Contemporary Pediatric Dentistry

Case Report
Contemp Pediatr Dent 2025:6(2):160-171
DOI: 10.51463/cpd.2025.18

Correction of skeletal Class III in mixed dentition: A case report

Antônio Giroto dos Santos[1], Thaísa Maria Vellasco Queiroz Pimenta[2] ✉, Gabby Chacon Ruiz[3], Sara Gollino[4], Franciele Lucca Longo[5], Gabriela Leite Pedroso[6], Paôla Caroline da Silva Mira[7], Maria Bernadete Sasso Stuani[8]

Highlights

- Early orthopedic treatment with rapid maxillary expansion and facial mask improved skeletal Class III malocclusion and facial harmony in a growing patient.
- Orthopedic intervention corrected maxillary retrusion, achieving positive overjet, Class I molar relationship, and improved cephalometric outcomes.
- Early treatment may reduce the severity of Class III malocclusion and minimize the future need for surgical or complex orthodontic interventions.

[1] *Master Student, Departament of Orthodontics, University of São Paulo, Brazil*
[2] *PhD Student, Departament of Orthodontics, University of São Paulo, Brazil*
[3] *PhD Student, Departament of Orthodontics, University of São Paulo, Brazil*
[4] *PhD Student, Departament of Orthodontics, University of São Paulo, Brazil*
[5] *PhD Student, Departament of Orthodontics, University of São Paulo, Brazil*
[6] *PhD Student, Departament of Orthodontics, University of São Paulo, Brazil*
[7] *PhD Student, Departament of Orthodontics, University of São Paulo, Brazil*
[8] *Assoc. Prof., Departament of Orthodontics, University of São Paulo, Brazil*

Correspondence:
Departament of Orthodontics,
University of São Paulo, Brazil
E-mail address:
thaisa.pimenta@usp.br

Received: 24 Apr 2025
Accepted: 03 Jul 2025
Online First: 03 Aug 2025

Abstract

Anterior crossbite rarely resolves spontaneously, and early orthodontic intervention is often necessary to support normal maxillofacial development. The present case involved a patient with anterior crossbite and skeletal Class III malocclusion, characterized by a concave facial profile. In both habitual maximum intercuspation (HMI) and centric relation (CR), the molar and canine relationships were classified as Angle Class III, with a mesial terminal plane in the second primary molars. Initial cephalometric analysis confirmed skeletal Class III malocclusion, with upright and retruded maxillary incisors, and well-positioned mandibular incisors relative to the apical base. The soft tissue profile was concave, while the skeletal profile appeared straight. Orthopedic intervention was initiated during the mixed dentition phase. The treatment plan included rapid maxillary expansion (RME) using the McNamara appliance, followed by maxillary protraction (MP) with a facial mask. Follow-up continued through the completion of craniofacial growth. The chosen approach was effective in correcting the malocclusion during the mixed dentition phase, demonstrating the utility of early orthopedic intervention in managing skeletal Class III discrepancies.

Keywords: Dentition, Interceptive; Malocclusion; Mixed; Orthodontic Appliances

INTRODUCTION

Anterior crossbite is a malocclusion with multifactorial etiology and can be classified as dental, functional, or skeletal. Dental crossbite results from abnormal inclination of the maxillary incisors, without alterations in the underlying skeletal bases.[1] Functional crossbite arises from adaptive mandibular deviations in response to occlusal interferences.[2] Skeletal crossbite, in contrast, is associated with maxillary deficiency or mandibular prognathism.[3] The prevalence of anterior crossbite varies across populations. Studies report that skeletal Class III malocclusion affects a significant proportion of orthodontic patients and is particularly prevalent in certain Asian populations.[4] This condition may compromise facial aesthetics and psychosocial development, emphasizing the need for early diagnosis and timely intervention.[5]

The difficulty in predicting craniofacial growth makes the treatment of skeletal crossbites particularly challenging. The etiology involves both hereditary and environmental factors, such as harmful oral habits and prolonged retention of primary teeth.[6] Many cases are due to maxillary deficiency, which supports the viability of early orthopedic interventions.[7]

The differential diagnosis between skeletal and functional crossbite requires cephalometric, occlusal, and hereditary assessment.[8] Distinguishing skeletal imbalance from functional adaptation is essential for guiding appropriate treatment.[9] Early intervention with maxillary orthopedics can prevent the progression of malocclusion and reduce the likelihood of future orthognathic surgery.[10]

Interceptive orthopedic treatment often involves maxillary protraction combined with rapid maxillary expansion, leading to both skeletal and occlusal improvements.[11,5] The facial mask is particularly effective in young patients, as it promotes favorable maxillary growth.[12] Orthodontic planning should be individualized, taking into account the patient's age, malocclusion severity, and growth prognosis to ensure long-term stability and satisfactory aesthetics.[13]

This clinical case report presents an effective treatment approach for correcting skeletal anterior crossbite in pediatric patients, using reverse maxillary traction with a Petit facial mask in combination with a McNamara-type expander.

