



Stability of dental position post-orthodontics with the use of thermoplastic retainers vs fixed retainers. Systematic review

Estabilidad de posición dental post ortodoncia con el uso de retenedores termoplásticos vs retenedores fijos. Revisión sistemática

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ABSTRACT

Objective: to establish the best retainer for maintaining orthodontic post-treatment results. based on this information. **Method:** PRISMA systematic review. 23 articles were processed, the PICO question was applied. **Results and conclusion:** Fixed retainers: They are effective, especially those placed from 13-23, as they show fewer changes in stability parameters compared to those from 12-22. However, both are effective if good adhesion to the lingual surfaces of the teeth is ensured. Vacuum-formed retainers (VFR) are also an excellent option, but their effectiveness depends on patient compliance in their regular use. Lack of use can lead to relapse.

Descriptors: orthodontics; orthodontics corrective; orthodontic appliances; orthodontic appliances fixed. (Source, DeCS).

RESUMEN

Objetivo: establecer cuál es el mejor retenedor para mantener los resultados postratamiento de ortodoncia. a partir de esta información. **Método:** Revisión sistemática PRISMA. Se procesaron 23 artículos, se aplicó la pregunta PICO. **Resultados y conclusión:** Retenedores fijos: Son eficaces, especialmente aquellos colocados de 13-23, ya que muestran menores cambios en los parámetros de estabilidad en comparación con los de 12-22. Sin embargo, ambos son efectivos si se asegura una buena adherencia en las caras linguales de los dientes. Retenedores removibles al vacío (VFR): También son una excelente opción, pero su eficacia depende del cumplimiento del paciente en su uso regular. La falta de uso puede llevar a recidiva.

Descriptores: ortodoncia; ortodoncia correctiva; aparatos ortodóncicos; aparatos ortodóncicos fijos. (Fuente, DeCS).

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Original short



INTRODUCTION

Orthodontic treatment aims to improve aesthetics, function and maintain long-term stability of the teeth. This last parameter represents a major challenge for the orthodontist, which can be addressed by the placement of fixed retainers or the use of removable retainers (1-8). If the fixed appliance is not properly retained after removal, this can lead to a relapse of the results, i.e. the teeth tend to return to their pre-treatment position.

This phenomenon can be caused by tension of the periodontal tissue fibres, natural tooth movement, ageing, occlusion and pressure exerted by soft tissues such as the tongue and lips (1,5-12). Relapse is not predictable; about 70% of patients who have had any orthodontic treatment may present alterations in tooth position after some years (5). Therefore, retention must be continued after the use of fixed appliances to obtain good future results (7,11,13).

Already in the 19th century, it was proposed that retention procedures were necessary to maintain treatment results. It was mentioned that teeth "could only be retained in the new position by the constant use of appliances" (14,15). In 1908, a removable retainer for the upper jaw, made of platinum and gold, was suggested. In 1914, the Hawley retainer appeared, initially made of vulcanite, which is still in use today, but with other materials such as acrylic and wire. In 1950, vacuum-formed retainers (VFR), transparent thermoplastics, were developed in a dental vacuum prior to obtaining the patient's plaster model. Subsequently, bonded fixed retainers appeared, hand in hand with the advent of adhesive systems (10,15).

Fixed retainers are placed on the lingual surfaces of the teeth, have good aesthetics as they are not visible on the vestibular surfaces and ensure retention because they



do not depend on the patient's cooperation. However, they have some disadvantages, such as the detachment of the retainer, tartar accumulation that can affect periodontal health, and limitation of functional tooth movement (1,2,5,6,9). Removable retainers are also effective in maintaining dental stability; however, their effectiveness depends on patient compliance (6,9,16).

Post orthodontic stability can be assessed by the following parameters: Little's Irregularity Index (LII), which analyses the movement of the horizontal contact points of six anterior teeth (12); the arch length, which is measured from the attachment point of the central incisors to the mesial attachment point of the right and left first permanent molar, respectively; the intercanine width, which is measured across the cusps of the canines; the intercanine width, which is measured across the mesiovestibular cusps of the first permanent molars, and the intercanine width, which is measured across the mesiovestibular cusps of the first permanent molars; the intermolar width, which is measured at the level of the mesiovestibular cusps of the left and right first permanent molars; the overjet, which corresponds to the space between the vestibular face of the lower incisor and the incisal edge of the upper incisor; and the overbite, which refers to the overbite between the maxillary incisors and the mandible (7-9).

