Growth Modification in Unilateral Cleft Lip and Palate Patients with Face Mask

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The intended aim of treatment in cleft lip and palate patients with growth modification is to improve the relation of jaws by advance the maxilla, restrict the mandible or combination of these. The appliances usually used are face mask or protraction head gear (Delaire and Petit types). Modification of growth is advocated to be applied before the end of adolescent growth spurt and long term and permanent improvement cannot be guaranteed. Achieving the aim of growth modification is still controversial since most reported results of this treatment are dento-alveolar changes and backward rotation of the mandible that would not be considered to be growth modification.

Keywords: *Growth modification, Face mask, Cleft lip and palate*

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Cleft lip and palate (CLP) may have undesirable esthetic and functional consequences for affected individuals because oral clefts interrupt with the important communication such as facial expression and speech. Many studies, including both unoperated and operated cleft individuals have suggested that some facial deviation are directly caused by the primary anomaly, where as others are caused by the surgical intervention and the subsequent dysplastic and compensatory growth of facial bone[1-4].

Semb and Shaw stated that several factors that may be potential sources of interference with the normal craniofacial growth pattern in individuals with clefts are variations intrinsically associated with cleft malformation, and other variations associated with functional adaptations, and surgical iatrogenesis. However, there is still controversy concerning causal background of residual deformities[5,6].

Effect of severe surgical iatrogenesis on maxillary development in individuals with clefts has been documented many times[7-10]. The maxillary growth zones[11], including the premaxillary-vomerine complex, have been affected by harmful interference[12-14].

The knowledge of growth modification in cleft lip and palate patients is important for clinicians concerned with their care in order to understand the results of growth modification procedures and select the proper treatment.

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Growth of maxillary complex in unilateral cleft lip and palate

In newborns, common findings in unilateral cleft lip and palate (UCLP) are protrusion of premaxilla which is deviated to the non cleft side, decreased length of the basal part of the maxilla, reduced posterior maxillary height and increased posterior maxillary width[3]. Repair of lip and anterior part of hard palate at two to three months of age in unilateral cleft lip and palate patients appears to influence the development of the maxillary complex in two beneficial ways which are the premaxilla is no longer relatively protruding and it is less asymmetric[15]. However, Herman et al, in making a comparison of the craniofacial morphology of a group of patients with unilateral complete cleft lip and palate (UCCLP) after surgical closure of the lip with a group of young patients with another group of similar age having unrepaired isolated incomplete cleft lips (UICL) found unsatisfactory results of surgery[4]. Although the surgery for the UCCLP group led to favorable molding of the premaxilla, there was also

significant retraction compared with the untreated UICL group.

The growth of posterior region of maxilla is decreased in downward and antero-inferior directions. The dimension of the maxilla is smaller in unilateral cleft lip and palate patients when compared with patients without cleft lip and palate[4,16]. There is severe reduction in posterior maxillary height but only slightly reduction in anterior maxillary height. An increased vertical height of the anterior maxilla has also been reported[17].

Palatoplasty could inhibit the vertical growth of posterior region of maxilla[10,18]. It also may inhibit forward displacement of the maxillary base and antero-posterior development of the maxillary dento-alveolus in unilateral cleft lip and palate patients. But palato-plasty has no effects on the downward displacement of the maxillary base or on palatal remodeling in unilateral cleft lip and palate patients[19].

Smahel and co-workers[20] found that the maxilla was not shortened in unilateral cleft lip and palate patients before th epalate was repaired. The maxillary becomes shortened at a later stage because of scar tissue following palatal surgery.

Growth of mandible in patients with unilateral cleft lip and palate

Unilateral cleft lip and cleft palate patients often have a short mandible[3]. Ross[21] and Dogan et al[22] found that patients with UCLP have short mandibular ramus, increased gonial angle, and mandibular plane angle.

Growth modification

The aim of this treatment of young cleft lip and palate patients who have maxillary deficiency and Class III malocclusion is modification of the growth using appliances to advance the maxilla. Growth modi-fication, sometimes called dento-facial orthopedics, for a skeletal discrepancy problem is defined as altering unacceptable skeletal relationships for patients whose remaining facial growth is appropriately changed in size and position[23]. Such growth modification is attempted before the end of the adolescent growth spurt and before total ossification of the maxillary sutural system[24].

The typical appliance for modification of growth to overcome skeletal deficiency problems is the face mask (protraction head gear) but the consequences of this protraction therapy have been inadequately researched[25].

