Role of facemask in correction of skeletal midface deficiency in unilateral cleft lip and palate

— A Progress Case Report

Dr. Gaurav Khurana, MDS
Assistant Professor, Department of Orthodontics, Manipal College of Dental Sciences, Mangalore.

Dr. Navneet Arora, MDS
Assistant Professor, Department of Orthodontics, Manipal College of Dental Sciences, Mangalore.

Dr. Subraya Mogra, MDS
Professor and head of Department, Department of Orthodontics, Manipal College of Dental Sciences, Mangalore.

Dr. V Surendra Shetty, MDS
Professor and Dean, Department of Orthodontics, Manipal College of Dental Sciences, Mangalore.

Abstract
Cleft of lip and palate is one of the most common congenital defects with a multifactorial etiology. Several skeletal, dental and soft tissue defects accompany this malformation. These may have psychological and sociological implications. Functions such as suckling, swallowing, speech, and hearing may be impaired, while facial disfigurement and malocclusion is usually present. A multidisciplinary approach is usually required for such cases which rehabilitates the patient right from few weeks after birth. These involve skeletal and dental correction restoring function and esthetics. One of such procedures involves protraction of maxilla, which is carried out during mixed dentition phase, to improve the disfigurement and to correct the developing malocclusion. This case report presents improvement in esthetics of the patient by maxillary protraction using face mask, thereby restoring occlusion and function, and probably avoiding surgical advancement of maxilla in future.

Key words
Cleft lip and palate, maxillary deficiency, bonded R.M.E. and face mask

The most common craniofacial malformation in children is cleft of the lip and/or palate. In India the incidence is 1 in every 750-800 live births. The incidence varies widely and is the least in the Negroid (Blacks), the Mongoloids show the highest incidence (Asian, mainly Japanese and Chinese). Several skeletal, dental and soft tissue defects accompany this malformation. A multidisciplinary approach, involving medical and dental specialties, is usually required for such cases which rehabilitate the patient to restore the functional efficacy, structural balance and esthetic harmony. Various procedures like - Presurgical orthopedics, Lip repair, Alveolar molding, Primary bone grafting, Palatoplasty, Orthodontics, Orthognathic and Esthetic surgeries are undertaken from infancy to adulthood. Orthodontist has a vital role to play in correction of multiple dental and skeletal problems, which also aid in improvement of profile and esthetics. Orthodontic intervention can be performed at different stages of the patient's development, like - Presurgical orthopedics in an infant, expansion during primary dentition. Alignment of arches, expansion and protraction of maxilla, secondary bone grafting during mixed dentition. Establishment of occlusion, camouflage of skeletal discrepancy, preparing patient for orthognathic surgery during permanent dentition.

Orthodontic-Orthopedic Treatment in the mixed dentition
In most of the patients with a cleft lip and palate, where the cleft extends through the alveolus and the hard palate, the dentition and the maxillary complex are
frequently affected, which can lead to maxillomandibular positional deformities, like midface retrusion with a pseudo mandibular prognathism and gross malalignment in developing dentition especially near the cleft area in alveolus. Although the distribution of the adipose tissue and the soft tissue thickness of the young child camouflage the developing skeletal deficiency of the midface in children with clefts, the dentition often reflects the underlying skeletal discrepancy. Once retrusion becomes apparent, clinical options include - a) allowing abnormal facial development to continue, with surgical intervention after growth is completed. b) Treating with extraoral traction to maxilla. The latter choice minimizes the amount of therapy that will be necessary as the patient matures. Therefore, expansion and protraction of maxilla, secondary bone grafting, are the primary goals during mixed dentition treatment. Alignment tasks and unilateral or bilateral anterior and/or posterior cross bite correction should be achieved before graft placement. A functional shift (ie, a slide from centric relation to centric occlusion) may be associated with the crossbite. In some cases, removal of the occlusal interference by equilibration may alleviate the problem but in cases of true skeletal crossbite, a combined orthopedic and orthodontic approach is required at right age may be necessary.

This article presents a progress report on a patient with unilateral cleft of lip and palate with orthopedic and orthodontic intervention. An attempt was made to correct the sagittal maxillary discrepancy by protracting the maxilla using a facemask after rapid maxillary expansion.

