

Efficacy of orthopaedic and orthodontic treatment of anterior open bite in mixed dentition

Eficacia de los tratamientos ortopédicos y ortodónticos en mordida abierta anterior en dentición mixta

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ABSTRACT

Objective: To determine the efficacy of orthopaedic and orthodontic treatments in anterior open bite in mixed dentition. **Method:** A systematic review of the literature was conducted in three digital databases, PubMed, Scopus and Web of Science, based on the PRISMA criteria and answering the PIO question. Bias analysis was performed using the RoB2 tool. **Results:** Six non-randomised clinical trials potentially eligible for inclusion in this study were found that evaluated the effectiveness of orthopaedic and orthodontic treatments in mixed dentition. **Conclusion:** 85.83% of cases treated in mixed dentition with quad helix, palatal grid, bionator, high traction chin cup, rapid maxillary expansion combined with bite block proved to be effective with statistically significant changes. The results obtained should be interpreted with caution, as the subject matter is broad and requires further investigation.

Descriptors: open bite; treatment failure; orthodontics; myofunctional therapy (Source, DeCS).

RESUMEN

Objetivo: Determinar la eficacia de los tratamientos ortopédicos y ortodónticos en mordida abierta anterior en dentición mixta. **Método:** se realizó una revisión sistemática de la literatura en 3 bases digitales como son PubMed, Scopus y Web of science, basándose en los criterios PRISMA y dando respuesta a la pregunta PIO, el análisis de sesgo se realizó con la herramienta RoB2. **Resultados:** se obtuvo 6 ensayos clínicos no aleatorizados potencialmente incluíbles en la presente investigación que lograron evaluar la eficacia de los tratamientos ortopédicos y ortodónticos en dentición mixta. **Conclusión:** el 85.83% de los casos tratados en dentición mixta con quad hélix, rejilla palatina, bionator, mentonera High pull de alta tracción, expansión rápida del maxilar combinada con bite block, demostraron ser eficientes con cambios significativos estadísticamente, se recomienda tomar con cautela los resultados obtenidos ya que el tema abordado es amplio y requiere una investigación profunda.

Descriptores: mordida abierta; insuficiencia del tratamiento; ortodoncia correctiva; terapia miofuncional. (Fuente, DeCS).

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Original article



INTRODUCTION

Malocclusions represent a significant oral health problem worldwide. These alterations in occlusion are highly prevalent and affect a large proportion of the population, and are a frequent reason for orthodontic consultation. Among the most common malocclusions are crossbite, overbite and anterior open bite. The latter, characterised by its obvious clinical presentation, is easily identifiable by oral health professionals and constitutes between 25% and 38% of orthodontic cases (1).

To begin to address this subject, it is important to understand that anterior open bite refers to a malocclusion that alters the vertical plane, causing the upper incisors not to contact or not to fully contact the lower incisors. This definition, based on the one described by Carabelli from the middle of the last century, although quite accepted, is not unique, it varies according to the different authors, and since that time, Defoulon has noted that there are external and internal muscular influences in its development (2,3). Therefore, in an expected occlusion, the upper incisors should cover at least 2-3 mm of the antagonist incisors, which is visible to the clinician and the patient, and also causes them to seek immediate help and treatment (4).

The prevalence of malocclusion in the mixed dentition is 75% caused by several factors such as: partial eruption of the incisors, abnormal size of the lymphoid tissue, causing an inadequate position of the tongue, persistence of infantile swallowing and the presence of oral habits (5). Therefore, malocclusion can affect oral health, affect feeding, speech and the maintenance of good oral hygiene. Malocclusion can also influence appearance, decreasing self-confidence and self-esteem (6). It is a complex dental problem that can be triggered by a variety of circumstances, such as genetics due to facial growth pattern, environmental factors, sucking habits, tongue



protrusion, mouth breathing, adenoid hypertrophy, syndromes, occlusal and eruptive forces, dental ankylosis and mandibular postural imbalance.

Additional factors such as the time of initial treatment and the severity of the malocclusion may also contribute to its persistence, making correction more difficult to achieve over time (7). A study conducted in Mexico City by Ramirez and colleagues examined a group of children aged 3-6 years and found a prevalence of 38% (8). Another researcher, Wurgajt, studied a group of 67 patients of both sexes aged 5 to 19 years, determining a prevalence of 16.3% for anterior open bite, being more common in children aged 5 to 8 years (9).