Face mask (protraction head gear)

The face mask was first used in the treatment of patients with cleft lip and palate and with maxillary deficiency and Class III malocclusion by Delaire et al in 1972[26].

Berkowitz[27] used a modified Delaire type which had a padded chin cup and forehead rest for treating maxillary retrusion among young patients with cleft lip and palate (Fig. 1). He claims that this appliance is very successful without causing severe sore spots on the chin and forehead. He states that the maxillary protraction forces do not change the direction of mandibular growth but increase midfacial height and downward and backward rotation of the mandible which makes the maxillary retrusion appear less evident.

The Petit type of protraction face mask, similar in function to that used by Berkowitz, has two pads for contacting the soft tissue at forehead and chin regions. The pads are carried on a rigid and slightly curved vertical midline bar to match the facial contour with height adjustment for the pads and position for the maxillary traction force (Fig. 2). If maxillary expansion is also required, an appliance such as quad helix, W-spring, or Hyrax expansion screw is used in conjunction with

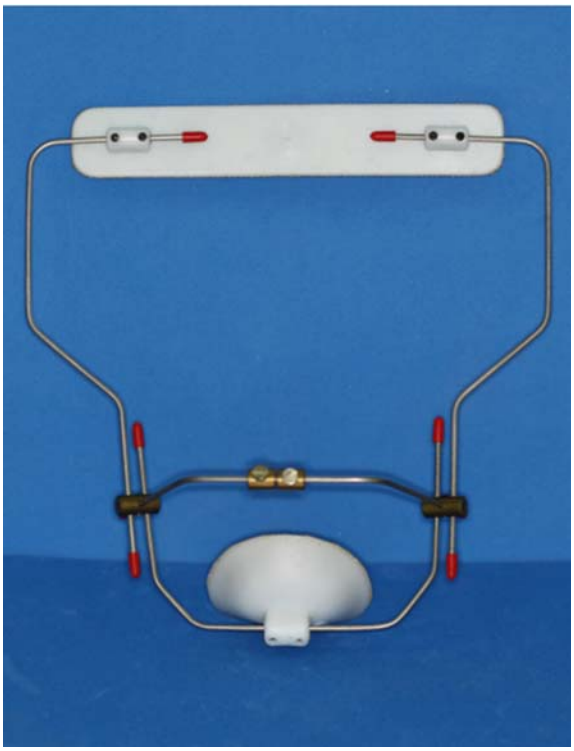

Fig. 1 Delaire type has padded chin and forehead rests

the face-mask. Any rigid maxillary orthodontic appliance, with or without the expansion component has buccal hooks to provide connection of traction elastics with the bar of the face-mask. The elastic pull of elastics from the face-mask is adjusted to provide the desired direction of traction on the maxilla through the medium of the maxillary dental arch. Because the face mask is partly supported by the chin pad, there will be a reciprocal retracting force on the mandible contributing to the total face-mask effect of correcting Class III malocclusion.

The mechanical concept is that the direction of the traction force is adjusted to produce the desired displacement of the maxilla force both anteriorly and vertically. Thus it may aim to reduce any anterior openbite by lowering the palatal plane anteriorly (Fig. 3). Control of direction of the force can minimize the bite opening. Pulling down from the molars should be avoided because it will tilt the maxilla downward posteriorly by extruding the molars and so change occlusal plane cant leading to anterior bite opening. If the aim is to increase midfacial height as well as anterior growth, this is done using more vertically directed elastic force[23,24,27].

Keles and co-workers[28] stated that the forward bodily movement of maxilla without rotation can occur when applying the force near the center of resistance of the maxilla which is located just above the roots of premolar teeth.

Bilaterally applied forces of between 300 and 600 gms for at least 12 hours per day have been advocated by various authors[23,27-29].

In order to obtain more favorable conditions for midfacial growth and development, transverse expansion followed by maxillary protraction allows the permanent incisors to erupt spontaneously into a positive overjet and overbite position. This is the reason for using a quad-helix expander with bands and hooks with the face mask to control transverse expansion of the maxillary arch[30]. An alternative to the banded appliance is to use a bonded acrylic expansion appliance[23]. There is concern that such expansion may open up a naso-palatine fistula[31], but such possible fistula formation can be attributed to absence of complete soft tissue closure of the cleft at primary surgery and subsequent maxillary dento-alveolar collapse with only approximation of soft tissues but no union.

Most studies use palatal expansion to produce dento-alveolar changes such as to correct posterior crossbite, increase arch length and open the bite.