CASE REPORT

An 8-year-and-6-month-old female patient presented to the undergraduate clinic of the Preventive Orthodontics Discipline at FORP-USP for an orthodontic evaluation. The chief complaint, as reported by her mother, was that "the chin was protruding and the front teeth did not fit together correctly," indicating the presence of an anterior crossbite. The patient's medical history was unremarkable, with no systemic conditions or other relevant clinical findings. The treatment plan and the importance of cooperation from both the patient and her family were clearly explained to the guardian. Written informed consent was obtained for the proposed procedures and for the use of clinical images for scientific and educational purposes.

Extraoral examination revealed facial symmetry, satisfactory lip seal, an acute nasolabial angle, a well-defined cervicomandibular angle, and mild chin projection. These features were consistent with a slightly concave profile and an increased lower facial third, characteristic of a dolichofacial pattern. The midface was deficient in the malar region, with absent zygomatic prominence. In the profile analysis, the lower lip was protrusive in relation to Steiner's S-line (a soft tissue reference used to assess facial profile balance[14], resulting in concave tegumentary profile (Figure 1).

Figure 1. Pretreatment extraoral photographs at baseline. A: Right profile view showing slightly concave profile; B: Frontal view at rest with reduced midfacial prominence; C: Frontal view on smiling demonstrating anterior crossbite impact on smile esthetics

Intraoral examination revealed that the patient was in the first transitional period of the mixed dentition phase, with the presence of canines and first and second deciduous molars. Oral hygiene was good, and the gingival tissues appeared healthy across all teeth, with no evidence of dental restorations or carious lesions. In habitual maximum intercuspation (HMI), the relationship of the first permanent molars and deciduous canines was classified as Angle Class III, with a mesial step of the second deciduous molars. A negative overjet of -3 mm confirmed the presence of anterior crossbite, and the overbite measured 2 mm. Functional examination showed coincidence of the upper and lower midlines when the mandible was guided into centric relation (CR). The maxillary arch was parabolic with a deep palate, while the mandibular arch was U-shaped with well-aligned lower incisors. The dentoalveolar discrepancy was +2.0 mm in the lower arch and +1.0 mm in the upper arch (Figure 2).

The panoramic radiograph showed the presence of all developing permanent tooth germs, no evidence of periapical pathology, and normal root development of the permanent teeth (Figure 3).

Initial cephalometric analysis revealed a skeletal Class III relationship in the anteroposterior dimension, with an ANB angle of -2°, indicating maxillary retrusion (SNA = 79°) and a normally positioned mandible (SNB = 81°) relative to the cranial base. According to McNamara's cephalometric parameters, the maxillary length was reduced by 2 mm (Co-A = 81 mm), while the mandibular length was within normal limits (Co-Gn = 108 mm). These findings confirmed a Class III skeletal pattern primarily due to maxillary retrusion. In the vertical dimension, a tendency toward vertical growth was observed, as indicated by SN.GoGn = 36°, SNGn = 67°, and a facial axis of 87°. Analysis of the dental pattern showed that the maxillary incisors were upright and retracted (1.NA = 20°; 1-NA = 2 mm), whereas the mandibular incisors were well positioned relative to their apical base (1.NB = 25°; 1-NB = 4 mm). The facial profile was classified as concave (S-Ls = -2 mm; S-Li = -3 mm), while the skeletal profile was considered straight (NA.Pog = 6°) (Figure 4, Table 1).

