

Effectiveness of removable expander appliances in posterior crossbite: A review of the literature

Eficácia dos aparelhos expansíveis removíveis na mordida cruzada posterior: Uma revisão da literatura

Efectividad de la aparatología expansora removible en la mordida cruzada posterior: Una revisión de la literatura

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María Yolanda Yunga Picón¹

ORCID: <https://orcid.org/0000-0002-6134-2683>

Universidad de Cuenca, Ecuador

E-mail: yolanda.yunga@ucuenca.edu.ec

Johanna Pamela Galarza Pintado

ORCID: <https://orcid.org/0009-0004-9470-4646>

Universidad de Cuenca, Ecuador

E-mail: Johanna.galarzap@ucuenca.edu.ec

Alisson Milena Rengel Espinosa

ORCID: <https://orcid.org/0009-0003-2900-4208>

Universidad de Cuenca, Ecuador

E-mail: alisson.rengele@ucuenca.edu.ec

Kelly Tatiana Malla Bernal

ORCID: <https://orcid.org/0009-0002-6918-1965>

Universidad de Cuenca, Ecuador

E-mail: kelly.malla@ucuenca.edu.ec

Gabriel Alexander Chasi Morocho

ORCID: <https://orcid.org/0009-0002-0466-056X>

Universidad de Cuenca, Ecuador

E-mail: gabrielchasi1999@gmail.com

Yuliana Elizabeth Paladinez Carrion

ORCID: <https://orcid.org/0009-0003-1037-5535>

Universidad de Cuenca, Ecuador

E-mail: yuliana.paladinez01@ucuenca.edu.ec

Mónica Beatriz Dávila Arcentales²

ORCID: <https://orcid.org/0000-0002-5098-6133>

Universidad de Cuenca, Ecuador

E-mail: monica.beatriz.davila@ucuenca.edu.ec

Milton Fabricio Lafebre Carrasco¹

ORCID: <https://orcid.org/0000-0003-4947-8411>

Universidad de Cuenca, Ecuador

E-mail: fabricio.lafebre@ucuenca.edu.ec

Abstract

Objective: To evaluate the effectiveness of removable expander appliances in the treatment of posterior crossbite by reviewing and analyzing clinical studies, scientific articles and published case reports. **Background:** Posterior crossbite is a dental malocclusion characterized by a transverse misalignment of the upper and lower teeth, where the upper teeth bite into the lower teeth. This condition can affect one or more dental organs and if left untreated, can lead to functional and esthetic problems, as well as imbalances in maxillofacial growth. Early correction of posterior crossbite is crucial to avoid future complications such as uneven tooth wear, temporomandibular dysfunction and facial asymmetries, and different treatment methods have been used, including removable appliances. **Methodology:** The research was structured from a search tree (PubMed, Scielo, Google Scholar, Dialnet, Scopus), with keywords such as: removable expandable appliance; posterior crossbite; removable orthodontics; treatment efficacy AND posterior crossbite; posterior crossbite NOT fixed appliance. **Conclusions:** Removable expander appliances are an effective option for treating posterior

¹ Docente titular de la Facultad de Odontología de la Universidad de Cuenca, Ecuador.

² Docente de la Facultad de Odontología de la Universidad de Cuenca, Ecuador.

crossbite in children. Studies show that these devices correct malocclusion, promote maxillary growth and improve dental alignment. The effectiveness of the treatment depends on the cooperation of the child and parents. The choice of appliance should be based on a careful evaluation of the patient's needs, considering cooperation, severity of the malocclusion and the preferences of the patient and the orthodontist.

Keywords: Removable expandable appliance; Posterior crossbite; Removable orthodontics; Treatment efficacy; Fixed appliance.

