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# Hayder's Proposed Fixed Banded 4 x 4 Retainer

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## ABSTRACT

*Orthodontic retention involves keeping teeth in their ideal aesthetic and functional positions after treatment. Although the necessity of the retention phase has long been debated among orthodontists, it is now widely accepted as crucial for maintaining treatment results. Effective retention methods prevent relapse and enhance patient satisfaction. Initially, removable appliances were used, but fixed retainers later gained popularity due to their aesthetic demand, independence from patient compliance, effectiveness, and suitability for lifelong use. However, the new proposed Hayder's fixed banded 4 x 4 retainer was suggested in this article to overcome the drawbacks of the fixed bonded type including the need for precise bonding, fragility, and potential to cause periodontal issues due to compromised oral hygiene.*

## Keywords

Orthodontic, Retention, Tooth stability, Relapse, Fixed retainer.

## Introduction and Review of Literature

The primary motivation for patients seeking orthodontic treatment is to improve the appearance of their front teeth, addressing issues such as crowding or spacing. However, the stability of the treatment outcome, particularly for the upper and lower incisors, is also crucial. Tweed reported that there is a correlation between upright incisors and improved stability and retention [1]. Similarly, Mills recommended maintaining the current position of the lower incisors, as they occupy a very narrow zone of stability [2]. In line with this perspective, Williams advocated for a treatment goal of positioning the lower incisors within 2mm of the A-Pog line, which he considered both stable and aesthetically optimal [3].

The definition of stability and relapse varies among authors. Some view relapse as the lower incisors returning to their original positions [2]. Others define it based on the degree of crowding or spacing in the lower incisor segment, measured through dental casts and cephalometric analyses conducted in the years following the end of treatment [4,5]. Retention is the final phase of orthodontic treatment, aimed at stabilizing teeth in an optimal esthetic and functional occlusion. This phase is crucial for maintaining the stability of treatment outcomes.

Long-term stability of orthodontic treatment results remains a significant challenge. Increasingly, clinicians are turning to long-term or even lifelong retention using bonded retainers. These retainers offer an efficient and attractive method of retention, particularly because they demand minimal patient compliance. However, bonded retainers are not without complications; they frequently experience adhesive layer detachments or wire fractures and can sometimes lead to unexpected issues with potentially severe consequences, impacting periodontal and general health. It is crucial for the entire dental team to be aware of these potential pitfalls and complications, and to understand how to minimize and address them [6].

The study by Lin et al. investigated how different designs of resin-bonded fixed partial denture (RBFPD) retainers affect clinical retention using three-dimensional finite element analysis. They varied retainer thickness, height, and angle in 27 models. Results showed that increasing retainer thickness and height reduced stress

on both the tooth and prosthesis, while the angle had no significant effect. The study highlighted that optimizing retainer height is crucial for minimizing stress and improving clinical outcomes [7].

Robert Cerny reported that bonded lingual retainers are increasingly popular, but their long-term reliability is not well-documented. His retrospective study examined the reliability and failure factors of upper and lower bonded lingual retainers in 149 patients who experienced retainer failure between 2002 and 2005. Annually, around 230 patients were debonded, with 1150 patients covered by a 5-year repair guarantee. Retainers were made of 0.018-inch round stainless-steel wire, with loops at specific points. He found that 35-40 patients needed repairs each year, with approximately 9% experiencing multiple failures. Males had a higher fracture rate than females, and failures were mostly due to extra-oral and intra-oral trauma, operator error, and wire fracture. Central incisors were the most common failure sites, and single tooth repairs took about 12 minutes. He concluded that bonded lingual retainers are a reliable post-orthodontic retention method [8].

Frederick et al. mentioned that many orthodontists advocate for permanent retention to maintain ideal tooth alignment post-treatment. This study assessed the health effects and effectiveness of long-term retention by recalling 60 patients who had fixed bonded canine-to-canine retainers for at least 20 years. Of the 45 patients who still had their retainers, only one had significant tooth misalignment. Most retainers had minimal issues, with some requiring repairs. In contrast, those who had their retainers removed showed greater misalignment. Gingival health was not adversely affected by the retainers, and patients with retainers demonstrated better hygiene. Thus, long-term mandibular incisor retention is generally well-tolerated and beneficial for periodontal health [9].