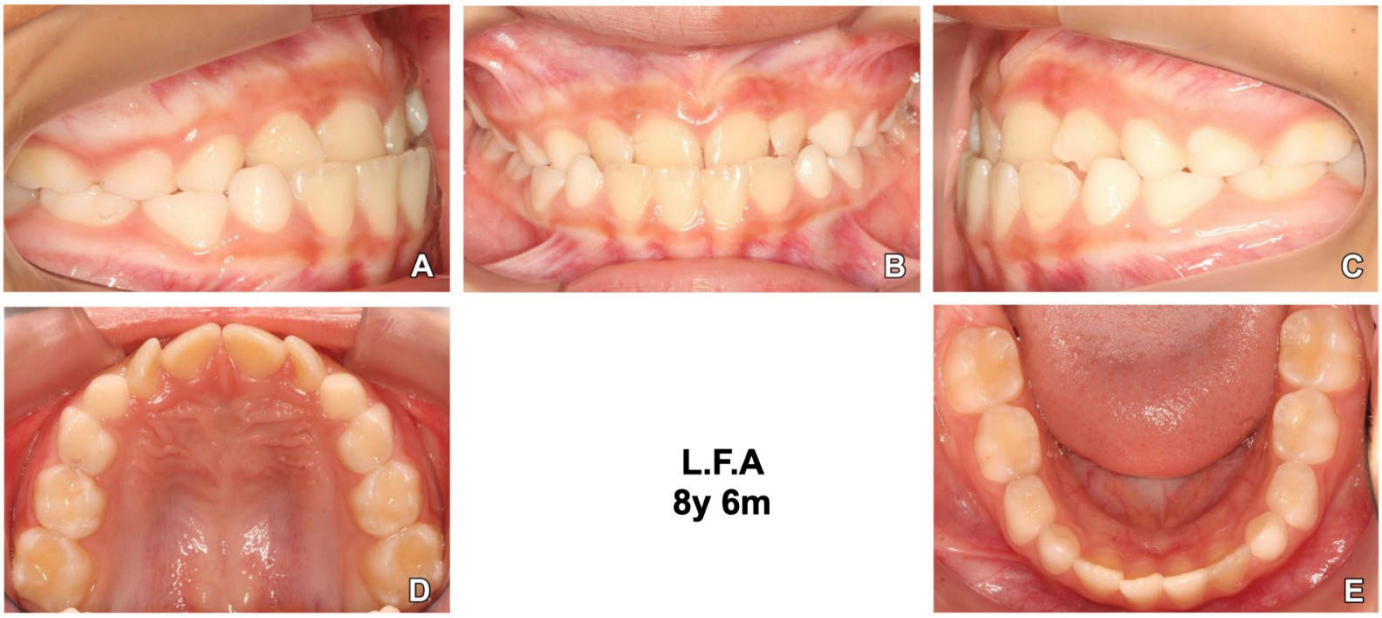

Figure 2. Pretreatment intraoral photographs at baseline. A: Right lateral view showing anterior crossbite and Class III molar relationship; B: Frontal view with negative overjet; C: Left lateral view confirming bilateral Class III tendency; D: Maxillary occlusal view showing arch constriction; E: Mandibular occlusal view with well-aligned incisors

Figure 3. Pretreatment panoramic radiograph demonstrating the presence of all developing permanent tooth germs, normal root development, and absence of periapical pathology

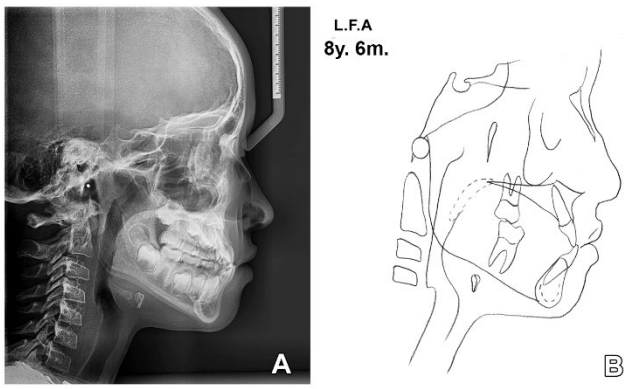

Figure 4. Pretreatment cephalometric records. A: Lateral cephalometric radiograph demonstrating skeletal Class III relationship due to maxillary retrusion; B: Cephalometric tracing highlighting ANB discrepancy and vertical growth pattern

Table 1. Cephalometric measurements at baseline and after treatment

Measurements	Normative Value	Age 8y 6m	Age 9y 7m
SNA (°)	82°± 2°	79°	82°
SNB (°)	80° ± 2°	81°	80°
ANB (°)	0 to 4°	-2°	2°
Co-A (mm)	85 mm	81mm	83 mm
Co-Gn (mm)	105-108 mm	108 mm	109 mm
Co-Gn–Co-A (mm)	23mm	27 mm	26 mm
SN-GoGn (°)	32°	36°	36°
SN-Gn (°)	68°	67°	69°
Facial Axis (°)	90°	87°	87°
1.NA (°)	22°	20°	23°
1-NA (mm)	4 mm	2 mm	3 mm
1.NB (°)	25°	25°	25°
1-NB (mm)	4 mm	4 mm	4 mm
1.1 (°)	131°	133°	130°
S-Ls (mm)	0 mm	-2 mm	2 mm
S-Li (mm)	0 mm	3 mm	3 mm
NA.Pog (°)	-8 to 10°	6°	6°

A diagnosis of skeletal Class III malocclusion with anterior crossbite was established. The prognosis was considered favorable given the patient's age, which was optimal for orthopedic intervention, and the absence of mandibular prognathism, both of which supported the potential for a satisfactory treatment outcome. However, treatment success would be contingent upon the patient's adherence and cooperation.

