

EFFECTIVENESS AND MAGNITUDE OF SEQUENTIAL MOLAR DISTALIZATION WITH ALIGNERS: A SYSTEMATIC REVIEW

Eficacia y magnitud de distalización molar secuencial mediante alineadores: una revisión sistemática

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ABSTRACT

Introduction: Molar distalization has emerged in the last years as a viable alternative for treating mild to moderate sagittal discrepancies without extractions. Aligners enable this process through sequential movement with reported effectiveness. **Objective:** This systematic review aims to evaluate the effectiveness and magnitude of sequential molar distalization using aligners.

Material and Methods: A systematic literature search was conducted from January 2013 to July 2024 to identify potentially relevant English-language articles addressing the research question. Databases searched included *PubMed*, *EBSCO*, and *Scopus*. Two reviewers independently assessed the quality of included studies; discrepancies were resolved by a third reviewer. The ROBINS-I tool was used for risk of bias analysis in non-randomized intervention studies due to the characteristics of the included studies.

Results: Thirteen studies were included: eight retrospective, four prospective, and one finite element simulation. Four studies demonstrated high risk of bias, and nine moderate. Variability in the effectiveness of maxillary molar distalization was observed, ranging from 35.4 to 88.4%, with a magnitude between 0.91 and 2.7 mm.

Conclusions: Despite the methodological limitations, findings suggest that molar distalization with aligners is a viable treatment option for malocclusions, emphasizing the need for individualized treatment planning. Clinically, it underscores the importance of aligning treatment goals with individual characteristics.

Keywords: *Orthodontics; Malocclusions; Clear aligner appliances; Invisalign; Molar; Systematic review*

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RESUMEN

Introducción: Dentro de los últimos años la distalización molar ha surgido como una alternativa frecuente para el tratamiento de discrepancias sagitales leves a moderadas sin recurrir a exodoncias. La distalización con alineadores es una alternativa cada vez más popular entre los ortodoncistas por ser un movimiento secuencial, con aparentes buenos resultados. **Objetivo:** Fue establecer la efectividad y magnitud del movimiento de distalización molar secuencial mediante alineadores dentales, en base a la revisión de la literatura.

Material y métodos: Se realizó una búsqueda sistemática en la literatura médica producida entre enero de 2013 y julio de 2024 para identificar todos los artículos en inglés revisados por pares potencialmente relevantes para el objetivo de la pregunta de investigación. Se utilizaron las bases de datos de *PubMed*, *EBSCO* y *Scopus*. Dos revisores (D.A.V. y G.P.F.) evaluaron la calidad de los estudios incluidos y, si se observaba una falta de coherencia, el tercer autor (C.V.S.) llegaba a una conclusión. Los estudios incluidos al ser no aleatorios, se evaluaron mediante la herramienta ROBINS-I (Riesgo de sesgo en estudios no aleatorios).

Resultados: Se incluyeron trece estudios, ocho retrospectivos, cuatro prospectivos y un estudio de simulación de elementos finitos, los cuales utilizaron diferentes sistemas de alineadores. La evaluación del riesgo de sesgo reveló deficiencias metodológicas en todos los estudios, con cuatro que presentaron riesgo serio y nueve riesgo moderado. Los resultados destacaron la variabilidad en la efectividad de la distalización molar maxilar, que osciló entre un 35,4% y un 88,4%, y la magnitud de la distalización en milímetros, que varió de 0.91 mm a 2.7 mm.

Conclusiones: A pesar de las limitaciones, los hallazgos sugieren que la distalización molar con alineadores puede ser una opción viable en el tratamiento de maloclusiones, enfatizando la necesidad de enfoques personalizados. Las implicaciones prácticas subrayan la importancia de considerar cuidadosamente los objetivos de tratamiento y las características clínicas individuales.

Palabras clave: *Ortodoncia; Maloclusión; Alineadores ortodóncicos transparentes; Invisalign; Diente molar; Revisión sistemática.*

INTRODUCTION

With the increasing aesthetic demands of adult patients, orthodontic treatment has evolved through technological and aesthetics enhancements aimed at reducing the visibility of appliances. In recent years, orthodontists have noted a rise in adults seeking orthodontic care, with nearly 1.5 million adult patients recorded in the United States and Canada.¹

This shift has driven continuous innovation in orthodontic treatments in response to available technologies, striving to meet aesthetic needs. Manufacturers have thus developed systems to attract patients by minimizing appliance visibility, such as clear aligner systems.^{2,3}

Clear aligners can achieve various movements, including molar distalization, which has become a common alternative for managing mild to moderate sagittal discrepancies without extractions.¹ Alternatives for this movement include devices using extraoral force like low or high-pull headgear,² though these require substantial patient cooperation and are not aesthetically favorable.⁴

Intraoral devices such as the Herbst appliance, Jasper Jumper, repelling magnets, pendulum, Jones Jig, coil springs, and distalization appliances with temporary anchorage devices (TADs) have also been described.³ In the context of clear aligners, sequential distalization implies

moving one tooth at a time rather than mass movement. Ojima *et al.*,⁵ inferred from clinical observation that sequential distalization could maximize anterior anchorage.

