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**ORIGINAL ARTICLE**

# Patterns and Treatment Modalities of Maxillofacial Fractures due to Motorcycle Accidents

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## ABSTRACT

**Aim:** Maxillofacial fractures due to motorbike accidents are common in Pakistan. The aim of current study was to evaluate the pattern of fractures in motorbike accidents and the common treatment modalities used to deal these fractures.

**Methodology:** In this cross-sectional study 274 patients with facial fractures were recruited consecutively from Maxillofacial surgery unit of Khyber College of Dentistry, from April 2021 to December 2021. Patterns were classified broadly into midface, mandible and combined fractures while treatment modalities included close reduction and ORIF at 1, 2, 3 and 4 or more points. Simple descriptive statistics were used with SPSS version 20.0. Chi-Square and Fisher's Exact tests were applied where required, with p>0.05 kept as significant.

**Results**: Out of 274 patients, 260 were male and 110 belonged to age group 21 to 30years. Mandible fracture (n=108) was the most common pattern followed by combined fractures (n=88). Symphysis/parasymphysis was the most common site of single mandibular fractures while most common single midfacial bone to fracture was ZMC (n=56). Overall 2 points fixation (n=88) was the most common treatment modality used followed by 1 point fixation (n=72). Mandibular fractures were treated mostly by single point fixation and combined fractures by ORIF at 3 or more points (p=0.000).

**Conclusion:** Maxillofacial fractures due to motorbike accident are common in men of 21 to 30 years age. Mandibular fractures are the most common followed by combined fractures. Mandibular fractures require 1 point, midface fractures 2 points and combined fractures 3 or more points fixation for their optimal management.

**Key words:** motorbike accidents, patterns, treatment modalities

## INTRODUCTION

Being an exposed, prominent and unprotected part of the body, the maxillofacial region is commonly prone to trauma.[1] Trauma to this region not only injures the facial skeleton but also damage the soft tissues and dentition.[2,3] These injuries not only cause functional and aesthetic compromises but also has severe psychological implications.[4,5] The etiology and pattern of these fractures vary according to the socioeconomic, environmental, cultural and legislative differences in different regions of the world.[1,6-8] Known causes of these fractures include road traffic accidents (RTAs), interpersonal violence, fall, sports injuries, industrial accidents and gunshot and bomb blast injuries.[1,6]

Pattern of maxillofacial fractures can range from a simple isolated bone fracture to complex multiple panfacial fractures and may be associated with fractures and injuries in other part of the body, requiring multidisciplinary approach for their management.[1,8] Over the years management of these fractures evolved from close reduction to limited fixation by intraosseous wiring and stainless steel plating to complex open reduction and internal fixation (ORIF) with newly developed titanium plates and screws.[9]

The use of motorcycle has dramatically increased in the past two decades due to its low cost, low fuel consumption, easy maintenance and ability to move through heavy traffic. This increase in motorcycle use has resulted in a corresponding increase in RTAs and is the most common cause of fatal and non fatal injuries worldwide.[10-12] Motorcyclists are three times more likely to be injured and 16 times more likely to die as compared to car users.[11]

In Pakistan the use of motorcycles as a means of transport has increased considerably over the last decade resulting in increased motorbike accidents and maxillofacial fractures.[13] The objective of this study was to evaluate the patterns of maxillofacial fractures due to MCAs and the common treatment options used to manage these fractures. This study gives the maxillofacial surgeons an idea about the complex pattern of facial fractures expected in MCAs and the optimal treatment methods required to deal these fractures.

## METHODOLOGY

This descriptive cross-sectional study was conducted at Khyber College of Dentistry, Peshawar from April 2021 to December 2021. Sample size was calculated to be 274 with 95% confidence interval, on the basis of 15.7% incidence of midface fractures.[8] Patients fulfilling the inclusion criteria were recruited consecutively from the in-patient and out-patient department of Oral & Maxillofacial surgery unit. All the motorbike riders and passengers, irrespective of gender and age were included in this study. Pedestrians and those using helmets at the time of accidents were excluded from the study as they may change the pattern of fractures. Patients having bone pathologies, undergone radiotherapy, systemic disease that affect bones and those previously treated for maxillofacial fractures were also excluded. Ethical approval from the institution review board for bioethics was obtained. After obtaining approval, written informed consents from all the patients were taken. Detailed history of all the patients was recorded and clinical examination of the maxillofacial region carried out. The pattern of fracture were confirmed using plain radiographs using OPG, PNS, OM view, Jug handle view and specialized radiographs like CT scan when required. A structured proforma was used to record the patients' name, age, status of motorbike occupant, mode of accident, pattern of fracture, associated fractures, treatment option used and anatomical site of fracture. Pattern of maxillofacial fractures were divided broadly into mid-face, mandible and combined fractures.

