

**CONTEMPORARY APPROACHES IN THE DIAGNOSIS OF LE FORT
FRACTURES: A LITERATURE REVIEW**

**ABORDAGENS CONTEMPORÂNEAS NO DIAGNÓSTICO DAS FRATURAS LE
FORT: REVISÃO DE LITERATURA**

**ENFOQUES CONTEMPORÂNEOS EN EL DIAGNÓSTICO DE LAS FRACTURAS
LE FORT: REVISIÓN DE LA LITERATURA**

 <https://doi.org/10.56238/sevened2025.036-060>

Thais Rosental Silva¹, Maria Luiza Hudson Lopes², Eduardo Stehling Urbano³

ABSTRACT

Le Fort–type fractures represent one of the most complex and challenging conditions in facial trauma due to their high clinical severity, potential functional and aesthetic impairment, and the diagnostic difficulty resulting from the anatomical complexity of the midface. Most cases are associated with high-energy trauma, such as assaults and motor vehicle accidents, predominantly affecting young men. Clinical diagnosis should be based on a thorough physical examination, including inspection, palpation, and assessment of bone mobility, as well as the identification of signs such as malocclusion, crepitus, edema, and bilateral epistaxis. However, diagnostic confirmation depends on high-precision imaging exams, such as Cone-Beam Computed Tomography (CBCT), considered the gold standard because it enables detailed three-dimensional reconstructions and precise visualization of fracture lines, overcoming limitations of conventional radiography. Waters, Caldwell, Towne, and Hirtz radiographic views may still be useful in specific cases, while complementary methods such as magnetic resonance imaging and ultrasonography assist in evaluating soft tissues and diagnosing associated injuries. Thus, it is concluded that effective diagnosis of Le Fort fractures must be grounded in a multidisciplinary approach that integrates careful clinical assessment with advanced imaging methods, ensuring greater accuracy in identifying the extent of lesions and enabling adequate surgical planning for functional and aesthetic restoration of the traumatized patient, ultimately improving their quality of life.

Keywords: Le Fort Osteotomy. Diagnostic Imaging. Clinical Diagnosis. Maxillofacial Surgery.

RESUMO

As fraturas do tipo Le Fort representam um dos quadros mais complexos e desafiadores da traumatologia facial, devido à elevada gravidade clínica e potencial de comprometimento funcional e estético, bem como à dificuldade de diagnóstico decorrente da complexidade anatômica do terço médio da face. Destaca-se que a maioria dos casos está relacionada a traumas de alta energia, como agressões e acidentes automobilísticos, acometendo principalmente homens jovens. O diagnóstico clínico deve basear-se em um exame físico

¹ Undergraduate student in Dentistry. Universidade Federal de Juiz de Fora (UFJF).
Lattes: <http://lattes.cnpq.br/9077887374782306>

² Undergraduate student in Dentistry. Universidade Federal de Juiz de Fora (UFJF).
E-mail: mariahudson.ctga@gmail.com

³ Dr. in Implantology. Universidade Federal de Juiz de Fora (UFJF).
Lattes: <http://lattes.cnpq.br/8519709284079939>

minucioso, contemplando inspeção, palpação e avaliação de mobilidade óssea, além da identificação de sinais como má oclusão, crepitação, edema e epistaxe bilateral. No entanto a confirmação diagnóstica depende de exames de imagem de alta precisão, como a Tomografia Computadorizada de Feixe Cônico (TCFC), considerada o padrão-ouro por permitir reconstruções tridimensionais detalhadas e visualização exata das linhas de fratura, superando limitações radiográficas. As radiografias de Waters, Caldwell, Towne e Hirtz ainda podem ser úteis em casos específicos, enquanto métodos complementares, como a ressonância magnética e a ultrassonografia, auxiliam na avaliação de tecidos moles e em diagnósticos associados. Assim, conclui-se que o diagnóstico eficaz das fraturas Le Fort deve ser fundamentado em uma abordagem multidisciplinar, que associe a análise clínica criteriosa aos métodos de imagens avançados, garantindo maior precisão na identificação da extensão das lesões e um planejamento cirúrgico adequado para restauração funcional e estética do paciente traumatizado, promovendo melhora de sua qualidade de vida.

Palavras-chave: Osteotomia de Le Fort. Diagnóstico por Imagem. Diagnóstico Clínico. Cirurgia Maxilofacial.