**History**

An 8 year old female patient reported with the chief complaint of irregularly placed upper front teeth. The patient presented with a partial unilateral cleft of lip and palate on the left side. The patient underwent surgery of cleft lip at the age of 3 months and palate at 4 years of age, but the alveolus and hard palate were still unrepaird, with a persistent partial defect. No communication between the nasal cavity and oral cavity was found.

**Clinical Examination:** Build of the patient was mesomorphic, with normal height, weight, gait and posture.

**Extraoral examination**

Patient presented with a mesocephalic head type, mesoprosoptic face type with an oval facial form. The face was symmetrical with concave profile and anteriorly divergent face. The mandibular plane angle was steep and growth pattern was towards vertical. The lips were incompetent due to surgical scar in the upper lip. Patient had slightly everted lower lip, an obtuse nasolabial angle due to maxillary deficiency, shallow mentalabial sulcus and normally developed chin. (FIGURE 1)

**Intraoral examination**

Revealed cleft of lip and palate with partial unrepaird defect still remaining behind the upper left central incisor after surgery. Extension of the cleft as depicted by surgical scar, was from left part of upper lip, alveolus, premaxilla, extending posterior to incise foramen, involving almost entire length of the hard palate. The soft palate was not involved. Teeth present in maxillary arch in both the quadrants were permanent central incisor, deciduous canine, deciduous molars, and permanent first molars. Permanent left lateral incisor corresponding to the cleft area was missing. There was 3 mm of expected crowding based on the evaluation of arch form, arch perimeter, and taking into consideration the erupted, unerupted, and missing teeth.

Teeth present in mandibular arch in both the quadrants were, permanent central, lateral incisors, deciduous canine, deciduous molars and the permanent first molars. The lower right second deciduous molar, had exfoliated. No tooth size-arch length discrepancy was expected on eruption of all permanent teeth. (FIGURE 2)

Interarch relation: Deciduous Molar relation was mesial step on the left side and on right side it could not be evaluated as the lower second deciduous molar had exfoliated. There was an anterior crossbite with the maxillary anterior teeth completely contained behind the mandibular anterior teeth. Left buccal quadrant was also in cross-bite relation with the collapsed upper arch. (FIGURE 2)

**Radiographic examination:**

- Orthopentomogram showed absence of tooth bud of upper left permanent lateral incisor. Upper right permanent lateral incisor, canines and pre-molars were in various stages of eruption. The left maxillary canine was poised for eruption into the cleft area.
- Hand-Wrist x-ray showed the patient is in Stage II of skeletal maturity(Bjork, Grave and Brown)
- Intraoral Occlusal view of maxilla showed cleft remaining behind left permanent central incisor (FIGURE 3)
Diagnosis: An 8 year old female patient diagnosed with cleft of lip and palate with partial unrepaired defect behind upper left central incisor and corresponding maxillary deficiency, crossbite in the anterior region and the left buccal quadrant with missing upper left permanent lateral incisor.

Treatment objectives:
Short-term objectives as follows:
- Expansion and protraction of the maxilla.
- Guiding the eruption of unerupted teeth
- Fixed mandibular lingual arch to conserve leeway space for future aligning and leveling

Long-term objectives were as follows:
- Maintain sagittal and transverse correction.
- Alveolar grafting as soon as possible to allow the left maxillary canine to erupt through the grafted bone.
- Attainment of normal overjet and overbite with normal axial inclinations
- Replace missing maxillary left lateral incisor.

The anticipated finished occlusion would have a Class I molar and Class I canine on both the sides, with normal overjet and overbite and a pontic for maxillary left lateral incisor.

Treatment plan:
Since patient had maxillary deficiency, and was in the growth phase, so treatment priority was to do growth modulation for this case using facemask and protract the maxilla. After attainment of a positive overjet, teeth were aligned and guided as they erupted. A Secondary alveolar bone graft to be given in cleft area during eruption of permanent canine.