Upper face was considered as part of skull and recorded in associated fractures.

Treatment modalities were divided into close reduction without internal fixation, ORIF at single site, ORIF at 2 sites, ORIF at 3 points and ORIF at 4 or more points.

All the open reduction and internal fixations were carried out under general anesthesia using titanium osteosynthesis plates. Close reduction were carried out with intermaxillary fixation for most mandible and maxillary fractures, and with circum-zygomatic suspension in some midface fractures. Close reduction of ZMC fractures was done using Keen's intra-oral and Gillie's temporal approach.

Simple descriptive statistics were used to analyze the data by using the Statistical Package for Social Sciences version 20.0 software. The data was presented in tables as proportions and percentages. Chi-Square and Fisher's Exact tests were applied as required, to see the associations and a value of less than 0.05 was taken as significant with 95% of confidence interval.

## RESULTS

**Age and Gender:** The 274 patients included in this study had an age range of 6 to 70 years with a mean age of 26.7 ±9.6 years and 94.9% (n=260) were male. Most of these patients belonged to the age group of 21 to 30 years (n=110, 40.1%) followed by 20 years and less (n=73, 26.6%) age group. Most of the male patients belonged to 21-30 years age group while most female patients belonged to 31-40 years age group. This association was statistically insignificant (p=0.751) Details are given in table 1.

Table 1: Age Groups and Gender Distribution

| Age groups (in years) | Gender | | Total |
|---|---|---|---|
| | Male n (%) | Female n (%) | |
| ≤20 | 69 (25.2) | 4 (1.5) | 73 (26.6) |
| 21 to 30 | 106 (38.7) | 4 (1.5) | 110 (40.1) |
| 31 to 40 | 59 (21.5) | 5 (1.8) | 64 (23.4) |
| 41 to 50 | 18 (6.6) | 1 (0..4) | 19 (6.9) |
| ≥51 | 8 (2.9) | 0 | 8 (2.9) |
| Total | 260 (94.9) | 14 (5.1) | 274 (100) |

Statistical significance, P=0.751

**Status of motorbike occupant:** Most of the 274 patients were motorbike riders (n=193, 70.4%) while others were passengers. All the female (n=14, 5.1%) patients were pillion passengers.

**Mode of accident:** The most common mode of accident was collision with another vehicle (n=140, 51.1%) followed by fall/skidded (n=86, 31.4%) and collision with an object (n=48, 17.5%).

**Pattern:** With regard to pattern of fractures, mandible (n=108, 39.4%) was the most common pattern of fracture followed by combined midface and mandible fractures (n=88, 32.1%). Mandible fracture was common in both genders. All the patterns were more commonly observed in 21 to 30 years age group followed by 20 years or below age group. The association of pattern with gender (p=0.341) and age groups (p=0.715) was not significant. Combined fractures were the most common pattern observed in riders (n=73, 37.8%) while mandible fractures were common in passengers (n=47, 53.1%). Similarly associated fractures were also more commonly observed in combined fractures pattern (n=50, 43.9%). Both these associations were statistically significant (p=0.002). The cross-tabulation of pattern with mode of accident was analyzed and the results were combined fractures was the most common pattern in accidents with another vehicle (n=52, 37.1%) while mandible fracture was common in other modes of accident. However this association was statistically not significant (p=0.329).