Sujaritwanid *et al.*,⁶ found that this approach was the most efficient for controlled molar distalization, applying relatively low forces with minimal dentoalveolar side effects. The distalization protocol typically starts with upper second molars; once they are two-thirds distalized, the upper first molars are moved, followed by premolars, and finally mass retraction of the four incisors to complete the treatment plan. Other protocols may involve 50% distalization, as shown in Figure 1.⁷

Sequential molar distalization with aligners is increasingly popular among orthodontists due to its stepwise approach and reportedly positive outcomes. More narrative and systematic reviews are needed⁸⁻¹⁰ to thoroughly assess the efficacy and magnitude of sequential molar distalization protocols, in the upper jaw and especially in the lower jaw.

Hence, reviewing current evidence is essential to guide clinicians in assessing the feasibility of three-dimensional graphic representations of movement tables. This systematic review aims to evaluate, in patients with malocclusions and permanent dentition, the effectiveness and magnitude of sequential molar distalization using clear aligners based on the available scientific literature.

MATERIALS AND METHODS

A systematic review was conducted based on the scientific literature published from January 2013 to July 2024 to address the clinical question: What is the effectiveness and magnitude of upper and/or lower molar distalization with aligners in patients with permanent dentition?

Eligibility criteria

Included studies involved individuals with permanent dentition, treated with aligners or simulated maxillary models where upper and/or lower molar distalization was performed. Eligible studies were original, prospective or retrospective, involving human subjects. Finite element simulation studies were included if they provided clear descriptions of materials and techniques and had appropriate statistical analysis. The eligibility criteria applied to the obtained studies are described in Table 1.

Search strategy

The search was conducted in July 2024 using the PICO framework:

P: Patients with permanent dentition.

I: Intervention molar distalization using aligners.

C: Comparison with systems other than aligners.

O: Outcome molar distalization in millimeters and/or effectiveness percentage.

Three different search engines and databases were used for this search. The first search was conducted in the open-access database PubMed® (<https://pubmed.ncbi.nlm.nih.gov/>), which contains the contents of the U.S. National Library of Medicine, MEDLINE. Another bibliographic citation and reference database consulted was Scopus, owned by ELSEVIER.

Finally, the scientific information database EBSCO host (<https://www.ebsco.com/>), owned by EBSCO Industries, was used. The search algorithm in Table 2.

Study selection process

The search was conducted independently by two reviewers (D.A.V. and G.P.F.), who then reviewed the retrieved articles to apply the eligibility criteria. In case of disagreements, a third reviewer (C.V.S.) was consulted to

resolve the differences. Therefore, each article was evaluated at least once. For this process, the automated tool Rayyan,¹¹ Intelligent Systematic Review, and the reference management software Mendeley,¹² were used.

After removing duplicate articles, the remaining records were initially screened independently by title and abstract to apply the eligibility criteria. Once this initial step was completed, blinding was lifted to compare results and reach a consensus. For the articles that had already been agreed upon, the full text was then retrieved to apply eligibility criteria that could not be assessed due to insufficient information in the abstract. The primary variable to be determined at this stage was the "outcome" measured in millimeters and/or the percentage effectiveness of molar distalization achieved by aligners.

To assess the risk of bias, the "Risk of Bias in Non-Randomized Studies of Interventions" (ROBINS-I) tool was applied for the evaluation of observational studies, non-randomized clinical trials and in silico finite element simulation studies.¹³

Biases of "confounding", "participant selection", "intervention classification", "deviations from planned interventions", "lack of data", "outcome measurement" and "selection of reported outcome" were evaluated. Triangulation was performed, where each reviewer independently evaluated the studies, and if consensus was not reached, a third reviewer defined them.

The protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under registration N° 1051259.

