



OVERVIEW OF MAXILLOFACIAL TRAUMA, DEFINITIONS, EPIDEMIOLOGY, MANAGEMENT, AIRWAY, CIRCULATION, BLEEDING CONTROL, SYSTEMIC ANTIBIOTIC PROPHYLAXIS AND MAXILLOFACIAL SURGERY

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SUMMARY

Introduction: Injuries to facial bones, orbits, and adjacent soft tissue structures are common. They are usually caused by motor vehicle accidents. Scientific evidence has shown that maxillofacial trauma is related to severe injuries, so a meticulous evaluation of the injuries should be performed because they can have a devastating sequelae. The treatment of these situations is complex and challenging, since in addition to compromising the esthetic aspect, it also compromises the function of multiple structures and also causes psychological damage.

Objective: to detail the current information related to maxillofacial trauma, definitions, epidemiology, management, airway, circulation, hemorrhage control, prophylaxis with systemic antibiotics and maxillofacial surgery.

Methodology: a total of 52 articles were analyzed in this review, including review and original articles, as well as clinical cases, of which 39 bibliographies were used because the other articles were not relevant for this study. The sources of information were PubMed, Google Scholar and Cochrane; the terms used to search for information in Spanish, Portuguese and English were: facial trauma, maxillofacial trauma, facial fractures, airway management in trauma, antibiotic prophylaxis, facial surgery.

Results: oral-maxillofacial trauma represents approximately 7.4 to 8.7% of medical emergencies. Male-female ratio of 4:1, the most frequent causes being traffic accidents, aggressions, falls, sports accidents and accidents at work. The anatomical sites usually affected by facial fractures are the



mandible with 44.2 %, zygomatic complex with 32.5 %, nasal bones with 16.2 %. There is a 10 to 15% probability of presenting a cervical spine injury in unconscious individuals with severe maxillofacial trauma. The frequency of infection following maxillofacial fractures varies according to various findings, with results ranging from 0 to 62%.

Conclusions: Trauma management has improved over time, decreasing mortality in the golden hour, however, there are still challenges in trauma management such as those presented in maxillofacial alterations in a polytraumatized individual. The importance of the totality of maxillofacial injuries is found in that they pose an immediate threat to life as a result of their proximity to both the airway and the brain. The approach to airway management in maxillofacial trauma is of utmost importance, so a patent or definitive airway must be maintained by means of orotracheal intubation, nasotracheal intubation and surgical airway. It is essential to have an adequate protocol for airway management in maxillofacial trauma, as well as to maintain control of circulation and possible bleeding. Currently the use of systemic antibiotic prophylaxis is an accepted procedure to reduce the risk of infection or clinical prevention strategy. Surgery in individuals with maxillofacial trauma, particularly those with full face fractures or severe complex comminuted fractures remains a challenge. Usually, maxillofacial trauma coexists with other injuries, which could imply not being able to perform early surgical correction, increasing the risk of leading to situations of infection, nonunion and malocclusion.

KEY WORDS: trauma, maxillofacial, airway, fractures, management, surgery.

INTRODUCTION

Maxillofacial trauma (MFT) is considered one of the major health problems worldwide because of the sensitivity, the severity of the region involved, the psychological consequences and the impairment of quality of life in affected individuals(1).

Injuries to facial bones, orbits and adjacent soft tissue structures are common. Despite safety measures in modern automobiles, the main cause of facial injuries is usually motor vehicle accidents. In severe trauma to the face it is essential to perform a radiological study in order to evaluate the existence of a fracture or lesion in the structures of the region(2).

Scientific evidence has shown that facial trauma is related to other serious injuries and therefore a meticulous evaluation of the injuries should be performed since they can have a devastating sequelae. According to some bibliographies, cervical spine injury (CSI) is frequently associated with maxillofacial trauma, being mainly the result of direct or indirect transmission forces(1).

The treatment of these situations is complex and challenging, since in addition to compromising the aesthetic aspect, it also compromises the function of multiple structures and also causes psychological damage(3-8).

Stabilization of the affected individual with the ACLS protocol should be the first action in trauma management; a complete head and neck examination should always be performed followed by a neurological assessment to rule out associated injuries and prevent future complications(9).

