Agnieszka Pękala A, B, D–F, Ewa Chmielewska A, D

Fixed Orthodontic Retention
Stała retencja ortodontyczna

Private Orthodontic Practice, Inowrocław, Poland

A – concept, B – data collection, C – statistics, D – data interpretation, E – writing/editing the text, F – compiling the bibliography

Abstract
The aim of the study is to draw attention to the problem of instability of the results of orthodontic treatment. This article presents recommendations and contraindications for using fixed retention. The most common positions and types of bonded retainers have been presented. Preparatory procedures related to installation of a fixed retainer and retainer installation methods have been described. The effects of such therapy on the condition of the periodontium and dental hard tissue have also been presented. Comparable research has been shown following a 3-year period of retention of four kinds of retainers: fixed retainers made of plain wire and spiral wire bonded only to canines, fixed six-point retainers made of flexible, multistrand wire and removable retainers. The differences in use have been described in terms of: accumulation of plaque and calculus around the wire and along the marginal periodontium, loss of attachment, Little’s index, and failure during the application of a fixed retainer. The research of FSWR retainers and vacuum-formed retainers in contrast to the Schwarz retainer have been presented. The most frequent complications and side effects of retention therapy have been shown. Chemical and photo polymerization composites to cement retainers and the reasons of losing them have been compared. The impact of this kind of therapy on the condition of the soft and hard tissue of the periodontium has been described. The research has proved that, in the case of removable retainers and fixed retainers, a change can be observed in occlusion in the period of retention, however its intensity is not statistically significant (Dent. Med. Probl. 2013, 50, 3, 355–361).

Key words: fixed orthodontic retainer, retention, FSWR.

Orthodontic treatment consists of two parts: active and passive (retention). According to the available literature, only 30% of orthodontic patients examined after 10 years following the end of treatment do not show any signs of relapse or changes in occlusion. Therefore, it is very im-

Streszczenie

Słowa kluczowe: stały retainer ortodontyczny, retencja, FSWR.
important to plan complex orthodontic care in detail [1].

Instability of orthodontic treatment is caused by the following factors [1–4]:
- reconstruction of periodontal and gingival tissues takes time – remodeling of periodontal fibers lasts ca. 3–4 months. Collagen gingival fibers reorganize from 4 to 6 months and supraspinal flexible fibers even a year;
- pressure from soft tissues, i.e. an imbalance between lingual and labial forces;
- age-related and growth-related changes in the oral cavity;
- misdiagnosis or incorrect treatment plan.

The type of retention therapy depends on numerous factors: patient’s age, genetic predispositions, type and degree of malocclusion, applied treatment, therapeutic effect achieved and growth pattern. In the case of malocclusions class II and III, open and deep bite, continuation of growth processes in the late stage of adolescence is the main reason of instability of the treatment results [5].

Factors preventing relapse of malocclusion include:
- thorough planning of active and passive treatment;
- commencing therapy at the right time;
- achieving correct occlusion and articulation;
- maintaining individual intercanine distance;
- correction of overbite and overjet;
- obtaining correct points of contact;
- early rotation control;
- obtaining a correct interincisal angle;
- elimination of dysfunctions and parafunctions;
- correcting defects with recurring tendencies – crowding, rotation, midline shift. According to Zachrisson [6], treatment should always include overcorrection;
- control of third molar germs – as the etiology of late crowding has been constantly debated, according to the available literature, wisdom teeth should be removed only in case of insufficient space in the arch or incorrect position of the germs – inclined or impacted teeth. In the case of extraction therapy, the decision to extract teeth other than third molars should be postponed until the treatment is completed;
- circumferential supracrestal fiberotomy;
- reproximation – stripping [1–3].

Types of retainers:
- removable retainers – Hawley retainer, Schwarz retainer (Fig. 1), positioner, functional appliance, Essix retainer made of thermoplastic (Fig. 2), Essix corrective retainer, snap-on retainer,
- fixed retainers – described further in the article [1–3, 7].

The retention phase should not last less than half of the active treatment period and amounts to 1–2 years [1]. In the case of removable retainers, wearing such retainers 24 hours/day for 3–4 months is recommended immediately after removal of the appliance. After that time, it can be worn only at night.

