Case Report II

A case of maxillary hypoplasia with cleft lip and palate corrected using Mid Maxillary Osteodistraction

D.K. Dias and P.D.C. Fernando

Abstract
The method of mid maxillary osteodistraction (MMOD) using tooth borne custom-made device is performed on cleft patients in oral and maxillofacial unit Teaching Hospital Karapitiya, Galle over the past ten years. Aims of this case report are to assess the correction of maxillary retroclination, reverse over-jet and class III occlusal discrepancy with improvement of facial appearance and soft tissue harmony. All these objectives were assessed using pre and post surgical study models, true lateral skull radiographs and photographs.

MMOD is a less expensive, less invasive orthognathic surgical procedure where adequate distraction is possible with minimum relapse comparing to maxillary advancement osteotomy. Peri-operative orthodontic approach facilitates adequate space for osteotomy cuts pre-surgically and proper alignment of teeth post-surgically. Bone formations on either side of osteotomy cuts facilitates tissue histogenesis providing favourable soft tissue balance which improves facial aesthetics and reduce velo-pharyngeal insufficiency to improve speech.

Key words: mid-maxillary distraction osteogenesis, tooth - borne appliance

Introduction
Congenital oro-facial clefts and related growth defects are prime causes of maxillary/mid facial hypoplasia(1). Repaired cleft lip and cleft palate itself have a negative impact on mid-facial growth. Sixty percent of children with surgically corrected cleft lip and cleft palate will require correction of maxillary hypoplasia and 25% of them are beyond the boundaries of conventional orthodontic treatments(1). Class III skeletal base, crowded upper-arch with insufficient alveolar space and clefts causing malocclusion, three dimensional facial profile defects, altered soft tissue harmony in nose, orbit and upper lip have negative functional, aesthetic and social impact on these patients. Further altered anatomy and insufficient length of soft palate leads to speech and swallowing problems due to velo-pharyngeal insufficiency. This oro-facial clefts associated moderate maxillary hypoplasia can be effectively managed with MMOD technique.

Distraction osteogenesis (DO) is the surgical technique in which new bone formation is induced by gradual separation of bony segments after a precise osteotomy. The method produces unlimited quantity of living bone, directly by controlled mechanical distraction of the bony segments. The concept was described by Codivilla in 1905 and proven by Ilizarov, a Russian surgeon in 1951 by applying it to lengthen limbs during second world war(2). The use of DO on craniofacial skeleton was introduced by McCarthy in 1992 to correct a
congenital hypoplastic mandible(3).

DO comprise of four basic steps osteotomy phase, latency phase, distraction phase and consolidation phase. Gradual expansion of surrounding soft tissues, muscles and mucosa termed distraction histogenesis enables minimum relapse comparing to advancement osteotomy procedures(4,5). MMOD is a definitive surgical procedure to gain aesthetic and functional improvement.

Case report
A 24 year old boy with defective maxillary growth with altered speech was seen at the Oral & Maxillo-facial Surgery and Orthodontic multidisciplinary joint clinic at the Teaching Hospital Karapitiya. He had undergone successful surgical correction of left side unilateral cleft lip and complete cleft palate at appropriate ages. The cleft alveolus had been grafted during canine eruption with iliac crest at the age of 13 years.

Patient was neither syndromic nor had first or second degree relatives with congenital deformities or malformations. He had a concave facial profile associated with a prominent broad nose, hypertelorism, acute naso-labial angle with para-nasal hollowing (Figure:1). Further patient showed marked maxillary deficiency in anterior-posterior direction, average Frankfort Mandibular Plane Angle (FMPA), lip incompetency with everted lower lip associated with adaptive tongue thrust, minimum upper incisal display and visible buccal corridors.

Further patient had a reverse over jet of 4mm with missing upper central and lateral incisors on left side (Figure:1). Over retained second deciduous molar occupied the space of left upper second premolar tooth. Acceptable alignment of upper arch was achieved by fixed orthodontic appliance pre-surgically. Patient had mild to moderate lower anterior crowding with bilateral Angle’s class III molar relationship in occlusion.

Regarding altered speech, he had hypernasality, nasal air emission and consonant production errors due to velo-pharyngeal insufficiency.

As a summary patient had class III malocclusion with 4mm reverse over jet on class III skeletal base discrepancy with moderate maxillary hypoplasia.

Pre-surgical preparation
Photographs, study models (Figure:2) and true lateral skull radiographs (Figure:4) were obtained for pre-surgical assessment. Corrective surgical options, Le Fort I advancement osteotomy or MMOD in combination with orthodontic support were discussed in joint clinic. Considering the significant maxillary advancement needed, altered speech and the previous surgical scaring of cleft repair, MMOD planned. Vertical Maxillary osteotomy cuts were planned on left side between first and second molars and on right side between second premolar and first molar teeth (Figure:2). Custom made distraction device was constructed with a rapid maxillary expansion screw oriented to provide antero-posterior expansion. Speech recording was done before the surgery by speech and language therapist.

Surgical procedure
Muco-periosteal flaps were raised following vestibular incisions from incisor to molar region on either side of maxilla with preserving labial mucosal sling anteriorly. Palatal mucoperiosteum was tunneled towards mid-palatal suture from pre-planned vertical osteotomy sites. Buccal bony cuts were made on Le Fort I level from pyriform rim to pre planned sites and vertical cuts across the maxilla using oscillating saw with copious saline irrigation. Nasal septal and lateral wall osteotomies were done to separate the anterior maxilla completely with great care not to damage palatal mucoperiosteum. All these specific bony cuts were planned to incorporate maximum amount of maxilla to osteotomized segment (Figure:3) and all incisions were primarily closed with 3/0 vicryl sutures.
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Figure 1. Pre-operative photographs showing repaired left side cleft lip, maxillary hypoplasia, concave facial profile and class III occlusal discrepancy with reversed over-jet.