RESULTS

Study selection

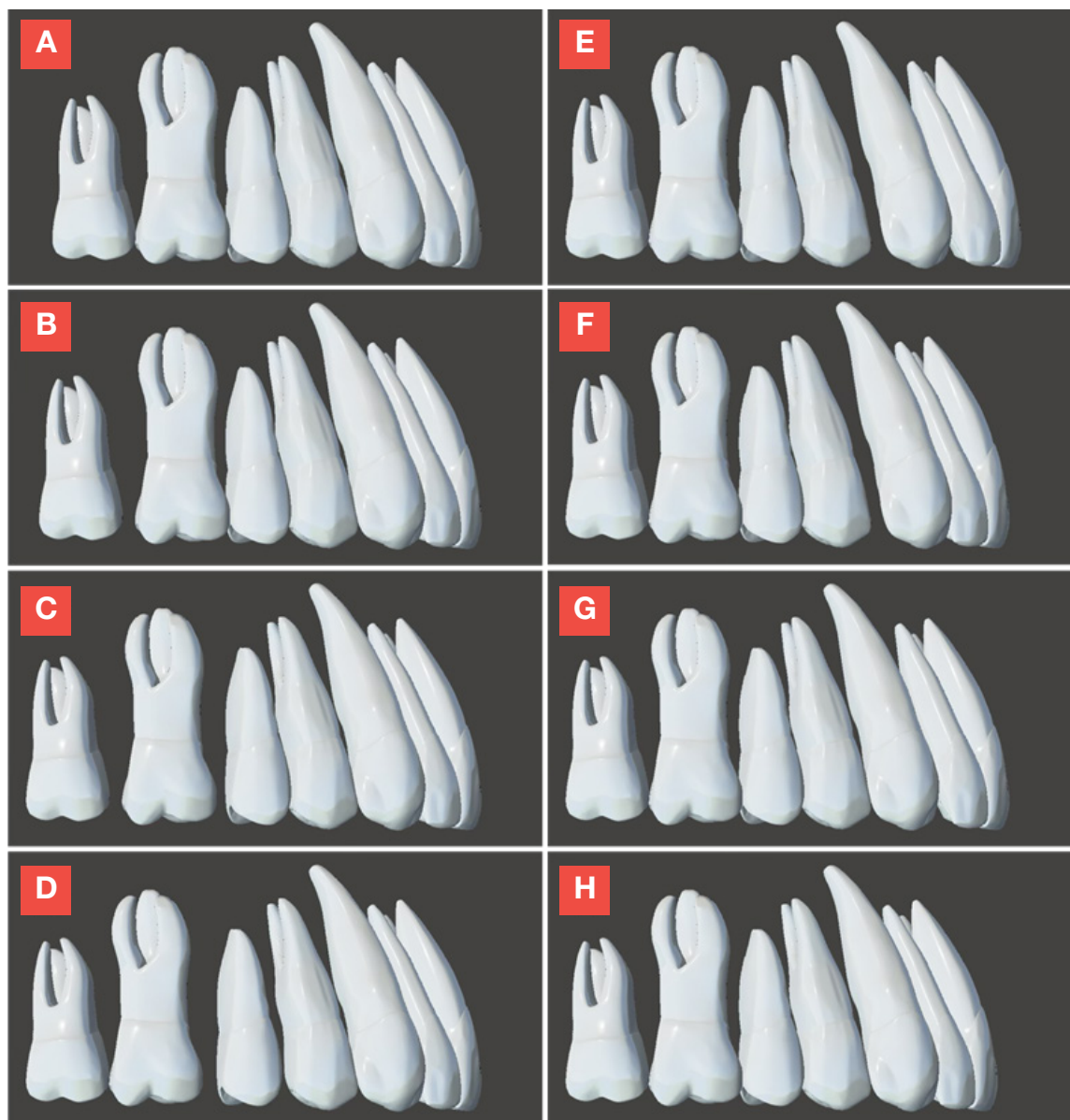
A total of 1,069 articles were identified across PubMed (410), EBSCOhost (146), and Scopus (513). After removing 204 duplicates (Figure 2), 694 articles were excluded based on titles and abstracts as they were irrelevant to the research topic. A total of 70 studies were identified, of which only 65 could be retrieved and assessed in full text according to the eligibility criteria. Ultimately, 13 articles were included in this review.⁴⁻¹³

Characteristics of selected studies

Thirteen relevant publications were identified, eight of which were retrospective observational studies, two prospective observational studies, two prospective randomized studies, and one finite element simulation study. The sample size in the individual studies ranged from 7 to 49 patients, with a total of 285 patients evaluated in all the selected studies and one finite element simulation maxillary model. The age at initiation of aligner treatment in the evaluated samples ranged from 13 to 72 years. The characteristics of the included studies are summarized in Table 3.

Regarding the country of origin of the research team, four articles were published in Italy,^{7,14-16} four in China,^{4,17-19} and one each from Taiwan,²⁰ Germany,² Canada,²² Turkey,²³ and Thailand.²⁴ Different study groups were recorded in the selected articles, both in terms of authors and universities, endorsed by orthodontic departments or a university ethics committee. Only one study did not mention university affiliation, and its patients came from private practice.¹⁶ Nine studies applied their distalization mechanics using the Invisalign® aligner system,^{4,7,15,16,18-21,24} one using Ordoline® Aligners,¹⁹ one using Orthero Clear Aligner®,²³ and one not stated.¹⁷

Figure 1. The distalization protocol.



A. Initial situation.

B. 50% of the planned movement of the maxillary second molar has been achieved in the sequential distalization protocol with aligners.

C. The maxillary first molar has achieved 50% of the planned movement, while the maxillary second molar has achieved 100% of the planned movement.

D AND E. The maxillary first molar has achieved 100% of the planned movement and individual movement begins in the same manner for the maxillary premolars.

F. The distalization movement of the maxillary canine begins.

G. The group movement of the maxillary incisors begins once 50% of the planned distalization of the maxillary canine has been achieved.

H. The sequential distalization movement ends. The 3D file modeling and editing process was performed using Meshmixer, a free tool from Autodesk, Inc. Tooth modeling courtesy of Dr. Milivoj Sherrington Puratic.

Figure 1. Selection of articles according to the PRISMA flowchart (Preferred Reporting Items for Systematic reviews and Meta-Analyses).