Resumo

Objetivo: avaliar a eficácia dos aparelhos expansores removíveis no tratamento da mordida cruzada posterior, através da revisão e análise de estudos clínicos, artigos científicos e relatos de casos publicados. **Introdução:** a mordida cruzada posterior é uma má oclusão dentária caracterizada por um desalinhamento transversal dos dentes superiores e inferiores, onde os dentes superiores mordem os dentes inferiores. Esta condição pode afetar um ou vários órgãos dentários e, se não for tratada, pode levar a problemas funcionais e estéticos, bem como a desequilíbrios no crescimento maxilofacial. A correção precoce da mordida cruzada posterior é crucial para evitar complicações futuras, como o desgaste irregular dos dentes, a disfunção temporomandibular e as assimetrias faciais. Diferentes métodos de tratamento têm sido utilizados, incluindo aparelhos removíveis. **Metodologia:** a pesquisa foi estruturada com base em uma árvore de busca (PubMed, Google Scholar, Dialnet, Scopus), com palavras-chave como: aparelhos expansores removíveis; mordida cruzada posterior; ortodontia removível; eficácia do tratamento AND mordida cruzada posterior; mordida cruzada posterior NOT aparelhos fixos. **Conclusões:** os aparelhos expansores removíveis são uma opção eficaz para o tratamento da mordida cruzada posterior em crianças. Estudos demonstram que esses aparelhos corrigem a má oclusão, promovem o crescimento da maxila e melhoram o alinhamento dentário. A eficácia do tratamento depende da cooperação da criança e dos pais. A escolha do aparelho deve ser baseada numa avaliação cuidadosa das necessidades do paciente, considerando a cooperação, a severidade da má oclusão e as preferências do paciente e do ortodontista.

Palavras-chave: Aparelho expansor removível; Mordida cruzada posterior; Ortodontia removível; Eficácia do tratamento; Aparelhos fixos.

Resumen

Objetivo: Evaluar la efectividad de la aparatología expansora removible en el tratamiento de la mordida cruzada posterior, mediante la revisión y análisis de estudios clínicos, artículos científicos y reportes de casos publicados. **Antecedentes:** La mordida cruzada posterior es una maloclusión dental caracterizada por una desalineación transversal de los dientes superiores e inferiores, donde los dientes superiores muerden dentro de los dientes inferiores. Esta condición puede afectar uno o varios órganos dentales y de no ser tratada, puede llevar a problemas funcionales y estéticos, así como desequilibrios en el crecimiento maxilofacial. La corrección temprana de la mordida cruzada posterior es crucial para evitar complicaciones futuras, como el desgaste dental desigual, disfunção temporomandibular y asimetrías faciales. Se han utilizado diferentes métodos de tratamiento, incluyendo la aparatología removible. **Metodología:** La investigación fue estructurada a partir de un árbol de búsqueda (PubMed, Google Académico, Dialnet, Scopus), con palabras clave como: Aparatología expansora removible; mordida cruzada posterior; ortodoncia removible; eficacia de tratamiento AND mordida cruzada posterior; mordida cruzada posterior NOT aparatología fija. **Conclusiones:** La aparatología expansora removible es una opción efectiva para tratar la mordida cruzada posterior en niños. Los estudios muestran que estos dispositivos corrigen la maloclusión, favorecen el crecimiento del maxilar superior y mejoran la alineación dental. La efectividad del tratamiento depende de la cooperación del niño y sus padres. La elección del aparato debe basarse en una evaluación cuidadosa de las necesidades del paciente, considerando la cooperación, la severidad de la maloclusión y las preferencias del paciente y del ortodontista.

Palabras clave: Aparatología expansora removible; Mordida cruzada posterior; Ortodoncia removible; Eficacia de tratamiento; Aparatología fija.

1. Introduction

Dental malocclusions are considered the third most prevalent problem in the population worldwide, after caries and periodontal disease (Ramon et al., 2022). Dental malocclusions are considered anomalies that directly affect the growth and development of the jaw structures, thus causing an imbalance at the level of phonation, swallowing and function (Ayaz et al., 2019). Posterior crossbite (PCB) is a term that describes an anomaly of occlusion in a transverse sense, it presents an inverse vestibulo lingual relationship between antagonist teeth during occlusion, involving at least one posterior tooth, molar or premolar (Moyers, 1996). It can occur unilaterally or bilaterally. Its prevalence varies between 2.7% and 23% (Kennedy et al, 2005). Its etiology involves genetic factors such as maxillary hypoplasia, mandibular hyperplasia and craniofacial alterations related to syndromes, environmental factors such as non-nutritive sucking habits or pacifier use, atypical swallowing that generates an

