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CARRERA DE ODONTOLOGIA

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Treatment with bone distraction and orthognathic surgery in patients with cleft lip and palate. Most commonly used techniques. Bibliographic review

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Abstract

Cleft lip and palate (CLP) is a frequent congenital anomaly that impairs craniofacial development, compromising masticatory, respiratory, and aesthetic functions. Its treatment involves a multidisciplinary approach, in which orthognathic surgery (OS) and distraction osteogenesis (DO) have emerged as key strategies for correcting maxillary hypoplasia.
Objective: This literature review focuses on describing the most commonly used orthognathic surgery (OS) and distraction osteogenesis (DO) techniques in patients with cleft lip and palate sequelae.
Methods: A systematic search was carried out in databases such as PubMed and Scopus, considering articles published in the last ten years. Clinical studies, systematic reviews, and meta-analyses evaluating the outcomes of OS and DO in adolescents and adults with CLP were included.
Results: The findings indicate that OS is effective in the correction of moderate malocclusions and skeletal deformities, offering immediate results in occlusion and facial harmonization. However, it presents a significant risk of recurrence and velopharyngeal alterations. DO, on the other hand, allows progressive bone regeneration and better adaptation of soft tissues, which favors long-term stability, although it involves a longer process and the use of devices that may cause discomfort.
Conclusion: The selection between OS and DO should be based on the level of maxillary hypoplasia, the patient's age, and functional aesthetic objectives. Further long-term studies and the development of new technologies are required to optimize surgical outcomes and improve the quality of life of CLP patients.

Keywords: Orthognathic Surgery, Osteogénesis, Cleft Lip, Distraction, Cleft Palate.

Resumen

La fisura labiopalatina (FLP) es una anomalía congénita frecuente que afecta el desarrollo craneofacial, comprometiendo la función masticatoria, respiratoria y estética. Su tratamiento implica una intervención multidisciplinaria, en la que la cirugía ortognática (CO) y la distracción osteogénica (DO) han emergido como estrategias clave para la corrección de la hipoplasia maxilar.
Objetivo: Esta revisión bibliográfica se centra en describir las técnicas de cirugía ortognática (CO) y distracción osteogénica (DO) más utilizadas en pacientes con secuelas de labio paladar fisurado
Métodos: Se realizó una búsqueda sistemática en bases de datos como PubMed y Scopus, considerando artículos publicados en los últimos diez años. Se incluyeron estudios clínicos, revisiones sistemáticas y metaanálisis que evaluaran los resultados de la CO y la DO en adolescentes y adultos con FLP.
Resultados: Los hallazgos indican que la CO es efectiva en la corrección de maloclusiones y deformidades esqueléticas moderadas, ofreciendo resultados inmediatos en la oclusión y armonización facial. Sin embargo, presenta un riesgo significativo de recidiva y alteraciones velofaríngeas. La DO, por otro lado, permite una regeneración ósea progresiva y mejor adaptación de los tejidos blandos, lo que favorece

la estabilidad a largo plazo, aunque implica un proceso más prolongado y el uso de dispositivos que pueden generar incomodidad.
Conclusión: La selección entre CO y DO debe basarse en la severidad de la hipoplasia maxilar, la edad del paciente y los objetivos funcionales y estéticos. Se requieren más estudios a largo plazo y el desarrollo de nuevas tecnologías para optimizar los resultados quirúrgicos y mejorar la calidad de vida de los pacientes con FLP.

Palabras clave: Cirugía Ortognática, Osteogénesis, Labio Hendido, Distracción, Paladar Hendido.

INTRODUCTION

Cleft lip and palate (CLP) is the most common congenital craniofacial deformity, affecting approximately 1 in every 700 live births. This condition can be detected from the 16th week of gestation through imaging studies. CLP exhibits a higher incidence in males than in females, with a 2:1 ratio, and a predominance of clefts on the left side compared to the right(1). Orofacial clefts are attributed to multiple factors, including genetic predisposition, exposure to chemicals, radiation, nutritional deficiencies, and poor maternal health during pregnancy(1).

The congenital condition presents maxillary deficiencies in all three dimensions, often accompanied by a constriction of the maxillary dental arch(2). It is proposed that the disorder in the growth of the maxilla may originate from an intrinsic alteration in the embryonic tissue from its first stages of development, aggravated by previous surgical procedures at an early age that leads to a later formation of scars and contractures(3).

In addition, Class III skeletal malocclusions are frequently observed, affecting between 20% and 40% of patients, due to deficient development of the maxilla, which can lead to functional problems, and affect facial harmony(4). Associated severe complications are scar contractures, lip tension, and maxillary hypoplasia, which often coexist with airway narrowing contributing to functional breathing disorders such as mouth breathing, snoring, and obstructive sleep apnea(5).