On the other hand, Thilander points out that in younger patients, the percentage of anterior open bite is higher because the occlusion is still developing and adapting to the anatomical changes of the bone. Also, neurological maturation is occurring in children, which reduces parafunctional habits, although they may develop such habits over time. These habits may be related to systemic problems that improve with development, such as stabilisation of swallowing in adults and reduction in adenoid size. However, other problems such as allergic rhinitis and tonsillar hypertrophy do not improve with time (10). While in Bogotá, Colombia, a study was carried out to identify the percentage of open bite in children and adolescents aged 5-17 years. From a sample of 4724 patients, it was found that 9% presented this condition, being more frequent in the primary and mixed dentition in its first phase (10).

Based on the above, we know that anterior open bite causes changes that interfere with function and affect aesthetics, impacting a significant number of patients, especially in the primary and mixed dentition. It also has a high recurrence rate, so it is essential that clinicians are familiar with the orthopaedic and orthodontic treatment options for this condition. Despite the extensive literature on anterior open bite, interventions lack sound scientific support. In this regard, there is a need for



more research on this topic due to the variety of treatments available and to determine if there is a connection between open bite, breathing pattern, sleep disturbance and snoring, especially considering the critical systemic disorders that could be related.

Therefore, the aim of this systematic review was to evaluate the efficacy of orthopaedic and orthodontic treatments for anterior open bite in the mixed dentition.

METHOD

Protocol and registration

The following study was registered in the INPLASY system (International Platform for Registered Protocols for Systematic Reviews and Meta-Analyses) under registration number INPLASY2024100037 with its DOI 10.37766/inplasy2024.10.0037, and was conducted following the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) statement (11).

Selection of studies

The selection of the studies was based on the IOP question: "Are early treatments of anterior open bite in mixed dentition effective?"

Gathering information

In October 2024, the search for information began in the digital databases: PubMed, Scopus and Web of Science. The information was reviewed by two independent reviewers, including the assessment of bias. Boolean AND operators were used. The descriptors used were extracted from the health sciences (DeCS) descriptors: *open bite*, *treatment failure*, *corrective orthodontics*, *myofunctional therapy*; and from MeSH: *open bite*, *treatment failure*, *orthodontics*, *myofunctional therapy*. The



combinations used were: *open bite AND treatment failure, open bite AND myofunctional therapy, open bite AND orthodontics.*

Selection criteria

Inclusion criteria:

Non-randomised clinical trials, retrospective studies, systematic review articles and meta-analyses, articles in English and Spanish, with no time limit, that included a statistical significance value and a percentage value representing efficacy were included.

Exclusion criteria:

Randomised clinical trials, literature that did not include statistical significance (p) value and grey literature were excluded.

Therefore, data were collected on study design, treatment modalities, sample characteristics, measurement methods, success rate, open bite and divergence reduction, treatment duration, side effects, costs and stability.

Risk of bias

For data analysis, risk of bias assessment of articles from clinical trials was performed using the Cochrane clinical trials tool (RoB 2) (Table 2).

Conflict of interest

There was no conflict of interest between the researchers.

Search strategy

The preliminary search for information in the Digital Databases: PubMed, Scopus, Web of Science, showed a total of results of 2569 articles on anterior open bite, then duplicate documents were eliminated leaving 240 articles, the search continued with



the addition of the filter of non-randomised clinical trials to obtain the results and articles that have the value of statistical significance, As for the manual search, 18 articles were obtained, some of which were discarded because they did not quantitatively measure the efficacy of orthopaedic and orthodontic treatments, others that did not take mixed dentition into account, giving a final of 6 articles included.

RESULTS

The results were based on the 6 potentially important randomised clinical trials in the present investigation, taken from the 3 digital databases mentioned above, which took into account orthopaedic and orthodontic treatments used in the mixed dentition for the management of anterior open bite, significance, number of participants, patient age, duration of treatment and the outcomes mentioned by the authors which are described in the present table. Efficacy will be categorised by the percentage value given by the authors in their studies.