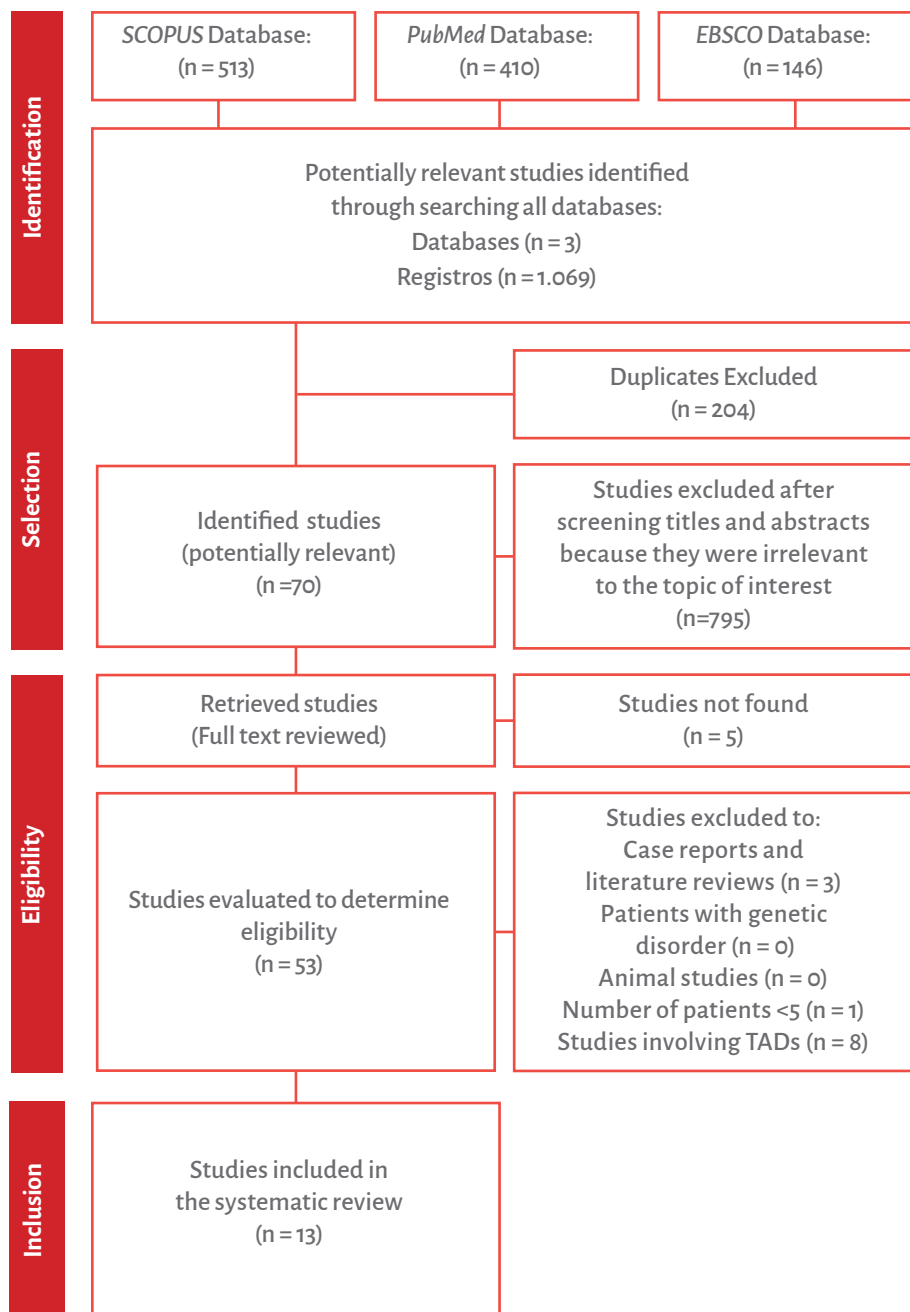


Figure 3. Summary of the risk of bias of non-randomized outcomes for each of the assessed studies, using the ROBINS-1 tool¹³

