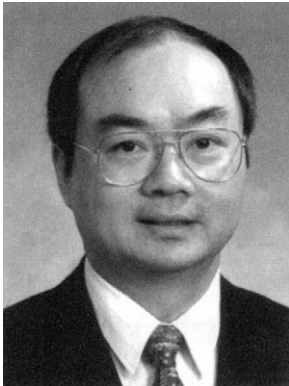




Early treatment of Class III malocclusion: Is it worth the burden?

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Protraction facemask therapy has been advocated in early treatment of Class III malocclusions with maxillary deficiency. The dental and skeletal effects of this appliance are well documented in the literature.¹⁻⁵ One reason that clinicians are sometimes reluctant to render early orthopedic treatment in Class III patients is the inability to predict mandibular growth.⁶ Patients receiving early orthodontic or orthopedic treatment might need surgical treatment at the end of the growth period. Is it worth the burden to treat a Class III malocclusion early? If so, what type of Class III malocclusions will benefit from early facemask treatment? When is the best time to start treatment? Can early treatment help to predict excessive mandibular growth?

The severity of Class III malocclusions ranges from dentoalveolar problems with anterior posturing of the mandible to true skeletal problems with significant maxillomandibular discrepancies.⁶ In addition, the condition could be complicated by vertical growth problems. A systematic way to diagnose Class III malocclusion can help in identifying patients who might respond favorably to early orthopedic treatment (Fig 1). For the *dental assessment*, check whether the Class III molar relationship is accompanied by a negative overjet. A positive overjet or end-to-end incisal relationship together with retroclined mandibular incisors usually signifies a compensated Class III malocclusion. For the *functional assessment*, check whether a centric relation (CR) or centric occlusion (CO) discrepancy exists.

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Anterior positioning of the mandible can result from an abnormal tooth contact that forces the mandible forward, a situation referred to as pseudo Class III malocclusion. Elimination of the CO or CR discrepancy should show whether it is a simple Class I malocclusion or a compensated Class III malocclusion. For the *profile assessment*, check the position of the maxilla and mandible and whether the jaws are proportionately positioned in the anteroposterior plane of space. Place the patient in natural head position; drop a line down from the bridge of the nose to the base of the upper lip and a second one extending from that point downward to the chin. A straight or concave profile in young patients indicates a skeletal Class III jaw relationship. For the *cephalometric assessment*, the best analyses are those that relate the maxilla to the mandible. Discriminant analysis found that the Wits appraisal was most decisive in distinguishing camouflage treatment from surgical treatment.⁷ A Wits appraisal greater than -5 indicates that the malocclusion might not be resolved by camouflage treatment with facemask or chin cup therapy. Differential diagnosis of patients with pseudo or true skeletal Class III malocclusions should include family history of Class III malocclusion, dental assessment of molar and incisal relationships, functional assessment to determine the presence of a CO or CR shift on mandibular closure, cephalometric analysis to determine the anteroposterior discrepancy of the maxilla relative to the mandible, and determination of the individual growth rate and direction by using the growth treatment response vector (GTRV) analysis as described below.⁸

When is the best time to start protraction facemask treatment? The main objective of early facemask treatment is to enhance forward displacement of the maxilla by sutural growth. It was shown by Melsen and Melsen⁹ in histological findings that the midpalatal suture is broad and smooth during the infantile stage (8-10 years of age), and the suture became more squamous and overlapping in the juvenile stage (10-13 years of age).⁹ Clinically, studies have shown that maxillary protraction is effective in the deciduous, mixed, and early permanent dentitions.¹⁰⁻¹² Several