RESUMEN

Las fracturas del tipo Le Fort representan uno de los cuadros más complejos y desafiantes de la traumatología facial debido a su elevada gravedad clínica, al potencial compromiso funcional y estético, y a la dificultad diagnóstica derivada de la complejidad anatómica del tercio medio facial. La mayoría de los casos se relaciona con traumas de alta energía, como agresiones y accidentes automovilísticos, que afectan principalmente a hombres jóvenes. El diagnóstico clínico debe basarse en un examen físico minucioso que incluya inspección, palpación y evaluación de la movilidad ósea, además de la identificación de signos como maloclusión, crepitación, edema y epistaxis bilateral. No obstante, la confirmación diagnóstica depende de pruebas de imagen de alta precisión, como la Tomografía Computadorizada de Haz Cónico (TCHC), considerada el estándar de oro por permitir reconstrucciones tridimensionales detalladas y la visualización precisa de las líneas de fractura, superando las limitaciones de la radiografía convencional. Las proyecciones radiográficas de Waters, Caldwell, Towne y Hirtz aún pueden ser útiles en casos específicos, mientras que métodos complementarios como la resonancia magnética y la ecografía contribuyen a la evaluación de tejidos blandos y al diagnóstico de lesiones asociadas. Así, se concluye que el diagnóstico eficaz de las fracturas Le Fort debe fundamentarse en un enfoque multidisciplinario que combine un análisis clínico riguroso con métodos avanzados de imagen, garantizando mayor precisión en la identificación de la extensión de las lesiones y un adecuado planeamiento quirúrgico para la restauración funcional y estética del paciente traumatizado, promoviendo la mejora de su calidad de vida.

Palabras clave: Osteotomía de Le Fort. Diagnóstico por Imagen. Diagnóstico Clínico. Cirugía Maxilofacial.

1 INTRODUCTION

Bone fractures result from the application of a mechanical load greater than the absorption capacity of the tissue, resulting in the rupture of the facial structure and the alteration of local blood flow (Araújo, Gabrielli and Medeiros, 2007). This biomechanical imbalance causes pain, edema, hemorrhage and, in more severe cases, can compromise the airways and adjacent structures, requiring immediate care and an interdisciplinary approach (Mesquita et al., 2019). As for the etiology, according to a study carried out by Zamboni and collaborators in 2017, cases of aggression are the main cause of facial trauma, followed by car and motorcycle accidents, falls, being run over, complications in sports or at work, in addition to injuries caused by firearms. These occurrences reflect social behavior and increased exposure to risk situations in certain population groups (Rao and Raghani, 2013).

Regarding epidemiology, there is a greater involvement of men between the second and third decades of life, a group more exposed to facial traumatology, especially due to associated factors such as the consumption of alcoholic beverages and illicit drugs, more frequently related to this gender (de Moura, Daltro and de Almeida, 2016). According to Almeida et al. 2023, late diagnosis and treatment are more common in this patient profile, which worsens the prognosis and increases the risk of functional and aesthetic complications.

Anatomically, facial trauma is divided into fractures of the upper third, involving frontal bone and supraorbital boundaries; middle third, which may affect, together or individually, the nasal, orbital, maxillary and zygomatic bones; and lower third, where mandibular fractures occur. Fractures in the central region of the face correspond to approximately 70% of all maxillofacial traumas (Kim and Huoh, 2010). This predominance is due to the exposed anatomical position and the relative fragility of the structures of the middle third, often associated with dentoalveolar and orbital fractures (Hupp, Ellis, and Tucker, 2015). Its intimate anatomical connection with other bones of the skull, such as the palatine, sphenoid, ethmoid and vomer, favors the occurrence of associated traumas (Kim and Huoh, 2010).

The classification of fractures involving the middle third of the face, described by René Le Fort in 1901, was based on the orientation of the bone disjunction: Le Fort I, horizontal; Le Fort II, pyramidal; and Le Fort III, cross-sectional (Bilésimo et al., 2025). While type I refers to the separation of the maxilla from the viscerocranium, from the piriform opening to the pterygomaxillary suture area, type II involves the

disengagement of the nasomaxillary complex of the skull, from the zygomatic-orbital rim area. On the other hand, Le Fort III fractures, the most severe, result from sufficiently high facial impingement vectors, capable of promoting the dissociation of the naso-orbito-ethmoid complex, zygomas, and maxilla, configuring a craniofacial separation (Hupp, Ellis, and Tucker, 2015).

The diagnosis of facial trauma, which includes Le Fort fractures, must be thorough and based on a complete detailed clinical and radiographic examination, since, when performed correctly and early, it will provide the best clinical outcome and functional recovery (Silva et al., 2025; Bohneberger et al., 2021). Therefore, the present literature review aims to highlight the methods for diagnosing Le Fort fractures, including the mechanisms performed during the physical examination, the main signs and symptoms presented by trauma patients, and the radiographic techniques that allow a better evaluation of facial bone structures and functional rehabilitation of the maxillofacial complex.