Treatment mechanics:
- A Bonded rapid palatal expansion appliance was used (FIGURE 4). Rapid expansion opens circum-maxillary sutures (e.g. zygomatico-maxillary, frontomaxillary) which displaces the maxilla forward and downward, opening the bite and moving Point A anteriorly. Also, loosening of these sutures help in protraction of maxilla with reverse headgear/facemask. Like normal individuals, the pattern of expansion is triangular with a greater opening in the anterior region. But as there is no midpalatal suture, expansion moves unfused segments apart.
- The purpose of the acrylic occlusal coverage was three fold: (2) Open the bite and free up the occlusion during protraction; (3) prevent maxillary teeth from extrusion; and (4) better anchorage.
- Activated one turn per day for 6 days to loosen the circummaxillary sutures.
- On the seventh day, activation of the expansion appliance was stopped. RME screw was sealed using self cure acrylic (FIGURE 5).
- The protraction headgear2 (petit type) was started using heavy elastics attached to the RME hooks, applying 500gm force on each side for a minimum of 16 hours per day (FIGURE 6).
- After 8 months of protraction therapy, positive overjet of 2mm was attained (FIGURE 7 AND 8), but the protraction headgear was continued with the same force applied 8 to 10 hours of wear per day for another 4 months, in order to prevent the relapse. Upper right permanent lateral incisor erupted during this period.
- Anterior permanent teeth were bonded with 022 preadjusted edgewise appliance - Roth prescription. Alignment was done using 016 Niti wire (FIGURE 9 AND 10).
- After 4 months, RME was removed and replaced by removable slow expansion device, which was activated one turn every 3 weeks (FIGURE 12). This was to overcorrect the transverse malrelationship.

Excellent patient cooperation has helped us to reach the current clinical stage (FIGURE 11). There is now a +3 mm overjet and 3 mm overbite. In 1 year, the maxillary length increased by 2 mm (Table I). The SNA angle has improved from 75° to 76°. The ANB angle has increased from -2 to +1. The maxillary incisor inclination has improved considerably and has changed from -2mm and 20° to +5 mm and 31° to the line NA. The upper lip to E line improved from -3mm to 0 mm and lower lip to E line from +5 to +2mm

Discussion
The results demonstrate a definite and desirable response to maxillary expansion and facemask therapy. It must be emphasized that the end result was due to cumulative effects of both orthopedic and orthodontic changes - ie forward protraction of maxilla, backward mandibular rotation, proclination of maxillary incisors and retroclination of mandibular incisors. Although the skeletal changes are limited, they do produce marked improvement in soft tissue profile (FIGURE 11).

The results of this case report were similar to previously published reports as far as the amount and nature of
protrusion effects. Most studies report between 1 to 3 mm of maxillary protrusion and forward rotation, which falls in line with the current study (Table 1). The force vector of protrusion passes below the center of resistance of the maxilla, causing the expected forward rotation. As a result, the posterior maxilla drops down more than the anterior segment. The treatment changes in the maxillary position, associated with protrusion, could be attributed to rotation of the mandible in a clockwise direction, thus opening the mandibular plane angle. Moreover, as the maxillary arch width is increased, the maxillary teeth have a tendency to tip outward and extrude, thereby displacing the mandible downward. Since, for this case a rapid palatal expansion appliance with acrylic occlusal coverage was used, which prevents maxillary teeth from extrusion to a great extent, downward rotation of the mandible as a consequence to the expansion per se, would be very minimal.

The effects of protrusion on the dentition were limited. There was expected uprighting of the lower incisors during treatment and the upper incisors were flared. A large part of the overjet correction may be caused by the uprighting of the lower incisors. The uprighting of the lower incisors may be compensating for the downward rotation of the mandible caused by the force on the chin, with pressure transmitted to the teeth through the soft tissues. Thus, the major effect of maxillary protrusion is downward and backward movement of the mandible combined with retroclination of the mandibular incisors. These treatment responses described with reverse-pull face masks are in line with the present case report.

The patient is currently 10 years and is being monitored the eruption of the remaining permanent teeth. The next treatment objective is the placement of graft at canine region, to make canine erupt through the graft. As soon as all the succedaneous teeth erupt, maxillary and mandibular arches will be leveled and aligned.

A pertinent question at this stage would be: "Will the correction achieved hold up?" It is hoped that the positive overbite that has been created will induce both jaws to grow simultaneously during the remaining growth period. Moreover in our opinion, anticipation of relapse should not be the deterring factor for an orthopedic intervention. The psychosocial benefit that the child has received is a sufficient reward and justification. The patient will be monitored closely for signs of maxillary A-P relapse, even if patient were to grow out of this correction toward the end of the growth period, the surgical correction required will be less drastic than if the deformity had been left uncorrected.

