

RETENTION IN ORTHODONTIC PRACTICE

РЕТЕНЦИЈА ВО ОРТОДОНТСКАТА ПРАКТИКА

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Abstract

Introduction: Retention in orthodontics is an obligatory phase in orthodontic treatment designed to prevent relapse after the completion of orthodontic therapy. Relapses occur as a result of forces exerted by the periodontal fibers, which tend to return the teeth to their original position, thereby moving the teeth back to the position they were in before orthodontic treatment. Growth and changes in the surrounding soft tissues also affect the outcome of orthodontic treatment; therefore, retention after the completion of fixed appliance treatment is imperative in orthodontic practice. **Aim:** The aim of this article is to present and review different types of retention appliances, both removable and fixed, used in everyday orthodontic practice after treatment with fixed orthodontic appliances. **Material and methods:** To realize the set goals, we conducted a literature search of the PubMed/MEDLINE, Academia.edu, and Google Scholar databases covering the past twenty years and reviewed articles and books containing the following keywords: retention in orthodontics, removable and fixed retention appliances. **Results:** The results of our study and the analysis of the literature showed that both removable and fixed retention appliances are equally used and appropriate, with similar effects and reliability in maintaining the results achieved through orthodontic therapy. The combined type of retention is usually used after dental arch expansion, while fixed retention is used when tooth extraction has been performed. **Conclusion:** Retention is certainly one of the most important phases of orthodontic treatment. The most common type of retention is the combined type, using a fixed retainer and a removable appliance for the maxillary dental arch and a fixed retainer for the mandibular dental arch. The importance of cooperation between the patient and the orthodontist is enormous for achieving the most satisfactory long-term aesthetic and functional results. **Keywords:** retention in orthodontics, removable and fixed retention appliances.

Апстракт

Вовед: Ретенцијата во ортодонцијата е неопходна фаза по ортодонтичкиот третман за да се спречи појавата на рецидив по завршувањето на ортодонтичкиот третман. Рецидивите се јавуваат како резултат на силите од пародонталните влакна, кои имаат тенденција да се вратат во првобитната положба, а со тоа да ги поместат и забите во положбата во која биле пред ортодонтичкиот третман. Самиот раст и промените во околните меки ткива, исто така, влијаат на резултатот од ортодонтичкиот третман, оттаму ретенцијата, по завршениот третман со фиксни апарати, е императив во ортодонтичката практика. **Цел:** Целата на овој труд е да се направи приказ и преглед на различни типови на подвижни и фиксни ретенциони апарати што се користат во секојдневната ортодонтичка практика по третманот со фиксни ортодонтички апарати. **Материјал и метод:** За реализација на поставените цели, спроведовме истражување на базите на податоци на Pubmed/Medline, Academia Edu и Google Scholar, во изминатите дваесет години, како и анализа на статии и книги што ги содржат следниве клучни зборови: ретенција во ортодонцијата, подвижни и фиксни ретенциони апарати. **Резултати:** Резултатите на нашите испитувања и анализата на литературните податоци покажаа дека подеднакво се применуваат и мобилните и фиксните ретенциони апарати, со слични ефекти и сигурност во однос на ретенцијата на резултатите добиени со ортодонтичка терапија. Комбинираниот тип ретенција обично се користи по експанзија на денталниот лак, додека фиксните ретејнери обично се применуваат по спроведени екстракции. **Заклучок:** Ретенцијата е сигурно една од најважните фази во ортодонтичкиот третман. Најчест е комбинираниот тип ретенција, со примена на фиксен ретејнер и подвижен апарат за максиларниот дентален лак и фиксен ретејнер во мандибуларниот дентален лак. Огромно е значењето на соработката помеѓу пациентот и терапевтот со цел да се добијат максимално задоволителни долготрајни естетски и функционални резултати. **Клучни зборови:** ретенција во ортодонцијата, подвижни и фиксни ретенциони апарати.

