

Rapid maxillary expansion for maxillary atresia and mandibular alignment: A mixed dentition case report

Expansão rápida do maxilar para atresia maxilar e alinhamento mandibular: Um relato de caso em dentição mista

Expansión rápida del maxilar para atresia maxilar y alineación mandibular: Un informe de caso de dentición mixta

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Abstract

Introduction: Posterior crossbite is a common malocclusion in orthodontics. It often accompanies maxillary atresia, leading to unilateral or bilateral posterior crossbite. Rapid maxillary expansion (RME) is an approach to treat atresia, correct transverse discrepancies, and increase the perimeter of the maxillary arch. **Objective:** To present the case of an 8-year-old patient with maxillary atresia, skeletal Class I, dental Class I, and no space in the maxillary anterior and mandibular regions for the alignment of the incisors. **Clinical procedures:** RME was performed using a HYRAX type expander. After 20 days of daily activations, there was a change in the morphology of the palate, an increase in the arch perimeter, facilitating the eruption of incisors and canines. **Final considerations:** RME is an effective and efficient orthopedic treatment, recommended for correcting transverse deviations, normalizing structural and functional problems. As positive side effects, the indirect action on the mandibular molars and canines allowed the alignment of the incisors.

Keywords: Posterior crossbite; Orthodontics; Rapid maxillary expansion; HYRAX.

Resumo

Introdução: O cruzamento posterior é uma maloclusão comum em ortodontia. Frequentemente, acompanha a atresia maxilar, levando a um cruzamento posterior unilateral ou bilateral. A expansão rápida da maxila (ERM) é uma abordagem para tratar a atresia, corrigir discrepâncias transversais e aumentar o perímetro do arco maxilar. **Objetivo:** Apresentar o caso de um paciente de 8 anos com atresia maxilar, Classe I esquelética, Classe I dental e sem espaço nas regiões anteriores maxilares e inferiores para o alinhamento dos incisivos. **Procedimentos clínicos:** A ERM foi realizada

usando um expansor tipo HYRAX. Após 20 dias de ativações diárias, houve uma mudança na morfologia do palato, um aumento no perímetro do arco, facilitando a erupção de incisivos e caninos. Considerações finais: A ERM é um tratamento ortopédico eficaz e eficiente, recomendado para corrigir desvios transversais, normalizando problemas estruturais e funcionais. Como efeitos secundários positivos, a ação indireta sobre os molares e caninos inferiores permitiu o alinhamento dos incisivos.

Palavras-chave: Cruzamento posterior; Ortodontia; Expansão rápida da maxila; HYRAX.

Resumen

Introducción: El cruzamiento posterior es una maloclusión común en ortodoncia. A menudo acompaña a la atresia maxilar, lo que lleva a un cruzamiento posterior unilateral o bilateral. La expansión rápida del maxilar (ERM) es un enfoque para tratar la atresia, corregir las discrepancias transversales y aumentar el perímetro del arco maxilar. Objetivo: Presentar el caso de un paciente de 8 años con atresia maxilar, Clase I esquelética, Clase I dental y sin espacio en las regiones anteriores maxilares e inferiores para la alineación de los incisivos. Procedimientos clínicos: Se realizó la ERM utilizando un expansor tipo HYRAX. Después de 20 días de activaciones diarias, hubo un cambio en la morfología del paladar, un aumento en el perímetro del arco, facilitando la erupción de incisivos y caninos. Consideraciones finales: La ERM es un tratamiento ortopédico efectivo y eficiente, recomendado para corregir desviaciones transversales, normalizando problemas estructurales y funcionales. Como efectos secundarios positivos, la acción indirecta sobre los molares y caninos inferiores permitió la alineación de los incisivos.

Palabras clave: Cruzamiento posterior; Ortodoncia; Expansión rápida del maxilar; HYRAX.

1. Introduction

Rapid maxillary expansion (RME) is used to correct skeletal and dental transverse discrepancies and to increase the perimeter of the maxillary arch. (McNamara, 2000) These needs can be clinically identified by unilateral or bilateral posterior crossbite (PCB), narrowing of the dental arch, crowding, or dental protrusion (Oshagh et al., 2012).