The primary objective of treatment was to correct the skeletal anterior crossbite by addressing maxillary retrusion. Additional goals included monitoring the dentinogenesis of the permanent teeth and maintaining the stability of the early interceptive intervention.

Based on clinical and cephalometric evaluations, a treatment plan was established consisting of rapid maxillary expansion (RME) using a McNamara expander, followed by maxillary protraction with a Petit facial mask. The RME was indicated to disarticulate the maxillary sutures, thereby enhancing the effectiveness of protraction mechanics and contributing to improved maxillary arch form.

A McNamara expander with a Hyrax screw (Morelli®, 11 mm, ref. 65.05.012, Brazil) was fixed to the palate in the region of the second deciduous molars, incorporating vestibular hooks for reverse maxillary traction. The appliance featured an acrylic cover that functioned as a bite ramp in the posterior segment, aiding in the correction of the crossbite. In addition to promoting buccal displacement of the crossbite-involved teeth, the acrylic covering the occlusal surfaces of the posterior teeth enhanced appliance retention. Given the patient's dolichofacial pattern, the acrylic design also helped prevent extrusion of the posterior teeth and the resulting clockwise rotation of the mandible.[15]

The hooks were positioned at the level of the deciduous canines to allow for the attachment of elastics during maxillary protraction. The activation

protocol for the Hyrax-type expansion screw consisted of two quarter-turns per day, corresponding to 0.5 mm of daily expansion, with one quarter-turn in the morning and another in the afternoon. Activation continued until the palatal cusps of the upper molars contacted the buccal cusps of the lower molars.[16] However, activation of the expander began one week after placement to assess the patient's adaptation to the appliance and to ensure correct positioning and stability.

The opening of the median palatine suture was monitored using occlusal radiography. In addition to expander activation, the patient received instructions on proper oral hygiene and appliance maintenance. Once the desired disjunction was achieved, a small amount of acrylic resin was applied to the area of the expansion screw, completing the expansion phase. From that point onward, the appliance functioned as a retainer.

A Petit-type facial mask (Morelli®, Sorocaba, São Paulo, Brazil) was used for reverse maxillary traction, initially applying 150 grams of protraction force on each side. The force was gradually increased on a monthly basis according to treatment progress, reaching 400 grams per side over the course of eight months. This level of force is classified as orthopedic and was applied while the expander remained in place as a passive retainer, with no further activations. The use of the facial mask was prescribed for a minimum of 12 hours per day.[17]

An important factor considered during treatment was the correct positioning of the elastic support on the facial mask. It was adjusted to an angle of approximately 30 degrees relative to the occlusal plane to minimize undesirable side effects, such as excessive buccal tipping of the maxillary incisors and the development of an anterior open bite. This positioning also helped prevent soft tissue injuries at the labial commissures.[18,19]

The elastics used in this treatment were manufactured by Morelli® and varied among ½ l light, ½ medium, and ½ heavy force levels. To ensure appropriate force application throughout each stage of treatment, the force exerted by the elastics was routinely measured using a Morelli® Orthodontic Dynamometer. This allowed for precise control and adjustment of the elastic force as needed.

At the end of the initial treatment phase, which involved the use of a facial mask and reverse maxillary traction, favorable outcomes were achieved in both esthetic and occlusal evaluations. A positive overjet of approximately 2 mm was observed, along with encouraging prospects for subsequent treatment phases.

After one year of treatment, extraoral analysis revealed facial symmetry, adequate lip seal, an acute nasolabial angle, a well-defined cervicomandibular angle, and improvements in the soft tissue profile, resulting in a straight facial profile. The midface showed enhanced esthetics in the malar region. However, the lower third of the face remained elongated, consistent with a dolichofacial growth pattern. This was supported by final cephalometric measurements: SN-GoGn angle of 36°, SN-Gn of 69°, and a Facial Axis of 87° (Table 1). These values deviate from normative standards and suggest a vertical growth tendency with downward and backward mandibular rotation, which are typical features of dolichofacial skeletal morphology. In profile analysis, the lower lip demonstrated improved positioning in relation to Steiner's S-line, resulting in a straight tegumentary profile and enhanced facial harmony (Figure 5).

The treatment lasted 12 months and aimed to improve the maxilla–mandible discrepancy. Upon completion of this phase, the expander and facial mask were removed, and new orthodontic records were obtained. In the transverse dimension, the rapid maxillary expander (RME) effectively expanded the upper arch, resulting in improved arch form. In the anteroposterior dimension, clinical evaluation revealed a slight positive

horizontal overlap of the incisors, indicating resolution of the anterior crossbite. The relationship between the maxillary and mandibular arches was satisfactory, with a well-established molar Class I relationship on both sides, proper intercuspation, and correction of the anterior crossbite. The final overjet measured 2 mm. Review of the patient's final records confirmed that the main treatment objectives were successfully achieved (Figure 6).

