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Review Article

Risk in the Polytraumatized Patient

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Abstract

Trauma is defined as an individual's experience of an event or an enduring condition that is a real or perceived threat to his or her life and personal integrity, or that of a caregiver or family member. The nature of the experience is so overwhelming for the person that he or she is unable to successfully integrate previous experiences or knowledge into his or her emotional response to the event or condition. A bibliographic review was carried out with the aim of describing and compiling the main maxillofacial injuries due to trauma as well as the risks and complications that these may present.

Keywords: Trauma; Facial Fractures; Facial Bruises; Facial Wounds

Introduction

Trauma is defined as an individual's experience of an event or an enduring condition that is a real or perceived threat to his or her life and personal integrity, or that of a caregiver or family member. The nature of the experience is so overwhelming for the person that he or she is unable to successfully integrate previous experiences or knowledge into his or her emotional response to the event or condition.

The impact of trauma is manifested in biological, psychological, and social sequelae. The precise nature of trauma in the craniofacial region is determined by the degree of force and the resistance to force offered by the bones. Injuries create a very obvious and noticeable alteration of the facial profile and soft tissues. Fractures with bone displacement are a frequent phenomenon and can cause functional and cosmetic problems. Maxillofacial injury occurs in approximately 5 to 33% of those who experience severe trauma [1,2].

The maxillofacial region involves soft and hard tissues that form the face. It extends from the frontal bone at the top to the mandible at the bottom. The face is the most exposed part of the body and particularly prone to trauma. Injuries to skeletal components, teeth, and soft tissues can occur in the facial region. Polytrauma is considered to be a set of injuries caused simultaneously by external violence, affecting 2 or more organs of one or more systems. This simultaneity results from the sum of the physiological alterations caused by each of the injuries and causes their interaction and reinforcement. This gives rise to a very complex clinical picture that compromises the vital functions of the traumatized patient. (Morales Navarro 2020). Patients with maxillofacial trauma require careful evaluation due to the anatomical proximity of the maxillofacial region to the head and neck. Facial injuries can range from soft tissue lacerations and non-displaced nasal fractures to severe complex fractures, ocular injuries, and possible brain injuries.

Objective

Describing and compiling the main maxillofacial injuries due to trauma as well as the risks and complications that these may present.

Reference search methods

Scientific information was collected through a search using the following descriptors in English: The Medical Subject Headings (MeSH): "maxillofacial trauma, risks for maxillofacial trauma" Analysis strategy.

The search was based solely on conditions, risks and complications for maxillofacial trauma

Developing

Trauma to the maxillofacial regions constitutes a public health challenge and providing an accurate epidemiology is nearly impossible due to the level of variability in the epidemiology. Over the past decades, the incidence has increased worldwide due to increasing urbanization and industrialization. The etiology of facial injuries varies between different countries, depending on the socioeconomic, cultural, and environmental factors specific to the area. Maxillofacial injuries can be particularly difficult to assess, as they can range from simple soft tissue lacerations to complex facial bone fractures. Failure to recognize and adequately treat concomitant injuries in a patient suffering from multiple trauma can have a negative impact on overall morbidity [3].

Although the Advanced Trauma Life Support (ATLS) guidelines provide a framework for the management of trauma patients, they do not provide a detailed reference for many subtle or complex facial injuries. The primary goal in managing maxillofacial trauma in the emergency department is to recognize potential complications and manage a difficult airway if the need arises. A thorough secondary examination, including assessment for possible fracture patterns of the nasal, orbital, maxillary, and mandibular bones, is also critical. The initial evaluation of a patient with maxillofacial injuries should also exclude any potential vision-threatening injuries. Severe hemorrhage from trauma to the maxillofacial region in isolation is rare and life-threatening. However, hypovolemia can result from injuries that occur in unison. Early examination of trauma patients includes assessment for cervical spine abnormalities, particularly in the patient with neurologic damage. Providing efficient and timely care can prevent any damage and/or after-effects, in addition to improving the prognosis of the affected person, achieving better aesthetic results [1,2,4].

Initial Evaluation and Treatment Maxillofacial surgeons must master the principles of facial fracture care. They will often be serving in an emergency ward, where a basic knowledge of traumatology is essential, and they can assess, evaluate, and carry out appropriate therapy. The initial evaluation of the patient with craniofacial trauma should be systematic, complete, and consistent to ensure that injuries are not overlooked. Life-threatening conditions are first identified using the principles of ATLS, followed by a focused head and neck examination. Imaging is used to guide surgical planning, as many craniofacial injuries ultimately benefit from repair to prevent permanent cosmetic or functional deformity. The intraoperative course is often multidisciplinary, with efficient consultation with different specialists. Control and monitoring of the airway, breathing, and circulation is essential. It is rare for facial injuries to be life-threatening; However, the practitioner should not be complacent and should always inquire into the mechanism and energy of impact with the injuring agent. Initially, each examination of a trauma patient should follow a systematic approach, typically using the ATLS protocol. Facial injuries in particular should cause the examiner to be alert for airway compromise, uncontrolled bleeding and aspiration, as well as concomitant neurologic injuries. Undiagnosed, these conditions can have disastrous outcomes.

A primary review is performed, which includes a quick and thorough assessment of the patient according to the ATLS protocol, i.e. ABCDE: A - airway management with control of the cervical spine. B - assessment of breathing and assurance of ventilation. C - circulation control with bleeding control. D - assessment of neurological status. E - exposure and control of the environment. Subsequently, the secondary review is performed. Where a brief and detailed description is obtained, emphasizing the time and form of the trauma, as well as the treatment(s) received. The injury should not be viewed as a separate entity; it is necessary to check if there is a history of an adjacent trauma. The physical examination is aimed at evidencing the following aspects: • The location and extent of the injuries. • The number of facial structures injured. • The presence of fracture or bone loss. • The loss of soft tissue. • Dentoalveolar injuries and occlusion. Not all conditions are detected from the start, so it is beneficial for the patient to follow up closely, carrying out various complementary tests depending on the signs and symptoms that appear, such as bleeding, swelling or other body injuries. A more selective test can be carried out as new information comes to light [3-5].

