Research Article

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A State of the Art Transantral Device in the Management of Severe Cleft Deformities in Maxilla

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ABSTRACT

Aims and Objectives: The aim and objective of our study was to discuss our experience in the advancement of maxilla in cleft patients using transantral distraction device.

Materials and Method: The surgical procedure for distraction was completed in fifteen patients. The distraction device designed by Konrad Wangerin was used in all the patients. The distraction distances were upto 25 mm. The preoperative, postoperative, and follow-up cephalometric measurements were compared including angular and linear changes.

Results: There was good bone formation in distraction pitch between lines of osteotomy. After distraction of median facial zone, there was improvised occlusion and profile. All patients after postoperative time required final orthodontic treatment and their final occlusal relationships were satisfactory.

Conclusion: The transantral distraction device is a new treatment modality for severe maxillary hypoplasia and helps in gradual advancement of maxilla without it being visible in cleft patients.

Keywords: Cleft lip and palate, Distraction osteogenesis, Maxillary hypoplasia, Osteotomy, Transantral distraction device.

INTRODUCTION

Transantral distraction devices allow gradual advancement of maxilla by about 25mm. Le Fort I internal distraction osteogenesis is an alternative approach to one-step orthognathic advancement of maxilla[1,2]. These devices are arranged in pairs for each case and they are activated with screw drivers using two jointed extension pieces in the frontal vestibule of maxilla[3] .The indications for using these transantral devices are patients with congenital and acquired maxillary retrognathia, cheilognathouranoschisis, maxillary hypoplasia syndromes and midfacial fractures[4,5].

The initial repair of cleft lip and palate during infancy and early childhood enhances facial appearance, speech and deglutition but these the early surgical repair might cause restricted maxillary growth and secondary deformities of jaw with malocclusion[6,7]. Patients with severe cleft deformities such as orofacial clefts are difficult to treat with just orthognathic surgery as they are highly unstable. Although rigid fixation and bone grafting have greatly improved post-surgical

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Fig 1: Transantral distraction device designed by Konrad Wangerin.

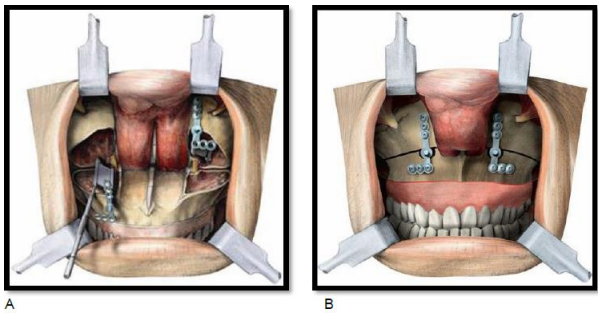

Fig 2a & b: A – fitting the Konrad Wangerin transantral distractor, whose rear spike is extended with the screwdriver in accordance with the depth of the maxilla and inserted into the bony rear wall of the maxillary sinus lateral to the neurovascular bundle. B – the mobile maxilla is folded up and with the aid of the angled miniplates is fixed on the lateral upper border of the osteotomy near the canine fossa.

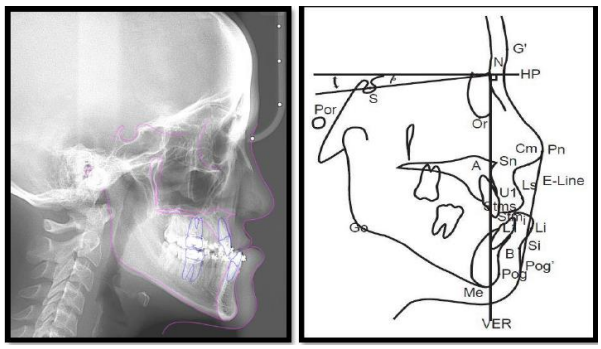

Fig 3a & b: Reference landmarks used for the cephalometric analysis.

stability, the restriction of soft tissue scar and poor quality of skeletal bone available for rigid fixation will tend to make the relapse chances as high as 40 to 60 percent[8,9].

Distraction osteogenesis has provided wholly new ideas and methods for the correction of such kinds of severe maxillary cleft deformites. Cohen et al. changed the concepts of craniofacial reconstruction by successful midface advancement

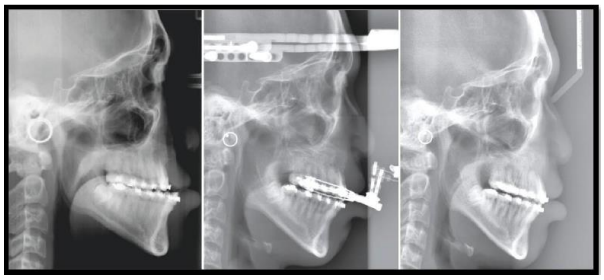

Fig 4: Lateral cephalograms. The patient at 26 years old (Above, left) Preoperative view. (Above, centre) Immediately after Distraction,(Above, right) 12 months postoperatively.

by distraction in maxillary hypoplasia . An external adjustable rigid distraction device was used for midface distraction which showed good results . The two types of distracters like external and internal distraction devices were used for maxillofacial distraction osteogenesis, particularly in the maxillary and midface regions[10].

