Correction of midface deficiency using intra-oral distraction device

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Suresh Menon¹✉ · Ramen Sinha² · Ravi Manerikar³ · Roy Chowdhury SK⁴

¹ Associate Professor, Oral and Maxillofacial Surgery, Vydehi Institute of Dental Sciences, Bangalore

² Professor & HOD, Dept. of Dental Surgery, AFMC, Pune

³ Associate Professor in Orthodontics, Pravara Dental College, Maharashtra

⁴ Commanding Officer, MDC BEG, Kirkee Cantt

Abstract A wide variety of disease processes produce alteration of midfacial skeletal growth, resulting in moderate-to-severe midface deficiency presenting as retrusion associated with Angle's class III malocclusion. Most cases of midface deficiency are seen in patients of cleft lip/palate. The surgical procedure to correct the clefts, undertaken over a long period of time from infancy to the teens tends to take its toll on the soft tissues over the midface. The scarring that is a feature in these conditions results in hampering of normal growth of the midface causing the deformity. Conventional procedures to correct the deformity by surgical advancement have been less than satisfactory in terms of success. This is where the concept of multidimensional growth using distraction proved useful. Today distraction has proved to be a versatile tool in the correction of midface deficiencies due to its various advantages. Six patients of cleft lip/palate were taken up for advancement of the hypoplastic midface using intra-oral distractors with successful and stable results.

Keywords Midface · Cleft lip and palate · Distraction

Address for correspondence:

Suresh Menon
Associate Professor,
Oral & Maxillofacial Surgery
Vydehi Institute of Dental Sciences
Bangalore, India
E-mail: menon_ps@vsnl.net

Introduction

Distraction osteogenesis has transformed the field of craniomaxillofacial surgery in recent times quite drastically. The initial success of distraction in mandibular deformity correction [1] resulted in its application to the other bones of the facial region. Considering the high incidence of maxillary deformities, it was logical to assume the shift of these procedures from mandible to the maxilla and the midface [2].

A wide variety of disease processes produce alteration of midfacial skeletal growth, resulting in moderate-to-severe midface deficiency presenting as retrusion associated with Angle's class III malocclusion. Most cases of midface deficiency are seen in patients of cleft lip / palate. The surgical procedure to correct the clefts, undertaken over a long period of time from infancy to the teens tends to take its toll on the soft tissues over the midface. The scarring that is a feature in these conditions results in hampering of normal growth of the midface causing the deformity.

Conventional procedures to correct the deformity by surgical advancement have

been less than satisfactory in terms of success due to the need for bone grafts [3], the risk of haemorrhage and lack of improvement or even deterioration of existing airway problems. The relapse rate of 20–30 % has been another deterrent in advocating these procedures [4]. The three dimensional deformity that is a feature of midface deformity cannot be corrected by conventional procedures in all three planes. This is where the concept of multidimensional growth using distraction proved useful. Today distraction has proved to be a versatile tool in the correction of midface deficiencies due to its various advantages.

Materials and method

A thorough clinical and cephalometric analyses was done to quantify the deficiency of the midface (Fig. 1,2). The Leibinger Modular Internal Distraction System (MID System) [5] (Fig. 3) was used to advance the midface in six cases of uni/bilateral cases of operated cleft lip/palate patients with established midface deficiency. The system is a miniaturized

device with adaptable titanium mesh on both sides that can easily be customized to adapt to the patient's zygomatico – maxillary contours without distorting the vector of distraction.

Procedure

Presurgical orthodontics: A significant finding in cleft patients is a collapsed malaligned arch (Fig. 4). The presurgical requisite is the widening of the arch and aligning the teeth optimally. This was accomplished by orthodontic therapy in 3 months time (Fig. 5,6).

Alveolar grafting: The persistence of a residual alveolar cleft prevents the movement of teeth into this defect and complicates the advancement as the maxilla is in two segments. After expansion of the arch, the cleft area was redefined and grafted with cancellous autogenous graft in order to unite the two segments and allow movement of teeth into this gap. Under general anaesthesia, cancellous bone from the iliac bone was harvested using the medial trap door technique thus preserving the crest. The defect was grafted and water

Table 1 Details of the cases treated with amount of distraction and relapse

S No	Age	Sex	Diagnosis	Distraction in millimetres	Relapse after 1 year in millimetres
1	23	M	UCLP	14/12	1.5
2	17	F	UCLP	9	0
3	15	F	UCLP	19	1.5
4	21	F	UCLP	16	1
5	12	M	UCLP	10.5	1
6	14	M	BCLP	13	1

tight closure of both nasal and oral mucosa achieved. A minimum period of six months was allowed for take up of the graft and after radiological confirmation, the distraction procedure was undertaken.

