Stability and Side Effects of Orthodontic Retainers - A Systematic Review

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Abstract

Background: The role of orthodontic retainers in maintaining stability after orthodontic treatment, and side effects associated with orthodontic retainers have not been well established.

Objective: To investigate whether fixed retainers improve stability after orthodontic treatment, or increase the risk of side effects on the teeth and periodontium in comparison with removable retainers, no retainer, or fiberotomy.

Methods: A systematic literature search was conducted in PubMed, Embase, the Cochrane Library, HTA-databases of NHS Centre for Reviews and Dissemination, Swedish Council on Health Technology Assessment (SBU), Norwegian Knowledge Centre for the Health Services (NOKC), Danish Health and Medicines Authority, and reference lists. Data extraction was verified by at least two authors. The quality of evidence was rated. Meta-analysis was not suitable.

Results: Two systematic reviews (SR), two randomized controlled trials (RCT), four non-randomized controlled studies (CT), and five case series were included. The SRs were well reported, but addressed issues that differed from the addressed question, or did not add to the identified primary studies. Both RCTs and CTs had study limitations, and problems with directness and/or precision. None of the studies compared fixed retainers to fiberotomy.

Conclusion: According to the literature there is only low quality of evidence, that treatment stability may be improved by a fixed retainer after orthodontic treatment in comparison with a removable retainer, or no retainer (GRADE ⋅⃝⃝⃝). Furthermore, there is very low quality of evidence, whether periodontal outcomes, dental caries prevalence, or presence of calculus differ between the various types of retainer regimens (GRADE ⋅⃝⃝⃝).}

Keywords: Orthodontic retainers; Post treatment; Post retention; Systematic review

Abbreviations: CT: Non-randomized Controlled Studies; GRADE: Grading of Recommendations, Assessment, Development and Evaluation; PICO: Population, Intervention, Comparators, outcomes; RCT: Randomized Controlled Trial; SR: Systematic Review

Introduction

Orthodontic treatment in general accomplish well-aligned teeth and a good occlusion. After the teeth have been orthodontically moved into the new position, it takes approximately a year for the surrounding tissues to adapt [1]. If the teeth are not retained during this period a relapse usually occurs, meaning that the teeth return towards their original position. Studies have demonstrated that most of the irregularities appear during the first two years post treatment [2,3].

In addition to the relapse after orthodontic treatment there is a continuous risk that the teeth change position throughout life due to inheritance/genetics and aging processes [4]. The ongoing mesial migration of teeth usually results in a gradual crowding especially for the lower front teeth. Many studies have tried to find predictors of stability without success. A review article from 2006 concludes that most malocclusions are unstable after treatment in the long-term and that stability is unpredictable at the individual level [5].

It is of great importance for the patient to achieve long-term conservation of the orthodontic treatment result. The orthodontic treatment takes up to two years and is often associated with a substantial cost. These two years are demanding for the patient with regular visits to the orthodontist, pain, discomfort, problems to maintain oral hygiene, and difficulties to eat certain types of food. Furthermore, the patient is exposed to potential side effects including root resorption/shortening and increased a risk of caries.

Patients often receive retainers after the fixed appliance is removed since it is difficult to predict stability on an individual level and because it is important for the patient to maintain the treatment results.

Retainers can be produced chair side or by a dental technician after a dental impression, and they can be fixed or removable. The fixed retainers are custom made of metal and are bonded to the teeth on the lingual side with composite resin. Fixed retainers usually span the six front teeth, although the extension varies. The removable retainers, usually covers all the teeth and can be vacuum formed or in the form of an acrylic splint with clasps. The vacuum formed splints can be made chair side on casts the acrylic splints need to be constructed by a dental technician. The fixed retainers and the removable retainers can be used separately or together and the protocols vary. The choice of retainers is a matter of preference and tradition. For the patients there are both pros and cons. The bonded lingual retainer is invisible, but requires proper oral hygiene and frequent maintenance by the dentist. With the removable retainer there is no oral hygiene problem, but patient compliance is important since the patient must remember to use the retainer, and not to lose it.

Fiberoptomy, i.e. cutting the gingival fibers after finishing orthodontic treatment, is another retention approach aiming to shorten the adaption time of the surrounding tissues, in order to prevent relapse.

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This systematic review was initiated to investigate whether fixed retainers improve stability after orthodontic treatment, or increase the risk of side effects on the teeth and periodontium in comparison with removable retainers, no retainer, or fiberotomy.

Materials and Methods

The predefined focused question was: ‘do fixed retainers improve stability after orthodontic treatment, and do they increase the risk of side effects on the teeth and periodontium in comparison with removable retainers, no retainer, or fiberotomy?’

To be included the studies had to concur with the predefined focused question from which the PICO (population, intervention, comparators, outcomes), was derived, and be within the predefined limitations (see below). After the protocol was set (27 September 2013) the focused question or the PICO were not changed.

Population

Patients treated with fixed appliance due to malocclusion of teeth (excluding malocclusion caused by periodontitis or trauma).

Intervention

Fixed retainer for more than two years, after orthodontic treatment.

Comparators

Removable retainer(-s) for more than two years, or no retainer, or fiberotomy.

Outcomes

Treatment stability (of teeth alignment measured by validated index); periodontal outcomes (i.e. alveolar bone level, attachment loss, gingival recession); dental caries; dental plaque (i.e. biofilm); calculus; gingivitis; complications (e.g. retainer failure).

Limitations Study design

systematic review (SR); randomized controlled trials (RCT); non-randomized, controlled study (CT); case series if ≥ 60 patients (only regarding retainer complications); no case reports or narrative reviews.

Languages

English, Swedish, Norwegian, Danish.

Publication date: Year 1977-, except for the outcome ‘treatment stability’, for which the limit was set at year 2005-, when a comprehensive systematic review from The Swedish Council on Technology Assessment in Health Care was published [6].