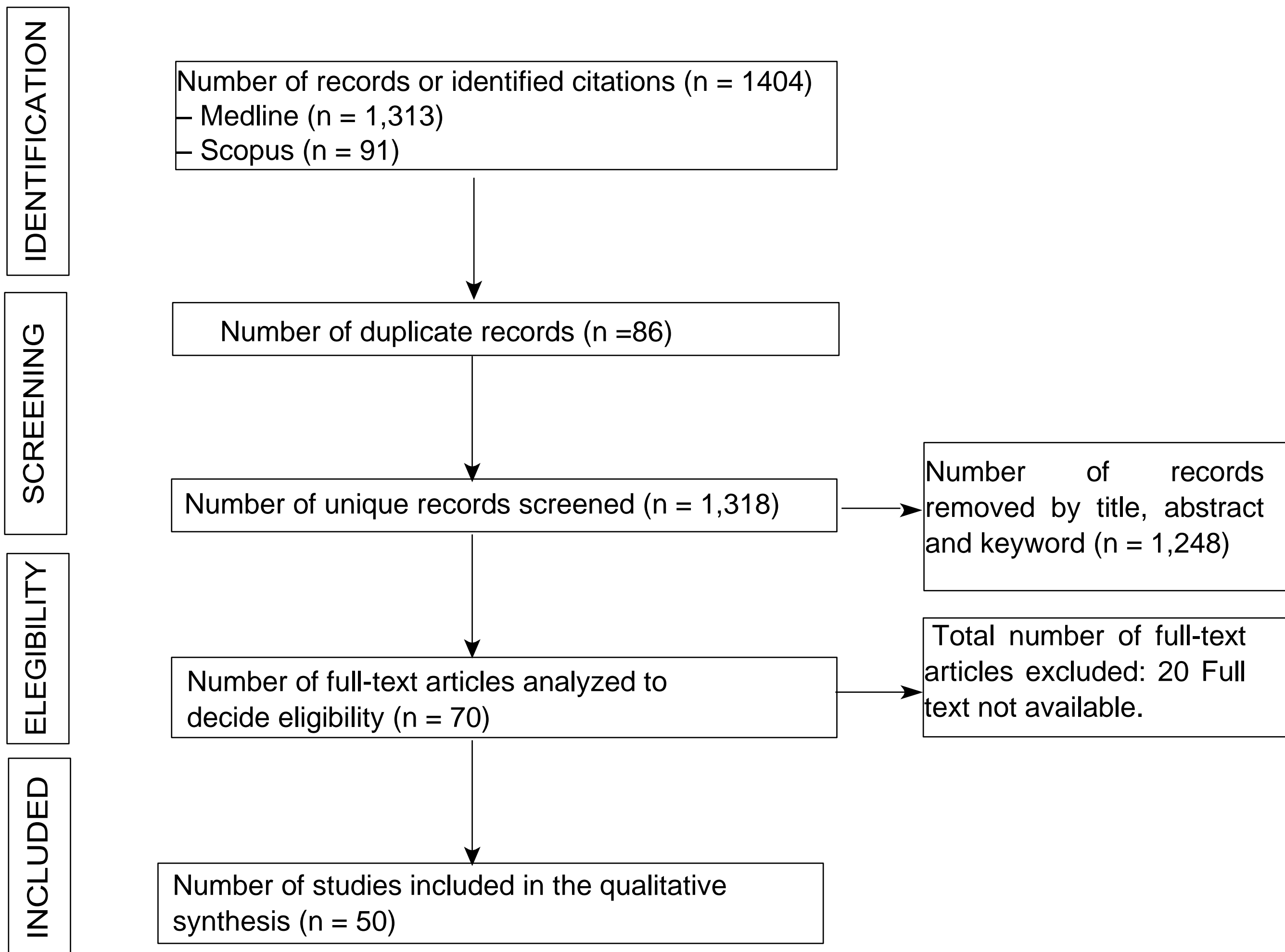
The management of CLP is a challenge that requires the collaboration of a multidisciplinary team of professionals including maxillofacial surgeons, plastic surgeons, orthodontists, and speech therapists. In many cases, treatment varies according to the complexity of the cleft and the specific needs of each patient. For this reason, various surgical procedures are included, ranging from the neonatal period to early adulthood, adjusting to the specific conditions at each stage of development(1)(6).

The present study focuses on describing the orthognathic surgery (OS) and distraction osteogenesis (DO) techniques most commonly used in patients with cleft lip and palate sequelae, this approach will allow us to know the appropriate treatment for each case. It is also intended to serve as an informative resource for students in training who rotate through the cleft lip and palate clinic, facilitating their understanding of the most prevalent malformation of the head and neck.

