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Dental materials:

The multi-stranded wire retainer

Fixed retainers offer many advantages for the orthodontic patient, including reduced need for patient compliance, better aesthetics and long-term stability, with the multi-stranded wire retainer, the gold standard, explains **J. I. J. Green**¹

Abstract

Retention is the phase of orthodontics that aims to preserve teeth in their desired positions after active orthodontic treatment and is achieved with fixed or removable retainers. Fixed retainers offer many advantages over the removable type: reduced need for patient compliance, better

aesthetics and predictable long-term stability. The first fixed retainer consisted of a stainless steel wire soldered to bands on the canines or premolars but today they are usually bonded to the teeth with light-cured composite. Many materials and wire diameters have been proposed; this article focuses on the multi-stranded wire retainer, which has become the gold standard for maintaining incisor alignment.

Introduction

Studies have found that teeth have a tendency to relapse to their pre-treatment positions in around 70% of orthodontic treatment cases.¹⁻³ The aetiology of this phenomenon is not completely understood but is probably related to growth, the periodontium, soft tissue pressures or the occlusion³ and less likely to be linked to the degree of tooth movement,⁴⁻⁷ number of extractions or pre-treatment tooth positions.^{6,8} Therefore patients will invariably need to wear retainers after orthodontic treatment to maintain teeth in their new positions. There is no accepted duration for this retention phase but on average, in relation to the periodontium, it takes a minimum of 232 days for the periodontal fibres to become accustomed to the new tooth positions.⁹

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Table 1. Advantages and disadvantages of bonded retainers

Advantages	Disadvantages
When compared with removable retainers:	More complicated oral hygiene procedures
Requires little patient compliance	Possible obstruction of the occlusion
Superior aesthetics	Impassive wire can result in unwanted tooth movement
More predictable long-term retention	
Specific to multi-stranded wire retainers:	
Flexibility of the wire allows for physiological tooth movement	
Irregular surface should give increased mechanical retention for the composite	

A retention period of 12 months is commonly recommended because of this¹⁰ but relapse can still occur after this time because of skeletal growth and maturation of the soft tissue, so indefinite retention has been advocated to minimise this.^{11,12} Long term retention is commonly achieved with fixed retainers, especially for the lower anterior teeth.^{13,14}

have since been proposed but the multi-stranded wire, introduced by Björn Zachrisson,^{17,18} is now the gold standard.¹³ Multi-stranded wire is round or rectangular in cross-section and formed from strands that are twisted (Fig. 1), arranged coaxially (five wires of equal size wrapped around a single, core of wire of the same-size) (Fig. 2) or

Fig. 1 Three stranded twisted round wire

Fig. 2 Six stranded coaxial round wire

Fig. 3 Eight stranded braided rectangular wire

‘MULTI-STRANDED WIRE HAS BEEN A SUCCESSFUL MATERIAL FOR BONDED RETAINERS BECAUSE ITS FLEXIBILITY ALLOWS FOR PHYSIOLOGICAL TOOTH MOVEMENT,²² MEANING THAT TEETH CAN MOVE INDEPENDENTLY OF ONE ANOTHER’

Fixed retainers

The first fixed retainer consisted of a length of stainless steel wire fitted to the lingual surface of the anterior teeth and soldered to bands on the canines or premolars. The first retainer to be bonded directly to the teeth was reported by Rupert Kneirim¹⁵ and consisted of a length of 0.028" (0.7mm) stainless steel wire, adapted to the lingual surfaces of the lower anterior teeth and bonded to the canines. Bonded retainers have the same advantages as banded retainers but also offer greater aesthetics.^{15,16} Numerous wire diameters and materials

braided (Fig. 3).^{13,19-21} Multi-stranded wire for retainers is most commonly round in cross-section, made from stainless steel and is widely available in imperial (0.015" to 0.0215") and metric (0.38mm to 0.5mm) sizes from various orthodontic supply companies. Gold (0.5mm) and titanium (0.44mm and 0.5mm) multi-stranded wire is also available (Dentaurum, Ispringen, Germany).