Table 2: Associations of Pattern of Fractures with Different Variables

| Variables | Pattern of Fractures | | | P-Value |
|---|---|---|---|---|
| | Midface (n=78) n (%) | Mandible (n=108) n (%) | Combination (n=88) n (%) | |
| Gender | | | | |
| Male | 73 (28.1) | 101 (38.8) | 86 (33.1) | 0.341 |
| Female | 5 (35.7) | 7 (50) | 2 (14.3) | |
| Age Group | | | | |
| 20 Or Less | 19 (25.7) | 30 (40.5) | 25 (33.8) | 0.715 |
| 21 To 30 | 31 (28.2) | 43 (39.1) | 36 (32.7) | |
| 31 To 40 | 18 (28.6) | 23 (36.5) | 22 (34.9) | |
| 41 To 50 | 7 (36.8) | 10 (52.6) | 2 (10.5) | |
| 51 Or Above | 3 (37.5) | 2 (25.0) | 3 (37.5) | |
| Mode of accident | | | | |
| Vs Another Vehicle | 37 (26.4) | 51 (36.4) | 52 (37.1) | 0.329 |
| Fall/Skidded | 29 (33.7) | 36 (41.9) | 21 (24.4) | |
| Vs Object | 12 (25) | 21 (43.8) | 15 (31.3) | |
| Status of occupant | | | | |
| Rider | 55 (28.5) | 65 (33.7) | 73 (37.8) | 0.002 |
| Passenger | 27 (28.4) | 47 (53.1) | 15 (18.5) | |
| Associated injuries | | | | |
| No associated injuries | 50 (31.2) | 72 (45) | 38 (23.8) | 0.002 |
| Associated injuries | 28 (24.6) | 36 (31.6) | 50 (43.9) | |
| Treatment | | | | |
| Close Reduction | 6 (27.3) | 12 (54.5) | 4 (18.2) | 0.000 |
| ORIF (1 Point fixation) | 15 (20.8) | 47 (65.3) | 10 (13.9) | |
| ORIF (2 Points fixation) | 27 (30.7) | 42 (47.7) | 19 (21.6) | |
| ORIF (3 Points fixation) | 21 (20.4) | 5 (7.2) | 43 (62.3) | |
| ORIF (4 or more Points fixation) | 9 (39.1) | 2 (8.7) | 12 (52.2) | |

**Associated injuries:** Associated injuries in other parts of the body were present in 114 (41.6%) patients.

**Treatment:** The most common treatment was ORIF at 2 points (n=88, 32.1%) followed by 1 point (n=72, 26.3%) and 3 points fixation (n=69, 25.2%). Mandibular fractures were most commonly treated by ORIF at single point, midface by 2 points fixation and combined fractures by ORIF at 3 points. This association of treatment modalities with pattern was statistically highly significant (p=0.000).

**Anatomical site:** Multiple fractures in mandible occurred in 123 (44.9%) cases while single fracture in mandible was present in 71 (25.9%) cases. With regards to the anatomical site involved, symphysis/parasymphysis was the most common site of single mandibular fractures and combination of symphysis/parasymphysis and angle was the most common pattern in multiple mandibular fractures. Similarly the most common of 107 (39.1%) single midfacial bone fracture was ZMC fracture (n=56, 20.4%) while combinations of Lefort fractures (n=13, 4.7%) were the most common pattern of all multiple midfacial fractures (n=59, 21.5%).

Table 3: Anatomical site involved

| Mandible (n=196, 71.5%) | | Midface (n=166, 60.6%) | |
|---|---|---|---|
| Single mandibular fracture (n=71, 25.9%) | | Single midface fracture (n=105, 38.3%) | |
| Anatomical site | n (%) | Anatomical site | n (%) |
| Sym/Ps | 33 (12) | Nasal | 5 (1.8) |
| Body | 7 (2.6) | Lefort 1 | 12 (4.4) |
| Angle | 21 (7.7) | Lefort 2 | 20 (7.3) |
| Ramus | 1 (0.4) | Lefort 3 | 9 (3.3) |
| Condyle | 9 (3.3) | ZMC | 56 (20.4) |
| | | NOE | 3 (1.1) |
| Multiple mandibular fractures (n=125, 45.6%) | | Multiple midfacial fractures (n=61, 22.3%) | |
| Anatomical site | n (%) | Anatomical site | n (%) |
| Sym/PS + Angle | 38 (13.9) | Lefort combination | 16 (5.8) |
| Sym/PS + Cond | 33 (12) | ZMC + Orbit | 5 (1.8) |
| Sym/PS + Body | 11 (4) | ZMC + Lefort | 12 (4.4) |
| Bil PS | 5 (1.8) | Lefort + Orbit | 2 (0.7) |
| Bil angle | 7 (2.6) | ZMC + Nasal | 10 (3.6) |
| Body+angle | 4 (1.5) | Lefort + Nasal | 7 (2.6) |
| Sym/PS + Bilateral Cond | 14 (5.1) | ZMC + Lefort + NOE | 4 (1.5) |
| Sym/PS+ Angle+ Cond | 10 (3.6) | ZMC + Lefort + Nasal | 5 (1.8) |
| Bil PS+Bil Cond | 3 (1.1) | | |

## DISCUSSION

Road traffic accident is the main cause of maxillofacial trauma in developing countries and most of these accidents involve motorcycles.[2,14] This study was undertaken to know the common patterns and treatment modalities for facial fracture due to MCAs. Most of the patients in this study were male in their third decade of life. Similar male dominance in third decade of life was reported in other studies as well.[14-19] The high percentage of males in our study is because of cultural and religious restriction on females where mostly men ride the bikes. All the female patients reported in our study were pillion passengers. Moreover the 3rd decade is an active and busy phase of life where most men go out to study and work using motorcycles which expose them to traffic accidents more often.