The examination in the specialty begins in a step-by-step manner where inspection and palpation are the fundamental pillars. A general view of the face must be achieved to detect any asymmetry, contusions, excoriation, inflammation or bleeding. The faster the examination is done, the easier the details of the trauma can be seen, since the asymmetry can be hidden due to facial edema. Palpation of the facial regions allows us to point out if there is any unevenness or instability of the underlying bone tissue. The authors recommend focusing from the upper to the lower third to be more organized and not leave any element unseen. The examiner, without diminishing their importance, should not divert their attention completely to the most obvious injuries, because they could overlook alterations that pose a greater risk for the proper development of the condition. When inspecting soft tissues, emphasis must be placed on detecting whether any important structure was injured. In the case of the genian region, patients are frequently seen after suffering an attack with a knife or sharp objects. (Figure 1) In these cases, the integrity of the parotid gland duct must be checked, as well as that of the buccal and zygomatic branches of the facial nerve.

Figure 1: Patient who suffered an attack with a sharp object that caused a deep wound in the genitalia region. Courtesy of Dr. Otto Alemán Miranda.

A thorough ophthalmological examination must then be performed. Because even if the damaging agent does not directly impact the orbit and its contents, indirectly, as is the case with malar fractures, they bring with them ophthalmological conditions.

Figure 2: Patient who suffered a car accident that caused a malar fracture. The eyelid hematoma that prevents him from opening his eye can be seen. Courtesy of Dr. Otto Alemán Miranda.

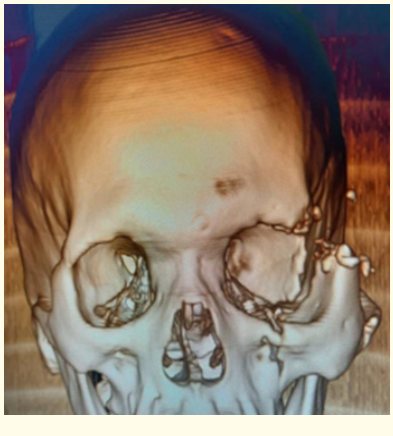

Figure 3: Computed tomography of a patient with a fracture of the malar bone. Courtesy of Dr. Carlos Juan Puig González.

It is important to consult with an ophthalmologist; all tests relevant to detecting any ocular alteration depend mainly on the patient's cooperation. Visual acuity, inspection of the anterior chamber, visual field tests, pupillary reflexes, light perception and extraocular movements can be evaluated quickly and efficiently. It is important to write down everything that is detected in the tests, since they can later be used as a guide if any complication arises. The naso-orbital region should not be overlooked, evaluating the stability of the canthal insertions, the nasal bones and the septum should be palpated and inspected for deformity, bony steps, crepitation, etc. It should be evaluated if there is any impairment of the motor and/or sensory function of the facial region. The oral cavity should be inspected for malocclusion (open bite), abnormal movements, hematomas on the floor of the mouth, fracture or loss of teeth, hemorrhage, dentoalveolar fracture, etc. Once everything related to the physical examination has been completed, and any complications have been detected and controlled, complementary tests are carried out, among which imaging tests are essential [4-6].

The gold standard is high-resolution computed tomography, which uses 1 mm slices with the ability to reconstruct the facial skeleton in three dimensions. This makes it easier for the professional to diagnose, classify and sometimes even give a prognosis of the different injuries that the injured person presents. Keeping a photographic sequence of the patient, with their prior consent, is important from a legal point of view and so that the patient's evolution can be evaluated. At certain times, they can influence therapeutic decision-making, in the event of a secondary deformity. Just as it is comforting to show the proper evolution of a patient.

Figure 4: Patient operated on for a fractured mandible with favorable evolution, showing the almost imperceptible scar. Courtesy of Dr. Otto Alemán Miranda.

Risks related to the airway The upper airway compromise can be mild, moderate or severe, depending on the degree of obstruction. It is directly related to post-trauma edema, bleeding and/or foreign bodies. The condition becomes more complex when there is involvement of the cervical spine.

The injured patient with maxillofacial trauma presents serious challenges for the professional because airway management can be complicated by his or her injury. The first challenge is to secure the airway for sufficient and effective breathing and ventilation. When planning to secure the airway, the professional must consider several aspects

- The nature of the trauma and its effect on the airway.
- The possible difficulties in mask ventilation or endotracheal intubation.
- The possible trauma to the cervical spine.
- The risk of regurgitation and aspiration of gastric contents.
- Significant bleeding that prevents the anatomy of the airway from being seen and can cause circulatory impairment.

Figure 5: Patient with panfacial fracture. Courtesy of Dr. Carlos Juan Puig González.

The type of maxillofacial operation to be performed and whether the mouth must be empty to perform the procedure, or closed with maxillomandibular fixation at the end of the surgery. The time available to decide and then perform the optimal method to secure the airway is often short because the patient's condition can deteriorate rapidly. Adequate and effective control of the airway patency of the injured patient with maxillofacial trauma is essential. There are many maxillofacial injuries that require early treatment, especially if there is acute compromise of the airway or when there is profuse bleeding. There are many diagnoses in maxillofacial traumatology that will negatively influence the patency of the upper airways

- Le Fort fractures in any of their classifications can partially or completely obstruct the nasopharyngeal portion, due to their posteroinferior displacement. This can be compounded by possible bone comminution and bleeding, sometimes forcing the professional to perform a tracheotomy.
- A bilateral fracture of the anterior jaw that is vertically and horizontally unfavorable, due to the posterior traction of the muscles, can occlude the oropharynx with the en bloc recoil of the fractured area and the base of the tongue.
- The remains of dental or bone structures, together with different foreign bodies that may be present, with added vomit, secretions or bleeding, can block the airway in any portion of the oropharynx and larynx.
- Profuse bleeding into the oropharynx, such as hemorrhage in the posterior nasal region, can contribute to air blockage, or the formation of a severe hematoma, due to compression, will also have a negative influence.
- When the injured patient's venous return and/or lymphatic drainage are affected for different reasons during the course of his or her life, soft tissue edema in the head and neck may occur, which may cause late compromise of the airway.
- Direct trauma to the larynx and trachea may cause wounds, tears, avulsion, inflammation and displacement of the different structures that make them up, increasing the risk of cervical airway obstruction.
- A panfacial fracture due to the degree of displacement and severe comminution may cause serious obstruction. The following should be performed
    - Evaluation of the verbal response; if the patient responds adequately, it is possible that the airway is not compromised [5-7].
    - Examination of the mouth and pharynx for any bleeding or foreign body. All debris should be removed by suction/sweeping with the finger/Magill forceps, as appropriate.