Removable retainers are used in orthodontic practice very often. As such appliances come in many variations, the physicians have a broad range of therapeutic solutions. Apart from numerous advantages, their main disadvantage is the lack of control over patients. Fixed retention is used in cases of expected instability of treatment effects or poor cooperation on the patient’s part. Elongated retention therapy should be carried out on patients in a growth period, where retention

Fig. 1. Schwarz retainer
Ryc. 1. Retencyjna płyta Schwarza

Fig. 2. Retainer made of thermoplastic
Ryc. 2. Retainer z tworzywa termoplastycznego
Treatment should last until a significant slowdown of growth processes, as well as on adults with periodontal diseases, who should wear permanent retainers for life.

According to some authors, fixed retainers in the anterior section of the mandible are a standard orthodontic procedure, claiming that this section of the arch is the “occlusion base”. Eliminating the secondary crowding problem, they ensure a long-term therapeutic effect.

Because of contact with the opposite arch, installation of such retention in the maxilla is technically more difficult, sometimes even impossible. The difficulties concern cases with severe overbite, when the attachment of a retainer would cause occlusal interference or if the retainer is located too close to interdental papillae. Another contraindication to fixed retention is bruxism, as the risk of damaging the retainer is very high [8].

Retainers cemented on bands, bonded only to the lower canines, from rigid wire 0.7 – 1mm in diameter [3, 6] and retainers made of metal mesh, bonded intracoronally go down in the history of orthodontics.

Among fixed retainers applied contemporarily, we can distinguish:
- retainer made of thick, plain or spiral wire – 0.032 inches, bonded only to canines;
- FSWR – Flexible Spiral Wire Retainer made of thin, flexible spiral wire from 3–7 strands, at a thickness from 0.0175 to 0.0215 inches bonded to each tooth in the segment from canine to canine [9, 10].

This is the most popular kind of retention, because of good control over individual teeth and the physiological response of periodontal ligaments to pressure;
- splint retainer made of glass fiber, e.g. Fibersplint (Fig. 3) – used in cases of absence of interdental papillae, because a metal retainer would create an adverse esthetic effect. Also for splinting teeth in patients with periodontopathy – permanent retention. Due to the high stiffness and esthetic qualities, it allows for reconstruction of individual missing teeth. It has a high force of bonding strength to golden and ceramic surfaces [2, 3, 7, 10, 12]. The disadvantage it prevents physiological tooth movement.

Permanent retainers can also be classified according to their location:
- lingual – the most commonly used (Fig. 4);
- palatal – used less frequently because of occlusal interference (Fig. 5);
- labial – most rarely used due to its adverse esthetic qualities, installed as temporary retention while waiting for the eruption of permanent teeth. It is also installed when it is impossible to bond it from the lingual or palatal side, e.g. the maintenance of closed extraction gaps,

Fig. 3. Splint retainer made of glass fibre
Ryc. 3. Retainer stały z włókna szklanego

Fig. 4. Permanent lingual retainer in lower arch
Ryc. 4. Retainer stały językowy w łuku dolnym

Fig. 5. Permanent palatal retainer in upper arch
Ryc. 5. Retainer stały podniebienny w łuku górnym
highly rotated teeth or palatally displaced canines. Often in combination with vacuum retainers;

- in the dental arch line – after premature loss of second deciduous premolars or maintaining space for prosthetic reconstruction – in lateral sections bonded between the mesial and distal edge of the teeth neighboring the gap. Due to strong chewing forces, a retainer made of thick wire should be used – 0.018 × 0.022 inches, bending it towards the gums in order to eliminate occlusal interferences. It is suggested to leave such retention for a short period due to the risk of damage. In cases of planned reconstruction using a dental bridge, retention grooves can be made in the enamel for better fixing of the retainer [3, 7].

Recommendations for fixed retention:

- stabilization until the end of the adolescence period – even a residual mandibular growth between 16 and 20 years of age can cause crowding of teeth in the anterior section of the mandible;
- strong crowding and rotation – the highest risk of tertiary crowding occurs until 30 years of age, then it drops significantly [4];
- modification of intercanine width [11];
- after correction of deep bite;
- maintenance of closed gaps – diastema and extraction gaps in adults;
- maintenance of space for prosthetic reconstruction – implant, bridge – among patients with periodontal diseases;
- cases of inclination of the lower incisors by 2 mm [2, 3];
- single-arch therapy – treatment with one upper permanent retainer causes adverse changes in the anterior section of the mandibular arch. Therefore, it is necessary to install a fixed six-point retainer in the lower dental arch as early as at the beginning of orthodontic treatment [13].