Material y Methods

A scientific search was performed based on bibliographic reviews and meta-analyses of the last 10 years, in English, using validated scientific information. The search was carried out in recognized databases, obtaining 1,313 results in PubMed and 91 in Scopus. The keywords used included Boolean operators and terms such as: Cleft Lip and Palate, Treatment, Cleft Lip Treatments, Orthognathic Surgery, and Distraction Osteogenesis.

The following inclusion criteria were considered: articles on Distraction Osteogenesis (DO) and Orthognathic Surgery (OS) in clinical cases of adolescents and adults aged 15 years or older, published in the last 10 years, open access, and with bibliography based on studies conducted in different countries. Exclusion criteria included cases related to syndromic conditions, the presence of systemic diseases in the patients studied, duplicate articles, and incomplete research or insufficient data for analysis.



Treatment sequence for cleft lip and palate

The surgical process begins in the neonatal period, where lip closure is recommended at 10 weeks of age or between 2 and 3 months of life. The initial surgical treatment is lip closure, also known as cheiloplasty. This procedure includes the Millard rotation and advancement flap technique, which corrects unilateral and bilateral defects(6).

The next phase under discussion is palatoplasty, an intervention designed to close the cleft palate, facilitating optimal speech development and the prevention of hearing disorders. The planning of this surgery requires a careful balance between the benefits of early repair and possible adverse consequences, such as inhibition of three-dimensional growth of the maxilla. Therefore, it is suggested to perform the surgery between 18 and 36 months of age, this interval allows to minimize iatrogenic restrictions and promote a harmonious development of the arch. and the midfacial region. The most commonly used technique is the Furlow double Z-plasty opposite, used for single-stage palatorrhaphy(1)(6)(7).

Subsequently, alveolar bone grafting, a pioneering technique introduced by Boyne and Sands in 1972, is considered. This procedure is essential in patients with CLP, as it facilitates the closure of the oronasal fistula, reinforces the alar base, and the nasal structure, and ensures the bony stability of the teeth adjacent to the cleft. In addition, it prevents the collapse of the alveolar segments, favoring both spontaneous eruption and orthodontic movement of the canine or lateral incisor[8].

During palatoplasty, a secondary bone graft can be performed, which is recognized as the current standard due to its remarkable success rate. This procedure is typically carried out during the mixed dentition period, ideally between 8 and 12 years old, prior to the eruption of the permanent canine. Performing the graft at this stage maximizes its integration and ensures stability once the canines erupt[7][8].

In later stages, during the period of permanent dentition tertiary bone grafting may be required to correct residual defects or provide additional structural support for prosthetic or implant rehabilitation. On the other hand, primary bone grafting, performed in children under two years of age, is associated with a higher risk of interfering with facial growth, for this reason, its indication is limited to exceptional cases[8].

In the surgical progression of CLP treatment, orthognathic surgery, and bone distraction techniques are categorized as the culminating stage of the surgical process that involves correcting the skeletal deformity and stabilizing the maxillary bones to restore facial function and harmony in patients suffering from the condition.

Orthognathic Surgery

Orthognathic surgery is the result of the evolution of several techniques and contributions of different pioneer surgeons, such as Paul Tessier, Hugo Obwegeser, and William Bell, who have sought to correct facial skeletal deformities, particularly in CLP. The incidence of the need for OS in patients with CLP ranges from 14% to 75% depending on the severity of the cleft. However, it is reported to affect 25% of unilateral cases and 65% of complete bilateral cases[9][10].

This technique consists of the fragmentation and repositioning of the jaws in order to correct dentofacial deformities that affect both the functionality and aesthetics of the face. To carry out this technique rigid fixation is used, such as plates and screws, to maintain the bone position during the healing process to ensure stability and long-term results[11].

Patients with bilateral CLP face multiple issues residual, such as scars, agenesis of incisors lateral, alveolar defects, abnormal nasal anatomy and upper lip muscle dysfunction. Surgery is usually performed in patients over 16 years of age when facial bone growth has concluded, although this varies according to gender[10][11]. Females usually reach bone maturity between the age of 16 and 18 years old, while in males it occurs between 18 and 21 years old. In younger patients, these surgeries are rare due to the risk of interrupting maxillary development or the risk of continued mandibular growth leading to a relapse into a Class III malocclusion[11].

Distraction osteogesis

Distraction osteogenesis, described by McCarthy et al in 1992, is a sophisticated and effective technique for treating severe maxillary hypoplasia, particularly in patients with oral clefts and craniofacial syndromes. This procedure allows for gradual bone regeneration and harmonious adaptation of the surrounding soft tissues such as muscles, nerves, and skin[4][12].