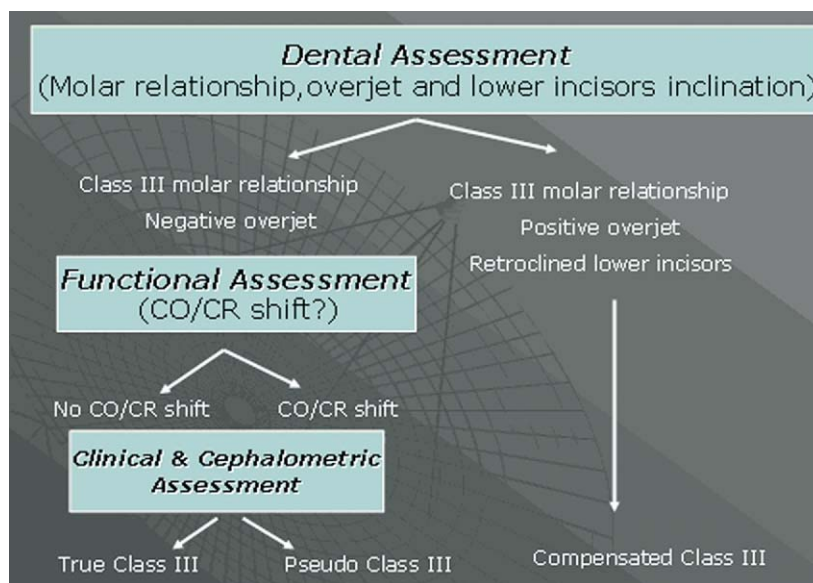


Fig 1. Diagnostic scheme to differentiate pseudo Class III patients from true skeletal Class III patients.

studies suggested that more anterior maxillary displacement can be found when treatment begins in the deciduous or early mixed dentition.^{2,11,13} The optimal time to intervene in a Class III malocclusion seems to be when the maxillary incisors erupt.¹⁴ A positive overjet and overbite at the end of the facemask treatment appears to maintain the anterior occlusion. Biologically, the circummaxillary sutures are smooth and broad before age 8 and become more heavily interdigitated around puberty. A long-term study comparing patients treated in the deciduous and early mixed dentition with patients treated in the late mixed dentition showed that, at the end of phase 2 fixed appliance therapy, greater forward movement of the maxilla and less mandibular projection were found only in the early treatment group.¹⁵

One goal of early Class III treatment is to eliminate any CO and CR discrepancies. Treatment with a facemask can help to correct an anterior crossbite and allow a more favorable environment for dentofacial growth. If these patients are followed for a few years into puberty, one can determine the growth rate and direction, which can be used to predict excessive mandibular growth. Björk¹⁶ used a single cephalogram to identify 7 structural signs of extreme mandibular growth rotation 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 width of the symphysis, the interincisal angle, the intermolar angle, and the anterior lower face height.

Discriminant analysis of long-term results of early treatment identified several cephalometric variables such as position of the mandible, corpus length, gonial angle, and ramal height that had predictive values.¹⁷⁻¹⁹ However, these predictive formulas can only predict unsuccessful outcomes with a 70% accuracy. We propose the use of serial cephalometric radiographs and GTRV analysis to predict excessive mandibular growth.

GTRV analysis

Patients with Class III malocclusion and maxillary deficiency are treated with maxillary expansion and protraction facemasks to eliminate anterior crossbite and CO or CR discrepancy, and maximize the growth potential of the nasomaxillary complex. Lateral cephalometric radiographs are taken after facemask treatment and during the 3 to 4-year follow-up visit. The horizontal growth changes of the maxilla and mandible between the posttreatment and follow-up radiographs are determined by locating A-point and B-point on the posttreatment radiograph (Fig 2). The occlusal plane (O) is constructed by using the mesiobuccal cusp of the maxillary molars and the incisal tip of the maxillary incisors as landmarks. The lines AO and BO are then constructed by connecting points A and B perpendicular to the occlusal plane.