METHODOLOGY

A total of 52 articles were analyzed in this review, including review and original articles, as well as cases and clinical trials, of which 39 bibliographies were used because the information collected was not important enough to be included in this study. The sources of information were Cochrane, PubMed and Google Scholar; the terms used to search for information in Spanish, Portuguese and English were: facial trauma, maxillofacial trauma, facial fractures, airway management in trauma, antibiotic prophylaxis, facial surgery.

The choice of bibliography exposes elements related to maxillofacial trauma such as definitions, epidemiology, management, airway, circulation, hemorrhage control, systemic antibiotic prophylaxis and maxillofacial surgery.

DEVELOPMENT

The concept of trauma is defined as an unexpected event beyond the control of the affected individual, which follows a traumatic injury. There are different variants of trauma, the most common being those originated by physical injuries, forming one of the greatest health problems worldwide. Oral maxillofacial injuries are any injury affecting the oral cavity, tongue, mucous membranes, teeth, jaw, maxilla, zygomatic bones, temporomandibular joint, vessels, nerves and the soft tissues that make up the face. In the dental area, lesions can be classified as follows:

Injured Tooth Itself

- Uncomplicated coronary fracture.
- Complicated coronary fracture.
- Incomplete enamel fracture.
- Radicular fracture.
- Coronary-radicular fracture.

Bone Fracture

- Fracture of the alveolar process.

Injured Periodontal Tissue

- Intrusion.
- Avulsion.
- Concussion.
- Subluxation.
- Extrusion.
- Dislocation.
- Lateral.

This classification is according to the system designed by Andreasen(3,10,11).

Epidemiology

Within the epidemiology of oral-maxillofacial trauma, it represents approximately 7.4 to 8.7% of medical emergencies. Its



different origins vary from region to region being different due to culture, socioeconomic level and environmental factors. They are generally caused by traffic accidents, falls and violence(3,12).

Some bibliographies report a male to female ratio of 4:1, with the causes in order frequency being traffic accidents, assaults, falls, sports accidents and accidents at work. The anatomical sites usually affected by facial fractures are:

- Mandible with 44.2 %.
- Zygomatic complex with 32.5 %.
- Nasal bones with 16.2 % (13).

Management

Trauma management has improved over time, decreasing mortality in the golden hour, however, there are still challenges in the management of trauma such as those presented in maxillofacial alterations in a polytraumatized individual. A major alteration in the maxillofacial surface complicates early treatment of a traumatized individual because of its contiguity to the airway, brain and cervical spine. Procedures frequently used in the management of breathing and airway circulation are continually changed, modified or supplemented by other protocols at the site of maxillofacial injuries(14).

The maxillofacial area is richly vascularized, traumas in this region are complicated by the existence of the upper airway, the proximity of the cranial and cervical structures, which can be compromised, having in some cases fatal effects. The series of steps for the management of the airway, breathing and circulation is well established, in case of not presenting maxillofacial injuries, on the contrary in case of injuries in this region, the steps to follow have been a subject of discussion(14).

In the same way as in the rest of traumatism, the basic fundamentals of advanced life support have to be used, regarding the initial assessment of the affected individual, which means to perform the primary and secondary survey. After the secondary examination, the definitive care begins.

