

# Variations of the Plaque Index in Four Timelines during 12 Months in Patients with Two Models of Fixed Retainers after Orthodontic Treatment is Finished

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## Abstract

**Background:** Fixed retainers are retention tools bonded on the lingual side of the frontal teeth to prevent relapse after orthodontic treatment is finished. While stability remains the biggest concern, periodontal response remains the subject of discussion. This study aimed to compare plaque index (PI) levels on the lingual side of the lower dental arch in the inter-canine region after bonding two different models of fixed retainers.

**Methods and Results:** The study included 60 subjects aged 16-25 who finished orthodontic treatment. Thirty subjects got flat fixed retainer (FFR), and 30 other subjects got round fixed retainer (RFR) bonded in the lower six frontal teeth on the lingual side. Adapted PI was recorded and photographed at four time points (3, 6, 9, and 12 months). Three months after the intervention, there were no significant differences between the FFR and RFR related to the PI value ( $P=0.363$ ). PI was significantly lower in the FFR group than in the RFR group 6, 9, and 12 months after the intervention ( $P<0.004$ ,  $P=0.004$  and  $P=0.001$ , respectively).

**Conclusion:** Bonded fixed retainers, in general, cause increased plaque formation and make oral hygiene routines more difficult. (International Journal of Biomedicine. 2024;14(1):148-152.)

**Keywords:** fixed retainers • flat retainer • round retainer • plaque index

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## Abbreviations

FFR, flat fixed retainer; IQR, interquartile range; Me, median; PI, plaque index; RFR, round fixed retainer

## Introduction

Orthodontic treatment aims to move teeth to correct malocclusion. After the treatment is finished, there is often a tendency for teeth to relapse; therefore, to maintain final results, orthodontists use various retention tools such as fixed retainers in order to maintain achieved outcomes.<sup>(1)</sup>

Despite suggestions that a precise diagnosis and treatment planning, followed by comprehensive stability of the final outcomes, would diminish the relevance of retention, relapse tendencies persist in a considerable fraction of treated cases.<sup>(2)</sup>

Through the years, there have been presented and documented various types of methods and tools that have been used to retain post-treatment tooth position. Various removable retainers have been advocated, but most often, the use of bonded fixed retainers has been suggested. These fixed retainers are bonded in both jaws' lingual side of anterior teeth but mostly in mandibular incisors and canines.<sup>(3-5)</sup> In most

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studies related to fixed retainers, orthodontists believe that the only way to maintain the ideal alignment after orthodontic treatment is a form of permanent retention. This can be an FR bonded in the lingual area of anterior teeth, left in the mouth for an extended period of time.<sup>(1)</sup>

Research has found that this technique doesn't require strong compliance from the patients, and it has served as a reliable solution for long-term stability.<sup>(6)</sup> While for some researchers, the main concern was stability, many studies focused on changes and periodontal response during the retention phase. Studies suggest that after tooth movement, significant residual forces persist in the periodontal tissue.<sup>(7)</sup> When using bonded fixed retainers for a long time, the main worry is that they might make it more difficult to maintain oral health and harm periodontal health.<sup>(8,9)</sup>

However, no consensus is found on this topic when the literature is evaluated. Many studies have shown that bonded fixed retainers increase plaque and calculus formation and induce gingival irritation, while many others have found no detrimental consequences. Therefore, this study aimed to compare, every 3 months during a year, PI levels from the lingual side of the lower dental arch in the inter-canine region after bonding two different models of fixed retainers.

Our study focused on whether the different shapes and sizes of retainers influences plaque accumulation during one year of the post-treatment phase.

## Materials and Methods

The study included 60 subjects aged 16-25 who finished orthodontic treatment in the Orthodontic Department (Dental Faculty, UBT College, Prishtina, Kosovo). Thirty subjects got flat fixed retainer (FFR), and 30 other subjects got round fixed retainer (RFR) bonded in the lower six frontal teeth on the lingual side (Figure 1). All the fixed retainers were bonded by the same experienced orthodontist with the same bonding technique and the same bonding tools. The subjects got an informational letter with all the details about the retention phase, and they signed a consent letter to participate in the study. The subjects were called for obligatory follow-up visits in 3, 6, 9, and 12 months.



**Fig. 1** (a) FFR- Flat fixed retainer, (b) RFR- round fixed retainer

Inclusion criteria were no caries, restorations, crowns, or bridges presented and no plaque at the time of bonding the retainer. Exclusion criteria were the participants that failed to be present at requested follow-up periods, those that had

any kind of prosthetic restoration during the follow-up period, smokers, pregnant subjects, subjects with syndromes, subjects with general conditions like diabetes, and those had used any kind of hormonal and other medications.

