



The Correction of Maxillary Deficiency with Internal Distraction Devices: A Multidisciplinary Approach

A Alper Öz, Mete Özer, Lütfi Eroglu, Oguz Suleyman Özdemir

ABSTRACT

Aim: The purpose of this case report is to present the orthodontic, surgical and restorative treatments in the case of an operated cleft lip and palate and severe maxillary deficiency in a 14-year-old female patient.

Background: Only orthodontic treatment could be inefficient for cleft lip and palate patients characterized with maxillary hypoplasia. Orthodontic and surgical treatment shows sufficient results, especially with severe skeletal deficiency.

Case report: A cleft lip and palate patient required complex multidisciplinary treatment to preserve health and restore esthetics. Dental leveling and alignment of the maxillary and mandibular teeth were provided before the surgery. Maxillary advancement and clockwise rotation of the maxillary-mandibular complex was applied by a Le Fort 1 osteotomy with two internal distraction devices. After the active treatment including orthodontic treatment and orthognathic surgery, upper full mouth ceramic restoration was applied.

Conclusion: This report shows the efficiency of internal distraction devices in cleft lip palate patients and exemplifies the multidisciplinary care required for such difficult cases.

Clinical significance: Stable improved occlusion and skeletal relations were observed after a follow-up examination period of 12 months.

Keywords: Internal distraction, Cleft lip and palate, Maxillary deficiency.

How to cite this article: Öz AA, Özer M, Eroglu L, Özdemir OS. The Correction of Maxillary Deficiency with Internal Distraction Devices: A Multidisciplinary Approach. *J Contemp Dent Pract* 2013;14(5):957-962.

Source of support: Nil

Conflict of interest: None declared

INTRODUCTION

Gavril Ilizarov, a Russian physician, further developed the technique for lengthening bones and applied distraction osteogenesis (DO) to the enchondral bones of the upper and lower extremities.¹ Application of DO to the human

craniofacial skeleton on the midface for the treatment of craniofacial deformities was first introduced by Cohen et al using a distractor device.²

Le Fort 1 osteotomy is a frequently performed procedure for maxillary deficiency to protract the maxilla, and some studies have shown that Le Fort 1 advancement osteotomy is a stable and surgically predictable procedure.³ Conventional orthognathic surgery techniques may not be stable in the cleft lip and palate patients due to scarring and severe deficiencies.³ However, it has been reported that maxillary advancement with DO in cleft palate patients is stable.⁴ Because of skeletal deficiency, these patients generally exhibit poor bone formation. Therefore, rigid fixation techniques, such as screws, are difficult to use. By limiting of the maxillary advancement through the palate scar and the patient's velopharyngeal efficiency, a Le Fort 1 osteotomy could result in undesirable effects that cause unsatisfactory treatment results. In the treatment of unilateral and bilateral cleft lip and palate patients, better results have been reported with distraction of the deficient maxilla compared to conventional surgical methods. Extraoral^{5,6} and intraoral^{7,8} distraction devices are both used in such patients who present maxillary hypoplasia. The rigid external distractor (RED) is the widely used device for maxillary advancement but especially due to the patient comfort and some complications, internal craniofacial distraction devices are also alternative appliances for maxillofacial deformities.^{7,8}