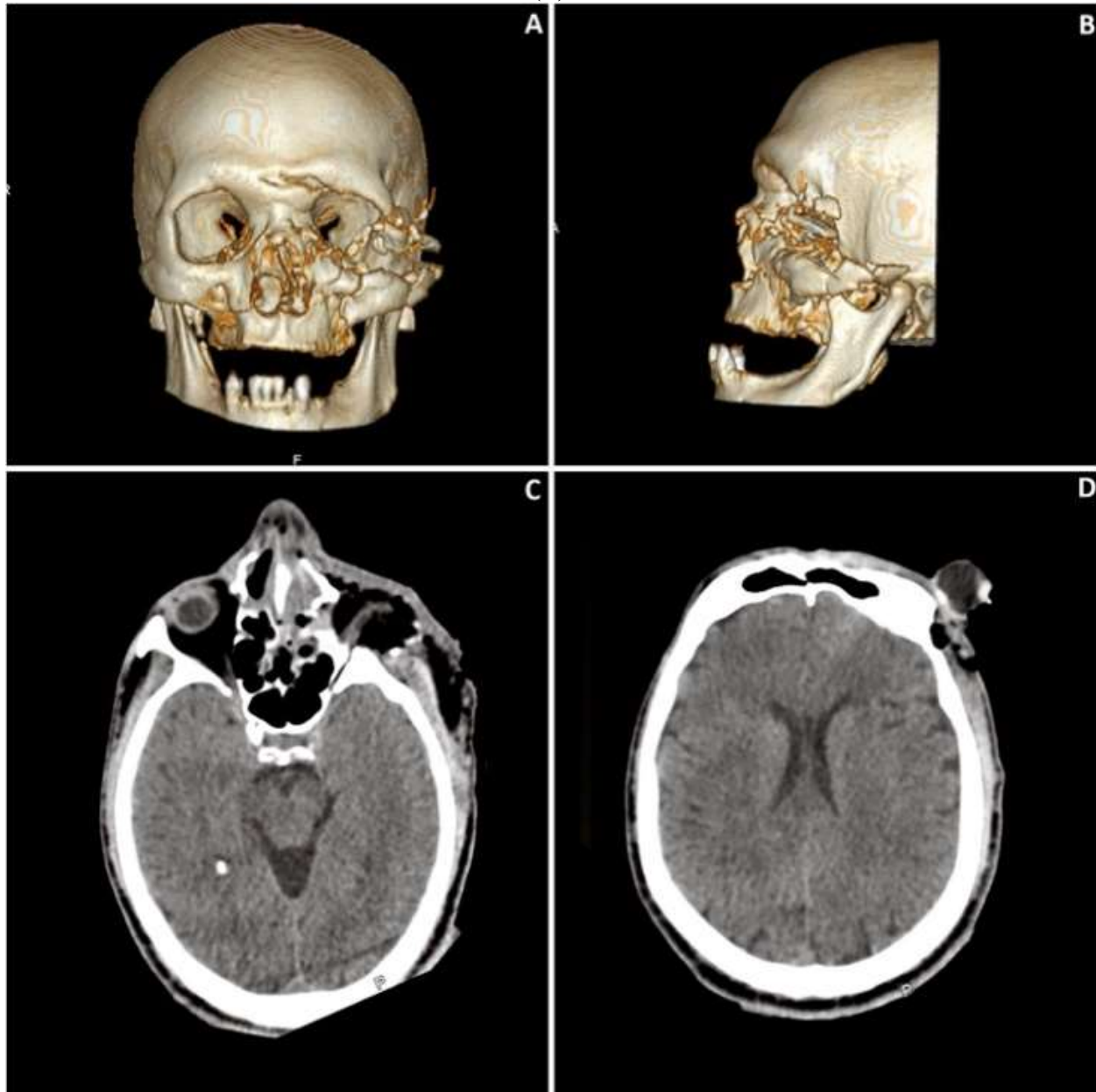
Some bibliographies present that approximately half of the maxillofacial injuries are secondary to an assault and that half of these present high levels of alcohol. However, alcohol should not be assumed to be the direct cause of drowsiness, it should be well identified, because confusion may be caused by head injury and/or hypoxia. There is a 10-15% chance of cervical spine injury in unconscious individuals with severe maxillofacial trauma, so appropriate measures should be taken(15).

The management of the individual with maxillofacial trauma has complex challenges due to the compromise of the airway; therefore, the airway must be provided with sufficient and effective respiration and/or ventilation, taking into account some important aspects such as:

- The probable trauma to the cervical spine and spine.
- The nature of the trauma.
- The impact on the airway.
- The likely complications of mask ventilation or endotracheal intubation.
- Possible regurgitation and aspiration of gastric contents.
- Significant bleeding that does not allow proper observation of the airway anatomy.
- Circulatory impairment.
- The type of maxillofacial operation to be performed; with empty oral cavity to perform the procedure and closed with maxillomandibular fixation (MMF) at the end of the surgery(16).