Introduction

Retention is the final step of orthodontic treatment, the main purpose of which is to keep the teeth in the position achieved after orthodontic treatment, where they are properly aligned within the dental arch and proper occlusion has

been achieved. While active orthodontic treatment is focused on correcting malocclusion and straightening the teeth, retention has the task of opposing the forces that tend to return the teeth to their initial position. Primarily, teeth move due to the elasticity of the gingival fibers, but also because of the forces produced by the muscles of the lips

and tongue, the pressure of the surrounding soft tissues, and the changes are influenced by the patient's age as well.

Unwanted tooth movement after orthodontic treatment can be directly proportional to the patient's age. Changes in the pressure of the soft tissue and skeletal structures around the teeth in combination with ongoing growth are part of the normal aging process and can be unpredictable. Therefore, retainers are not only indicated to prevent the force from returning the teeth to their original position before orthodontic treatment, but they also counteract the undesirable factors of aging¹.

In addition to the orthodontist's success, the desire and persistence of the patient are also important during the retention phase. Inchingolo et al.² reported relapse and re-crowding of the lower incisors when the retainers were worn for less than 9 hours per day. This emphasizes the need for longer retention, especially during the first months of post-orthodontic treatment.

Retention treatment includes different types of retainers, including fixed or removable appliances, depending on the specific condition and needs of the patient.

The large-scale production of materials, the study of biomechanics, and technological innovations have increased the need to improve existing designs and overcome their limitations, leading to the development of new retainers. Despite these advances, retention remains a subject of discussion among clinicians. Treatment time, different types of retainers, and protocols are topics that are most often discussed among orthodontists³.

Aim

The purpose of this paper is to provide an overview of the different types of retention appliances used in everyday

orthodontic practice, their basic characteristics, their application, the possibility of combining removable and fixed retention appliances, and the justification and significance of their application, all with the aim of improving the long-term outcome of post-orthodontic treatment.

Material and methods

The main tool in our study was a literature search of databases covering the last twenty years, including PubMed/MEDLINE, Academia.edu, Google Scholar, and relevant literature in the field of retention in orthodontic practice, focusing on evidence indicating the importance of retention, as well as the justification for the choice of specific retention appliances.

Results and Discussion:

Our analysis of the literature on the protocols and trends in orthodontic retention revealed that more than 40% of orthodontists combined fixed and removable retainers in different clinical situations. The first-choice option after expansion of the maxillary dental arch was the removable retainer (54.3%); meanwhile, a fixed retainer was used after correction of rotations in the mandibular anterior teeth (49.4%).⁴

For orthodontic retention in the upper dental arch, clinical preferences vary: fixed retainers were more often chosen in Switzerland⁵ and the Netherlands⁶, Hawley retainers in the USA⁷ and Saudi Arabia⁸, and vacuum-formed retainers in the UK⁹, Ireland¹⁰, and Malaysia¹¹. A combination of a fixed and removable retainer in the form of a vacuum-formed retainer (VFR) was the most commonly used in Norway¹²; however, orthodontists in Lithuania gave priority to Hawley retainers (Table 1).

Table 1. Preferred types of retention in maxillary dental arch

	Authors	Country	VFR	Hawley retainer	Fixed retainer
Maxilla	Renkema at al.	Netherlands			x
	Meade at al.	Ireland	X		
	Singh at al.	UK	X		
	Vandevska-Radunovic at al.	Norway	X		x
	Lai CS at al.	Switzerland			x
	Pratt MC at al.	USA		x	
	Ab Rahman at al.	Malaysia	X		
	Al -Jewair TS at al.	Saudi Arabia		x	
	Padmos J. at al.	Denmark	X		x
	Abid MF at al.	Iraq		x	x
	Andriekute Aat al.	Lithuania		x	x

Table 2. Type of retention in different regions in mandibular dental arch

Mandibula	Authors	Country	VFR	Hawley retainer	Fixed retainer
	Renkema at al.	Netherlands			x
	Meade at al.	Ireland	X		
	Singh at al.	UK	X		x
	Vandevska-Radunovic at al.	Norway			x
	Lai CS at al.	Switzerland			x
	Pratt MC at al.	USA			x
	Ab Rahman at al.	Malaysia	x		
	Jans AD at al.	Denmark			x
	Abid MF at al.	Iraq		x	x
	Andriekute Aat al.	Lithuania		x	x

