Early Timely Treatment of Class III Malocclusion

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The protrusion facemask has been widely used in the treatment of Class III malocclusion with maxillary deficiencies. However, the benefit of this early treatment modality is not clear. One of the reasons orthodontists are reluctant to render early orthopedic treatment in Class III patients is the inability to predict mandibular growth. The use of a single cephalometric radiograph to predict excessive mandibular growth has severe limitations. The use of serial cephalometric radiographs taken a few years after facemask treatment, and a Growth Treatment Response Vector (GTRV) analysis to individualize and enhance the accuracy in predicting excessive mandibular growth, is presented and proposed. This article discusses the rationale for early "timely" treatment of Class III malocclusion, the indications and contraindications for early Class III treatment, and provides a method of predicting excessive mandibular growth using the GTRV analysis.

Rationale for Early Timely Treatment of Class III Malocclusions

The objective of early orthodontic treatment is to create an environment in which a more favorable dentofacial development can occur.12 The goals of early Class III treatment may include the following:

1. To prevent progressive irreversible soft tissue or bony changes. Class III malocclusion is often accompanied with an anterior crossbite. Uncorrected anterior crossbite may lead to abnormal wear of the lower incisors, dental compensation of mandibular incisors, leading to thinning of the labial alveolar plate and gingival recession.

2. To improve skeletal discrepancies and provide a more favorable environment for future growth. Excessive mandibular growth is often accompanied by dental compensation of the mandibular incisors. Early orthopedic treatment using facemask or chin cup therapy could help orthodontists to plan for future orthodontic care.

The use of a single cephalometric radiograph to predict mandibular growth has limitations. Discriminant analysis from long-term results of early treatment identified several cephalometric variables such as the position of the mandible, condylar length, gonial angle, and ramal height that have predictive values.10,11 However, these predictive formulae are better in predicting successful outcomes than unsuccessful outcomes.

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Indications and Contraindications for Early Class III Treatment

Turpin developed a list of positive and negative factors to aid in deciding when to intervene in developing Class III malocclusions. The positive factors include good facial esthetics, mid-skeletal disharmony, good family prognosis, presence of an anteroposterior functional shift, convoluted facial type, symmetrical condylar growth, and growing patients with good cooperation. The negative factors include poor facial esthetics, severe skeletal disharmony, condylar pattern established, no anteroposterior shift, divergent facial type, asymmetric condylar growth, growth complex, and poor cooperation. Turpin recommends that early treatment should be considered for patients that present with positive characteristics. For individuals who present with negative characteristics, treatment can be delayed until growth is complete. Patience should be aimed that surgery may be needed at a later date, even when an initial phase of treatment may be successful.

Early Treatment of Skeletal Class III Malocclusions

Chin Cup Therapy

Skeletal malocclusion with a relatively neutral mandible and a moderately active mandible may be treated with the use of a chin cup. This treatment modality is popular among the Asian populations because of its favorable effects on the sagittal and vertical dimensions. The objective of early treatment with the use of a chin cup is to provide growth inhibition or restriction and repositioning of the mandible.

The orthopedic effect of a chin cup on the mandible includes reduction of mandibular growth vertically, backward positioning (retraction) of the mandible, and remodeling of the mandible with closure of the gonial angle. If there is no agreement in the literature as to whether chin cup therapy may or may not inhibit the growth of the mandible, the treatment objective is to produce a change in the mandible associated with a downward and backward movement and a decrease in the angle of the mandible. In addition, there is less incisor crowding in mandibular incisors together with posterior movement of the mandible. Because of the downward and posterior movement of the mandible, control of vertical growth is difficult to manage, especially in long-face patients.

Chin cups are divided into two types: the occipital-pull chin cup that is used for patients with mandibular protrusion and the vertical-pull chin cup that is used in patients presenting with a steep mandibular plane angle and excessive anterior facial height. Most of the reported studies recommended an orthopedic force of 400 to 500 g per side. Patients are instructed to wear the appliance 14 hours per day. The orthopedic force is visually directed either through the condyle or below the condyle.

Evidence suggests that treatment of mandibular protrusion is more successful when it is started in the primary or early mixed dentition. In addition, the treatment is usually completed within 1 to 3 years, depending on the severity of the malocclusion. The stability of chin cup treatment remains unclear. Several investigations reported a tendency to return to the original growth pattern after the chin cups are discontinued. Sugawara and coworkers published a report on the long-term effects of the chin cup on three groups of Japanese girls who received treatment at ages 5, 7, and 11 years of age. The authors found that patients who started at an early age had a catch-up mandibular displacement in a forward and downward direction before growth was completed. However, several investigators believe that early correction of anterior crossbite reinforces the horizontal growth of the maxilla and prevents deterioration of incisor proclination relationships.

