

Orthodontic Retainers: A Contemporary Overview

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ABSTRACT

Aim: The aim of this article is to provide an insight into the various modalities of retention and types of appliance used in achieving this objective.

Background: Maintaining the orthodontically treated teeth in their corrected position is a challenging and ominous task since the inception of this specialty. Orthodontic retainers play a pivotal role in preventing posttreatment tooth movement, thereby maintaining the esthetic, function, and stability of the stomatognathic system.

Results: An extensive study of literature suggests that there are significant variations in the results describing the effectiveness, cost factors, survival times, oral hygiene status, and regimen of various orthodontic retention appliances. In terms of patient's satisfaction and speech articulation, vacuum-formed retainers (VFRs) are better than Hawley retainers. Occlusal contacts are better achieved with Hawley retainers than VFRs.

Conclusion: Currently, there is insufficient high-quality evidence in favor of a particular retention appliance/regime or protocol. There is a need for further evidence-based high-quality studies/randomize controlled trial studies (RCTs) to evaluate different orthodontic retention appliances and regime after the orthodontic treatment.

Clinical significance: Irrespective of the appliance, the patients should be prepared for a long-term or indefinite retention phase following orthodontic treatment to prevent relapse.

Keywords: Orthodontic retainers, Relapse, Removable retainers, Retention, Vacuum formed retainers.

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INTRODUCTION

"It's not over until it's over" and this dictum holds completely true for an orthodontic treatment. Even after completing an orthodontic treatment successfully, the daunting task of keeping the teeth in their rightful position persists. The onus of this responsibility lies on both the orthodontist and the patient. On the one hand, it is the job the orthodontist to provide with well-fitting, comfortable retainers with proper instructions and motivation for the patient to wear it regularly. On the other hand, the patient is incumbent to wear the retainer as directed by the orthodontist. But, easy said than done, the retention stage remains the most difficult part of the orthodontic treatment. Many reputed personalities in orthodontics like Angle, Case, Tweed, and Hawley have highlighted the concerns in retention and attributed it to professional negligence.¹ Such is the problem of retention that once Tweed and his orthodontist friend quipped that "I would gladly pay someone half my fee if he relieves me of the responsibility of successfully carrying my patients through their retention periods."²

Many appliances are used for the posttreatment retention phase. In the Angle era, banded fixed appliances were used as retainers.³ In 1919, removable retainers were introduced by Hawley.⁴ With the advent of the acid-etch technique, Kneirim for the first time in 1973 described the use of fixed bonded retainers.⁵ In the present scenario, many retention appliances are being advocated to prevent relapse and offer long-term stability. The aim of this article is to appraise the orthodontic retainers by providing an extensive review of literature.

DISCUSSION

The origin of this problem lies in the treatment itself. Ideally, after achieving proper alignment and occlusion, it takes around a year for the surrounding periodontium to reorganize and adapt itself.⁶ Most of the studies have reported that the maximum quantum of

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relapse occurs in the first 2 years posttreatment.^{7,8} This relapse can be attributed to the following factors:

- Continuous skeletal maturation or aging process
- Inherited characteristics/genetics
- Recoil of the periodontal ligament and gingival fibers
- Soft-tissue maturation
- Occlusal factors
- Limits of the dentition
- Presence of third molars
- Maxillary and mandibular expansion

The road to an eternal, perpetual straight smile begins and ends with an orthodontic retainer. Retainers are defined as orthodontic appliances used to prevent relapse/return following correction, of features of the original malocclusion. They can be classified as shown in Table 1.

REMOVABLE RETAINERS

These categories of retainers can be removed and reinserted by the patient. Hawley retainers are the most common and popular, century-old appliance designed by Charles Hawley in the year 1919.⁹

Table 1: Classification of orthodontic retainers

<i>S. no.</i>	<i>Classification</i>	<i>Types</i>	<i>Examples</i>
1	According to their force application	Active retainers	Retainers which apply force Ni-Ti retainers Positioners
2	According to their usability by the patient	Passive retainers	Retainers which do not apply force
		Removable retainers	Hawley's retainer Begg's wraparound retainer Barrer/Spring retainers Removable canine to canine retainers Removable molar to molar metal retainers Positioners Thermoplastic vacuum-formed retainers Essix retainers
3	According to their visibility	Fixed retainers	Multistranded stainless steel wire Plain stainless steel wire Glass fiber-reinforced retainers Ortho-Flextech retainers V-loop design Ling-lock retainers Labial bonded retainers
		Visible retainers	Have a labial wire component Hawley's retainer Begg's wraparound retainer Barrer/Spring retainers Removable canine to canine retainers Removable molar to molar metal retainers
4	According to their generations	Invisible retainers	Have a lingual wire placement or made from transparent thermoplastic sheets Thermoplastic vacuum-formed retainers Essix retainers Multistranded stainless steel wire Plain stainless steel wire Glass fiber reinforced retainers Ortho-Flextech retainers V-loop design Ling-lock retainers
		First generation	Plain round 0.032–0.036" blue elgiloy wire with a terminal loop
5	Adjunctive retention procedures	Second generation	Same as first generation but without terminal loops
		Third generation	Easier to place and conforms more closely than third-generation retainers
			Pericision Frenectomy Interproximal reduction (IPR)