Conclusion
Correction of maxillary deficiency in a cleft case by orthopedic intervention should be done during growing phase after careful diagnosis and treatment planning. Maxillary protrusion following rapid palatal expansion leads to improvement in profile, esthetics and function. It has limitations of mandibular rotation and dental changes or continuation of an abnormal growth pattern, but if correction is done efficiently and retained, it still helps to overcome the skeletal deformity to a certain extent and avoid surgery later.

FIGURE 1: PRETREATMENT PHOTOGRAPHS
FIGURE 2: PRETREATMENT STUDY MODELS

FIGURE 3: PRETREATMENT X RAYS
FIGURE 4: BONDED RME IN PLACE WITH EXPANSION SCHEDULE OF 2 QUARTER TURNS PER DAY FOR 6 DAYS

FIGURE 5: RME SEALED WITH COLD CURE ACRYLIC

FIGURE 6: PETIT FACE MASK
FIGURE 7: POST FACE MASK PHASE

FIGURE 8: POST FACE MASK LATERAL CEPhALOGRAM

FIGURE 9: FIXED APPLIANCE IN PLACE
FIGURE 10: POST ALIGNMENT AFTER R.M.E. AND FACE MASK

FIGURE 11: IMPROVEMENT IN PROFILE BY MAXILLARY PROTRACTION
FIGURE 12: PROGRESS WITH A SLOW EXPANSION APPLIANCE IN PLACE FOR OVERCORRECTION OF COLLAPSED ARCH AND RETENTION SUBSEQUENTLY. LINGUAL HOLDING ARCH IS CEMENTED ONTO LOWER MOLARS

TABLE 1: CEPHALOMETRIC VALUES

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>PRETREATMENT VALUE</th>
<th>POST FACEMASK VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAXILLA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNA</td>
<td>75</td>
<td>76</td>
</tr>
<tr>
<td>N PERPENDICULAR TO A</td>
<td>-5mm</td>
<td>-3</td>
</tr>
<tr>
<td>EFFECTIVE MAXILLARY LENGTH</td>
<td>77</td>
<td>79</td>
</tr>
<tr>
<td>MANDIBLE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNB</td>
<td>77</td>
<td>75</td>
</tr>
<tr>
<td>N PERPENDICULAR TO POG</td>
<td>-9</td>
<td>-9</td>
</tr>
<tr>
<td>EFFECTIVE MANDIBULAR LENGTH</td>
<td>92</td>
<td>99</td>
</tr>
<tr>
<td>MAXILLO-MANDIBULAR RELATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANB</td>
<td>-2</td>
<td>+1</td>
</tr>
<tr>
<td>WITTS</td>
<td>-6</td>
<td>-4</td>
</tr>
<tr>
<td>ANGLE OF CONVEXITY</td>
<td>-3</td>
<td>0</td>
</tr>
<tr>
<td>MAXILLO-MANDIBULAR DIFFERENCE</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>VERTICAL RELATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FMA</td>
<td>31</td>
<td>33</td>
</tr>
<tr>
<td>SN-GoGn</td>
<td>37</td>
<td>40</td>
</tr>
<tr>
<td>JARABAK'S RATIO</td>
<td>57.4%</td>
<td>50</td>
</tr>
<tr>
<td>SN-PP</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>DENTAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UPPER INCISOR TO NA</td>
<td>20/-2</td>
<td>31/5</td>
</tr>
<tr>
<td>UPPER INCISOR TO FH</td>
<td>103</td>
<td>116</td>
</tr>
<tr>
<td>UPPER INCISOR TO SN</td>
<td>95</td>
<td>106</td>
</tr>
<tr>
<td>LOWER INCISOR TO NB</td>
<td>21/4</td>
<td>16/2</td>
</tr>
<tr>
<td>IMPA</td>
<td>85</td>
<td>79</td>
</tr>
<tr>
<td>SOFT TISSUE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UPPER LIP TO E LINE</td>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>LOWER LIP TO E LINE</td>
<td>+5</td>
<td>+2</td>
</tr>
</tbody>
</table>