Adapted plaque index (PI) was recorded and photographed at four time points (3, 6, 9, and 12 months). Measurements were performed by one experienced periodontologist and calculated. PI, according to Turesky plaque scoring, was adapted for six frontal teeth of the mandibula on the lingual side where the fixed retainer was bonded, and measured on three surfaces: mesial, distal, and lingual. Premeasurement was applied with the same plaque indicator solution and rinsed according to the instructions.

The measure used to determine plaque score:

- (1) No plaque
- (2) A thin continuous band of plaque ( $\leq 1$  mm) at the cervical margin of the tooth
- (3) A band of plaque  $>1$  mm but covering less than 1/3 of the crown of the tooth
- (4) Plaque covering at least one-third but less than two-thirds of the crown of the tooth
- (5) Plaque covering two-thirds or more of the crown of the tooth

The value was given to each tooth separately, multiplied, then divided to 6 (teeth) and divided to 3 (surfaces).

Statistical analysis was performed using the statistical software package SPSS version 22.0 (SPSS Inc, Armonk, NY: IBM Corp). The normality of the distribution of continuous variables was tested by the Shapiro-Wilk W test. The Mann-Whitney U Test was used to compare the differences between the two independent groups. The Wilcoxon criterion was used to compare the differences between two paired samples. The Friedman test was used to test the differences between 3 and more dependent samples. A probability value of  $P < 0.05$  was considered statistically significant.

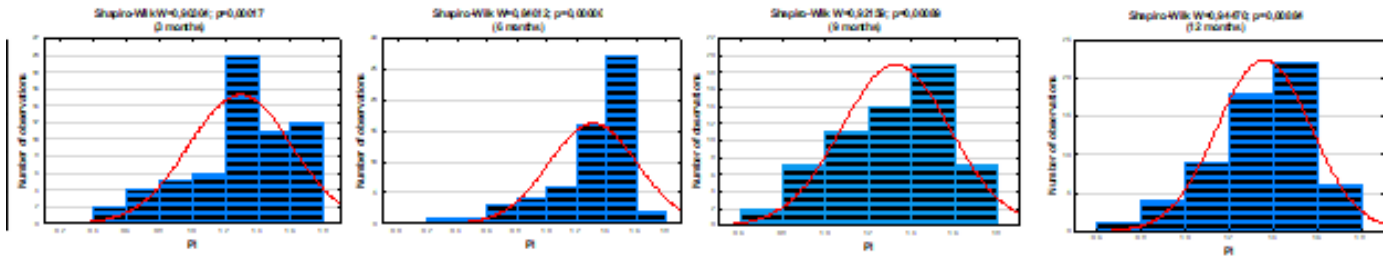
## Results

The subjects from both groups (FFR/RFR) were analyzed in relation to PI at four time points. PI was determined for each respondent individually.

The analysis of the distribution of the obtained PI values indicated a non-normal distribution of the frequencies in all four measurement times (Graph 1), and non-parametric tests were applied in the further analysis. The analysis covered intra-group comparison of FFR and RFR, as well as intergroup comparison of FFR/RFR in four time points.

### Intra-group comparison of PI

In each of the two groups, the PI level was compared between the four time points after the intervention (Table 1, Graphs 2-3). In the FFR group, 3 months after the treatment, 50% of the patients had  $PI < 1.28$  mm. In the period 3-9 months, there was a general decrease in PI, followed by no change between 9 and 12 months. In 50% of the patients, the PI value was  $< 1.27$  mm after 6 months,  $< 1.22$  mm after 9 months, and  $< 1.22$  mm after 12 months. In the FFR group, there were no significant differences between the four time points related to PI ( $P = 0.714$ ) (Table 1, Graph 2).

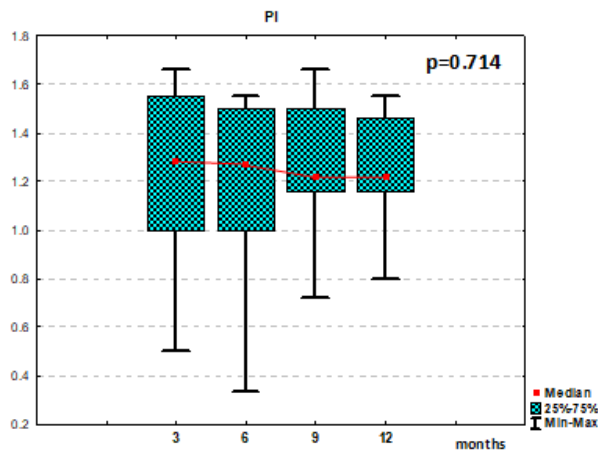


Graph 1. Distribution of PI in four time points.