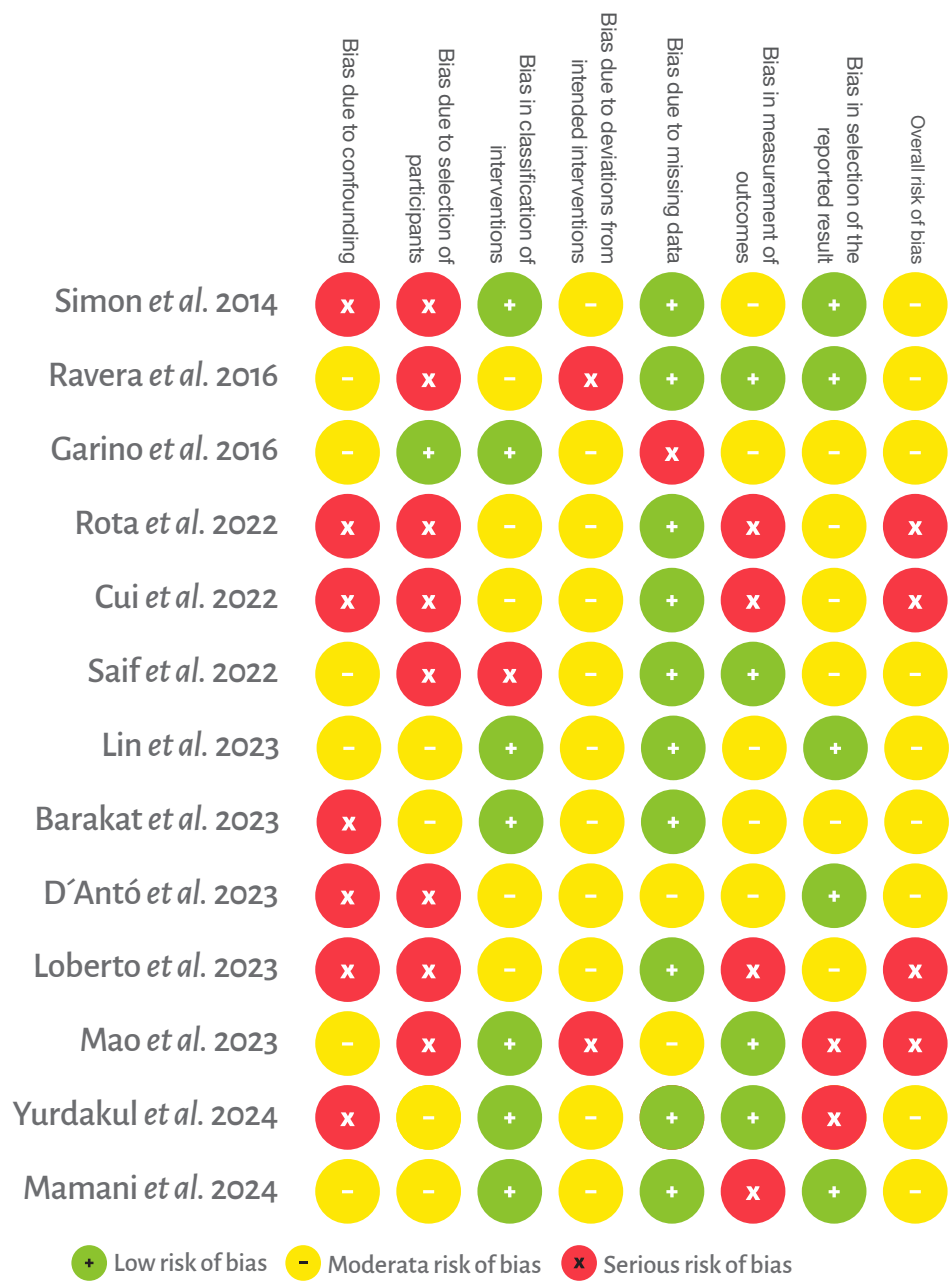


Figure 4. Summary of risk of bias in non-randomized intervention studies using the ROBINS-I tool.¹³

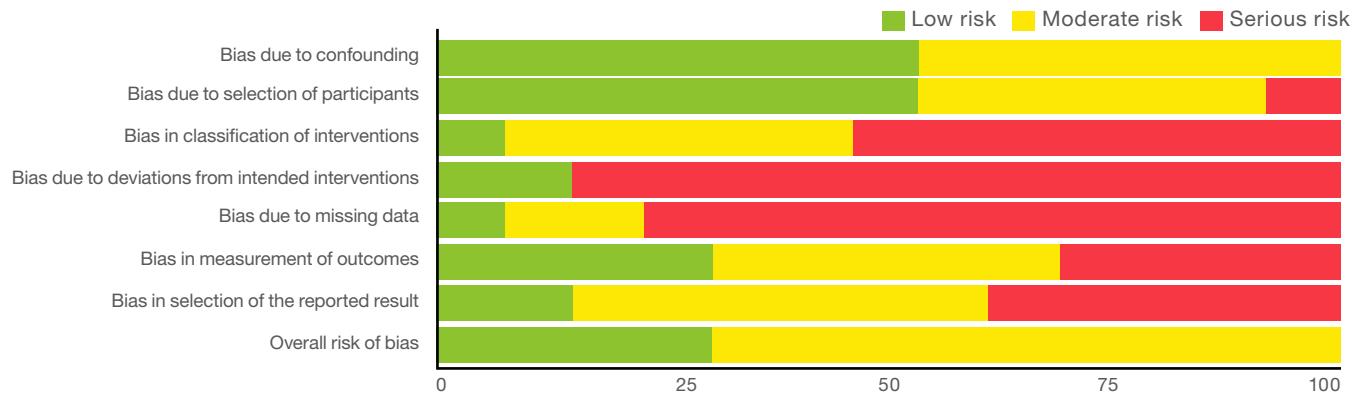


Table 1.
Eligibility criteria applied to studies obtained.

