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Review Article

An Overview of the Diagnosis and Management of Common Maxillofacial Injuries in the Emergency Setting

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Abstract

The maxillofacial region occupies a prominent position on the body, where it is vulnerable to injury. The injuries are associated with high morbidity including functional and cosmetic disfigurement. The close association of concomitant body injuries in the maxillofacial fracture is well documented due to the region's proximity to vital organs including the brain, spinal cord, and eyes. For that, we provide an overview of the management of common maxillofacial injuries in the emergency setting. We performed an extensive literature search of the Medline, Cochrane, and EMBASE databases on 25 October 2019 using the medical subject headings (MeSH) terms "Maxillofacial Injuries"[Mesh] AND " Emergency Service, Hospital" [Mesh]. Papers discussing diagnosis and management of common maxillofacial injuries in the emergency setting were screened for relevant information. There were no limits on date, language, age of participants or publication type. Management of maxillofacial injury can be categorized broadly into two groups; emergency treatment and definitive treatment. Great attention should be paid to airway patency since its obstruction is the main cause of death among patients with severe maxillofacial injuries. The next step would be controlling any present hemorrhage, large-bore intravenous lines establishment and a crystalloid solution or blood may be given for resuscitation. Finally, evaluation and palpation of the superior and inferior orbital rims, nose, maxilla, zygomatic arch, mandible, and both alveolar ridges should be done. Further examination, investigation or management are mainly based on the initial assessment and the patient's stabilization.

Keywords: *Maxillofacial; Fractures; Management; Emergency*

Introduction

The maxillofacial region occupies a prominent position on the body, where it is vulnerable to injury [1]. The injuries are associated with high morbidity including functional and cosmetic disfigurement [2]. Road-traffic related facial injuries are mostly soft tissue injuries (STIs) in isolation or in combination with bone injuries, the middle third of the face being the most vulnerable site [3]. The injuries can thus be classified into facial bone fractures, and dentoalveolar injuries [4].

The close association of concomitant body injuries in the maxillofacial fracture is well documented due to the region's proximity to vital organs including the brain, spinal cord, and eyes [5]. Injuries to the brain have been described as the most commonly associated concomitant body injuries with facial fractures [6]. Physiological functions such as airway control and feeding may be compromised [7]. In such injuries management of skeletal and STI of the face constitutes a significant portion of treatment offered by maxillofacial surgeons to trauma patients [8]. More than 50% of patients with maxillofacial injuries have other multiple injuries requiring coordinated management with other subspecialties [9]. There is a huge the financial cost to be considered as well as morbidity, loss of function and psychological effects to the patient [10].

Management of maxillofacial injuries is often aimed at the restoration of satisfactory facial aesthetics and function [11]. Several treatment modalities are available for the patients; for example, for those with mildly displaced fractures, a conservative approach of rest and supportive medications is advised [12]. Those patients who require surgical intervention are treated using the following options: wound debridement, mandibulo-maxillary fixation (MMF) using arch bars or eyelet wiring, open reduction and internal fixation (ORIF), which usually gives good aesthetics and function [13]. Patients from developing countries may unfortunately not afford the latter form of treatment [14]. In this study, we aim to provide an overview of the management of common maxillofacial injuries in the emergency setting.

Methods

We performed an extensive literature search of the Medline, Cochrane, and EMBASE databases on 25 October 2019 using the medical subject headings (MeSH) terms "Maxillofacial Injuries" [Mesh] AND "Emergency Service, Hospital" [Mesh]. Papers discussing diagnosis and management of common maxillofacial injuries in the emergency setting were screened for relevant information. There were no limits on date, language, age of participants or publication type.

Initial management of maxillofacial injuries

Management of maxillofacial injury can be categorized broadly into two groups; emergency treatment and definitive treatment [15]. The Advanced Trauma and Life Support (ATLS) protocol of management is followed strictly in the Accident and Emergency units [16]. During this process, the following important aspects of a patient's state are examined and urgent interventional measures instituted to save the patient from further deterioration [16].

Airway patency is paramount and can be assisted using a chin lift or jaw thrust maneuver [5,7]. Airway adjuncts may be required [5,7]. The clinician should have a high index of suspicion for a cervical spine injury in all patients with traumatic head and neck injuries and protection by a cervical collar is mandatory until the cervical spine injury has been ruled out [17]. Hemorrhage should be controlled as it can lead to hypovolemic shock. Large-bore intravenous lines may be established and a crystalloid solution may be given [18]. Resuscitation using colloids and blood transfusion may be instituted in moderate to severe hypovolemic shock [18]. The Glasgow Coma Scale guideline is used to assess and administer appropriate treatment [19]. Appropriate analgesics, antibiotics, and vaccines should be given [19].