The aim and objective of our study was to discuss our experience in the advancement of maxilla in cleft patients using transantral distraction device.

PATIENTS AND METHODS

The surgical procedure for distraction was completed in fifteen (12 males and 3 females) with severe maxillary hypoplasia (negative overjet of 7mm or more) were treated between August 2011 and December 2011 .The distraction device designed by Konrad Wangerin **(Fig. 1)** was used in all the patients. The distraction distances were upto 25 mm. The preoperative, postoperative, and follow-up cephalometric measurements were compared including angular and linear changes. Age groups selected for surgery ranged from 24 to 35 years. The types of cleft lip and palate deformity of the patients were: unilateral cleft lip and palate 5 patients, bilateral cleft lip and palate 6 patients and cleft palate alone 4 patients. All had undergone primary lip and palate repair in their infancy. They also had been treated by secondary bone grafting of the alveolus and maxilla when they were 8 years. The inclusion criteria for patient selection included patients aged more than 20 years of age who had maxillary hypoplasia with class III relationships and a negative overjet of 7 mm or more.

Table 1: Cephalometric Values before Distraction, after Distraction and at 1 year Follow-Up (n=15 patients).

Variables	n=15			
	Preoperatively T-1	Immediately after distraction T-2	1 year after distraction T-3	p
SNA (degrees)	70.3±3.4	82.1±3.1	82.0±3.2	*
ANB (degrees)	-4.1±0.5	5.0±1.4	3.8±1.3	*
Upper 1 to SN(degrees)	91.1±2.1	100.8±1.8	101.3±1.8	*
Overjet(mm)	-10.8±3.1	2.7±1.4	2.6±1.5	*
Maxillary length Co-A(mm)	81.3±2.5	101.8±2.4	102.6±2.3	*
Upper lip protrusion(mm)	-5.1±2.1	1.1±1.2	1.0±1.4	*
Nasolabial angle (degrees)	87.0±2.2	105.0±2.4	103.3±2.6	*
Gl'-Sn'-Pog' (degrees)	3.0±1.4	13.5±1.2	13.0±1.2	*

*** T1 versus T2, T2 versus T3, T3 versus T4: p<0.05**

Surgical Techniques and Osteotomy

All the fifteen patients underwent Le Fort I osteotomy and then insertion of a transantral distraction device **(Fig. 2a,b)**. The size of the device can be altered with the screwdriver by extending the blunt spike, which will be stuck into the bony rear wall of the sinus. Moreover, Lefort 1 osteotomy was done in front of maxillary tuberosity so that the bony pterygoid wasn't injured. Stability of posterior wall of the sinus is a main requisitie to correct fixation of transantral distractor. The angled miniplate is fixed on the canine fossa of the mobile maxilla to advance it forward. Intraoperative distraction will be done by anticlockwise rotation of the distraction screw. The angled extension piece causes transmucosal activation in the maxillary floor of the mouth and may be removed post distraction.Vector of distraction was checked. A complete osteotomy for each patient included pterygomaxillary disjunction , septal disjunction and careful medial sinus wall separation. The maxilla was mobilized just enough to ensure that the skeletal osteotomy has been completed. Access and adaption of the distraction device was performed, followed by the monocortical fixation and wound closure. The fixation of the devices above the osteotomy line is performed by a pin in the pterygoid bone and a miniplate paranasally. Conventional down fracturing was not performed.

Distraction Protocol

The latency period was five days and transantral distraction was performed at a rate of 1 mm per day for 7 to 21 days, according to the patients degree of deformity. The vector of distraction was controlled forward and slightly downward. The amount of distraction was measured at the osteotomy line. This measurement was done on the basis of preoperative and postoperative lateral cephalograms. The activation pins, which were placed in the upper vestibule are pulled off post distraction period. The distraction devices were removed after 12 months consolidation period.

Cephalometric Evaluation

The reference landmarks and parameters for cephalometric tracing was done using the lateral cephalometric radiographs (**Fig 3)**. Lateral cephalograms were taken preoperatively (T1), after distraction (T2) and after 1 year (T3) of follow-up (**Fig 4)**. Cephalometric measurements of skeletal and dental relationships were taken and the results were compared **(Table 1)**. The cephalometric analysis consisted four sets of measurements:

- Skeletal : SNA: sagittal position of maxillary alveolar process relative to the anterior cranial base; maxillary length (Co-A).

- Skeletal: SNB: sagittal position of mandibular alveolar process relative to the maxillary alveolar process and anterior cranial base.

• Dental relationship: upper 1 to Sn (sellanasion); overjet.