inadequate position of the tongue, altered nasal breathing due to airway obstruction or allergies, also tonsil and adenoid hypertrophy and in general factors that affect the transverse diameter of the upper dental arch. There are also functional factors such as displacement of the mandible, due to occlusal interferences that are highly associated with the canines in the primary dentition, the eruption of the first molar in the early mixed dentition and with the prolonged retention of a primary tooth in the late mixed dentition, these situations cause changes and instability in the occlusion (Bell et al, 2014). This malocclusion affects the development of the transverse plane, limiting the width of the upper arch, and maxillary expansion is an accepted therapeutic alternative (Ortu et al, 2014). Early treatment is essential to prevent alterations in the different structures of the stomatognathic system. If not addressed early, bony asymmetry may develop in the mandibular ramus on the affected side, leading to mandibular or facial asymmetries. Temporomandibular joint (TMJ) disorders may also arise, as well as morphological and positional changes in the mandibular condyle (Kennedy et al, 2005). This expansion can be performed in a rapid manner (ERM) or in a slow or controlled manner and can be performed with fixed or removable appliances. Several appliances have been proposed to increase the width of the upper arch, for example, Hawley plates with expander, Schwartz appliance, among others (Ramoglu et al, 2010) For this reason, the present literature review aims to analyze the efficacy and indications of removable expander appliances in the treatment of posterior crossbite.

2. Methodology

A search for original scientific articles, cases and controls, systematic reviews, literature reviews, and clinical case studies was carried out in the Pubmed, Scielo, Dialnet, Scopus, and Google Scholar databases. In addition, the search was optimized with Boolean operators "AND", "OR" and "NOT" that helped the search algorithm with keywords: removable expandable appliance; posterior crossbite; removable orthodontics; treatment efficacy AND posterior crossbite; posterior crossbite NOT fixed appliance.

For the inclusion criteria, the following criteria were used as limiting factors: language (English, Portuguese, Spanish), open access, any type of research study, systematic reviews, meta-analysis, randomized clinical trials, case reports, observational studies, articles with direct clinical data, articles published less than 5 years ago.

Within the present review we excluded those repeated studies that were found within the search engines, studies not competent to our analysis, series that did not report clinical data. In addition, a secondary selection was made based on the title and abstract of the articles, selecting only those relevant to the objective of the present study.

For the population of interest in this review, all individuals treated with removable appliances were included.

In order to carry out this study on the effectiveness of removable expandable appliances in the treatment of posterior crossbite in pediatric patients, the guidelines and theoretical frameworks established by several recognized authors in the field of scientific methodology were followed. The main authors and works that give methodological support to this type of research are presented below:

Pereira, et al. (2018): In their work "Metodología de la pesquisa científica", Pereira et al. offer a comprehensive overview of scientific research methods, highlighting the importance of rigor and systematicity in literature reviews. This book provides a solid foundation for structuring and conducting integrative reviews.

Estrela, (2018): In "Scientific methodology: science, teaching, research", Estrela discusses the different methodological approaches in scientific research, highlighting the characteristics and benefits of integrative reviews as a tool for knowledge synthesis.

Snyder, (2019): In his article "Review of literature as a research methodology: overview and guidelines", Snyder provides a clear framework for conducting literature reviews, highlighting the integrative one for its ability to combine diverse studies and offer a holistic view of the topic under investigation.