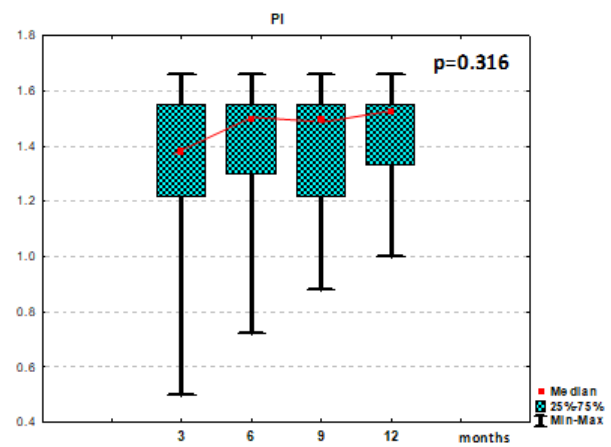
Table 1.

Intra-group comparison of PI in four time points.

Intra-group comparison	Plaque index – PI					Friedman Test
	N	Mean± SD	Min/ Max	Me (IQR)	Mean Rank	
<b>FFR</b>						
3 months	30	1.25±0.34	0.50/1.65	1.28 (0.98-1.55)	2.72	$\chi^2 (3) = 1.366$ $P=0.714$
6 months	30	1.21±0.33	0.33/1.55	1.27 (1.00-1.50)	2.50	
9 months	30	1.23±0.26	0.72/1.66	1.22 (1.10-1.50)	2.40	
12 months	30	1.27±0.20	0.80/1.56	1.22 (1.15-1.47)	2.38	
<b>RFR</b>						
3 months	30	1.34±0.28	0.50/1.66	1.38 (1.22-1.55)	2.17	$\chi^2 (3) = 3.535$ $P=0.316$
6 months	30	1.42±0.21	0.72/1.68	1.50 (1.29-1.55)	2.50	
9 months	30	1.42±0.22	0.88/1.66	1.50 (1.22-1.55)	2.63	
12 months	30	1.45±0.18	1.00/1.66	1.52 (1.33-1.56)	2.70	



Graph 2. Intra-group comparison of PI in four time points in the FFR group.



Graph 3. Intra-group comparison of PI in four time points in the RFR group.

In the RFR group, after 3 months of intervention, in 50% of the patients the value of PI was <1.38 mm. In the period of 3-12 months, a general increase in PI was observed. In 50% of patients, the PI value was <1.50 mm after 6 months, <1.50 mm after 9 months, and <1.52 mm after 12 months. In the RFR group, no significant difference was found between the four measurement time points related to PI value ( $P=0.316$ ) (Table 1 and Graph 3).

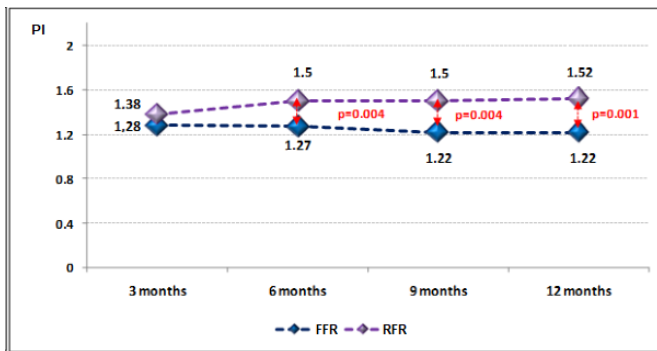
Intergroup comparison of PI

Intergroup comparison of PI between the FFR and RFR groups was made at four time points after the intervention (Table 2 and Graph 4). Three months after the intervention, there were no significant differences between the FFR and RFR related to the PI value ( $P=0.363$ ). PI was significantly lower in the FFR group than in the RFR group 6, 9, and 12 months after the intervention ( $P<0.004$ ,  $P=0.004$  and  $P=0.001$ , respectively).

Table 2.

Intergroup comparison of PI in four time points.