Literature searches

Systematic literature searches were conducted (30 September 2013) in PubMed, Embase, the Cochrane Library, and the HTA-databases of NHS Centre for Reviews and Dissemination, the Swedish Council on Health Technology Assessment (SBU), Norwegian Knowledge Centre for the Health Services (NOKC) and Danish Health and Medicines Authority, by two of the authors (ELD, AL), specially trained for search strategies in health technology assessment and SRs. Reference lists of relevant articles were scrutinized for additional references. Detailed search strategies are accounted for in the Appendix, and a graphic presentation of the selection process is presented in Figure 1. Two authors (ELD, AL) selected studies and independently assessed the obtained abstracts.

Figure 1: Selection process – PRISMA flow diagram according Moher et al. [22].
for initial selection of full-text articles for inclusion or exclusion. Any disagreements were resolved in consensus.

Study appraisal and rating of evidence

Two of the authors with previous experience in conducting SRs (OS, PS) trained the other authors in study appraisal and rating of the evidence. All included studies were critically appraised. The appraisal of RCTs, and CTs was based on checklists from The Swedish Council on Health Technology Assessment (SBU) [7,8], and the SRs were appraised using the AMSTAR checklist [9]. Case-series were not critically appraised or included in the rating of the quality of evidence. Data extraction from the included studies was verified by at least two authors, for each outcome. In a separate meeting the quality of evidence was rated, for all the studied outcomes separately, across the studies, according to the GRADE approach [10]. Since only two RCTs were available, no meta-analysis was attempted.

Results

Study selection

The literature search identified a total of 1,151 articles, after removal of duplicates (Figure 1). Two authors (ELD, AL) then excluded 1,038 articles after reading the abstracts. Additionally, 77 articles were excluded after reading the articles in full text. The remaining 36 articles were sent to all the authors, who read the articles independently. In a consensus meeting 13 articles were included in the systematic review.

There were two SRs, two RCTs, and four CTs that had studied the effect of a fixed retainer compared to a removable retainer, or to no retainer, after orthodontic treatment.

None of the included studies had compared fixed retainer with fiberotomy.

Five case series were included with regard to complications. Study characteristics of the included articles are presented in Table 1, and excluded articles in Table 2.

Methodological quality

The SRs were well reported, but addressed issues that differed from the here addressed question, or did not add to the included primary studies. Littlewood et al. included only one of the studies included in the present SR [2], whereas Bondemark et al. evaluated morphologic

<table>
<thead>
<tr>
<th>Article</th>
<th>Study Design</th>
<th>Follow-up period (years)</th>
<th>Study Groups: Intervention vs control</th>
<th>Patients (n)</th>
<th>Mean Age (years)</th>
<th>Men/women</th>
<th>Outcome variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bondemark et al. (2007) [5]</td>
<td>Systematic review</td>
<td>≥ 5 years</td>
<td>Various different</td>
<td>38 studies</td>
<td>nr</td>
<td>nr</td>
<td>Treatment stability</td>
</tr>
<tr>
<td>Littlewood et al. (2006a) [2]</td>
<td>Systematic review</td>
<td>&gt; 3 months</td>
<td>Various different</td>
<td>5 studies</td>
<td>nr</td>
<td>nr</td>
<td>Treatment stability Retainer failure</td>
</tr>
<tr>
<td>Edman Tynellius et al. (2013) [13]</td>
<td>RCT</td>
<td>2 years</td>
<td>Removable upper retainer and fixed lower retainer</td>
<td>25</td>
<td>14</td>
<td>30/45</td>
<td>Treatment stability Retainer failure</td>
</tr>
<tr>
<td>Artun et al. (1997) [11]</td>
<td>RCT</td>
<td>3 years</td>
<td>Fixed retainer</td>
<td>35</td>
<td>N/A</td>
<td>N/A</td>
<td>Calculus Dental caries Gingivitis Incisor irregularity Loss of attachment Plaque Retainer failure</td>
</tr>
<tr>
<td>Levin et al. (2008) [16]</td>
<td>CT</td>
<td>4.6 years</td>
<td>Fixed retainer (mixed groups)</td>
<td>41</td>
<td>N/A</td>
<td>N/A</td>
<td>Treatment stability Alveolar bone level Calculus Dental caries Periodontitis (Gingival recession) Gingivitis Plaque Retainer failure</td>
</tr>
<tr>
<td>Rody et al. (2011) [15]</td>
<td>CT</td>
<td>≥ 4 years</td>
<td>Fixed retainer</td>
<td>10</td>
<td>28</td>
<td>7-May</td>
<td>Gingivitis</td>
</tr>
<tr>
<td>Artun (1984) [14]</td>
<td>CT</td>
<td>1-9 years</td>
<td>Fixed 3-3 retainer</td>
<td>49</td>
<td>17</td>
<td>19</td>
<td>Calculus Dental caries Gingivitis</td>
</tr>
<tr>
<td>Andrén et al. (1998) [18]</td>
<td>Case-series</td>
<td>≥ 5 years</td>
<td>Fixed retainer</td>
<td>103</td>
<td>35</td>
<td>22/81</td>
<td>Complications</td>
</tr>
</tbody>
</table>
stability and patient satisfaction after at least five years of orthodontic treatment [5]. Thus, the SRs were only commented on.

The RCTs had some, or major study limitations (risk of bias), mainly regarding randomization and blinding, and had problems with directness and/or precision (Table 3).

None of the four CTs were blinded, and all had some, or major problems regarding directness and precision (Table 3).