All patients with maxillofacial trauma should be considered to have cervical spine injury unless proven otherwise. Cervical spine immobilization should be maintained by application of a hard collar/spinal board. • Routine airway maneuvers such as chin lift and jaw thrust may not be possible due to distorted anatomy and poor patient cooperation when conscious. • Head tilt and sniffing position are contraindicated in patients with cervical spine injury to prevent inadvertent neurologic injury. • Airway adjuncts such as oropharyngeal airway and nasopharyngeal airway may be used to maintain airway patency. The former may induce vomiting and la-

ryngospasm in a patient with an intact gag reflex. The latter is better tolerated in these patients but is not recommended in basilar skull fractures. • Injured patients with absent gag reflex are candidates for definitive airway. Preoxygenation is crucial to increase oxygen reserve and prevent critical level of hypoxemia during the period of apnea. • Periodic airway assessment is mandatory to avoid late airway compromise due to tissue displacement, hematoma, and edema.

Figure 6: Comminuted and complex fracture of the middle third. Courtesy of Dr. Carlos Juan Puig González´.

Early airway maintenance When there are multiple trauma patients who have suffered severe injuries, maintaining a patent airway and immobilizing the cervical spine is of vital importance. Failure to maintain a patent airway can be fatal and can occur quickly, even before other circulatory conditions. Therefore, when intervening in a multiple trauma patient and saving his or her life, it is clear that management of the airway begins, whenever necessary. In fact, the most common critical care errors that contribute to the death of trauma patients are related to airway management. The first action in the early airway management process is preoxygenation, which can prolong the time interval until the state of hypoxemia. Effective preoxygenation of the lungs increases the oxygen content in the functional residual capacity, which is the main oxygen reservoir during apnea. Since the time to achieve airway control before the onset of dangerous levels of hypoxemia is critical, preoxygenation is crucial and should be performed as much as possible, using a non-rebreathing mask. In some patients, preoxygenation is not feasible due to the maxillofacial trauma itself, and hypoxemia is to be expected.

Endotracheal intubation is the most valuable procedure to secure the airway in polytraumatized patients. It should be performed orally, but always keeping in mind that it will not be easy in all cases. Carrying it out in a patient with maxillofacial trauma is a challenge, mainly due to the difficulty of visualizing the vocal cords with the conventional direct laryngoscope. The oral cavity, oropharynx and supraglottic larynx may be filled with blood, secretions, soft tissue and bone fragments, or other foreign bodies, which will make it difficult or impossible to properly view the vocal cords. When this difficulty becomes evident, it is recognized as a direct cause of morbidity and mortality in injured patients treated in the emergency department. Mask ventilation sometimes becomes difficult in patients with maxillofacial trauma, because the anatomy of the buccofacial complex and oropharynx may be altered by the trauma and obstructed by hemorrhage. Therefore, the equipment will not fit properly to the face, thus preventing the efficient arrival of air from the mask to the lungs [7,8].

Bag-mask ventilation in patients with maxillofacial trauma, par excellence, is recommended to be carried out by "two people" given the degree of complexity of mask ventilation, although it may not provide effective ventilation. One must be aware that, due to positive pressure, the apnea condition may worsen due to displacement of the fractured bone fragments. Sometimes, the mask contributes to stabilizing the fracture site(s), acting as a "splint." To achieve spontaneous ventilation, while securing the airway in difficult airway situations, this can be achieved using topical anesthesia or controlled sedation. In addition to these aforementioned aspects, certain difficulties or complications may arise, such as

• Regurgitation and/or aspiration • Cervical spine injury • Patient with dyspnea who is already hypoxemic • Patient who is uncontrollable and combative • Esophageal intubation • Esophageal tear • Heart rate disturbances • Cardiac arrhythmias • Cardiac arrest • Inexperienced emergency professional Surgical airway Methods to maintain a patent airway can be basic as mentioned above or advanced, which is primarily through surgical methods. The latter should be considered as a last resort, however, in patients with facial trauma it is sometimes the best solution. To be well prepared, a qualified surgeon should remain on site during conventional airway management to be immediately in charge. Performing a cricothyroidotomy or tracheostomy under local anesthesia is a life-saving procedure in selected patients in the "cannot intubate, cannot ventilate" situation. Surgical creation of an airway is a safe method of securing the airway when the procedure is performed by a qualified surgeon. However, this approach has its drawbacks: it carries a 6% rate of complications such as bleeding or pneumothorax in an elective setting. This procedure can be difficult to perform in an urgent or emergent situation and can sometimes be fatal. When a tracheostomy is performed under local anesthesia, it is uncomfortable or even painful for the patient, who may already be experiencing severe pain and anxiety. For the operator, especially the less experienced one, it can be extremely stressful. Advanced methods are the choice when the trauma is extensive and intermaxillary fixation with postoperative ventilation is also required.

Cricothyroidotomy The relative ease of locating the cricothyroid membrane makes it a preferred site for urgent and timely airway management. In addition, it is less vascular and is associated with a low complication rate. • Needle cricothyroidotomy The options available for needle cricothyroidotomy are as follows: • Commercial kit: There are now commercially available cricothyroidotomy kits that allow the introduction of a small cuffed tube using a technique similar to cannula cricothyroidotomy. • No commercial kits: If the above kits are not available, then the readily available assembly can be used for the same purpose. A 14 G cannula is inserted through the cricothyroid membrane. Oxygen can be supplied through a three-way stopcock at 15 L/min. Inspiration is provided for 1 s with three-way in the closed position, while it is opened for 4 s to allow expiration. Oxygen flow is reduced to 2 L/min if there is upper airway obstruction to prevent barotrauma to the lungs. The third port of the stopcock can be used to connect the EtCO2 monitor. Alternatively, the jet ventilator can be connected to the cannula which works on the same principle. Possible complications: • Lung hyperinflation. • Subcutaneous emphysema. • Hypercapnia. • Provides oxygenation only for a limited period. • Surgical cricothyroidotomy This is considered the most suitable option for emergency airway control. Scalpel cricothyroidotomy is recommended as the fastest and most reliable method of securing the airway in situations where "can't ventilate, can't oxygenate". It is advantageous over needle cricothyroidotomy as it allows the introduction of a cuffed endotracheal tube.

Advantages: • Protects the airway from aspiration. • Provides a safe route for exhalation. • Allows EtCO2 monitoring. Risks of Circulation Control with Bleeding Control The head and neck region is richly supplied by a network of multiple major and minor blood vessels. Therefore, any penetrating injury to the maxillofacial region demands early and prompt attention due to the relatively high mortality rate associated with bleeding from these regional vessels. While bleeding from superficial penetrating wounds is relatively easy to treat, deep wounds to the lining layer of the deep fascia are not. Bleeding from the head and face is virtually impossible to control by external pressure packing alone. This is due to the presence of bony structures and the compromised state of fragile anatomical structures such as the eyeballs, brain, and airway. The most commonly affected vessels in penetrating injuries to the region are the branches of the external carotid artery and its branches.