Airway and breathing

Great attention should be paid to airway patency since its obstruction is the main cause of death among patients with severe maxillofacial injuries [20,21]. Accordingly, it is always recommended to check trachea and along with the symptoms of the obstruction including; high breath sound, snoring, voice hoarseness and any palpable fracture of the chest [20,21]. Removing debris and good suction is the first step to establish a patent airway. In addition, lifting the chin by chin lift or jaw thrust will relieve the obstruction of soft tissues [21,20]. In cases of bilateral mandibular fracture, pulling the central part of the mandible will help in clearing the airway [20,21].

In comatose patients, a towel clip will be helpful in preventing the tongue from falling backward [20,21]. If the maxilla has moved backward (as in severe facial fractures), it should be pulled forward to relieve the airway [20,21]. If all these procedures were done

without establishing the airway, a laryngoscope should be used to check the presence of foreign bodies (FB) or any debris [20,21]. If the FB cannot be removed, surgical removal should be done [20,21].

If no visible FB, an endotracheal tube (with cuff) has to be inserted to secure a patent airway [20,21]. A cricothyroidotomy is performed in case of failure of intubation or visualization of the vocal cords [20,21]. In this procedure, a cuffed tracheostomy tube (5 or 6 mm) will be inserted through the incision and in children aged below 12 years, a needle cricothyroidotomy is preferred to avoid damaging cricoid cartilage [20,21].

Circulation

If the major blood vessels of the neck and the face have not been injured, the possibility of hypovolemic shock is reduced; however, it may harden establishing the airway [22,23]. Head and neck soft tissue bleeding is ceased by applying direct pressure over the bleeding site then the wound should be examined carefully [21-23]. In adult patients, laceration of the scalp isn't dangerous but in children, if large, it may be a life-threatening condition [20,22,24]. Scalpel arterial bleeding can be controlled safely by clipping it off and approximating wound tissues by sutures [20,21].

Biting on a swap can stop the intraoral bleeding in most cases and in conscious patients, sitting up will help draining secretions and blood [21-23]. However, in tongue laceration, those methods may be insufficient so deep sutures must be done to stabilize the patient [22-24]. In the same context, reduction of a present mandibular fracture will help in bleeding control; nevertheless, the patient may still need a bridle wire to retain the reduction [20,22,24].

In order to control the bleeding from the nasopharynx and middle one-third of the face, a tube with both anterior and posterior balloons can be used as a tamponade as an epistat [20,22,24]. Additionally, a rubber mouth gauge is used in the mobile maxilla [21,24].

Initial examination of the face

Clinical examination of the face should begin with a detailed examination and documentation of the area for localized tenderness, numbness, bleeding, deformity, periorbital edema, ecchymosis, otorrhea, rhinorrhea and facial asymmetry [25]. Evaluation and palpation of the superior and inferior orbital rims, nose, maxilla, zygomatic arch, mandible, and both alveolar ridges should be done [25].

Maxillofacial fractures

Mandibular fractures

Classification of mandibular fractures

Mandibular fractures are a unique component of the maxillofacial trauma regarding the approach to history and treatment. There are many classifications according to the type, cause anatomic site, condition, and inter-fragmental situation or the presence of dentate/edentate segments [15]. The most accepted classification is according to the anatomic location which includes; angle, alveolar process, body, condyle, coronoid, ramus and Symphysis/parasymphysis [15]. Another popular method is the classification of mandibular fractures into traumatic and pathological fractures (infections, tumours and cysts) [26].

Management

The main aim of fracture management is retaining of the mechanical strength at the fracture site to the original heathy state with restoring the normal function of masticatory muscles. Reduction is the first stage of treatment with returning the fractured parts into their anatomic position [26]. Fixation of these parts at their anatomic site is the second step in management process [26]. The fixation can be done manually, with or without local anesthesia, if the fracture is still in its first eight to ten days [26]. Moreover, any mobile dentoalveolar structures should be fixed using wires or any similar ways [26].

Reduction of mandibular fractures can be done by either closed or open methods [26]. In closed reduction method, the restoration of the fracture done without visualization with the main aim of correcting the maxilla-mandibular relation [26,27]. Accordingly, this is called intermaxillary fixation (IMF) or maxillomandibular fixation (MMF) [26,27]. On failure of closed reduction or whenever it is not possible, open reduction (with surgical approach) is the method of choice [26]. Examples of different fixation cases are presented in figures 1 to 5 [26].