The study by Schneider and Ruf assessed the frequency and types of upper bonded retainer failures and identified potential predisposing factors. Analyzing records of 466 patients, it was found that 58.2% experienced retainer failures, with an average of 1.26 failures per retainer. Failures were most common in 3-3 retainers and least common in 1-1 retainers. Operator experience significantly influenced failure rates, with less experienced practitioners having higher rates of detachment and total loss. Retainer fractures were more frequent when canines were included, and total retainer losses were more common in patients with previous multibracket appliance defects [10].

Kaji et al. investigated the impact of bonded mandibular orthodontic retainers on local periodontal health by comparing two groups: one with fixed wire retainers (Group F+) and one without (Group F−). Clinical, biochemical, and bacteriological analyses were performed at baseline, 1 week, 4 weeks, and 8 weeks after retainer placement. Both groups showed significant increases in gingival crevicular fluid, elastase activity, and protein content over time. Group F+ also had increased F-Hb concentration. Differences in elastase activity and protein content were noted between the groups, but no significant periodontal health differences were found between those with and without retainers. The vertical position of the retainer wire did not affect periodontal health. Good oral hygiene is crucial when using fixed retainers [11].

Bovali et al. conducted a single-center trial aimed to compare the placement time and failure rates of mandibular lingual retainers using indirect versus direct bonding procedures. Sixty-four patients from the University of Geneva's orthodontic clinic were randomly assigned to either method. Bonding time was shorter with the indirect procedure. At six months, failure rates were similar between the two methods. While plaque accumulation was observed, no serious harm was reported. In conclusion, indirect bonding proved significantly faster without increasing the risk of failure compared to direct bonding [12].

Zachrison stated that fixed or bonded retainers are commonly used at the end of orthodontic treatment. These retainers come in various types and sizes of wires, which can be bonded either labially or lingually. He noted that the article discusses the background and evolution of multistrand fixed retainers and offers clinical recommendations for their use. Based on his 20 years of experience, he recommends using a 5-stranded wire with a diameter of 0.0215 inches [13].

Kazem and Jarrir AL-nimri conducted study compared the shear bond strength of fixed retainer wires of different diameters using either a conventional composite resin or a specific retainer composite. The study involved 120 extracted premolar teeth, divided into six groups, with various wire diameters bonded using either Filtek Z250 or Transbond LR adhesive. After storage and thermal cycling, the specimens were debonded, and the failure sites and bond strengths were recorded. The specific retainer composite showed significantly higher bond strength than the conventional composite, and the 0.0215” wire had the highest bond strength among the wires tested. The optimal combination for maximum bond strength was the specific retainer adhesive with a 0.0215” wire [14].

In 2015 two authors independently screened assessed quality and extracted data from 27 studies on fixed orthodontic retention protocols found in MEDLINE, EMBASE, and CENTRAL databases. These comprised nine randomized controlled trials, six prospective, and twelve retrospective studies, all exhibiting low quality in reporting. Glass-fibre retainers showed bond failure rates ranging from 11% to 71%, while multistrand retainers ranged from 12% to 50%. Comparing multistrand wires to polyethylene woven ribbon revealed no significant difference in bond failure rates. Overall, the evidence quality is low, and no definitive guidance exists for selecting the best retention protocol. The subjective nature of protocol determination persists due to unreliable evidence despite the widespread use of fixed orthodontic retainers in clinical practice [15].

Al-Moghrabi1 et al. reported that this review evaluated fixed and removable orthodontic retainers' impact on periodontal health,

survival rates, cost-effectiveness, and patient-reported outcomes. 24 studies, including randomized controlled trials and prospective cohort studies, were reviewed, with 16 deemed high quality. Meta-analysis was impractical due to clinical heterogeneity. Mean failure risk for mandibular stainless-steel fixed retainers was 0.25 to 0.29, with no clear correlation to placement time. They concluded that, further prospective studies are needed for a comprehensive understanding of retainer benefits and risks [16].