•Soft tissue: Upper lip protrusion, nasolabial angle, Gl'-Sn'-pog (glabellasubnasalpogonion).

RESULTS

All 15 patients with cleft lip and palate after lip and palate surgery in infant period had several deformities of maxilla. This was mainly because of degree of severity in the width, length and height of maxilla, retroposition of maxillary segment, bite disturbances in sagittal, vertical and transversal planes along with discrepancy of dentition. The shortening of maxillary length was manifested mainly by maxillary length (Co-A), reduced SNA angle and a negative overjet **(Table 1)**. The distraction procedure was completed in fifteen patients. In all patients, the average maxillary advancement was 12 mm (10 mm on the left side and 11 mm on the right; 9 to 23 mm). There were no complications post surgery like morbidity, dental injury, infection or gingival injury. None of the patients needed a blood transfusion. The follow-up period ranged from 1 year to 2 years. The patients were comfortable with wearing the distraction device and had no problems with maintenance of the intraoral splint throughout the active and retention phases.

The preoperative and post treatment cephalometric measurements were evaluated in Table. The maxillary movement was evaluated by the increased SNA angle and maxillary length (Co-A) **(Table 1)**. The mean maxillary anterior movement (dental overjet)before diatraction was -10.8±3.1 mm, and the occlusion changed from class III to class I with slight overcorrection . The overjet was found to be 2.7±1.4 post distraction.SNA angle was between 68.5 degrees and 77.0 degrees, with an average of 70.3±3.4 degrees preoperatively, 82.1±3.1 degrees immediately after distraction and 82.0±3.2 degrees 12 months postoperatively. ANB angle was in negative side -4.1±0.5 degrees which responded to dental correlation by Angle class III. The ANB values (in degrees) preoperatively was -4.1±0.5; immediately post distraction 5.0±1.4 ; and followup (1 year) 3.8±1.3. There was improvement in facial convexity, as seen by the increased Gl'-Sn'-Pog' angle.

The increased nasolabial angle was due to the maxillary support at the base of the nose. The surface of a new bone was a little lower than the surface of surrounding normal bones but had rigid structure. Cephalometric measurements was performed in 12 months showed stable position of the distracted maxillary segment **(Fig. 4)**. In all fifteen patients after 11 months retention phase distraction device was removed. In 6 of 15 patients autobone plasty from iliac crest was used and hence fixed with titanic miniplates for maxillary stabilization. All the surgical procedures were combined with fixed orthodontic treatment. The cephalometric measurements for the skeletal and dental relationships were compared after 1 year and proved good stability **(Table 1)**.

DISCUSSION

Patients with cleft lip and palate require maxillary advancement to correct the maxillary hypoplasia and improve aesthetic facial proportion in most of the cases[11,12,13]. In the treatment of hypoplastic cleft palate with conventional Le Fort I osteotomy for maxillary advancement, the severe discrepancies make stabilization tough, and the resultant effect of palatal scarring can cause significant post surgical relapse[14,15]. Distraction osteogenesis hence provides an alternative approach for maxillary advancement in these patients with a great tendency to relapse[16,17]. McCarthy et al. introduced the use of mandibular distraction on membranous bone in 1992[18,19]. Figueroa and Polley used a rigid external distraction device to treat maxillary deficiency[20,21] . Molina et al. suggested the use of an introral spilnt in incomplete Le Fort I osteotomy for a face-mask appliance[22,23]. However, Swennen et al. recommended a complete osteotomy[24,25] .

In our institute, an internal device is preferred over an external device because the device is hidden, so esthetically sound and better tolerated by the patients .The internal distraction device has benefits, like elimination of the skin scarring, improved patient acceptance during the consolidation period as external component is missing. In comparison with the conventional surgical method, the distraction osteogenesis technique can advance the maxilla to a greater distance[26,27]. A continuous distraction force

enhances bone formation in the distraction gap and promotes soft-tissue proliferation. This helps to lower the soft-tissue scar restriction and increase postoperative stability. Hence, this has a less negative effect on the patients with velopharyngeal closure[28,29,30]. Advancement of the maxilla in all fifteen patients with an intraoral distraction device has been performed successfully. In the present study, the distraction length was between 7 and 25 mm, with an average distraction length of 12 mm. In all of patients, distraction was done after the secondary bone grafting. It took place between the ages of 8 and 11 years. After distraction , the occlusion and profile of soft tissues were significantly improved. All patients required final orthodontic treatment and their occlusal relationships were found satisfactory[31,32,33].

CONCLUSIONS

Distraction osteogenesis is a new method for correction of maxillary deformities. Its use permits gradual maxillary advancement due to stimulation of osteogenesis. The results of this study show that the maxilla in cleft patients can be lengthened using transantral internal distraction device with long-term stability. The advantage of maxillary distraction lies in the greater soft-tissue changes of increased nasal projection, average nasolabial angle, and a more prominent upper lip.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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