The first tracing was superimposed on the follow-up radiograph by using the stable landmarks on the mid-sagittal cranial structure (Fig 3).²⁰ A-point and B-point on the follow-up radiograph were located, and the lines

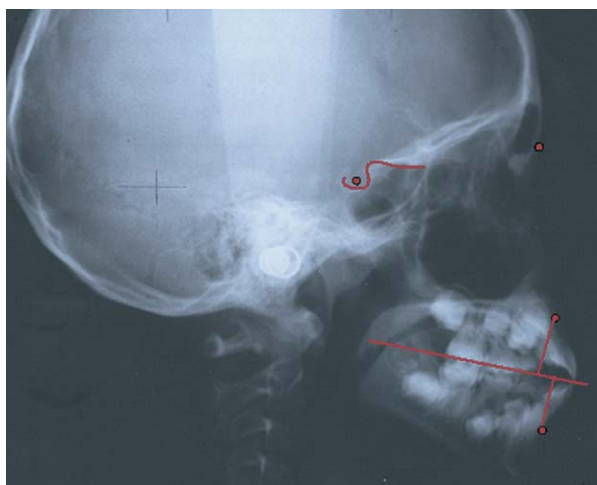


Fig 2. Horizontal growth changes of maxilla and mandible between posttreatment radiograph and follow-up radiograph were determined by locating A-point and B-point on first radiograph. Occlusal plane (O) constructed by using mesiobuccal cusp of maxillary molars and incisal tip of maxillary incisors as landmarks. Lines AO and BO were then constructed by connecting Points A and B perpendicular to occlusal plane.

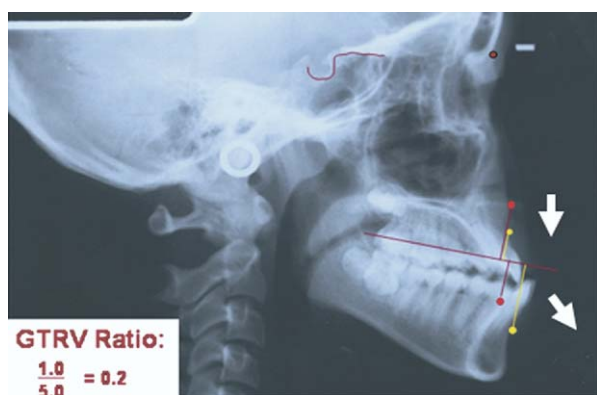


Fig 3. First tracing was superimposed on follow-up radiograph by using stable landmarks on midsagittal cranial structure. Distance between A-point of 2 tracings along occlusal plane represents growth changes of maxilla, and distance on occlusal plane of B point represents growth changes of mandible. GTRV ratio was then calculated.

AO and BO were then constructed by connecting points A and B on the follow-up radiograph to the occlusal plane of the first tracing. The distance between the A-point on the 2 tracings along the occlusal plane represents the growth changes of the maxilla, and the distance on the occlusal plane of B-point represents the growth changes of the mandible (Fig 3).

The GTRV ratio was calculated by using the following formula:

$$\text{GTRV} = \frac{\text{horizontal growth changes of the maxilla}}{\text{horizontal growth changes of the mandible}}$$

Horizontal growth changes of the mandible

A study of 20 patients who were successfully treated with facemask therapy and 20 patients who were unsuccessfully treated with facemask therapy showed that the GTRV ratios are significantly different.⁸ The mean GTRV ratio for the successful group was 0.49 ± 0.14 with a range of 0.33 to 0.88. The mean GTRV ratio for the unsuccessful group was 0.22 ± 0.10 with a range of 0.06 to 0.38. These results suggest that Class III patients with mild to moderate Class III skeletal patterns with a GTRV ratio between 0.33 and 0.88 can be successfully camouflaged with orthodontic treatment. Class III patients with excessive mandibular growth and a GTRV ratio below 0.38 should be warned of the need for future orthognathic surgery.

Accurate diagnosis and understanding of the individual growth pattern is crucial in determining the proper timing of Class III treatment. Optimal treatment timing for facemask therapy is in the deciduous or early mixed dentition. Early treatment with a facemask allows for favorable sutural response; elimination of any CO or CR discrepancies; and improvement in facial profile and self-esteem. A follow-up lateral cephalogram can be taken 3 to 4 years after protraction facemask treatment to calculate the GTRV ratio. This ratio and vector analysis provides information on growth rate and direction and helps clinicians to decide whether the Class III malocclusion can be camouflaged by orthodontic treatment or whether a surgical treatment is warranted.

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