RESEARCH PAPER | Medical Science | Volume : 6 | Issue : 5 | May 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

Distraction Osteogenesis for a Patient With Unilateral Cleft Lip and Palate

KEYWORDS: Cleft Lip and Palate, Maxillary Hypoplasia, Distraction Osteogenesis, Orthognathic Surgery

Dr. Nandakishore
Reader, Dept. of Orthodontics, A. B. Shetty Memorial Institute of Dental Sciences

*** Dr. Aniket Potnis**
PG Student, Dept. of Orthodontics, A. B. Shetty Memorial Institute of Dental Sciences.
* Corresponding Author

Dr. Vikram Shetty
Director & Head, Nitte Meenakshi Institute of Craniofacial Surgery

Dr. U. S. Krishna Nayak
Dean & Head, Dept. of Orthodontics, A. B. Shetty Memorial Institute of Dental Sciences

ABSTRACT *Cleft lip and palate are commonly noticed congenital deformities in the orofacial area causing several functional and esthetic problems. The management of maxillary retrusion in cleft lip and palate patients is performed using Le Fort I advancement or distraction osteogenesis using an external or an internal device. Distraction mostly involves movement of the entire maxilla at the Le Fort I level and is characterized by a higher relapse. Distraction of the anterior maxilla using a tooth-borne palatal distractor similar to the one proposed by Gunaseelan et al (J Oral Maxillofac Surg 65:1044, 2007) has previously yielded stable results. A modification of this technique by placing the distractor postoperatively after performing the osteotomy cut was followed. The main advantage of this modification is that more control over the vector can be achieved and chances of cement failure caused by contamination and an inability to achieve isolation is drastically decreased.*

Introduction:
Distraction osteogenesis (DO) is the process of generating new bone in a gap between two bone segments in response to the application of graduated tensile stress across the bone gap. Since 1905 when Codivilla described the technique of distraction, reporting the lengthening of the femur by axial distraction forces, the science of Distraction Osteogenesis has come a long way. A unique feature of the distraction technique is that bone regeneration by DO is accompanied by simultaneous expansion of the functional soft tissue matrix, including blood vessels, nerves, muscles, skin, mucosa, fascia, ligaments, cartilage and periosteum.[1]

Cleft lip and palate (CLP) are common congenital deformities in the oromaxillary area.[2] Patients with orofacial clefts commonly have maxillary hypoplasia that is caused by the cleft itself, the patients' genotype, or scarring from early surgical intervention.[3] Early surgical corrections usually are performed to improve esthetics and function, but these early surgeries tend to result in poor skeletal and dental growth in the transverse and anteroposterior planes in the maxilla. Moreover, the maxillary dentition is often collapsed because of missing teeth. The selection of a proper treatment method for patients with CLP and severe maxillary hypoplasia is complicated because of palatal scar contracture, upper lip tension, and decreased postoperative stability from large anteroposterior discrepancies.[4]

The management of maxillary retrusion in a patient with cleft lip and palate traditionally has been performed using Le Fort I advancement.[5] However, it has a higher relapse and alters the speech of the patient.[5,6] It is also limited by the negative effect on speech and the risk of developing velopharyngeal insufficiency.[7]

Anterior maxillary distraction for the management of maxillary retrusion has been advocated by Gunaseelan et al.[8] However, a modification of this technique was used in this case.

The purpose of this article was to report the use of a Hyrax expander aided distraction osteogenesis device for maxillary advancement in a 25-year-old male with CLP and severe maxillary hypoplasia.

Case History:
A 19-year-old male with a unilateral cleft lip and palate reported to the department with a chief complaint of an oro-nasal communication. The lip had been repaired at four months and the palate at one and half years of age. Secondary alveolar bone grafting was done at three years of age. There had been no active treatment provided after three years of age.

Facial analysis revealed a slightly concave profile with no gross facial asymmetry (Figure. 1).

