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RESEARCH ARTICLE

REVERSE PULL HEADGEAR

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ABSTRACT

Skeletal Class III malocclusion is considered to be one of the most difficult orthodontic problems to treat. This malocclusion may be associated with the retrognathic maxilla or prognathic mandible or sometimes a combination of both. Orthopedic correction of skeletal Class III malocclusion in a growing patient is important as it may predict the future surgical procedures. This article describes about various procedures of growth modification during growth period.

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INTRODUCTION

A developing Class III malocclusion is one of the most challenging problems confronting an orthodontic clinician. If left untreated the Class III malocclusion may worsen, with the majority of these patients ultimately requiring orthognathic surgery as adults.

Features of class III malocclusion

A developing Class III malocclusion can present with maxillary skeletal retrusion, mandibular skeletal protrusion, or a combination of the two. There may be posterior and anterior crossbites. Dental compensation, such as maxillary dentoalveolar protrusion and mandibular dentoalveolar retrusion, poor facial profiles due to midface deficiencies. Protraction facemask has been used in the early treatment of Class III patients with maxillary deficiency or mandibular prognathism (or both) (Proffit, 2007). The principle of maxillary protraction is to apply tensile force on the circumaxillary sutures and thereby stimulate bone apposition in the suture areas. The maxillary teeth become the point of force application, and the face (forehead, chin, zygoma) or occipital area becomes the anchorage source (Ishii *et al*., 1987).

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Indications for facemask therapy

For treating skeletal Class III malocclusion with a retrusive maxilla and a hypodivergent growth pattern. Patients presenting initially with some degree of anterior mandibular shift and a moderate overbite have an improved treatment prognosis. Correcting the anterior crossbite usually results in a downward and backward rotation of the mandible that diminishes its prognathism. For patients presenting with a hyperdivergent growth pattern and a minimal overbite, a bonded palatal expansion appliance to control vertical eruption of the molars is recommended. In case of cleft palate patients (Ellis, 1984).

Biomechanics of reverse pull headgear

Maxillary protraction below centre of resistance produces anticlockwise rotation of the maxilla. Protraction elastics attached near the maxillary canine with a downward and forward pull of 30 degrees to the occlusal plane minimize bite opening. In the late 1970's Delaire and coworkers in France showed that forward positioning of the skeletal maxilla could be achieved with reverse headgear if treatment was begun at an early age. Increase in maxillary growth occurs only in young

patients (below age 10). Hence a child with maxillary deficiency should be referred for complete evaluation as early as possible. The chance of successful forward movement is essentially zero by the time maturity is achieved (Harrington *et al*., 2015; Turley, 1996). Hence ideal patients for this method should have either normally positioned or retrusive, but not protrusive, maxillary teeth. Normal or short, but not long, anterior facial vertical dimensions. Protraction forces applied 10 mm above the Frankfort horizontal plane produced a posterior rotation of the maxilla with a forward movement of nasion. Protraction forces applied 5 mm above the palatal plane produced a combination of parallel forward movement and a very slight anterior rotation. Protraction forces applied at the level of the maxillary arch produced an anterior rotation and forward movement of the maxilla. All three protraction forces caused the constriction of the anterior part of the palate (Foersch *et al*., 2015).

Types of reverse pull headgear

- Delaire's facemask
- Petit type of face mask
- Modification of petit type of face mask mcnamara
- Other modifications

Delaire's facemask

The individual most responsible for reviving interest in this orthopedic technique is Jean Delaire of Nantes, France. Delaire's approach involves applying traction to the maxillary sutures, while reciprocally pushing on the mandible and the forehead through the anchorage provided by the facial mask. This approach provides a repositioning of the bones of the craniofacial complex to a greater extent than that which could be carried out by traditional orthodontic methods. Delaire's facemask is simple and well accepted by children. The attachment is to a maxillary splint incorporating all the teeth. If a three dimensional deficiency exists so that the maxilla is narrow as well as deficient anteroposteriorly and vertically, slow expansion can be done simultaneously with protraction (Sar *et al*., 2014).