Fig. 2 Petit type has two pads for contacting the soft tissue at forehead and chin region. The pads are joined by a rigid vertical midline framework and adjustable through the loosening and tightening screws

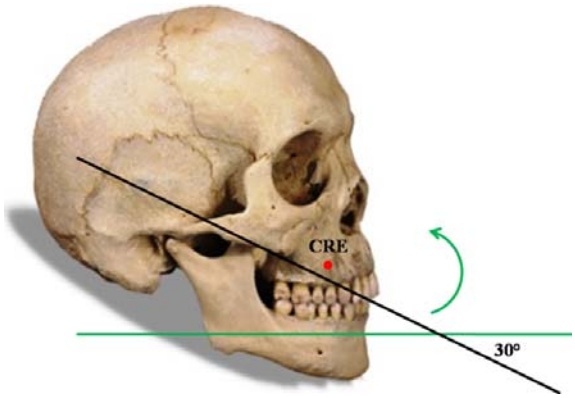

Fig. 3 Maxillary protraction below the center of resistance produces opening rotation of maxilla (arrow). Protraction elastic attached near the maxillary canine with downward and forward pull of 30 degrees to the occlusal plane minimizing bite opening

Berkowitz[27] stated that the combined use of palatal expansion and protraction forces before the pubertal growth spurt is a more efficient means of gaining orthopedic advancement.

Baik[32] reported that the maxilla was moved forward more when using the protraction with rapid maxillary expansion in Class III malocclusion with maxillary hypoplasia patients.

In unilateral cleft lip and palate, Liou and Tsai[33] claimed maxillary protraction using repeated rapid maxillary expansion and constriction and intra oral springs could advance the maxilla significantly with a more stable result. They believed that such alternate expansion and contraction would loosen the circum-maxillary sutures releasing the maxilla for easier protraction. The need for maxillary protraction with rapid maxillary expansion should be based on clinical criteria[34].

Tindlund et al reported a large study comparing changes resulting from use of the face masks for young subjects with cleft lip and palate (CLP) with similarly aged, untreated non-cleft subjects[30]. They found improvement in maxilla-mandibular relationships among the CLP group that generally matched the natural growth changes among the non-cleft subjects. However, the amounts of change were more variable among the CLP group. Buschang and co-workers[25] in a similar but smaller comparative study arrived at similar conclusions. Neither study reported long term follow-up comparisons to determine if the early changed were sustained into adolescence.

Treatment needs and effects of face mask therapy are correction of any anterior functional shift of the mandible to achieve dental occlusion (pseudo Class III malocclusion), displacement of the maxillary skeleton slightly forward with downward opening rotation, movement of maxillary dentition forward, lingual tipping of the lower incisors and redirection of mandibular growth in a more vertical direction[35]. The line of the protraction force directed below the maxillary center of resistance produces maxillary closing rotation, but it is unpredictable and independent of skeletal morphology, age, peak height velocity (PHV), and duration of traction[25,34,36].

The contra-indications for using conventional maxillary traction hook positions next to the canines for traction with the facemask are labially inclined maxillary incisors and a vertical facial growth pattern. These positions for the hooks are frequently used because it is difficult to orient the protraction force to pass through the center of resistance of the maxilla.

Tindlund found that the protraction of the maxilla in unilateral cleft lip and palate patients affects the skeletal part more than in bilateral cleft lip and palate cases[35]. Ahn, Kim, Yang, et al found that the maxilla of unilateral cleft lip and palate was more advanced than the bilateral cleft lip and palate[37].

Baek, Kim and Choi[38] reported results of three patients with cleft conditions who had maxillary protraction connecting the face mask to miniplates placed on the bucccal plates of the maxilla on the anterior aspects of the zygomatic buttresses. Hooks at the anterior ends of the minplates corresponded to the positions of the hooks used with the conventional dental a anchorage. There was greater protracting effect on the maxilla with less dental change than with conventional dental anchorage because the intra-oral appliance was not supported by the maxillary teeth. Ahn and co-workers[37] found that the clockwise rotation of mandible and increase in lower facial height were minimized using the protraction facemask with miniplates by controlling the line of protracting force.

So[39] reported that the treatment in unilateral complete cleft lip and palate with face mask can improve the combined sagittal jaw discrepancy and incisor crossbite, two thirds being skeletal advancement, and one third dento-alveolar change. The maxilla moves forward whereas the mandible moves backward with matching improvement of maxilla-mandibular incisor relationships.

