PATTERN AND MANAGEMENT OF MAXILLOFACIAL FIREARM INJURIES

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Abstract

Objective: *The objective of this study was to determine the pattern of maxillofacial fractures involved in patients reporting with firearm injuries and the management of such patients.*

Materials & Methods: *A total of 148 patients of maxillofacial fractures due to firearm injury reporting within 72 hours were included in the study. Firearm injuries treated previously, pathological fractures, and the fractures of upper third were excluded from the study. The pattern was divided into midface, mandible, and both, while treatments were classified into open/internal fixation and close/conservative. A detailed history followed by clinical and radiographic examination of the patient was performed. Data analysis was done using SPSS version 20.0.*

Results: *The male population (70.9%) was affected more than females (29.1%) by firearm injury with male to female ratio of 2.5:1. Mandible (60.8%) was involved in a higher number of patients than midface (25%). Closed treatment (75.7%) was the most common modality used for management of these cases. Young patients were managed with closed reduction, i.e. conservative treatment, while open reduction, i.e., internal fixation via osteosynthesis plates and screws was preferred in older age.*

Conclusion: *Maxillofacial fractures due to firearm injuries (FAI) occur commonly in young adult men. The mandible is the common site involved in these injuries, and close treatment is widely used and a practical approach to managing these cases.*

INTRODUCTION

Firearm injuries (FAI) cause severe health and financial issues in society.[1] Due to the increase in civil unrest and lack of arms control program the frequency of FAI has also increased.[2] Maxillofacial FAI previously classified as low velocity and high velocity are now categorized according to the energy transfer characteristics along the missile path which correlate with the magnitude of tissue injury and tissue loss. Injuries involving low energy transfer typically lead to non-avulsed, penetrating or perforating wounds, usually with some comminution at the point of bone penetration. High-energy ballistic injuries commonly produced by riffle bullets are recognized by their extensive avulsed nature involving hard and soft tissues.[3] Etiologies of FAI in Pakistan are terrorism, assaults, domestic violence, suicide attempts, accidents, armed robbery, illegal arms possession, and aerial shooting.[2]

Maxillofacial area is a prominent region for FAI especially in close range target incidents, e.g. suicides and assaults.[4] Mandible is more commonly affected by FAI to maxillofacial regions.[2, 5, 6] Maxillofacial FAI cause a lot of morbidity and distress in the affected individuals and may result in bone defects in

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the mandible and midface.[5, 7] It is a tough challenge for a maxillofacial and reconstructive surgeon as it produces a considerable deformity in the body. Management of firearm wounds has been evolving from conservative delayed repair to new aggressive single-stage approach. Penetrating and perforating wounds caused by low-velocity projectiles are managed in the same fashion as blunt facial trauma ranging from closed reduction to open reduction and internal fixation with minimal debridement and primary closure.[5] Studies from Brazil and Iran favor an open approach towards management of such cases, whereas local studies show preponderance towards closed management utilizing mandibular-maxillary fixation (MMF) in such injuries.[1, 5, 7, 8]

The aim of this study was to produce local data on the type of maxillofacial fractures in FAI and the preferred treatment modality for such injuries when presented to our department. This study will help us in understanding the typical patterns of maxillofacial fractures expected in firearm cases in the local population and the preferred treatment modality used in management of these fractures and thus helping the maxillofacial surgeons better prepared for the management of the expected patterns of facial fractures in FAI.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted in the Department of Oral and Maxillofacial Surgery, Khyber College of Dentistry, Peshawar, from June 2015 to June 2017. The total sample size was 148 based on 56% proportion of closed management[5], 95% confidence level, and 8% margin of error under WHO software for sample size determination.

All the patients of maxillofacial fractures due to firearm irrespective of gender and age, presenting to Department of Oral and Maxillofacial Surgery were included in this study. Patients who received treatment in another center, having bony pathology in maxillofacial region and fractures of the upper third of face were excluded from this study.

Approval to carry out the study was sought from the Institutional Ethical Review Committee at Khyber College of Dentistry. Informed written consent was obtained from all the patients regarding his/her participation in the study. In case of a minor, the consent was obtained from the patient's parents or official guardian. A detailed history, followed by clinical examination and radiographic investigations of the patient was performed. The data was collected using a customized Proforma, which included the patient's biographical data as well as note the study variables such as the area of hard tissue injury and treatment performed. The pattern of the fractures was diagnosed based on history and clinical examination with radiographic confirmation. Plain radiographs were taken in mandibular fractures while computed tomography scans were used in midface and combined fractures. Those patients who were managed conservatively via debridement and mandibulomaxillary fixation (MMF) were assigned to close management group while those treated with open reduction and internal fixation via osteosynthesis plates and screws were assigned to open management group.