**Summary of findings and quality of evidence**

**Fixed orthodontic retainer versus removable retainer** -

### Articles

<table>
<thead>
<tr>
<th>Author(s) and Year</th>
<th>Study Design</th>
<th>Reason for exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Booth et al. (2008) [24]</td>
<td>Case-series</td>
<td>Wrong comparison (time point when retainer was lost was not stated)</td>
</tr>
<tr>
<td>Danz et al. (2012) [25]</td>
<td>Case-series</td>
<td>Wrong patient groups (data not extractable for different types of retainers)</td>
</tr>
<tr>
<td>Devreese et al. (2007) [26]</td>
<td>Case-series</td>
<td>Wrong outcome (case-series, no complications reported)</td>
</tr>
<tr>
<td>Freitas et al. (2013) [27]</td>
<td>Case-series</td>
<td>Wrong intervention and comparison (compares other interventions)</td>
</tr>
<tr>
<td>Johnson et al. (2007) [28]</td>
<td>Case-series</td>
<td>Wrong intervention and comparison (compares two clinics)</td>
</tr>
<tr>
<td>Kuipers et al. (2009) [29]</td>
<td>Case-series</td>
<td>Wrong outcome (studies occlusal changes)</td>
</tr>
<tr>
<td>Lagerström et al. (2011) [30]</td>
<td>Case-series</td>
<td>Wrong comparison (time point when retainer was lost was not stated)</td>
</tr>
<tr>
<td>Lagravere et al. (2005) [31]</td>
<td>Case-series</td>
<td>Wrong intervention (studies rapid maxillary expansion)</td>
</tr>
<tr>
<td>Littlewood et al. (2006b) [3]</td>
<td>Case-series</td>
<td>Same data as in Littlewood et al., 2006a</td>
</tr>
<tr>
<td>Maia et al. (2010) [33]</td>
<td>Case-series</td>
<td>Wrong outcome (case-series, no complications reported)</td>
</tr>
<tr>
<td>McNamara et al. (2003) [34]</td>
<td>Case-series</td>
<td>Wrong intervention (studies rapid maxillary expansion vs. no orthodontics)</td>
</tr>
<tr>
<td>Millet et al. (2012) [35]</td>
<td>Case-series</td>
<td>Wrong Intervention studied in systematic review</td>
</tr>
<tr>
<td>Morton and Pancherz (2009) [36]</td>
<td>Case-series</td>
<td>Wrong outcome (case-series, no complications reported)</td>
</tr>
<tr>
<td>Myser et al. (2013) [37]</td>
<td>Case-series</td>
<td>Case-series with too few patients (included 25 out of 66 eligible)</td>
</tr>
<tr>
<td>Renkema et al. (2008) [38]</td>
<td>Case-series</td>
<td>Data not extractable</td>
</tr>
<tr>
<td>Renkema et al. (2013a) [39]</td>
<td>Case-series</td>
<td>Wrong outcome (case-series does not study complications)</td>
</tr>
<tr>
<td>Renkema et al. (2013b) [40]</td>
<td>Case-series</td>
<td>Wrong intervention (does not study retainer)</td>
</tr>
<tr>
<td>Renkema et al. (2013c) [41]</td>
<td>Case-series</td>
<td>Wrong intervention (does not study retainer)</td>
</tr>
<tr>
<td>Sari et al. (2009) [42]</td>
<td>Case-series</td>
<td>Wrong intervention (too short follow-up)</td>
</tr>
<tr>
<td>SBU (2005) [8]</td>
<td>Case-series</td>
<td>Data presented in Bondemark et al., 2007</td>
</tr>
<tr>
<td>Tofeldt et al. (2007) [43]</td>
<td>Case-series</td>
<td>Wrong intervention and comparison (compares two clinics)</td>
</tr>
</tbody>
</table>

### Table 2: Excluded articles (alphabetically, with reasons for exclusion).

### Table 3: Study limitations in controlled studies.

<table>
<thead>
<tr>
<th>Article / Study design</th>
<th>Random generation</th>
<th>Allocation concealment</th>
<th>Blinding of participants and personnel</th>
<th>Blinding of outcome assessment</th>
<th>Incomplete outcome data</th>
<th>Selective reporting</th>
<th>Other bias</th>
<th>Directness</th>
<th>Precision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerny et al. (2010) [12] / CT</td>
<td>Na</td>
<td>Na</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Levin et al. (2008) [16] / CT</td>
<td>Na</td>
<td>Na</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Rodv et al. (2011) [15] / CT</td>
<td>Na</td>
<td>Na</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Artun (1984) [14] / CT</td>
<td>Na</td>
<td>Na</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* = low risk/no problems; ? = unclear risk/some problems; + = high risk/major problems; CT = non-randomised controlled study; Na = Not applicable; RCT = Randomised controlled trial


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**Treatment stability:** The SRs did not report comparisons of different types of retainers [2,5]. Two RCTs and one CT compared treatment stability with fixed retainer and removable retainer [11-13] (Table 4). The RCT by Edman Tynelius et al., reported significantly better treatment stability after two years of retention in the lower dental for a fixed retainer (change in Little’s irregularity index, LII: 0.6) compared to removable retainers (Δ LII: 1.6) [13]. There was also a significant difference regarding other measurements of dental alignment between

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study design</th>
<th>Number of patients (n)</th>
<th>Withdrawals - dropouts</th>
<th>Results</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edman Tynelius, 2013 [13]</td>
<td>Sweden</td>
<td>RCT</td>
<td>n=75</td>
<td></td>
<td></td>
<td>Little’s Irregularity Index (LII)= the linear distance from anatomic contact point to adjacent anatomic contact point of mandibular anterior teeth (sum of five measurements) Group 1= upper removable retainer (vacuum formed) and lower fixed retainer. Group 2= upper removable retainer (vacuum formed) and lower stripping. Group 3= removable retainer upper and lower (positioner).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>n=6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Maxilla</td>
<td>Group 1 at 2 years: Δ LII 0.5 (sd 0.8)</td>
<td>Group 2 at 2 years: Δ LII 0.9 (sd 1.1)</td>
<td>Group 3 at 2 years: Δ LII 1.1 (sd 1.4) ns.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Intercanine width maxilla</td>
<td>Group 1 at 2 years: Δ -1.0 mm (sd 0.8)</td>
<td>Group 2 at 2 years: Δ -1.0 mm (sd 1.0)</td>
<td>Group 3 at 2 years: Δ -1.1 mm (sd 1.2) p&lt;0.001 group 1 &amp; 2 vs. group 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mandible</td>
<td>Group 1 at 2 years: Δ LII 0.6 (sd 0.7)</td>
<td>Group 2 at 2 years: Δ LII 0.9 (sd 0.8)</td>
<td>Group 3 at 2 years: Δ LII 1.6 (sd 1.4) p&lt;0.001 between group 1 and 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Occlusal traits</td>
<td>Overjet Group 1 at 2 years: Δ -0.3 mm (sd 1.1)</td>
<td>Group 2 at 2 years: Δ 0.5 mm (sd 1.1)</td>
<td>Group 3 at 2 years: Δ 0.9 mm (sd 1.0) p&lt;0.05 between group 1 and 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Overbite</td>
<td>Group 2 at 2 years: Δ 0.4mm (sd 0.9)</td>
<td>Group 3 at 2 years: Δ 0.2mm (sd 1.3) ns.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intercanine width mandible</td>
<td>Group 1 at 2 years: Δ -1.8 mm (sd 1.5) p&lt;0.01 group 1 &amp; 2 vs. group 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intercanine width mandible</td>
<td>Group 2 at 2 years: Δ -1.1 mm (sd 1.2) p&lt;0.001 group 1 vs. group2 &amp; 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intercanine width mandible</td>
<td>Group 3 at 2 years: Δ -1.1 mm (sd 1.2) p&lt;0.001 group 1 vs. group2 &amp; 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intercanine width mandible</td>
<td>Group 2 at 2 years: Δ -1.0 mm (sd 1.0)</td>
<td>Group 3 at 2 years: Δ -1.1 mm (sd 1.2) p&lt;0.001 group 1 vs. group2 &amp; 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Occlusal traits</td>
<td>Intermolar widths and arch lengths were statistically non-significant. between groups</td>
<td></td>
</tr>
</tbody>
</table>