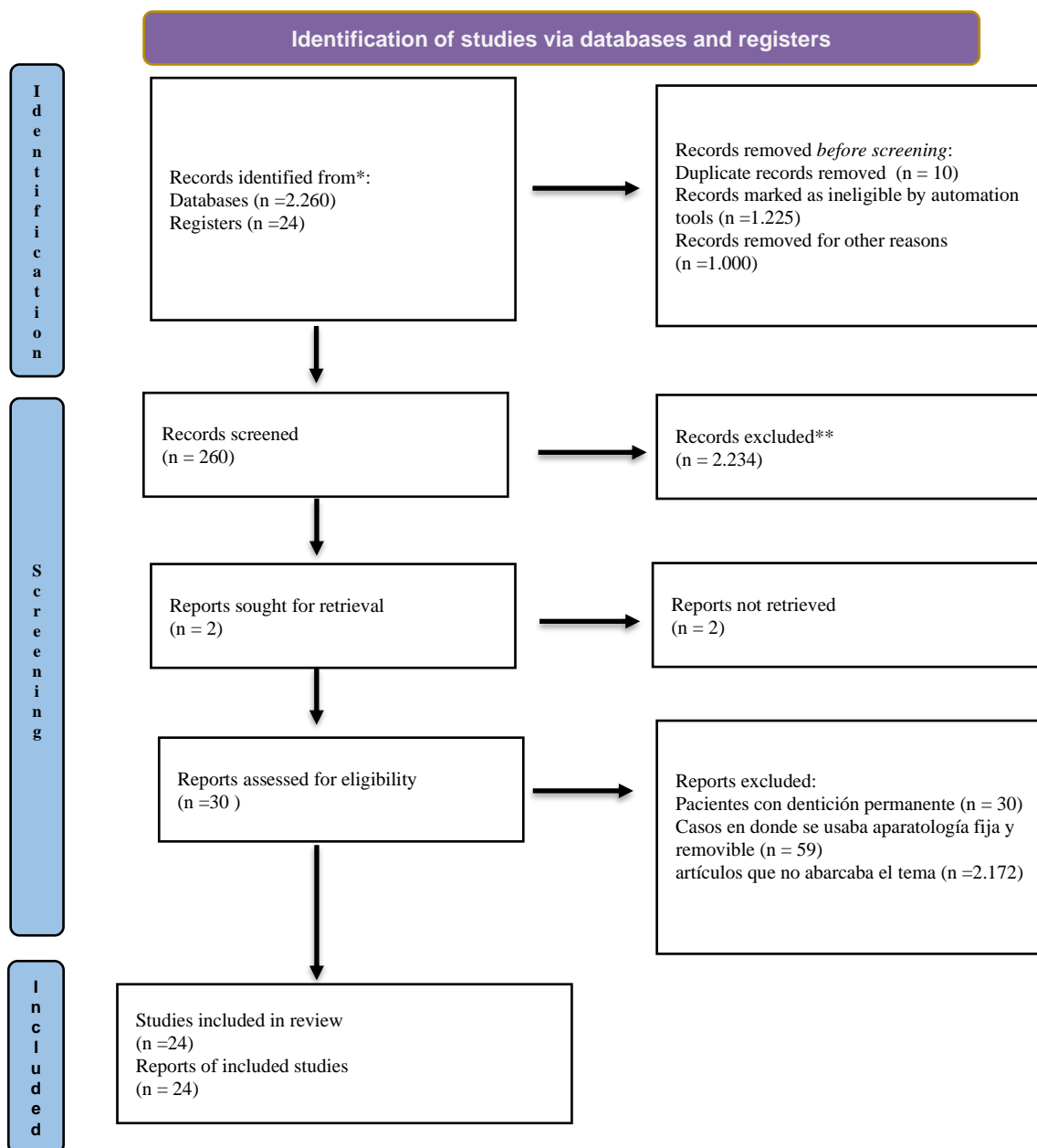
These methodological references not only guide the process of data collection and analysis, but also ensure that the study is carried out with the rigor and accuracy necessary to be recognized and accepted by the academic and scientific community.

Table 1 - Systematic literature review flowchart.