Keim cautions that the results of use of maxillary expansion with face mask for the young patient can resolve the problem of Class III only to see it relapse during later adolescent growth[40]. He emphasises the need for attempting overcorrection in application of growth modification in young patients.

The treatment age for expanding and protracting the maxilla with combined rapid maxillary expansion and facemask therapy remains limited to the deciduous or early mixed dentitions, especially, before upper permanent incisor eruption[41]. Tindlund[35] stated that the most logical time for the intervention is before 10 years of age, a time during which the circum-maxillary sutures are more responsive to forcible movement. Because protraction during the deciduous dentition minimizes unwanted dento-alveolar proclination of maxillary incisors in the permanent dentition, so it establishes positive overbite, overjet relationships, and good vertical closure of incisors which helps to maintain a normal dental relationships and also increases post-treatment stability[30,31]. However, maxillary protraction with skeletal anchorage and Class III elastics can be

applied more successfully at the late mixed or permanent dentition stages of development[42].

In cases of severe malocclusions, skeletal correction should be delayed until the permanent dentition stage, a time when comprehensive orthodontics in combination with orthognathic surgery or distraction osteogenesis may be a more predictable option. Surgical advancement of the maxilla, such as Le Fort I osteotomy can correct maxilla retrusion in cleft lip and palate patients. The frequency of maxillary advancement in bilateral cleft lip and palate is more than in unilateral cleft lip and palate[43] and the frequency of using orthognathic surgery is increased with the severity of the cleft type[44,45]. However, maxillary distraction osteogenesis is being increasingly used for correcting maxillary hypoplasia in moderate and severe cleft lip and palate patients. This technique can significantly lengthen the maxilla in forward and downward direction which induces protraction of soft tissues, including muscle, blood vessels and nerves, as well as bones[46]. Moreover, maxillary distraction is indicated for growing cleft lip and palate patients[47]. A long-term follow-up of maxillary distraction osteogenesis in growing cleft lip and palate patients showed that the ANB angle and overjet were decreased but positive overjet remained[48].

Conclusion

The objects of treatment planning in growing cleft patients using growth modification is to improve the relation of jaws by advancing the maxilla, restricting the mandible or combination of these. The results of treatment depend on the treatment planning, skill of operator, co-operation of patients, ages of patients and severity of malocclusion. There are insufficient studies to demonstrate the efficacy of growth modification in cleft patients. Patient selection may be essential for successful treatment outcome and it is necessary to follow the effects of face-mask treatment of patient with cleft lip and palate by multiple case control studies over long periods of time. A severe malocclusion in the primary or early mixed dentition is unlikely to be corrected with growth modification, and may then simply become a costly and unnecessary burden to the patient, one with questionable and often transient benefit.

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Potential conflicts of interest

None.

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การเปลี่ยนแปลงการเจริญเติบโตของผู้ป่วยปากแหว่งเพดานโหว่ข้างเดียวโดยใช้หน้ากาก

มนเทียร มโนสุดประสิทธิ์, ทัศนีย์ วังศรีมงคล, พูนศักดิ์ ภิเศก, ธณัชช์ปิยา สมสุข, บวรศิลป์ เชาวน์ชื่น

วัตถุประสงค์ในการรักษาผู้ป่วยปากแหว่งเพดานโหว่โดยใช้การเปลี่ยนแปลงการเจริญเติบโตเพื่อช่วยทำให้ความสัมพันธ์ของกระดูกขากรรไกรดีขึ้น โดยการเคลื่อนกระดูกขากรรไกรบนไปด้านหน้า, ยึดกระดูกขากรรไกรล่าง หรือการทำร่วมกันทั้งสองวิธี การเปลี่ยนแปลงการเจริญเติบโตควรจะทำก่อนหมดการเจริญเติบโตสูงสุด ซึ่งเครื่องมือที่นิยมใช้คือ หน้ากาก (ชนิดดีแลย์ และ พีติ) ส่วนผลของการเปลี่ยนแปลงการเจริญเติบโตยังคงเป็นที่โต้เถียงกัน เนื่องด้วยมีการศึกษามากมายถึงผลของการรักษาโดยวิธีนี้ว่าเป็นการเปลี่ยนแปลงของฟันและกระดูกเบ้าฟัน และการหมุนของขากรรไกรไปด้านหลัง ซึ่งไม่มีผลต่อการเปลี่ยนแปลงการเจริญเติบโต