Traditionally, bleeding from the maxillofacial region is usually controlled by ligation of the vessel, gauze packing, external digital compression, balloon packing (posterior nasal packing), bone compression with a blunt object, etc. Bleeding is usually due to fractures of the upper portion of the middle third of the face or nasoorbitoethmoidal fractures. Anteroposterior packing can stop bleeding in most cases. In other cases, bleeding could also come from the base of the skull, where once the patient is stabilized, an angiography with embolization of the causative vessels will be performed. As a last resort, the external carotid artery can be tied. In the presence of clinical suspicion of hemodynamic alterations and in all non-mild polytraumatized patients, two large peripheral accesses should be channeled in the elbow flexures [7-9].

Regarding volume replacement, this will be with two liters of fluids, either colloids or crystalloids. It is usually done initially with the administration of crystalloid solutions. Risks of neurological status assessment in maxillofacial trauma, neurological involvement may exist, as it is adjacent to the facial region. The impact

must be of high force and speed, in order for one or more facial fractures to occur. Due to the different organs and systems that may be affected, multidisciplinary care has become essential.

Certain injuries will take priority over others when deciding the time of initial repair. Head trauma, along with maxillofacial fractures, have a high risk of morbidity and mortality. It is important to assess the injured person using the Glasgow Coma Scale, measuring pupillary reactivity and the presence of motor or sensory neurological focality. If the scale is below 8, it is recommended to obtain a definitive airway and perform mechanical ventilation, thus avoiding possible hypoxemia that would aggravate a possible brain condition and the bronchial condition from aspiration due to the abolition of the vomiting reflex. Neurological evaluation using the Glasgow Coma Scale is a simple and rapid method to determine the level of consciousness and has a prognostic character. The clinical detection of cerebrospinal fluid rhinorrhea can be complicated by the presence of tears, blood and nasal secretions. Traditional methods, such as the glucose or protein test, are neither sensitive nor specific. The beta-2 transferrin test, a specific brain variant, is accepted as the best diagnostic method available. Rhinorrhea is often unilateral. Clinically, it can be seen that the cerebrospinal fluid does not clot and, being in close proximity to the clotted blood, a pattern called a tram line or train track is observed in the facial region. Neurological alterations are often not a contraindication for surgical treatment of facial trauma, based on the assumption that the neurological trauma is stable and does not worsen. Biological and occupational risks in the polytraumatized patient In all emergency rooms there are protocols that should not be violated. Efficient care must be provided quickly and energetically, so as not to lose time that may be vital to maintaining the life of the injured person(s). Therefore, biosecurity measures cannot be violated by all medical and paramedical personnel directly related to this stage of care for the polytraumatized patient.

The protective measures to be used by health personnel include, among others, the following: • Use of gloves, masks and glasses to protect the skin and mucous membranes from any contact with blood or body fluids. • Careful use of sharp objects. Needles should not be re-sheathed, bent or detached from syringes. • Proper handling of blood, body fluids and tissues. This includes not only the handling of samples in the emergency area, but also their transport and handling in the laboratory.

• Immediate washing of hands and body surfaces if contaminated with blood or other body fluids, before and after contact with patients and always after removing gloves. (20) Risk management in initial care of maxillofacial trauma This management of trauma is complex and multiple errors can be made by the professionals in charge: • "The patient's injuries seemed isolated to the orbital and nasal region, so I only performed a maxillofacial CT scan." Severe maxillofacial trauma can be associated with head trauma and intracranial injury. This is especially important in patients who have an altered mental status or who cannot provide data for the preparation of a medical history. Facial fractures can extend to the base of the skull. • "The patient did not complain of any neck pain, so I did not order a CT scan of the cervical spine." Even soft tissue injuries to the maxillofacial region can have associated injuries to the cervical spine. Injuries to the midface are likely to be associated with C5-C7 disruption, while injuries to the lower face are likely to be associated with C1-C4 disruption.

• "I didn't notice any obvious injuries to the mouth, so I didn't think to check for missing teeth." Dental injuries frequently occur with maxillofacial trauma. Mandibular fractures and Le Fort fractures are more likely to have associated dental injuries. If a trauma patient appears to have a recently lost tooth, consider aspiration. Signs of a missing tooth include an empty socket, possibly with bleeding, or remnants of a fractured tooth. Consider performing a soft tissue x-ray of the neck and chest to assess for the presence of aspirated teeth. • "Both of the patient's eyes were swollen, so I couldn't assess extraocular movements." In an alert patient, be sure to perform a complete neurologic exam. If the patient complains of diplopia, consider further imaging studies. Diplopia should raise suspicion for entrapment from a burst fracture. CT of the facial bones will demonstrate whether any of the orbital walls have been fractured. An abnormal neurologic exam should also prompt evaluation of the patient for intracranial trauma. Remember that ultrasound can be used to assess extraocular movements in patients who are unable to open their eyes due to swelling [9,10].

• "The patient's nose keeps running. I'm not sure why." Cerebrospinal fluid rhinorrhea should be considered if there is persistent nasal discharge. Once confirmed, a CT of the head and facial bones should be ordered to assess how the skull has been affected. Neurosurgical consultation is required. • "The patient keeps bleeding from somewhere inside his mouth, but I'm not sure where it's coming from." The tongue has a large blood supply, and deep or

complex lacerations may cause enough bleeding to make it difficult for the practitioner to see while assessing the mouth. More importantly, persistent bleeding from the tongue could obscure the oropharynx, possibly complicating airway management. • "I performed the physical exam. The patient's airway appears intact." Once the patient has been initially stabilized and appears to have an intact airway, re-assess the patient several times to ensure that soft tissue edema or hematomas have not developed to the point of compromising the airway.

• "I placed a nasal catheter to stop the patient's epistaxis, but now his face looks more swollen." When trying to control intractable epistaxis, especially from posterior sources, an inflatable nasal pack is usually used. However, in fractures of the naso-orbital-ethmoid complex or midface fractures, overinflated nasal packing may displace fracture fragments and cause further injury. (2) Soft Tissue Injuries Maxillofacial soft tissue injuries may differ in epidemiologic characteristics from other maxillofacial injuries. (21) Soft tissue injuries are closed when the skin retains its integrity despite disruption of adjacent blood and lymphatic vessels, such as contusions, excoriations, and concussions. Excoriations are the simplest and most common; they are limited to an erosion of the skin surface without penetration. Open soft tissue injuries are those in which the attacking agent causes tissue damage with a solution of continuity; they are known as wounds. They favor complications by having an open door to infection. These wounds are classified as contused, fractured, linear, avulsive, bite, and by firearm or sharp weapon. (22) (See Figure 7).