Lithuanian orthodontists⁴ preferred a combination of a fixed and removable retainer in the upper and lower arches, except after expansion of the maxillary dental arch or correction of rotations of the mandibular anterior teeth. The reason for combined retention might be that orthodontists are concerned about the tendency for relapse and about patients who are not compliant with wearing their removable retainer as prescribed. Additionally, the findings of the study by Attack et al.¹³ showed similar results for fixed and removable retainers and confirmed that relapse of the lower anterior teeth can occur with both types of retainers.

Studies performed in other European countries^{5,6,9,12}, the USA⁷, Saudi Arabia⁸, and Australia and New Zealand¹³ showed that fixed retainers in the mandibular dental arch were dominant, except in Ireland¹⁰ and Malaysia¹¹, where vacuum-formed retainers were the most popular choice (Table 2).

According to the literature, fixed retainers are among the most commonly used appliances during the orthodontic retention phase. Since they cannot be detached for cleaning, the accumulation of plaque and tartar is increased, so maintaining excellent oral hygiene is crucial. Since the bonding and attachment of the retainer to the tooth are critical factors, they must be regularly checked, and care must be taken to ensure that they do not come loose at any point. Various types of occasional, unwanted tooth movements have been observed in cases of incorrectly placed retainers or debonding of the retainer from a tooth.

Inchingolo et al.² (2023) compared the benefits of fixed and removable retainers and showed that both types reduce the possibility of relapse, but there are situations in which 24-hour retention is required, and a fixed retainer is preferred in cases where there is a higher risk of relapse, such as: after diastema closure in cases with spacing (including median diastema); after space creation before prosthetic

treatment; in patients with reduced periodontal support; or after correction of large rotations.

A combination of fixed and removable retainers is often chosen in a process called double retention. In the Netherlands,⁶ most orthodontists are using a bonded retainer in the upper and lower arch, except when the upper arch was expanded during treatment or when extractions were performed in the upper arch, in which case they placed a removable retainer or used double retention.

A recent Cochrane review by Littlewood et al.¹⁵ on retention methods showed that there is insufficient evidence to support the best retention protocol. As a result, each practitioner should develop their own protocol based on clinical experience and market availability, but also taking into account the patient's needs, expectations, and conditions.

From the group of fixed retainers, palatal retainers are less commonly used than lingual retainers due to the possibility of detachment due to contact with antagonists or during biting. However, they are necessary for retention at the end of treatment, especially in adults, since many patients develop diastemas or other movements of the incisors in the absence of a retainer. The patient's overjet and overbite must be considered, and the retainer should be placed further away from the contact surface with the antagonist teeth.

As for the lingual retainers, certain authors such as McLaughlin, Bennett, and Trevisi¹⁶ concluded that a mandibular fixed canine-to-canine retainer is the best option for retention in all patients at the end of treatment. In cases where first premolars have been extracted, this retainer is placed on the mesial fossae of the second premolars.

Fixed retainers are usually used in situations where instability in the occlusal relationship is expected and long-

term retention is planned. There are four main indications for their use: the first is to maintain the position of the lower incisors during late growth. The main reason for the occurrence of crowding of the mandibular incisors in late adolescence in those who have had and those who have not had previous orthodontic treatment is the physiological growth of the mandible. Especially if there was crowding in the region of the mandibular incisors before treatment, even a small mandibular growth between the ages of 16 and 20 can cause a reappearance of incisor crowding.¹⁷ Recurrence is usually accompanied by lingual inclination of the central and lateral incisors. In these cases, in order to avoid distortion of the material, a wire of appropriate thickness should be placed; therefore, a 28–30 mil steel wire is placed from canine to canine. Booth et al.¹⁸ (2008) in their study concluded that, with regular controls, patients who wore this type of retainer for more than 10 years showed no relapse or signs of periodontal problems.

