Skeletal open bite Class III compensatory treatment with biofunctional therapy

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ABSTRACT

Introduction: Class III skeletal malocclusion in adult patients presents mainly two treatment options: the surgical-orthodontic approach or compensatory treatment.

Case Report: In the present report, it was described the case of a 23-year-old male patient who presented skeletal Class III malocclusion associated with anterior open bite. The patient refused surgical-orthodontic treatment. Thus, the compensatory orthodontic treatment was performed with the biofunctional technique, consisting of preadjusted brackets with accentuated palatal torque on the maxillary incisors and accentuated buccal torque on mandibular incisors. This prescription aims to minimize the effects of Class III intermaxillary elastics, promoting more bodily movement than tipping of the anterior segments and improve bone remodeling. The anterior open bite was treated with lingual spurs, differentiated bonding of the accessories and early intermaxillary elastics. After 23 months of treatment, a functional occlusion was observed with bilateral Class I canine and molar relationships, overbite correction, and satisfactory smile esthetics.

Conclusion: The great outcomes indicate that compensatory orthodontic treatment is possible in skeletal discrepancies, with the correct diagnosis and considering patient compliance. The biofunctional technique provided a favorable dental positioning for Class III correction.

Keywords: Angle Class III malocclusion, Corrective orthodontics, Esthetics, Open bite

INTRODUCTION

Class III is a malocclusion characterized by the mandibular first molar’s mesial position related to the maxillary first molar. When there is skeletal involvement, due to a prognathic mandible, retrognathic maxilla, or combination of both, the treatment in adult patients presents mainly two options: the surgical-orthodontic approach or compensatory treatment [1–4]. The greater the skeletal discrepancy, the greater the chance of the patient chooses orthognathic surgery. However, many patients do not undergo surgical intervention due to the risks involved, the postoperative period’s difficulties, and the high cost of this procedure [3, 5]. Moreover, compensatory treatment represents a more acceptable and viable option for patients who do not complain about the profile, providing satisfactory results [3, 6].

Many techniques have been improved for the Class III malocclusion compensatory treatment, and one of the
alternatives is the use of brackets with the Biofunctional prescription [7]. In this prescription, the preadjusted brackets present a buccal torque in the mandibular incisors and palatal torque in the maxillary incisors. There is a force resistance in the rectangular archwires due to the association with intermaxillary Class III elastics, resulting in a greater bodily movement of the anterior teeth. Since the Class III elastics apply a contrary movement in relation to the prescription, they decrease the incisors’ inclination, favoring their positioning on their bone bases [3].

The skeletal anterior open bite is a malocclusion that also allows orthodontic camouflage through several strategies. Among the techniques, we can highlight the brackets’ differentiated bonding for the extrusion of the anterior teeth when there is little exposure during smile, bonding of lingual spurs and the use of early vertical anterior elastics [8].

When there is an association between different skeletal malocclusions, the treatment represents a great challenge to the orthodontist. This article aims to present a treatment of skeletal Class III malocclusion associated with anterior open bite with compensatory treatment, using the biofunctional prescription and some strategies to correct the vertical discrepancy of the anterior teeth.

CASE REPORT

A 23-year-old male patient presented the chief complaint of dissatisfaction with his occlusion. He was already treated orthodontically during childhood, and in that time, his orthodontist warned about the possible future need for retreatment when his growth phase finishes.

The clinical examination verified a vertical growth pattern, increased lower anterior face height (LAFH), and anterior open bite. He presented a convex profile, increased nasolabial angle, absence of passive lip sealing, and a short chin-neck line due to the mandibular clockwise rotation (Figure 1).

Intraoral examination revealed a negative overbite. Dental midlines presented deviated, with the mandibular midline deviated 3 mm to the left in relation to the midsaggital plane. In the sagittal relationship, he presented ¾-cusp Class III on the left side and full-cusp Class III on the right side (Figure 1). Occlusal views showed teeth alignment, absence of third molars, and a 3 × 3 bonded retainer in the mandibular arch (Figure 1).

Panoramic radiograph showed the normality of the teeth, adjacent structures, and absence of the third molars (Figure 2). In addition to that, the 3 × 3 bonded retainer in the mandibular arch and the presence of a radiopaque image at the left mandibular second premolar apex were consistent with bone sclerosis. Lateral cephalogram showed maxillary retrusion and mandibular protrusion with a clockwise rotation (Figure 2). The anterior open bite was also evident.

To assist the treatment planning, another complimentary exam requested was the cone-beam computed tomography (CBCT) to evaluate the bone thickness of maxillary and mandibular incisors (Figure 3).

Treatment objectives included teeth alignment and leveling, correction of the dental midline deviation, normalization of the overjet and overbite and the establishment of Class I canine and molar relationships, with proper functional occlusion.