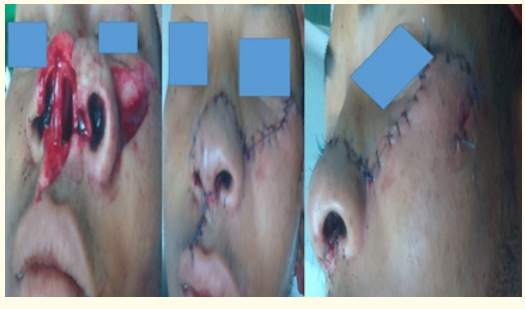

Figure 7: Patient with a stab wound. Courtesy of Dr. Otto Alemán Miranda.

The most common type of soft tissue injury is the wound. The soft tissue surrounding the facial skeleton consists of skin, superficial fascia, muscles, fat, salivary glands with a rich blood supply, and a large number of nerves. The presence of several muscles and the facial nerve, responsible for facial expression, makes it more difficult to repair facial trauma. Facial injuries should be treated as quickly as possible to reduce the likelihood of adverse outcomes such as infection, loss of function, poor aesthetics, etc. Often, and depending on the force of the impact, soft tissue injuries are associated with regional bone injuries, therefore, when an injured person arrives at the emergency room with severe facial soft tissue trauma, the presence of a surgeon who has the appropriate training for the treatment of these injuries is required. There are options for repair: healing by secondary intention, primary closure, skin graft placement, mobilization of local or regional flaps, and free flaps [11,12].

Facial lacerations require optimal wound repair skills to achieve favorable results. Because short-term complications such as wound dehiscence, skin necrosis, and wound infection can impair wound healing and ultimately lead to long-term cosmetic problems, facial wound repair should be performed with appropriate closure methods chosen through judicious wound assessment. (23) Soft tissue injuries in the setting of facial trauma may be isolated or associated with additional injuries; damage may be limited to superficial tissues or involve deeper structures. These injuries occur at a mean age of 28 years. Common causes of facial soft tissue trauma include falls, activities of daily living, sports, violence, motor vehicle accidents, animal attacks, recreational activities, and self-inflicted injuries [13].

Initial Evaluation and Treatment The patient should first be evaluated according to the ATLS protocol and examined for associated injuries. Unless the facial injury is causing significant bleeding or airway compromise, the patient is usually stabilized before facial injuries are diagnosed and treated. History and Physical Examination • After initial stabilization, a focused history and physical ex-

amination will help determine the management plan. The physician should establish the timing and mechanism of injury to assess the risk of contamination and whether a crush injury occurred. The patient should also be asked about previous craniofacial surgeries and preexisting functional deficits. A history of diabetes, smoking, alcohol use, or radiation therapy should be inquired into; all of which have been shown to inhibit wound healing. When the injury or resulting soft tissue inflammation is severe, photographs of the patient before the injury can help determine preexisting facial morphology and aid in future closure and reconstruction. A vaccination history will help determine the need for rabies or tetanus prophylaxis. • Initial soft tissue examination is best performed when the injured is lucid enough to respond to verbal commands to allow an assessment of motor and sensory nerve function, with particular attention to the facial and trigeminal nerves. This examination of nerve function should also be performed prior to administration of an anesthetic. The wound is examined, along with an assessment of the lacrimal apparatus, external auditory meatus, facial nerve, parotid duct, underlying bone, and tarsal plates [12-15].

Early Wound Management After examination, the wound is irrigated with saline and debris and small foreign bodies are removed to prevent infection or traumatic tattooing. Digital agitation may help facilitate irrigation, or saline may be placed in a large syringe with an 18-gauge needle to increase irrigation pressure. When this is not sufficient to clean the wound, dilute hydrogen peroxide may help remove dried blood and debris, but careful use is needed because it can irritate tissue and may be toxic to the cornea. Pulse lavage can potentially damage soft tissue and is only indicated when the wound is contaminated and previous measures have not sufficiently cleaned the wound. Devitalized tissue is then conservatively removed with sharp debridement while preserving as much soft tissue as possible, especially in specialized areas of the face. Bleeding is initially controlled to prevent severe blood loss; hemostasis is then again achieved during and after irrigation and debridement. Direct pressure is the primary method of stopping bleeding, along with identification and ligation of visible vessels. Electrocautery is reserved for when these methods fail because its use is associated with poor wound healing. Ideally, wound closure should occur as soon as the patient is stabilized. Closure within 12 hours, or ideally within 6 hours, reduces infection rates, improves cosmetic results, and prevents subsequent inflammation from obscuring landmarks. However, wounds cannot be closed immediately if there is too much tissue tension or if complex closure is required [15-17].

General Repair Concepts Primary Closure Some minor facial injuries can be effectively treated with tissue approximation in the emergency department. Tissue approximation is most commonly achieved by suturing, which facilitates optimal cosmetic results by allowing wound edges to be everted and precisely aligned. Tissue should be closed in layers, and any exposed cartilage or bone should be covered with soft tissue. Muscle edges are realigned with a 4-0 absorbable suture. For deep dermal sutures, a 4-0 or 5-0 absorbable monofilament is appropriate. For superficial layers of the skin, a 5-0 to 7-0 nonabsorbable or rapidly absorbable monofilament, such as propylene or nylon, is used [1,2].

Staples can be used in hairy areas, and adhesive-free or adhesive-free tape can be used alone on subcentimeter wounds or in conjunction with sutures. Adhesives may be the quickest, easiest, and most cost-effective way to close a small, clean wound in children or uncooperative patients. However, the adhesive often gets into the wound, preventing accurate tissue approximation. Lacerations that can be treated in the emergency department are anesthetized using local field blocks or regional blocks. Children may also require conscious sedation if they cannot hold still or are in significant pain during wound closure.

Image 8. Skin injury in the left frontotemporal region caused by a gunshot wound. Courtesy of Dr. Carlos Juan Puig González. Wound care Ointment keeps the wound moist and prevents scab formation, which helps in the reepithelialization process. Antibiotic ointment is recommended for the first 2 to 7 days, followed by non-antibiotic ointment, such as Vaseline. Systemic antibiotics are generally not recommended for clean, simple wounds of the face and neck that are adequately irrigated and debrided. Systemic antibiotics should be considered in specific cases, such as bite wounds, puncture wounds, presence of foreign bodies, heavy contamination, irregular wound edges, delayed closure, and in immunocompromised patients or those at high risk for adverse outcomes.

