Original Article

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EARLY MANAGEMENT OF MAXILLOFACIAL INJURIES IN COMBAT CONDITIONS

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ABSTRACT:

Facial gunshot wounds, often comprising significant soft and bone tissue defects, pose a significant challenge for maxillofacial surgeons.

AIM: To assess our early management of patients suffering
from gunshot injuries to the maxillofacial region.

METHODS: From 2015 to 2018, 34 patients with missile injuries (high velocity gunshot and bullet wounds, explosive injuries and shrapnel etc.) affecting the maxillofacial region were treated. All except for 6 patients were males. All had soft tissue injuries with or without bone injuries. These patients were reviewed: Tishreen University Hospital.

CONCLUSION: We used early intervention for soft and bone tissues in facial firearm injuries.
Early intervention resulted in restoration of occlusion and continuity of the jaw and early return of function.We recommend this approach when feasible.

Key Words: Mandibular-Midface Region, Titanium Mesh, Gunshot Injuries, Projectile, Velocity.

INTRODUCTION:

Firearm injuries continue to be a major public health problem. Here in, we review and evaluate the current trends in the management of maxillofacial gunshot injuries.

This clinical study was carried out to evaluate the effect of gunshot injuries in the mandibular-facial region caused by modern weapons that are used in the current Syrian crisis.

The management of patients with facial gunshot wounds varies and involves four main steps namely: securing an airway, control of haemorrhage, identifying concomitant injuries and finally definitive repair of the facial deformity.[1,2,3].

Surgical management of facial gunshot wounds is basically divided into three stages: debridement, fracture stabilization and primary closure.

Debridement: In military maxillofacial surgery, the basic principles of maxillofacial gunshot wound debridement formulated in the 1940s still hold. These principles require sparing of damaged tissues. Also, soft tissues of wound margins should be excised removing only the obvious non-viable tissues.[4]

Shvyrkov and Yanushevich [4] stated that in high-velocity projectile wounds the sparing of soft tissue in gunshot wound debridement may result in disability, multiple surgical interventions and prolonged duration of treatment. They recommended radical primary surgical

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debridement of gunshot wounds, and excision of soft tissue wound margins to the point of active capillary bleeding (indicative of normally functioning microcirculation system in the remaining viable soft tissues which heal rapidly). They excised 3.5 mm or more of skin and mucosa from wound margins. They assessed muscle viability by the strength of capillary bleeding and muscle jerk under the scalpel. However, the current trend in facial gunshot injuries comprises early conservative debridement, removal of traumatic tattoos, all non-viable tissues and attention to aesthetic result of the face in all steps using primary closure when possible and antibiotics.[5,6]

Local undermining and use of regional soft tissue advancement rotation flaps for primary closure of maxillofacial soft tissue defects during the same operation has proved beneficial from both an aesthetic and functional point of view in gunshot injuries.[5,6,7,8,9]

Fracture stabilization: Facial fractures resulting from gunshot injuries have been treated by many different methods including closed reduction, external pin fixation, internal wire fixation and open reduction and internal stable fixation (ORIF) using titanium plates and screws.[5,6]

In the past most facial fractures as a result of gunshot injuries were treated by closed reduction. The goal was correct reduction and stabilization of facial bone fractures and minimal morbidity for patients. Before rigid fixation, closed techniques were preferred because of poor treatment outcomes with open reduction, which primarily involved internal wire fixation. These cases frequently developed infection and non-union.

Nowadays most gunshot fractures treated using ORIF for optimal results, since it showed less complication compared with internal wire fixation.

Timing reconstruction: Timing of definitive reconstruction is an area of continuing debate.[10]

Proponents of delayed reconstruction have typically stated that the prolonged period decreased infection rates, reduced necrotic debris, and allowed the surgeon to obtain a better idea of the extent of irreversible injury. Additionally, by allowing adequate time for oedema resolution, the decrease in inflammation provides better assessment of the pre-traumatic facial structure.

Although traditional approaches advised delayed reconstruction, the contemporary paradigm demonstrates success with more immediate definitive reconstruction within 24–48 h.

The terms primary and delayed treatment are somewhat ambiguous and can be defined differently depending on the context.[2,11,12,13] In our study, primary treatment was defined as initial treatment of a wound within 48h (or the first major operation) with the intent to definitively manage

all aspects of the injury, in such a way both of injured hard and soft tissues were restored and all wounds primarily closed.

Despite the increased reported cases of gunshot injuries in the countries of the world (USA, Iraq, and Afghanistan and currently Syria) scientific studies and existing research are very limited.

The aims of this study were to evaluate the effects of gunshot injuries on the soft and hard tissues in mandibular-facial region, evaluate the efficiency of the surgical treatments of the patients and define the most appropriate approach in such cases.