Protraction Facemask Therapy

The facemask has been used in the treatment of patients with Class III malocclusions and a mandibular deficiency. The facemask has an adjustable anterior wire that can accommodate a downward and forward pull on the maxilla with elastics. To minimize the tipping of the palatal plane, the protraction elastics are attached to the mandibular canines with a downward and forward pull of 10 lb from the occlusal plane. Mandibular protraction usually requires 300 to 400 g, or force per side, depending on the age of the patient. Patients are instructed to wear the appliance for 12 hours per day. In the mixed dentition, a bonded or bonded expansion appliance can be fabricated as an anchorage for mandibular protraction. The expansion appliance is activated twice daily (0.25 mm per turn) by the patient or parent for 7 to 10 days. In patients with a more constricted maxilla, activation of the appliance is performed for 2 weeks or more.

Several facial features play an important role in the development of the maxillomandibular complex. Functionality,
Growth Prediction of Class III Malocclusion

Several investigators have attempted to predict the progression of Class III malocclusions. 17, 26-28. Schultz and associates compared several morphological characteristics of Class III patients with the norm (tooth relationships, cranial deformities, premolar occlusion, and premolar position). 17 Using the Bailey Protraction Pattern, the lower incisors were moved forward as far as the teeth would permit and the change in overjet was used to determine the range of overjet in the patient. The authors noted that this method was useful in skeletal Class III patients with average growth patterns. Descriptive analysis of long-term results of early treatment identified several variables that had predictive values. Frank and associates found that the inclination of the condylar head, the mandibular vertical relationship with the width of the mandibular arch, could predict success or failure of early treatment. 27, 28. Class and associates found that the position of the mandible, the ramus length, the corpus length, and the vertical angle can predict successful outcomes with 95% degree of accuracy. 29 However, using a single cephalogram, the prediction formula can only accurately diagnose unsuccessful cases with only 70% degree of accuracy. The present author proposes the use of serial cephalometric radiographs of patients taken every year after facemask treatment and the use of a Growth Treatment Response Vector analysis to individualize and enhance the success of predicting excessive mandibular growth in Class III patients. The diagnostic procedure is usually performed during the early mixed dentition once a patient is diagnosed with mandibular deficiency. The patient will then be treated with maxillary expansion and a protraction facemask to eliminate the anterior crossbite, COCCIR discrepancy, and
maximize the growth potential of the nasomaxillary complex. The patient is followed for 3 to 4 years for growth observation. A GTRV analysis will then be performed during the early permanent dentition to allow clinicians to decide whether the malocclusion can be controlled by orthodontic treatment or whether a surgical intervention is necessary when growth is completed.

**Growth Treatment Response Vector (GTRV) Analysis**

Patients who presented with a Class III malocclusion and maxillary deficiency were treated with mandibular expansion and protection facemask to eliminate anterior crossbite. COCVR discrepancy, and maximize the growth potential of the nasomaxillary complex. Lateral cephalometric radiographs were taken before facemask treatment (Fig. 1) and during the 3- to 4-year follow-up visit (Fig. 2). The horizontal growth changes of the maxilla and mandible between the pretreatment radiograph and the follow-up radiograph are determined by locating the A point and B point on the posttreatment radiograph (Fig. 3). The occlusal plane (OP) is constructed by using the mental bicuspid cusp of the maxillary molars and the mental tip of the mandibular incisors as landmarks. The lines AO and BO are then constructed by connecting point A and B perpendicular to the occlusal plane similar to the "Wits" analysis.

The first tracing is superimposed on the follow-up radiograph using the stable landmarks on the anidontal cranium structure (Fig. 4). The A point and B point on the follow-up radiograph are located and the lines AO and BO are then constructed by connecting point A and B point of the follow-up radiograph to the occlusal plane of the first tracing. The distance between the B point of the two tracings along the occlusal plane represented the growth changes of the maxilla and the distance on the occlusal plane of the B point of the two tracings represented the growth changes of the mandible.

The GTRV ratio was calculated by using the following formula:

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\text{GTRV} = \frac{\text{Horizontal growth changes of the maxilla}}{\text{Horizontal growth changes of the mandible}}
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The arrows show the growth vector of the maxilla and the mandible after facemask treatment (Fig. 4). Clinicians can compare the growth changes of their Class III patients with the normal skeletal growth pattern derived from the Bolton Growth Study (Fig. 5). The GTRV ratio of an individual with normal growth pattern from age 6 to 16 is calculated to be 0.77. That means the mandible usually exceed the maxilla in horizontal growth by 23% to maintain a good skeletal rela-
Conclusions

It has been shown that in a random clinical trial when patients are followed until completion of skeletal growth, one out of three patients may be candidates for orthodontic surgery. Early treatment of Class III patients with maxillary deficiency using appliances such as the maxillary expansion can be used to eliminate anterior openbite, correct jaw angles, and maximize the growth potential of the posterior maxillary complex. In addition, it can be used together with the GRYV analysis as a tool to help clinicians in predicting patients with excessive mandibular growth that may not be able to be treated with orthodontic treatment.

References