Eligibility criteria
•Studies involving patients with genetic syndromes, severe craniofacial anomalies, and/or malformations. •Studies employing surgical orthodontic techniques, case reports, reviews, abstracts, author commentaries, summarized articles, and studies with fewer than five patients. •Animal studies or simulations. •Studies involving the use of Temporary Anchorage Devices (TADs). •Studies that do not report outcomes measuring the effectiveness of molar distalization and/or molar distalization in millimeters. •Publications in languages other than English.

Table 2.
Search algorithm applied to the metasearch engines PubMed®, Scopus and EBSCOhost

("aligner" OR "aligners" OR "thermoformed splints" OR "invisible orthodontics" OR "Invisalign") AND ("molar distalization" OR "sequential distalization").
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Among studies reporting protocols, five detailed their sequential distalization approach: three applied a 50% protocol,^{7,14,15} one applied a two-thirds protocol,¹⁶ and one used 33% and 50% in separate groups.²³ The remaining studies did not report a specific distalization protocol. Finally, regarding the attachments or auxiliary elements used in the sequential distalization protocols of the studies, eleven incorporated the use of attachments^{4,7,14-16,18,20-24} and eight incorporated the use of intermaxillary elastics.^{4,14,17,18,20,22-24}

Individual study results

Molar distalization was assessed in two ways:

- Effectiveness evaluation by comparing the relative percentage of simulated molar distalization and that actually achieved by patients.^{14,17,18,20,21,24}
- Molar distalization achieved in millimeters.^{4,7,15,19,22-24}

Effectiveness assessment

The effectiveness of maxillary molar distalization ranged from 63.4% to 87%.^{14,17,18,21} Two studies reported effectiveness below 50%, ranging from 31% to 41%.^{20,24}

Achieved molar distalization

In terms of distalization measured in millimeters, maxillary molar distalization ranged from 1.71 mm (measured from the crown center) to 2.54 mm.^{4,7,16,19,23,24} Finally, regarding mandibular molar distalization, only one study reported an average distalization of 2.47 mm.¹⁵

Risk of bias in individual studies

All studies showed methodological limitations. According to the ROBINS-I tool, four non-randomized studies, including one finite element simulation, showed serious bias risk.^{7,15,17,18} The remaining nine showed moderate risk.^{4,14,16,19-24} Details of the risk of bias assessment are shown in Figure 3 and Figure 4.

Table 3. Main characteristics of each article included in the review.

Author, Year	Study Design	Population	Intervention	Comparison	Effectiveness
Cui <i>et al.</i> ¹⁷ 2022.	Retrospective observational.	n=18 patients. Average age 27.8 ± 5.38; in a range of 18 to 38 years.	Quantitative cephalometric measurement in CBCT.	Pre (T0) and Post (T1) treatment with aligners.	Translational movement without significant tipping in the maxillary first and second molars. Effectiveness was 83.44% for the first molar and 85.14% for the second molar ($p<0.005$).
Loberito <i>et al.</i> ⁷ 2023.	Retrospective observational.	n=49 patients. 27 female y 22 male. Average age 14.9 ± 6 years.	Quantitative measurement in intraoral scan (STL files) and Clincheck® predictive model.	Pre-treatment (T1) at the end of the distalization of the first maxillary molars (T2) with Invisalign® aligners.	
Rota <i>et al.</i> ¹⁵ 2022.	Retrospective observational.	n=16 patients. 8 male y 8 female. Average age 25.6 years.	Quantitative measurements in cephalograms.	Pre-treatment (T0) and at the end of treatment (T1) with Invisalign® aligners	
Ravera <i>et al.</i> ¹⁶ 2016.	Retrospective observational.	n=20 patients without growth. Average age 29.73 ± 6.89 years.	Quantitative measurements in cephalograms.	Pre (T1) and Post (T2) treatment with Invisalign® aligners.	
Simon <i>et al.</i> ²¹ 2014.	Retrospective observational.	n=30 patients. 11 male y 19 female, between 13 y 72 years. Average age 32.9 ± 16.3 years.	Quantitative measurement of digitalized model.	Pre and Post Treatment with Invisalign® aligners, the latter compared with the prediction provided by Clincheck®.	With attachment, an average effectiveness of 88.4% $p=0.38$. Without attachment, an average effectiveness of 86.9% $p=0.46$.
Al-Tayar <i>et al.</i> ⁴ 2023.	Retrospective observational.	n=23 CBCT 3D images of patients who were not growing. 7 male y 16 female. Average age 29.8 ± 4.6 years.	Quantitative measurement in CBCT.	Pre (T0) and Post (T1) treatment with Invisalign® aligners.	
Lin <i>et al.</i> ²⁰ 2023.	Retrospective observational.	n=7 CBCT 3D images of patients who were not growing.	Quantitative measurement in CBCT.	Pre (T1) and Post (T2) treatment with Invisalign® aligners the latter compared with the prediction provided by Clincheck®.	Distalization effectiveness of 46.7%, which was significantly lower than virtual planning $p<0.05$.
D'Antò <i>et al.</i> ¹⁴ 2023.	Prospective observational.	n=16 patients. 4 male y 12 female. Average age 25.7 ± 8.8 years.	Quantitative measurement in intraoral scan (STL files) and predictive model.	Pre (T0), Post (T2) treatment and the end of the first set of aligners planned virtually (T1) with Ordoline® Aligner aligners. In Geomagic Control X® software.	Distal shifting of buccal cusps had an overall effectiveness of 69% for the first molar and 75% for the second molar. $p>0.05$ between the maxillary first and second molar groups.