Repair of complex facial trauma Severe facial trauma can cause significant morbidity and disfigurement and represents a unique challenge to the surgeon, given the specialized nature of facial tissues and the importance of the face to the patient's self-esteem and personal identity. After initial stabilization and salvage measures, attention turns to a reconstructive process that aims to provide acceptable functional and aesthetic results.

General principles There are many methods available to import tissue to the head and neck region; the management plan is individualized to the case at hand. Local tissue flaps have limited amounts of tissue and a modest vascular supply and are therefore often reserved for the final stages of reconstruction for minor contour. Pedicled myocutaneous flaps offer large amounts of tissue with reliable vascularity to cover soft tissues, but are often bulky and limited by the length of the vascular pedicle. Free tissue transfer allows for early reconstruction of damaged bones and provides soft tissue coverage soon after injury. Additional reconstructive techniques and tools include implants, tissue expanders, and epidermal skin grafts, although these are not frequently used in acute situations.

Timing of repair At the initial encounter, following stabilization and management of life-threatening injuries, initial reconstruction in the operating room serves to debride the wound, establish adequate occlusion, and close the wound as best as possible. The timing of definitive reconstruction is currently a matter of debate. Some authors suggest that, when possible, patients requiring free tissue transfer should receive their definitive treatment immediately (within 24 to 48 hours). Immediate definitive reconstruction leads to fewer revision procedures and better outcomes, whereas delayed reconstruction has a higher incidence of wound contracture. Others suggest providing conservative coverage in the acute setting and then performing longer definitive reconstructions after the patient has been stabilized.

Anatomic considerations Severe facial trauma often involves multiple aesthetic units of the face. Ideally, reconstruction should be planned within each facial aesthetic unit because human facial perception is based on a feature-by-feature analysis: • Forehead. The forehead is a prominent aesthetic unit of the face and therefore care must be taken to ensure adequate approximation of skin tension lines, hairlines, and eyelid margins. Tissue expansion allows for adequate color and tissue matching that cannot be achieved with skin grafting, although skin grafting is sometimes used for temporary tissue closure in nearly complete forehead defects until tissue expansion can be performed. • Periorbita. Trauma to the eyelids and periorbita should prompt a thorough evaluation of the globe for penetrating injuries. Simple lacerations are closed in layers from the inside out (conjunctiva, tarsus, and then skin). When the eyelid margin is involved, the gray line and tarsal plate must be approximated carefully [15-17].

Full-thickness eyelid defects can be closed primarily when less than 50 % of the eyelid is involved; a lateral canthotomy with cantholysis may help relieve tension in this setting. Partial-thickness defects involving more than 50 % of the eyelid require a full-thickness skin graft, whereas those involving less than 50 % of the eyelid may be reconstructed with local advancement flaps. Damage to the lateral eyelid often involves the lateral canthus, which can be repaired with a canthopexy or canthoplasty. Damage to the medial eyelid may involve damage to the medial canthal tendon or the lacrimal system, and is also often associated with fractures in this region. Canthal attachments are fixed as needed, and ophthalmologic evaluation is required for injuries to the lacrimal system. • Lips. In lip reconstruction, realignment of anatomic landmarks and restoration of muscle and sensory function should be considered. When less than 30% of the lip is involved, primary closure may be attempted. Skin grafts and local advancement flaps are also management options, although the best option for restoring lip form and function is to reconstruct the defect with available lip tissue. Traumatic amputation of the upper or lower lip, although rare, may result from facial animal bites, assault, or other traumatic accidents. Since the lip is a specialized facial structure, lip replantation, when possible, is the best way to restore its form and function. The small caliber of the upper and lower labial artery and vein makes lip replantation difficult, and venous outflow often becomes a problem [15-17].

During initial surgical exploration of the amputated lip, identification and anastomosis of suitable vessels is attempted. Successful lip reimplantation reports in the literature have anastomosed the artery and vein, the artery only, the vein only, or have joined the artery to the vein for a “flow-through” reimplantation for venous flow. Even a loose insertion of the lip segment can compromise blood flow, so delayed insertions, partial delayed insertions, or further loosening of the insertion may be necessary to prevent or control congestion. Most patients undergoing lip reimplantation also require leeches or chemical leeches, along with anticoagulant therapy, to assist venous flow. When there is no venous anastomosis, it takes on average 6.6 days to relieve venous congestion, which correlates with the time needed for neoangiogenesis. Prophylactic antibiotics are suggested to prevent infection, although revision procedures are often necessary. Many lip replantations lead to return of muscle function, stoma competence, and at least partial return of sensation [15-17].

• Ear. Many ear injuries can be closed in the emergency department. A laceration of the auricle involving cartilage is reapproximated with as few sutures as possible; the ear is then monitored for hematoma formation, with pressure dressings applied when indicated. Small skin defects not involving the perichondrium are repaired with skin grafts or local flaps, and small avulsed segments can be replanted within the first 12 hours after injury. Complete avulsion should be repaired immediately with microsurgical replantation, when possible. As with lip reimplantation, arterial-only anastomosis is successful when venous drainage is provided with medicinal leeches and anticoagulation. (See Figure 8).

Figure 8: Patient with severe injury to the auricular region resulting in comminution of the cartilage. Courtesy of Dr. Otto Alemán Miranda.

Risks of Facial Animal Bites Epidemiology and Etiology Animal bites to the face are inherently complex due to their potential for polymicrobial infection, severe and disfiguring wounds, and subsequent psychological trauma. The most severe injuries occur in children younger than 5 years of age. More than 80% of severe dog bites in children involve the head and neck, and most are caused by dogs known to the child. Facial dog bites are most commonly concentrated in the midface and involve the periorbita, nose, lips, and cheeks. Most injuries caused by dog bites are superficial, such as soft tissue lacerations. However, dog bites can also cause larger soft tissue defects, as well as damage to muscles, tendons, and bones or concomitant bone fracture.

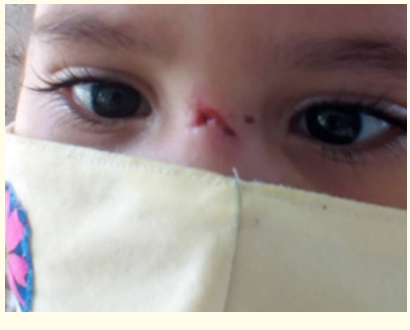

Figure 9: Patient with dog bite wound on the nasal dorsum. Courtesy of Dr. Otto Alemán Miranda.