**Author, year**
- Edman Tynelius, 2013 [13]

**Country**
- Sweden

**Study design**
- RCT

**Number of patients (n)**
- Maxilla: Group 1 = 25, Group 2 = 25, Group 3 = 25
- Mandible: Group 1 = 25, Group 2 = 25, Group 3 = 25
- Overjet Group 1, Group 2, Group 3
- Overbite Group 1, Group 2, Group 3
- Intercanine width maxilla Group 1, Group 2, Group 3
- Intercanine width mandible Group 1, Group 2, Group 3

**Results**
- Maxilla
  - Group 1 at 2 years: Δ LII 0.5 (sd 0.8)
  - Group 2 at 2 years: Δ LII 0.9 (sd 1.1)
  - Group 3 at 2 years: Δ LII 1.1 (sd 1.4) ns.

- Mandible
  - Group 1 at 2 years: Δ LII 0.6 (sd 0.7)
  - Group 2 at 2 years: Δ LII 0.9 (sd 0.8)
  - Group 3 at 2 years: Δ LII 1.6 (sd 1.4)

- Occlusal traits
  - Overjet: Group 1 at 2 years: Δ -0.3 mm (sd 1.1)
  - Group 2 at 2 years: Δ 0.5 mm (sd 1.1)
  - Group 3 at 2 years: Δ 0.9 mm (sd 1.0)

- Overbite: Group 2 at 2 years: Δ 0.4 mm (sd 0.9)

- Intercanine width maxilla: Group 1 at 2 years: Δ -1.0 mm (sd 0.8)

- Intercanine width mandible: Group 1 at 2 years: Δ -1.1 mm (sd 1.2)

the three study groups, but the interventions were mixed between upper and lower arch, which made it difficult to draw clinically meaningful conclusions. The other RCT did not report significant differences regarding treatment stability [11].

The CT reported a significantly higher proportion of relapse in the removable retainer group [12]. However, the outcome was not reported on the individual patient level, but on the dental arch level. Furthermore, there was no information of baseline characteristics of the study groups.

**Conclusion:** Treatment stability may be improved by fixed retainer compared to removable retainer. Low quality of evidence (GRADE ⊕⊖⊖⊖).

Fixed orthodontic retainer versus removable retainer - Periodontal outcomes: One RCT and three CTs reported on periodontal outcomes after treatment with fixed retainer and removable retainer [11,12,14,15]. One CT reported statistically significant (0.27 mm), but not clinically important, deeper gingival crevices in the fixed retainer group than in the removable retainer group [14]. There were no significant differences between study groups group in any other periodontal outcomes, across the studies (Table 5).

**Conclusion:** It is uncertain whether periodontal outcomes differ between fixed retainer and removable retainer. Very low quality of evidence (GRADE ⊕⊖⊖⊖).

Fixed orthodontic retainer versus removable retainer - Dental caries: One RCT and two CTs reported on caries prevalence after treatment with fixed retainer and removable retainer [11,12,14,15]. No dental caries was detected in the study groups (Table 6).

**Conclusion:** It is uncertain whether the prevalence of dental caries differs between individuals with fixed retainer or removable retainer. Very low quality of evidence (GRADE ⊕⊖⊖⊖).

Fixed orthodontic retainer versus removable retainer - Gingivitis: One RCT and three CTs reported prevalence of gingivitis after treatment with fixed retainer versus removable retainer [11,12,14,15]. There were no significant differences between the study groups (Table 7).

**Conclusion:** It is uncertain whether accumulation of dental plaque differs between individuals with fixed retainer or removable retainer. Very low quality of evidence (GRADE ⊕⊖⊖⊖).

### Table 4: Fixed orthodontic retainer versus removable retainer - Treatment stability (alphabetically, according to study design)

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline</th>
<th>At 3 years</th>
<th>At 15 years follow up:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>0.65 (se 0.24)</td>
<td>1.19 (se 0.27)</td>
<td>No relapse: 7.0% p&lt;0.001</td>
</tr>
<tr>
<td>Group 2</td>
<td>0.90 (se 0.08)</td>
<td>0.36 (se 0.12)</td>
<td>Mild relapse: 40% p&lt;0.001</td>
</tr>
<tr>
<td>Group 3</td>
<td>0.30 (se 0.16)</td>
<td>0.30 (se 0.16)</td>
<td>Moderate relapse: 42% p&lt;0.001</td>
</tr>
<tr>
<td>Group 4</td>
<td>0.25 (se 0.16)</td>
<td>1.19 (se 0.27)</td>
<td>Severe relapse: 11% ns.</td>
</tr>
</tbody>
</table>

