face account for 15.29%. As midface has weak bone structure, the comminuted fractures are most frequently associated with the upper third facial bones.

Conclusion

This study differentiates the etiological factors causing facial trauma in several age groups. By examining the statistical information, we reveal a slight difference in mean age incidence of fractures from the second decade to the early third decade with greater incidence in men. Alcohol influence played a major contributing element in causing fractures in road traffic accidents and violations. Mandibular region is the most prone area followed by midface and upper face. Extended information on traffic accidents along the importance of preventive strategies is to be laid, which is the flashiest means to reduce direct and collateral costs of fractures. More effective protective systems are needed to prevent these injuries. If more studies are encouraged to evaluate the frequency of fractures, prevention and treatment can be designed for more upright life of humanity.

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