Given the great need to maintain the results obtained in orthodontic treatment, it was decided to carry out a systematic review with the aim of establishing which is the best retainer for maintaining post-treatment orthodontic results.

METHOD

This review was carried out according to the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) statement (17) and was registered with INPLASY under registration number INPLASY202490010. The aim



of the study was to establish the best retainer for maintaining orthodontic post-treatment results.

The selection of the studies was based on the PICO question: "Which retainer maintains stability of tooth position after orthodontic treatment?"

In May 2023, the search for information began in the digital databases PubMed, Scopus and LILACS. The Boolean operator AND was used. The *Mesh Terms* used were: *orthodontic*, *orthodontic retainers*, *orthodontic appliances*, *fixed*. The keywords used were: orthodontics, orthodontic retainers, orthodontic appliances, fixed.

In order to select the articles, the first step was to read the title and abstract of each article found. In the studies that matched the search criteria, the full text was read. Only randomised clinical trial articles were included, in English and Spanish, which analysed the stability of teeth after orthodontic treatment with the use of removable (thermoplastic) retainers and fixed retainers in the last 5 years. Systematic reviews, meta-analyses and case reports were excluded. For the selection, collection and cleaning of the data, a data table was created in Excel.

The variables analysed in the studies were: irregularity index, overbite, overjet, arch length, intermolar width and intercanine width, in bonded fixed retainers and vacuum removable retainers. For data analysis, *risk-of-bias* assessment of the articles was performed using *Version 2 of the Cochrane Risk-of-Bias Tool for Randomised Trials* (RoB 2) (18,19) for randomised clinical trials.

RESULTS

Figure 1 shows the flow diagram of the information obtained through the different phases of a systematic review (PRISMA) (17). The preliminary search for information in the digital databases PubMed, Scopus and LILACS showed a total of 2146

articles. Then, a filter was applied to identify articles from the last 5 years in order to obtain more up-to-date information, obtaining 1076 articles.

The search was continued by adding the randomised clinical trials filter, obtaining a total of 218. After reading the title and abstract in relation to the research topic, 17 articles were selected. Subsequently, the articles were read in full and only 8 met the inclusion criteria, of which 4 were duplicates. As a result, 4 articles were obtained with a total of 388 participants in the selected studies.