Figure. 1 Facial examination showing a concave profile

Volume : 6 | Issue : 5 | May 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

Figure. 2 Anterior and Posterior crossbite seen on Intraoral examination

An increase in alar base width and a decrease in columellar height was noted. The upper arch was "V" shaped with crowding in the upper anterior segment. An anterior and posterior crossbite was seen. Teeth 12 and 22 was missing congenitally (Figure. 2). The panoramic radiograph showed that the original cleft was in the maxillary left lateral incisor area (Figure 3).

Figure. 3 Pre-treatment Panoramic Radiograph

Skeletally, the patient exhibited a class III growth pattern with a hypoplastic maxilla and a prognathic mandible (Figure. 4).

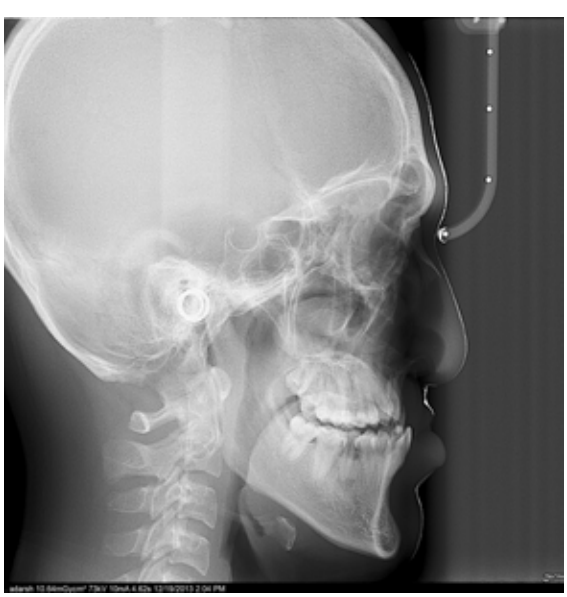

Figure. 4 Pre Treatment Cephalogram

Treatment objectives

The treatment objectives were to correct

1. the midface anteroposterior deficiency,
2. the skeletal Class III relationship and improve the facial profile, and
3. the Class III molar relationship and the anterior and posterior crossbite.

Appliance Fabrication:

Lateral cephalograms were analysed and the initial size of the maxilla (ANS-PNS Anterior Nasal Spine to Posterior Nasal Spine) and the amount of maxillary deficiency were recorded. Separators were placed between the upper premolars and the molars to facilitate the placement of the appliance. The appliance was fabricated on the maxillary dental model by the orthodontist. The molars on either side were banded. The orientation of the hyrax screw (Forestadent Co., Pforzheim, Germany) was rotated by 90° such that its activation would result in an anteroposterior movement and not in a transverse movement. The arms of the hyrax screw were soldered to the bands. After application of the separating medium, an acrylic plate was fabricated separately around the anterior teeth, covering the teeth from the lingual, incisal/occlusal, and buccal sides to hold the anterior fragment firmly and distribute the forces of distraction. The appliance was then tried in the patient's mouth and minor corrections, if any, were performed.

To address the skeletal and dental discrepancies, the following treatment plan was implemented:

- Orthognathic surgery to produce the Distraction cuts.
- Distraction device with Hyrax Screw post operatively to advance the maxillary anterior segment

Surgical technique:

Under general anesthesia with oral endotracheal intubation, the antero-lateral walls of the maxilla and the pyriform aperture were exposed through a vertical incicion between the second premolar (15) and the first molar (16). Buccal and Palatal mucoperiosteal flaps were elevaterd. A periosteal elevator was inserted palatally to protect the palatal mucosa and a vertical osteotomy was done between the roots of 15 and 16. The osteotomy was extended upwards beyond the roots of the teeth and was connected to the pyriform aperture with a horizontal osteotomy. Through the vertical osteotomy site, the palatal process of maxilla was osteotomized with a broad osteotome. Similar procedure was done on the other side of the maxilla between 25 and 26. With this, the osteotomy was completed and the anterior maxillary segment was mobilised. Wound closure was done with 3-0 Monocryl. The site was maintained in the same was for a latency period of 4 days.