Goenharto et al. performed study aims to compare the efficacy of removable (e.g., Hawley, Beggs, clip-on, Kesling's tooth positioners, invisible retainers) and fixed (e.g., banded, bonded, band & spur type) retainers in orthodontic treatment, evaluating factors such as cost, aesthetics, fabrication process, durability, occlusion, hygiene, and convenience. They concluded that both types demonstrating effectiveness in preventing relapse post-treatment, contingent upon individual cases [17].

Juloskia et al. carried-out study to investigate the effect of fixed lingual retainers on mandibular gingival recession over 5 years, comparing outcomes with untreated individuals. While no significant differences in gingival recession were found between groups at the 5-year mark, the retainer group exhibited significantly higher calculus accumulation compared to the non-retainer group [18].

Egli et al. conducted a 2-year follow-up of a single-center randomized controlled trial. Study. They reported that this 2-arm parallel trial compared the failure rates of mandibular fixed retainers bonded with indirect and direct methods and assessed post treatment changes 2 years after placement. Sixty-four patients were randomly assigned to either bonding method. After 2 years, 40% of retainers failed: 43% in the indirect group and 37% in the direct group, with no significant difference in failure rates. No significant changes were observed in mandibular inter-canine and interpremolar distances or incisor inclination. However, 17% of patients in the direct bonding group experienced unexpected post-treatment changes, specifically lingual inclination of the mandibular left canine. Overall, both bonding methods were effective in maintaining tooth position [19].

Katharina et al. did a cohort study assessed long-term failure risk of maxillary and mandibular fixed lingual retainers in 88 patients, 10–15 years post-orthodontic treatment. In the mandible, 53.4% had stainless steel (SS) retainers bonded to six teeth, and 46.6% had beta-titanium (TMA) retainers bonded to canines. No failures occurred in 40.4% of SS and 61% of TMA retainers. SS retainers averaged 2.17 failures per retainer, TMA 0.66. In the maxilla, 93.2% had SS retainers bonded to four incisors, with 74.4% experiencing no failures. Detachments were the most common failure. Most retainers remained intact after 10–15 years, with 98.9% of mandibular and 97.6% of maxillary retainers still in place, and no adverse torque changes observed [20].

Karta and Kaya in a review article stated that orthodontic retention maintains teeth in their optimal positions post-treatment, crucial for stabilizing results and preventing relapse. Initially, removable appliances were used, but fixed retainers are now preferred for their aesthetics, effectiveness, and independence from patient compliance. However, fixed retainers need precise bonding, can break, and may cause periodontal issues by affecting oral hygiene [21]. A systematic review carried out by Modaa et al. aimed to evaluate the stability of two types of lower fixed retainers: those bonded to all anterior teeth versus those. bonded only to the canines. Databases searched included PubMed, Scopus, Web of Science, Cochrane Library, Lilacs, OpenGrey, Clinical Trials, and Google Scholar, with no restrictions on language or year. Five studies were included from 180 retrieved, with three showing a low risk of bias and two a high risk of bias. Two studies indicated better stability with retainers bonded to all six teeth, while three found no difference. One study reported a higher breakage rate for retainers bonded to all teeth. Overall, retainers bonded to all anterior teeth may offer better stability, though further methodologically robust studies are needed for a definitive conclusion [22].

Laure et al. in 2020 performed a systematic review to evaluate the impact of fixed orthodontic retainers on periodontal health by analyzing studies from various databases up to August 31, 2019. It included 11 RCTs, 4 prospective cohort studies, 1 retrospective cohort study, and 13 cross-sectional studies. Most studies were of low quality. While the majority found no severe negative effects on periodontal health, some reported poorer conditions with fixed retainers. Overall, fixed retainers seem compatible with periodontal health, though findings on different types of retainers varied [23].