They are made of acrylic baseplate and wire component. The wire components consist of either short or long labial bow to contact the labial surface of incisors fabricated from 0.7 mm stainless steel wire and clasps for retention. Adams clasp is the most commonly used clasp, but full-circle, half-circle, or soldered clasp can also be used depending on the clinical situation.

Instructions and Monitoring the Appliance Wear

Currently, there are no specific guidelines regarding the best retention regime for a particular case. There is a consensus

amongst the orthodontist for a long-term retention and follow-up protocol.¹⁰ The patients are asked to wear the retainers for as long as they want straight teeth. This should be informed to the patient at the beginning of the treatment. This way the responsibility is transferred to the patient to take care of his/her teeth after the active orthodontic treatment. Lack of compliance is common fallout with removable retainers. This can be indicated if the patient does not enter the clinic with appliance in his/her mouth, appliance does not fit well, shows no sign of wear and tear, is clean with no food accumulation, no marks of the mucosa of labial bow, and patient

cannot remove and insert the appliance confidently. If observed, it should be clearly explained to the patient/guardian about the risk involved. It is also helpful to obtain a written consent about following a retention protocol.

VACUUM-FORMED RETAINERS (VFRs)

They were first designed in 1971 by Ponitz¹¹ and referred in the literature as VFRs, clear overlay retainers (CORs), or Essix retainers. They are invisible retainers made of thermoplastic material like polyethylene polymers and polypropylene polymers. On the one hand, polyethylene polymers are more esthetic, transparent, and allow bonding to acrylic. Hence, they are material of choice when bite planes are to be added in the appliance. Polypropylene polymers, on the other hand, are esthetically inferior and translucent but more durable and flexible compared to polyethylene polymers.¹² The VFRs are fabricated on a vacuum machine that adapts a heat-softened plastic by negative pressure and, under vacuum, pulls the thermoplastic material on the working cast.¹³ These retainers are made from commercially available materials like Essix C+, Essix ACE, Duran, and Tru-Train. They are also supplied in the market by certain brands like Essix, Zendura, and Vivera. They are available in thicknesses of 0.75, 1, 1.5, and 2 mm. Until now, no uniform standard has been established for the thickness of VFRs.¹⁴ Also, there is no published evidence to indicate whether the differences in thickness influence the effectiveness of VFRs.¹⁵ The most common design for the VFRs is the full coverage including the occlusal surface of the most distal tooth. The VFRs are trimmed past the gingival margin by 1–2 mm on the buccal and 3–4 mm on the lingual side.¹⁶

FIXED RETAINERS

These retainers are acid etched and bonded on the tooth surface.⁵ They can be used independently or along with removable retainers. There are two types of basic designs for lingual bonded retainers: rigid mandibular canine to canine retainers and flexible spiral wire (FSW) retainers. The rigid retainers are attached to the canines only. They are effective in maintaining the intercanine width but difficult to control individual incisor movement between them. The FSW retainers allow physiologic tooth movement of the bonded teeth and prevent their rotation.¹⁷ Round and rectangular wires of various materials, sizes, and dimensions were used previously and have been replaced by multistrand wires containing 3–6 strands of wire braided or arranged coaxially.¹⁸ These types of retainers have specific indications.

Indications for Fixed Retainers^{19,20}

- Closed midline diastema
- Generalized anterior spacing
- Severe rotations and displaced teeth
- Space closure following mandibular incisor extraction
- Significant incisor proclination during treatment
- Significant increase in lower intercanine width
- Nonsurgically treated open-bite cases
- Impacted teeth
- Teeth with loss of periodontal support
- Teeth with no opposing tooth

Instructions and Maintenance of Fixed Retainers

Fixed bonded retainers should be placed with the utmost isolation and care. They should be checked regularly for any breakage,

distortion, or plaque accumulation. They should be replaced when deemed necessary. Failure is common with such retainers owing to improper isolation during placement, distortion of wire during curing, inadequate adhesive or setting time, and direct trauma to the retainer.²¹ The site of failure can be at:

- Wire–composite interface (most common)
- Composite–enamel interface
- Stress fracture of the wire²²

Whenever a fixed retainer is to be repaired, it should be replaced completely without attempting to correct the old retainer. Until the retainers are repaired, the patient is asked to wear the removable retainers.

