Treatment of Severe Maxillary Hypoplasia With Combined Orthodontics and Distraction Osteogenesis

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Abstract: Distraction osteogenesis (DO) is a technique that allows the generation of new bone in a gap between 2 vascularized bone surfaces in response to the application of graduated tensile stress across the bone gap.

Distraction osteogenesis has become a routine treatment of choice to correct skeletal deformities and severe bone defects in the craniofacial complex over the past decade. Distraction osteogenesis has been successfully chosen in lengthening the maxilla and the mandible; in the maxilla and recently in the mandible, the jawbones have been distracted and widened transversely to relieve severe anterior dental crowding and transverse discrepancies between the dental arches.

Distraction osteogenesis for maxillary advancement started in 1993 and is now widely used, especially in patients with skeletal Class III malocclusion caused by maxillary hypoplasia.

The aim of this study was to present the efficiency of combined orthodontic and DO in the severe maxillary hypoplasia.

A 35-year-old Italian man presented to our clinical practice with the chief complaint of esthetic and functionally problems because of skeletal Class III malocclusion with anterior crossbite.

Considering that the severity of the skeletal discrepancy is remarkable but compensated by the DO potential, the combined orthodontic and DO treatment was considered adequate, like less invasive and equally effective.

It was obtained a good alignment with the upper and lower arch dental alveolar maxillary advancement that allowed to correct the sagittal relationships.

The patient was satisfied for the treatment results and had considerable improvement in his self-esteem.

Key Words: Distraction osteogenesis, maxillary hypoplasia, osteodistraction

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Distraction osteogenesis (DO) is a technique that allows the generation of new bone in a gap between 2 vascularized bone surfaces in response to the application of graduated tensile stress across the bone gap.[1,2]

Distraction can relate the maxilla or the mandible, unilaterally or bilaterally, and can correct deficiencies on the 3 spatial planes.

Codivilla[2] was the pioneer of the union between the techniques of osteotomy and skeletal distraction to achieve lower limb lengthening. He developed a "continuous extension" procedure for the lower limb fractures treatment.[2]

Sonntag and Rosenthal[3] has shown the ability to stretch the mandible bone in a microgenia patient and Wassmund[4] advanced the maxilla in a patient with hypoplasia of the upper jaw.

Ilizarov[5] used the principles of DO for orthopedic practice, to reconstruct long bone fractures. McCarthy et al[6] published the first clinical reports of mandibular ramus lengthening by gradual distraction with the use of an extraoral distraction device. After the experience of Molina and Ortiz-Monasterio,[7] intraoral devices replaced only extraoral appliances. Distraction osteogenesis has become a routine treatment of choice to correct skeletal deformities and severe bone defects in the craniofacial complex over the past decade. Distraction osteogenesis has been successfully chosen in lengthening the maxilla and the mandible; in the maxilla and recently in the mandible, the jawbones have been distracted and widened transversely to relieve severe anterior dental crowding and transverse discrepancies between the dental arches.[6,8–16] Distraction osteogenesis for maxillary advancement started in 1993 and is now widely used, especially in patients with skeletal Class III malocclusion caused by maxillary hypoplasia.[17–22]

Molina and Ortiz-Monasterio originally presented the concept of gradually advancing the maxilla after Le Fort I corticotomy.[23] In their technique, an orthodontic facemask with elastic was used to deliver the traction force to the maxilla. This technique had several shortcomings, such as not delivering controlled forces, pressure sores on the chin and forehead, compliance, and the inefficiency to advance the maxilla sufficiently to correct severe cleft maxillary hypoplasia.

Later on, Polley and Figueroa modified this technique; they proposed a rigid, external, and adjustable distraction device to lengthen the entire maxilla for the treatment of severe maxillary deficiency in children and adolescents with cleft problems (RED I; KLS Martin, Tuttlingen, Germany). This technique has been applied to treat severe mid-facial hypoplasia related to cleft lip and palate or other syndromes. In this clinical report, we present the treatment of an adult cleft patient who had skeletal Class III malocclusion because of maxillary hypoplasia.

The aim of this study was to present the efficiency of combined orthodontic and DO in the severe maxillary hypoplasia.