Figure 2. Study models showing occlusal discrepancy and maxillary osteotomy cut.

Figure 3. MMOD osteotomy cut marked on skull.

Figure 4. Pre and post distraction true lateral radiographs showing skeletal correction of the maxillary deficiency.
**Post operative care**

Distractor was cemented and activation started after 5 days, 1mm per day for 13 days. Patient developed an anterior open bite during distraction which was corrected with box elastics during consolidation period. Patients’ appearance changed dramatically with correction of facial concaveness and reversed over jet (*Figure:6*). Comparison of radiographs showed lengthening of anterior posterior dimensions of maxilla (*Figure:4*). Speech recording after one year confirmed improvement in VPI. Mirror view of maxilla showed excess alveolar space gained (*Figure:5*) with DO, which can use effectively for correction of maxillary crowding and missing teeth.

![Figure 5. Intra oral distractor and the alveolar space created by MMOD.](image)

![Figure 6. Improvement of facial profile and corrected reversed over-jet. Box elastics with orthodontics need for further correction and alignment.](image)

**Discussion**

Improper or defective growth of maxilla terms maxillary hypoplasia. It produces facial retrusion and creates the illusion of protuberance of the lower jaw. Structural defects (oro-facial clefts and localised maxillary defects) and associated syndromes (crouzon, apert, marfans…) are the main aetiological factors of maxillary hypoplasia (3).

Hypoplastic maxilla will results in functional problems as dento - alveolar discrepancy, insufficient space in alveolar process and clefts, speech and swallowing defects due to fistula and VPI. Facial profile may alter in all three planes as facial soft tissue harmony of nose, orbit and upper lip are disturbed. Alteration of facial growth causes psychological and social impact in addition.(4).
functionally. Reverse over-jet was functionally and aesthetically unacceptable. Patient’s expectation was a new aesthetical balance of the face involving good occlusion, good masticatory function, aesthetics of the smile and facial profile.

Depending on the severity of the maxillary hypoplasia varieties of treatment options are available (5). Le Fort I maxillary advancement osteotomy is beneficial for mild, localised maxillary hypoplasia where as severe syndromic cases need rigid external distractor (RED) or modified Le Fort III osteodistraction. Moderate maxillary hypoplasia specially due to oro-facial clefts can effectively manage with MMOD (9).

The degree of correction and stability with DO is better than conventional osteotomies, rigid fixation, and bone grafting (10). Le Fort I level osteodistraction was initially used in our center for correction of moderate maxillary hypoplasia in cleft patients(6), but jutting out activation devices in maxillary vestibules cause continuous intra-oral trauma and not aesthetically pleasing to wear for a long time(1). Bone anchored internal distracters are more aesthetically acceptable but need an additional surgery for removal at the end of the consolidation period. Further they have poor vector control and the distraction achievable is limited by the length of the screw incorporated in the device(1).

A relatively new approach for maxillary advancement by DO using a combined surgical and modified orthodontic technique with toothborne custom-made osteodistractor is a versatile treatment option for mild to moderate maxillary hypoplasia with oro-facial clefts (1). Histogenesis is the main advantage of MMOD over Le Fort I maxillary advancement osteotomy as it expands bone and surrounding soft tissues with minimum relapse. Excess alveolar space could be effectively utilized for orthodontic correction of maxillary crowding. Since the posterior maxilla is not involved in this surgical procedure, potential bleeding risk is minimum. Length of maxillary unit increases in anterior-posterior direction (ANS to PNS distant) improves VPI (11). Evidence of similar case series study showed 6.2mm antero-posterior expansion of maxillary unit length (12). Comparatively lesser reciprocal distraction of posterior maxillary segment will improve the structural defect of the velo-pharyngeal sphincter by increasing the palatal length resulting decrease of VPI, showing reduction of hypernasality and nasal-emission in speech after treatment, which would get worsened by Le Fort I advancement osteotomy. Adequate distraction is possible with multiple surgical attempts with provision of sufficient time intervals for bone remodeling and maturation. Further DO can be used as an alternative to bone grafting and osteotomies. DO in contrast appear to provide low operative and post operative morbidity.

In surgical technique of MMOD the vertical alveolar osteotomy cuts preferably place between the maxillary second premolar and first molar teeth. But for this case maxillary deciduous second molar occupied the space anterior to permanent first molar on left side. As it is unable to bare the distraction forces, osteotomy space on left side was created between the first and second maxillary molar teeth, became the alternative choice(1).

In this case, to assess the improvement, cephalometric comparison was not done due to unavailability of such facility in TH Karapitiya. But pre operative and post distraction true lateral skull radiographic comparison shows anterior posterior dimensional improvement of maxilla (Figure: 4). Improvement of speech was assessed by comparing pre operative and one year post operative speech recordings. Post surgical orthodontic and restorative management was provided to achieve functionally and aesthetically stable pleasing results.

Tipping movements/extrusion of anterior
distractor arm cemented teeth may occur causing anterior open bite during distraction phase which needs to be corrected with box elastics. Defective distraction vectors and insufficient distraction are some other drawbacks of the internal tooth borne distractors(9). Further desired distractions will not be possible if unfavourable fracture occurs in posterior maxilla due to loss of anchorage.

Using this technique, significant improvements in facial appearance was able to achieve (Figure:6). The appliance was well tolerated with high patient compliance. In conclusion this relatively simple and cost effective technique corrects mild to moderate maxillary hypoplasia, with the utilization of available facilities and is very much suited to developing countries.

**References**


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