Figure 1: *Parasymphysis fractures accompanying ramus fractures, rarely require reduction [26].*

Figure 2: *Angulus fracture [26].*

Figure 3: *Open reduction with monocortical single plate at the superior border of angulus as Champy's method [26].*

Figure 4: *Open reduction with monocortical with double plate, one at the superior border and the other at compression zone, as Champy's principle [26].*

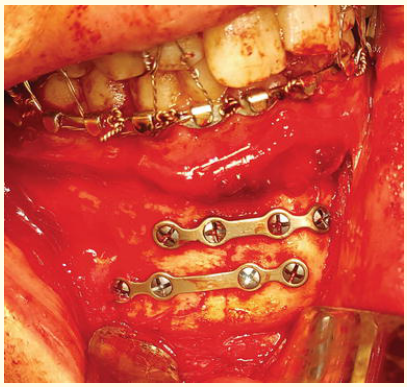

Figure 5: *Open reduction with mini plates [26].*

Le fort fractures

Signs and symptoms

Le forte fracture has three types according to the injury and to diagnose le fort fracture maxilla mobility should be evaluated (Figure 6) [28,29]. The maxillary arch should be supported by the thumb and pointing finger of one hand, while the other hand checks its mobility at the anterior nasal aperture, frontonasal suture as well as zygomaticofrontal suture [28,30].

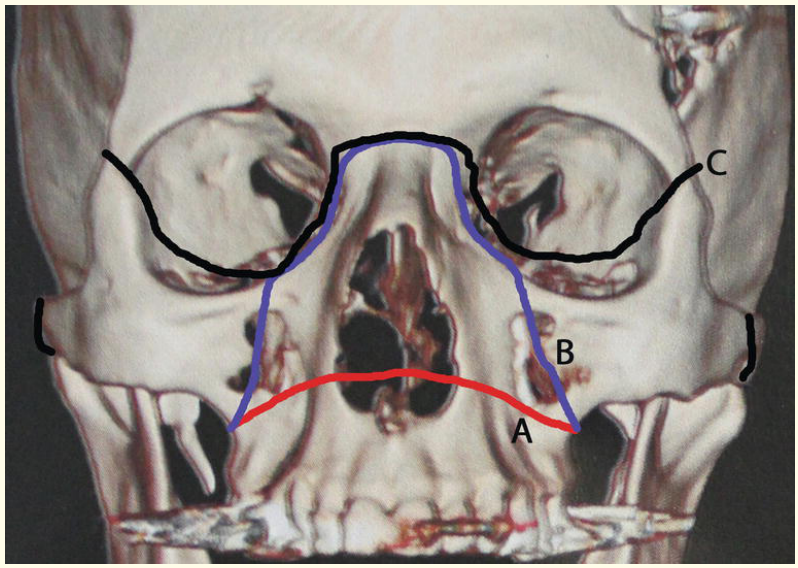

Figure 6: *Le Fort I (A), II (B), III (C) fracture patterns on a three-dimensional model [28].*

As a result of the dragging force of both lateral and medial Pterygoids, the fracture will be moved backward and inferiorly and cause an anterior open bite deformity [28]. Therefore, one of the important signs in diagnosis is malocclusion [28].

In the same context, bleeding nose, raccoon eye, and hypoesthesia of the infraorbital nerve are present with some types of le fort fracture [28]. Additionally, cerebrospinal fluid leakage is possible to occur with type II and III fractures [28,29].

Management

There are two procedures to treat Le Fort fractures; closed and open techniques, choosing one of them depends on the mobility and severity of displacement of the maxilla [28,31]. Minor malocclusion, minor displacement and decreased the mobility of the fractured part are suggestive to perform closed technique [28]. The closed procedure can be done by skeletal suspension or maxillomandibular fixation (MMF) [28]. In cases of severe malocclusion, open reduction and internal fixation (ORIF) are indicated [28,31].

Palatal fractures

Signs and symptoms

Palatal fractures are classified anatomically into six patterns (Figure 7) [28,32] and for diagnosis; the mobility of alveolar segments of the whole maxillary arch should be checked [28]. As a result of the displacement of fractured segments; malocclusion happens and forms an important sign in the clinical diagnosis [28,32]. A line fracture should be considered in the presence of palatal ecchymosis [28].