The RME technique was first described by Angell in 1860 and remains in use, (Tanaka et al., 2023) with the HYRAX device being one of the most commonly employed to treat transverse discrepancies (Brunetto et al., 2021).

The prevalence of PCB varies between 8% and 16% in children aged 7 to 9 years, (Oshagh et al., 2012) and this incidence does not show a specific gender distinction, (Chisari, McGorray, Nair, & Wheeler, 2014) it is important to note that the transition from mixed to permanent dentition often coincides with a significant growth period, during which orthodontic and orthopedic changes occur. (Martina et al., 2012)

The posterior crossbite can manifest in various forms: bilateral or, more commonly, unilateral with a shift of the mandible to the affected side. The latter is a consequence of maxillary atresia, prevailing in 80 to 97% of cases among children aged 3 to 12 years (Alsawaf et al., 2022). The etiologies may stem from genetic or environmental factors and are often related to conditions such as dental crowding, other forms of crossbite, Class II and III malocclusions, and dysfunctions of the temporomandibular joint (TMJ) (Adina et al., 2020).

The constriction of the maxillary dental arch, in turn, is often associated with unilateral or bilateral posterior crossbites (Kutin & Hawes, 1969). Given the persistence of transversal malocclusions during craniofacial growth, there is a consensus on the need for early interventions, such as RME as soon as possible (Sandikcioglu & Hazar, 1997; Thilander et al., 1984).

Several factors are identified as potential causes of PCB, including non-nutritive sucking habits, mouth breathing, adenotonsillar hypertrophy, and chronic allergy (Grippaudo et al., 2016; Subtelny, 1980). Other associations include TMJ disorders (Thilander et al., 1984).

Spontaneous changes in the mandibular arch have been reported following RME, despite the high resistance of the mandibular bone (Gryson, 1977). According to Haas, (Haas, 1980) a permanent increase in the maxillary apical base leads to a significant, permanent, and spontaneous increase in the width of the mandibular arch. Comparisons between rapid maxillary expansions, assessing changes in the arch on study models, have shown significant increments in both the maxilla and mandible in terms of arch widths at the end of the treatment (Grassia et al., 2015).

When considering RME, it's reasonable to anticipate an adaptive response from the mandible. This expectation stems

from the potential shift in the equilibrium of forces exerted by the cheek and tongue on the mandibular dental arch following expansion, which could affect the positioning of the mandibular molars (Alves et al., 2017; Tanaka et al., 2023). Nonetheless, the impact of maxillary expansion on the mandibular arch is a subject of ongoing debate. This uncertainty largely arises from the fact that most studies have evaluated the dental and skeletal effects of RME through two-dimensional analyses using lateral and postero-anterior cephalometric radiographs, or study models (Bruno et al., 2020).

In light of this, the purpose of the current case report is to comprehensively detail the application of RME using the HYRAX device in a patient with mixed dentition, focusing specifically on its effects on the mandibular arch.