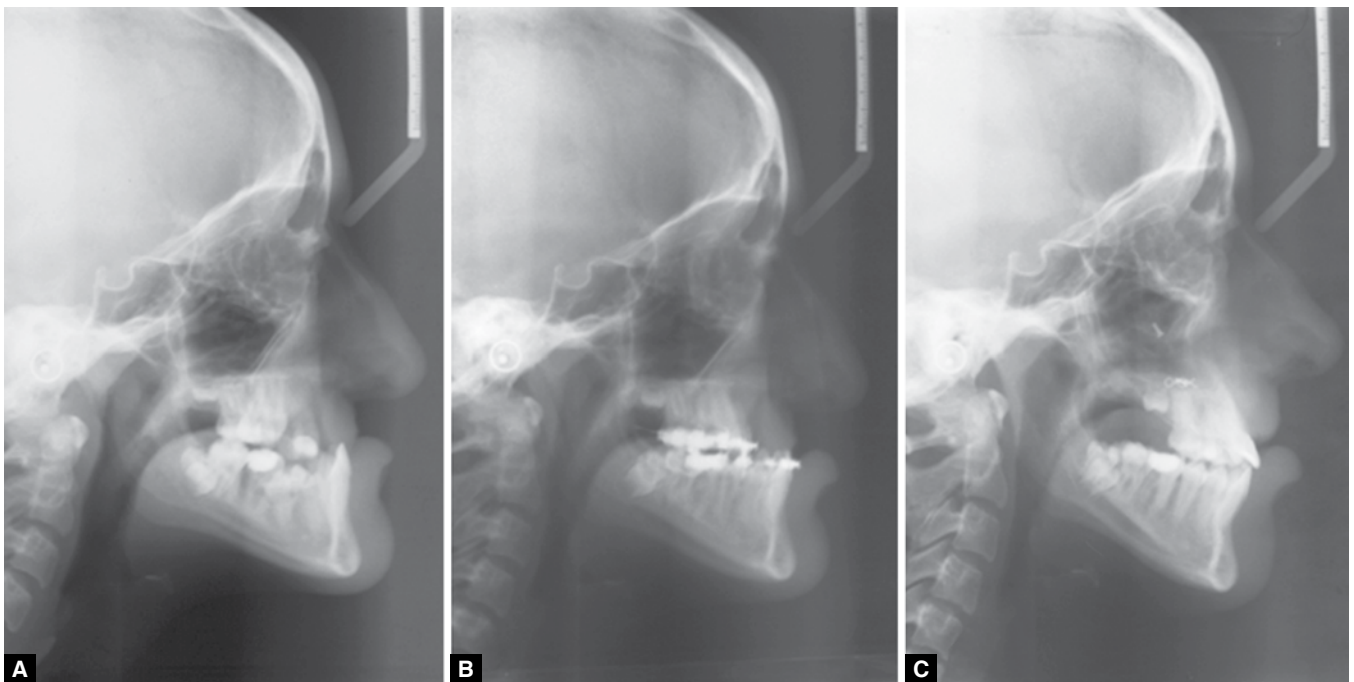
The purpose of this case report is to present the orthodontic and orthognathic surgical treatment of a patient in which internal distraction devices were used to treat severe maxillary hypoplasia with cleft lip and palate.

CASE REPORT

The patient was a female who was 14 yearsold when she received orthodontic treatment in our orthodontic clinic. She



Fig. 1: Pretreatment records of the patient



Figs 2A to C: Lateral cephalometric radiographs. (A) Pretreatment; (B) before the surgery and (C) Post-treatment

had a congenital right complete cleft lip and palate, which had been repaired in childhood and class III malocclusion with severe maxillary hypoplasia and mandibular prognathia. The patient's past medical history included a series of surgical operations, including cheiloplasty and palatoplasty. Other medical problems were determined for the combined orthodontic and orthognathic surgery treatment.

Clinical examination revealed a concave profile, nasal deformity and vestibular scarring. Intraoral examination found palatal scarring after the surgical procedures, severe crowding in the upper arch, lingually inclined upper incisors due to vestibular scarring and severe underjet (Fig. 1). Some teeth were missing on the upper arch, and the unilateral cleft was on the right premaxillar region.

Table 1: Summary of cephalometric

	<i>Pretreatment</i>	<i>Before surgery</i>	<i>Post-treatment</i>	<i>Norm</i>
SNA (°)	69	69	77	81 ± 3
SNB (°)	79	80	75	78 ± 3
ANB (°)	-10	-11	2	3 ± 2
A-N ⊥ FH (mm)	-9	-8	0	0 ± 1
Pg- N ⊥ FH (mm)	7	7	-3	-4
SN-GoGn (°)	33	34	41	32 ± 6
NL-ML (°)	24	23	30	25 ± 5
1-NA (°)	19	21	31	22
1-NL (°)	98	100	119	109
1-NB (°)	3	12	27	25
1-ML (°)	69	77	88	94 ± 4.5
PLi-EL (mm)	-5	-7	-1	0 ± 2
PLi-SL (mm)	3	7	4	0
PLs-EL (mm)	-19	-19	-13	-2
PLs-SL (mm)	-8	-9	-4	-8

Radiographic examination, including a panoramic radiograph, showed the absence of upper laterals, first and second premolars on the left, second premolar on the right side. There was no graft material or bone formation on the cleft region. A lateral cephalogram showed deficient and posteriorly positioned maxilla relative to the cranial base and the mandible (Fig. 2 and Table 1).

A combined surgical-orthodontic treatment was planned for the patient. The orthodontic treatment involved the leveling and alignment of the teeth before the distraction osteogenesis procedure. The orthodontic appliances were bonded, and NiTi open coil was placed between the upper right canine and molar because of the lack of space for the upper right first premolar to erupt correctly. After 14 months,

**Fig. 3:** Before the surgery



Fig. 4: Post-treatment records just after the active orthodontic therapy

the leveling and alignment of the teeth had been completed, and 0.021×0.025 inch stainless steel arch wires were placed, and a palatal arch was bonded to the upper molars to reinforce all the maxillary teeth before the orthognathic surgery (Fig. 3). Two internal maxilla distraction devices for midface distraction were determined. The maximum distracted length permitted by the device was 20 mm.