Little's Irregularity Index

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline</th>
<th>At 3 years</th>
<th>At 15 years follow up:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>0.36 (se 0.13)</td>
<td>0.66 (se 0.25)</td>
<td>No relapse: 7.0% p&lt;0.001</td>
</tr>
<tr>
<td>Group 2</td>
<td>0.65 (se 0.13)</td>
<td>0.36 (se 0.12)</td>
<td>Mild relapse: 40% p&lt;0.001</td>
</tr>
<tr>
<td>Group 3</td>
<td>0.30 (se 0.16)</td>
<td>0.30 (se 0.16)</td>
<td>Moderate relapse: 42% p&lt;0.001</td>
</tr>
<tr>
<td>Group 4</td>
<td>0.25 (se 0.16)</td>
<td>1.19 (se 0.27)</td>
<td>Severe relapse: 11% ns.</td>
</tr>
</tbody>
</table>

Mean: 3.37 mm

The retainers were used different times for different individuals, after treatment. The groups were analyzed according to retainer type used for each dental arch. Not for each individual. Smokers and those >50 years were excluded from analysis.

**Conclusion:** It is uncertain whether presence of calculus differs between individuals with fixed retainer or removable retainer. Very low quality of evidence (GRADE ⊕⊖⊖⊖).

Fixed orthodontic retainer versus removable retainer - Calculus: One RCT and two CTs reported on presence of calculus after treatment with fixed retainer and removable retainer [11,12,14,15]. There were no significant differences between the study groups (Table 8).

**Conclusion:** It is uncertain whether presence of calculus differs between individuals with fixed retainer or removable retainer. Very low quality of evidence (GRADE ⊕⊖⊖⊖).

Fixed orthodontic retainer versus removable retainer - Gingivitis: One RCT and three CTs reported prevalence of gingivitis after treatment with fixed retainer versus removable retainer [11,12,14,15]. None of the studies reported significant difference between individuals with fixed or removable retainers (Table 9).
**Table 5**: Fixed orthodontic retainer versus removable retainer - Periodontal outcomes (alphabetically, according to study design).

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study design</th>
<th>Number of patients (n)</th>
<th>With withdrawals - dropouts</th>
<th>Result</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artun, 1997 [11]</td>
<td>USA</td>
<td>RCT</td>
<td>n=49</td>
<td>?a</td>
<td>Group 1: 0.85mm (sd 0.55)</td>
<td>Group 4: 0.72mm (sd 0.33) ns.</td>
</tr>
<tr>
<td>Cerny, 2010 [12]</td>
<td>UK</td>
<td>CT</td>
<td>n=61</td>
<td>?a</td>
<td>No gingival recession</td>
<td>No gingival recession</td>
</tr>
<tr>
<td>Rody, 2011 [15]</td>
<td>Canada</td>
<td>CT</td>
<td>n=31</td>
<td>?a</td>
<td>Group 1 Incisor: 1.85 mm (sd 0.81) Premolar: 2.15 mm (sd 0.94)</td>
<td>Group 2 Incisor: 1.68 mm (sd 0.46) Premolar: 2.04 mm (sd 0.56) ns.</td>
</tr>
<tr>
<td>Artun, 1984 [14]</td>
<td>Norway</td>
<td>CT</td>
<td>n=108</td>
<td>?a</td>
<td>Group 3 1.87mm (sd 0.44)</td>
<td>Group 4 1.60mm (sd 0.31) p&lt;0.05</td>
</tr>
</tbody>
</table>

*a*Withdrawals and drop-out not explicitly stated. CT = non-randomised, controlled study. ns = not significant

**Conclusion:** It is uncertain whether prevalence of gingivitis differs between individuals with fixed retainer or removable retainer. Very low quality of evidence (GRADE ⬜⬜⬜⬜).  

**Fixed orthodontic retainer versus no retainer - Treatment stability:** None of the included studies reported this outcome.  

**Fixed orthodontic retainer versus no retainer - Periodontal outcomes:** Three CTs compared periodontal outcomes in subjects with fixed retainer or without any type of retainer [14-16]. Only Levin et al., reported significantly less lingual gingival retraction in the removable retainer group, but the difference was not clinically important (0.08 mm) [16] (Table 10).  

**Conclusion:** It is uncertain whether periodontal outcomes differ between individuals with fixed retainer or no retainer. Very low quality of evidence (GRADE ⬜⬜⬜⬜).  

**Fixed orthodontic retainer versus no retainer - Dental caries:** One CT reported on caries prevalence after treatment with fixed retainer or with no retainer [14]. No caries was detected on the lingual surfaces in the two study groups (Table 11).
Table 6 Fixed orthodontic retainer versus removable retainer - Dental caries (alphabetically, according to study design).

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study design</th>
<th>Number of patients (n)</th>
<th>With withdrawals - dropouts</th>
<th>Result</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artun, 1997</td>
<td>USA</td>
<td>RCT</td>
<td>n=49</td>
<td>?&lt;sup&gt;a&lt;/sup&gt;</td>
<td>No caries</td>
<td>Group 1= Mandibular cuspid retainer .032 plain wire. Group 2= Mandibular cuspid retainer .032 spiral wire. Group 3= Mandibular 3-3 retainer .0205 flexible spiral wire. Group 4= Removable lower retainer. Cuspid retainer- bonded only to cuspids. 3-3 retainer- bonded to each tooth.</td>
</tr>
<tr>
<td>Cerny, 2010</td>
<td>UK</td>
<td>CT</td>
<td>n=61</td>
<td>?&lt;sup&gt;a&lt;/sup&gt;</td>
<td>No caries</td>
<td>Group 1= Permanent bonded retainer (PBR ) (upper or lower) Group 2= Removable retainer (RR). Smokers and those &gt;50 years were excluded from analysis.</td>
</tr>
<tr>
<td>Artun, 1984</td>
<td>Norway</td>
<td>CT</td>
<td>n=108</td>
<td>?&lt;sup&gt;a&lt;/sup&gt;</td>
<td>No caries</td>
<td>Group 1= Mandibular cuspid retainer .032 spiral wire. Group 2= Mandibular cuspid retainer .032 plain wire. Group 3= Maxillary .0195 flexible spiral wire retainer. Group 4= Maxillary retainer plate. (Group 5= No retainer). Cuspid retainer= bonded only to cuspids. 3-3 retainer= bonded to each tooth.</td>
</tr>
</tbody>
</table>

*Withdrawals and drop-outs not explicitly stated. CT = non-randomised, controlled study. ns = not significant.
Conclusion: It is uncertain whether caries prevalence differs between individuals with fixed retainer or no retainer. Very low quality of evidence (GRADE ⊕⃝⃝⃝).