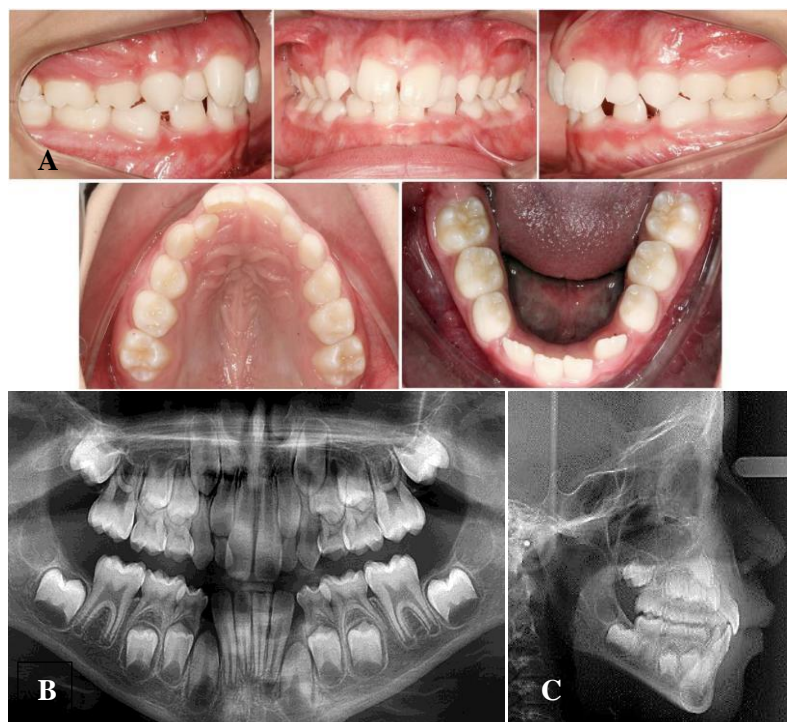
2. Methodology

This case study, following Estrela (2018) and Coimbra and Martins (2013), delves into real-world scenarios to enhance scientific knowledge using Gil's (2002) qualitative research approach. Originating from private practice and based in literature, it employs a focused action research method, emphasizing ethical data collection and analysis. Informed consent was obtained from the patient for the use of their data and images for research purposes.

3. Case Report

An 8-year-old patient was referred to an orthodontist on the recommendation of a pediatric dentist. Clinically, the patient exhibited skeletal and dental Class I malocclusion, with a normal overjet and overbite in the central incisors. However, the right maxillary lateral incisor tended towards an edge-to-edge relationship. The maxilla was constricted, displaying a triangular shape. There was a noticeable lack of space for the eruption of the maxillary lateral incisors and permanent mandibular canines, with rotation in the lateral incisors and the mandibular right central incisor. A visible diastema was present between the left mandibular lateral and central incisors (Figure 1).

Figure 1 - A. Initial intraoral photographs display lateral views of both the right and left sides, as well as occlusal views of the maxilla and mandible. B. Panoramic and C. lateral cephalometric radiographs.



Source: Authors (2024).

In terms of dentition at that time, the patient had erupted first permanent molars, maxillary and mandibular central incisors, first and second maxillary and mandibular molars, maxillary canines, and maxillary lateral incisors in their primary state. The second and third permanent maxillary and mandibular molars, as well as the mandibular primary canines, were absent. Panoramic radiography revealed mixed dentition. Partial root resorption (rizolysis) of the right maxillary lateral incisor and maxillary molars was noted, with more advanced resorption in the right maxillary lateral incisor. The roots of the mandibular primary canines and molars remained intact. The second molars, premolars, and permanent canines had approximately three-quarters of their crowns formed. The crypts of the mandibular molars were visible, but there was no sign of formation of the mandibular third molars (Figure 1A).

Cephalometric analysis diagnosed mild maxillary retrognathism, with a predominance of vertical over horizontal growth. The nasopharyngeal space was unobstructed. The maxillary and mandibular incisors were well-positioned, resulting in a slightly convex lower facial profile (Figure 1C).

Treatment Objectives

Transversal correction: Improving the shape of the maxillary arch through Rapid Maxillary Expansion (RME).

Proper eruption: Creating space for the correct eruption of permanent teeth.

Occlusal stability: Ensuring proper and lasting tooth position.

Prevention: Anticipating and preventing the need for more complex treatments in the future.

Functional improvement: Refining mastication and phonation.

Periodontal health: Facilitating hygiene and preventing gum diseases.

Space: Allowing for the alignment of the mandibular incisors.

Treatment Alternatives

The treatment options presented to the guardians were:

Monitoring: Periodic reassessment of dental development and the eruption of permanent teeth.

Rapid Maxillary Expansion: Correcting maxillary constriction to create space.

Orthodontic appliance: Adjusting the position of the incisors, correcting rotations, and closing diastemas.

Selective extraction: Exodontia of deciduous teeth with advanced root resorption to expedite the eruption of successors.