Activation:

The appliance was luted into the patient's mouth, with the acrylic blocks being luted separately, using GC II cement (GC Corporation, Tokyo, Japan) to maintain a dry field, on the 4th day after the surgery (Figure. 5).

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Figure. 5 Intra oral cementation of appliance

Activation of the appliance was started after a latency period of 4 days postoperatively. Distraction was performed at a rate of 2 turns twice a day. The pitch of the screw was 0.18 cm. Hence, the daily movement was approximately 0.72 cm. The anterior maxilla was moved forward slowly to achieve a positive interincisal relation. After completion of the distraction, the appliance was left in situ without activation for a period of 16 weeks for consolidation. Check radiographs (Orthopantomogram and lateral cephalogram) were taken immediately after distraction to observe the movement.

Results

The amount of maxillary advancement achieved was recorded by analyzing the lateral cephalometric radiograph. The ANS-PNS values were recorded and analyzed. The post treatment OPG showed a good amount of bone formation in the distraction site (Figure. 6).

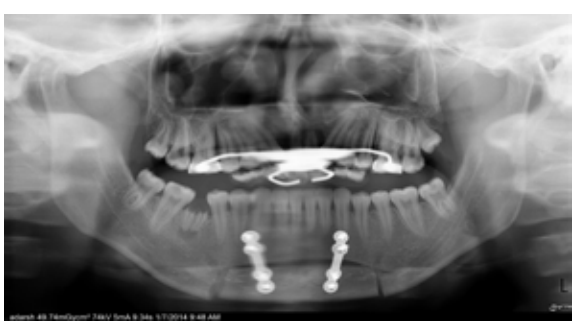

Figure. 6 OPG showing Distraction site

Pre- and postoperative lateral cephalograms showed the amount of advancement and changes in the anteroposterior dimension of the maxilla (Figure. 7).

Figure. 7 Comparison of Pre and Post distraction lateral cephalograms

Pre- and postoperative facial photographs of the patients were also evaluated (Figure. 8).

Figure. 8 Comparison of pre and post distraction facial photographs.

Discussion

The present technique differs from that described by Gunaseelan et al [8] because of the placement of the distractor post - operatively, as opposed to intraoperatively by Gunaseelan et al. The intraoperative placement of the distractor as described by Gunaseelan et al [8] is difficult and cumbersome because of the difficulty in achieving a thorough dry field, which increases the chance of cement failure, thus increasing the chance of distraction failure. Also, the presence of the orthodontist who fabricated the appliance is necessary during the surgical procedure. Moreover, the intraoperative time is increased. Hence, the procedure was modified and the appliance was cemented 4 days after the surgery under adequate isolation. The advantage of cementing the appliance after surgery is that adequate operating field is available without any hinderance from the appliance.

After a 4-day latency period, the distractor was activated by 2 turns twice daily until achieving the final result, and the appliance was maintained for an additional 4 months (16 weeks) for consolidation. The distractor was maintained in the present cases for the consolidation of a regenerate distractor for a period of 16weeks.

The nasolabial angle between the columella and the upper lip tangent decreased because of the increased support of the upper lip. In addition, there was an improvement in the tip support of the nose, leading to an improved esthetic appearance.

Le Fort I osteotomy traditionally has been used to correct maxillary hypoplasia in cleft cases. Anterior maxillary distraction is used as an alternative to Le Fort I advancement because of the obvious drawbacks of the latter. However, segmental osteotomy does not correct the skeletal deformity adequately because it does not address the malar region. A reverse overjet is corrected satisfactorily. However, according to the authors, in cases with mild to moderate deformity, anterior maxillary distraction produces excellent results. Le Fort I advancements cause a stretch on the palatal musculature, worsening the velopharyngeal incompetence and, hence, speech. This drawback is overcome by anterior maxillary distraction, which does not hamper speech.

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