Considering the objectives, two treatment options were proposed. The first option was the alignment and leveling of maxillary and mandibular arches and orthognathic surgery to correct the skeletal Class III discrepancy and the anterior open bite, improving the facial profile.

The second option involved the compensatory orthodontic treatment, which consisted of the use of biofunctional prescription and intermaxillary 3/16” (medium) Class III elastics to correct the sagittal discrepancy and use of lingual spurs and anterior elastics to correct the anterior open bite.

Since the profile was not the main complaint of the patient, the compensatory orthodontic treatment was chosen.

Initially, molars were banded, and brackets were bonded (biofunctional prescription, slot 0.022” × 0.030”, Morelli, Sorocaba, São Paulo, Brazil) (Figure 4).

The mandibular second molars were also included in the mechanics. To assist the correction of the anterior open bite, lingual spurs were used on the maxillary and mandibular incisors to conditionate the lingual posture more posteriorly (Figure 4).

For the alignment and leveling phase, the following archwires sequence was used: 0.012”, 0.014”, 0.016”, 0.016” × 0.022”, 0.017” × 0.025”, and 0.019” × 0.025” NiTi. After six months, the use of bilateral 3/16” medium force Class III intermaxillary elastics was started for 24 hours and daily change of the elastics (Figure 5).

After five months of the elastics’ mechanics, the left side was in a Class I relationship. Therefore, the elastics were used as retention at night on the left side, while at the right side, it was still being used for 24 hours a day. The Class I relationship on the right side was obtained after nine months.

With the Class I relationship established, use of bilateral 3/16” medium force intercuspatation anterior elastics was initiated, 24 hours a day (Figure 6). The elastics were used for six months for correction and two additional months, at night, as retention.

After 23 months of treatment, the fixed appliances were removed, obtaining a bilateral Class I canine and molar relationship. The anterior crossbite was corrected, and the anterior open bite was closed, obtaining satisfactory overjet and overbite (Figure 7). As retention, in the maxillary arch, was installed a Hawley plate with an orifice in the interincisive papilla region to keep the tongue in the ideal position and in the mandibular arch, a fixed canine to canine bonded retainer.
The facial profile did not present significant changes, and the radiographic exams presented aspects of the normality of teeth and adjacent structures (Figure 8).

The patient also performed the CBCT at the end of treatment to compare the bone thickness in the maxillary and mandibular incisor regions with the beginning of treatment. In the CBCT exams, it was observed that there was no significant change in maxillary and mandibular buccal bone thickness (Figure 9).

At the end of treatment, it was observed that the maxillary and mandibular skeletal components did not present significant changes and the maxillomandibular relationship. The vertical component variables increased, showing a clockwise rotation of the mandible and an increase of the lower anterior face height (Table 1, Figure 10).

The major treatment changes were found in the dentoalveolar components. There was extrusion, labial inclination, and protrusion of the incisors in the maxillary arch, while the maxillary molars presented mesial angulation, extrusion, and a slight mesial movement. In the mandibular arch, the incisors presented extrusion, lingual inclination, and a slight retrusion. In the mandibular molars, there was distal angulation. Regarding anterior dental relationships, the overjet and overbite presented correction at the end of treatment, with significant increases (Table 1, Figure 10).

There was a decrease in the nasolabial angle and slight protrusion of the upper and lower lips (Table 1, Figure 10).

**DISCUSSION**

Compensatory treatment of skeletal malocclusion is always challenging. In this case, there was an association of Class III malocclusion with a skeletal anterior open bite. The skeletal anterior open bite is a complex and multifactorial malocclusion, including abnormal growth patterns and a tongue involvement in the function [9, 10]. At the initial clinical exam, an inadequate lingual posture was observed, favoring the anterior open bite's development. The hereditary factor was also observed.
For the correction of the lingual interposition, lingual spurs were applied on the maxillary incisors’ palatal surface and the lingual surface of mandibular incisors, establishing a new lingual position more posteriorly [11]. The skeletal anterior open bite’s main morphological characteristics are the clockwise rotation of the mandibular plane, increased LAFH, absent or forced lip sealing, and convex profile [9, 10, 12–14], characteristics observed in our patient by the increase in the vertical component measures.
At the end of the treatment, there was the correction of the dentoalveolar discrepancies (Table 1) [15]. Considering the skeletal involvement, an orthognathic surgery would probably provide a better occlusal and aesthetic result. Even so, the compensatory treatment provided satisfactory results [3]. The major changes observed were in the maxillary and mandibular incisors and the correction of the sagittal relationship. These changes also resulted in a good functional occlusion and a very esthetic smile.