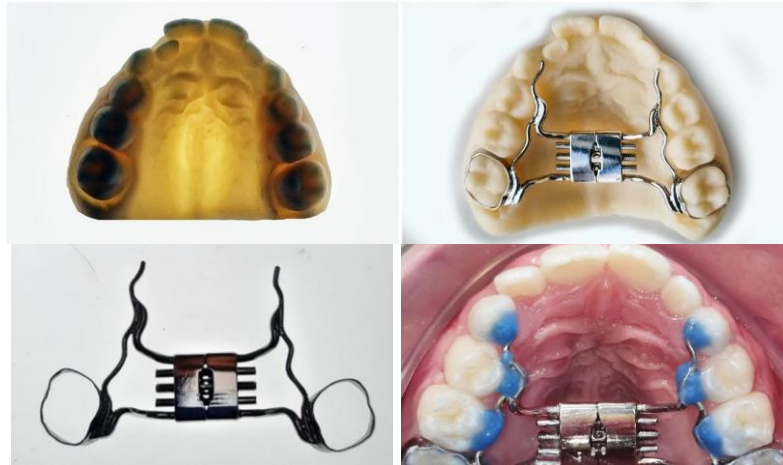
Growth control: Using devices to direct facial growth.

Speech therapy: Evaluating tongue and lip function and posture.

Treatment Progress

A HYRAX-type appliance was fabricated and fitted (Figure 2). After installation, the patient was instructed to activate it twice on the first day and once on subsequent days, continuing this alternating pattern for 20 days, totaling 30 activations.

Figure 2 - The photograph displays a model created by a 3D printer following intraoral scanning. The lighting highlights the designated space for band adaptation. The HYRAX palatal expander is precisely fitted onto the printed model and is ready for cementation. For bonding, Band-lock cement was used, although any other composite resin could also be suitable.



Source: Authors (2024).

After the activation period, the expander was maintained in position as a retainer, preserving the expansion achieved. This retention phase lasted 6 months, ensuring stabilization and consolidation of the results. During this period, an improvement in the positioning of the mandibular teeth was observed (Figure 3).

Figure 3 - Progress intraoral photographs. Advancements in interception during the stabilization phase of the expander screw following the completion of RME. Both mandibular first deciduous molars were exfoliated.



Source: Authors (2024).

Results of the Interceptive Orthodontic Treatment

RME led to significant clinical and radiographic transformations in the patient. The maxillary arch was reshaped into a more parabolic form, facilitating harmonious dental alignment. This process allowed for the necessary space for the proper positioning of the maxillary lateral incisors and the correct eruption of the mandibular canines (Figure 4A).

The final panoramic radiography highlighted a more favorable eruptive direction for the maxillary permanent canines (Figure 4B). Cephalometrically, the maintenance of good positioning of the maxillary and mandibular incisors on the bony base and the

continuation of the slightly convex lower facial profile was noted (Figure 4C).

Figure 4 - Final results of the interceptive phase. A notable enhancement in the contour of the maxillary arch is observed. Beyond the increase in space, there was a corrective effect on dental alignment in both the maxillary and mandibular arches. A more pronounced buccal eruption of the mandibular teeth is evident. Observe the change in the maxillary and mandibular morphology with a more parabolic arch form. The panoramic radiograph reveals an improved eruptive path of the maxillary canine compared to the initial panoramic radiograph. C. The cephalometric radiograph shows a well-positioned incisor in the mandibular symphysis.



Source: Authors (2024).

Follow-up

After 17 months, the results obtained from the interceptive treatment remained stable. The development of the dentition and occlusion progressed well, with the eruption of the maxillary canines in their ideal position. In the mandible, there was notable progress in alignment, especially of the left lateral (Figure 5).

Figure 5 - Follow-up, after the completion of the interceptive treatment with the evolution in the shape of the maxillary arch and the alignment of the mandibular left lateral incisor. Phase 2, a corrective phase, is recommended.



Source: Authors (2024).