Kocher et al. did a retrospective cohort study assessing the long-term effectiveness of different maxillary and mandibular fixed lingual retainers in 80 orthodontic patients over 10-15 years. Measurements of irregularity index, inter-canine width, overjet, and overbite were taken pre-treatment, post-treatment, and 10-15 years post-treatment. They found that mandibular retainers bonded to all six anterior teeth (0.016” x 0.022” braided stainless steel) were slightly more effective in maintaining alignment than those bonded to canines only (0.027” β-titanium). Maxillary retainers without canine extensions effectively maintained alignment, and all retainers effectively maintained inter-canine width [24].

Adanur-Atmaca and colleagues conducted a study to assess the impact of different lingual retainers on periodontal health and stability of mandibular anterior teeth over one year. They randomly assigned 132 patients to four groups, each receiving a different type of retainer. Periodontal health was evaluated using plaque, gingival, and calculus indexes, while stability was measured through irregularity, intercanine width, and arch length at various time points post-treatment. The Memotain nitinol retainer showed the lowest gingival and calculus index values, with groups 2 and 3 displaying the least irregularity. Overall, Memotain and stainless-steel retainers demonstrated the most favorable outcomes, exhibiting reduced gingival inflammation and calculus accumulation. However, no significant deterioration in periodontal health or relapse was observed across all groups after one year [25].

Kučera et al. reported that Long-term stability in orthodontic treatments remains a challenge, leading to an increasing use of bonded retainers for extended retention periods, even lifelong. While bonded retainers offer convenience by requiring minimal patient compliance, they come with frequent complications like adhesive detachment or wire fractures. Additionally, unexpected complications can arise, posing risks to periodontal and general health. It's crucial for the entire dental team to recognize and address these pitfalls and complications effectively [6].

In 2022, Hashim introduced an innovative non-bonded retainer method. He discussed its advantages and disadvantages, highlighting its superiority over other fixed retainers in preventing relapse during the crucial period of two to nine months after orthodontic therap. The method outlined in this article is straightforward and cost-effective. It significantly simplifies plaque control around the retainer. However, further studies on long-term stability after extended retention periods are necessary to confirm the technique's efficacy and durability [26].

## Aim

To present a method of stabilizing the incisor teeth using a soft stainless-steel wire, avoiding the fixation with bonded composite resin, resulting in a band cemented & non-bonded fixed retainer.

## Material and Methods

### Materials Required

Stainless steel wire, Condenser, Mouth mirror, Explore, Tweezers, Ultrasonic scaler, Contra-angle hand piece, Rubber cup, Pumice.

### Method

Laboratory steps for preparation of fixed banded retainer.

1. Start by immersing the impression in *Actichlor Solution* for 10 minutes to disinfect it.
2. Use dental ortho stone (White) to pour into the impression, creating a working model.
3. Trim the working model to the desired specifications.
4. Shape a 9 mm stainless steel wire and bend it beneath the cingulum of the lower anterior teeth, spanning from tooth 44 to tooth 34.
5. Solder the stainless-steel wire onto the premolar bands on both the right and left sides.
6. Proceed to solder ball clasps between the anterior teeth, from canine to canine, utilizing laser welding.
7. Once laser welding is complete, solidify the fix by applying silver solder.
8. Conclude the process by refining, shaping, and polishing the retainer until it achieves a smooth finish.

### Clinical Steps of Fixation of the Fixed Banded Retainer

#### Step 1: De-bonding

***Removal of Brackets and Residual Composite*:** Following the de-bracketing process, debride the teeth to remove any composite remnants.

***Polishing:*** Polish all tooth surfaces using a rubber cup and pumice to ensure a smooth surface.

***Cleaning:*** Employ an ultrasonic scaler to eliminate any plaque or calculus deposits, paying special attention to the mandibular incisor region.

#### Final Preparation

Thoroughly polish, wash, and dry the lingual and labial surfaces of the lower premolars and canines in both sides with compressed air. These surfaces will be utilized for the retainer fixation.

**Figure 1:** The device before cutting of the buccal surface of the premolar's bands in both sides.

#### Step 2: Fixation of the Retainer

***Preparation of Premolar Bands*:** Using the scissors to cut the buccal surface of the premolar band along with its bracket.

**Figure 2:** The device after cutting the buccal surface of the premolar's bands along with its bracket in both sides.

**Placement Check:** Insert the two *halves premolars bands* in place and check for proper retention.

***Cement Application*:** After confirming the fit, remove the bands and apply *glass ionomer cement* to the two halves premolar bands.

