

# Fixed retainers in orthodontics

Tanes Ouejaraphant\* Udom Thongudomporn\*

## **Abstract**

*Relapse, the loss of any correction achieved by orthodontic treatment, is the major problem after remove orthodontic appliance as a result of teeth returning to their initial position. Hence, retention is necessary to maintain the treatment result accomplished through active stage of orthodontic treatment. It can be achieved by placing either removable or fixed retainers. The objective of the review is to describe the fixed retainers, including their indications, bonding method, advantages and disadvantages, and failure of fixed retainers.*

**Keywords:** Fixed retainer; retention; relapse

\*Orthodontic section Department of Preventive Dentistry, Faculty of Dentistry, Prince of Songkla University Hatyai, Songkhla

## Introduction

Moyers<sup>1</sup> defined the retention after orthodontic treatment as, "the holding of teeth following orthodontic treatment in the treated position for the period of time necessary for the maintenance of the result" or by Riedel<sup>2</sup> as "the holding of teeth in ideal aesthetic and functional position." The objective of retention is to maintain the teeth in final position for periodontal and gingival remodeling and to minimize changes from growth. Orthodontic relapse is the common problem after realignment tooth by orthodontic treatment.<sup>3</sup> It has been reported that 70–90% of the orthodontically treated cases presented varying degree of relapse during the post retention period. Lower dental arch generally occurred orthodontic relapse more than upper arch.<sup>4</sup> Orthodontic relapse related to a number of factors such as retention period, compliance of patient, growth and final occlusion after treatment.<sup>5</sup> In addition, the mesial migration of teeth effect crowding especially for the lower anterior teeth. Moreover, many studies conclude that the most malocclusion is unstable after treatment in the long-term and that stability is unpredictable.<sup>6</sup>

The etiology of orthodontic relapse is still unclear because the periodontal fibers around the teeth are complex so the lower anterior teeth crowding increased throughout life. It has been suggested that maintaining teeth in their corrected positions after orthodontic treatment has been and continue to be a challenge. According to Zachrisson<sup>7</sup>, orthodontic treatment have to include overcorrection, circumferential supracrestal fiberotomy (CSF), interproximal reduction and control of third molar germs for preventing the etiology of late crowding.<sup>8</sup> The methods preventing relapse are obtained from long-term retention and it should has been maintained more than half of the active treatment time or should not less than 232 days so the fibers around the teeth can reorganized. Minimized the relapse, all patients have to use some type of retainer.<sup>9</sup>

Retainer appliances can be broadly classified as removable appliance and fixed

appliance. Removable retainers are usually used in orthodontic practice but the main disadvantage is the effective of appliance is depended on patient cooperation. Fixed retainers are normally used in intra-arch instability and in case that have to obtain prolong retention.<sup>10</sup> Various types of fixed retainers have been introduced, to minimize the need for patient compliance.

## Development of fixed retainer

The acid-etch technique became a new technique in dentistry. In 1965, Newman<sup>11</sup> first presented bond orthodontic attachments to tooth surfaces directly. Plain round or rectangular orthodontic wires were initially made in bonded fixed retainer. In 1977, Zachrisson<sup>12</sup> presented the benefits of using custom multistranded wires bonded to the lingual surface of tooth to attain long term retention. Artun and Zachrisson<sup>13</sup> first reported the clinical use of a multistrand wire canine-to-canine bonded fixed retainer that the wire was bonded only on canines. In 1983, Zachrisson<sup>14</sup> described the use of bonding multistranded wire on labial surface of teeth. Using the multistranded wire as a bonded fixed retainer has two major advantages. First, increase in mechanical retention from its irregular surface for the composite resin without the use of retention loops.<sup>14</sup> Second, from its flexibility, allowing physiologic movement of the teeth.<sup>15</sup>

Canine-to-canine boned fixed retainers have to fabricate from a wire which rigid enough to resist distortion over the rather long span between these teeth. Such retainers are classified into three generation.<sup>7, 16</sup> The first generation, retainers were designed in normal round 0.032 to 0.036" blue elgiloy wire with a retention loop at each terminal end. In 1983, there were replaced by a twisted, three stranded 0.032" wire. The second generation, instead of retention loop, retention was obtained from spiral wire. It has been used for more than 10 years with bond failure rates less than 15%. However, spiral wire was less comfortable to the tongue than a smooth or round wire.

The third generation, canine-to-canine

boned fixed retainer was harder and easier to use than second generation wire. Allowing the retainer to conform to the lingual surfaces of the anterior teeth during bonding. This design also had advantages over mandibular retainers in which all six anterior teeth were bonded. The only disadvantage of the third generation canine-to-canine bonded fixed retainer is the possibility of teeth to move labially. Although, there were protected by the upper anterior teeth in case of normal overjet and overbite.