Combination Retainers

Removable and fixed retainers are used in combination. VFRs are combined with wires which are bonded on the lingual surfaces of teeth. In case the bonded retainer fails, the removable retainer prevents the relapse. Otherwise, if the patient fails to wear the removable retainer, the bonded retainer holds the teeth. The patient does not have to contend with the removable retainers. Also, the doctor avoids confrontations with unreasonable and uncooperative patients and parents.²³ Circumferential supracrestal fibrotomy (CSF) conjoined with a removable retainer has shown to significantly reduce the relapse by 2 mm compared with using a removable retainer alone.²⁴ The comparison of various orthodontic retainers is shown in Table 2.

Effectiveness of Various Retainers

Patients prefer VFRs due to their appearance, comfort, and superior aesthetics.^{25–27} According to Rowland et al., they are more effective in holding corrections of the maxillary and mandibular labial segments as compared to Hawley retainers.¹⁶ According to Artun, 3 years assessment of three bonded retainers and one removable retainer has shown no difference in the type of retainers used except for incisor irregularity when the bonded retainers were fractured.²² A systematic review conducted by Mai et al.¹⁴ in 2014 has concluded that there are no differences with respect to changes in intercanine and intermolar width between VFRs and Hawley retainer after active orthodontic treatment. However, currently, the evidence is insufficient for VFR being more effective than Hawley retainers and high-quality RCTs are necessary. A recent RCT conducted by O'Rourke et al.²⁸ in 2016 has compared the effectiveness of bonded and VFRs in 82 subjects for 18 months post-debond. They have found that bonded retainers have a better ability to hold the mandibular incisor alignment in the first 6 months after treatment than do VFRs. Another RCT conducted by Ramazanzadeh et al.²⁹ in 2018 had compared the effectiveness of wearing the Hawley retainer for 4 months full-time and then night time, VFRs for 4 months full-time and then night time, and VFR for 1 week full-time and then night time. They have reported both regimens of VFR to be more effective than the Hawley retainer in maintaining arch length and tooth alignment in the upper arch. VFRs for 4 months are advocated for better incisor alignment in the lower arch compared to the Hawley retainer.

Survival and Failure of Retainers

A recent study published in 2018 by Jin³⁰ has concluded that the lingual fixed retainers and Hawley retainers have the longest survival followed by combination retainers and vacuum-formed retainers. Hawley retainers were lost, and fixed retainers were debonded;

Table 2: Comparison of various types of commonly available orthodontic retainers

Type	Hawley's retainer (removable)	Vacuum-formed retainers (removable)	Fixed/bonded retainers
Material	Acrylic with metal wire	Polypropylene or polyethylene polymers	Metal wire of stainless steel, nickel, or titanium
Advantages	<ul style="list-style-type: none"> • Easy to maintain oral hygiene since they can be removed • Easy to fabricate, clean and repair if broken • Cost-effective 	<ul style="list-style-type: none"> • Highly esthetic and versatile • Minor tooth corrections can be performed by altering the cast • Possess flexibility, positioner effect, and bite-plane effect • Serve as mouthguards and nightguard for bruxisms • Easy to wear, thin, and rigid 	<ul style="list-style-type: none"> • Esthetic compared to removable retainers • Less patient compliance required • Well tolerated by the patient • Provide predictable long-term retention in comparison to removable retainers
Disadvantages	<ul style="list-style-type: none"> • Relapse is prone to occur due to the negligence of patient in not wearing the retainers • Labial bow made up of stainless steel wire is esthetically inferior to transparent retainers • Initial difficulty in adapting to the appliance • Difficulty in speaking, hypersalivation and taste alteration for a few days • Frequent breakage with the appliance • Risk of losing the appliance 	<ul style="list-style-type: none"> • Not cost effective compared to Hawley's type removable retainers • Fabrication requires costly equipment • Worn and broken easily, needs replacement as cannot be repaired • Not suitable for retention of expanded arches • Less settling of occlusion 	<ul style="list-style-type: none"> • Tends to accumulate more plaque and calculus leading to compromised oral hygiene • Technique sensitive to place • High risk of bond failure, fracture or distortion of wire leading to unwanted tooth movement • Risk of tooth movement if the wire is active • Interfere with the occlusion of opposing teeth

