ORTHODONTIC COMPENSATION IN SKELETAL CLASS III MALOCCLUSION: A CASE REPORT

Aim: To describe the dentoskeletal changes occurring during treatment of a patient with a skeletal Class III malocclusion treated for orthodontic compensation at 10 years 4 months of age. Methods: Rapid maxillary expansion was performed with a Hyrax appliance, Petit orthopedic face mask, high-pull chin cap, and bioprogressive fixed mechanics. Results: The mechanics employed yielded downward and backward mandibular rotation (3 degrees of opening of the facial axis), advancement of the maxillary incisors, and retraction of the mandibular incisors. The result was satisfactory from both esthetic and functional standpoints, providing adequate overjet and overbite, and with stability at 5 years posttreatment. Conclusion: The option for compensatory treatment of the skeletal Class III malocclusion without extractions and without orthognathic surgery might be a good option for young patients with good compliance, convergent facial pattern (brachyfacial), and with deep bite, since such occlusal characteristics allow the downward and backward mandibular rotation that is necessary for correction of this problem. World J Orthod 2007;8:xx–xx.

Class III malocclusions may be classified into 2 types: pseudo Class III and true Class III. According to Gianelly et al,1 pseudo Class III involves anterior crossbite in maximum intercuspation; however, in centric relation, there is Class I malocclusion with an orthognathic facial profile. According to Bench et al,2 pseudo Class III may be caused by inadequate positioning of the maxillary incisors (crowding, ectopic eruption, trauma, early loss of primary or permanent teeth), which interferes with mandibular closure, displacing it anteriorly; in general, the problem is solved after removal of the interference. The true Class III involves a skeletal Class III pattern in centric relation.1 As mentioned by Bench et al,2 the true Class III shows a genetic trend toward extreme upward and backward condylar growth, anterior crossbite, null overbite or open bite, and dolichofacial pattern, which contraindicates its correction by downward and backward mandibular rotation. The clinician should determine if there is another family member with the same malocclusion to help in the diagnosis.

According to Bench et al2 and Fränkel and Fränkel,3 the anterior crossbite caused by interferences (pseudo Class III) may lead to upward and backward condylar growth with downward and forward mandibular displacement, giving rise to a true Class III because of inadequate growth stimulus. Gianelly et al1 stated that even though this relationship may not be clear, it is advisable to adopt the idea that prevention would be the best option and thus perform early correction of the crossbite.
The true Class III malocclusion may also be called skeletal due to the involvement of skeletal structures; it may be caused by maxillary retrusion, mandibular protrusion, or a combination of both. Frequently, there is also maxillary constriction, represented by posterior crossbite.

There are 3 options for the treatment of skeletal Class III malocclusion: orthopedic, compensatory, or surgical. Selection of treatment type is based on the diagnosis, especially the indication of heredity, facial pattern, age, gender, severity of the problem, and patient compliance.

Turpin and Campbell mentioned positive and negative factors for the interceptive treatment of Class III malocclusion. Positive factors are convergent facial pattern (brachyfacial), anterior functional deviation (difference between centric relation and maximum intercuspation), symmetric condylar growth, growing status, ANB angle less than or equal to −2 degrees, expectation of good compliance, absence of hereditary involvement, and good facial esthetics. Negative factors include divergent facial type (dolichofacial), absence of anterior functional deviation, asymmetric growth, nongrowing status, ANB angle larger than −2 degrees, expectation of poor compliance, familial history, and unpleasant facial esthetics.

According to Langlade, during normal growth, the amount of growth of the cranial base is nearly equivalent to that of the mandibular body; in the surgical Class III syndrome there is hypodevelopment of the cranial base, exaggerated mandibular growth (3.5 mm per year, as analyzed by the facial axis). In addition to this growth, the patient with a Class III malocclusion may be in a growth period for up to 16 years for females and 20 years for males.

As mentioned by Gianelly et al, orthopedic treatment of Class III malocclusion in the permanent dentition is more difficult. Thus, treatment should be performed early whenever possible.

