An overview of orthodontic retainers

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Orthodontic retention is the maintenance of the teeth in their ideal position from an aesthetic and functional point of view. The aim of this work is to illustrate the different orthodontic retainers. For this study we proceeded with a research of the abstract concerning this topic from the scientific archive "Pubmed" using terms relating to orthodontic retainers: 40 articles were selected from the research. In addition, 4 textbooks related to this topic have also been consulted. 7 fixed and 10 removable retainers have been identified. The most used retainers are the bonded ones for the lower arch and the Hawley and/or vacuum-formed ones for the upper one. Although numerous studies relating to orthodontic retention have been performed, there is no definitive evidence to identify the best type of orthodontic retainer.

Orthodontic retention can be defined as the maintenance of the teeth in their ideal position from an aesthetic and functional point of view: the purpose of the retainers is therefore to counteract the tendency of the teeth to return to their previous position (1). The choice of the type of retention must be individualized and must take into account: the severity of the initial malocclusion, the quality of the result achieved with the treatment, anatomical-functional characteristics, age, needs and collaboration of the patient (2). Orthodontic retainers can be accompanied by some surgical, gnathological and myofunctional procedures aimed at eliminating or controlling some etiological factors that may be present (3). Since numerous orthodontic retainers have been identified in the literature, the aim of this work is to illustrate them and their main characteristics to help the clinician in their daily practice.

MATERIALS AND METHODS

For this study we proceeded with a research of the abstracts concerning this topic from the scientific archive "Pubmed" using terms relating to orthodontic retainers such as 'orthodontic retainer', 'orthodontic retention' and 'orthodontic relapse'. Forty articles were selected. In addition, 4 textbooks related to this topic have also been consulted.

RESULTS

Seven fixed retainers were identified: multi-stranded wire retainer; thick wire retainer; fiber reinforced composites retainer (FRC); palatal/lingual arch; retainer with pontic; fixed prosthesis; space maintainer. 10 removable retainers were identified: Hawley retainer; Begg retainer; Schwarz appliance;

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Van der Linden retainer; vacuum-formed retainer (VFR); wraparound retainer; positioner; acetal ferula; Crozat removable appliance; Osamu retainer.

DISCUSSION

Multi-stranded wire retainer is an appliance made of multiple twisted-stranded stainless steel wires. It is bonded to the lingual surface of each tooth of the mandibular anterior sextant. At the level of the upper arch, however, it is less used for a greater risk of detachment due to masticatory trauma. The twisted wire offers a better mechanical retention of the composite than the other types of wire. Moreover, this retainer allows the physiological tooth mobility thanks to its elastic properties. Then it is essential that the wire is completely passive to avoid the onset of undesired movements of the teeth (4-6). Thick wire retainer is a stainless steel wire of variable diameter (usually .028, .030 or 0.32 inch) with a loop bent at each end that is bonded to the lingual surface of the lower canines. This retainer effectively maintains the intercanine width; furthermore, it prevents the lingual tipping of the lower incisors, but it hardly controls their rotations (7, 8). FRC is a glass fiber reinforced resin or polyethylene strip that is bonded to the lingual or palatal surfaces of the anterior teeth (from canine to canine). Its advantages are: transparency, aesthetics, ease of modeling, reduced plaque accumulation, comfort and reduced mechanical stress. Initially, the main disadvantage of this retainer was the stiffness, which determined a greater risk of failure than the multi-stranded wire retainer (51% *vs* 12%): however, the current mechanical characteristics have significantly reduced the difference in reliability between the two appliances (9-11). Palatal/lingual arch consists of a stainless steel wire with a diameter of 0.9 mm, welded to the bands. It is mainly used in the lower arch; it is useful to avoid changes in length or width of the arch and to prevent tooth rotations. Retainer with pontic is a metallic appliance, created in the dental laboratory, which is bonded to the palatal or lingual surface of the anterior teeth in patients with periodontitis or who have undergone important tooth movements on the vertical and sagittal plane. It can have pontics in case the patient lacks some teeth (12-17). Fixed prosthesis is used if one or more teeth are missing or to stabilize periodontally compromised teeth (18-25). Space maintainer is an orthodontic band to which a 0.9 mm diameter steel wire or a pontic is welded and it is used to prevent the mesialization of the tooth on which the band is cemented (13).

Regarding the removable appliance, Hawley retainer is the most common retainer, especially in the maxillary arch. The upper Hawley retainer consists of: an acrylic palatal cover; Adams' clasps on the upper first molars; a "U" loop labial bow, usually spanning from canine to canine. There are variants of this orthodontic appliance: for example, the labial bow can be welded to Adams' clasps or extended to the premolars to keep the spaces closed in patients who have undergone extractions. In addition, a bite plane lingual to the upper incisors can be added to this appliance, on which there is a slight contact of the lower incisors, which serves to maintain an adequate overbite and to avoid deep bite relapse (26-35). The Begg retainer differs from the Hawley retainer due to the fact that Adams' clasps are absent and the labial bow extends to the last molar in the arch and then it is incorporated into the acrylic that covers the palate. These characteristics permit a better settling of the occlusion and a lower risk of reopening the space between canine and premolar (36). The Schwarz appliance is a removable appliance consisting of an acrylic palatal cover, two Adams' clasps (or ball clasps) and a metallic or acrylic labial bow. It allows maintaining the sagittal and transversal dimensions of the dental arches (13). The Van der Linden retainer is an acrylic appliance for the upper arch with a labial bow (0.028 inch diameter stainless steel wire), passing between lateral incisor and canine, and "C" clasps that surround for three quarters the last molar in the arch. The acrylic palatal cover contacts the anterior teeth maintaining them in position, while material is removed at the level of the posterior teeth allowing the settling of the occlusion (37). VFR is a removable and clear appliance that is manufactured using a vacuum machine, which adapts heat-softened plastic to a cast by negative pressure. It is thin (0.5-1.5 mm) so as not to interfere too much with the occlusion. It can be used for orthodontic finishing, it is well tolerated by the patient for its transparency and can support

