LeFort fractures. A review

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Background: The classic fractures with anatomical distributions located at the level of the lines of weakness described by René Le Fort in 1901 are rarely observed in clinical practice; it is more common to observe various combinations between these patterns, or atypical fractures, comminuted maxillary fragments related to severe trauma. Facial traumas are frequent, generally associated with traffic accidents, work accidents, assaults or accidental falls, recently associated with an increasing frequency with extreme sports. They represent a diagnostic challenge due to the complexity of the facial skeleton and the difficulty in obtaining clear images. Mortality ranges between 15-20%, they are associated with multiple trauma in 60% of cases and injuries in other locations whose treatment is a priority must be ruled out. Computed tomography (CT) is the diagnostic technique of choice due to its availability, speed and possibility of performing reconstructions that can be fundamental for the diagnosis and planning of surgical management, which can generally include multidisciplinary collaboration between different specialties, since the combination of These types of fractures can involve structures such as the airway and eyes.

Keywords: LeFort fracture, facial trauma, maxillary trauma, atypical fractures, facial skeleton.

The classic fractures with anatomical distributions located at the level of the lines of weakness described by René Le Fort in 1901 are rarely observed in clinical practice; it is more common to observe various combinations between these patterns, or atypical fractures, comminuted maxillary fragments related to severe trauma. The classification proposed by Le Fort, based on the highest level of fracture, continues to be useful in teaching and for rapid transmission of information between professionals. However, it does not have this same validity from the point of view of the therapeutic approach. Facial traumas are frequent, generally associated with traffic accidents, work accidents, assaults or accidental falls, recently associated with an increasing frequency with extreme sports. They represent a diagnostic challenge due to the complexity of the facial skeleton and the difficulty in obtaining clear images. Mortality ranges between 15-20%, they are associated with multiple trauma in 60% of cases and injuries in other locations whose treatment is a priority must be ruled out.[1] Computed tomography (CT) is the diagnostic technique of choice due to its availability, speed and possibility of performing reconstructions that can be essential for the diagnosis and planning of surgical management.

LeFort I fracture

LeFort I fractures are multibuttress injuries of the midface that separate the hard palette containing segment of the maxilla from the remainder of the face. The resulting fragment has been referred to as the occlusion-bearing maxillary segment. The fracture line runs from the piriformis notch, continues above the tooth apices, through the anterior wall of the maxillary sinus, reaching the tuberosity and quite frequently to the lower third of the pterygoid processes. **(Figure 1)** Its mechanism of production is usually a completely horizontal trauma to the upper lip. A horseshoe ecchymosis can be seen at the bottom of the upper vestibule and on the soft palate. On manual examination, mobility of the upper jaw can be observed, as well as very selective pain by pressing with the ball of the finger on the pterygoid process. Restoration of normal bite is the most important surgical goal and is usually achieved by maxillomandibular fixation via arch bars and wires. The 2 intersections of buttresses and fracture lines in the anterior face are optimal sites for plate fixation. [2]

Le Fort II fracture or pyramidal fracture

It is produced by oblique trauma from top to bottom and from front to back. The fracture path includes the nasal bones in their middle part, the ascending process of the maxilla, occasionally the infraorbital ridge, the pyramidal process in its joint with the malar, the tuberosity and the middle third of the pterygoid processes. It affects the lateral wall of the nasal passages, approximately between the middle and inferior turbinates, the vomer, and the perpendicular plate of the ethmoid. LeFort II injuries extended through the inferior orbital rim and resulted in a free-floating pyramidal fragment, a "floating maxilla," with the nasoseptal region at its apex and the occlusion-bearing maxillary segment as its base. **(Figure 2)** LeFort III injuries extend through the

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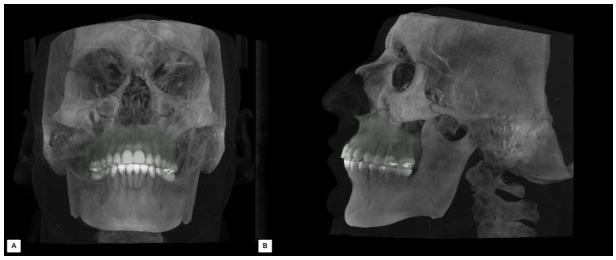

Figure 1. Representation of the LeFort Fracture. A. LeFort I fracture, frontal view. B. LeFort I fracture, lateral view.

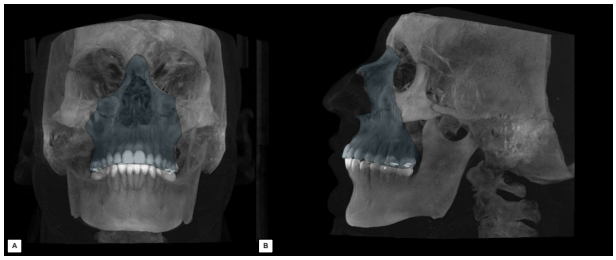

Figure 2. Representation of the LeFort Fracture. A. LeFort II fracture, frontal view. B. LeFort II fracture, lateral view.

lateral orbital walls, lateral orbital rims, and the zygomatic arch with complete dissociation of the midface from the remainder of the skull, resulting in a "floating face". [3, 4]