Through the controlled application of a progressive traction force by means of an adjustable distraction device, a remarkable maxillary advancement is achieved without resorting to bone grafts or rigid fixation. This mechanism activates mesenchymal and osteoprogenitor stem cells in the affected area, which differentiate into osteoblasts, responsible for the new bone tissue formation. Simultaneously, fibroblastic growth factors in the zygomatic-maxillary suture respond to mechanical stimulation, adopting a configuration similar to the vascular endothelium. This phenomenon promotes angiogenesis under tension, favoring osteogenesis and facilitating bone regeneration(13).

In addition to correcting the jaw structure, the progress achieved with DO contributes to improving air space, offering a therapeutic or preventive solution to obstructive respiratory disorders such as sleep apnea. Although it stands out for its versatility in growing patients and adults by facilitating soft tissue elongation, it presents significant challenges, such as the physical and emotional impact of prolonged device fixation, the need for additional intervention to remove the internals, and the complexity of precisely controlling the elongation vector, which underscores the importance of rigorous planning(12)(14).

Distraction devices

Mechanical devices are designed specifically to facilitate the DO process and lengthen the bone in a controlled manner, it is classified according to their mechanism of action and anatomical location. In the case of treating CLP, it is essential to include transpalatal support, as this stabilizes both sides of the maxilla, preventing the forces generated by the distractors from negatively affecting the bone structure. Although the alveolar bone graft helps to consolidate the bone in the cleft lip and palate cleft, it may not be strong enough to withstand such pressures, which increases the risk of pathological fracture(15).

Rigid External Distraction Device

The rigid external distraction device (RED) distinguishes itself as the pioneer in midface bone distraction and remains a fundamental tool for repositioning the maxilla and midface. Its configuration includes a cranial halo secured to the skull by pins, connected to a central vertical bar. This design incorporates adjustable horizontal bars that slide along the vertical bar, providing strategic anchorage points for wires attaching distractor plates or orthodontic anchors(15).

One of the main strengths of the RED device is the ability to adjust the distraction vector in multiple directions during the activation phase, in addition to allowing unlimited distraction length. It is also characterized by its ease of operation and the relative simplicity with which it can be removed at the end of the consolidation phase(16).

However, the use of the RED device carries certain inherent risks, such as the possibility of infections at the placement points, displacement of the device, migration of the pins into the skull, hair loss in the fixation areas, and vulnerability to trauma. In addition, its use for a prolonged period of time, which generally varies between 8 and 12 weeks, can be uncomfortable, making it difficult to use in everyday environments such as school or public spaces, negatively impacting the patient's well-being(16).

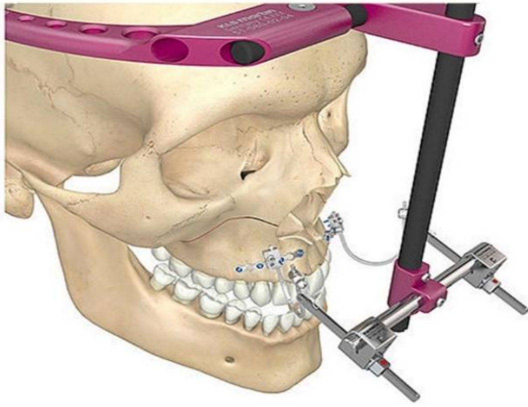


Figure 1. External rigid distractor with parasanal bone anchorage. Source: KLS Martin Group[51].

Internal distraction device

In 1995, Cohen and his collaborators introduced an innovative approach to maxillary advancement using internal devices. These systems offer significant benefits by minimizing physical and emotional impact as their more discreet and functional design favors early reintegration into work and social activities, improving quality of life[17]. Nevertheless, in their first applications, the internal devices faced technical challenges related to the dimensions of the lengthening screws, which limited the extent of the maxillary advancement, and stability problems during the elongation process[18].

Challenges in using these devices include the difficulty in aligning the devices in parallel and symmetrical distraction vectors, as well as the inability to modify the unidirectional vector during the active phase of treatment[19]. Patients may also experience discomfort due to stretching of the oral tissues caused by the distractor rods, and a second surgery to remove the device after bone healing is unavoidable[19]. The most common limitation is the inability to adjust the distraction vector during activation. However, this deficiency can be mitigated by the application of elastics anchored to micro-implants, which allows a more precise control of the vector in devices designed for the midfacial región[20].

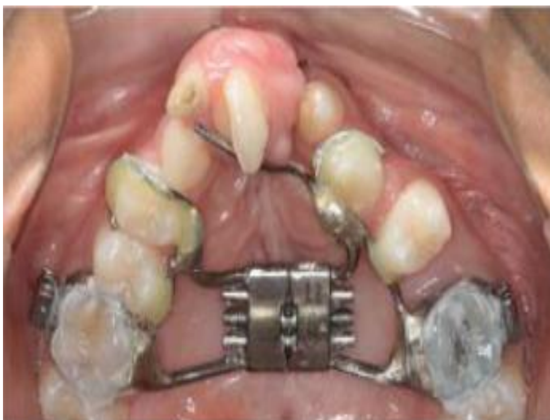


Figure 2. Hyrax disjunctor in a patient with cleft lip and palate. Image taken from: Shaw B, Ngan PW, Yen S. Cleft and Craniofacial Orthodontics. 1st ed. New York: John Wiley & Sons; 2016. p. 291 [52].