Petit type of face mask

Major changes in facial mask design have been prompted by Henri Petit, formerly of Baylor Dental College and now of Paris. Petit has advocated the use of the facial mask for a relatively short period (4-6 months); however, during this treatment period very heavy forces are applied to the craniofacial complex. The Petit facial mask originally was constructed on a patient-by-patient basis, using 0.25" round lengths of stainless steel, to which pads for the forehead and chin were attached. This initial approach was not practical on a routine basis, because several hours were required to fabricate each appliance. Later, the design of the facialmask was simplified and made available commertially. The current version of the Petit facial mask is made of two pads that contact the soft tissue in the forehead and chin regions. The pads are made from acrylic and are lined with soft closed-cell foam that is non-absorbent, easily cleaned, and replaceable. The pads are connected by a midline framework made from round, contoured length of .25" stainless steel with acron nuts on each end. The positions of the pads are adjustable through the loosening and tightening of a set-screw. The midline framework also can be bent to conform better to the outline of the face of the individual patient. In the center of the midline framework is a crossbar made from 0.075" stainless steel that is secured to the main framework by a setscrew, thus allowing the position of the crossbar to be adjusted vertically. The ends of the crossbar are contoured for patient safety (Westwood *et al*., 2003).

McNamara (1987) described a version of the petit facial mask that attaches to a maxillary splint which is bonded to the posterior dentition. The splint is fitted with hooks to attach elastics to the facemask, and an expansion screw is incorporated in the appliance. Mid facial orthopaedic expansion can produce a slight anterior movement of Point A and a slight inferior, and anterior movement of the maxilla (Saadia and Torres, 2000). There are now reverse pull facemasks available (Grummons) for patients suffering from severe temporomandibular joint dysfunction. These reverse pull facemasks are designed to keep all reciprocal forces completely off the mandible.

Components of reverse pull headgear

3 components

- Facial mask
- Maxillary splint
- Elastic traction

Facial mask

The facial mask consists of a Forehead pad and a Chin pad that are connected with a heavy steel support rod. A crossbow is connected to support this rod to which are attached rubber bands to produce a forward and downward elastic traction on the maxilla. The position of the pads and the crossbow can be adjusted simply by loosening and tightening set screws within each part of the appliance (Williams *et al*., 1997).

The maxillary splint

The second component of this appliance system is the maxillary splint, which is attached to posterior dentition. It may be of two types: Banded maxillary splint or Banded maxillary splint.

Banded palatal expansion appliance

In the mixed dentition, banded palatal expansion appliance is constructed by using bands fitted on the maxillary primary second molars and permanent first molars. Molar bands are joined by soldering a heavy wire (0.043 inch) to the palatal plate and a hyrax type screw is placed in the midline. The appliance is activated twice daily (0.025 mm per turn) for one week. In patients with constricted maxilla, activation is carried out for two weeks or more depending on the discrepancy (Ngan *et al*., 1997).

Bonded palatal expansion appliance

This appliance incorporates a hyrax type screw into a wire framework made from 0.040 inch that extends around the buccal and lingual surfaces of the dentition. The primary molars and permanent first molars are covered with acrylic. A separate wire is bent to cross the occlusion between the primary first and second molars and ends with a hook for protraction with elastics.

The benefits of palatal expansion

It includes expansion of a narrow maxilla and correction of posterior crossbite, increase in arch length and Bite opening. Loosening or activation of circum-maxillary sutures. Initiating downward and forward movement of the maxillary complex (Tanne *et al*., 1989).

Elastic traction

The facial mask is secured to the face by stretching elastics from the hooks on the maxillary splint to the cross-bow of the facial mask. Heavy forces are generated, usually with a sequence of elastics, beginning with 8 oz. of force being generated by 1/2" elastics and ultimately resulting in the use of. 14 oz of force by 5/16" elastics. Lighter forces are used during the break-in period, but forces increase as the patient adjusts to the appliance.