Fixed orthodontic retainer versus no retainer - Dental plaque: Three CTs reported on dental plaque accumulation after treatment with fixed retainer or with no retainer [14-16]. Two of them reported a significantly higher accumulation of plaque on the tooth surfaces adjacent to the fixed retainer compared to same tooth surfaces in individuals without a retainer, 82% vs. 52%, and 60% vs. 10%, respectively [14, 16] (Table 12).

Conclusion: It is uncertain whether fixed retainer contributes to increased accumulation of dental plaque compared to no retainer. Very low quality of evidence (GRADE ⊕⃝⃝⃝) (Table 12).

Fixed orthodontic retainer versus no retainer – Calculus: One CT reported on the presence of calculus after treatment with fixed retainer or with no retainer [14]. There was no significant difference between the study groups (Table 13).

Conclusion: It is uncertain whether presence of calculus differs between individuals with fixed retainer or no retainer. Very low quality of evidence (GRADE ⊕⃝⃝⃝).

Fixed orthodontic retainer versus no retainer – Gingivitis: Three CTs reported prevalence of gingivitis after treatment with fixed retainer

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study design</th>
<th>Number of patients (n)</th>
<th>With withdrawals - dropouts</th>
<th>Results</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artun, 1997</td>
<td>USA</td>
<td>RCT</td>
<td>n=49</td>
<td>7a</td>
<td>Group 1 = Mandibular cuspid retainer .032 plain wire.</td>
<td>Calculus index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group 1: n=11</td>
<td>Group 1: Baseline: 16.67 (se 8.03) At 3 years: 3.33 (se 2.22)</td>
<td>Group 2 = Mandibular cuspid retainer .032 spiral wire.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group 2: n=13</td>
<td>Group 2: Baseline: 8.64 (se 4.45) At 3 years: 3.09 (se 3.09)</td>
<td>Group 3 = Mandibular 3-3 retainer .0205 flexible spiral wire.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group 4: n=14</td>
<td>Group 4: Baseline: 9.52 (se 5.45) At 3 years: 8.33 (se 5.61) ns.</td>
<td>Cuspid retainer- bonded only to cuspids. 3-3 retainer- bonded to each tooth.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Group 5: n=25)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Artun, 1984 [14]  
Norway  
CT  
n=108  
Group 1:  
n= 31  
Group 2:  
n=18  
Group 3:  
n=14  
Group 4:  
n=20  
(Group 5:  
n= 25)  
?  
Gingivally along wire:  
Group 1  
Interproximal:  
0.22 (sd 0.37)  
Lingual:  
0.15 (sd 0.28)  
Group 2  
Interproximal:  
0.54 (sd 0.53)  
Lingual:  
0.37 (sd 0.43)  
p<0.05 (group 1 vs. 2)  
Gingival margin:  
Group 3  
Interproximal:  
0 (sd 0)  
Lingual:  
0 (sd 0)  
ns. (group 1 vs. 2)  
Gingival margin:  
Group 4  
Interproximal:  
0 (sd 0)  
Lingual:  
0 (sd 0)  
ns. (group 1 vs. 2)  
Presence of calculus at different locations (different calculus indices)  
Group 1= Mandibular cuspid retainer .032 spiral wire.  
Group 2= Mandibular cuspid retainer .032 plain wire.  
Group 3= Maxillary .0195 flexible spiral wire retainer.  
Group 4= Maxillary retainer plate (Group 5= No retainer).  
Cuspid retainer = bonded only to cuspids.  
3-3- retainer = bonded to each tooth.

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study design</th>
<th>Number of patients (n)</th>
<th>Withdrawals - dropouts</th>
<th>Result</th>
<th>Comments</th>
</tr>
</thead>
</table>
Group1: n=11  
Group 2:  
n=13  
Group 3:  
n=11  
Group 4:  
n=14 | 7 a | Group 3  
Baseline:  
1.14 (se 0.07)  
At 3 years:  
0.39 (se 0.15)  
Gingivitis  
Group 1 = Mandibular cuspid retainer .032 plain wire.  
Group 2 = Mandibular cuspid retainer .032 spiral wire.  
Group 3 = Mandibular 3-3 retainer .0205 flexible spiral wire.  
Group 4 = Removable lower retainer.  
Cuspid retainer- bonded only to cuspids.  
3-3 retainer- bonded to each tooth. |
or with no retainer [14–16]. In two of the studies, there was significantly more gingivitis in areas adjacent to the fixed retainer compared to same areas in individuals without retainer [14,16] (Table 14).

**Conclusion:** It is uncertain whether the prevalence of gingivitis is higher among individuals with fixed retainer compared to those with no retainer. Very low quality of evidence (GRADE ⊕⃝⃝⃝).

**Fixed orthodontic retainer versus removable retainer, no retainer – Complications:** Complications were reported in two RCTs [11, 13], one CT [12], and in five case series [17–21]. The most common complication reported in the studies was retainer failure. The incidence varied substantially across the studies with a range from 0% to 100% of the retainers. In the SR by Littlewood et al., there were no reported differences in the technical survival rates of fixed or removable retainers over three years follow-up [2]. This conclusion was based on data from Årtun et al. [11]. However, in the more recently published RCT failures were significantly more common for fixed retainers [13] (Table 15).