Bonding methods:

- direct – the retainer wire is adjusted to the tooth surface on a model by the doctor or in the patient’s mouth;
- indirect – it consists of fitting the wire to the tooth surface and gluing it to a plaster model with a composite. In the next stage, a technician makes a transparent, 2–3mm thick transfer splint. Silicone impression material can be used as a transfer. Before placing the splint in the oral cavity, the base of the composite material to be glued to the teeth should be cleaned [3, 12].

A fixed retainer can be bonded to the teeth immediately before or after debonding of a fixed appliance [8]. Gingival inflammation is observed very often then. In order to prevent composite bonding being damaged by bleeding from the marginal periodontium, a hygienization procedure should be performed about one week before removal of the retainer. If the patient cleaned his/her teeth regularly and properly, low-pressure micro-sanding can be applied immediately before retainer installation [7].

A perfectly clean enamel surface ensures proper structure of the prism during etching. Etching should be carried out by using 37% phosphoric acid for 20–30 seconds. After washing and drying the enamel, the operating field should be isolated from moisture as much as possible. Some authors suggest application of a dental dam, as it makes the procedure only slightly longer.

The technique of fitting fixed retainers is not complicated but a lot of precision is required. Accurate adjustment of the retainer to the surface of each tooth is necessary to avoid loosening of the appliance or to avoid unwanted tooth movement. Failure during the application of fixed retainers depends on the strength of the wire and the forces of the enamel-composite or composite-wire interface. According to Butler and Dowling [14], fixation of the composite-wire is damaged most frequently. It is extremely important to use an appropriate composite, in the proper amount [9]. Recent research demonstrates that there is no difference in the durability interface between chemical and photo polymerization composites [15]. According to Bearn [16], Concise-3M Unitek is the most force resistant, while the most abrasion resistant is composite Transbond® and Concise®. The value was comparable to composite used restoration. Reinforce interface can be obtained by a thicker layer of composite – over 1 mm. It is very important that the material should cover the ends of the wire to prevent it from the unraveling, which results in unwanted tooth movement. In the case of resin fiberglass retainers soaked in composite, the layer can be thinner.

According to Butler and Dowling [14], fixed retainers do not have a negative effect on the condition of the periodontium or development of caries. The research conducted on two groups of patients – with and without fixed retainers, demonstrates little increase of plaque and tartar around the retainers, with no impact on the condition of the soft and hard tissue of the periodontium. Also, the vertical position of the retainer (nearer or further from the incisors edge) does not substantially influence the surrounding tissues [17].

No statistically significant differences were found in the research comparing plaque and tartar accumulation due to the type of wire – plain or
multistrand [10]. After cementing, hygiene training should be carried out, i.e. the proper use of dental floss and interdental brushes. There is also a recommendation for more frequent hygienic treatment.

The main disadvantages of such retention method are: precision, time consumption and unreliability. According to Zachrisson [6], a failure of the method in his 30-month research is 11.6%, and according to Artun et al. [10] in 36-month observation is 20%. The difference between the retainer bonding method (indirect or direct) was not statistically significant. According to Taner [18], damage of the retainer was in the first months of use, which Artun noticed in 3 years of use. Repeating defects among the same patients suggested that the problem resulted from insufficient care. According to the authors of the study, the retainers usually broke on the right mandibular incisor. The fact that teeth can change their position even when the retainer is bonded to the teeth is amazing. One of the reasons could be the incurvation of the wire in the interdental space. Sifakakis et al. [19] noticed that the average value of force is 1N. In the literature, changes were also described in the positions of teeth while wearing a retainer, which was not a relapse: differences in the torque of the incisors and magnification buccal inclination of the canine [20, 21].

A side effect of wearing retainers can be an allergic reaction to nickel, characterized by itchy places around the mouth and eyes. Atopic indications abate after debonding of the retainer [22].

There is little information regarding a comparison of efficiency in different types of retention. In his research, Artun compared a 3-year period of using four types of retainers in the lower dental arch (10):

- group 1 – fixed retainer made of thick, plain wire – 0.032 in., bonded to canines;
- group 2 – fixed retainer made of thick, spiral wire – 0.032 in., bonded to canines;
- group 3 – fixed retainer made of flexible, spiral wire 0.0205 in. in diameter, bonded to six anterior teeth;
- group 4 – removable acrylic retainer also covering the labial surface.

The screening was carried out on a small group of 35 patients regarding [10]:

- retainer failures, total amounts to 22.9%: group 1 – 9.1%, group 2 – 30.8%, group 3 – 27.3%, group 4 – 14.3%;
- loss of clinical attachment, examined by dental probe: group 1 – 0.85 mm, group 2 – 0.63 mm, group 3 – 0.62, group 4 – 0.72 mm.