Table 1 continues on the next page →

Author, Year	Study Design	Population	Intervention	Comparison	Effectiveness
Saifi <i>et al.</i> ¹⁹ 2022.	Prospective observational.	n=38 patients. 4 male and 34 female. Average age 25.4 years.	Quantitative measurement in intraoral scan (STL files) and Clincheck® predictive model.	Clinchek® predictive model and final distalization of maxillary first and second molars with Invisalign® aligners.	
Mao <i>et al.</i> ¹⁷ 2023.	Experimental (In Silico simulation).	Simulation of 1 maxillary model.	Finite element simulation of twenty steps of distalization of maxillary first and second molars.	The percentage of distalization efficiency of the second molar was compared at 0-0.5 mm, 0.5-1 mm, 1-1.5 mm, 1.5-2 mm.	The effectiveness of simulated distalization was: 0-0.5 mm. 63.45% 0.5-1 mm 71.83%, 1-1.5 mm, 69.65% and 1.5-2 mm 67.21%.
Mamani <i>et al.</i> ²⁴ 2024.	Retrospective observational.	n=14 patients 4 male and 10 female. Average age 33.61 ± 8.57 years.	Quantitative measurements in cephalograms.	Invisalign® aligners Pre- and post-treatment cephalograms were compared, the latter compared with the prediction provided by Clincheck®. For this purpose, the displacement of the first and second maxillary molars was measured.	The percentage of actual distal translation relative to planned movement was 40.11% for maxillary first molars ($p \leq 0.05$) and 35.39% for maxillary second molars ($p \leq 0.05$).
Yurdakul <i>et al.</i> ²³ 2024 .	Randomized clinical trial.	n=24 patients. 16 female and 8 male. Distributed in two groups the average of group 1 and 2 was 22.9±0.7 years, 25.83± 0.5 years respectively.	Random distribution into 2 groups (Group 1 distalization protocol at 33% and Group 2 at 50%) with subsequent quantitative measurement of digital maxillary models and cephalograms.	Cephalograms and digital models of Pre (T0) and Post Treatment (T1) were compared with the Ortho Clear Aligner® aligner system.	

Five of the thirteen selected studies showed a risk of bias in the D1 and D2 domains. It is not clear in these studies that for D1 there is no other factor or variable (age, characteristics of the dentoalveolar process, root length, among others) that previously influenced the magnitude of molar distalization, and the participants were probably selected by convenience,

which affects D2.

DISCUSSION

General interpretation of results and effectiveness of distalization

The results of the systematic review express that molar distalization, mainly of maxillary molars, using systems such as Invisalign® and Ordoline®, show some variability in effectiveness and suggest that, in general,

molar distalization with aligners is possible and, in most cases, successful. On the other hand, conflicting results were found in the study by Lin *et al.*,²⁰ who reported only 46.7% effectiveness, but in a quite small sample (less than 10 patients), as well as Mamani who reported an even lower result of 35.4%.²⁴

However, it is crucial to highlight that this effectiveness may depend on several factors, such as the specific treatment protocol and the clinical characteristics of the patients. Proof of this is that in the study that shows the greatest effectiveness, Simon *et al.*,²¹ presents great variability in the age of their sample. These results are in line with previous work such as the systematic review by Rossini *et al.*,²⁵ who concluded an effectiveness of 88% in molar distalization.

However, most studies reviewed were non-randomized and retrospective, which weakens the overall evidence due to potential bias and lack of internal validity.²⁶ There was also significant variability in treatment protocols and study populations, further limiting generalizability of the results. The included studies did not include any control group or where it was compared with another form of molar distalization, they only focus on the pre and post intervention comparison of distalization with aligners, two of them based on studies in CBCT.⁴

As mentioned above, eleven studies included attachments,^{4,7,14-17,20-24} which can enhance movement predictability,²⁷ although their positioning and design were not consistently described. Eight studies,^{4,14,17-19,22-24} reported using intermaxillary elastics to prevent uncontrolled anterior tipping and reinforce anchorage.²⁸

Simon *et al.*,²¹ did not use elastics, but an-

chorage loss was not measured. Saif *et al.*,¹⁹ did not use elastics either and concluded that there was a loss of anchorage, with the incisor group being the most affected with an uncontrolled pro-inclination movement, which is in accordance with the above.