Fig 1 Initial photographs taken on December 1992. (a,b) Frontal and lateral views of the face. (c to e) Posterior and anterior crossbite.
Patient LRJ, a male 13 years of age, requested treatment at the authors’ clinic, with referral to facial orthopedic treatment. He and his parents brought records taken 2.5 years earlier (cephalometric radiograph, panoramic radiograph, dental casts, extraoral and intraoral photographs). Anamnesis revealed that the patient was being treated with a Fränkel appliance (FR-3); the initial records of the patient showed a skeletal Class III malocclusion, as observed on the extraoral and intraoral photographs, dental casts (Figs 1 and 2), and the cephalometric analysis (Figs 3 and 4, Table 1).

The patient was asked to interrupt use of the Fränkel appliance and obtain new records for reevaluation of the case. These records revealed lack of space for the maxillary right canine, which was unerupted and impacted (Fig 5), and the presence of a skeletal Class III malocclusion with an anterior edge-to-edge relationship and posterior open bite (Fig 6).
Table 1  Cephalometric analysis

<table>
<thead>
<tr>
<th></th>
<th>Patient</th>
<th>Normative value</th>
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<tbody>
<tr>
<td>SNA (degrees)</td>
<td>85</td>
<td>82</td>
</tr>
<tr>
<td>SNB (degrees)</td>
<td>101</td>
<td>80</td>
</tr>
<tr>
<td>ANB (degrees)</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Cranial deflection (degrees)</td>
<td>31</td>
<td>27</td>
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<td>Anterior cranial base (mm)</td>
<td>54</td>
<td>55</td>
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<td>Posterior cranial length (mm)</td>
<td>27</td>
<td>41</td>
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<tr>
<td>Mandibular body length (mm)</td>
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<tr>
<td>Facial depth (degrees)</td>
<td>100</td>
<td>86.7</td>
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<tr>
<td>Convexity (mm)</td>
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<td>0.1</td>
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<tr>
<td>Facial axis (degrees)</td>
<td>96</td>
<td>93</td>
</tr>
<tr>
<td>Growth pattern</td>
<td>Brachyfacial</td>
<td></td>
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</tbody>
</table>

Fig 5  Panoramic radiograph confirming presence of the maxillary right canine, unerupted and impacted.

Fig 6  Photographs taken on October 1995, when treatment was initiated with fixed orthodontics. (a to c) Frontal, smiling, and lateral views of the face. (d to f) Anterior edge-to-edge bite and posterior open bite.
The lateral cephalogram (Figs 7 and 8) was taken with the patient in the edge-to-edge position, which masked some cephalometric measurements (SNB, 86 degrees; ANB, 1 degree; facial depth, 96 degrees; convexity, 1 mm; facial axis, 90 degrees) because of the downward and backward mandibular rotation; however, the internal structures revealed signs of a Class III malocclusion, according to Langlade, including increased cranial deflection (32 degrees), reduced posterior cranial length (30 mm), and increased mandibular body length (81 mm). This information confirmed the presence of a skeletal Class III malocclusion and the brachyfacial growth pattern.

Evaluation of the linear measurements, using the McNamara analysis, revealed the presence of a Class III malocclusion with mild maxillary retrognathism and mandibular prognathism.

Analysis of the mandibular dental casts was done according to Ricketts. Even though the measurements were increased when compared to normative values, they were considered normal, due to the patient’s large tooth size.

Treatment plan

There were 2 treatment options for the skeletal problem: (1) orthodontic treatment with orthognathic surgery and (2) compensatory orthodontic treatment. Orthodontic compensation was selected by consensus between parents and orthodontist, especially due to the patient’s age, which contraindicated surgery. According to Gianelly et al, an orthopedic approach is the first option until puberty is reached. Pinho et al mentioned cost reduction and potential risk associated with orthognathic surgery as advantages to the orthopedic approach, and the involvement of esthetic appearance and potential of occlusal instability as disadvantages. McNamara and Brudon highlighted that early correction of the Class III malocclusion might lead to the need for surgical correction later, and that a careful specialist should never guarantee the Class III correction, since the individual long-term result of such treatment is difficult to forecast.