***Final Insertion*:** Reinsert the retainer device into position and remove any excess cement.

#### Patient Instructions

Provide the patient with thorough instructions on oral hygiene measures to ensure effective plaque control around the retainer. Instruct the patient to bite down on a cotton roll placed on the cemented premolar bands until the cement sets.

## Cases received the Fixed banded 4 x4 retainer

In this article, three cases were presented and show the effectiveness of the Hayder's fixed banded 4x 4 retainer. Moreover, all patients showed good compliance and none of them reported any complain from failure/looseness or esthetic as well as function.

### Case 1:

**Figure 3:** Lingual and front views. Hayder's fixed banded 4 x 4 retainer in place after cementation.

### Case 2:

**Figure 4:** Lingual view after cementation of Hayder's fixed banded 4 x 4 retainer.

### Case 3:

**Figure 5:** Hayder's fixed banded 4 x4 retainer in place after cementation without showing the buccal sides of the premolars band which is esthetically accepted.

A B

**Figure 6:** Hayder's fixed banded 4 x 4 retainer in place [A] at debonding March 2023 and [B] after 10 months July 2024. Indicating good esthetic and stable results.

Hence, in case 3 the result indicated that this proposed fixed banded 4x4 retainer allows for effective stabilization of the incisors without the need for bonded composite resin. The use of stainless-steel wire and premolar bands ensures durability and stability while maintaining oral hygiene as well as it is esthetically accepted. Moreover, the *glass ionomer cement* resist caries formation.

## Discussion

The literature indicates no significant difference between removable and fixed retainers regarding post-retention irregularities. However, there is still a lack of long-term, high-quality studies assessing orthodontic stability with fixed retainers [27,28].

A recent Cochrane review found no clear evidence of greater stability with vacuum-formed retainers worn full-time compared to part-time. Additionally, there is a lack of high-quality evidence to support specific recommendations for the stability of orthodontic results [27]. The distinction between changes due to natural growth and post-retention relapse is important for understanding the underlying causes of dental changes after orthodontic treatment. Despite the difficulty in separating these two factors, the emphasis on the necessity for long-term retention remains crucial for ensuring the stability of the treatment results from the patient's perspective [24].

Abduraheem et al. noted that at least 25% of post-retention changes, which are unpredictable in direction, could be attributed to natural growth rather than post-retention relapse. However, distinguishing between these two events is challenging, and from the patient's viewpoint, it underscores the importance of long-term retention regardless of the type of retainer used [29].

In contrast, Houston and colleagues stated that "there is no evidence to support the use of a particular cephalometric line as a guide to posttreatment stability of the lower labial segment" [30]. However, this statement underscores the need for further research to identify reliable indicators of posttreatment stability. It suggests that current cephalometric guidelines may not be sufficient for predicting long-term outcomes in the lower labial segment, highlighting the importance of developing more accurate assessment tools. The longevity and effectiveness of bonded

retainers largely depend on the quality of materials used and the precision of their placement. Utilizing high-quality materials and ensuring skilled application can significantly reduce the risk of detachment and fractures. Clinical studies support the use of non-fixed retainers (NFRs), demonstrating their effectiveness in maintaining tooth position during the critical early retention phase, which is vital for long-term stability [26]. To ensures the continued stability of orthodontic results and allows for prompt resolution of any problems, regular monitoring and dental check-ups are essential for the early detection of any issues with bonded retainers. Dental professionals should check for signs of adhesive failure, wire damage, and any adverse effects on periodontal health. Moreover, educating patients about proper oral hygiene and specific care for bonded retainers can help prevent complications. Patients should be instructed on how to clean around the retainer and the importance of attending regular dental visits. Advantages of the proposed fixed band cemented retainer offer several benefits over fixed bonded retainers. They generally present a lower risk of complications, such as adhesive layer detachments and wire fractures, since they are not bonded directly to the teeth as well as the *glass ionomer cement* resist any caries formation. This can lead to fewer emergency visits and reduced overall maintenance. Further, the design described emphasizes the importance of preserving the natural ability of teeth to move within their sockets. This movement is essential for the teeth to adapt to forces exerted on their front (labial) and back (lingual) surfaces. Further, the proposed fixed banded 4 x 4 retainer is esthetically accepted. The *glass ionomer cement* Maintaining oral hygiene with a non-bonded fixed retainer is simpler and requires less dexterity than with a bonded retainer. Regular flossing is sufficient for interproximal cleaning, without needing floss threaders or other interdental aids. This design simplifies daily oral care, enhancing user-friendliness and promoting better periodontal health, which can improve patient compliance and overall oral health outcomes.