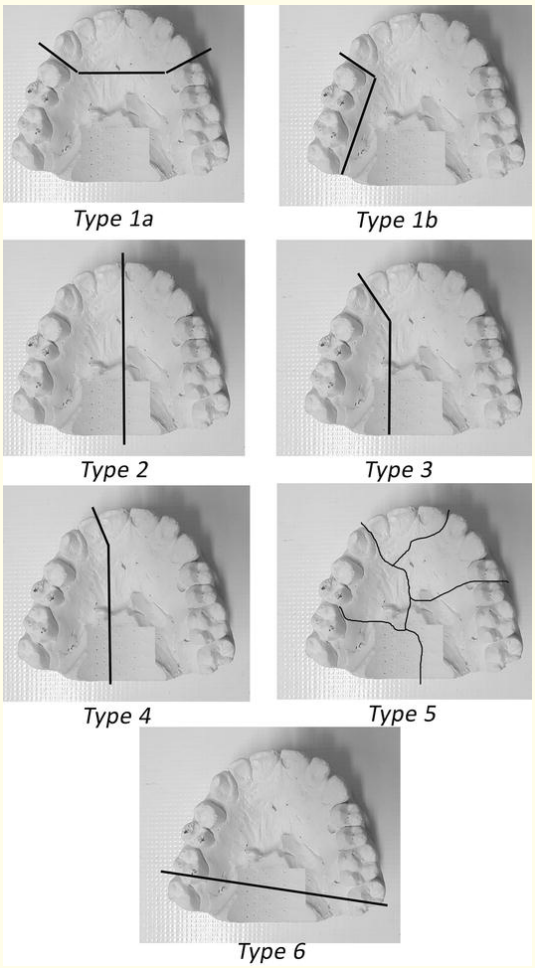

Figure 7: *Classification of palatal fractures [28].*

Management

If there is no malocclusion or displacement, surgeons will decide to observe the patient and not to use any intervention [28]. In minimal displacement, MMF is the treatment of choice, if no contraindications were present [28]. Moreover, palatal splints and gunning may be used in a closed technique, while ORFI is highly indicated to treat highly mobile and displaced types to prevent segments diverge [28].

Naso-orbital-ethmoid (NOE) fractures

Signs and symptoms

NOE fractures have three types (I, II and III) and epistaxis is the common sign in all of them (Figure 8) [28,33]. Widening of the nasal bridge and splayed nasal complex are common in trauma patients [28,34]. Rounding of medial canthus is a sign of traumatic telecanthus (an intercanthal distance of > 40mm) and detachment of medial canthal tendon [28,34-36]. To detect the instability of the NOE fracture, a bimanual test will be very useful [28,34-36].

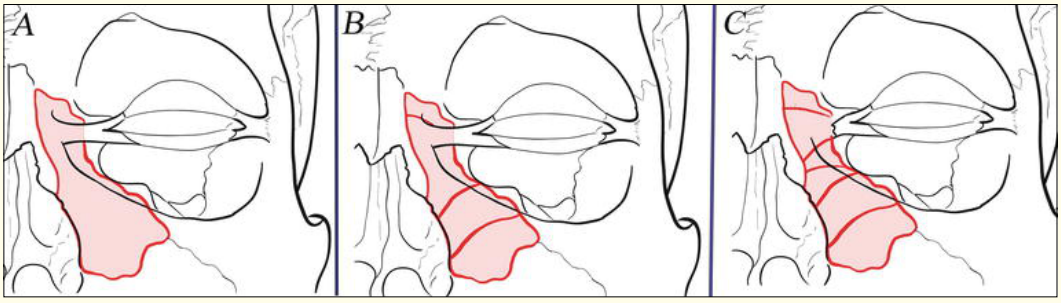

Figure 8: *Naso-orbital-ethmoid fracture types. A, type I Naso-orbital-ethmoid fracture. B, type II naso-orbital-ethmoid fracture. C, type III naso-orbital-ethmoid fracture [28].*

Management

In type I, the only treatment is stabilizing of the fracture, while stabilizing the central segment is the intervention of choice in type II [28,35]. Additionally, reconstruction of medial orbital wall and transnasal wiring is done in type III [28,37].

Orbital fractures

Signs and symptoms

Orbital wall fractures have five patterns and diplopia is the common sign in them all [28,38,39]. When suspecting orbital wall fractures, extraocular muscle entrapment has to be assessed and forced duction test is considered to differentiate between entrapment and neurological disturbance of the muscle [28]. However, negative false results may be encountered as a result of edema [28].