PATIENT AND METHODS

A 35-year-old Italian man presented to our clinical practice with the chief complaint of esthetic and functionally problems because of skeletal Class III malocclusion with anterior crossbite.

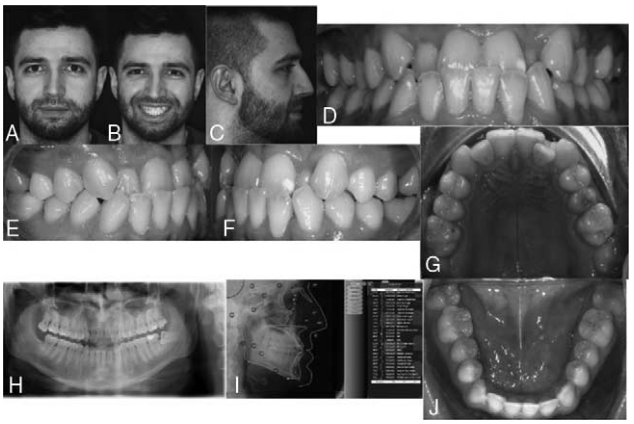

FIGURE 1. (A-J) Records before treatment.

The extraoral clinical examination revealed a slightly asymmetric face with a deviation to the right of the mandibular symphysis.

The three-thirds of the face are well balanced, but skeletal pattern appears brachifacial (Fig. 1A).

The exposure to smile is lacking, the mid-lines are slightly decentralized, with the maxillary jaw deviation to the left and the mandibular jaw deviation to the right, following the mandibular symmetry (Fig. 1B).

The profile shows a predominance of the mandible with a maxilla slightly retrusive and a nasolabial angle slightly open; furthermore, the competence of the lips is good and pogonion appears to be accentuated (Fig. 1C).

Also the frontal photography shows the displacement between mandible and maxilla, with the presence of an anterior crossbite and a midline shifted (Fig. 1D).

The transverse dimensions are good, and from this point of view, the jaw and the jaw are balanced; however, the posterior mandible segment was to be compensated with very accentuated Wilson curve.

An intraoral examination revealed a bilaterally Class I canine relationship and light Class III molar relationship (Fig. 1E-F).

The upper arch is well proportioned with the upper lateral incisors in a palatal position, and is lacking space in the arch for their repositioning (Fig. 1G).

The lower arch is presented slightly disproportionate, with a slight misalignment and the third quadrant which presents an accented curve of Wilson (Fig. 1H).

The orthopantomography shows all elements visible, with the exception of the element 4.8, and 3.8 is tilted 90° and therefore need to be removed at the end of treatment; the upper third molars instead are extruded due to the absence of the antagonist (Fig. 1I).

The lateral cephalometric analysis (Fig. 1J) shows the mandibular overdevelopment and maxillary growth restriction with a brachifacial skeletal pattern (SNA angle [Sella-Nasion-A point]: 78.4°; SNB angle [Sella-Nasion-B point]: 80.6°; ANB angle [A point-Nasion-B point]: −2.2°).

The inclination of the upper incisors is correct, as well as of the lower incisors, the maxillary retrusive results to be compared with the remaining structures (IMPA angle [incisor mandibular plane angle]: 99.4°).

TREATMENT OBJECTIVES

The treatment objectives were to correct the skeletal Class III relationship with an improvement of the facial profile, the Class III molar relationship and the anterior crossbite, the maxillary yaw deviation; and to satisfy the patient's esthetic improvement request.

Treatment Alternatives

Based on the treatment objectives, the following treatment alternatives were considered:

(1) Combined orthodontic and orthognathic surgery.
(2) Combined orthodontic and DO treatment. The maxillary advancement would be done with DO.

Considering that the severity of the skeletal discrepancy is remarkable but compensated by the DO potential, the second choice was considered adequate, like less invasive and equally effective.

Treatment Progress

Surgery was carried out under general anesthesia.

An incision in the superior vestibular fornix was performed with rhino-tracheal intubation, and mepivacaine and vasoconstrictor infiltrations.

Dissection planes were completed up to periosteum plan, which was engraved.

The operation was continued with the elevation of premaxillary region highlighting piriform aperture, disconnecting the nasal mucosa.