Table 1. *Treatment results in mixed dentition for open bite.*

Study	Participants	Age	Treatment	Duration	Results	Significance	Efficiency
(12)	n = 21	8.4 years	Quad-Helix	6 months	Improvement of the anterior open bite by 4.1 mm, 2 years after treatment.	Mann-Whitney U test (p<0.05).	85%
(13)	n = 41	7-10 years	Palatine grille	6 months	Improvement of the anterior open bite of 3.84 mm.	Kolmogorov-Smirnov test (p<0.05).	76%
(14)	n = 20	8.3 years	Bionator	18 months	Net overbite gain of 1.5 mm, with a total overbite of 2.7 mm.	Mann-Whitney U test (p<0.05).	85%
(15)	n = 19	9.7 years	High pull chin strap with high traction	12 months	Cephalometric analysis performed on a case group and a control group 15 months after treatment, with improvement of the overbite by 0.56 mm.	Student's t-test (p<0.05).	95%
(16)	n = 16	8.1 years	ERM and bite block	12 months	Evaluation 4 years after treatment in a case group and a control group, with improvement of the overbite by 1.8 mm and decrease in facial divergence (-2.8°).	Kolmogorov-Smirnov (p<0.05).	100%
(17)	n = 24	9.1 years	Bionator and combination	8-12 months	Improvement of the overbite by 2.2 mm and	(p<0,05).	74%



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Systematic review
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			with traction guard	high-chin		decrease in the cephalometric parameter of anterior facial height. Not recommended in hyperdivergent patients.		
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Elaboration: The authors.

Of the 6 articles analysed, 3 were case-control studies, among the treatments used to treat open bite were; Quad Helix, palatal grid, bionator, High pull high traction chin rest, rapid maxillary expansion combined with bite block, ages ranged from 7 to 9.7 years.

Of the 6 articles cited in the present investigation, the efficacy of orthopaedic treatments was evaluated with the measurement and improvement of the overbite in millimetres, and cephalometric values that were mentioned in the table. When talking about the improvement of the overbite, a trend of 2.03mm was obtained among all the studies mentioned.

To answer the IOP question posed in the research "Are early treatments of anterior open bite in mixed dentition effective?", a percentage improvement value of 85.83% was obtained, which were extracted from the percentage values given by the authors.

Table 2. *RoB2 risk of bias tool.*

		Bias in the randomisation process	Deviations from planned interventions	Missing data on results	Measuring the result	Selection of the reported result	General bias
Studio 1 (Cozza P.)		●	●	●	●	●	●
Studio 2 (Slaviero)		●	●	●	●	●	●
Study 3 (Defraia E.)		●	●	●	●	●	●
Study 4 (Carvalho Ferreira. F.)		●	●	●	●	●	●
Studio 5 (Mucedero. M)		●	●	●	●	●	●
Study 6 (Christopher S. Freeman.)		●	●	●	●	●	●

Legend: ● High risk of bias ● Unclear risk of bias ● Low risk of bias. **Elaboration:** Authors.



In the risk of bias assessment by the two reviewers, 90% of the articles had a low risk of bias, which represented five articles, and 10% of the articles had an unclear risk of bias. Articles with a high risk of bias were excluded prior to the bias assessment.

Management in the primary dentition

In the primary dentition, anterior open bite has been found to be associated with dentoalveolar problems in about 95% of cases. When this dental condition is a consequence of thumb sucking, mouth breathing and unusual swallowing habits, the treatment approach is mainly "aetiological". The health professional should motivate the patient to abandon these non-functional oral habits through positive incentives and reward strategies. Interceptive devices, when necessary, aim to correct the improper tongue position (18).

Orofacial myofunctional therapy

Orofacial myofunctional therapy consists of a series of exercises designed to re-educate the muscles of the face and mouth with regard to swallowing, speech and resting posture. The goal is to modify oral functions and eliminate non-nutritive sucking habits before the age of 6 years, thus creating a suitable environment for the eruption of permanent teeth (19).

Management in the mixed dentition

In the prepubertal growth period, children with prolonged sucking habits and excessive facial height are considered to be at risk of developing an anterior open bite (16). It has been shown that if this anterior open bite persists during pubertal growth of the skull and face, it rarely corrects spontaneously and may even worsen (20). Also, in individuals with a marked vertical skeletal imbalance, there appears to be an underlying craniofacial pattern from early stages that tends to continue or intensify.