MATERIALS AND METHODS:

This study consisted of 34 patients who were sustained gunshot injuries and attended to Tishreen University Hospital.

Patients who suffered of cerebrovascular accident and suicide cases were excluded from the study.

The sample were classified according to the area of injury (Mandible, Midface or periorbital). The effectiveness of the surgical treatment was evaluated and followed up in each case.

Treatment Protocol

The following is our experience-based protocol used in treatment of high-velocity and high-energy ballistic injuries to the maxillofacial region.

1.Primary lifesaving and organ preservation procedures: intubation upon arrival, cervical spine radiography, direct pressure and packing for hemostasis, and hemodynamic stabilization in accordance with ATLS protocols.
2.Imaging: multiplanar computed tomography (CT), 3-D CT.
3.Interdisciplinary patient evaluation, registration and classification of injuries, establishment of a list of diagnoses, and formulation of a multidisciplinary prioritized treatment plan.
4.Restoration and stabilization of occlusal relations via maxillomandibular fixation. Facial bony framework stabilization and rigid fixation using load-bearing bicortical plates (2.4 mm) in the mandible and monocortical plates (2.0 mm) in the remaining facial skeleton and reconstruction of the orbital floor using titanium mesh.
5. Tissue preservation: meticulous primary closure of the intraoral and extraoral soft tissue to provide full coverage of the comminuted fractures.
The following data were recorded before and post-surgery:

RESULT:

Peri orbital fractures:

1-Ocular Vertical Dystopia:

Ocular Vertical Dystopia were measured using a photograph of the patient with a vertical ruler at the same level. The level of the median line of the pupil of the eye was recorded on each side. Two horizontal lines were drawn from the

center of the pupil of each healthy and diseased eye and dropped on the ruler, where the two measurements were recorded on the ruler and the difference between the two numbers was taken to determine the difference between the healthy and injured eye. We neglected any measurement less than 1 mm, since Edgerton and his associates found that Ocular Vertical Dystopia were not clinically significant unless the difference in eye level was greater than 1 mm. [14]

2-Enophthalmos:

A simple ruler was used for this purpose, measuring the distance from the lateral edge of the orbit to the center of the pupil and comparing it with the intact side. [15]

3-Eye Movement:

The movement of the eye had been tested in all directions up, down, medial and lateral. Difficulty of eye movement in any direction were recorded.

4- Diplopia

The diplopia had been examined using Banks and Brown method, which include movement of the doctor's finger in 9 direction at an arm distance from the patient, and asking him if he experienced double vision in any direction.

Mandibular fractures:

1-Union:

A CT scan was performed 3 months post-surgery in each patient had been treated from mandibular fracture and the presence or absence of union was assessed.

2-Trismus:

We examined the patient clinically 3 months post-surgery and assessed the mouth opening. The presence of trismus was recorded.

3-Malocclusion:

After 3 months of surgery the occlusion of each patient had been evaluated and any malocclusion was recorded, in addition the patient was questioned about his sense of the existence malocclusion.

test and Independent sample t test with significance level kept at $P<0.05$ was performed to compare the proportions and means respectively. Pearson correlations between Quality of life score and sub domains in children with and **peri orbital fractures:**

1-Ocular Vertical Dystopia:

There was ocular vertical dystopia in 8 cases among 14 periorbital fractures. 3months after surgery there was complete resolution of the ocular vertical dystopia in all cases.

2-Enophthalmos:

Enophthalmos was existed in 3 cases. 6 months after surgery there was complete resolution in 2 cases, in the third case there was persistent

enophthalmos, but it was insignificant since it was less than 3mm.

3-Eye Movement:

There was limited eye movement in 9 cases among 14 periorbital fractures. 3 months after surgery there was complete resolution in all cases.

4- Diplopia

There were 9 patients presented with diplopia. And all the cases had been resolved 3 months after surgery.

Using one-tailed t-student test, p-value was less than 0,01 and there were statistically significance differences between presurgery and postsurgery regarding (Ocular Vertical Dystopia P-value was 0.001), (Eye Movement P-value was 0.003) and (Diplopia P-value was 0.003) but there was no statistically significance difference between presurgery and postsurgery regarding (enophthalmos P-value was 0.163). (table 1).

Mandibular fractures:

1-Union:

There were 20 mandibular fractures. All cases treated surgically till the appropriate union had been achieved.

2-Trismus:

10 patients with mandibular fracture presented with trismus. In 8 cases the trismus had been resolved completely, in the other 2 cases despite there was still minor trismus the mouth opening had been improved.

3-Malocclusion :

Malocclusion was presented in 11 cases. And all the cases showed complete resolution 3 months after surgery.