After a 1 week latency period, the distraction devices were activated at a rate of 1 mm per day for 20 days. On the fourth day, there was an increase in the vertical dimension of the face owing to slight downward movement. Sufficient advancement of the maxilla could not be achieved because of the resistance of the scar in the palatine tissue. Cephalometric analysis demonstrated the downward movement of the maxilla and the resistance at the palatine tissue. Then we decided to apply reverse headgear-assisted traction with heavy elastics to control the vector of the movement. After traction was applied to the maxilla with an extraoral appliance and internal distractor devices, forward movement was achieved, but downward maxillary movement also occurred at the end of the distraction procedure.

Intermaxillary class III elastics were used immediately to correct the malocclusion when distraction was completed. After a 3 month consolidation period, the distraction devices were removed and orthodontic treatment was continued to detail the occlusion and positions of the teeth.

At the end of the combined orthodontic and orthognathic surgery treatment, the position of the maxilla relative to the cranial base and the mandible was satisfactory; there was also considerable improvement on soft-tissue profile and the occlusion (Figs 2, 4 and 5). Before prosthodontic rehabilitation, a small aesthetic operation including the upper lip was done to allow for a pleasant smile. After 6 months of follow-up, a lateral open bite occurred although the patient used the retention appliances. A full-mouth ceramic restoration was planned in order to reinforce the maxillary teeth because of the lateral open bite and the necessity of permanent retention. Periodontal treatment was performed for prosthetic approach. A metal supported fixed partial denture design was applied to upper right first molar to upper left first molar in maxillary jaw (Fig. 6).



Fig. 5: Superimposition of the pre-and post-treatment cephalometrics

DISCUSSION

One of the most difficult problems in orthodontics and craniofacial surgery is cleft lip and palate, which is a congenital abnormality. Maxillary hypoplasia and class III malocclusion appears early in life in these patients.⁹ Distraction osteogenesis and conventional orthognathic surgery are both usable in skeletal class III malocclusions, but there are differences in the indications between the two methods. Age, amount of advancement, osteotomy design, need for bone grafts, postoperative care, complications, stability/relapse and impact on speech all effects the surgeon's decision.^{7,9}

The DO technique has been successfully applied to young children, adolescents and adults with craniofacial deformities. A meta-analysis had concluded that DO tends to be preferred over conventional osteotomy for younger cleft lip and palate patients with more severe deformities.⁹ The major difference is that the maxilla is slowly advanced into the objective occlusion at the DO. Orthognathic surgery can produce limited maxillary advancement but it shows more predictable control for correction of the occlusion than distraction does. Distraction has a greater protraction distance and advancement of the maxilla, so DO is more useful in patients with severe maxillary hypoplasia.^{10,11} Conventional orthognathic osteotomy techniques, such as Le Fort 1 surgery, may not be stable in cleft lip and palate patients due to scarring and severe movement of the maxilla.³ The clinical results after correction of sagittal maxillary deformities with DO have been stable in both adults and young patients.⁴ In the present case, we preferred to advance the maxilla by distraction osteogenesis because of the advancement distance and the possibility of relapse.

The rigid external distractor (RED) appliance is an effective technique for the correction of maxillary hypoplasia in patients with orofacial clefts but there are some complications, such as pin loosening, pin site infection, pin penetration, pressure sores, nerve injury, pin site bleeding, dysphagia, pin scars and patient discomfort.¹² The biggest disadvantage of the RED is that it create a difficult psychosocial situation for the patient.¹³ On the



Fig. 6: After the ceramic restorations

other hand, internal distraction devices save the patient from the psychosocial effects that come from the use of external skeletal distractor devices.

The greatest advantage of RED devices is that, most of them can be manipulated to move the maxilla in three dimensions. But internal distraction devices can be useful with careful planning of the vector of movement with presurgical setup. The maxilla exhibits better stability when using internal distraction because the internal devices act as rigid fixation during the period of consolidation.¹³

Because of the slow movement of the surrounding mucosal and muscular tissues, a better opportunity to adapt to the skeletal changes than with the sudden changes produced by conventional surgical osteotomy procedures. Some studies report that velopharyngeal insufficiency of cleft lip patients increased after Le Fort 1 surgery.^{14,15} However, one study showed that the risk for velopharyngeal insufficiency following maxillary distraction is similar to the risk observed in conventional maxillary advancement.¹⁶ Articulation improved in the patient, in this report, by the 12-month follow-up.