Figure 1. Pre-operative CT scan. Frontal (A) and lateral view (B) of a 3D CT reconstruction showing a panfacial fracture with comminution of the left orbito-zygomatic complex. Axial cuts showing a sectioned optic nerve (C) and the displaced left globe (D).



Source: de Moraes ATL, Quaresma MCA, Silva TF, Sousa NWA, Menezes SAF, Ribeiro ALR, et al. Traumatic enucleation of the left globe after a road traffic accident – A case report of an uncommon occurrence in maxillofacial trauma (17).

Airway

Usually, the first and most notable maxillofacial injuries are complicated by airway disruption. Due to their location in the "deformable zone" of the face, small injuries can sometimes cause significant damage to the airway. This circumstance may worsen with altered state of consciousness, alcohol and/or drug intoxication, in addition to altered laryngeal and pharyngeal reflexes, which increases the risk of aspiration for the affected individual. In addition to this, other problems such as foreign

bodies, avulsed tissues, broken teeth, dentures, multiple mandibular fractures and massive edema of the glottis can generate imminent risk of death due to airway compromise. Head injuries, in addition to alcohol, drugs, ingested and accumulated blood can cause nausea and vomiting. Vomiting is induced by increased intracranial pressure which increases bleeding, salivation and may obstruct the airway. Evidence indicates that the relationship between vomiting and the risk of aspiration is elevated primarily in supine individuals. In individuals with



multiple facial fractures, posterior displacement of the maxilla or mandible may reduce airway patency(14,18).

The look, listen and feel tactic helps to recognize airway obstruction and anticipated airway complications. The approach to airway management, especially in individuals who have sustained trauma with loss of consciousness, should be to perform proper spinal protection. In high impact trauma that may involve the jaw, swallowing is modified due to pain and unproductive modulation of the protective reflex, causing problems in keeping the airway clear; therefore it is crucial to protect the airway from blood and vomit in order not to present a situation of fluid aspiration, in addition to other complications in the lungs. Palpation of the trachea shows any apparent collapse or deviation, auscultation should be performed on the larynx trying to distinguish stridor; when observing a tracheal pull or hearing a laryngeal stridor we have to think of an imminent airway alteration. The "difficult intubation tray" should always be accessible, including tracheal tube introducer, supraglottic airway devices, tracheostomy equipment, combitubes, endotracheal tubes and craniotomy kit(14,19).

Individuals with maxillofacial trauma should receive optimal oxygenation with uninterrupted saturation monitoring. In addition, spinal collars should be placed very carefully so as not to cause involuntary posterior jaw movement. In maxillofacial trauma, be alert for delayed airway compromise due to tissue displacement, bleeding and swelling. The oropharyngeal Guedel can be used effectively, once the airway is clear, be aware that it can cause gagging, laryngospasm and displacement of the tongue posteriorly. When there is no protector, emergency endotracheal intubation should be performed.

Bag-mask ventilation is of choice in individuals with patent airway and absence of spontaneous breathing, in obese and bearded individuals the effectiveness of ventilation decreases. Complementary airway maneuvers, such as chin lift and mandibular traction, should be done with care(14,15,20).

The concept of the definitive airway is that maxillofacial trauma probably has greater relevance relative to trauma at other anatomic sites. The main indications are given in Figure 2.

Figure 2. Indications for Definitive Airway

| Indications of definitive airway in maxillofacial injury |
|--|
| Absent spontaneous breathing |
| Comatose patient (glasgow coma scale <9) |
| Airway injury or obstruction |
| Persistent oxygen saturation <90% |
| High-risk for aspiration |
| Systemic shock (systolic blood pressure <80) |
| "Cannot ventilate cannot intubate" situations |

Source: Jose A, Nagori SA, Agarwal B, Bhutia O, Roychoudhury A. Management of maxillofacial trauma in emergency: An update of challenges and controversies(14).