Using one-tailed t-student test, p-value was less than 0,01 and there were statistically significance differences between presurgery and postsurgery regarding (union P-value was 0.000), (trismus P-value was 0.000) and (malocclusion P-value was 0.000). (table3)

DISCUSSION:

1-Ocular vertical dystopia:

There were complete resolution in all cases 3 months after surgery, and this is because the appropriate reduction of the peri orbital fracture which in turn achieve appropriate reposition of lockwood ligament in whitnail tubercle.

2-Enophthalmos*:*

Enophthalmos usually happens in periorbital fractures because the increased volume of the orbital cavity or because the decreased volume of the periorbital fat tissue, in current study early intervention allowed to restore the normal volume of the orbital cavity, and repose the displaced fat tissue and this is the mainstay of hindering the occurrence of enophthalmos. In one case there was still minor enophthalmos

(less than 3mm) but this considered insignificance.

3-Eye Movement and Diplopia:

There were 9 cases presented with eye limited movement and diplopia. It could be because periorbital tissue entrapment or entrapment of the muscle itself or because contusion of the tissue. Early intervention freed the tissues which were entrapped in the fracture line and that is save it from ischemic necrosis, and provided free eye movement and resolution of diplopia.

Mandibular fractures:

1-Union:

There were 20 mandibular fractures. These fractures treated with open reduction and MMF. After 3months all fractures were stable clinically, and there was complete union noticed in radiographic examination in all cases. That's ascertain the importance of the rigid fixation which achieve bone healing in first intention.

2-Trismus:

10 patients with mandibular fracture presented with trismus. In 8 cases the trismus had been resolved completely, in the other 2 cases despite there was still minor trismus the mouth opening had been improved may be because there were comminuted fractures with condylar involvement.

3-Malocclusion :

Malocclusion was presented in 11 cases. And all the cases showed complete resolution 3 months after surgery.

Wound dehiscence:

The rate of occurrence of wound dehiscence after the initial suture was as following:

In periorbital injuries 71%, mandibular injuries 95%.

And after the surgical interventions the rates became as following:

In periorbital injuries 0%, in mandibular injuries 5%.

P-value was >0,05. So there was no impact for the site of injury on wound dehiscence.

The occurrence of wound dehiscence was high after the initial suture and that's may be because the dead space which induced by temporary cavity which is characteristic for gunshot injuries. After the surgical interventions the underlying bony support of the soft tissues had been restored by reduction and fixation of the bone fractures, so there was no wound dehiscence, except in one case was in the mandible where a minor dehiscence was occurred due to infection.

CONCLUSION:

We used early intervention for soft and bone tissues in facial firearm injuries.

Early intervention resulted in restoration of occlusion and continuity of the jaw and early return of function.

We recommend this approach when feasible.

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TABLES:

Table (1)

Pvalue	T	SE	SD	N	Mean	
**0.001	4.163	.137	.514	14	0.57	ocular vertical dystopia
		0	0	14	0	ocular vertical dystopia 3 months after surgery
0.163	1.475	.114	.426	14	0.21	Enophthalmos
		.071	.267	14	0.07	Enophthalmos 6 months After surgery
**0.003	3.606	0.133	0.497	14	0.64	Eye Movement
		0	0	14	0	Eye Movement 3 months After surgery
**0.003	3.606	0.133	0.497	14	0.64	Diplopia
		0	0	14	0	Diplopia 3 months After surgery

Table(2) :mandibular

Pvalue	T	SE	SD	N	Mean	
**0.000	19	.167	.224	20	0.95	Union
		0	0	20	0	Union 3 months After surgery
**0.000	4.485	.105	.470	20	0.70	Trismus
		.069	.306	20	0.10	Trismus 3 months After surgery
**0.000	7.550	.099	.444	20	0.75	Malocclusion
		0	0	20	0	Malocclusion 3 months After surgery

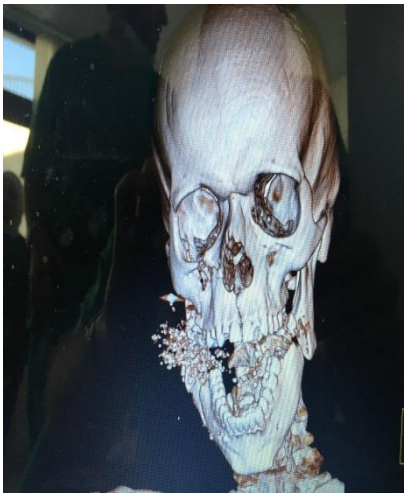
FIGURES

Case1:

Figure(1):pre treatment

Figure(2): after treatment

Case2:



Figure(3):pretreatment

Figure(4):after treatment