INTRODUCTION

Management of facial gunshot wounds poses a challenge not only for the oral and maxillofacial surgeons but also for the reconstructive surgeons. Facial gunshot wounds bear a lot of morbidity for the affected patients.\(^1\)\(^2\) Inordinate attention has been given in the past to wound classification based merely on the projectile's velocity.\(^1\) These wounds can appropriately be classified as penetrating, perforating and avulsive wounds. Management of facial gunshot wounds has been evolving through ages from conservative delayed operative repair to early aggressive single stage approach.\(^1\) Penetrating and perforating wounds, mainly resulting from low velocity projectiles, are managed in the same way as blunt facial trauma, ranging from closed reduction to open reduction and internal fixation with minimal debridment and primary closure.\(^2\)\(^3\) While management of avulsive wounds resulting from high velocity projectiles has been evolving through ages with controversies involving early and delayed reconstruction as it suffers an evolving type of tissue necrosis.\(^2\)\(^4\)\(^5\)

Recently Futran and colleagues have proposed a phased approach for management of avulsive wounds.\(^6\) The first phase involves evaluation of the ABC, life and limb threatening injuries, intracranial, ocular, facial nerve, vascular and other major injuries, excision of all necrotic tissue and maintenance of tissue of questionable prognosis, maintaining occlusal relationships, maintaining mandibular segments with reconstructive plates and maxillary defects and soft tissue envelope with temporary bone grafts to avoid later tissue contracture. Pre-operative planning should also be done for anticipated definitive reconstruction with 3-D CT scan and stereolithography. Second phase involves definitive reconstruction which should be as early as possible. The third phase focuses on aesthetic and functional refinements which may occur over weeks to years in which free flap debulking and contouring is required. Dental rehabilitation with tissue borne or implant borne prosthesis, additional cosmesis, facial prosthesis and tissue tattooing may be done.\(^6\)

The timing and sequence of different stages in the management of facial gunshot wounds with reconstruction and rehabilitation is of prime importance for successful aesthetic and functional outcomes, if inadequate may lead to graft rejection and frequent infection and as such multiple revisional operations.\(^7\)\(^8\)\(^9\)

With the development of microsurgical techniques and local tissue advancement to distant free flaps re-

ABSTRACT

Objective: To determine pattern and presentation in terms of site of injury, airway, associated injuries; and management of facial gunshot wounds.

Study Design: Case series.

Place and Duration of Study: Oral Surgery Department, Armed Forces Institute of Dentistry, Rawalpindi, between January 2001 and December 2008.

Methodology: All patients with gunshot wounds of the face managed at the Oral Surgery Department during the study period were included by convenient sampling method. Patients were treated by a multidisciplinary team of maxillofacial surgeon, otorhinolaryngologist and plastic surgeon. Descriptive statistics were used to determine frequencies and mean ±SD for qualitative and quantitative variables respectively.

Results: A total of 38 patients with gunshot wounds to the face were identified. Age ranged from 15 to 42 years with mean of 28±4.98 years. There were 32 (84%) males and 06 (16%) females. Twenty two (57%) patients required airway management. The most frequent site involved was mandible in 25 (65%) patients while midface was involved in 13 (35%) patients. Open reduction and internal fixation (ORIF) was performed in 17 (44%) patients, while 21 (56%) patients were managed conservatively. Out of 38 patients, 15 (39%) patients had some complications; trismus, sinusitis and infection being the most frequent (10.5% each).

Conclusion: Facial gunshot wounds frequently involve mandible with more likely requirement of establishment of emergency airway and open reduction and internal fixation (ORIF). Early management of gunshot wounds results in better psychosocial profile, aesthetics, reduced hospital stay and early return to function.

Key words: Facial gunshot wound. Facial reconstruction. Microvascular free flaps.
Facial gunshot wounds and their management are very complex. Its management has to be refined with evolving projectiles and increasing incidence of new victims in South Asia, especially in Pakistan to reduce morbidity. In this study the pattern of gunshot injury with respect to site, injury to associated structures, their complications following management and complications following management of 38 gunshot wounds, 25 (65%) involved the mandible and 13 (35%) involved the midface. Out of 25 (65%) patients with mandibular entry sites, 16 (42%) patients required emergency airway, whereas out of 13 (35%) patients of midface entry sites, 06 (18%) patients required emergency airway. Types of emergency airway establishment according to entry site are given in (Table I).

**Table I:** Emergency airway establishment according to entry site.

<table>
<thead>
<tr>
<th>Type of emergency airway</th>
<th>Mandible (n=25)</th>
<th>Midface (n=13)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cricothyroidotomy</td>
<td>2 (8%)</td>
<td>1 (7%)</td>
</tr>
<tr>
<td>Tracheostomy</td>
<td>13 (52%)</td>
<td>2 (15%)</td>
</tr>
<tr>
<td>Emergency airway</td>
<td>1 (4%)</td>
<td>3 (23%)</td>
</tr>
</tbody>
</table>

Out of 38 patients, 17 (44%) patients required open reduction and internal fixation (ORIF) in the form of plating and trans-osseous wiring. The frequency of patients managed with open reduction and internal fixation (ORIF) and those managed conservatively according to entry site is given in (Table II).

**Table II:** Type of treatment according to entry site.

<table>
<thead>
<tr>
<th>Type of treatment</th>
<th>Mandible (n=25)</th>
<th>Midface (n=13)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORIF</td>
<td>12 (48%)</td>
<td>05 (38%)</td>
</tr>
<tr>
<td>Conservative</td>
<td>13 (52%)</td>
<td>08 (62%)</td>
</tr>
<tr>
<td>Total</td>
<td>25 (100%)</td>
<td>13 (100%)</td>
</tr>
</tbody>
</table>

ORIF = Open reduction internal fixation.