Orthodontic treatment to correct open bite in the prepubertal growth stage generates debate in the specialised literature. Feres pointed out that spontaneous correction is more complicated and requires more time (21). It is also considered important to intervene in dysfunctional habits which, if eliminated early, can promote proper development of the masticatory system (16). Rosa and colleagues emphasised that most cases of anterior open bite have the potential to correct themselves during the prepubertal stage and recommended that active correction should not be undertaken during this period of development (22). In cases where active correction is suggested, orthodontic appliances are used to adjust vertical growth and manage tongue position and vertical eruption of molars in growing patients (25). Early treatment approaches in the mixed dentition include mainly functional appliances, bracket or fixed appliance techniques, extraoral appliances and bite blocks (23,24).

DISCUSSION

Open bite is a dental malocclusion that can cause oral and health problems such as difficulty chewing, speech problems, digestive problems, facial muscle pain, tendency to breathe through the mouth, facial aesthetic alterations and temporomandibular joint disorders. It is known that in the mixed dentition the incidence of open bite is higher due to habits acquired during childhood that may cease during growth (10). After more than 50 years of research, the extensive literature on early treatment of anterior open bite remains controversial and covers a wide variety of therapeutic approaches.

In this systematic review it was shown that 85.83% of orthopaedic and myofunctional treatments treated at an early age are effective, mainly those that treat oral breathing and parafunctional habits in infants. However, Van Dyck et al. mentioned that in their study there was no significant improvement when treating patients in mixed dentition with myofunctional therapy, joint and tongue muscle exercises (25). He agrees with Feres, who mentions that early correction is more difficult and takes longer, but it is



important to mention that in the 22 articles included in his study, he only considered subjects with mixed dentition and there was considerable variation in therapeutic approaches, due to poor quality or insufficient evidence, so he concludes that no consistent results were found (21).

Treatments such as myofunctional devices, the bite block, Frankel 4, tongue grid, spurs and the high traction harness in younger subjects are reported to be effective; however, these results should be taken with caution, as the studies showed important methodological limitations and did not reach a sufficient level of quality to draw conclusions, as they were not evaluated in untreated control groups. Phelan mentions that in his study they only reported an improvement of 75%, in contrast to the present investigation which was 87.5% (26).

Authors such as Slaverio, Canuto, Nascimento MHA and Cayley mentioned great occlusal, aesthetic and cephalometric improvements in the treatment of anterior open bite, but it should be stressed that all these studies were based on the treatment of parafunctional habits. However, if presented with a patient with a true skeletal anterior open bite, these treatments would actually be insufficient (13,27-30). Rosa mentions that no treatment should be performed to correct the minimal anterior open bite (1-3 mm) in the mixed dentition, as this may be transitional (31).

The correlation between open bite and respiratory disorders can be investigated together with otolaryngologists or other sleep professionals. In addition to cephalometric measurements, masticatory, swallowing and respiratory functions, maxillary and mandibular growth, as well as facial analysis should be assessed to check the validity of interventions (31). Despite all the results and inferences mentioned here, further research could still be conducted to confirm several assumptions. The authors encourage prospective, retrospective and case-control trials to investigate both the effectiveness and stability of orthopaedic treatments in



mixed dentition. Despite great variability and methodological inaccuracies, specific inferences and directions for future studies were presented.

CONCLUSION

Orthopaedic treatment of anterior open bite in mixed dentition proved to be efficient, mainly treating parafunctional habits. There are several studies that do not coincide with the present research as they mention that there is great variability and methodological inaccuracies in the research, and no articles were found that treated open bite with orthodontic appliances in mixed dentition.

In the present investigation 85.83% of the cases treated in mixed dentition with quad Helix, palatal grid, bionator, high pull high traction chin rest, rapid maxillary expansion combined with bite block proved to be efficient with statistically significant changes, according to the classification of the authors of the present investigation.

In the systematic reviews studied, it was mentioned that the treatment of choice in the mixed dentition in the first stage are appliances such as the lingual grid, Frankel IV, twin blocks, Simoes Network and Klammt. The same studies mentioned that in the permanent dentition, open bite can be treated if it is due to habit with fixed orthodontic therapy plus lingual educators, in addition to molar intrusion through mini-screws, anterior extrusion of incisors, extraction of premolars, or through control of the occlusal plane in the case of using philosophies such as the MEAW technique.

Despite all the results and inferences mentioned here, further research could still be conducted to confirm various assumptions, especially retrospective studies, prospective studies, randomised clinical trials and case-control groups, it is recommended to take the results obtained with caution as the topic addressed is broad and requires in-depth research.

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CONFLICT OF INTEREST

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Systematic
review

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