2 METHODOLOGY

This study was carried out based on searches in the PubMed and Scielo databases, using the descriptors DeCs/MeSH: Le Fort osteotomy; Diagnostic Imaging; Clinical Diagnosis; Maxillofacial surgery. Articles in both Portuguese and English were included, aiming to evaluate the recurrent patterns already described in the literature on the subject studied. The selection of studies considered publications from the last 20 years, focusing on literature reviews, case reports, and renowned books in the area that addressed diagnostic and clinical aspects related to Le Fort fractures. Studies that did not specifically address the diagnostic methods applied to fractures of the middle third of the face, including Le Fort classifications, were excluded. After screening, the data were analyzed qualitatively, seeking to identify convergences among the authors for the fabrication of the present work.

3 RESULTS/DISCUSSION

Injuries caused by facial traumatology represent an important public health problem, given that their high frequency, in addition to their significant functional and aesthetic impact, have the capacity to generate significant morbidities (Bohneberger et al., 2021). Le Fort-type lesions, in turn, are extremely complex and represent a great challenge in the scope of maxillofacial surgery, mainly because they also follow the same pattern of possible and

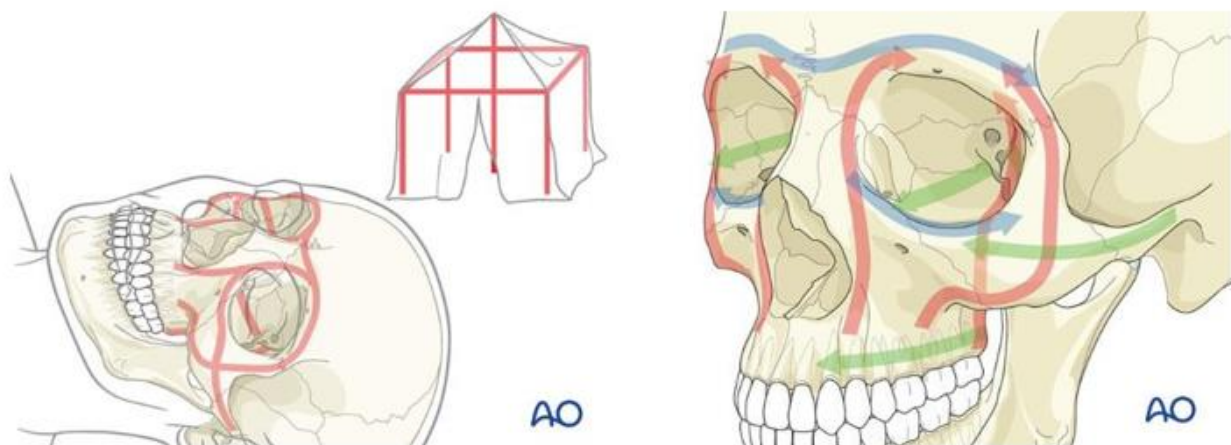
considerable complications that affect not only the functionality, but also the patient's facial aesthetics (Almeida et al., 2023).

Although not all facial fractures require surgical fixation, Le Fort fractures generally imply this need due to the impairment of the resistance pillars of the skull bone structure. The

The main ones are the nasomaxillary, the pterygomaxillary and the zygomatic-maxillary. They act in the absorption of superoinferior forces, but become susceptible to rupture when submitted to anteroposterior vectors. These structures define facial dimensions and, when compromised, result in morphological changes that give a dimorphic aspect to the face. In all Le Fort fractures, the pterygomaxillary pillar is affected, and it is the only one that does not receive surgical fixation due to the difficulty of access, as it is located in the deepest region of the middle third of the face (Hohman, Patel and Waseem, 2024).

Figure 1

Face Resistance Pillars



Source: surgeryreference.aofoundation.org

The trauma patient referred for oral and maxillofacial surgery does not always have immediate treatment of fractures, since, as a rule, the initial management is based on the pre-established protocols of SAVT (Advanced Trauma Life Support). The ABCDE of Trauma is based on the maintenance of the airways, followed by the analysis of the patient's breathing and ventilation, the control and correction of possible hemorrhages, the neurological evaluation and the subsequent total exposure of the body for examination, with the prevention of hypothermia and so that other injuries are not left unattended (Araújo, Gabrielli and Medeiros, 2007). This occurs because, in facial trauma, there is the possibility of immediate

implications in view of the involvement of the upper airways, which can be obstructed by factors such as excessive bleeding, edema, cerebrospinal fluid drainage, and teeth or fragments that may hinder ventilation (Mesquita et al., 2020). Such complications, including vision-threatening conditions, may initially be subtle, which requires two principles: the need for great suspicion on the part of the surgeon and the requirement of frequent reassessment, through secondary examinations, of this trauma patient (Rao and Raghani, 2013).