The second indication for the use of these retainers is the retention of closed diastemas. In cases of median diastema, although frenectomy has been performed, there is still a tendency for recurrence in certain cases. The retainer should be contoured so that it fits close to the cingulum so that it is out of occlusal contact. A flexible wire should be used in order to allow functional movement of the teeth and at the same time to hold them together.

The third indication for a fixed retainer is to maintain a space that was created for a bridge pontic or implant. A fixed retainer reduces the mobility of the teeth on which a bridge is planned to be made and provides stability before definitive prosthetic restoration. The preferred way to maintain space in the posterior region is a strong intracoronary wire bonded to the adjacent teeth (with shallow preparations where the future bridge abutments will be). For maintaining spaces in the anterior region, in cases of trauma or hypodontia, it is necessary to place a replacement tooth connected to a mobile retainer. It is satisfactory for short periods and until adolescent vertical growth is complete; therefore, it is preferable to place a fixed retainer in the form of a bridge.

The other indications for fixed retainers are the maintenance of closed extraction spaces in adults. According to Axelsson and Zachrisson¹⁷, a fixed retainer can be placed on the labial surface of the posterior teeth in adults, when the spaces have been closed, especially when skeletal anchorage was used to bring the posterior teeth forward over a greater distance.

In the group of different types of retention appliances, removable orthodontic appliances have a special place in everyday orthodontic practice. Among the most used removable retainers is Hawley retainer named by the author¹⁹. It is an acrylic retainer with a labial bow, which whose main purpose is to act on the teeth, keeping them

straight in the desired position after orthodontic treatment.

The acrylic base lies on the palate or envelops the lingual surfaces of the lower teeth. Ramazanzadeh et al.²⁰ emphasize the effectiveness of the labial bow in controlling the torque of the frontal teeth. According to Lyros et al.²¹, the passive Hawley retainer is the most well-known and used removable retainer for many years. Their variations include the use of teardrop or equatorial clasps instead of Adams clasps, which are easy to make and do not irritate the gingiva, but are contraindicated in patients with short clinical crowns²².

Although used in many cases, over time, different Hawley modifications have also appeared, such as: the Wrap-around retainer, with an extended labial arch to the premolars; the Aesthetic (Astycs) retainer, which is an aesthetic variant of the traditional Hawley retainer; and the Reinforced Removable Retainer (RRR), where the acrylic base is reinforced with a metal mesh, and small balls are added to the retention hooks at the end parts²⁰.

Chagas et al.²² highlighted the following advantages of mobile Hawley retainers: easy fabrication; affordable price for patients; easy maintenance of hygiene; comfort during wear; and good patient acceptability. They compared 70 subjects who were in the retention phase. Patients wore a Hawley retainer and a thermoplastic retainer for 1 month. Their conclusion was that the Hawley retainer was better in maintaining hygiene and was more resistant to damage than the thermoplastic retainer, while the thermoplastic retainer was more acceptable to patients in terms of swallowing liquids and saliva²¹.

Regarding the maintenance of hygiene of acrylate retainers, Topaloglu et al.²³ stated that in patients who wore removable retainers for 6 months, bacteria of the type *Streptococcus mutans* and *Lactobacillus* spp. were present.

Wan et al.²⁴ concluded that removable retainers could affect speech as well. Their study was conducted on 20 volunteers from the Chinese-speaking area and a comparison was made between speech with a Hawley retainer and with a thermoplastic vacuum-formed retainer. Their conclusion was that the Hawley retainer had a greater impact on speech changes than the thermoplastic retainer. Regarding relapse, in cases of rotated teeth before orthodontic treatment, Littlewood et al.²⁵ concluded that the Hawley retainer showed weaker effectiveness and a higher relapse rate of rotated teeth compared to other removable retainers¹⁵.

The more recent retention devices are vacuum-formed retainers (VFRs), which are also referred to in the literature. The first to use these appliances was Pontick, who introduced Essix retainers, removable thermoplastic retainers, invisible retainers, or overlay retainers (VFR), and later Sheridan²⁶ further developed them. VFRs are the most commonly used retention devices in Ireland, Australia, and

the United Kingdom.