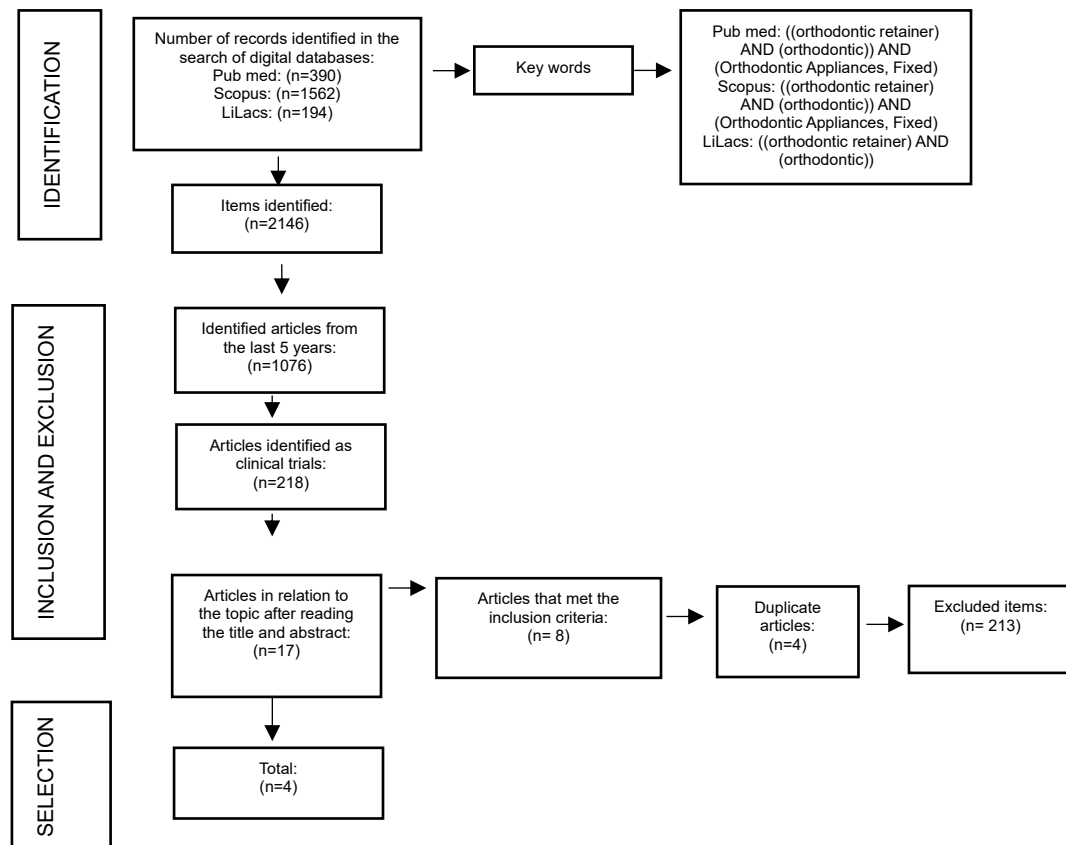


Figure 1. *PRISMA search strategy schematic flow diagram*
Elaboration: The authors.



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The investigators of the different studies evaluated the variables by obtaining plaster models that were digitised, which were performed at different time periods: at completion, at 6, 12, 12, 18 and 24 months, and 5 years after removal of orthodontic treatment (2,3,11,16). One study evaluated treatment stability 1 year after removal of the retention appliances (9). Table 1 describes the results of the studies evaluated (2,3,8,11).

Table 1. *Characteristics of the studies included in the systematic review.*

Author	Year	Evaluation time	Sample	Age	Type of retainer assessed	Evaluation Site	Conclusions
Krämer et al.	2020	6 and 18 months after the removal of orthodontic treatment	104	17.1 years	Fixed (13-23), VFR	Max Sup., Max Inf.	VFR and 13-23 fixed retainers have the same retention capacity in the mandible at 6 and 18 months.
Naraghi et al.	2021	2 years after orthodontic treatment	90	13.9 years	Fixed (13-23), Fixed (12-22), VFR	Max Sup., Max Inf.	All 3 retention methods showed effective retention capacity and all changes were small and clinically insignificant.
Naraghi et al.	2023	1 year after withholding is removed	90	(-)	Fixed (13-23), Fixed (12-22), VFR	Max Sup., Max Inf.	The changes were clinically insignificant during and after the retention period. Therefore, all three methods showed equal retention capacity.
Krämer et al.	2023	5 years after orthodontic removal	104	(-)	Fixed (14-24), VFR	Max Sup., Max Inf.	Post-treatment changes in both jaws were small. The anterior alignment in the mandible was more stable with a bonded CTC retainer compared to a removable VFR after 5 years of retention.

Elaboration: The authors.

Post-treatment orthodontic retention stability was evaluated in 104 adolescent patients: 52 VFR and 52 fixed canine-to-canine (CTC) retainers were delivered and both types of retainers were evaluated in the lower jaw. The variables analysed were:



LII, overbite, overjet, arch length, intermolar width and intercanine width. Records were obtained in models after removal (T1), at 6 months (T2) and at 18 months (T3). In the CTC group, at T1 and T2 there were significant increases in LII and overbite, as well as at T1 and T3 in the VFR group. There were no significant differences between the groups. There were minimal variations in protrusion. In both groups, after 6 and 18 months, arch length decreased, while intermolar and intercanine widths remained unchanged (8).

In another study, IIL and single-tooth contact point discrepancy (CPD) were evaluated in 90 adolescent patients. Two types of fixed retainers were used: a 13-23 and a 12-22 retainer; in addition, a maxillary VFR covering all teeth up to the second molars was evaluated. For the measurement of the variables, models were obtained before and after two years of retention. There was a slight increase in LII and CPD in all groups evaluated, but no statistically significant differences were found in each group. A minimal increase in intercanine width and some canine rotations were also evident in the group of patients using VFR (3).

In a comparative study, VFRs and CTCs were analysed after 5 years of retention. The study included 104 adolescent patients with previous fixed orthodontic treatment in both the upper and lower jaw. All patients received a VFR for the upper jaw, while 52 patients received a VFR for the mandible and 52 patients received a CTC in the mandible. The plaster casts were obtained at different stages: at orthodontic removal (T1), at 6 months (T2), at 18 months (T3) and finally after 5 years (T4). The variables evaluated were LII, protrusion, overbite, arch length, and intercanine and intermolar width. There were small changes in both jaws between T1 and T4. The LII was significantly increased equally in both groups. In both the CTC and VFR groups, the protrusion remained stable, the overbite increased, the arch lengths decreased, and the intercanine and intermolar widths in the lower jaw remained the same. In the



upper jaw, the intermolar width decreased significantly. No differences were found between the groups (11).