**Fixed orthodontic retainer versus fiberotomy:** No studies were identified in which fixed retainer was compared with fiberotomy. The ratings of the quality of evidence (GRADE) for different outcomes regarding fixed orthodontic retainer versus removable retainer are presented in Table 16, and regarding fixed orthodontic retainer versus no retainer in Table 17.

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Design</th>
<th>n</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>Modified gingival index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerny, 2010</td>
<td>UK</td>
<td>CT</td>
<td>61</td>
<td>n=46</td>
<td>n=43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rod, 2011</td>
<td>Canada</td>
<td>CT</td>
<td>31</td>
<td>n=10</td>
<td>n=11</td>
<td>(Group 3: n=10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artun, 1984</td>
<td>Norway</td>
<td>CT</td>
<td>108</td>
<td>n=31</td>
<td>n=18</td>
<td>n=14</td>
<td>n=20</td>
<td>(Group 5: n=25)</td>
</tr>
</tbody>
</table>

Table 9: Fixed orthodontic retainer versus removable retainer – Gingivitis (alphabetically, according to study design).

Withdrawals and drop-outs not explicitly stated. CT = non-randomised, controlled study. ns = not significant

or with no retainer [14–16]. In two of the studies, there was significantly more gingivitis in areas adjacent to the fixed retainer compared to same areas in individuals without retainer [14,16] (Table 14).

**Conclusion:** It is uncertain whether the prevalence of gingivitis is higher among individuals with fixed retainer compared to those with no retainer. Very low quality of evidence (GRADE ⊕⃝⃝⃝).

**Fixed orthodontic retainer versus removable retainer, no retainer – Complications:** Complications were reported in two RCTs [11, 13], one CT [12], and in five case series [17–21]. The most common complication reported in the studies was retainer failure. The incidence varied substantially across the studies with a range from 0% to 100% of the retainers. In the SR by Littlewood et al., there were no reported differences in the technical survival rates of fixed or removable retainers over three years follow-up [2]. This conclusion was based on data from Årtun et al. [11]. However, in the more recently published RCT failures were significantly more common for fixed retainers [13] (Table 15).

**Fixed orthodontic retainer versus fiberotomy:** No studies were identified in which fixed retainer was compared with fiberotomy. The ratings of the quality of evidence (GRADE) for different outcomes regarding fixed orthodontic retainer versus removable retainer are presented in Table 16, and regarding fixed orthodontic retainer versus no retainer in Table 17.
### Discussion

The objective was to systematically review and estimate whether fixed retainers improve stability after orthodontic treatment, or increase the risk of side effects on the teeth and periodontium in comparison with removable retainers, no retainer, or fiberotomy. The literature search was comprehensive, and included several databases, as well as hand searches in the references lists of relevant articles. Throughout the study conduct the PRISMA recommendations were followed [22], and the rating of evidence was performed according to the GRADE approach [10]. We consider the summary of findings representative for the addressed question: ‘do fixed retainers improve stability after orthodontic treatment, and do they increase the risk of side effects on the teeth and periodontium in comparison with removable retainers, no retainer, or fiberotomy?’

Two RCTs were identified [11,13], both of which had study limitations, mainly regarding randomization and blinding, as well as problems with directness and/or precision. None of the CTs were blinded, and all had problems regarding directness and precision. Altogether, these aspects reduced the confidence in the effect estimates for different outcomes, reported across the studies. Therefore, the quality of evidence was low, or very low for all the studied outcomes. It was very difficult to estimate effects of different outcomes across the studies, since the studies were heterogeneous in their design (only two were RCT), in the methodological aspects, methods for outcome measurements, as well as the studied interventions, and follow-up periods. Thus, a meta-analysis was not deemed suitable.

The main findings were that, based on low quality of evidence (GRADE ⊕⊕), treatment stability may be improved by a fixed...
Table 12: Fixed orthodontic retainer versus no retainer - Dental plaque (alphabetically, according to study design).

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study design</th>
<th>Number of patients (n)</th>
<th>With withdrawals - dropouts</th>
<th>Intervention Fixed retainer</th>
<th>Control No retainer</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levin, 2008 [16]</td>
<td>Israel</td>
<td>CT</td>
<td>n=92</td>
<td>n=0</td>
<td>Group 1</td>
<td>Group 2</td>
<td>Group 1 = One or two fixed retainers. Group 2 = No retainer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group 1: n=48 dental arches</td>
<td></td>
<td></td>
<td>Lingual 82.4%</td>
<td>Lingual 51.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group 2: n=72 dental arches</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group 1: n=10 (Group 2: n=11)</td>
<td></td>
<td></td>
<td>Incisors: 60% (sd 51.6)</td>
<td>Incisors: 10% (sd 31.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group 3: n=10</td>
<td></td>
<td></td>
<td>Premolars: 10% (sd 31.6)</td>
<td>Premolars: 0% (sd 0)</td>
</tr>
<tr>
<td>Artun, 1984 [14]</td>
<td>Norway</td>
<td>CT</td>
<td>n=108</td>
<td>?</td>
<td>Group 1 and Group 2</td>
<td>Group 5</td>
<td>Plaque along the gingival margin</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group 1: n= 31</td>
<td></td>
<td></td>
<td>Interproximal: Mean: 0.94 (sd 0.57)</td>
<td>Interproximal: Mean: 1.12 (sd 0.59)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group 2: n=18</td>
<td></td>
<td></td>
<td>Lingual: Mean: 0.59 (sd 0.48)</td>
<td>Lingual: Mean: 0.62 (sd 0.48)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group 3: n=14 (Group 4: n=20)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group 5: n= 25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 13: Fixed orthodontic retainer versus no retainer – Calculus (alphabetically, according to study design).