Le Fort III fracture or complete craniofacial disjunction

It is produced by a frontal trauma of high energy and generally of a large surface. The fracture lines run through the frontonasal and frontomaxillary suture on the unguis and the medial wall of the orbit surrounding the optic foramen to the posterior portion of the superior orbital fissure. At this point the fracture line divides in two. A line follows the pterygopalatine fossa to the base of the pterygoid process; the other part of the anterior end of the sphenomaxillary cleft until dividing the lateral rim of the orbit at the level of the zygomaticofrontal suture. **(Figure 3)** The craniofacial disjunction is completed with the fracture of the zygomatic arch and the lateral wall of the nasal cavities, the vomer, the vertical plate of the ethmoid and, with some frequency, the cribriform plate of this same bone. The symptoms of these types of Le Fort II and III fractures present with facial and interorbital space edema, a flattened nose with a skin fold at the root, edema with herniation of the conjunctival sacs that prevents the eyes from opening. Nosebleeds and skin bruising will occur, and crepitus due to subcutaneous emphysema can often be seen.

Treatment

Immediate treatment of facial trauma includes establishment of a safe airway, control of hemorrhage, treatment of shock, neurological evaluation, and evaluation of definite immediate or deferred surgical treatment. The treatment of facial fracture has as its specific objective the three-dimensional restoration of the face, which is achieved by reestablishing its normal relationships with the upper third of the face and with the jaw. Fronto-orbital and zygomatic fractures must also be repaired with precision and rigidity. The zygomatic arches are a key piece to restore the width and projection of the face. The upper jaw will be disimpacted using manual maneuvers or using Rowe-Killey forceps, with occlusion restored using stable intermaxillary fixation. After securing the airway and establishing hemostasis, then assessment and correction of dental occlusion should be prioritized, intermaxillary fixation (IMF) or maxillomandibular fixation (MMF) is used to establish a functional occlusion. In certain cases, IMF may not be a viable option, as in the edentulous patient, necessitating open reduction and internal fixation (ORIF) to achieve both an anatomical and a functional reconstruction.

Open Reduction and Internal Fixation; Exposure of the involved anatomical subunits of the facial fracture(s) can be accomplished through several approaches. A coronal approach may be used for LeFort II and III level fractures, often in conjunction with orbital and intraoral incisions. LeFort II level fractures can also be approached via glabelar approach, and LeFort I level exclusively through transoral incisions. It bears mentioning that since most of these fractures may present in a polytrauma setting, the use of existing lacerations to access fractures is quite advantageous.

LeFort II and III fracture exposure are more complex, requiring greater exposure with a combination of a periorbital and intraoral approaches. If there are concomi- tant frontal sinus fractures, a coronal exposure is preferred. The nasofrontal area is commonly fixated first, followed by periorbital buttress fixation, zygoma fixation (in LeFort III cases) and maxillary buttress fixation. Rigid fixation is achieved with at least two screws on either side of the fracture line for each buttress. Bone grafts are commonly used for larger gaps, spanning greater than five to 10 mm. [5]

Figure 3. Representation of the LeFort Fracture. A. LeFort III fracture, frontal view. B. LeFort III fracture, lateral view.

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Discussion

It is essential to perform an optimal initial study that includes the entire facial region and reduce multiple examinations as necessary, so the objective of imaging studies is to define the number and location of facial fractures, with special attention to the identification of injuries in functional structures of the face and those with repercussions aesthetics, as well as possible involvement of the spine or skull. [6,7] One of the disadvantages of Le Fort's classification is that it may be outdated or invalid, especially in cases of comminuted, incomplete or combined injuries of the maxilla, in addition to not defining the supports of the facial skeleton. [8] In 2022, a structured report was proposed by Doctors Dualde and Cervera in which they can evaluate different anatomical regions in a uniform manner, with higher quality in the report due to the order of the anatomical structures, greater intra- and interobserver agreement, and a lower number of diagnostic errors where they are evaluated if there are cranial or intracranial conditions or if there is pneumocephalus, subsequently evaluating the walls and floor of the frontal sinus, continuing with the orbit, where the walls and ridges are evaluated, as well as the presence of muscle or fat herniation, entrapment of the extrinsic muscles, infraorbital nerve canal, fissure, emphysema, the eyeball and the tear duct. Subsequently, the ethmoidal cells, nasal pyramid and malar are evaluated, with special attention to sutures and possible displacements. It continues with evaluation of the maxilla, sphenoid and mandible, in the latter it is important, in addition to considering the fracture lines and possible temporomandibular dislocations, to evaluate the airway, reporting if there is a bilateral fracture, intraoral bleeding or hematoma in the floor of the mouth. [1]

Any combination of unilateral or bilateral LeFort I, II, and/or III injuries are possible. CT evaluation should focus on the detection of the fracture patterns and reporting of clinically relevant, [2] especially when the maxilla is involved. The maxilla serves an important role in facial architecture, separating the nasal and oral cavities, forming the upper jaw, [9] containing the maxillary sinus, and contributing to the orbit.[10] The midface contains buttresses, which are areas that support the anatomy and provide the strength needed for masticatory function. In addition, they are separated by weaker areas that provide protection for key structures, such as the eyes and brain.[11, 12] It has been proposed that the paranasal sinuses may function as ‘‘crumple zones’’ or shock absorbers that can protect the eyes, optic nerves, carotid arteries, and brain from trauma.[13]

Conclusion

LeFort fractures usually have a combined presentation and require comprehensive evaluation of the patient with multidisciplinary collaboration of different specialties. There are proposed classifications that can more accurately evaluate facial trauma injuries that should be validated.

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