Pubmed	Inclusion criteria	Results
	5 years old	4
	Languages (English, Spanish, Portuguese)	4
	Open access	4
	Systematic reviews, meta-analysis, RCTs, case reports.	1
Scielo	Inclusion criteria	Results
	5 years old	25
	Languages (English, Spanish, Portuguese)	25
	Open access	25
	Systematic reviews, meta-analysis, RCTs, case reports.	3
Dialnet	Inclusion criteria	Results
	5 years old	108
	Languages (English, Spanish, Portuguese)	108
	Open access	108
	Systematic reviews, meta-analysis, RCTs, case reports.	3
Scopus	Inclusion criteria	Results
	5 years old	236
	Languages (English, Spanish, Portuguese)	94
	Open access	42
	Systematic reviews, meta-analysis, RCTs, case reports.	3
Google scholar	Inclusion criteria	Results
	5 years old	3.080
	Languages (English, Spanish, Portuguese)	3.080
	Open access	3.80
	Systematic reviews, meta-analysis, RCTs, case reports.	17

Source: Authorship.

Figure 1 - Flowchart of the systematic literature review.



Source: Authorship.

Search results

The initial search showed 2,260 studies whose title was related to the search patterns, from which 2,235 articles were excluded based on their title and abstract, resulting in 70 potentially relevant articles. After reading, 46 articles that did not meet the inclusion criteria were excluded: repeated studies that were found within the search engines, studies that were not competent to our analysis, series that did not report clinical data. Thus, 24 articles were finally selected for the present review.

Table 2 - Characteristics of the articles included.

Authors	Title of the article - DOI	Type of studio	Magazine	Umbral concepts
Silva, W. M. da, Souza, L. O., Rocha, R. A. S. de S., Alencar, C. R. B. de, Barbosa, T. de S., & Fonseca, F. R. A. (2021)(12)	Clinical-Surgical and Orthodontic Approach to Unilateral Posterior Crossbite in a Child Patient: Report on Conduct and Intercurrences Doi: https://doi.org/10.21270/archi.v12i1.5246	Case report	<i>Archives of health investigation</i>	Interceptive treatments, such as the use of removable appliances like the expansion plate, have been effective in improving aesthetics, function and gaining space in the upper arch. This is confirmed by visible changes in the patient's clinical appearance before and after follow-up. Patient cooperation is essential for the success of these treatments. In addition, the interdisciplinary approach between orthodontics and pediatric dentistry has improved the professional-patient relationship and the effectiveness of the treatments.
Luis Efraín Mora-Pesantez; Ronald Roossvet Ramos-Montiel (2022)(13)	Early treatment of crossbite DOI: https://doi.org/10.35381/s.v.v6i1.1780	Literature review	<i>Arbitrated Interdisciplinary Journal of Health Sciences. Health and Life,</i>	The evidence regarding orthodontic treatments for crossbite in this study was homogeneous in terms of their effectiveness.
Guadalupe Rita Viltres Pedraza , Tatiana de la Caridad Barrero Castillo , Yosvany Herrero Solano , Lisbet Arcia Cruz , Lilianne de la Caridad Estrada Viltres. (2021)(14)	Treatment of transverse micrognathism caused by deforming oral habits. Doi: https://cibamanz2021.sld.cu/index.php/cibamanz/cibamanz2021/paper/view/23/0	Cuasiexperimental studio	Cibamanz	With the use of Klammt's elastic open activator, clinical changes were achieved that demonstrated its effectiveness in correcting transverse micrognathism and in 89% posterior crossbite was corrected.
Danya Hassan Alsawaf, Salam Ghazwan Almaasarani, Mohammad Y. Hajeer* and Nada Rajeh (2022)(15)	The effectiveness of the early orthodontic correction of functional unilateral posterior crossbite in the mixed dentition period: a systematic review and meta-analysis. Doi: https://doi.org/10.1186/s40510-022-00398-4	Systematic review and meta-analysis.	Prog Orthod	Treatment of functional posterior crossbite (FPXB) with the Quadhelix (QH) shows weak to moderate evidence that it increases maxillary intermolar anchorage, improves the success rate and reduces the duration of treatment compared to the palatal expander (PE). Hyrax also successfully corrected FPXB, although the evidence of its effectiveness is very low. Due to the variable quality of the tests, more research is needed using randomized controlled trials (RCTs) with different expansion devices for the early treatment of FPXB.
Souza, R. A. de, Reis, V. S. C., Silva, D. F. Almeida , A. P. de, Freitas, L. M. A. de, Python, M. M. (2021)(16)	Effectiveness of interceptive orthodontic treatment with removable braces in children with crossbite and open bite in the mixed dentition phase Doi: https://doi.org/10.33448/rsd-v10i2.12433	Quantitative, cross-sectional, retrospective and descriptive study	Research, Society and Development	This study concludes that removable orthodontic appliances such as the lingual rejilla and expander are effective in correcting open bite and posterior crossbite respectively, despite the need for children in the mixed dentition stage to cooperate with the use of the appliance.
Solano Campos, Cristhel (2023)(17)	Study of the change shown by the use of fixed and removable interceptive orthodontic appliances in the treatment of malocclusions, evaluated using the Orthodontic Treatment Need Index (IOTN), in orthodontic patients at the Dental Clinic of the Latin University of Costa Rica, between September 2022 and April 2023.	Degree Thesis	Latin University of Costa Rica	In short, the IOTN is a clinically applicable, effective and efficient method for determining the degree of need for orthodontic treatment, as well as for analyzing the change in the patient's occlusion through the use of interceptive orthodontic appliances.