The panoramic radiograph showed the presence of all developing permanent tooth germs, with no evidence of periapical pathology and normal progression of root formation in the permanent teeth. Additionally, initial calcification of the lower third molars was observed (Figure 7).

Final cephalometric analysis revealed a significant improvement in the maxilla–mandible relationship, now presenting a Class I skeletal pattern (ANB = 2°). Both the maxilla (SNA = 82°) and the mandible (SNB = 80°) were well positioned relative to the cranial base. According to McNamara's analysis, maxillary length (Co-A = 83 mm) and mandibular length (Co-Gn = 109 mm) were within normal limits, with a slight improvement noted in maxillary development.

The facial pattern remained dolichofacial, as indicated by SN.GoGn = 36°, SNGn = 69°, and Facial Axis = 87°. The maxillary incisors were slightly proclined (1.NA = 23°; 1-NA = 3 mm), while the mandibular incisors remained well positioned (1.NB = 25°; 1-NB = 4 mm), resulting in a favorable interincisal angle (1.1 = 130°). An improvement in the facial profile was observed, with the upper and lower lips positioned at 2 mm and 3 mm, respectively, behind Steiner's S-line (S-Ls = 2 mm; S-Li = 3 mm). The skeletal profile remained straight (NA–Pog = 6°). Overall, the facial profile appeared more harmonious, with improved balance between the lips and correction of the anterior crossbite (Table 1).

The initial stage of treatment focused on orthopedic correction, with the objective of improving maxillary positioning and enhancing the facial profile. Once eruption of all permanent teeth is complete, a second phase will be initiated, consisting of compensatory fixed orthodontic treatment to address the Class III malocclusion. The patient remains under follow-up at the interceptive orthodontics clinic, where regular evaluations are conducted to monitor treatment effectiveness and to determine the need for further orthodontic intervention.

Figure 5. Post-treatment extraoral photographs. A: Right profile view with improved facial harmony; B: Frontal view at rest showing enhanced midfacial projection; C: Frontal smiling view displaying corrected anterior crossbite and improved smile esthetics

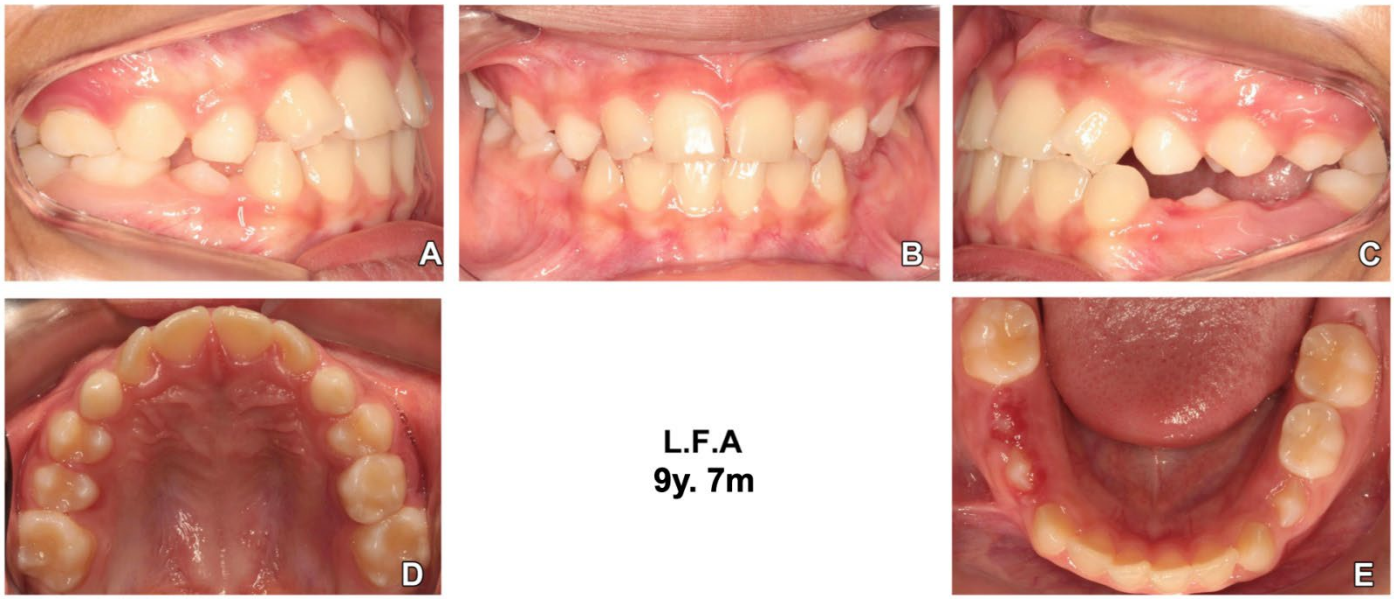

Figure 6. Post-treatment intraoral photographs at 9 years and 7 months of age. A: Right lateral view demonstrating corrected overjet and Class I molar relationship; B: Frontal view with positive overjet of 2 mm; C: Left lateral view showing stable occlusal contacts; D: Maxillary occlusal view displaying expanded arch form; E: Mandibular occlusal view with well-aligned teeth and stable interarch relationship