The usual direct definitive airway choices are orotracheal intubation, nasotracheal intubation and surgical airway. Orotracheal intubation with the support of a laryngoscope is the most feasible and safe procedure of choice, however, if the spine is not clear, it is cautious to perform manual in-line axial stabilization at orotracheal intubation. Orotracheal intubation is comparatively safe in an unclear cervical spine, is simpler to perform, quicker and results in less cervical spine mobilization in skilled hands. When there are important avulsive facial lesions, in case of laryngeal or tracheal collapse, placing the orotracheal tube is complex, so surgical airway is the most effective alternative.

Nasotracheal intubation is another good alternative in individuals without communicating lesions at the base of the skull or the medial part of the face. It is generally used in case of management of airway obstruction due to injury to the lower portion of the face and also in individuals with inadequate mouth opening. It can be performed either blind or fiber optically guided. The blind

technique in good hands is fast and effective; the fiber optic technique has limitations such as secretions or blood in the airway and requires more time.

Non-definitive techniques such as laryngeal mask airway (MLA) and combitube are options for failed or complex intubation(14,21-23).

When non-invasive procedures do not help to maintain a good airway, a surgical airway should be considered as the only option, it can be performed in 2 ways:

- Cricothyroidotomy: more convenient in case of emergency and can be done with needle or surgical scalpel. The use of needle cricothyroidotomy is debatable due to failure rates and insufficient oxygenation, so surgical cricothyroidotomy is of choice in emergencies.
- Tracheostomy: frequently used as an elective procedure, once the affected individual is stabilized by cricothyrotomy. Routine use is not indicated in the ED(14,24,25).



Protocol For Airway Management in Maxillofacial Trauma

1. Anticipate and recognize airway obstruction.
2. Clear the airway, position the affected individual.
3. Perform chin lift and jaw thrust maneuver.
4. Confirm that the nasal and oral openings are clear, then use an artificial airway.
5. Perform bag-valve-mask ventilation. Preferably "two-person technique".
6. Oro-endotracheal intubation.
7. If orotracheal intubation cannot be achieved or if the patient is in a "no ventilation, no intubation situation", perform a surgical airway(14).

Circulation and hemorrhage control

In the absence of evidence of injury to the major vessels of the neck or the middle third of facial fractures, blood suppression is usually insufficient to cause problems such as hypovolemic shock, but may cause problems in establishing and maintaining an airway.

Soft tissue hemorrhage in the head and neck can be controlled by direct pressure at the site of bleeding. After the bleeding stops, it is not advisable to probe the wound. Scalp lacerations may bleed profusely, but rarely cause hypovolemic shock, although in children major lacerations can be life-threatening. In arterial sources of bleeding in the scalp, hemostasis can be achieved by performing tissue synthesis. Intraoral bleeding can be controlled by having the affected individual bite down on a swab. Bleeding from a tongue laceration becomes profuse so that sometimes direct pressure may not be able to keep the bleeding under control so deep sutures are indicated. Bleeding from the ends of the fractured jaw can be slowed by manual reduction of the fracture; often a bridle wire is needed to maintain this reduction(15).

Massive hemorrhage is likely to occur in maxillofacial trauma; life-threatening hemorrhage may occur in 1.4 to 11%. One tenth of complicated facial fractures bleed profusely, with the major blood vessels involved being the following:

- Maxillary artery.
- Ethmoidal artery.
- Ophthalmic.
- The vidian branch of the internal carotid artery.

Generally, the hemorrhage is easily controlled, however there are cases of severe epistaxis between 2 to 4%. Bleeding from skull base fracture should be identified and distinguished from oral bleeding by close inspection of the pharynx(14,26-29).

Hemorrhage control can be achieved by pressure tamponade, manual reduction of fractures, balloon tamponade and in some more complex situations by angiography followed by transarterial embolization(27,30-32).

Prophylaxis with Systemic Antibiotics in Maxillofacial Trauma

Infection following maxillofacial trauma remains a notable complication, leading to significant morbidity, as well as increased health values. The frequency of infection following

maxillofacial fractures varies according to various results, with results ranging from 0 to 62%. Currently the use of systemic antibiotic prophylaxis is an accepted procedure to reduce the risk of infection or clinical prevention strategy, however the type of antibiotic used and its duration is still controversial. Some clinical trials indicate that there is no benefit in maintaining antibiotic prophylaxis for more than 24 hours in the case of surgically treated fractures. Other studies indicate that at present there is no evidence for the use of antibiotic therapy in conservatively treated fractures. These results should be interpreted carefully due to their limitations. Antimicrobial resistance (AMR) is on the rise, so the importance of limiting antibiotic use should be carefully considered(33-37).