The lack of space for eruption of the maxillary right canine led to 3 treatment options: (1) extraction of the impacted canine; (2) extraction of 1 premolar on the same side, to achieve space for orthodontic extrusion of the canine; or (3) orthodontic space opening. The third option was selected because the skeletal Class III malocclusion may be worsened by the extraction of a maxillary tooth.
Treatment

Treatment was performed within the principles of Ricketts’ bioprogressive therapy, with use of the following appliances: Hyrax rapid maxillary expander (Fig 9), Petit face mask, mandibular bite block to release the occlusion, chin cap, utility arches, segmented arches (Fig 10), and ideal arches.

The expander was activated 10 turns (nearly 1 cm per turn [AU: correct?]). The face mask was placed immediately after finalization of rapid maxillary expansion, delivering nearly 900 kgf with 2 elastics 5/16-inch (8 oz) placed on each side of the mask.

The chin cap was worn by the patient during sleep, throughout the treatment and follow-up years until he reached 20 years of age, with a force of 250 kgf. Use of the chin cap may have helped in the mandibular posterior positioning in the temporal fossa, followed by downward and backward rotation. According to Gianelly et al,\(^1\) mandibular posterior repositioning and rotation are important components of the response to Class III treatment, and a successful treatment is rarely achieved if such repositioning does not occur. The final result is shown in Figs 11 and 12.
Fig 11 Final intraoral and extraoral photographs following removal of the appliances on December 18, 1998 (patient was 16 years 3 months of age).

Fig 12 Final panoramic radiograph reveals normality (mandibular third molars were extracted during the treatment).
DISCUSSION

Analysis of the results through cephalometric analysis (Figs 13 and 14) reveal skeletal and dentoalveolar alterations that can be described by the superimposition method of Ricketts.\textsuperscript{13}
Evaluation of skeletal and dentoalveolar changes

The skeletal and dentoalveolar changes discussed below occurred between December 1992 (T1, treatment with Fränkel FR-3), July 1995 (T2, treatment onset), and January 1999 (T3, treatment completion).

**Basion-nasion plane with center in point Cc (Fig 15).** The facial axis was opened 6 degrees (downward and backward mandibular rotation) between T1 and T2, and was closed 3 degrees between T2 and T3, yielding an opening of 3 degrees in the period between T1 and T3. Analysis of these data reveals that the Fränkel FR-3 appliance yielded downward and backward mandibular rotation; after interruption of the FR-3 use, the mandible showed upward and forward rotation, despite the use of extrusion mechanics (Hyrax, Petit face mask). This effect, to a large extent, may be due to the brachyfacial pattern.

Finally, this result (opening of the facial axis) helped in the correction of the Class III malocclusion, yielding downward and backward mandibular rotation. According to Gianelly et al,\(^1\) when there is a deep bite, the occlusal complex may show the effect of bite opening resulting from mandibular rotation. Therefore, these mechanics may be successfully employed in brachyfacial patients with Class III malocclusion since, when the mandible is rotated in a downward and backward direction and the anterior open bite is corrected, a favorable overbite is achieved, increasing the outcome stability. On the other hand, dolichofacial patients do not have a favorable response, since this downward and backward mandibular rotation gives rise to anterior open bite, which is not ideal for the esthetics and function of the patient.\(^1\)

**Basion-nasion-point A with center in nasion (Fig 16).** During the period from T1 to T2 and T1 to T3, there was only mild anterior maxillary displacement, which may have occurred due to the stimulation of maxillary development provided by the Fränkel FR-3 appliance\(^3\) or by normal growth itself since, as shown by Baik et al,\(^14\) the orthopedic effects in the maxilla with use of the Fränkel FR-3 appliance are mild.

Between T2 and T3, there was no alteration in horizontal maxillary positioning, even though the Petit face mask was applied with orthopedic force. This may be explained by the bone maturation of the patient, which reduced the skeletal outcomes.

The rhythm of maxillary vertical growth was more remarkable in the period during which the patient was treated with the Fränkel appliance (T1 and T2). This was reduced when treatment was performed with fixed appliances (T2 and T3), thus keeping normal values (1.16 mm per year), as shown in the period between T1 and T3.