Figure 7. Post-treatment panoramic radiograph demonstrating proper development of permanent teeth, normal root formation, and initial calcification of lower third molars

DISCUSSION

Class III malocclusion can present significant therapeutic challenges, particularly when influenced by genetic factors. In severe cases, surgical intervention may become necessary.[20] Early diagnosis and orthopedic treatment are essential, as they can help reduce the severity of skeletal discrepancies, decrease the likelihood of future surgery, and promote more favorable craniofacial development.[21] However, a notable limitation of early intervention is the difficulty in accurately predicting craniofacial growth patterns, which may result in an extended overall treatment duration.[20]

The clinical management of this case report, involving a female patient diagnosed with skeletal Class III malocclusion, dolichofacial pattern, and anterior crossbite, was divided into two phases. The first phase consisted of RME followed by maxillary protraction. During the course of treatment, it became evident that the complexity of the case would require ongoing monitoring until the completion of the patient's facial growth.

In cases presenting both maxillary retrusion and transverse deficiency, early intervention using maxillary expansion combined with protraction is considered highly effective. Expansion appliances assist in correcting posterior crossbite, increasing arch length, and facilitating forward and downward movement of the maxilla by promoting the opening of the midpalatal suture.[22] This results in anterior displacement of the maxilla and induces clockwise rotation of the mandible. However, this approach remains controversial in patients with a long-face pattern and open bite, as mandibular rotation may exacerbate vertical dimensions and potentially increase the likelihood of requiring surgical intervention.[23,24]

The chosen expansion method was the McNamara appliance, which aims to disarticulate the maxilla. It also features an occlusal plane designed to increase the vertical dimension by completely disengaging the anterior teeth, thereby facilitating the correction of the anterior crossbite. Additionally, this occlusal plane helps prevent the extrusion of posterior teeth, minimizing any further increase in facial vertical dimension.[15] This approach was particularly suitable given the patient's dolichofacial pattern, as it reduced the risk of exacerbating vertical facial proportions.

In this patient, rapid maxillary expansion was performed using an activation protocol of two quarter-turns per day (one in the morning and one in the evening), which continued until bite disocclusion was achieved or the median palatine suture opened.[16] However, activations began only one week after the expander was installed, allowing time to assess the patient's adaptation and ensure the appliance was properly fitted. The patient was monitored weekly for approximately four weeks during the active phase. Although various activation protocols exist, typically ranging from one to two quarter-turns per day, no significant differences have been reported in skeletal or dental outcomes among children in the mixed dentition phase.

Maxillary protraction was performed using a Petit-type facial mask. The direction of force application is a crucial factor in treatment planning, as it helps prevent unwanted mandibular rotations and promotes proper maxillary displacement.[20]

The elastics should be adjusted with a slightly altered inclination (30°), considering the anterior maxillary rotation required for bite opening.[18] A more horizontal force vector, applied via hooks positioned distal to the canines, results in a higher center of rotation and promotes predominantly horizontal maxillary movement. In contrast, a steeper force inclination facilitates both forward advancement and vertical displacement, leading to upper molar extrusion and counter-clockwise rotation of the palatal plane. To produce this effect, the force must be directed toward the upper molars.[19,25] In the present clinical case, the force

vector was directed toward the canine region to minimize clockwise mandibular rotation, given the patient's dolichofacial growth pattern.

The anterior advancement of the maxilla is primarily attributed to the remodeling of sutures such as the zygomatic-maxillary, zygomatic-temporal, and median palatine sutures.[25] The use of a facial mask produces dento-skeletal effects, including 2–4 mm of maxillary advancement, counter-clockwise rotation of the maxilla, extrusion of the upper molars, downward and backward mandibular rotation, lingual inclination of the lower incisors, increased facial convexity, slight lower lip retrusion, and bite opening due to increased anterior-inferior facial height (AIFH).[26]

In the clinical case presented, force application began at 150 grams on each side, initiated after activation of the expansion screw and using light elastics (Morelli®) to allow the patient to adapt to the appliance. The force was gradually increased to 400 grams per side, with instructions for daily replacement of the elastics.[27,28] Force levels were carefully monitored throughout treatment using a Morelli® Orthodontic Dynamometer, which allowed precise adjustments between light, medium, and heavy elastics to ensure optimal force application at each treatment stage. The patient wore the facial mask for 12 hours per day over a period of 12 months, until a positive overjet of 2 mm was achieved.