Anchorage of distraction devices

Le fort I bone distraction is used in patients with severe maxillary deficiency, requiring displacements greater than 10 mm. It is key to evaluate the bone quality and the

presence of teeth for anchorage since their absence can complicate the use of distractors. An overdistraction of 15 to 25% should be considered to compensate for limited growth post-surgery[21].

The internal anchorage is characterized by being fixed to the upper part of the zygomatic bone by screws, while the lower portion is anchored to the maxilla above the dental roots and below the Le Fort I cut. In some cases, if it cannot be placed directly on the bone, it can be fixed to an appliance on the upper teeth[21]. On the other hand, the external anchorage is used through devices that are attached to the skull with bone screws to keep the distractor in place, thus both upper and lower jaws are connected to bone plates that can go directly to the bone or to an appliance attached to the teeth[21]. Subsequent to the osteotomy, a distraction device is placed, which consists of several stages in the bone distraction process.

Bone distraction phases

Latency phase

After surgery, a latency period of 4 to 7 days is established, during which no lengthening is performed, allowing the bone to begin to heal and stabilize[22][23].

Distraction phase

After the latency period, the distraction process begins, in which the device generates a gradual lengthening of the bone. This process is performed at a rate of 0.5 to 1 mm per day, in intervals of 2 to 4 rhythms, until the desired advancement or expansion is achieved[24].

Consolidation phase

Once the distraction goal is achieved, a consolidation period follows, usually lasting three to six months, during which the bone stabilizes and strengthens[24].

Orthodontic correction or prosthetic rehabilitation phase

Finally, orthodontic correction or prosthetic rehabilitation is carried out to ensure optimal alignment, restoring both esthetics and functionality of the jaw[25].

Radiographic Imaging

In orthognathic surgery and bone distraction, various imaging techniques and analysis methods are used for the planning and evaluation of procedures. Among the most commonly used tools are lateral cephalometric (2D) radiographs, which are considered the standard for examining skeletal and dental relationships in the preoperative and postoperative stages. These radiographs allow the measurement of fundamental parameters, such as SNA, SNB, and ANB angles, as well as the evaluation of changes in facial length and mandibular structures[25].

However, these images have limitations, as they do not provide three-dimensional information or capture complex asymmetries, especially in patients with craniofacial clefts. These cases are usually associated with maxillary deficiencies in the three main axes: vertical, anteroposterior, and lateral, affecting various regions such as nasal, paranasal, infraorbital and zygomatic. To address these limitations, computed tomography (CT or CBCT) is used to provide a detailed three-dimensional (3D)

representation of the skull and its structures. This approach allows for a more accurate assessment of asymmetries, bone quality, and more effective planning of osteotomies[9][26].

Radiographic analysis reveals that the severity of maxillary hypoplasia is linked to the type of cleft. In unilateral cases, the maxillary segment tends to be hypoplastic and is displaced upward, posteriorly, and medially, resulting in a deviation of the maxillary midline toward the affected side. In contrast, bilateral cases usually present an extremely narrow maxilla, due to medial collapse of the posterior alveolar segments[27]. Although mandibular development is not usually compromised in patients with cleft lip and palate (CLP), an anterior open bite and an increase in the angle of the mandibular plane are frequently observed. This is due to a reduction in posterior facial height, resulting in a characteristic elongated anterior facial appearance[28].

Surgical planning

Pre-surgical orthodontic preparation is of utmost importance to optimize the results in patients who will undergo orthognathic surgery. This process includes tooth alignment and arch form restoration. However, in CLP patients undergoing early maxillary distraction, are unlikely to experience significant growth of the anterior maxilla, often requiring final distraction adjustments or orthognathic surgery at the facial maturity stage[29]. In the surgical phase, patients with CLP undergo general anesthesia by nasotracheal intubation to facilitate surgical access and ensure respiratory ventilation.

Surgical process in orthognathic surgery

It is crucial to understand that in these procedures the incisions are made intraorally, in particular in the Le Fort I technique for patients with conventional fissures, the incision is designed following the edge of the fistula present, being adequate for unilateral fissures with minor alveolar defects. Similarly, in unilateral fissures with significant defects, a buccal gingival mucoperiosteal flap is raised over the minor segment of the fissure[15][30]. It may even be necessary to perform additional releases in the periosteum to ensure tension-free closure of the defect. Likewise, in bilateral fissures, incisions are made in both lateral segments, preserving the mucosa over the premaxilla to maintain its vascularization. It should be noted that if the bony junction between the premaxillary and lateral maxillary segments is not sufficient, it may be necessary to extend the incisions to optimize access[31].