Taheri R. B (2021)(18)	Diagnosis and multidisciplinary treatment of a patient with respiratory alterations, posterior crossbite and enamel alterations.	Degree Thesis	Complutense University of Madrid, Madrid.	With regard to posterior crossbite, there was an improvement in transverse malocclusion. However, this improvement is not complete due to a lack of cooperation in activating the apparatus. Trulsson et al. observed that in patients aged between 6 and 13, the degree of parental supervision of treatment is fundamental to achieving a good response to orthodontic treatment.
Vasquez G, Luevano J. (2022)(19)	Early treatment of unilateral posterior crossbite	Case report	Revista de Odontopediatría Latinoamericana	Early diagnosis and orthopedic treatment are crucial for correcting malocclusions. It has been proven that the use of the modified SN2 and the Hawley plate with an attached loop are effective for treating posterior crossbite and improving the circumference of the upper arch. The cooperation of the patient and their parents is essential at all stages of treatment.
Di Biase, A. T., Sandler, P. J., & Benson, P. E. (2019)(20)	Treatment of posterior crossbite comparing 2 appliances: A community-based trial Doi: https://doi.org/10.1016/j.ajodo.2019.03.023	Comparative analysis	American Journal of Orthodontics and Dentofacial Orthopedics	A community study comparing two types of appliance for the treatment of posterior crossbite. The results showed that both appliances were effective in correcting crossbite, although consistency in the use of the appliance and follow-up are crucial.
Tortarolo A; Di Benedetto L. (2023)(21)	Improvement in the transverse dimension of dental arches in mixed dentition patients with posterior crossbite treated with functional therapy Doi: https://doi.org/10.2319/091622-647.1	Case report	The Angle Orthodontist	This study shows that functional therapy with removable appliances can significantly improve the transverse dimension of dental arches in patients with mixed dentition and posterior crossbite. A rigorous methodology was used to measure interdental distances before and after treatment, showing an effective expansion of the dental arches.
Behroozian A(2021)(22)	Clinical outcomes of using removable appliances for the correction of posterior crossbite in children Doi: https://doi.org/10.1055/s-0041-1733303	Clinical research	Thieme	The clinical results of using removable appliances in children with posterior crossbite. The results indicate that removable appliances are effective, especially when there is good cooperation from the patient and their parents, who play a crucial role in the success of interceptive orthodontic treatment.
Genaro L; Zanqueta M (2021)(23)	Interceptive Orthodontic Treatment of Posterior Crossbite using Removable Appliance with Expander Vise	Case report	Biomedical Research	The use of removable appliances with expander laths for the treatment of posterior crossbite in children is presented, highlighting the importance of early diagnosis and treatment to facilitate the growth and proper development of occlusion.
Beltrami, F., Kiliaridis, S., & Antonarakis, G. S. (2024)(24)	Long-term stability of posterior crossbite correction, treated in the mixed or permanent dentition of growing children: A systematic review and meta-analysis. Doi: https://doi.org/10.1111/ocr.12690	A systematic review and meta-analysis	Orthodontics & craniofacial research	Removable appliances are effective for correcting posterior crossbite in growing children, but long-term stability remains a challenge. Appropriate retention protocols and early intervention are essential to improve the stability of results.