Advantages and disadvantages

Bonded retainers require less patient compliance, improved aesthetics and

predictable long-term retention compared with removable retainers.¹³

Multi-stranded wire has been a successful material for bonded retainers because its flexibility allows for physiological tooth movement,²² meaning that teeth can move independently of one another, making bond failure less likely.^{13,21} The irregular surface of this material means that it has a greater surface area than regular wire, which should give increased mechanical retention for the composite.¹⁸

It is generally accepted that bonded retainers complicate oral hygiene procedures²³ but while the presence of a bonded retainer has been associated with an increased incidence of gingival recession, increased plaque accumulation and increased bleeding on probing,²⁴ it does not necessarily lead to caries,^{23,24} affect periodontal health^{22,25} or lead to long-term tissue damage.^{26,27}

As with all bonded retainers, care needs to

Fig. 4 A 0.0195" stainless steel three stranded wire retainer for the upper anterior teeth

Fig. 5 A 0.0195" stainless steel three stranded wire retainer for the lower anterior teeth

Fig. 6 Upper and lower retainers on models to ensure the wire does not impede the occlusion

be taken to ensure that the wire or composite does not obstruct the occlusion and torque may be introduced if the wire is not entirely passive, which can result in unwanted tooth movement.²⁸

The advantages and disadvantages of bonded retainers are summarised in Table 1.

Fabrication

The retainer will typically consist of a length of stainless steel multi-stranded wire bonded to the mid third of the palatal or lingual surfaces of each tooth in the anterior segment (Fig. 4 and 5) with composite. They can involve fewer teeth or may be extended around the second premolar to prevent space reopening in extraction cases.¹⁵ The retainer extends two thirds of the width of the last tooth involved to allow for composite encapsulation of the wire ends. The retainer may be fabricated directly on the teeth at the chairside or on a model. If constructing on a model, upper and

lower impressions and a bite registration are necessary, even in cases where only an upper or lower retainer is required to confirm that the wire does not interfere with the occlusion (Fig. 6).

Fitting

Bonded retainer positioning can be assisted with dental floss, elastic separators²⁹ or ligature wires. The use of an acrylic transfer tray,^{30,31} molar bands,³² ceramic locking elements³³ and magnets^{34,35} have also been reported. Using a transfer stent has been found to be statistically significantly quicker than direct bonding.³⁶

The enamel surface is cleaned and may be sandblasted to ensure that there is no moisture contamination prior to bonding. Light-cured composites are the favoured material for bonding the retainer.³⁷ A 1mm thickness of composite is used, any more can result in plaque retention and gingival inflammation.³⁸ Glass ionomer cements are another option and these will bond to wet enamel surfaces and release fluoride to reduce the decalcification risk. Glass ionomers have a lower bond strength than composites but this should be sufficient for bonded retainers.^{39,40}

Long term maintenance

While a bonded retainer may offer a 'permanent' retention solution, long term monitoring is required, as with any other appliance. Failure rates have been the focus of many studies^{13,27,41–46} and vary between 11%¹³ and 50%.²⁷ Failures are more commonly seen during the first six months after bonding.^{43,44} Early failure is likely to be due to insufficient saliva isolation during bonding or insufficient composite. Failure after this period will probably be due to composite abrasion, occlusal forces or wire fatigue.^{43,47}

A thicker wire is likely to have a higher detachment rate because of increased rigidity^{47,48} but thinner wires can be distorted and will fracture more easily.²¹ Bonded retainers in the upper arch tend to have a higher failure rate than the lower arch, especially if extended to the canines^{21,43} – this may be because upper fixed retainers are exposed to greater occlusal forces.

Bonded retainers can fail due to a stress fracture of the wire or debond at the adhesive-enamel or wire-composite interface.²⁶ The wire-composite interface has been reported as the most frequent site of failure, usually because of composite abrasion.³⁷ This bond can be improved by sandblasting the wire ends prior to bonding. Sandblasting the enamel and avoiding wire movement during bonding should avoid bond failure at the adhesive-enamel interface.²⁶

Conclusion

While no retention system is without its drawbacks, fixed retainers offer a significant benefit in that they need little patient compliance beyond keeping them clean. They are usually bonded to the palatal or lingual surfaces of the teeth, so are generally considered more aesthetic than removable retainers. The multi-stranded wire retainer has been found to deliver an effective method of providing long term retention because its flexibility permits physiological tooth movement and its greater surface area should give better mechanical retention for the composite.

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