vacuum-formed retainers and combination retainers were fractured. Studies have reported the survival rate of bonded retainers from 90% to 30% over a 3–10-year period.³¹ Overall failure rates range from 10.3% to 47% according to Artun in 1988.³² Failure rate is two times in the maxilla compared to the mandible.³³ This can be attributed to the greater risk of occlusal forces being delivered to the maxilla along with the distortion in the wire to conform to the morphology of the canine.³⁴ This can be prevented by taking the impression of the lower arch and fabricating the retainers by avoiding occlusal trauma. Due to the greater occlusal forces and kink in the wire during bonding, the risk of failure increases when the upper canine or lower premolars are part of the retainers.^{20,31,34} Most of the bond failure occurs in the first year, after which the life of the retainer increases dramatically.³⁵ Since the orthodontic materials and techniques have evolved, the failure rates have been decreased. The failure occurs most commonly on the wire–composite interface.²² Hence, it is recommended to use composite with greater abrasion resistance to decrease the rate of failure.¹⁸ McDermott et al.³⁶ in 2017 have found no difference in the survival times over 6–12 months between the VFRs and Hawley retainers. Hichens et al.²⁷ reported that more Hawley retainers were broken than VFRs over 6 months. The survival time of the mandibular Hawley retainer or VFRs was shorter than that of maxillary retainers due to the increased buccal root torque on the posterior segment, greater deformity of the retainer to overcome the mandibular undercut and high lingual attachment. Sun et al.³⁷ found that the survival times of Hawley retainers and VFRs were not statistically significantly different and the choice of retainer should be advised without taking breakage into consideration.

Maintenance of Oral Hygiene Status

Removable retainers are easy to clean and maintain. Bonded retainers tend to accumulate more plaque and calculus, thereby predisposing

to decalcification, caries, and periodontal problems.³⁵ But in well-maintained mouths, the bonded retainers have shown no significant detrimental effects on the periodontium. Studies have shown no long-term damage to hard or soft tissues with the design of lingually bonded fixed retainers.²² It is important to note that the duration of the retainer in the mouth and the oral hygiene status of the patient do have an effect. The use of interdental cleaning aid is advocated to maintain good hygiene in the vicinity of bonded retainer.^{38,39}

Patient Satisfaction

Hichens et al.²⁷ in their study concluded that VFRs caused less embarrassment in terms of speech and appearance as compared to Hawley retainers. Pratt et al.⁴⁰ also reported a similar result of VFRs being more compliant than the Hawley retainer in after debonding fixed appliances. This can be attributed to the transparent appearance of the VFRs. Also, a greater amount of palatal coverage of the Hawley retainer affects the speech articulation in contrast to VFRs which have no palatal material. Wan et al.⁴¹ in 2017 have reported more changes in articulation in adult patients wearing the Hawley retainer as compared to VFRs.

Settling of Occlusion

Sauget in 1997 observed the settling of occlusion with Hawley and clear retainers. He found that there was a significant increase in the number of occlusal contacts with the Hawley retainer after 3 months signifying better settling of occlusion.⁴² Hence, Hawley retainer can be a better choice when compared to VFRs in patients who did not have good posterior settling after active orthodontic treatment.

Retention Protocol

Unfortunately, there is no universal consensus on the type of retention protocol to be followed or the retention appliance to

be used. Authors have cited a retention period ranging from a duration of 2–3 weeks till life-long retention.^{7,43} Cochrane review published in 2016 has reported insufficient high-quality evidence to favor a particular retention appliance or a retention protocol.⁷ Hence, the choice of retention protocol and appliance preference is largely determined by the orthodontist's experience, patient's expectations, and clinical circumstances.⁴⁴ In most of the clinical scenarios, the patients are reviewed for a year after the end of active orthodontic treatment. Many authors agree on providing long-term or indefinite retention for lower anteriors since they are more prone to relapse.⁴⁵ However, the idea of providing indefinite retention and taking an informed consent from the patient before beginning the treatment about the possibility of relapse on not wearing/maintaining retainers is gaining widespread acceptance.⁴⁴

CONCLUSION

Braces are temporary, but retention is forever. This notion should be explained to the patient clearly before commencing the orthodontic treatment if they wish to maintain their beautiful smile. We as an orthodontist should begin with the end in mind. The type of retainer, the technique of fabrication, different material to bond, and retention protocol should be carefully considered at the beginning of orthodontic treatment. This will ensure an excellent long-term stability and retention for the treatment. Irrespective of the appliance, the patients should be prepared for indefinite retention following orthodontic treatment.

Currently, there is insufficient high-quality evidence in favor of factors describing the effectiveness, cost evaluation, survival times, oral hygiene status, and regimen owing to a particular retention appliance. In terms of patient satisfaction and speech articulation, VFRs are better than the Hawley retainer. Occlusal contacts are better achieved with Hawley retainers than VFRs. There is a need for further evidence-based high-quality studies/randomized clinical trials (RCTs) to evaluate different orthodontic retention appliances and regime after the orthodontic treatment.

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