From the beginning, the Le Fort I osteotomy is performed according to standard surgical principles. Thus, osteotomies on the zygomatic processes of the maxilla and the lateral wall of the nasal cavity are performed using an oscillating saw and a straight osteotome[31]. Meanwhile, pterygomaxillary disjunction is performed using a curved osteotome, which involves the separation of the maxilla from the cranial bone. For separation of the maxilla, controlled pressure is applied using specialized instruments, such as the Rowe forceps. In addition, a meticulous inspection of the surgical field is performed to release any soft tissue adhesions that may restrict mobility. It is critical to note that during this procedure, the descending palatal neurovascular pedicle remains visible and must be carefully preserved[31].

In patients with fissures, soft tissue adhesions may limit the mobility of the osteotomized maxillary segment. However, to overcome this restriction, gradual and continuous traction should be applied until the planned advancement is achieved, thus allowing the positioning of the maxilla in a prefabricated occlusal splint which is temporarily fixed before proceeding with rigid osteosynthesis in the zygomatic processes of the maxilla and the medial area of the maxilla[29][31].

Afterward, segmentation is performed in which a division of the maxilla is made by means of round drills along a median line, that is, in the center of the maxilla, dividing it into two segments on both sides of the midline of the face. In fact, in patients with bilateral fissures, it is necessary to stabilize the maxilla to avoid uncontrolled movement, therefore a bone graft taken from the iliac crest is placed between the lateral segments of the maxilla and in this way, it also helps to stabilize the premaxillary segment[31] .

In this context, fixation is performed by means of titanium plates and screws, which guarantee immediate stability and correct alignment of the bone segments, ensuring that the position obtained during surgery is securely maintained, while the bone healing process begins[31][32] .

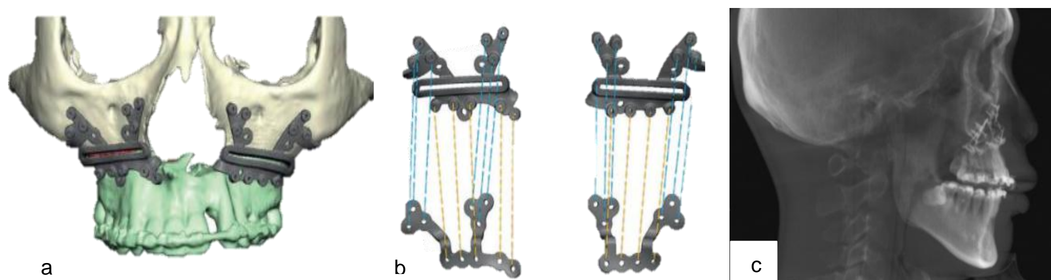


Figure 3. (a) Computerized surgical planning in Le Fort I orthognathic surgery (b) fixation guides (c) lateral cephalic. Image taken from: Shaw B, Ngan PW, Yen S. Cleft and Craniofacial Orthodontics. 2nd ed. New York: John Wiley & Sons; 2023. p. 480- 482 [53].

Surgical process in osseous distraction

There are several surgical methods of osteogenic distraction for the treatment of maxillary hypoplasia, each characterized by differences in the osteotomic cuts performed during the procedure. These are total maxillary distraction osteogenesis (TMDO), anterior maxillary distraction (AMD), and transverse distraction osteogenesis. Each approach presents particularities that allow its adaptation to the specific needs of each patient, with the aim of optimizing both functionality and facial aesthetics[33].

Anterior maxillary osteogenic distraction of the maxilla

The AMD technique is characterized by correcting anterior maxillary hypoplasia and improving labial and nasal support. It is performed using computed tomography (CT) scans of the maxillofacial skeleton, which are sent to a specialized laboratory for the fabrication of a 3D model of the maxilla, to adjust vertical titanium distraction devices on the model, ensuring that they adapt to the specific anatomy[34]. During the surgical procedure, strategic incisions are made to preserve the blood supply to the maxillary bone. At the mucogingival junction from the upper first molar to the other first molar, a vestibular incision is made in order to raise a mucoperiosteal flap[20][34].

The next step in the surgical procedure consists of performing osteotomies at strategic anatomical points to allow controlled mobilization of the maxilla, these include the level of the intermaxillary suture, at the upper lateral wall between the orbital floor and the alveolar rim, at the lower alveolar rim, above the dental roots, and at the pterygomaxillary pillar, freeing the posterior maxilla from the pterygoid processes[35].

At this stage, the distraction appliance is placed, which can be internal or external depending on the technique. In the case of the internal device, the plates are fixed in the maxillary areas using monocortical screws ensuring that the distractor rods are oriented in the desired plane[36]. In contrast, when an external distractor is used, cranial pins are placed on the frontal bones and the distraction arm is positioned over the maxilla using adjustable devices[34][36].