Intergroup comparison	Plaque index – PI						Mann-Whitney U Test
	N	Mean± SD	Min/ Max	Percentiles			
				25th	50th (Me)	75th	
3 months							
FR	30	1.25±0.34	0.50/1.65	0.98	1.28	1.55	Z=-0.909; P=0.363
RR	30	1.34±0.28	0.50/1.66	1.22	1.38	1.55	
6 months							
FR	30	1.21±0.33	0.33/1.55	1.00	1.27	1.50	Z=-2.868; P=0.004
RR	30	1.42±0.21	0.72/1.68	1.29	1.50	1.55	
9 months							
FR	30	1.23±0.26	0.72/1.66	1.10	1.22	1.50	Z=-2.867; P=0.004
RR	30	1.42±0.22	0.88/1.66	1.22	1.50	1.55	
12 months							
FR	30	1.27±0.20	0.80/1.56	1.15	1.22	1.47	Z=-3.363; P=0.001
RR	30	1.45±0.18	1.00/1.66	1.33	1.52	1.56	



Graph 4. Comparison of PI Me by groups (FFR/FRR) in four time points.

## Discussion

In our study, at the measurements in the 3-month follow-up period, we found no significant difference between the FFR group and the RFR group. But in 6, 9, and 12 months of follow-up, FFR subjects had significantly lower PI than RFR subjects. These findings agree with the study by Torkan et al.<sup>(10)</sup> and Dietrich et al.<sup>(11)</sup> They reported increased plaque accumulation in patients with round bonded retainers in short- and long-term follow-up periods during retention. In contrast, a study by Antun et al.<sup>(12)</sup> showed a decrease in the presence of plaque at 3 years in retention with various types of retainers. Still, FFRs were not included in the study, only several RFRs. However, the findings on the retention period and periodontal health are mixed. Some periodontal characteristics improve quickly after debonding, whereas others remain unchanged or worsen over time.<sup>(9,13,14)</sup>

According to a study by Levin et al.,<sup>(15)</sup> different types of fixed retainers were linked to higher plaque accumulation but with low clinical significance. However, the dimensions of the retainers

were uncertain. In agreement with our study are also several studies where subjects with round, multistrained fixed retainers showed higher plaque accumulation over a 24-month follow-up period despite receiving frequent oral hygiene education.<sup>(16,17)</sup>

This research contradicts the findings of Artun et al.,<sup>(12)</sup> who determined that there were no changes in plaque or calculus accumulation between round spiral wire and plain wire retainers.

A study by Shirasu et al.<sup>(18)</sup> agrees with our results and explains the effect of RFRs with the fact that the nature of the wire in a twisted shape, and also if the bends are close to the gingival papilla, could promote some retentive sites that would make tooth brushing and biofilm disorganization harder. Like our study, it states that multistranded RFRs tend to acquire more plaque and gingival inflammation than FFRs.<sup>(19)</sup> Other studies also mention the fact that bonding retainers to all anterior teeth retains more plaque than bonding exclusively to canines.<sup>(18,20)</sup> Shirasu et al.<sup>(18)</sup> looked at gingival parameters after using two different types of fixed retainers. The results showed that RFRs in the proximal and lingual surfaces had greater PI and Gingival Index, which agrees with our study, too. Also, they stated that FRRs were associated with the best hygiene and comfort for the patients. In the study of Buzzata et al.,<sup>(21)</sup> it was acknowledged that the small amount of research comparing the two types of retainers must be considered. The variability of wires and bonding types, as well as the small sample sizes and short follow-up timeframes, were significant drawbacks. On the other hand, the majority of trials comparing smooth plain or flat retainers to multistranded wires showed no difference between the methods.<sup>(10,22)</sup>

Regarding periodontal health in general, a literature review found no consensus on this topic. Studies have revealed that bonded fixed retainers, in general, cause increased plaque and calculus formation, as well as gingival inflammation. Other studies, on the other hand, have found no harmful impact. While

the long-term periodontal implications of using fixed retainers are unknown, it is widely agreed that fixed retainers make oral hygiene routines more difficult.<sup>(23)</sup> Patients must be trained in how to care for their bonded retainers, which involves using some type of interdental cleaning agent. Furthermore, the cleaning process affects oral hygiene, implying that a patient's motivation should be considered when determining whether or not to use a fixed retainer.<sup>(24)</sup> This study reveals that bonded fixed retainers, in general, cause increased plaque formation, as well as gingival inflammation. While the long-term periodontal implications of using fixed retainers are unknown, this study found that fixed retainers make oral hygiene routines more difficult.

## Competing Interests

The authors declare that they have no competing interests.

## Ethical Considerations

This prospective study was approved by the Ethics Committee of the UBT college (Protocol N # 05-PA-30-XV-3/2021) and the Ethical Committee of the Dental Chamber in Kosovo (N # 23/2021).

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