Accumulation plaque and tartar around different types of retainers indicated no significant differences between groups. Although, there was a suspicion that along spiral wire reserve more accretions on teeth, a comparable amount of plaque and tartar was noticed around the gingival margin among the 4 groups. The condition of the gingiva was noticeably better after a 3-year period of retention than on the day of debonding, without any differences between the groups. Signs of caries or white spot lesions were not found, which is probably due to good flow of saliva in this area. An examination of incisor irregularity with the aid of the Irregularity Index (Little, 1975) shows a higher value after 3 years of follow-up than on the day of appliance removal. A significantly higher level of Little’s index was noticed among patients who lost retainers. The observation of retainers cemented only to canines showed a slight increase of the index in comparison to groups of retainers bonded to six teeth. To prevent the retainer’s failure, the authors recommend use of a wire made of five rather than three strands that reduces a stress fracture of the wire.

Another examination was done among a group of 58 patients, at least one year after removal of braces [23], with the functioning of flexible retainers 0.0175 inch in diameter – Wildcat® wire (GAC) bonded to six teeth with Concise (3M) with Hawley’s removable retainers. The research did not show any statistically significant difference between groups. The recurrence of crowding in the group with fixed retainers was 0.3 mm, in removable retainers 0.66 mm. The reason for the minimal increase of Little’s index was deformation of the wire. In order to reduce the risk of tooth movement, a thicker multistrand arch 0.0215 inch in diameter is recommended. It has been observed that fixed retainers were used more frequently among older patients, while removable retainers were used among patients where irregularity of incisors was noticed at the end of the active treatment.

The comparison of efficiency in the use of Hawley’s removable retainers and formed vacuuming.

Dentamid Dreve Druformat® (Dentamid) and Tru-tain® – 0.030 inch (Rochester). Among patients wearing retainers 24 hours/day for half a year and a year, the research did not show statistically significant differences among groups. However, the comparison of two kinds of retention while wearing them 3 months 24 hours/day and 3 months at night has presented a more stable effect of incisor alignment among patients with vacuum retainers. The research has concentrated on such parameters as: length and width of dental arch line and Little’s index. In long-term research, the major disadvantage of thermoplastic retainers was bursting and hampered stage of settling occlusion, while in the
Hawley’s retainer – bursting of the appliance. The advantage of vacuum retainers is: visual appearance, ease of performance and cost [24].

In research comparing the stability of treatment of Class I cases with four extractions, three methods of retention were evaluated [25]:
- group 1: vacuum-formed retainer in maxilla and retainer bonded to six teeth in mandibular arch;
- group 2: vacuum-formed retainer in maxilla and stripping of 10 adjoining surfaces in mandibular arch;
- group 3: positioner covering the tooth surface in the lower arch and upper arch (made of soft material – Ortho Tain® – Positioner).

A checkup was carried out after 12 and 24 months. The research claimed that all the methods of maintenance retention mentioned above were effective. There were slight differences between them e.g. formed retainers maintain better intercanine width than positioners. During the first couple of days, the retainers were worn in the day and at night, but after that period only at night. The main changes in occlusal appeared in the first year following debonding fixed retainer [25].

Reports regarding the choice of retention are not uniform. The research carried out among American orthodontists shows higher supremacy of vacuum retainers and fixed retainers over Hawley’s retainers. The reduction in popularity of extraction therapy has caused doctors to use fixed retainers in both arches, while those who use removable retainers recommend wearing them till the end of life [26].

Retention is an integral part of orthodontic treatment without which therapeutic success is impossible. Because of the functional and esthetic aspects of retention, a fixed lingual retainer bonded to each of six anterior teeth is the most popular in the lower dental arch. In the maxilla, retention is maintained mostly by removable retainers, sometimes in connection with fixed retainers [27].

The decision about the kind of treatment should be made individually, with the patient’s approval.

It may be concluded that fixed retainers are usually used in the anterior section of the mandible as the tendency for crowding and rotation is the highest in this section of dental arches. A great advantage is the small size of the appliance and the elimination of cooperation with the patient, although it requires precision and time. Nevertheless, due to all retention procedures, slight changes in occlusion may occur with both removable and fixed retainers, but it is not statistically significant.

References

Address for correspondence:
Agnieszka Pękala
Private Orthodontic Practice
Świętokrzyska 53/12
88-100 Inowroclaw
Poland
Tel.: 502 259 977
E-mail: agnieszka.orto@gmail.com

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