Once the placement is completed, a latency period is waited before starting the activation. Thus, when the final position of the maxilla is reached, the device is maintained during a period of bone consolidation. Finally a second intervention is performed under general anesthesia to remove the device, ensuring the stability of the result obtained and completing the surgical process[37].

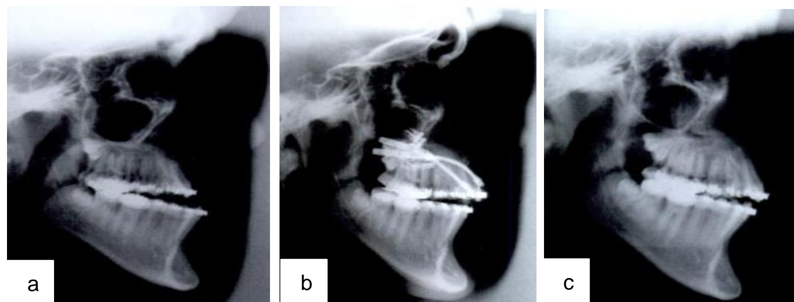


Figure 4. (a) Preoperative lateral cephalic (b) Intraoperative with internal distractor (c) postoperative lateral cephalic. Image taken from: McCarthy JG. Distraction Osteogenesis of the Facial Skeleton. Springer; 2007. p. 18[54].

Total maxillary osteogenic distraction

The TMDO technique is indicated for severe maxillary hypoplasia, this strategy involves the movement of the entire maxilla, and the cuts are made through a horizontal osteotomy at the level of the LeFort I plane, complemented with a vertical section at the pterygomaxillary junction[24][38]. The device to be used is a distractor (RED) since the advantage is that it allows an advance greater than 10 mm. However, it has a high risk of velopharyngeal incompetence when it comes to severe movements although it has greater complications[24][38].

The internal distractor is placed subperiosteally in the maxilla, usually in the posterior region and frontal bone, and fixed with screws to the maxilla and skull base. In contrast, the external distractor is placed using transcutaneous pins that pass through the skin and bone, allowing a gradual adjustment of the maxilla, and is used when intraoral access is limited[38].

Transverse osteogenic distraction

Regarding TDO, it is used to expand the maxilla transversely increasing its width and thus correcting the misalignment of the upper dental arch and the midline, mainly in patients with unilateral cleft lip and palate in which congenital absence of lateral incisors due to insufficient supply near the cleft or deficient mesenchymal support is also noted[39].

For this, it is necessary to evaluate the malocclusion, midline deviation, and anatomical features through radiographic studies. Similarly, previous orthodontic preparation is performed, to then intervene with Le Fort I osteotomy in which an additional vertical cut can be included in the area of the cleft to facilitate the correction of the midline employing the devices[19][39].

Complications

Velopharyngeal insufficiency (VPI) represents a significant postoperative complication in adolescents with LPF undergoing maxillary advancement, in whom both the hard and soft palate are forced to shift forward, potentially compromising velopharyngeal closure(40). This condition is identified by manifesting with hypernasality and nasal emission of air during speech due to anatomical alterations in the velopharyngeal port. Although there is consensus on the increased incidence of IPV after surgery, it ranges from 11% to 24%(41).

Complications related to OS include various clinical aspects, among the most prominent of which is sensory neuropathy of the infraorbital nerve, attributed to retraction, compression, or stretching of the nerve during the procedure, which can cause alterations in sensitivity, whether transitory or permanent. Likewise, maxillary sinusitis is a relevant complication, frequently associated with pre-existing infections, retention of bone fragments in the maxillary sinus, or anatomical modifications induced by the surgery(42).

As for ischemic difficulties, these tend to be more prevalent in patients with previous scarring and reduced vascularization of mucoperiosteal tissues, which increases the risk of necrosis. Similarly, nasal obstruction can arise as a consequence of deformities related to cleft palate or nasal septal deviations, requiring in some cases additional interventions for correction(42).

Risk of relapse by surgical technique

With the Le Fort I technique, there is a relatively high relapse rate (20%) due to factors such as soft tissue tension and previous scarring in CLP patients. In contrast, distraction osteogenesis with devices allows a more natural bone regeneration and a better soft tissue fit, resulting in a lower relapse rate (12%)(43).

Results

Table 1. Surgical techniques

Criteria	Surgery orthognathic	Bone distraction
Indications	Maxillary hypoplasia requiring advancement <6 mm. Asymmetries, malocclusions.	Bone defects with advancement >10 mm.
Age	Adolescents and adults with complete bone growth.	Teenagers in growth.
Requirements previous	Orthodontics presurgical.	Orthodontics presurgical.
Instruments used	Plates, screws, guides surgical.	Bone distractors internal and external

Table 2. Results functional

Criteria	Surgery orthognathic	Bone distraction
Changes functional	Immediate changes class I occlusion.	Progressive shifting with vector adjustment.
Stability over long periods term	High stability in short advances.	Greater long-term stability.