**Palatal plane with center in anterior nasal spine (Fig 17).** Between T1 and T2, the maxillary incisors were retruded (1 mm) and extruded (0.5 mm). This alteration in positioning of the incisors was not favorable for the Class III treatment, since it worsened the overjet. Between T2 and T3, the incisors were advanced 4 mm and intruded 1 mm. Analysis of this period reveals that this advancement had a favorable effect of compensatory treatment of the skeletal Class III malocclusion. In the period between T1 and T3, there was 3 mm of advancement and 0.5 mm of intrusion.

The maxillary molars were extruded 4 mm between T1 and T2 and did not show mesial movement, which are both unfavorable treatment sequelae for the cor-
rection of the Class III malocclusion. Between T2 and T3, the maxillary molars showed 1 mm of mesial movement and 1 mm of extrusion. Between T1 and T3, the maxillary first molars did not show mesial movement; since this is a Class III malocclusion, this is not a good result, yet it should be highlighted that at treatment onset there was lack of space for eruption of the right maxillary canine, which required blockage of the maxillary first molars for achievement of space for eruption. The maxillary first molars also erupted 5 mm.

**Plane Xi–Pm** [AU: What is this plane? Please spell out, as abbreviations are not familiar ones] with center in point Pm, **supra-pogonion** (**Fig 18**). During the period from T1 to T2, the mandibular first molars had 4 mm of extrusion and 1.5 mm of uprighting, a favorable alteration for Class III treatment. Between T2 and T3, the molars had nearly no movement, as observed in **Fig 18b**. This blockage occurred due to the mechanics employed (utility arches), since in normal conditions these teeth erupt 0.5 mm per year. Investigation of the changes occurring between T1 and T3 reveal 4 mm of extrusion, a normal amount for the 6-year period. The same first molars presented 2 mm of uprighting, which was beneficial for the treatment.

**Fig 18 (a to c)** Superimposition on Plane Xi–Pm (supra-pogonion) with center in point Pm.

**Fig 19 (a to c)** Superimposition on intersection of the esthetic plane with the functional occlusal plane.
The mandibular incisors were extruded 3 mm and advanced 1 mm in the period between T1 and T2, which was not favorable, since it worsens the overjet and overbite. Between T2 and T3, the incisors were retracted 1 mm and blocked in vertically. Between T1 and T3, the incisors moved distally 2 mm and 3 mm vertically. This movement was probably related to the effect of the compensatory treatment performed.

**Esthetic plane (E) in intersection with the occlusal plane (Fig 19).** During the period T1 to T2, the lower lip was lowered and there was mild posterior repositioning due to the downward and backward mandibular rotation; the upper lip was advanced, probably due to the effect of the Fränkel FR-3 appliance. These mild changes favored an improvement in the soft-tissue profile.

Between T2 and T3, the lower lip was mildly displaced backward and downward because of retraction of the mandibular incisors, whereas the upper lip showed only downward movement. These mild changes improved the soft-tissue profile, as can be seen in Fig 19b.

Between T1 and T3, the changes are more evident: The upper and lower lips show downward displacement because of opening of the facial axis (downward
and backward mandibular rotation). The upper lip was advanced and the lower lip was retruded, following the movement of the incisors, resulting in an improved soft-tissue profile.

The stability of the compensatory treatment, as well as the adequate esthetics from both facial and dental viewpoints, can be seen in Fig 20, taken 5 years after treatment completion.

CONCLUSION

This article investigated the dentoskeletal and soft-tissue alterations occurring during compensatory treatment of Class III malocclusion, by the superimposition method of Ricketts. These alterations included downward and backward mandibular rotation (opening of facial axis, 3 degrees), mild maxillary advancement (1.5 degree increase in the angle Ba-Na-A), advancement of maxillary incisors, retraction of mandibular incisors, and uprighting of the mandibular first molars.

Selection of the compensatory treatment (orthodontic camouflage) was satisfactory based on the final outcome, from both functional and esthetic standpoints, and the treatment stability at 5 years posttreatment.

REFERENCES