the home bleaching gels. However, it needs to be replaced periodically as it can deteriorate. Examples of VFRs include Invisalign® and Essix®. The Damon Splint is an appliance consisting of an upper and a lower Essix® connected to each other: in addition to acting as a retainer, it is also useful to rebalance any nighttime respiratory dysfunctions (38-41). Wraparound retainer consists of an acrylic structure, usually reinforced by a stainless steel wire, along the labial and lingual surfaces of the teeth of the entire arch. However, it shows disadvantages: it holds the teeth too firmly in place, not allowing the periodontal ligament to reorganize and it is less comfortable and less effective in maintaining overbite correction than the Hawley retainer. A variant of the wraparound retainer is the clip retainer or spring retainer: it consists of a stainless steel wire with a diameter of 0.9 mm adherent to the dental cervix of canines and covered with resin at the labial and lingual surfaces of the incisors. It is very effective in preventing relapse of crowding of the inferior anterior teeth. Moore retainer is a canine-to-canine clip retainer that extends distally on the lingual surface to the central groove of the first molar. It can be indicated in case of: treatment that involves the lower premolars extraction because it allows a good control of the closed space; misalignment of posterior teeth prior to orthodontic therapy (6). Positioner is a flexible horseshoe-shaped appliance that simultaneously incorporates the two arches, exceeding the neck of the teeth by 2-3 mm; it has breathing holes in the labial surface. It is an appliance that can be used both for the finishing and for the retention. The main advantage is to effectively maintain both the occlusal relationship and the tooth position. The major disadvantage is the difficulty in wearing it: in fact, this appliance should be worn for 4-6 weeks throughout the night and as much as possible during the day; subsequently it can be worn only at night for an unlimited period of time. It is indicated in highly compliant patients, with vicious oral habits or when the fixed appliance must be removed before the end of the treatment (42). The acetal ferula is an acetal resin strip that surrounds the teeth involved in the retention. It can be complete or partial; it is characterized by a good aesthetics. Furthermore, it has a high elastic memory and can be used as a passive or slightly active appliance if designed on set-up (43). Crozat removable appliance is an appliance made entirely of metal alloy consisting of a transverse bar, two Jackson clasps, two lingual arms that generally extend from the first molar to the first premolar and from additional elements that serve to maintain the space. It has less encumbrance and wear compared to the acrylic retainers and it is extremely precise (44-45). Osamu retainer is a thermoformed appliance made up of two superimposed layers: the inner layer is made of ethylene-vinyl acetate copolymer (thickness: 1.5 mm), it adapts to the interproximal areas and it covers the palatal and lingual surfaces of the teeth; the outer one is made of rigid elastic polycarbonate (thickness: 0.75 mm) and it covers the occlusal surfaces. This retainer is transparent, cheap, simple to build, thin and robust at the same time. It also allows to correct slight dental malpositions (46).

Fixed retention has the following advantages compared to the removable one: maximum efficacy, minimum encumbrance, good aesthetics, unnecessary patient compliance. The disadvantages are: impossibility of grading the use; impossibility to apply additional forces; difficulty in determining the time of removal; greater difficulty in maintaining an accurate oral hygiene; impediment of physiological occlusal settling (2). The most used retention appliances are the bonded retainer, the Hawley retainer and the vacuum-formed retainer (47). Currently, at the level of the mandibular arch, the multi-stranded wire retainer bonded to the anterior sextant is preferred to the other fixed and mobile appliances as it seems to have a greater effectiveness in maintaining the dental alignment (48-51). If a removable appliance is used for retention of the lower teeth, the vacuum-formed retainer appears to be slightly more performing than the Hawley one (52-55). The latter two appliances are the most chosen by orthodontists to avoid undesired movements of maxillary teeth: in general, their effectiveness is comparable (56), but patients prefer the vacuum-formed oens for their transparency and greater comfort (57-59). Regarding the effects on periodontal tissues, fixed retainers, especially the fiber reinforced composites ones, favor more plaque and tartar retention than mobile appliances (60). With regard to the survival of fixed retainers, fiber-

reinforced resin retainers have failure rates (fracture and detachment) now comparable to the metallic wire ones because their mechanical properties have been improved and their bonding occurs under rubber dam isolation (61-62). The detachment of the fiber-reinforced resin retainer occurs mainly due to the failure of adhesion at the level of the composite-enamel interface, while instead the metallic wire retainer detaches because the retention at the composite-retainer interface is lost (63). On the other hand, removable appliances, if compared to each other, do not seem to have large differences in survival time; lower Hawley and vacuum-formed retainers tend to break more easily than the upper ones because of their thinner thicknesses (64). Although numerous studies regarding orthodontic retainers have been performed, there is no evidence to provide definitive recommendations on retention procedures after fixed orthodontic treatment (65).

The most used retainers are the bonded retainer for the lower arch and the Hawley and/or vacuum-formed retainer for the upper one, but there is no definitive evidence to identify the best type of orthodontic retainer.

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