Table 3. Complications

Criteria	Surgery orthognathic	Bone distraction
Complications	Paresthesia, infection, recurrence.	Infection, lack of consolidation, poor fit of the distractor.

Table 4. Overview of techniques surgical

Surgical Technique	Age	Indications	Prerequisites	Instruments Used	Functional Changes	Long-Term Stability	Common Complications
Orthognathic Surgery	≥ 16	Severe malocclusion, maxillary hypoplasia, skeletal Class III, facial asymmetry	Pre-surgical orthodontics, 3D planning, evaluation of occlusion and velopharyngeal function	Reciprocating saws, fixing with mini plates	Correction of malocclusion, improvement of phonation and facial aesthetics	Moderate risk of recurrence, if there is no adequate retention	Infraorbital nerve paresthesia, recurrence, TMJ disorders, infection
Anterior maxillary bone distraction	≥ 16	Severe maxillary hypoplasia with labial incompetence and velopharyngeal abnormalities	Orthodontic evaluation, cephalometry and imaging planning	Internal distractors anchored to the skeleton	Projection of the middle third of the face, improvement of velopharyngeal closure and nasal breathing	Recurrence may occur if post-surgical stability is not maintained.	Bone resorption, screw exposure, residual hypernasality
Total Bone Distraction	≥ 16	Maxillomandibular hypoplasia with global bone deficiency	Cephalometric evaluation, 3D digital modeling, presurgical orthodontics	Rigid distractors fixed with miniplates	Increased maxillary bone volume and improved facial profile, better lip closure	Variable stability, depends on bone retention and consolidation	Lack of consolidation, infection, temporary feeding difficulties, temporomandibular dysfunction

Discussion

The correction of maxillary hypoplasia in patients with CLP and those without cleft poses significant challenges when advances exceed the limits set by the Le Fort I osteotomy. According to Olmez et al, displacements greater than 6 mm in patients with cleft and greater than 10 mm in patients without cleft cannot be achieved with the conventional OS technique, thus underlining the need for treatment under DO gives more bony stability[44].

Austin et al, found that stability is compromised when applying surgical techniques as they observed that greater horizontal recurrence in the maxilla after OS compared to DO when analyzing cephalometric points[45]. Meazzini et al, demonstrated that in adult patients the application of DO is a highly effective procedure and that in pediatric patients the implementation of this procedure is usually motivated by psychological rather than functional reasons, this technique is associated with a risk of skeletal relapse at an early age[46].

According to Yasin et al, the new position of the maxilla after DO generates significant changes in the facial structure and highlights the importance of esthetics as a determining factor in the decision to apply new complementary surgical measures. Among the most frequent interventions are rhinoplasty and genioplasty, which aim to harmonize facial proportions(47).

As described by Kageyama et al, in their case after performing AMD to correct the deficiency of the maxilla, it is necessary in some cases to complement the treatment with a bilateral sagittal osteotomy of the mandibular ramus to correct mandibular prognathism and anterior crossbite to reach a class I occlusion(48). In the comparisons found by Kanzaki et al, they say that AMD has less impact on velopharyngeal function since the posterior segment is stable, while Le Fort I increases the risk of deteriorating velopharyngeal function(49).

Shetty et al, emphasize that orthodontic alignment in the preoperative stage avoids interference with impacted teeth that may interfere with distractor placement, however, the CT scan should be evaluated and the palatal position anchored to the distractor skeleton should be considered since it is possible to address simultaneous orthodontic alignment while keeping the distractor in situ(50).

Conclusion

The choice between sequential treatment of orthognathic surgery and bone distraction should be based on the specific characteristics of each patient. Orthognathic surgery allows advancement of the maxilla in a single step, while bone distraction, although involving a longer and potentially uncomfortable process to induce osteogenesis, has significant advantages, such as a lower recurrence rate and greater long-term stability.

In the case of osseous distraction, this approach has shown benefits in facial soft tissue improvement, such as a more harmonious nasolabial angle, greater upper lip prominence, and a more defined nasal tip elevation. However, it is important to note that in many patients, after distraction, orthognathic surgery will also be necessary to obtain a complete functional and esthetic result. A thorough preoperative evaluation and detailed surgical planning are essential to reduce risks and optimize results. In complex cases, it is necessary to combine surgical techniques, such as bilateral mandibular sagittal osteotomy, to achieve adequate functional occlusion. Future research into the optimization of surgical techniques with the use of advanced technologies should continue to improve long-term results.

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