4. Discussion

Posterior crossbite (PCB) presents a challenging scenario in pediatrics, emerging during various stages of dental development, from the eruption of deciduous to permanent teeth. Notably, unilateral PCB often triggers an asymmetric mandibular deviation as a compensatory mechanism for achieving posterior teeth occlusion. This condition, if unaddressed, can have prolonged effects, including asymmetric mandibular growth, facial disharmony, and alterations in masticatory muscles and the temporomandibular joint (Ugolini et al., 2021).

The orthodontic community continues to debate the optimal timing for intervention in PCB cases. Due to PCB's tendency not to self-correct, early interception is generally recommended (O. Tanaka et al., 2023). However, there remains uncertainty about the frequency and ideal timing for spontaneous correction during the transition from deciduous to mixed dentition (Nascimento, Santos, Santos, & Normando, 2023).

Slow Maxillary Expansion (SME) has been validated as an effective method for correcting PCB. However, a study by Pereira et al. (2022) suggests that RME may induce more pronounced molar tilting compared to SME (Pereira et al., 2017). This insight underscores the necessity of tailoring treatment approaches to the individual patient, balancing clinical objectives with the patient's unique anatomical characteristics. In the presented case, RME was selected despite its association with greater molar inclination, emphasizing the importance of comprehensive clinical evaluation and adaptability in technique selection.

RME's influence extends beyond the maxillary arch, with observable dentoalveolar changes in the mandibular arch (Alves et al., 2017). While maxillary expansion impacts lower molars, these effects are not deemed clinically significant for substantial space gain in the mandibular arch. (Lo Giudice et al., 2020).

Over the years, orthodontics has thoroughly explored the biomechanical implications of maxillary expansion for correcting transverse discrepancies. While the effects on the maxillary arch are well-documented (Tanaka et al., 2016), the impact on the mandibular arch remains an area of ongoing research. Ugolini et al. (2016) (Ugolini et al., 2016) observed a beneficial effect on mandibular intermolar distance post-RME, indicating an adaptive response of the lower arch to maxillary arch changes. Conversely, Pacheco et al. (2018) (Pacheco et al., 2018), found that RME, specifically with Haas-type appliances, does not significantly increase mandibular intermolar width or arch perimeter in growing patients.

Secondary effects on the mandibular arch may include changes in the balance of tongue and cheek forces (Lagana et al., 2023), potentially leading to alterations in dental positioning in the mandibular arch (Cantore et al., 2016; Lo Giudice et al., 2020), including increases in intercanine and intermolar diameters. (Lagana et al., 2023).

These findings highlight the complexity and individual variation in response to RME, emphasizing the necessity for clinicians to adopt a personalized approach in planning expansion treatments and assessing potential effects on the mandibular arch. There's a misconception that all anterior crowding can be resolved with RME in the mixed dentition phase, where 30 turns of an expander screw result in approximately 7.5mm of expansion, or a 5.2mm gain in maxillary arch perimeter - roughly the width of a mandibular incisor.(Kravitz, 2023) However, RME typically provides only about 5-6mm of space, suggesting that additional crowding may require alternative strategies such as incisor protraction or extractions.

In the case study, RME facilitated the alignment of the mandibular teeth, reducing crowding in the permanent dentition. The successful functional and aesthetic outcomes were a result of a combination of factors, including an increase in dental arch perimeter. However, these results are specific to this case and should not be universally applied to all malocclusions.

In summary, this case underscores the benefits and efficacy of early orthodontic intervention in managing malocclusions. Early treatment during the mixed dentition phase simplifies future interventions and leads to more predictable results, positively impacting not just dental alignment and positioning, but potentially also facial aesthetics and function.

5. Conclusions

Rapid maxillary expansion is an effective and efficient orthopedic intervention for correcting structural and functional issues in orthodontics. The procedure not only addresses the primary concerns but also positively influences the alignment of mandibular molars and canines. This facilitates the alignment of incisors and plays a significant role in reducing the progression of malocclusions.

As suggestion, it would be valuable to explore the long-term stability of the results provided by RME. Additionally, comparative studies involving different types of expanders could provide deeper insights into optimizing treatment outcomes for specific malocclusion patterns.

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