Distraction

Prior to this procedure the arch was stabilised with a tooth borne palatal bar to maintain the expansion during the distraction. Under general anaesthesia, a vestibular intra-oral incision was made in the maxilla exposing the anterior maxillary antral wall and piriform aperture. The nasal floor and lateral wall was freed of the mucosal attachment and a modified LeFort I osteotomy performed after adapting the device and marking its position before the osteotomy. Pterygomaxillary dysjunction completed the osteotomy.

The device was then placed on both sides in the zygomatico-maxillary region and rigidly fixed (Fig. 7). The activation cable was tunneled through the tissues to emerge preauricularly. After a latency period of 72 hours, distraction was begun at the rate of 0.5 mm twice a day thus achieving a distraction of 1 mm/day. Once the amount of distraction was achieved the patient was discharged and after 8 weeks, the devices removed.

Results

Total distraction achieved ranged from 9 to 19 mm with an average of 13.35mm in the six cases treated. All cases showed excellent improvement in the profile and maxillo-mandibular relationship (Figs. 8 and 9). Results showed that the patients' severe maxillary hypoplasia was corrected as predicted and there was excellent new bone formation between the osteotomy edges. Significant improvement in facial contour and class I occlusion was obtained in all cases (Fig. 10). There was follow-up for one year

Fig. 1 Preoperative Cephalogram **Fig. 2** Preoperative profile **Fig. 3** Distractors fixed to maxilla **Fig. 4** Cephalogram after distraction **Fig. 5** Postoperative profile

with cephalometric analyses to assess the amount of relapse (Table 1). The amount of relapse ranged from 0–1.5mm (0–11.53%) with an average of 7.11%. This is similar to the relapse rate described by Rachmiel A [6].

The advantage of this technique was that any existing velopharyngeal problem was not exaggerated by the procedure unlike conventional procedures [7]. Post

surgical orthodontics to optimise the occlusion has resulted in a good facial balance.

Discussion

Midface hypoplasia is characterised by deficiency in height, width and antero-posterior relationship thus requiring 3 dimensional corrections. Conventional methods of midface advancement by osteotomy are beset with innumerable problems ranging from the need for a bone graft, high relapse rate and limitation in the magnitude of advancement due to the presence of scarred tissues. The advent of distraction has given surgeons a better alternative with the added advantage of new bone formation in the gap thus obviating the need for a bone graft, minimal relapse due to this phenomenon and the concomitant soft tissue distraction that occurs.

Till recently midface advancement was accomplished by extra-oral devices. The

most commonly used devices consist of a halo frame over the cranium with a vertical device in front of the face attached intra-orally to the maxilla [8]. The biggest disadvantage with this is the cumbersome device that needs to be worn for a long time during distraction and during the consolidation period totaling nearly 2 months. The use of an extra-oral halo-borne distractor, which allows free three-dimensional vector control, may cause problems in the connection between the midface and the distractor [9]. This can upset the daily routine and patient compliance becomes a problem. Pin loosening and frame migrations are the most common complications. Of the frame migrations 25% were traumatic intracranial penetration of fixation pin [10]. From the patient's perspective internal devices that do not hamper one's daily routine, permit multidirectional movement and easy removability are the ultimate objectives.

We therefore decided to use this modality, to use its advantages to the fullest and provide a more stable result in spite of its limitation in three dimensional vector control when compared to the RED device. The intra-oral device stands out because of the various advantages.

The technique of inserting the device intra-orally is an exacting procedure and is technique sensitive. The ability to position the device according to the direction of the midface advancement is another advantage of this technique. The incidence of relapse recorded in our cases is in variance with the findings of Denny et al. [9,11]. There were certain factors that were found to be difficult in the use of the device. The contour of the zygomatic buttress region is curved and fixation of a large flat base of the distractor

can ideally be done only in the region anterior to the molars. The orientation of the device here is converging from both sides with a danger of constriction of the anterior maxilla unless a stable rigid transpalatal appliance is given. One factor to be kept in mind when using the device on a child is the fact that since growth is still in progress, a certain degree of overcorrection may be required to compensate for the retarded growth in the region. The need for a correctional surgery after cessation of growth also has to be kept in mind.

Conclusion

The use of intra-oral distraction in managing a complex case of maxillary hypoplasia has highlighted the tremendous advantages of this procedure with minimal morbidity. Distraction osteogenesis definitely holds great potential for multifarious cranioskeletal congenital deformities.

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