Single-tooth ILL and CPD were evaluated 1 year after retention removal in two bonded and one removable retention methods. Ninety adolescent patients participated and were divided into three groups: A) adhesive retainer 13-23; B) adhesive retainer 12-22; and C) vacuum-formed removable retainer. Models were obtained before retention (T1), after 2 years of retention (T2) and 1 year after retention removal (T3). The changes in LII during retention were: in group A, 0.3 mm; in group B, 0.6 mm; and in group C, 1 mm. Changes after removal of retention were: in group A, 1.1 mm; in group B, 0.5 mm; and in group C, 0.4 mm. CPD did not show significant changes in any of the groups (2).

Most of the randomised clinical trials showed a low risk of bias in almost all domains, with the exception of one study in which the patients, operator and outcome assessor could not be blinded due to the study design. In addition, follow-up was lost to follow-up and there were withdrawals from the trial. Missing data were compensated with median values for the remaining subjects in each group (8).

Table 2. *Rob2 risk of bias assessment.*

Title of the study	Author	Year	D1	D2	D3	D4	D5
Vacuum-formed retainer versus bonded retainer for dental stabilization in the mandible-a randomized controlled trial. Part I: retentive capacity 6 and 18 months after orthodontic treatment.	Krämer et al.	2020	●	●	●	●	●
Stability of maxillary anterior teeth after 2 years of retention in adolescents: a randomised controlled trial comparing two bonded and a vacuum-formed retainer	Naraghi et al.	2021	●	●	●	●	●
Post-treatment stability after 5 years of retention with vacuum-formed and bonded retainers-a randomized controlled trial	Krämer et al.	2023	●	●	●	●	●
Stability of maxillary anterior teeth during retention and 1 year after removal of retention-an RCT on adolescents retained with two different bonded retainers and a vacuum-formed retainer	Naraghi et al.	2023	●	●	●	●	●

Source: Authors.



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Legend of the domains:

- D1: Bias due to the randomisation process
- D2: Biases arising from deviation from planned interventions
- D3: Biases arising from loss of results
- D4: Biases in the measurement of results
- D5: Biases in the selection of the described outcomes

Colours:

-  : Low risk of bias.
-  : Moderate risk of bias.
-  : High risk of bias.

DISCUSSION

There are some considerations when choosing a post orthodontic treatment retainer, among which we can mention: the position of the teeth before orthodontic treatment, the completion of the cases, whether or not there is potential for growth, especially in young patients, aesthetic requirements, patient responsibility, whether or not there were dental extractions, and skeletal class (20-23). Although some variables were analysed in the studies evaluated to determine dental stability, the final outcome of the treatment, i.e. how stable the occlusion was after completion, was not taken into account, nor was the growth potential analysed. All studies considered the age of the patients, where all participants were adolescents (2,3,8,11).

In the case of skeletal class, only one study mentioned the skeletal class that patients had before starting orthodontic treatment (11). Tooth rotations were not analysed in all the articles, only two of them did, this being an important parameter to analyse in dental stability (2,3). Not all studies were performed on both jaws; some were only on the maxilla and some only on the mandible. Consequently, all studies used plaster models at different stages of the evaluation, which were subsequently digitised (2,3,8,11).



CONCLUSION

Post-treatment retention in orthodontic treatment has so far been considered a challenge for successful orthodontic treatment. After reviewing the literature, studies determined that both fixed and removable retainers are effective in maintaining results. With regard to fixed retainers, those that were placed at 13-23 showed fewer changes in the different parameters for evaluating stability, compared to retainers of 12-22; however, the latter did not generate statistically significant changes, the important thing in this type of retention is good adherence of the retainer to the lingual surfaces of the teeth.

Vacuum removable retainers (VFR) continue to be a very good option, as long as the patient complies with their use, otherwise there may be a relapse. Although the existing studies provided us with valuable and useful information for decision-making on the retainer to be used, this research could not be conclusive in its results, due to the different methods and times for measuring the variables, which generated conflicts in interpreting and comparing the results. It would be good if future clinical studies could have a standardisation in the methodologies used, the analysis of the same variables, as well as the maxillary or mandibular study sites, thus benefiting future systematic reviews.

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CONFLICT OF INTEREST

There is no conflict of interest with persons or institutions involved in research.

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