The continuous use of the appliance is widely recommended by many specialists to promote favorable skeletal changes. In general, wearing the appliance for approximately 14 hours per day (primarily at night) for 12 to 15 months is advised, with the goal of achieving an ideal correction of 3 mm or obtaining a half Class II molar relationship.[27,29] Clinical evidence indicates that anterior crossbite can typically be corrected within 4 to 8 months using this protocol. In the present case, correction was achieved after 4 months, consistent with the findings of Hägg et al.[30], who reported positive overjet in all patients within 6 to 12 months. However, only two-thirds of the patients maintained this result after a 4-year follow-up. Approximately 70% of the correction was attributed to maxillary advancement and mandibular rotation, while the remaining 30% resulted from dental compensations.

At the completion of the first phase of treatment, the patient demonstrated successful correction of the anterior crossbite, achieving a positive horizontal overjet and a Class I molar relationship. Significant dentofacial improvements were observed, including enhancement of the facial profile, reduction of malar deficiency, and improved facial symmetry. Despite these positive outcomes, the dolichofacial growth pattern persisted, with only minor changes noted in cephalometric measurements when comparing the initial and final records. These clinical and cephalometric changes were thoroughly documented and confirmed in follow-up records collected 12 months after treatment initiation.

Given the complexity of the case and the continuation of craniofacial growth, the patient remains under regular observation at the interceptive orthodontics clinic to monitor treatment stability and plan additional interventions as necessary until growth is complete.

CONCLUSIONS

Early orthopedic treatment using rapid maxillary expansion combined with maxillary protraction proved effective in correcting the anterior crossbite and skeletal Class III malocclusion caused by maxillary retrusion. The intervention resulted in a positive overjet, a Class I molar relationship, and notable improvement in the facial profile. Cephalometric analysis confirmed favorable skeletal changes, including correction of the ANB angle from –2° to 2°. Long-term follow-up remains essential to ensure treatment stability and to monitor craniofacial growth until completion.

REFERENCES

1. Proffit WR, Fields HW, Sarver DM. Contemporary orthodontics. 4th ed. USA: Elsevier Health Sciences; 2007

2. Tashima AY, Verrastro AP, Ferreira SLM, Wanderley MT, Pinto EG. Tratamento ortodôntico precoce da mordida cruzada anterior e posterior: relato de caso clínico. J Bras Odontopediatr Odontol Bebê 2003;29:24-31

3. Fernandes LBD, Marsillac MWS, Cariello A. Mordida cruzada anterior causada por dentes supranumerários. Rev Gaúcha Odontol 2005;53:247-250

4. Kajiyama K, Nishii Y, Sugawara J, Iizuka T. Effects of protraction headgear on craniofacial structures and upper airway dimensions. Angle Orthod 2004;74:616-624

5. McNamara JA. An orthopedic approach to the treatment of Class III malocclusion in young patients. J Clin Orthod 1987;21:598-608

6. Lee RJ. The influence of oral habits on craniofacial development. Korean J Orthod 2010;40:435-445

7. Guyer EC, Ellis EE, McNamara JA, Behrents RG. Biomechanics of maxillary protraction in children with cleft lip and palate. Angle Orthod 1986;56:5-14

8. Araújo EA, Araújo CV. Diagnóstico diferencial da má oclusão de Classe III. J Orthod 2008;35:143-152

9. Litton SF, Ackermann LV, Isaacson RJ, Shapiro BL. A genetic study of Class III malocclusion. Am J Orthod 1970;58:565-577

10. Saadia M, Torres E. Orthopedic correction of Class III malocclusion in young patients: a cephalometric evaluation. Angle Orthod 2000;70:95-103

11. Haas AJ. Palatal expansion: just the beginning of dentofacial orthopedics. Am J Orthod 1970;57:219-255

12. Kim YH, Han UK, Lim DD, Serraon MLP. Stability of anterior openbite correction with multiloop edgewise archwire therapy: a cephalometric follow-up study. Am J Orthod Dentofacial Orthop 2000;118:43-54

13. de Almeida MR, de Almeida RR, Oltramari-Navarro PVP, Conti ACCF, Navarro RL, Camacho JG. Early treatment of Class III malocclusion: 10-year clinical follow-up. J Appl Oral Sci 2011;19:431-439