Osteotomy with a drill was completed with a chisel in the premaxillary region, passing at the inter-radicular level among dental elements 1.2 to 1.3 and 2.2 to 2.3. The roots were appropriately apart at the level of the presurgical orthodontic preparation, in order to avoid root injuries, and passing on the anterior region of the palate bone previously detached.

Once the osteotomy was completed, the mobilization of the premaxilla allowed gaining the correct position of the maxillary incisal group with correct overbite.

The patient was finally bonded with a 0.022-inch slot preadjusted appliance and McLaughlin-Bennet-Trevisi prescription (full size; 3M Unitek, Monrovia, CA). Leveling and aligning was initiated with 0.016 inch and completed with 0.019 × 0.025-inch heat-activated Ni–Ti wires. Finally, 0.019 × 0.025-inch stainless steel wires were placed.

The orthodontic treatment lasted for 9 months.

To retain the obtained results, a heterologous bone in osteomized zone was inserted, with simultaneous metal ligation at the 1.2 to 1.3 and 2.2 to 2.3 levels, and additional resinous materials, in order to ensure the highest possible rigidities of the osteotomies.

In addition, to protect the fragment, a steel arch 0.45, bonded with resinous materials to the front maxillary elements, was inserted into the cannulas welded on first upper molars bands.

RESULTS

Post-treatment extraoral and intraoral photographs, cephalograms and orthopantomography were taken (Fig. 2).

It was obtained a good alignment with the upper and lower arch dental alveolar maxillary advancement that allowed to correct the sagittal relationships. The inclination of the upper incisors is slightly accentuated, as it was with conversion potential treatment no extraction.

However, a good relationship also of smile areas between the upper and lower elements was obtained; SNA increase of 4° (82.4°), SNB increase of 0.7° (81.3°), ANB increase of 3.3° (1.1°), and IMPA decrease slightly (98.3°).

The transverse relations were maintained while the sagittal relations have improved, finishing the clinical patient with a first class molar and canine bilaterally.

The patient was satisfied for the treatment results and had considerable improvement in his self-esteem.

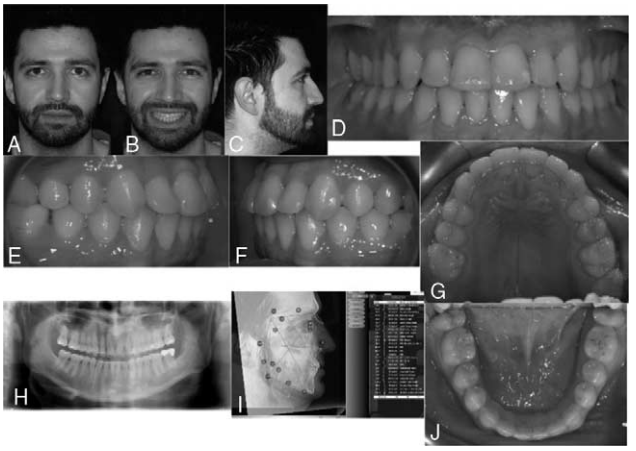

FIGURE 2. (A-J) Records before treatment.

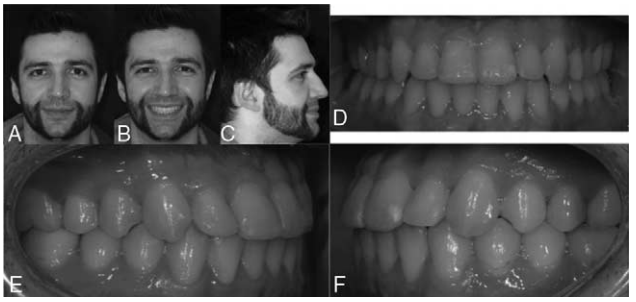

FIGURE 3. (A-F) Records 2 years away from the treatment end.

DISCUSSION AND CONCLUSIONS

The DO has allowed to obtain a good profile, although there is still a dominance of the jaw, as it has not been treated surgically. The nasolabial angle is around 90° and then is certainly improved. However, the DO of the maxilla is certainly a viable and less invasive alternative to orthognathic surgery, and it is stable over time (Fig. 3).

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