There were a total of 06 (15.8%) patients with injury of the facial nerve; 02 (5.2%) had complete transection of the nerve and 04 (10.5%) had neuropraxia. There were 04 (10.5%) patients with parotid injuries. Intracranial penetration was found in 08 (21%) patients. Globe was affected in 05 (13%) patients. There were 02 (5.2%) vascular injuries involving the facial artery.

Out of 38 patients, 03 (7.9%) underwent reconstruction. One patient referred from Afghanistan with avulsion of complete midface and anterior mandible, reported with the complaints of ill fitting dentures and poor aesthetics. Delayed reconstruction was done with rib on-lay grafts and later on patient acquired good retention of his dentures. Out of those 3 patients, 02 (5.2%) patients underwent early reconstruction with fibular free grafts.

Out of 38 patients, 15 (39%) patients suffered complications while 23 (60.5%) of the patients did not have any complications following management. The complication included trismus, infection and sinusitis in 10 patients each; facial nerve palsy occurred in two and vision loss occurred in one patient.

**DISCUSSION**

Facial gunshot wounds and their management are very complex. Its management has to be refined with evolving projectiles and increasing incidence of new victims in South Asia, especially in Pakistan to reduce morbidity. In this study the pattern of gunshot injury with respect to site, injury to associated structures, their management and complications following management...
is discussed. There are many classification systems for penetrating facial injuries but in this study entry site of facial gunshot wounds was divided into midface wounds and lower third or mandible wounds as in other studies.\textsuperscript{7,13}

In all trauma patients securing the airway is very important. The airway of all patients with facial gunshot wounds is at the risk of collapse later on due to extensive necrosis associated with these wounds. Studies reveal that gunshot wounds of lower face and especially with floor of the mouth entry sites are at increased risk of collapse and require emergency airway intervention.\textsuperscript{10,14,15} There are other studies which indicate that these patients may initially appear to have a stable airway but may decompensate rapidly due to extensive inflammatory edema associated with these wounds. They suggest airway intervention in both upper and lower jaw.\textsuperscript{10,16,17}

A frequency of 57% for emergency airway establishment was found in this study which is greater as compared to other studies with frequency of 25% and 35%.\textsuperscript{10} The reason for increased frequency of emergency airway management was that the most frequent entry site was mandible. The airway of most of those patients was managed in the field by general surgeons before referral. The need for emergency airway management differed according to entry site. Most of the patients with mandibular entry site required tracheostomy and it was also needed for later reconstructive surgeries. The airway of patients with facial gunshot wounds and especially those involving lower third of face must be managed immediately before either extensive edema or bleeding may cause life threatening emergency.

Facial gunshot wounds may result in injury of adjacent vital structures like facial nerve, globe, cranium, parotid gland and vascular structures. The kinetic energy of projectiles is very important. Greater the velocity of projectile greater will be the necrosis around its track and as such increased risk of damage to adjacent structures.\textsuperscript{18} The type of bullet and density and resilience of the tissue influence the degree of damage.\textsuperscript{3,14}

In this study, all patients with globe injury were referred to the concerned specialist. All of these globe injuries occurred in patients with midface entry site. So patients with midface entry sites and possible involvement of globe should be referred to the ophthalmologist.

In this study, gunshot wounds were having almost equal frequency for cranial entry irrespective of entry site. Plain face and lateral skull views should be immediately obtained in all patients to identify the path of projectile with no exit wound, to rule out potential intra-cranial penetration. Advanced imaging techniques should also be utilized to assess the potential damage of projectiles. In this study, facial nerve injuries mainly involved distal branches which did not require repair. There were two patients with neuropraxic injuries and were managed conservatively. If there is need for frequent debridement than severed facial nerve branches should be tagged and repaired later on.

Many patients did not require open reduction and internal fixation (ORIF) of midface or mandible fracture which is in accordance with other studies.\textsuperscript{14,18} The aim was to fix the unstable, grossly comminuted fractures with transosseous wires and with plates and screws in case reconstruction is later required. Maximum effort was done to remove the bullets and its secondary fragments because of early and delayed sequelae.\textsuperscript{16,19,20} Intraoperative C-arm fluoroscopy is recommended to check the final position of the bullet, because a bullet may move spontaneously even in paranasal sinuses.\textsuperscript{15,21,22} Latest radiographic techniques may be used to avoid excessive radiation exposure associated with fluoroscopy.\textsuperscript{6,22,23}

On the basis of patterns of injury, the importance of elective airway establishment is suggested in all facial gunshot patients especially with mandibular entry sites or if there is anticipated edema of airway. There must be multidisciplinary approach with active involvement of anesthetists, neurosurgeons, ophthalmic surgeons, vascular surgeons and otolaryngologists in addition to the oral and maxillofacial surgeons in the acute phase. Path of projectile must be assessed by latest radiographic techniques for its potential damage to adjacent vital structures cranium, globe, parotid gland etc. Avulsive wounds should be managed in minimum number of stages and as early as possible if general condition of the patient precludes this to avoid the potential consequences of scar tissue on aesthetic and functional outcomes.

Complications encountered in these patients were predominantly facial nerve palsy, sinusitis, trismus and infection requiring revisional operations.

CONCLUSION

Facial gunshot wounds frequently involve mandible with more likely requirement of establishment of emergency airway and open reduction and internal fixation. Management of facial gunshot wounds is highly individualized depending upon patient presentation, general condition of the patient, available resources and experience of operating team in the management of such patients. Better pre-operative planning and early aggressive management approach towards facial gunshot wounds result in good functional and esthetic results with reduced morbidity.

REFERENCES

Facial gunshot wounds


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