14. Steiner CC. Cephalometrics in clinical practice. Angle Orthod 1959;29:8-29

15. Mendes WD, Mira PC, Silvan PRÁ, Monteiro PM, Matsumoto MAN, Stuani MBS. Multidisciplinary approach in the anterior open bite using a McNamara expander with palatal crib during mixed dentition stage: a case report. Contemp Pediatr Dent 2021;2:166-175

16. Davidovitch M, Efstathiou S, Sarne O, Vardimon AD. Skeletal and dental response to rapid maxillary expansion with 2- versus 4-band appliances. Am J Orthod Dentofacial Orthop 2005;127:483-492

17. Arellano-Cotrina JJ, Marengo-Coronel N, Atoche-Socola KJ, Peña-Soto C, Arriola-Guillén LE. Effectiveness and recommendations for the use of dental masks in the prevention of COVID-19: a literature review. Disaster Med Public Health Prep 2021;15:43-48

18. Tanne K, Koenig HA, Burstone CJ. Moment-to-force ratios and the center of rotation. Am J Orthod Dentofacial Orthop 1988;94:426-431

19. Hägg U, Yiu C, Stickel B. Effect of protraction headgear on Class III malocclusion. Eur J Orthod 1992;14:95-102

20. Stuani MBS. A desafiadora Classe III. In: Matsumoto MAN, Stuani MBS, Romano FL, editors. Ortodontia: Abordagens Clínicas na Dentição Mista. Barueri: Manole; 2021. p.255-296.

21.Keski-Nisula K, Lehto R, Lusa V, Keski-Nisula L, Varrela J. Occurrence of malocclusion and need of orthodontic treatment in early mixed dentition. Am J Orthod Dentofacial Orthop 2003;124:631-638

22. Macdonald KE, Kapust AJ, Turley PK. Cephalometric changes after the correction of Class III malocclusion with maxillary expansion/facemask therapy. Am J Orthod Dentofacial Orthop 1999;116:13-24

23. Saga A, Vianna MS, Tanaka O, Maruo H. Interceptação da maloclusão Classe III de Angle por meio da protração maxilar. J Bras Ortodon Ortop Facial 2006:165-173

24. Seehra J, Fleming PS, Mandall N, DiBiase AT. A comparison of two different techniques for early

correction of Class III malocclusion. Angle Orthod 2012;82:96-101

25. Nanda R, Hickory W. Zygomaticomaxillary suture adaptations incident to anteriorly-directed forces in rhesus monkeys. Am J Orthod 1984;54:199-210

26. Cha KS. Skeletal changes of maxillary protraction in patients exhibiting skeletal class III malocclusion: A comparison of three skeletal maturation groups. Angle Orthod 2003;73:26-35

27. Antoniazzi SP. Facial changes resulting from the treatment of Class III malocclusion with maxillary deficiency using maxillary expansion and reverse traction [thesis]. Santa Maria (Brazil): Federal University of Santa Maria; [Internet] 2021 [cited 2025 May 14]. Available from: https://repositorio.ufsm.br/

28. da Silva Filho OG, Magro AC, Capelozza Filho L. Early treatment of Class III malocclusion with rapid maxillary expansion and maxillary protraction. Am J Orthod Dentofacial Orthop 1998;113:196-20

29. Perrone APR, Mucha JN. O tratamento da Classe III: revisão sistemática - Parte I. Rev Dent Press Ortod Ortop Facial 2009;14:109-117

30. Hägg U, Tse A, Bendeus M, Rabie ABM. Long-term follow-up of early treatment with reverse headgear. Eur J Orthod 2003;25:95-102

How to cite this article:

Antônio Giroto dos Santos, Thaísa Maria Vellasco Queiroz Pimenta, Gabby Chacon Ruiz, Sara Gollino, Franciele Lucca Longo, Gabriela Leite Pedroso, Paôla Caroline da Silva Mira, Maria Bernadete Sasso Stuani. Correction of skeletal Class III in mixed dentition: A case report. Contemp Pediatr Dent 2025:6(2):160-171

Declarations

Acknowledgements: *Not applicable.*

Conflict of Interest Statement: *Authors disclose no potential conflicts of interest.*

Ethics Statement: *Procedure was explained to the parents and written consent was obtained for the treatment and publication of the case report.*

Informed Consent: *Informed consent was obtained from the parents and/or guardians.*

Author contributions: *Conception and design: All authors; Acquisition of data: FLL, GCR; Interpretation of data: SG, PCSM; Drafting article: AGS, FLL, GCR, SG, PCSM, TMVQP, GLP; Revision article: TMVQP, GLP, MBSS; Final approval: All authors.*

Funding: *There is no financial support or sponsorship to declare.*

Data Availability: *The data used to support the findings of this study can be made available upon request to the corresponding author.*

Peer-review: *Externally double-blinded peer-reviewed.*