Source: Authorship.

3. Results and Discussion

Early treatment of posterior crossbite has been extensively studied, highlighting its importance in avoiding future orthodontic complications and improving the patient's quality of life. The literature reviewed provides a comprehensive overview of different clinical and orthodontic approaches, their results and the implications for professional practice.

Silva et al. (2021) highlight the need for an accurate diagnosis and careful planning of orthodontic and surgical treatment in pediatric patients. Their study shows that early and well-coordinated intervention can effectively correct posterior crossbite and prevent future skeletal maladjustments.

Mora-Pesántez and Ramos-Montiel (2022) presented cases where early treatment with interceptive appliances, such as the use of removable appliances, showed effective correction of posterior crossbite. This study supports the idea that removable expander appliances can be a viable option for the treatment of crossbite in the mixed dentition, but its long-term effectiveness depends to a large extent on an appropriate retention protocol and the individualization of treatment according to the specific needs of each patient.

Souza et al. (2021) investigated the effectiveness of removable appliances in children with crossbite and open bite. Their results indicate that these devices are an effective option in the mixed dentition phase, facilitating the proper growth of the upper jaw and the correction of malocclusion.

Solano (2023) evaluated the impact of interceptive appliances in the treatment of malocclusions including posterior crossbite in orthodontic patients at a university clinic. The results showed significant improvements in the Orthodontic Treatment Need Index (IOTN), demonstrating the effectiveness of these treatments in the early correction of malocclusions.

Taheri (2021) emphasizes the importance of a multidisciplinary approach in the treatment of patients with respiratory alterations, posterior crossbite and enamel alterations. Coordination between different specialties ensures comprehensive and effective treatment, addressing all facets of the problem.

Alsawaf et al. (2022) argues that removable appliances are an effective option for early correction of FPXB (functional unilateral posterior crossbite), although they have certain limitations compared to fixed appliances such as QH. The main advantage of FPXBs lies in their lower cost and ease of use, especially for young patients. However, the longer duration of treatment and the need for high patient cooperation are important disadvantages. Furthermore, although MEs are effective in expanding the jaw and correcting midline deviation, the success rate is lower and the risk of relapse is comparable to that of fixed appliances.

Beltrani et al. (2024) emphasize that removable plates are useful in correcting posterior crossbite, but their effectiveness and long-term stability are inferior to those of fixed appliances. The effectiveness of treatment with removable appliances depends on the choice of appliance, and must be based on a careful assessment of the patient's individual needs, taking into account factors such as cooperation, the severity of the malocclusion and the preferences of the patient and the orthodontist. Adequate follow-up and retention is crucial to ensure the long-term stability of treatment results. Removable appliances are an effective and versatile option for the early treatment of posterior crossbite in children. Its success depends largely on patient cooperation and appropriate case selection. The studies reviewed indicate that, although removable appliances may not be as effective as fixed appliances in all respects, they provide a less invasive and more comfortable solution for young patients.

It is important to continue researching and comparing results over the long term in order to optimize treatment strategies and improve the stability of the results obtained.

4. Conclusion and Considerations

Removable expander appliances are an effective and versatile option for the early treatment of posterior crossbite in children. The studies reviewed indicate that these devices are effective in correcting malocclusion, facilitating proper growth of the upper jaw and improving dental alignment. However, the effectiveness of this treatment depends not only on the device itself, but also on the cooperation and responsibility of the child and their parents or guardians. The choice of appliance should be based on a careful assessment of the patient's individual needs, taking into account factors such as cooperation, the severity of the malocclusion and the preferences of the patient and the orthodontist. An appropriate retention protocol is essential to ensure the long-term stability of the results obtained.

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