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study design</th>
<th>Number of patients (n)</th>
<th>With withdrawals - dropouts</th>
<th>Intervention Fixed retainer</th>
<th>Control No retainer</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group 1: n= 31</td>
<td></td>
<td></td>
<td>Interproximal: Mean: 0.37 (sd 0.39)</td>
<td>Interproximal: Mean: 0.38 (sd 0.36)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group 2: n=18</td>
<td></td>
<td></td>
<td>Lingual: Mean: 0.22 (sd 0.29)</td>
<td>Lingual: Mean: 0.14 (sd 0.20)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group 3: n=14 (Group 4: n=20)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group 5: n= 25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As the results from this study indicate, there is only weak evidence that treatment stability increase with retainers. Although the ‘retainer or not retainer’ discussion is considered ‘parachute-research’ for an orthodontist, especially for those with long experience, the reality is different. Theoretically, by keeping the teeth together the retainer prevents them from moving. However, not all the teeth are fixed with the retainer. Furthermore, there is always a risk that the retainer fractures or loosens without the patient being aware of or noticing it.
Thus, it is still unknown to what extent, or to what net gain, long-term retention contributes to maintain the orthodontic treatment results.

This systematic review also indicate that there are a lots of maintenance problems, especially with the fixed retainers since they frequently fail or fracture. This contributes to an additional workload for the dentist and orthodontist, as well as to a cost increase for the

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study design</th>
<th>Number of patients (n)</th>
<th>With withdrawals - dropouts</th>
<th>Results</th>
<th>Control</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levin, 2008</td>
<td>Israel</td>
<td>CT</td>
<td>n=92 Group 1: n=48</td>
<td></td>
<td>Intervention Fixed retainer</td>
<td>Control No retainer</td>
<td>Bleeding on probing Group 1: One or two fixed retainers. Group 2: No retainer.</td>
</tr>
<tr>
<td>Rody, 2011</td>
<td>Canada</td>
<td>CT</td>
<td>n=31 Group 1: n=10</td>
<td></td>
<td>Group 1 Failure rate: 30% (sd 48.3)</td>
<td>Group 3 Incisor: 20% (sd 42.16)</td>
<td>Bleeding on probing Group 1: 3-3 fixed lower retainer. Group 2: Removable lower retainer. Group 3: No retainer.</td>
</tr>
<tr>
<td>Artun, 1984</td>
<td>Norway</td>
<td>CT</td>
<td>n=108 Group 1: n=31</td>
<td></td>
<td>Group 1 and 2 GI Failure rate: 10% (sd 0.13)</td>
<td>Group 5 GI Mean: 1.13 (sd 0.15)</td>
<td>Gingival index (GI) Non bleeding papilla (NBP) Group 1= Mandibular cuspid retainer .032 spiral wire. Group 2= Mandibular cuspid retainer .032 plain wire. Group 3= Maxillary .0195 flexible spiral wire retainer. Group 4= Maxillary retainer plate. Group 5= No retainer. Cuspid retainer = bonded only to cuspid 3-3, retainer = bonded to each tooth.</td>
</tr>
</tbody>
</table>

*Withdrawals and drop-outs not explicitly stated. CT = non-randomised, controlled study. ns = not significant.

Table 14: Fixed orthodontic retainer versus no retainer – Gingivitis (alphabetically, according to study design).
### Dahl, 1991 [17]
- **Sweden**
- **Case-series**
- n=153
  - Group 1: n=81
  - Group 2: n=72
- **Loosening (n=retainers)**
  - Group 1
    - Maxilla: 14/56 (25.0%)
    - Mandible: 3/29 (10.3%)
  - Group 2
    - Maxilla: 5/84 (7.8%)
    - Mandible: 1/17 (5.9%)
- **Wire fracture (n=retainers)**
  - Group 1
    - Maxilla: 13/56 (23.2%)
    - Mandible: 3/29 (10.3%)
  - Group 2
    - Maxilla: 2/84 (3.1%)
    - Mandible: 0/17 (0.0%)

### Renkema, 2011 [21]
- **Netherlands**
- **Case-series**
- n=221
- At least one bonding failure 70/221 (31.7%)
- Less failures in incisors than canines p<0.001
- Central vs. lateral incisors ns.

### Störmann, 2002 [19]
- **Germany**
- **Case-series**
- n=103
  - Group 1: n=31
  - Group 2: n=38
  - Group 3: n=34
- Failure (% retainers)
  - Group 1: 29%
  - Group 2: 53%
  - Group 3: 18%
- Increased patient discomfort with cuspid retainer

### Tacken, 2010 [20]
- **Belgium**
- **Case-series**
- n=275
  - Group 1: n=45
  - Group 2: n=48
  - Group 3: n=91
  - Group 4: n= 90
- **Success rate (n=retainers)**
  - Group 1 and 2: (92/186) 49%
  - Group 3: 161/182 (88%) p<0.001
  - Failure
    - Group T and 2: Maxilla
    - Broken retainer 37/48 (77%) of all failures
    - Mandible: Loosening 34/46 (74%) of all failures
    - Group 3: Maxilla
    - Loosening 10/13 (77%) of all failures
    - Mandible: Loosening 8/8 (100%) of all failures

**Table 15**: Fixed orthodontic retainer versus removable retainer, or no retainer - Complications (alphabetically, according to study design).

*Withdrawals and drop-outs not explicitly stated. CT = non-randomised, controlled study. ns = not significant
patient and/or the dental care provider, depending on the health care system. An alternative to the use of fixed retainers is to lay the full responsibility on the patients by providing them with removable retainers, or to remove the bonded retainers after a few years and allow for natural aging of the occlusion.

Taken together, many patients receive retainers after orthodontic treatment that are kept for extended periods up to 10-20 years or even longer. This is time consuming and costly, and requires a lot of resources. It is therefore of important, not only for the patient but also health care providers and decision makers, to have high quality of evidence on; to what extent the retainers contribute to maintain treatment stability, which retainers are most effective, and what side effects can be expected of retainers in the long term. Therefore clinical studies need to be undertaken to answer these questions.

Conclusion

According to the literature there is only low quality of evidence, that treatment stability may be improved by a fixed retainer after orthodontic treatment in comparison with a removable retainer, or no retainer (GRADE ⊕⊕⊕⊖). Furthermore, there is very low quality of evidence, whether periodontal outcomes, dental caries prevalence, or presence of calculus differ between the various types of retainer regimens (GRADE ⊕⊖⊕⊖).

Adequately designed long-term studies on the effects and risks of different retainer regimens after orthodontic treatment are needed.

References