There are two types of VFR designs that have been described. The original Essix retainer is a canine-to-canine design initially^{29,30,31,32}, while the other type—VFRs—cover the entire occlusal surface^{33,34,35,36} or are extended to the most distal molar present^{37,38}. The margins of the VFR extend 1–2 mm buccally and 3–4 mm lingually to the gingival margin³⁹. Advantages of these types of retainers are aesthetics, patient acceptability, quick and easy fabrication, and affordable price^{39,40,41,42}, and disadvantages are compromised retention in areas with gingival hyperplasia, possibility of breakage, potential demineralization, caries, and gingival problems if drinks are consumed while wearing the retainer.

When it comes to stability after orthodontic treatment connected with the type of retention, most studies have focused on the position of the lower incisors, as this represents the most noticeable relapse and the most common patient complaint. The Little Irregularity Index (LLI)⁴¹ is most often used to determine this irregularity. Additional measurements in retention studies include intercanine width, intermolar width, overjet, overbite, and arch length. These retainers have no adverse effects on dental and periodontal health compared with bonded retainers, are more acceptable to wear, and cause less difficulty in speaking compared to acrylic retainers. They break more easily than acrylic retainers, especially the lower ones and along the midline. If they are not worn, relapse is inevitable^{43,44}.

The studies confirmed that VFR is as effective as an acrylic retainer in terms of post-treatment stability, but less effective than a bonded retainer when it comes to incisal alignment^{45,46,47,48}.

For enhancement of retention in orthodontics, supplementary methods such as pericision and interproximal reduction (IPR) are suggested. These are additional procedures that affect the hard and soft tissues in order to reduce the possibility of relapse and to help maintain the alignment of the teeth and jaws achieved at the end of the active phase of treatment. Interproximal reduction (IPR), as an additional measure to aid retention, was proposed by Peck and Peck⁴⁹ to increase post-treatment stability of the position of the lower incisors.

With pericision, an incision of the periodontal fibers around the necks of the teeth is performed in order to prevent relapse of the previous tooth position due to the pressure of the periodontal fibers during therapy. Sometimes it is referred to as a supracrestal circumferential fibrectomy⁵⁰. Certain authors such as Anjali Koul et al.⁴⁸ (2022) consider that pericision has limited effectiveness when it comes to retention, especially in the maxilla, and its role in long-term stability is debatable. They emphasized that it should be performed only in cases with a good gingival biotype, sufficient cortical bone, minimal or no recession, and excellent

oral hygiene. Since it is still a surgical procedure, it should be reserved for cases with significant tooth rotation.

Study conducted by L.R. Boese⁵¹ examined the stability of mandibular incisors four to nine years after treatment using circumferential supracrestal fibrotomy and IPR. They concluded that these procedures could increase stability in the mandibular anterior region without the use of retainers. IPR is included in all three phases of treatment: the first phase is during early treatment, when the lower incisors are aligned; the second, soon after the removal of the fixed appliance; and the third, when the contact points are too close and it is observed that the teeth are no longer properly aligned.

Maintaining the intercanine width at the same dimension is crucial in order to increase the chances of successful retention, and if IPR is used instead of expansion in the lower anterior region, the chances of maintaining the desired width are greater.

Conclusion

There are various factors which influence the final stability of teeth after treatment. Appropriate orthodontic diagnosis, treatment planning, and the achievement of appropriate occlusal and soft tissue treatment outcomes are the key factors for reducing orthodontic relapse.

Orthodontic retention and relapse continue to be one of the biggest challenges in orthodontics, and the role of patient compliance is important, as well. The type of retention depends on the movements and corrections that have been achieved and it is maintained with a combination of fixed and removable retainers. For the maxillary dental arch, retention usually is combined with the use of a removable and a fixed retainer, especially when there was an expansion in the maxilla, and for the mandibular dental arch, usually a fixed retainer is placed or a vacuum-formed retainer is used.

In order to prevent unwanted post-treatment changes and to avoid an unpredictable amount of post-treatment tooth movement, it is important to emphasize at the beginning of orthodontic treatment the importance of the passive phase of orthodontic treatment and the role and significance of proper wear of retention appliances.

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