Sutures involved in maxillary protraction

Several circum-maxillary sutures play an important role in development of the naso-maxillary complex. A change in these sutures during treatment in the growing period occurs. The sutures are Frontomaxillary, Nasomaxillary, Zygomaticotemporal, Zygomaticomaxillary, Pterygopalatine, Intermaxillary, Ethmomaxillary, Lacrimomaxillary. Most of the orthopedic effects are seen within 3-6 months after maxillary expansion. Prolonged use of protraction forces results in dentoalveolar changes including mesial movement of maxillary molars and proclination of maxillary incisors. Gallagher *et al* in AJO 1998 found that in the post treatment follow up for face mask therapy patients, the maxilla showed a relative relapse by not displacing forward as much as normal. The anterior rotation caused by treatment was neglected. The mandible followed a normal downward andforward growth pattern. Augmenting forward growth of maxilla is not as successful as restraining the growth as seen clinically. This is because of the inability to produce enough force at the posterior and superior sutures to separate them in older children and extent of interdigitation of bony spicules across the sutural lines. Clinical experience suggests that more than 3mm forward displacement of the maxilla is unlikely, probably because of soft tissue limitations.

Treatment timing

According to Kim *et al* in AJO 1999 and several other authors, treatment should be started as early as possible to produce a more significant response from protraction therapy.Treatment changes in the younger group are larger than those in the older group. Protraction face mask therapy is still effective but to a lesser degree in growing patients older than 10 years of age. The optimal timing for intervention is at the time of eruption of the upper central incisors. A positive overjet and overbite at the end of treatment appears to maintain the anterior occlusion at the end of treatment. Better skeletal and dental response is obtained in the primary and early mixed dentitions (Vaughn *et al*., 2005).

Treatment effects produced by face mask therapy

The maxilla moves downward and forward with a slight upward movement in the anterior and downward movement in the posterior palatal plane.Extrusion of posterior teeth.Correction of CO-CR discrepancy. This correction is immediate and usually is observed in pseudo-Class III patients. Maxillary skeletal protraction. Usually 1-3 mm of forward movement of the maxilla is observed. Lingual tipping of the lower incisors. This tipping often occurs as a pre-existing anterior crossbite is being corrected.Backward rotation of the mandible in relation to the cranial base. In instances in which the patient begins treatment with a short or neutral lower anterior facial height, this change obviously is advantageous. In instances in which a patient has a long lower anterior facial height at the beginning of treatment, this treatment effect may be undesirable. Face mask produced an increase in the effective length of the maxilla and a decrease in the length of the mandible. Protraction groups show an inhibition of mandibular growth. (AJO 1998)

Clinical management of face mask

Impressions

A standard aluminum tray can be used effectively when making an impression for the maxillary splint. The impression should be checked for proper reproduction of the teeth and associated soft tissue. The casts then are poured and trimmed.

Splint fabrication & delivery

The wire framework is formed from .045" stainless steel wire that is contoured to the posterior Hooks facing posteriorly are soldered to the frame in the desired position. Usually the hooks are attached to the framework in the region of maxillary; first deciduous molar or the deciduous canine. A expansion screw can be placed in middle of the palate and soldered to the base wire. Splint can be fabricated by using biostar material or cold cure acrylic. Activation of the splint. The patient is instructed to turn the midline expansion screw of the appliance once per day generally at the bedtime. The maxillary splint is expanded until the desired correction in the transverse dimension is achieved. No transverse change is necessary – the maxillary splint still is activated, usually once a day for ten days to produce a disruption in the sutural. In some patients may facilitate the action of facial mask (Turley, 1996).

Delivery of the face mask

Facial mask usually is delivered two to six weeks after placement of the splint. The current version of the facial mask is available in two sides and can be adjusted to fit the facial contours of most patients.