Facial fractures are uncommon after dog bites, affecting approximately 1.4% of children. Dog bites also differ from cat, rat, and human bites because they are crush injuries. Therefore, they may cause additional tissue damage through damage to the blood supply. Management Early treatment of facial bites involves extensive wound irrigation, conservative debridement, and early primary closure—all of which improve cosmetic outcomes and reduce the risk of infection. The use of prophylactic antibiotics in facial wounds from animal bites is controversial because the face is well vascularized and has a relatively low risk of infection. However, some authors suggest giving prophylactic antibiotics in all cases. Penicillin or Augmentin, or clindamycin if the patient is allergic to penicillin, are preferred. Surgical management of animal bites depends on the complexity and severity of the wound. (Figure 10)

Figure 10: Facial disfigurement from striped hyena bite. Courtesy of Dr. Carlos Juan Puig Gonzalez.

Risks of bullet wounds Epidemiology and etiology Ball wounds to the face occur at an average age of 27 years and affect men more often than women. These injuries are often caused by an assault, accident, or suicide attempt. The entry site suffers a crush injury; the bullet trajectory then creates a permanent cavity. The pressure shock wave from the bullet also creates a temporary cavity that damages nearby microvasculature. Some bullets are designed to fragment upon striking the body, causing multiple imprints and more extensive damage. Gunshot injuries create large soft tissue and bone defects and often injure numerous facial structures, including the eyes, tongue, cheeks, lips, and palate. Additional injuries to the brain, large vessels of the neck, pharynx, and larynx may occur and require immediate attention. Injury to remote organs is also possible.

Figure 11: Gunshot wounds. Courtesy of Dr. Carlos Juan Puig González.

Figure 12: Gunshot wounds. Courtesy of Dr. Carlos Juan Puig González.

Figure 13: Bullet impacted in the submandibular region. Courtesy of Dr. Carlos Juan Puig Gnzález.

Acute nonsurgical management Initial management of gunshot wounds to the face follows advanced ATLS protocols. Bleeding is controlled by direct pressure and packing. When these methods do not stop bleeding and damage to branches of the external carotid artery is suspected, angiographic embolization is indicated. The initial examination should look for potential threats to the airway, including laryngeal injuries, aspirated teeth or bones, and intraoral inflammation. A neurologic examination with an assessment of mental status, including a Glasgow Coma Score, and stabilization of the cervical spine is essential. A careful ophthalmologic examination, screening for malocclusion, and documentation of facial nerve deficiencies should also be performed. CT scans are the gold standard for assessing the nature of the injury. Three-dimensional skull reconstruction may be necessary for complex fractures, and panoramic radiographs will illustrate dental damage.

Surgical Management Early surgical treatment requires thorough decontamination and debridement with removal of all foreign debris before the wound is closed. Debridement should still be conservative. Serial debridement should then occur every 48 hours. Correction of the facial skeleton should then be attempted. Internal skeletal fixation plates are usually used unless there is severe bony comminution with minimal damage to the overlying soft tissue, in which case external fixation, bone from the iliac crest or fibula, may

be used. Nonvascularized bone is sometimes used for reconstruction if the defect is covered with well-vascularized soft tissue. (24) As mentioned above, the timing of definitive reconstruction of severe facial trauma is still under debate. Primary closure can often be attempted after gunshot injury and is facilitated by conservative undermining of the wound edges. When soft tissue defects do not allow primary closure without significant tension, a free flap transfer is used to cover the defect; some authors suggest an early aggressive approach with one-stage reconstruction, while others prefer more conservative staged approaches [15-17].

Sometimes these are extensive wounds that require the expertise of a team specialized in maxillofacial trauma care.

Figure 14: Patient who received multiple stab wounds. Courtesy of Dr. José Jardón Caballero.

In the case previously shown in the image, it is evident that the patient has multiple short-blunt and incised-blunt wounds, in the facial region, predominantly in the middle and lower third of the face, in the upper limbs and dorsal region, for which she was treated (with compression bandages and venous channeling for hydration), referred and transferred from her municipality to the emergency service of the provincial hospital where she is evaluated by the multidisciplinary group that decided on the extremely urgent surgery by the maxillofacial and orthopedic specialties. In the facial region, she presented several blunt-force wounds that extended from the mastoid region to the mental region, passing through the auricular, parotid, genital and bilateral labial regions. In depth, it affected the skin, subcutaneous cellular tissue, muscle, periosteum, multiple bilateral mandibular bones, muscle, and mucous membranes of the cheek, as well as a fracture of the dental crowns and a wound to the tongue, with profuse bleeding from the entire injury. The injured woman underwent emergency surgery and made a favorable recovery.

Figure 15: The patient had a favorable evolution. Courtesy of Dr. José Jardón Caballero.

Facial Transplants n the last decade, facial transplants have become a life-changing operation for people with massive soft tissue deficits after severe facial injury. Causes of these injuries include ballistic trauma, neurofibromatosis, burns, vascular injuries, blunt trauma, and radiotherapy for cancer. Facial transplants have demonstrated positive functional, aesthetic, and psychological outcomes. However, these transplants are controversial because they are not lifelong and carry a high risk of morbidity or mortality from complications of surgery or chronic immunosuppressive therapy.

Acute rejection is common within the first year after transplant. The first chronic rejection has recently been reported. Infections and metabolic disorders are also common, as well as a reduction in glomerular filtration rate from nephrotoxic immunosuppressive agents. Post-transplant malignancies may also occur due to immunosuppression and include skin cancer and smooth muscle neoplasms [15-17].

Lessons learned from the past decade of facial transplantation include careful patient selection with the inclusion of mental health and social work providers in the multidisciplinary transplant team. This helps ensure a thorough psychiatric evaluation before surgery and full patient compliance after surgery. Careful donor selection is also imperative; immunology, viral serology, cephalometry, and comorbidities should be considered. In general, in the management of soft tissue injuries of the maxillofacial region, good communication with the patient and family is crucial to success. It is important to convey the severity of the injuries as well as the prognosis to avoid misunderstandings as to what can be achieved. Close follow-up is necessary to offset any potential complications and unwanted sequelae [15-17].

Figure 16: Patient with shoemaker's needle introduced through the facial region towards the maxillary sinus and infraorbital portion. Courtesy of Dr. Otto Alemán Miranda.

Patients with conditions caused by unusual objects occasionally arrive in emergency rooms.