After stabilization of the patient, through the care of potentially life-threatening injuries, bone treatment should be carried out as soon as possible, within the first week after the trauma. Early intervention prevents the development of sequelae such as pseudoarthrosis, caused by inadequate consolidation of structures, which may require more complex correction surgeries later (Almeida et al., 2023). However, before any procedure, thorough and highly accurate physical and radiographic examinations are necessary, aiming to define the diagnosis in order to consequently establish a favorable prognosis for the patient (Bohneberger et al., 2021). In addition, the discussion of the case in a very clear way by the professionals involved is essential for making decisions about treatment, varying according to the energy of the trauma and the singularities of the patient involved (Mesquita et al., 2020).

3.1 PHYSICAL EXAMINATION

The patient's physical examination should include: inspection of the face in search of signs and symptoms characteristic of these lesions; palpation of bone structures, to evaluate the presence of crepitus and/or steps in the zygomatic-maxillary regions and the nasal complex, mainly; in addition to sensitivity tests to determine whether there was local nervous involvement (Silva et al., 2025). All these protocols are justified by the fact that facial traumas rarely occur in isolation, but rather in association with other injuries. Therefore, intraoral evaluation is equally essential, with attention to the presence of hematomas and dental impairment (Araújo, Gabrielli and Medeiros, 2007).

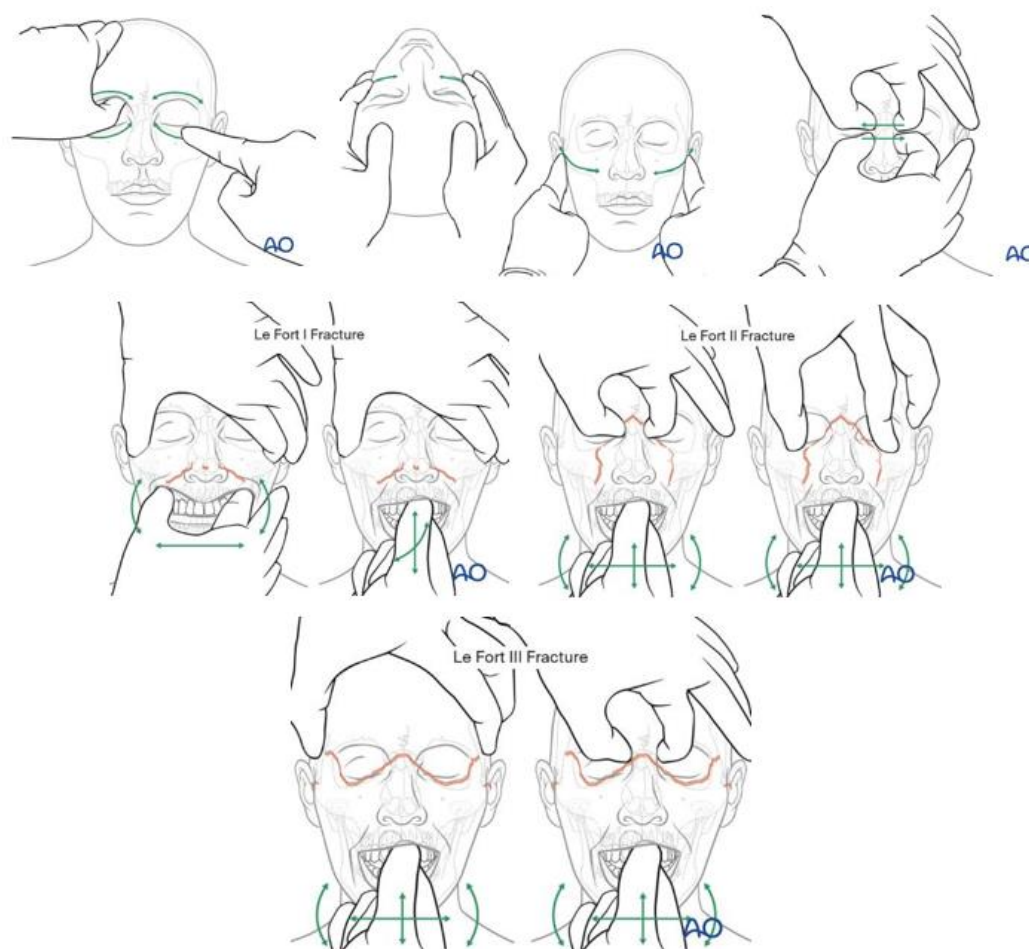
Regarding the symptomatology and profile of these traumas, common signs are: malocclusion, most commonly from the presence of an open bite; trismus; bone crepitation; anosmia (total or partial loss of olfaction); orbital and/or subconjunctival ecchymosis and edema; bilateral epistaxis; and hypoesthesia of the infraorbital nerve, which emerges in the region superior to the canine fossa in the maxilla (Almeida et al., 2023). In addition, Le Fort fractures may also be associated with increased vertical dimension of the face, septal fractures, cerebrospinal fluid fistula and, in more severe cases, significant ocular sequelae