Resin fiberglass strips were developed by Michael<sup>17</sup> as for an alternative to multistranded wire. The direct technique solved the major problem of canine-to-canine bonded fixed retainer and reduced preparation time. This system uses glass fiber from woven fiberglass fabric. The main advantage of the resin fiberglass strips is the high rigid of the retainer. Furthermore, the smooth margin, thinness of the retainer, tooth-colored material of resin fiberglass also provide patient appreciation and comfort. Resin fiberglass strips can be easily recontoured, repaired and removed in the mouth. The disadvantages of a rigid material are restricted physiologic tooth movement and increased a failure rate. Recently, solid

gold chain has been introduced. The advantages of the solid gold chain are high flexibility and can be bonded in place easily, which means no laboratory involvement is required. In addition, solid gold chain decreased failure rate due to its undercut and increased surface area which result in an improved bond strength. Moreover, due to its composition, 14 karats white gold, it can increase in patient comfort. High cost is the only disadvantage of this material. However, Aldrees et al<sup>18</sup> compared initial bond strength of solid gold chain and multistrand wire with three lingual retainer composites in vitro study. This study found that the bond strength from multistrand wire was higher when compared to solid gold chain.

Fixed retainers can also be classified according to their location: *lingual*, the most commonly used (Figure 1), *palatal*, less frequently used because of occlusal interference (Figure 2), and *labial*, rarely used because of esthetic limitation. It is also used only in some case that impossibility bonded the retainer from lingual or palatal side, for example the maintenance of closed extraction gaps, severe rotated teeth or palatally dis-placed canines.



**Figure 1** Mandibular lingual fixed retainer.



**Figure 2** Maxilla palatal fixed retainer.

### *Bonding methods*

Bonding fixed retainer can be broadly classified as direct and indirect techniques.<sup>19</sup> Direct techniques: The fixed retainer wire is adapted to tooth surface and checked clinically in the patient's mouth or on a model. Indirect techniques: This technique has been described to simplify the clinical procedure by directly placing composite resin on the model then a transfer splint is made by the technician. A silicone impression is performed to transfer the retainer to the teeth.

### *Materials used for bonded fixed retainer*

Materials used for bonded fixed retainer fabrication are; *wires*, the evolution of the bonded fixed retainer wires have mentioned above<sup>11</sup>, *composite resin*, a conventional restorative composite has been used for bonding the retainers. To improve its handling properties, several orthodontists suggested diluting it. Other bonding materials such as an unfilled acrylic resin; an UV light-activated conventional composite or a microfilled composite that consisted of 52.6% filler content had been tried. Also, hybrid composites had been used.<sup>20</sup>

### *Indications*

The major indications of bonded fixed retainer consist of many factors. The main purpose of bonded fixed retainer is holding teeth in alignment. The bonded fixed retainer attached only to the lingual surface of the anterior teeth.

This prevents the anterior teeth move lingually or buccally and effective in maintaining correction of rotations tooth.<sup>7</sup> Another indication of bonded fixed retainer is maintaining the closure of space between teeth. Even though, frenectomy has been performed, there is a tendency of space re-opening between incisors so the purpose of the retainer is to hold the teeth together to prevent relapse.<sup>14, 20-22</sup>

A bonded fixed retainer is also introduced to preserve space for a bridge pontic or implant by decreasing the mobility of the adjacent teeth, making it easier to place the fixed bridge. A bonded fixed retainer can be used full time without patient co-operation but removable retainer may make space re-open if the retainer isn't worn. It has been advocated that the elastic fibers of the periodontal ligament are complicated. Therefore, long term retention protocol for derotated teeth is necessary. Periodontal compromised orthodontic patients with crestal bone loss and those with root resorption have an increased risk of relapse after orthodontic treatment. Permanent retention is recommended in these cases.

### *Considerations about bonded fixed retainer*

There are many advantages of fixed retainer consist of the esthetic of bonded fixed retainer is more than removable retainer because fixed retainer locate at lingual side, long term prevention of recurrence of crowding in the mandibular anterior segment

that produce more stability and patient's compliance is good.<sup>14, 20, 21, 23</sup>

However, the main disadvantages of fixed retainers are discomfort or harmful to soft and hard tissue, deteriorated effectiveness, the potential for tooth movement because of distortion or lack of passivity of the wire and hygiene problems but it remain controversy. Pandis et al.<sup>24</sup> found that long-term bonded fixed retainer causes calculus deposition, gingival recession, and periodontal pockets or probing depths. Interproximal and areas adjacent to the wire have been shown to deposit of plaque and calculus thus cause inflammation of the tissue around it. Nevertheless, César Neto et al.<sup>25</sup> evaluated the periodontal health between anterior teeth that retained a bonded fixed retainer with non-bonded fixed retainer group. It was found that there was no clinically significant difference in the periodontal health between those 2 groups regarding to plaque index, gingival recession, bleeding on probing, pocket probing depths, clinical attachment level gingival.