The collected data was analyzed using Statistical Package for Social Sciences (SPSS) version 20.0. Frequencies and percentages were calculated for categorical variables like gender, hard tissues involved, and method of treatment. Mean, and the standard deviation was calculated for numerical variable like age. Hard tissue involved and method of treatment was stratified by age and gender. The post-stratification chi-square test was applied keeping p-value at 0.05 as significant. All the data were presented in the form of tables and charts/graphs.

RESULTS

A total number of 148 patients having FAI were recruited in the study. One hundred five patients (70.9%) were male while the remaining 43 patients (29.1%) were female with male to female ratio of 2.5:1. The age range was from 10 to 50 years. The mean age in this study was 25.08±8.33 years SD. The typical age group was from 21 to 30 years (57.4%), and the least numbers of patients were present in 41 to 50 years. Mandible (60.8%) was more commonly affected by firearm injuries. Out of the total 148 patients affected by FAI 24.3% were managed by open reduction. (Details are given in Table 1)

Midface and mandible were more commonly affected in males while in females combined midface and mandible were involved more frequently. This association of pattern with gender was statistically significant (p=0.008). All the patterns were more commonly observed in 21 to 30 years, followed by

20 years and below age group. In 31 to 50 years age group only mandible was affected. This age-wise difference was statistically significant. (Table 2)

Close treatment was commonly carried out in both genders. The percentage of female patients receiving extensive treatment was slightly higher than that done in males, but this was not statistically significantly (P=0.284). At young age the closed reduction was typical for the management of firearm injury while in old age, open was standard method. This difference was statistically highly significant (P=0.000). In all fracture patterns close treatment was standard. Patients reporting with mandible fractures were treated via open reduction, while combined midface and mandible fractures were treated exclusively with close reduction via MMF with or without sequestrectomy. (Table 3)

DISCUSSION

Our society faces the challenge of a significant increase in violent crimes due to which there is a steady rise in firearm assaults and injuries.[9] The pattern and severity of FAI gets more complicated in the maxillofacial region due to the involvement of hard and soft tissues.[4] In the current study we noticed that males were affected in a higher number by FAI than females. Similar results of higher male incidence in maxillofacial injuries due to firearm were reported in other studies as well.[5, 10-12] A study[13] conducted in Agha Khan University Hospital (AKUH) Karachi (Pakistan) reported a male to female ratio of 12:1 in firearm injured patients. This may because male population is more outgoing, which increases their

Table 1: Frequency of Age Groups, Pattern And Management

Variables	n	%
Age Groups		
≤20	42	28.4
21-30	85	57.4
31-40	12	8.1
41-50	9	6.1
Pattern		
Midface	37	25.0
Mandible	90	60.8
Midface + Mandible	21	14.2
Management		
Open	36	24.3
Close	112	75.7
Total	148	100

Table 2: Crosstabulation of Gender and Age with Pattern

Variables	Pattern			Total n (%)	P value
	Midface n (%)	Mandible n (%)	Midface + Mandible n (%)		
Gender					
Male	27 (18.2)	69 (46.6)	9 (6.1)	105 (70.9)	0.008
Female	10 (6.8)	21 (14.2)	12 (8.1)	43 (29.1)	
Age Groups					
≤20	12 (8.1)	25 (16.9)	5 (3.4)	32 (28.4)	0.034
21-30	24 (16.2)	45 (30.4)	16 (10.8)	85 (57.4)	
31-40	1 (0.7)	11 (7.4)	0	12 (8.1)	
41-50	0	9 (6.1)	0	9 (6.1)	

Table 3: Crosstabulation of Gender and Age with Management

Variables	Treatment		Total n (%)	P-Value
	Open n (%)	Close n (%)		
Gender				
male	23 (15.5)	82 (55.4)	105 (70.9)	0.284
female	13 (8.8)	30 (20.3)	43 (29.1)	
Age Group				
≤20	4 (2.7)	38 (25.7)	42 (28.4)	0.000
21-30	18 (12.2)	67 (45.3)	85 (57.4)	
31-40	9 (6.1)	3 (2.0)	12 (8.1)	
41-50	5 (3.4)	4 (2.7)	9 (6.1)	
Pattern				
Midface	10 (6.8)	27 (18.2)	37 (25.0)	0.019
Mandible	26 (17.6)	64 (43.2)	90 (60.8)	
Midface + Mandibe	0	21 (14.2)	21 (14.2)	

risk of trauma and injuries. The second reason can be that males are more aggressive and violent as compared to females.