such as diplopia, when there is a fracture of the orbital floor, for example (Araújo, Gabrielli and Medeiros, 2007).

The main palpation method for the diagnosis of Le Fort fractures consists of checking facial bone mobility, which allows the identification of the anatomical structures involved. To do this, the patient's head must be stabilized with one of the operator's hands, while the thumbs and index fingers of the other hand are positioned intraorally to assess maxillary movement through lateral and anteroposterior movements. Digital pressures must also be applied and the mobility of the other bones of the viscerocranium, periorbital ridge, and zygomatic and nasal regions, which may indicate the presence of associated fractures (Hupp, Ellis, and Tucker, 2015).

Figure 2

Steps of the Physical Examination of Le Fort Fractures



Source: surgeryreference.aofoundation.org

3.2 IMAGING EXAMS

After the initial evaluation and clinical examination of the patient, imaging tests are essential for the complete evaluation of the severity of the fracture, as well as to determine its diagnosis and plan

surgical intervention (Gonçalves et al., 2022). Cone-beam computed tomography (CBCT) is the reference method for assessing the level of the lesion and bone fragmentation, which has a three-dimensional reconstruction of the analyzed area by means of coronal, axial, and sagittal sections (Silva et al., 2025). Its proper interpretation requires deep mastery of regional anatomy on the part of the professional in charge (Gonçalves et al., 2022).

Radiography, which is two-dimensional, although not the method of first choice to obtain images of the lesion due to the high overlap of structures, has some views that are still used in these cases (Schuknecht, 2005). They are: the Fronto-naso, also called Caldwell, used mainly for the evaluation of the frontal sinus and orbital edges; the Mento-naso, or Waters, indicated for the diagnosis of fractures of the middle third of the face, allowing the visualization of the maxillary sinuses, nasal septum and ethmoidal cells; and the Fronto-occipital, or Towne, used to analyze the lateral walls of the maxilla, as well as the body and mandibular processes. There is also the Submentovertex, or Hirtz, radiograph, indicated for the examination of the regions of the foramen ovale and spinosum — from which branches of the trigeminal nerve emerge, as well as other regions such as the other sinuses, palate, and occipital bone (Silva et al., 2025).

Each Le Fort type injury has its respective technique for better observation of the fracture extent. While for Le Fort I and II the preference is given to CBCT, the incidence of Waters, always through the performance of two views, can also be used. For Le Fort type III, in addition to these two methods, the OPN test, characterized by the image of the lateral nasal complex, can be requested together (Schuknecht, 2005).

In addition to conventional CT scans and radiographs, magnetic resonance imaging and ultrasonography are alternative and associative exams. Even though they are more expensive, especially CBCT, they have the greatest benefit due to their high sensitivity in identifying fractures, almost completely reducing overlaps and distortions (Gonçalves et al., 2022).

4 CONCLUSION

Le Fort fractures are one of the greatest challenges in the field of facial traumatology, due to their high anatomical complexity, functional impairment and significant aesthetic impact. The diagnosis of these injuries requires the integration of clinical examination and highly accurate imaging methods, considering that the definition of the type and extent of the fracture is decisive for the favorable prognosis of the patient.

Thorough physical examination, which includes inspection, palpation, and evaluation of bone mobility, remains an essential step in identifying characteristic signs of these fractures. However, contemporary diagnostic approaches highlight the importance of imaging studies, especially CBCT, due to their capacity for three-dimensional reconstruction and superior anatomical detailing. These examinations allow for precise surgical planning and the reduction of diagnostic failures resulting from structural overlaps observed on conventional radiographs.

Therefore, it is concluded that the diagnosis of Le Fort fractures should be based on a multidisciplinary approach, supported by the association between detailed clinical evaluation and advanced imaging tests. This integration promotes greater diagnostic safety, favors individualized surgical planning, and contributes to the functional and aesthetic restoration of the face, directly reflecting on the improvement of the quality of life of affected patients.

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