Magnitude of distalization

This systematic review demonstrates that molar distalization using aligners, with a quantitative focus on millimetric measurement, yields variable results regarding the magnitude of movement. The included studies reported maxillary molar distalization ranging from 0.91 mm to 2.7mm.^{4,7,14-18,21-24}

This range of outcomes highlights the potential of achieving clinically meaningful tooth movement with aligners in the treatment of malocclusions—particularly in Class II malocclusions requiring the correction of mild dentoalveolar discrepancies.^{1,20}

Although various distalization protocols were applied, results were broadly similar. For example, those studies that used the 50% sequential distalization protocol^{7,15} obtained a distalization of 2.47 to 2.5 mm, versus two-thirds distalization¹⁶ that obtained a distalization of 2.25 mm. This agrees with previous systematic reviews.^{8,25}

Limitations of the included evidence

In the context of distalization measured in millimeters, the limitations of the reviewed studies include the lack of standardization in measurement protocols, indicating a moderate risk of bias,^{4,14,20-22} except for four studies,^{7,15,17,24} which exhibited a serious risk of bias.

Additionally, the heterogeneity in measurement methods may affect the comparability of results across studies. Notable

methods include measurements on cephalograms, digitized models derived from plaster casts, images imported via CBCT, and quantitative measurements from intraoral scans where predictive and achieved 3D models were compared.

Furthermore, most studies focused on maxillary molar distalization, with limited data on mandibular distalization.¹⁶ This leaves open questions about the effectiveness and jaw-specific considerations of using aligners for distalization, reflecting the more common clinical use of maxillary molar distalization for Class II compensation.

Limitations of the evidence from studies included in the review

A key limitation of the evidence is the predominance of non-randomized, retrospective studies. These study designs have a higher risk of bias and may not provide as robust a level of evidence as randomized clinical trials.^{13,26}

Furthermore, variability in treatment protocols and lack of standardization in outcome measurements could introduce bias and make direct comparisons across studies difficult. Another notable limitation is the diversity of the study populations, which could affect the applicability of the results to different patient groups.

The varied age of the participants and the lack of detailed information on baseline clinical characteristics could influence the interpretation of the effectiveness of molar distalization in specific contexts.

Limitations of the review process

Bias risk in non-randomized intervention studies was assessed using the ROBINS-I tool.¹³ While widely accepted, it involves subjective interpretation, which may affect the evidence synthesis. Discrepancies in risk of bias classification between studies could

be a challenge, even with the intervention of a third reviewer. Selection bias may also have occurred during study inclusion, and limiting to English-language studies could have excluded relevant research.

Implications of the results for practice, policy, and future research.

The results suggest that molar distalization with aligners may be a viable option for orthodontic treatment; however, given the variability in effectiveness and the limitations of the evidence, caution is warranted when applying these results to clinical practice. The choice of this approach should carefully consider patient characteristics and follow specific protocols to improve treatment predictability.

To date, the present review does not provide conclusive evidence regarding the differences in distalization protocols. From a health policy perspective, the current evidence would support the inclusion of molar distalization with aligners as an option within orthodontic treatment options.

However, further research, especially randomized controlled clinical trials, is needed to strengthen the evidence base and allow for more robust recommendations.

In terms of future research, one could focus on standardizing treatment protocols, conducting prospective studies with appropriate control groups, and more comprehensively evaluating long-term outcomes.

Furthermore, research could explore specific factors that influence the effectiveness of molar distalization with aligners, such as patient age, severity of malocclusion, and patient cooperation. It is also suggested that research be conducted that focuses on the study of mandibular molar distalization.

Conclusions

This systematic review provides a comprehensive analysis of molar distalization using orthodontic aligners, evaluating both the magnitude (in millimeters) and effectiveness (percentage). Sequential molar distalization in permanent dentition was shown to be effective, with outcomes ranging from 35.4% to 88.4% and magnitudes from 0.91 mm to 2.7 mm.

The heterogeneity of the results found reinforces the need to consider individualized approaches when planning aligner-based treatment for molar distalization. The findings of the included studies should be interpreted considering the moderate to high

risk of bias identified in their assessment. Furthermore, the studies demonstrated low methodological quality due to a lack of standardization in measurement protocols and the disproportionate focus on maxillary molar distalization. Despite these limitations, the results indicate that sequential molar distalization with orthodontic aligners may be a viable option for the treatment of malocclusions.

CONFLICT OF INTERESTS

The authors declare that they have no conflicts of interest.

ETHICS APPROVAL

Does not apply.

FUNDING

Does not apply.

AUTHORS' CONTRIBUTIONS

Daniel Arraya Valdés: Conceptualization, data curation, investigation, drafting of the original manuscript, and review and editing of the final version.

Gabriel Palavecino Fernández: Conceptualization, data curation, investigation, drafting of the original manuscript, and review and editing.

Carolina Vergara Santoro: Conceptualization, investigation, drafting of the original manuscript, and review and editing.

Jorge Godoy Olave: Data curation, project administration, supervision, and review and editing of the manuscript.

Patricio Rojas Bustos: Formal analysis, methodology, project administration, supervision, and review and editing.

María San Juan Zamora: Formal analysis, project administration, supervision, validation, and review and editing of the manuscript.

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PEER REVIEW

This manuscript was evaluated by the editors of the journal and reviewed by at least two peers in a double-blind process.

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