#### *Failure of bonded fixed retainer*

The common clinical complication of bonded fixed retention is the failure of bonded lingual retainers. The dislodgement of bonded fixed retainer either adhesive or cohesive failure from the wire-composite interface, the adhesive-tooth surface interface or in the adhesive-adhesive interface. Moreover, stress concentration of the wire can also make the wire fracture.<sup>16</sup> In 2005, Butler et al.<sup>16</sup> reported that the failure rates between the wire-composite interface and the rate of fracture are similar. In 1997, Bearn et al.<sup>26</sup> described that the wire-composite interface is the most common failure area. However, Lumsden et al.<sup>27</sup> reported that fracture rate occurred at the adhesive-adhesive interface more than at the wire-composite interface and found that early failures were the result of adhesive failures and fracture of the wire. Study from Lie Sam Foek et al.<sup>28</sup> reported that the highest failure rate occurred in the first 6 months after placement of bonded fixed retainer. The most

common causes of these failures were debonding, fracture plus debonding and fracture respectively.

Many studies have investigated on failure rate of bonded fixed retainers. This information is reported the failure of both maxillary and mandibular bonded fixed retainers. Failure rates reported for bonded fixed retainers range from 10.3% to 47.0%.<sup>14</sup> In the maxilla, failure rate of bonded fixed retainers range from 48% to 50% and from 15% to 20% for individual attachments. But in the mandible, failure rate of bond fixed retainers range from 15% to 20% and 4.4% for individual attachments. Seeing that failure rates of bonded fixed retainers in maxilla is greater than mandible because lower anterior teeth may occlude to the upper bonded fixed retainer.<sup>14</sup> Dahl and Zachrisson<sup>14</sup> reported lower failure rates when using concise composite resin and 0.0215" diameter Penta one wire.

Bonded failure rates of metal retainers range from 3.5 to 53%<sup>10</sup> but bonded failure rates of resin fiberglass range from 11% to 51%.<sup>29</sup> Bonded fixed retainers often requiring long-term retention, the method that can decrease the failure rate of bonded fixed retainer is necessary. Failure at wire-composite interface in bonded fixed retainers may result from fracture within the composite because of the deformation of the fixed retainer wire.<sup>30</sup> So choosing the wire is the main factor to minimize the failure rate of bonded fixed retainer. The most common failure occurs at wire-composite interface. Detachment of the wire from adhesive layer because lack of adhesive or loss of adhesive due to function, such as mastication and tooth brushing, causes the detachment of the wire from the adhesive layer.<sup>12, 31</sup> The abrasion of bonded fixed retainers caused by function such as mastication and toothbrushing. Moreover, abrasive of composite resin in bonded fixed retainer has been founded up to 62% of subjects.<sup>32</sup>

#### **Conclusion**

Retention phase after orthodontic treatment is the key of successful result.

Currently, lingual bonded fixed retainers are widely used for long-term orthodontic retention. By the way, the phase of retention should not less than half of the active phase of orthodontic treatment after that the retention appliance can be left gradually.

Nevertheless, the most obvious difficulty of using bonded fixed retainers is from the patient compliance. It involves with the difficulty in maintaining the oral hygiene and more chances of dental diseases such as dental caries, tooth demineralization and periodontal disease due to plaque and calculus accumulation adjacent to the bonded fixed retainer wire.

According to the literature review, relapse after orthodontic treatment is unpredictable. There are probably many underlying causes. Furthermore, new materials and technologies may be utilized to simplify the clinical procedure, reduce any clinical errors and complications. Therefore it is important to improve not only patient compliance, but also keep orthodontists up to date to new knowledge.

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***Corresponding author***

*Tanes Ouejaraphant  
Orthodontic section  
Department of Preventive Dentistry,  
Faculty of Dentistry,  
Prince of Songkla University  
Hatyai, Songkhla 90112  
Tel: 081-5413100  
Email: O\_Tanes@hotmail.com*

## เครื่องมือคงสภาพการจัดฟันชนิดติดแน่นในงานทันตกรรมจัดฟัน

ทพ.ชเนศ เอื้อเจียรพันธ์\* อุดม ทองอุดมพร\*

### บทคัดย่อ

การคืนกลับสภาพหลังรักษาทางทันตกรรมจัดฟัน จัดเป็นปัญหาหลักที่เกิดขึ้นหลังจากการ ถอดเครื่องมือจัดฟัน เนื่องจากฟันที่ได้รับการรักษาสามารถเคลื่อนกลับตำแหน่งเดิมก่อนการรักษา ดังนั้นการคงสภาพฟันหลังการรักษา ถือเป็นปัจจัยสำคัญที่จะรักษาสภาพของผลการรักษา ทางทันตกรรมจัดฟัน โดยการคงสภาพฟันสามารถทำได้โดยใช้เครื่องมือคงสภาพการจัดฟันชนิดถอดได้ หรือเครื่องมือคงสภาพการจัดฟันชนิดติดแน่น

วัตถุประสงค์ของการของบททวนบทความปริทัศน์ เพื่ออธิบายข้อบ่งใช้, วิธีการยึดติด, ข้อดีและข้อเสียและความล้มเหลวของเครื่องมือคงสภาพการจัดฟันชนิดติดแน่น

คำสำคัญ: เครื่องมือคงสภาพการจัดฟันชนิดติดแน่น; การคงสภาพฟัน; การคืนกลับ

\*ภาควิชาทันตกรรมป้องกัน, คณะทันตแพทยศาสตร์, มหาวิทยาลัยสงขลานครินทร์, อ.หาดใหญ่, จ.สงขลา