The most common mode of accident in this study was collision with another vehicle followed by fall from the bike. Other studies reported similar results.[1,12-14] The reason for this is the heavy traffic on the roads and disregard to traffic rules and regulations by most drivers and riders. The motorcyclists also try to maneuver through the heavy traffic due to its small size and change lanes abruptly and thus prone to collision with other vehicles. However Nyameino et al[14] from Kenya reported fall as the most common mode of motorbike accidents followed by collisions with another vehicle.

In our study most of the patients were motorbike riders. Other studies reported similar results.[2,14] This can be explained by the fact that many motorbike riders do not carry any passengers. An interesting finding in our study was that riders suffered combined fractures more commonly while passenger had mandibular fractures. This was statistically significant. The reason for this may be because the riders are sitting in front and are exposed to direct traumatic force from all directions and hence prone to multiple facial fractures.

Our study revealed that the most common pattern was fractured mandible followed by combined mandible and midface fractures. Other studies around the world also reported mandible as the most common bone to fracture in maxillofacial trauma.[14-16] Lima junior et al[17] and Nyameino et al[14] in contrast reported midface fractures more commonly in motorcycle accidents while Pungrasmi and Haetanurak[18] reported zygomatic complex fractures as the most common of all maxillofacial fractures in their decade long retrospective study. The high frequency of mandibuar fractures in our study can be explained by the large size and prominent and exposed position of mandible which makes it vulnerable to traumatic forces from different directions and the horse shoe shape of the mandible make it prone to indirect fractures as well. In this study the most common midfacial bone to fracture was zygomatic complex. This is in agreement with other studies done around the world.[12-19] While in mandible the most common site in isolated fracture was symphysis/parasymphysis and in multifocal fracture most common combination was symphysis/parasymphysis and angle fracture. The reason for high incidence of zygomatic fractures is because of prominent and exposed position and the weaker junctions of this bone with other bones. Similarly in mandible the chin prominence along with long root of canine tooth exposes the symphysis/parasymphysis region to fracture more often. Impacted mandibular third molar and the abrupt curvature at the angle region also provide a weaker zone for traumatic forces. This study found fractures in other parts of the body associated with facial trauma in 114 (41.6%) patients. These findings are consistent with those reported by Ramli et al.[11] Other studies revealed lower incidence of associated fractures, however their etiology was not limited to motorbike accidents.[20,21]

The most common treatment modality used in management of maxillofacial fractures due to motorbike accident in this study is ORIF at 2 point followed by ORIF at 1 and 3 points with very few patients managed conservatively and with close reduction. This is in contrast with other studies from developing countries which reported a higher percentage of conservative treatment and close reduction to decrease the overall cost of treatment.[8,22,23] However, these studies included all the causes of maxillofacial trauma. Other studies on facial fractures due to motorbike accidents[2] and road traffic accidents[24] reported a similar higher percentage of ORIF treatment. Most of the patients visiting the over burdened government hospitals in this part belong to poor and middle class families and as such facial fractures are managed with minimum fixation that give satisfactory results to decrease the overall cost of treatment. This is evident from previous studies in this part of the world[13,25] and other developing countries.[8,10,22] The higher incidence of ORIF in the current study is due to the fact that patients with motorbike accident are exposed to high impact from accidents and present with complex unfavorable patterns which require some form of fixation for satisfactory results. This is evident from this study as the patterns become complex the number of fixation points also increased, with ORIF at 4 or more points most commonly used in combined fractures.

## CONCLUSION

Motorbike accidents cause facial fractures most commonly in men in their third decade. Most of these accident occurr due to collision with other vehicles and most commonly involve the riders. Mandibular fractures are the most common followed by combined mandible and midface fractures. Parasymphysis is the most common anatomical site to fracture in mandible whereas ZMC fractures are common in midface. As the complexity of fracture pattern increases the number of fixation points also increases. The mandibular fractures require atleast 1 point fixation, midfacial 2 point fixation and combined fractures 3 or more point fixation for their optimal management.

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