The sagittal correction of the Class III malocclusion was achieved by the use of Class III elastics associated with the biofunctional prescription [4]. This also explains the vertical components' significant changes, with extrusion and mesial angulation of maxillary molars, extrusion and distal angulation of mandibular molars, clockwise rotation of the mandibular plane, and consequent increase in LAFH (Table 1) [4].

Usually, in skeletal Class III malocclusion, patients present a dentoalveolar compensation before treatment, with buccal tipping of maxillary incisors and lingual tipping of mandibular incisors [2, 3, 16]. Previous studies demonstrated that compensated orthodontic prescriptions of Class III malocclusions presented more efficient when compared with non-compensated torque brackets [17]. However, most of the preadjusted brackets for Class III treatment have accentuated buccal torque in maxillary incisors and lingual torque in mandibular incisors to assist in overjet correction [3]. Considering these compensatory inclinations, the biofunctional prescription, attempting to provide a more satisfactory smile and facial esthetics, with good functional occlusion and minor periodontal effects, differentiated the maxillary and mandibular incisors’ torque [4].

The significant changes in the dentoalveolar component were due to the mechanics applied. The slight buccal inclination, protrusion, and extrusion of the maxillary incisors were caused by the use of intermaxillary elastics associated with the biofunctional

**Table 1: Cephalometric variables at initial (T1) and final (T2) treatment stages**

| Variables                        | Initial: T1 | Final: T2 |
|----------------------------------|-------------|-----------|
| **Maxillary skeletal component** |             |           |
| SNA (°)                          | 78.3        | 78.4      |
| Co-A (mm)                        | 84.8        | 84.9      |
| **Mandibular skeletal component**|             |           |
| SNB (°)                          | 76.0        | 76.2      |
| Co-Gn (mm)                       | 126.4       | 127.5     |
| **Maxillomandibular relationship**|             |           |
| ANB (°)                          | 2.3         | 2.2       |
| WITS (mm)                        | −6.9        | −5.0      |
| **Vertical component**           |             |           |
| FMA (°)                          | 32.0        | 34.3      |
| SN-GoGn (°)                      | 44.5        | 45.0      |
| SN-occlusal plane (°)            | 23.4        | 18.8      |
| LAFH (mm)                        | 82.7        | 85.5      |
| **Maxillary dentoalveolar component** |         |           |
| Mx1-NA (°)                       | 23.6        | 24.0      |
| Mx1-NA (mm)                      | 3.4         | 5.9       |
| Mx1-PP (mm)                      | 33.0        | 35.2      |
| Mx6-PTV (mm)                     | 19.9        | 22.1      |
| Mx6-PP (mm)                      | 25.5        | 26.7      |
| Mx6-SN (°)                       | 68.4        | 80.0      |
| **Mandibular dentoalveolar component** |         |           |
| Md1-NB (°)                       | 28.6        | 19.6      |
| Md1-NB (mm)                      | 8.0         | 7.3       |
| Md1-GoMe (mm)                    | 41.7        | 47.2      |
| Md6-Symphysis (mm)               | 20.7        | 23.7      |
| Md6-GoMe (mm)                    | 31.2        | 30.7      |
| Md6-GoMe (°)                     | 71.7        | 62.3      |
| **Anterior relationships**       |             |           |
| Overjet (mm)                     | −1.6        | 3.1       |
| Overbite (mm)                    | −3.7        | 3.0       |
| **Soft tissue component**        |             |           |
| Nasolabial angle                 | 124.9       | 116.0     |
| UL-E plane (mm)                  | 0.9         | 3.7       |
| LL-E plane (mm)                  | −4.7        | −1.8      |
The compensatory treatment of this severe Class III malocclusion and anterior open bite with the biofunctional prescription showed minimal root resorption, clinically insignificant, good root parallelism, and no periodontal injury due to the controlled biomechanics.

It is very important to emphasize that the treatment success in this compensatory treatment was the patient compliance with elastics [17]. It is indispensable that the patient is aware of the treatment objectives and the role of his compliance.

Long-term stability of anterior open bite correction is reported as moderate, regardless of the treatment protocol, including surgery or not, since 35% of the cases present significant relapse [21]. The stability is influenced by the musculature, especially of the tongue [22]. Therefore, for greater stability and more appropriate treatment, the correct diagnosis must be applied.

CONCLUSION

The present case results were satisfactory with good esthetics and functional occlusal, improving the face harmony and establishing an adequate occlusion. Therefore, the compensatory treatment of skeletal Class III malocclusion associated with the anterior open bite is viable, considering the correct diagnosis, with great patient compliance. Biofunctional prescription represents a great alternative, providing Class III correction with proper dental positioning.