Sequence of elastics

SIZE	FORCE	DURATION
At the time of delivery	3/8 ” 8 oz	2 weeks
After 2 weeks	1/2 ” 14 oz	
Increased to a maximum of	5/16” 14 oz	

Discontinuation of treatment

The facial mask is worn until a positive over jet of 2-5 mm is obtained. At this time, part time or night time wear is recommended for an additional three to six month. A removable palatal stabilization plate is worn full time. In patients with initially severe skeletal imbalances and/or severe

neuromuscular imbalances, the FR-3 appliance should be worn as an active retainer following correction of the Class III relationship with the facial mask. A chin cup can be worn as a retainer in patients with residual mandibular prognathism. The facial mask should be discontinued immediately if the patient complains of any symptoms of temporo-mandibular (TM) disorders. Although rare, signs and symptoms of TM disorder have been observed in patients wearing the facial mask, and immediate discontinuance of the appliance usually results in a reversal of the symptomatology (Moullas *et al*., 2006).

Profile changes in patients with class iiimalocclusions after delaire mask therapy

Forward migration of both B and pogonion points was restricted, andthe mandible exhibited a downward and backward rotation. Accordingly, improvement in skeletal profile convexity was obtained but at the expense of vertical dimension. Dentally, the Class III incisor relationship was corrected by anterior displacement of the upper incisors and posterior displacement of the lowerincisors, whereas the axial inclination of these teeth showed no significant change. The Delaire face mask treatment can provide orthopedic effects on dentofacial morphologic features of growing skeletal Class III femalepatients.Treatment tended to reduce the concavity of the profile. This was characterized by a forward movement of the upper lip, backward repositioning of the pogonion soft, and slight inhibition of anterior migration of the lower lip. The effect of the treatment was found to be more marked on the upper lip area.

Effects of protraction mechanics on the midface

The post-protraction results indicated that there was significant movement of A point in a downward and forward direction as seen by an increase in the measurement from sella to A point. As a result of a statistically significant change in the horizontal vector of A point to nasion perpendicular and no change in the vertical measurement of A point perpendicular from sella nasion.

Cephalometric changes after the correction of classiiimaloccclusion with maxillaryexpansion/facemask therapy

Positive overjet after treatment.After facemask therapy, the maxilla continued to grow anteriorly in an amount equal to untreated class iii patients. There is a partial closure of the vertical opening associated with facemask therapy possibly the result of mandibular counter-clockwise rotation. Slight decrease in the mandibular plane angle and lower face height. The maxillary incisors proclined to compensate for decreasing overjet and erupted vertically more. The lower incisors retroclined during treatment and moved forward after treatment.

Soft tissue profile changes following maxillary protraction in Class III subjects

The maxilla and surrounding soft tissues showed significant anterior movement. The mandible and surrounding soft tissues showed a backward and downward rotation. The improvement in facial profile predominantly resulted from maxillary soft tissue changes and mandibular hard tissue changes. The concave soft tissue profiles of the Class III subjects were corrected by anterior movement of the maxilla and a concomitant increase in the fullness of the upper lip. The concave skeletal profiles were, however, corrected mainly by backward and downward rotation of the mandible (Cha *et al*., 2011).

A modified protraction headgear

Primary aim was to control important force variables such as magnitude, direction, and point of force application. The intraoral elastic component of the headgear was replaced by a headgear bow. The headgear bow was modified at its inner bow insertion end. A U-shaped loop was made at the end of the inner bow to insert it from the distal end of the maxillary molar headgear tube. The outer bow was placed according to the desired movement of the maxilla in relationship to the center of resistance of the maxillary dentition, which was estimated to be in the apical area of maxillary premolars (Turley, 2002).

Appliance activation

The appliance was activated by means of elastics attached from the outer bow to the wires of the chin cup. The elastics delivered a force of 500 to 750 Gm. on each side. The maxillary teeth were tied together as one unit by a heavy 0.019 by 0.025 inch stabilizing arch wire. It is assumed that, by using the whole dentition as one unit, the force distribution, if any, to the midfacial sutures will be evenly distributed (Cha *et al*., 2011).

Conclusion

In many of the mild to moderate and some rather severe Class III problems facemask therapy produces a pronounced occlusal change within a relatively short period. When used with caution this type of treatment has proven extremely rewarding in a wide variety of Class III conditions.

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