Additionally, Hayder's fixed banded 4 x 4 retainer tend to be more comfortable for patients and easier to maintain, potentially reducing the risk of periodontal issues linked to bonded retainers. Unlike bonded retainers, Moreover, it fit passively around the teeth, providing flexible and adaptive retention without the risks of adhesive failures. When fixed bonded retainers are used, this adaptive movement is restricted, which can negatively impact periodontal health. However, our proposed fixed band cemented retainer allowing teeth to move independently which promotes better periodontal health by enabling the teeth to adjust to various forces, maintaining their physiological balance within the oral cavity [26]. However, the only drawback of this proposed device; is that it cannot be completed in a single chairside visit. The banded retainer design preserves the adaptive movement of teeth and promotes periodontal health, its inability to be finished in one visit might be seen as a minor inconvenience compared to its long-term benefits. The necessity for multiple visits should be weighed against the advantage of maintaining natural tooth movement and overall periodontal well-being. While fixed banded 4 x 4 retainer offer several benefits, it is crucial for clinicians to evaluate each patient's specific needs and conditions to determine the most suitable retention method. Factors such as oral hygiene habits, patient compliance, and the complexity of the orthodontic treatment should be considered. By integrating these insights, dental professionals can make more informed decisions about retention strategies, ultimately enhancing long-term outcomes for their patients. Hence, emphasizing patient education, regular monitoring, and individualized treatment plans is essential in optimizing the effectiveness and longevity of orthodontic retention methods. Despite its promise in terms of simplicity and cost, ongoing research is essential on long-term stability after extended retention periods are necessary to confirm the efficacy and durability of this technique. These studies highlight the importance of evidence-based practice in validating the method's effectiveness and ensuring lasting stability and durability in clinical applications.

It is noteworthy that during the debonding appointment, the banded retainer can be cemented in the same visit. To achieve this, take an impression with the premolar bands in place during the pre-debonding visit and send it to the laboratory for the construction of the retainer and retied both arches. At the debonding visit, you can then debond the case and immediately cement the retainer using glass ionomer cement. It is important to instruct the patient not to play with their tongue on the connected arm, as this can cause the retainer to become loose.

## Conclusion

The Hayder's retainer method proposed in this article is straight forward and cost-effective, significantly simplifying plaque control around the retainer. By understanding these several benefits mentioned above and integrating them into practice, dental professionals can better manage the long-term use of bonded or banded retainers, ensuring both the stability of orthodontic results and the overall health of their patients.


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Figure Multi-strand wire retainer bonded to the lingual surfaces of mandibular anterior teeth.

Figure: Ortho-Flex-Tech™ wire retainer bonded to the lingual surfaces of mandibular anterior teeth

Al-Ma'aitah et al. in 2022 conducted a randomized clinical trial to compare round multi-strand wire retainers with Ortho-Flex-Tech™ rectangular wire retainers. They evaluated plaque and calculus accumulation, effectiveness in maintaining tooth alignment, and failure rates. The study found no difference in gingival health parameters and failure rates between the two types of retainers. However, Ortho-Flex-Tech™ retainers were slightly better at retaining the alignment of mandibular incisors, but this difference was not clinically significant.

Emad F. AL-MAAITAH1, Sawsan ALOMARI1, Kazem AL-NIMRI1 Comparison between round multi-strand wire and rectangular wire bonded retainers: a randomized clinical trial. Dental Press J Orthod. 2023;28(2):e2321101.