CONCLUSION

The female patient with cleft lip and palate was successfully treated with a combined treatment using DO. The most important advantage of DO of the maxilla seems to be a greater advancement distance than that produced by conventional osteotomy techniques. Because of the disadvantages of external devices, internal distraction osteogenesis could be a useful technique for maxillary hypoplasia.

CLINICAL SIGNIFICANCE

Internal distraction devices could be alternative appliances for correction of maxillary deficiency with DO and showed stable results after a follow-up examination period of 12 months.

REFERENCES

1. Swennen G, Schliephake H, Dempf R, Schierle H, Malevez C. Craniofacial distraction osteogenesis: a review of the literature. *Int J Oral Maxillofac Surg* 2001;30:89-103.
2. Cohen SR, Rutrick RE, Burstein FD. Distraction osteogenesis of the human craniofacial skeleton: initial experience with a new distraction system. *J Craniofac Surg* 1995;6:368-374.
3. Hoffman GR, Brennan PA. The skeletal stability of one-piece Le Fort 1 osteotomy to advance the maxilla (part 1): stability resulting from non-bone grafted rigid fixation. *Br J Oral Maxillofac Surg* 2004;42:221-225.
4. Figueroa AA, Polley JW, Friede H, Ko EW. Long-term skeletal stability after maxillary advancement with distraction osteogenesis

using a rigid external distraction device in cleft maxillary deformities. *Plast Reconstr Surg* 2004;114(6):1382-1394.

5. Figueroa AA, Polley JW, Ko EW. Maxillary distraction for the management of cleft maxillary hypoplasia with a rigid external distraction system. *Semin Orthod* 1999;5:46-51.
6. Ko EW, Figueroa AA, Polley JW. Soft tissue profile changes after maxillary advancement with distraction osteogenesis by use of a rigid external distraction device: a 1-year follow-up. *J Oral Maxillofac Surg* 2000;58:959-969.
7. Wang XX, Wang X, Yi B, Li ZL, Liang C, Lin Y. Internal midface distraction in correction of severe maxillary hypoplasia secondary to cleft lip and palate. *Plast Reconstr Surg* 2005;116:51.
8. Karakasis D, Hadjipetrou L. Advancement of the anterior maxilla by distraction (case report). *J Craniofac Surg* 2004;32:150-154.
9. Cheung LK, Chua HDP. A meta-analysis of cleft maxillary osteotomy and distraction osteogenesis. *Int J Oral Maxillofac Surg* 2006;35:14-24.
10. Polley JW, Figueroa AA. Management of severe maxillary deficiency in childhood and adolescence through distraction osteogenesis with an external, adjustable, rigid distraction device. *J Craniofac Surg* 1997;8(3):181-185.
11. Polley JW, Figueroa AA. Rigid external distraction: Its application in cleft maxillary deformities. *Plast Reconstr Surg* 1998;102(5):1360-1372.
12. Garfin SR, Botte MJ, Waters RL, Nickel VL. Complications in the use of the halo fixation device. *J Bone Joint Surg Am* 1986;68:320-325.
13. Drew SJ. Maxillary distraction osteogenesis for advancement in cleft patients, internal devices. *J Oral Maxillofac Surg* 2008; 66:2592-2597.
14. Mason R, Turvey TA, Warren DW. Speech considerations with maxillary advancement procedures. *J Oral Surg* 1980;38: 752-758.
15. Watzke I, Turvey TA, Warren DW, Dalston R. Alterations in velopharyngeal function after maxillary advancement in cleft palate patients. *J Oral Maxillofac Surg* 1990;48:685-689.
16. Guyette TW, Polley JW, Figueroa A, Smith BE. Changes in speech following maxillary distraction osteogenesis. *Cleft Palate Craniofac J* 2001;38(3):199-205.

ABOUT THE AUTHORS

A Alper Öz (Corresponding Author)

Assistant Professor, Department of Orthodontics, Ondokuz Mayıs University, Turkey, e-mail: alperoz@hotmail.com

Mete Özer

Associate Professor, Department of Orthodontics, Faculty of Dentistry Ondokuz Mayıs University, Turkey

Lütfi Eroglu

Associate Professor, Department of Plastic, Reconstructive and Esthetic Surgery, Faculty of Medicine, Ondokuz Mayıs University Turkey

Oguz Suleyman Özdemir

Prosthodontist, Department of Prosthodontics, Dental Care Hospital Samsun, Turkey