REFERENCES

1. Benyahia H, Azaroual MF, Garcia C, Hamou E, Aboural R, Zaoui F. Treatment of skeletal Class III malocclusions: Orthognathic surgery or orthodontic camouflage? How to decide. [Article in French]. Int Orthod 2011;9(2):196–209.
2. Burns NR, Musich DR, Martin C, Razmus T, Gunel E, Ngn P. Class III camouflage treatment: What are the limits? Am J Orthod Dentofacial Orthop 2010;137(1):9.e1–9.e13.
3. Janson G, de Souza JEP, de Andrade Alves F, et al. Extreme dentoalveolar compensation in the treatment of Class III malocclusion. Am J Orthod Dentofacial Orthop 2005;128(6):787–94.
4. Valarelli FP, Nascimento FEC, Batista DM, Freitas KMS, Caçado RH. Class III camouflage treatment with the Biofunctional technique. J Clin Orthod 2018;52(6–7):351–8.
5. Stellzig-Eisenhauer A, Lux CJ, Schuster G. Treatment decision in adult patients with Class III malocclusion: Orthodontic therapy or orthognathic surgery? Am J Orthod Dentofacial Orthop 2002;122(1):27–37.
6. Janson G, Maranhão OBV. Compensatory Class III malocclusion treatment associated with mandibular canine extractions. Dental Press J Orthod 2017;22(6):86–98.
7. Caçado RH, de Freitas KMS, Valarelli FP, Da Silva Vieira B, Neves LS. Treatment of skeletal Class III malocclusion with the biofunctional system. J Clin Orthod 2017;22(6):86–98.
8. Janson G, Valarelli FP, Beltrão RST, de Freitas MR, Henriques JFC. Stability of anterior openbite extraction and nonextraction treatment in the permanent dentition. Am J Orthod Dentofacial Orthop 2006;129(6):768–74.
9. Solow B, Kreiborg S. Soft-tissue stretching: A possible control factor in craniofacial morphogenesis. Scand J Dent Res 1977;85(6):505–7.
10. Nanda SK. Patterns of vertical growth in the face. Am J Orthod Dentofacial Orthop 1988;93(2):103–16.
11. Huang GJ, Justus R, Kennedy DB, Kokich VG. Stability of anterior openbite treated with crib therapy. Angle Orthod 1990;60(1):17–24.
12. Profit WR, Fields HW, Nixon WL. Occlusal forces in normal- and long-face adults. J Dent Res 1983;62(5):566–70.
13. Fields HW, Profit WR, Nixon WL, Phillips C, Stanek E. Facial pattern differences in long-faced children and adults. Am J Orthod 1984;85(3):217–23.
14. Hamamci N, Başaran G, Sahin S. Nonsurgical correction of an adult skeletal class III and open-bite malocclusion. Angle Orthod 2006;76(3):527–32.
15. Troy BA, Shanker S, Fields HW, Vig K, Johnston W. Comparison of incisor inclination in patients with Class III malocclusion treated with orthognathic surgery or orthodontic camouflage. Am J Orthod Dentofacial Orthop 2009;135(2):146.e1–9.
16. Ellis E 3rd, McNamara JA Jr. Components of adult Class III open-bite malocclusion. Am J Orthod 1984;86(4):277–90.
17. Aragón MLC, Bichara LM, Flores-Mir C, Almeida G, Normando D. Efficiency of compensatory orthodontic treatment of mild Class III malocclusion with two different bracket systems. Dental Press J Orthod 2017;22(6):49–55.
18. Küçükkeleş N, Acar A, Demirkaya AA, Evrenol B, Enercar A. Cephalometric evaluation of open bite treatment with NiTi arch wires and anterior elastics. Am J Orthod Dentofacial Orthop 1999;116(5):555–62.
19. Sarver DM. The importance of incisor positioning in the esthetic smile: The smile arc. Am J Orthod Dentofacial Orthop 2001;120(2):98–111.
20. Kanno Z, Kim Y, Soma K. Early correction of a developing skeletal Class III malocclusion. Angle Orthod 2007;77(3):549–56.
21. Lopez-Gavito G, Wallen TR, Little RM, Joondeph DR. Anterior open-bite malocclusion: A longitudinal 10-year postretention evaluation of orthodontically treated patients. Am J Orthod 1985;87(3):175–86.
22. Fränkel R, Fränkel C. A functional approach to treatment of skeletal open bite. Am J Orthod 1985;84(1):54–68.

**Author Contributions**

Fabricio Pinelli Valarelli – Conception of the work, Design of the work, Acquisition of data, Analysis of data, Interpretation of data, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

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**Guarantor of Submission**

The corresponding author is the guarantor of submission.

**Source of Support**

None.

**Consent Statement**

Written informed consent was obtained from the patient for publication of this article.

**Conflict of Interest**

Authors declare no conflict of interest.

**Data Availability**

All relevant data are within the paper and its Supporting Information files.

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