The FAI in this study occurred most commonly in the second and third decades of life with a mean age of 25.1± 8.3 years SD. These results are consistent with other studies that showed similar mean age in mid-twenties.[10, 12, 14] This can be because an individual becomes independent in early twenties. As a result outdoor activities are increased making them prone to various hazards, including FAI. Also this age is the active period in the life of an individual. Late teenage and early twenties are a rebellious and immature phase in life, and that can be related to aggression, rash decision making, and involvement in shady activities, all of which are etiologies of firearm incidents.

In the current study, mandible was the most commonly affected area. Schreuder et al[15] carried out a study in the Groote Schuur Hospital in Cape Town and reported that most patients suffered from a fracture of the mandible (58%) in nonfatal gunshot wounds to the face. These results are consistent with the current study. Abramowicz et al[16] reported similar results and found that the most common facial fractures in firearm injuries were open mandibular fractures. Bukhari et al[5], Norris et al[10] and Keyhan et al[12] in their respective studies also found mandible more commonly involved in FAI as compared to midface. However, in contrast, Wahid et al[17] found midface as the most common area to be affected in firearm injuries in his study on characteristics of FAI done in the Ear Nose and Throat Department of a tertiary care hospital. The difference may due to the reason that in our study we only include maxillofacial region while Wahid et al[17] included whole head and neck area. The reason for higher frequency of mandibular involvement in FAI maybe because it is a large and prominent area that makes it vulnerable to firearm injuries from different directions as compared to other maxillofacial regions.

Surgical management of facial gunshot wounds generally includes debridement, fracture stabilization, and primary closure. Hard tissues are reconstructed, provided soft tissue coverage is adequate with rehabilitation of the oral vestibule, alveolar ridge and secondary correction of residual deformities.[9] The primary treatment of facial fractures due to FAI is highly controversial with regards to initial open reduction and internal fixation or more conservative approach and closed reduction.[18] Facial gunshot injuries have been treated by several methods, including closed reduction, external pin fixation, internal wire fixation and more recently open reduction and stable internal fixation using plates and screws.[7,9] In the current study most of the patients were managed by closed reduction (75.67%). Schreuder et al[15] reported that patients with facial skeleton fractures due to FAI were addressed by intermaxillary fixation and closed reduction (33%), arch bars (10%), and ORIF (15%). These results are similar to current study. Lauriti et al[7] in their study used rigid internal fixation in most cases followed

by exploratory surgery and conservative treatment. Ebrahimi et al[19] reported a case series of gunshot injuries and used internal fixation primarily in all cases. Bukhari et al[5] used open reduction and internal fixation in 44% of the cases of missile injuries. In our study we found that more cases of mandibular fractures due to FAI were treated with open reduction as compared to the midface. Bukhari et al[5] and Lauriti et al[7] also performed internal fixation more commonly for mandibular fractures due to FAI.

Although firearm wounds are considered contaminated, not all maxillofacial FAI needs to be delayed. Many patients may be treated early. In the current study closed reduction was standard mode of management of FAI at young age while in old age open reduction has been preferred.[13] In most of the community fractures the injury site is considered as a bag of bone and managed conservatively. The reason for managing fractures conservatively maybe that infection is common in firearm cases, and opening mucosal barrier means access to oral flora. Another reason for conservative management is to maintain the periosteal blood supply that is still attached to the smaller fragments and can get disrupted and necrotized with manipulation. That is why in early ages closed reduction is the standard modality of treatment. In old age the bone is less elastic, and FAI leads to more scattering as compared to young with the need for aggressive management approach like open reduction. In our study we found that more cases of mandibular fractures due to FAI were treated with open reduction as compared to midface. Bukhari et al[5] and Lauriti et al[7] also performed internal fixation more commonly for mandibular fractures due to FAI. Open reduction and internal fixation were done more commonly in mandible because it is a sizeable cortical bone that provides stable areas for fixation of longer and more substantial plates. Before opting for any treatment plan different factors such as cost, hospital stay, side effects of general anesthesia, systemic conditions, co-morbidities, and patient's overall health and quality of life need to be kept in mind.

CONCLUSION/RECOMMENDATIONS

Firearm injuries most commonly occur in male patients in their second and third decades of life. The mandible is more commonly involved in these injuries, and close treatment is the most common modality used for managing maxillofacial fractures due to FAI.

We recommend educating the general population about the devastation of firearm injuries and their sequelae through public awareness programs in print and electronic media. Social issues and anger management need to be addressed. Dangers of possessing a gun should be emphasized. Strict regulations regarding possession of firearms need to be implemented to eliminate the etiologic factors.

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