EARLY TREATMENT SYMPOSIUM

Biomechanics of maxillary expansion and protraction in Class III patients

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During a 1981 presentation at an American Association of Orthodontists meeting, David Turpin[1] recommended that early treatment should be considered for young patients who present with positive factors such as convergent facial type, anteroposterior functional shift, symmetrical condyle growth, mild skeletal disharmony, some remaining growth, good cooperation, no familial prognathism, and good facial esthetics. For patients who present with negative factors, he suggested delaying treatment until growth was completed. In the 20 years that have passed, what have we learned to help us better treat our patients?

We now know, for example, that Class III patients with maxillary deficiency can be treated quite successfully with facemask therapy in conjunction with maxillary expansion. In a prospective clinical trial, 20 patients with skeletal Class III malocclusion were treated consecutively with maxillary expansion and a protraction facemask.[2] A positive overjet was obtained in all of them after 6 to 9 months of treatment. These changes were caused by forward movement of the maxilla, backward and downward rotation of the mandible, proclination of the maxillary incisors, and retroclination of the mandibular incisors. The molar relationship was overcorrected to a Class I or II dental arch relationship, and the overbite was reduced with a significant increase in lower facial height.

We have also learned that overcorrection is a key to long-term stability. At the end of the 4-year observation period, and after half of the patients completed their pubertal growth spurt, 15 of the 20 (75%) maintained a positive overjet or an end-to-end incisal relationship. Patients who reverted to a negative overjet were found to have excess horizontal mandibular growth. Clinically, the success rate of treating Class III patients with maxillary expansion and a protraction facemask is at best 50% to 60% at the completion of the pubertal growth spurt.

PREDICTING MANDIBULAR GROWTH

Can we predict mandibular growth to improve the prognosis of early treatment? Björk[3] used a single cephalogram to identify 7 structural signs of extreme mandibular growth rotation occurring during growth. The 7 signs are related to the inclination of the condylar head, the curvature of the mandibular canal, the shape of the lower border of the mandible, the inclination of the symphysis, the interincisal angle, the intermolar angle, and the anterior lower face height.

Aki et al[4] proposed the use of symphyseal morphology to predict the direction of mandibular growth. Mandibles that grew in an anterior direction were associated with reduced height, increased depth, a small ratio, and a large angle of the symphysis.

To predict abnormal growth, Schulhof et al[5] calculated the sum of the deviations of molar relationship, cranial deflection, porion location, and ramus position from the norm with the Rocky Mountain Data System. A sum greater than 4 indicates probable increased mandibular growth. However, the accuracy of prediction is about 70%.

The magnitude and direction of maxillary and mandibular growth can be determined by using serial cephalograms. Musich[6] proposed a growth treatment response vector (GTRV) analysis to warn of excessive mandibular growth after early orthopedic treatment.

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GTRV equals the horizontal growth of A-point divided by the horizontal growth of B-point. The norm for patients age 6 to 16 years is 0.77. If the ratio falls below 0.60, the patient might need surgical treatment. With the GTRV, clinicians can use early treatment as a tool rather than a shortcoming when deciding whether to initiate early treatment.

Discriminant analysis of long-term results of early treatment identified several variables that had predictive values. One study found the inclination of the condylar head to be predictive; the maxillomandibular vertical relationship together with the width of the mandibular arch can predict success or failure of early Class III treatment in 95% of cases.[7] Another study[8] found that the position of the mandible, the ramal length, the corpus length, and the gonial angle can predict successful outcomes with 95% accuracy and unsuccessful outcomes with 70% accuracy.

Variability in response to maxillary protraction was noted in our longitudinal study. Horizontal protraction of the maxilla ranged from −0.8 to 5.5 mm, and vertical movement of the maxilla ranged from –3.5 to 5.0 mm. The ability to maintain a positive overjet during the observation period depends on the differential horizontal growth of the maxilla and the mandible after treatment. Without treatment, there is tremendous individual growth variation. Creekmore and Radney[9] stated that "individual growth responses were not predictable, but looking at individual changes, we see tremendous variation. Is it no wonder, then, that the same orthodontic treatment does not elicit the same response for all individuals since individuals do not grow the same without treatment."

TREATMENT INDICATORS

What are the treatment indications for Class III patients? The facemask is a most effective tool 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. The presence of an overbite helps to maintain the immediate dental correction after treatment. 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. During retention, a mandibular retractor or a Class III activator with a posterior bite block can be used for vertical control.

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