Risks and complications of maxillofacial trauma in different tissues. When talking about traumatology, it is known that the phrases risks and complications will be mentioned on more than one occasion. They can occur during the trauma itself and in the subsequent evolution. Since different conditions have been shown in multiple tissues, organs and organ systems. Impacting the psyche of individuals, aesthetics, morphology, physiology, among other aspects, with different levels of severity. Next, the main risks and complications that can occur in both hard and soft tissues will be outlined in different boxes. Frontal region. Traumas in the frontal bone are very frequent from childhood, due to the characteristics of this bone that has a position and projection, behaving like a true bumper of the upper third. It has the advantage of being one of the bones most resistant to trauma, but traumatic conditions in this area constitute a great risk for those affected, mainly due to its proximity to the intracranial contents [15-17].

Nasal region The nasal region is one of the areas most affected by facial traumatology, due to its prominent location on the face. In our center, the most frequent causes are fights, car accidents, and sports accidents. This can cause different risks and complications.

Orbital region In our care centers, this region is most related to direct trauma from aggression, whether with a fist or blunt objects, followed by car and sports accidents.

Soft tissue injuries	Hard tissue injuries	Systemic state impairment
Unsightly scar	Fracture of the frontal bone	Loss of consciousness
Heavy bleeding	Fracture of the anterior wall of the frontal sinus	Motor Impairment
Supraorbital nerve bundle injury	Fracture of the posterior wall of the frontal sinus	Seizures
Cranial contents involvement	Involvement of the nasofrontal duct	Psychological condition
Excoriations	Bone loss deformity	Death
Wounds	Osteomielitis	
Bruises		
Areas of necrosis		
Tissue loss		

Table a

Soft tissue injuries	Hard tissue injuries	Systemic state impairment
Excoriations	Fracture of the nasal bone itself	Loss of consciousness
Wounds	Fracture of the nasal proper bone with an ascending process of the maxilla	Cerebrospinal fluid output
Bruises	Naso-orbito-ethmoid fracture	Seizures
Unsightly scar	Comminuted fracture	Psychological condition
Heavy bleeding	Bone avulsion	Airway obstruction
Cartilage injury	Fracture of the bone septum	Death
Cartilage septum deviation		
Hematoma septal		
Epistaxis		
Nerve injury		
Tissue loss		

Table b

Soft tissue injuries	Hard tissue injuries	Systemic state impairment
Excoriations	Orbital roof fracture	Diplopia
Bruises	Fracture of the orbital floor	Blindness
Eyelid wounds	Fracture of the side walls	Loss of consciousness
Corneal wounds	Naso-orbito-ethmoid fracture	Cerebrospinal fluid output
Compression of the eyeball	Bone conminution	Psychological affectation
Eyeball burst	Bone avulsion	
Nerve compression	Reaction to osteosynthesis material	
Muscle Entrapment	Pseudoartrosis	
Soft tissue avulsion	Necrosis	
Herniation of the orbital fat		
Tissue necrosis		
Infection		
Dacriocistitis, etc.		

Table c

Zygomatic region This is a frequently affected region, acting as a bumper, due to its prominence in the face of individuals. The main causes are traffic accidents, assaults, and sports accidents.

Maxillo-palatine region These are not the most affected areas, but when they do occur they can be risky and cause some complications for those affected. They can be caused by an assault with a knife or a firearm, and most of the time in conjunction with other fractures such as Lefort-type fractures.

Soft tissue injuries	Hard tissue injuries	Systemic state impairment
Excoriations	Fracture of the orbital floor	Diplopia
Wounds	Fracture of the side walls of the orbit	Blindness
Bruises	Zygomatic arch fracture	Loss of consciousness
Unsightly scar	Temporomandibular joint condition	Psychological affectation
Heavy bleeding	Condition of mandibular movement due to varus fracture of the zygomatic arch	
Compression of the eyeball	Bone conminution	
Eyeball burst	Bone avulsion	
Nerve compression	Reaction to osteosynthesis material	
Muscle Entrapment	Pseudoartrosis	
Soft tissue avulsion	Necrosis	
Herniation of the orbital fat		
Tissue necrosis		

Table d

Mandibular region

Traumas in this area are highly frequent in maxillofacial surgery emergency rooms due to the prominent nature of this bone. The main causes are assaults with blunt objects, fists, and knives, followed by sports and traffic accidents.

Dental tissues

In our experience, these injuries are mainly seen in childhood, as a result of the different games that children play, but they are

Soft tissue injuries	Hard tissue injuries	Systemic state impairment
Laceration of the palatal mucosa	Bone conminution	Loss of consciousness
Wound in the palatal mucosa	Bone avulsion	Psychological affectation
Soft palate wound	Reaction to osteosynthesis material	Nasal Gold Communication
Soft tissue avulsion	Pseudoartrosis	Orosinus communication
Nerve compression	Necrosis	Airway obstruction
Laceration of the oronasal and sinus mucosa by perforation	Fracture of both jaw bones	Loss of consciousness
Necrosis	Fracture of both palatine bones	Death
	Malocclusion	

Table e

Soft tissue injuries	Hard tissue injuries	Systemic state impairment
Soft tissue avulsion	Comminuted fractures	Loss of consciousness
Nerve compression	Bone avulsions	Cerebrospinal fluid output by otic region
Excoriations	Dental fractures	Seizures
Wounds	Dental avulsions	Psychological condition
Bruises	TMJ dislocation	Airway obstruction
Unsightly scar	Necrosis	Death
Heavy bleeding	Reaction to osteosynthesis material	
	Pseudoartrosis	
	Malocclusion	

Table f

also observed in adults due to direct trauma from physical aggression or sports accidents and ultimately from traffic accidents.

It is essential that professionals from the different branches of Stomatology master this subject in a general way. In the specific case of specialists in maxillofacial surgery, they cannot be satisfied with just reading this work, they must go to the specific ones in traumatology to delve deeper into this content.

Soft tissue injuries	Hard tissue injuries	Systemic state impairment
Lacerations of the buccal mucosa	Dental fracture	Loss of consciousness
Periodontal tissue involvement	Dental dislocation	Seizures
Nerve compression	Dental subluxation	Psychological condition
Heavy bleeding	Root fractures	Airway obstruction
Emphysema	Dental avulsion	
Necrosis	Oral communication	
	Dentoalveolar fracture	
	Malocclusion	
	Necrosis	

Table g

Conclusion

A bibliographic review was carried out with the aim of describing and compiling the main maxillofacial injuries due to trauma as well as the risks and complications that these may present.

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