Maxillofacial Surgery

Maxillofacial surgery is usually performed after stabilization of the affected individual, obtaining radiographic studies and evaluating the totality of alterations. Sometimes surgery is performed in conjunction with the intervention of other injured organs. Surgery in individuals with maxillofacial trauma, particularly those with full face fractures or severe complex comminuted fractures remains a challenge. The focus of the fracture must be reduced, damage controlled or if possible soft tissue repaired and occlusion restored. In order to improve conditions and maintain proper pre-traumatic function and function, occlusion must be maintained and controlled at every stage of surgery. In the final stage of surgery, the mouth will be kept closed by MMF, thus not allowing the use of an oral endotracheal tube. In trauma where MMF is not necessary, the use of an oral tube can be considered. The choice of an airway device to be used in the surgical procedure should be planned by the surgeon and take into account the possible alteration of the surgical plan and the probable post-surgical complications.

The individual with a difficult airway presents a high risk of postoperative complications. After surgery, the mucous membranes are edematous, the soft tissues are swollen and the airway may become compressed. The adequacy of neck expansion is relatively minor, sometimes so much so that a small amount of hemorrhage may lead to airway compromise. Extubation should be deferred until edema is no longer apparent. At the time of extubation, the individual should be monitored by trained personnel and the extubating health care provider should be prepared for eventualities leading to reintubation. Nausea and vomiting should be prevented because of the possible risk of gastric aspiration. According to the planned surgery, a different decision has to be taken, i.e., the most appropriate for each case, as in the case of conscious, spontaneously breathing patients with non-extensive maxillofacial trauma. In some individuals, naso-endotracheal intubation can be used in the middle of surgery for airway control; however, it should be kept in mind that naso-endotracheal intubation is relatively contraindicated in those who present fractures of the middle third of the face or fractures at the base of the skull(16,38).



Maxillofacial trauma coexists with some other related injuries that may eventually preclude immediate surgical restoration, due to the increased risk of infection, nonunion and malocclusion. Frequently affected individuals return for improvement of their secondary problems, such as malocclusion; among the most frequent problems are asymmetrical teeth and occlusal dysfunction. Secondary malocclusion can occur in the anterior or posterior part of the upper or lower jaw. Prosthodontic treatment, orthodontic treatment, surgical fracture reduction, surgical soft tissue repair and orthognathic surgery are some of the various approaches currently usable to improve malocclusion resulting from the traumatic event. Radiological imaging studies, photographic studies and dental models have to be taken into account prior to the intervention. Typically, three-dimensional stereolithographic models are used to manage some of these injuries by designing an optimal treatment strategy and appropriate surgery. Prosthetic treatment and implant rehabilitation have the potential to restore secondary malocclusion following maxillofacial injury(39).

CONCLUSIONS

Trauma management has improved over time, decreasing mortality in the golden hour, however, there are still challenges in trauma management such as those presented in maxillofacial alterations in a polytraumatized individual. The importance of the totality of maxillofacial injuries is found in that they pose an immediate threat to life as a result of their proximity to both the airway and the brain. The approach to airway management in maxillofacial trauma is of utmost importance, so a patent or definitive airway must be maintained by means of orotracheal intubation, nasotracheal intubation and surgical airway. It is essential to have an adequate protocol for airway management in maxillofacial trauma, as well as to maintain control of circulation and possible bleeding. Currently the use of systemic antibiotic prophylaxis is an accepted procedure to reduce the risk of infection or clinical prevention strategy. Surgery in individuals with maxillofacial trauma, particularly those with full face fractures or severe complex comminuted fractures remains a challenge. Usually, maxillofacial trauma coexists with other injuries, which could mean that early surgical correction may not be possible, increasing the risk of leading to infection, nonunion and malocclusion.

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