Moreover, periorbital ecchymosis and subconjunctival hemorrhage are indications for orbital fracture [40]. Hypoesthesia of the infraorbital nerve is an important symptom indicating an orbital fracture; especially in the case of infraorbital rim involvement [41]. Enophthalmus may also occur in cases of increased orbital volume or loss of its content, especially fat components, which is an indication to perform orbital reconstruction [28,42].

Management

Observation is the treatment of choice in non- or minimally displaced orbital fractures without any eye problems [28]. Orbital fracture repair is debatable issue to maxillofacial and oculoplastic surgeons [28,42]. However, positive-forced duction and enophthalmos are important indications of orbital re-construction/repair [42].

In addition, fracture size, timing, and availability of biomaterials are determining factors in the reconstruction process. Generally, any fracture that affects more than 50% or 2 cm of the orbit should be repaired. Noteworthy, it should be always kept in mind that there are high heterogeneity and insufficient information in this field [28,43].

Dentoalveolar injuries

History

Dentoalveolar injuries may be present alone or with other injuries [44,45]. The tooth may be fractured, loosen or forced out of position or even avulsion may happen (most likely in central incisors) [44,45]. A detailed history of the mechanism of injury, duration of avulsion and tetanus prophylaxis is important [44,45]. Additionally, attaining the relevant medical history to determine the need for bacterial endocarditis prophylaxis is a significant matter [44,45].

Clinical examination

The examination should be started with extra-oral soft tissues to detect any lacerations or bruising and to make sure that no Maxillofacial fractures are present [44-46]. Then, lips, gingiva, and mucosa should be examined and checked for buried teeth in the mucosa [45,47].

Counting all teeth should be performed and in case of missing any teeth; a chest radiograph is mandatory [44,45]. Both conscious and unconscious patients can inhale a tooth and it will appear in the right main bronchus [44,45]. Finally, assessing the mobility of all teeth, their alveolus and their occlusion should be performed [44,45].

Radiological assessment

Panoramic and posteroanterior mandible radiographs are used for diagnosis [47,46]. Moreover, a cone-beam computed tomography (CBCT) should be done if possible [47,46]. As mentioned before, chest radiography should be done to detect any inhaled teeth [44,45].

Management

Initial treatment

Displaced segments in alveolar bone fractures should be manually replaced back into proper alignment and this may require local anesthesia [44,45]. Impressions are taken and splint should be applied [44,45].

Avulsed teeth

Milk teeth should not be reimplanted as it may cause serious damage to the developing permanent ones so reimplantation is not needed in children below 6 years [44,45,48].

Permanent teeth reimplantation should be performed immediately to avoid periodontal ligament cell necrosis [45,48]. Attaching the roots with the periodontal ligament is the best way to avoid the damage to the ligament [44,45].

To reimplant the avulsed teeth, the crown should be held and washed very gently with saline [45,48]. The avulsed tooth should not be sterilized and the clot formed in the socket should not be removed before the reimplantation [45,48].

After placing the tooth in the socket, the buccal and alveolar plates should be compressed and in case the teeth have not been placed easily, the patient should bite on gauze to force it on the place [45,49]. Oral antibiotics, analgesics, and chlorohexidine should be started as well as tetanus prophylaxis if the patient is not immunized [44,45].

The avulsed tooth should not be dry at any circumstances to preserve the periodontal ligament [47]. The reimplantation should be performed within minutes and if not possible; storage media is used to maintain its viability [45].

Storage media

The tooth can be placed in saliva; specifically in the buccal sulcus of the patient's mouth [45,47]. In children, there is a risk of aspiration of the placed toot using this method. The next storage media can be used is the ice-cooled milk media, while saline is the last option to use [44,45]. Lacerations should be cleaned and washed and lips lacerations may be sutured under local anesthetic after checking that there is no buried FB [44,45]. If the frenulum has been cut, it would heal without any consequences [44,45].

Conclusion

Management of maxillofacial injury can be categorized broadly into two groups; emergency treatment and definitive treatment. Great attention should be paid to airway patency since its obstruction is the main cause of death among patients with severe maxillofacial

injuries. The next step would be controlling any present hemorrhage, large-bore intravenous lines establishment and a crystalloid solution or blood may be given for resuscitation. Finally, evaluation and palpation of the superior and inferior orbital rims, nose, maxilla, zygomatic arch, mandible, and both alveolar ridges should be done. Further examination, investigation or management are mainly based on the initial assessment and the patient's stabilization.

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Conflicts of Interest

No conflicts related to this work.

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