

Evaluation of the effects of different lingual retainer materials on post-treatment stability

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Objective: To evaluate the effects of different lingual retainers on mandibular anterior tooth stability one-year follow-up period.

Materials and methods: A total of 140 patients who had undergone non-extraction orthodontic treatment were included in the investigation. For lower incisor retention, Group 1 received a bonded 0.0175-inch seven-strand stainless steel wire (Ortho Technology, Tampa, FL, USA), Group 2 received a 0.022 x 0.016-inch eight-strand dead-soft wire (Bond-A-Braid, Reliance Orthodontic Products, IL, USA), Group 3 received a 0.038 x 0.016-inch prefabricated stainless steel wire (Ortho FlexTech®, Reliance Orthodontic Products, Itasca, IL, USA), and Group 4 received a fibre-reinforced composite wire (StickTech, Turku, Finland). Tooth stability was assessed using Little's Irregularity Index, intercanine width, and arch length measurements taken at five different time points.

Results: After one year, changes in Little's Irregularity Index were statistically greater in Groups 2 and 4 than in Groups 1 and 3. Reductions in intercanine width were also significantly greater in Groups 2 and 4. No significant differences in arch length changes were found between the groups. Wire breakages were statistically more frequent in Group 4, and bonding failures were higher in Group 2. Using a 0.0175-inch seven-strand stainless steel wire or a 0.038 x 0.016-inch prefabricated stainless steel wire for lingual retainers is recommended.

Conclusion: Stainless steel retainers are recommended for 1-year stability due to their durability and lower failure rate, whereas fibre-reinforced composite retainers may be less reliable.

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Introduction

Retention is the maintenance phase of orthodontic treatment aimed at preserving the achieved tooth positions after active correction. The reorganisation of periodontal and gingival tissues, unstable tooth positions, and continued skeletal growth are identified causes of post-treatment change¹ frequently noted in the mandibular anterior region. Little concluded that, regardless of the widening of the mandibular arch, the intercanine width ultimately decreases and crowding in the anterior region is inevitable. Therefore, it was recommended that permanent retention be applied to ensure long-term stability.²

Fixed lingual retainers are preferred because they do not require patient co-operation, provide greater stability, and do not cause speech problems. A recent long-term follow-up study indicated that maintaining bonded retainers in both the upper and lower arches can effectively preserve orthodontic treatment results even a decade after active treatment.³

A number of mandibular fixed retainers have been introduced to enhance stability and long-term retention following orthodontic treatment. Multi-stranded stainless steel wires (MSW) are commonly used materials due to their proven long-term clinical performance.⁴ A preferred fixed retention material

is a dead-soft wire due to its ease of manipulation. However, studies have shown that these wires have a high frequency of breakage and recurrence.^{5,6} A 0.038 x 0.016-inch prefabricated stainless steel wire is a retention alternative due to its high fracture strength and easy manipulation.⁷ Recently, fibre-reinforced composite (FRC) materials have gained popularity due to their aesthetics and biocompatibility. These materials are composed of carbon, polyaramide, polyethylene, and glass held in place by a resin bonding layer.⁸ However, multiple clinical studies have reported that FRC retainers, in addition to exhibiting higher bonding failure rates, are also more likely to result in anterior relapse, possibly due to their increased rigidity and susceptibility to intraoral degradation.^{4,9}

As long as orthodontic treatment remains a fundamental part of dental practice, the question of how best to maintain outcomes will remain equally relevant. Consequently, evaluating the effectiveness and reliability of different retention methods continues to be a topic of enduring clinical importance. The clinical success of retainer wires is particularly important, given their long-term use. Numerous studies have been conducted using retainer wires of different sizes and shapes in combination with various composites and bonding agents which have shown different clinical success rates.^{10–12} Therefore, the aim of the present study was to provide some clarity and compare the ability of four different lingual retainer wires to maintain post-treatment lower incisor stability over a one-year follow-up period.

Material and methods

The ethical approval for the present study was obtained from the Non-Drug and Non-Medical Device Research Ethics Committee of the Faculty of Dentistry, Necmettin Erbakan University, Türkiye (Decision Number: 2021/596). Patients and their parents were informed of the study objectives and signed a consent document prior to commencement.

A power analysis for the study was performed using GPower 3.1.9.2 (Franz Faul, Universitaet Kiel, Germany) software. In order to calculate the effect size, ratio values from a similar study were applied.⁴ A chi-square (X^2) test for contingency tables was used to evaluate the differences between the retainer

groups. The effect size for the ratio values between the different groups was calculated as $w=0.55$. With a power value of 0.95 and a type-I error rate of 5%, the total sample size was determined to be $n=88$. Considering the possibility of patients not attending the review visits, 8 additional patients were included in each group to a total of $n=35$. Therefore 140 patients (93 females, 47 males) were involved in the study. Gender distribution, brand and properties of the investigated materials are provided in Table I. Research Randomiser (<https://www.randomizer.org/>) was used to allocate patients to the study groups.

Participants were assigned to one of four groups based on the type of lingual retainer wire applied:

- Group 1: A 0.0175-inch seven-strand stainless steel wire (Ortho Technology, Tampa, FL, USA), (Figure 1)
- Group 2: A 0.022 x 0.016-inch eight-strand dead-soft stainless steel wire (Bond-A-Braid, Reliance Orthodontic Products, IL, USA), (Figure 2)
- Group 3: A 0.038 x 0.016-inch prefabricated stainless steel wire (Ortho FlexTech®, Reliance Orthodontic Products, Itasca, IL, USA), (Figure 3)
- Group 4: A Fibre-reinforced composite wire (StickTech, Turku, Finland), (Figure 4)

Included patients met the criteria of: non-extraction mandibular treatment, a moderate Little's irregularity index, good oral hygiene, consistent follow-ups, no caries on bonding surfaces, no parafunctional habits, and stable lower incisor angles.

All retainers were bonded by the same investigator, who had four years of professional experience (MS.) After scaling and polishing of the lingual surfaces using a fluoride-free polishing paste, isolation was achieved using cotton rolls and cheek retraction. The lingual surfaces of the six mandibular anterior teeth were etched with 37% phosphoric acid gel (Etch-Royale, Pulpdent, Watertown, Mass, USA) for 30 seconds, rinsed and air dried. Adhesive primer (Transbond XT primer, 3M Unitek, Monrovia, CA, USA) was applied using a microbrush, and bonding was completed using composite resin (Transbond LR, 3M Unitek, Monrovia, CA, USA). Vacuum-formed Essix retainers were provided in the maxilla for all group participants.

The seven-strand stainless steel wire for group 1 was pre-shaped on a plaster model to ensure close contact

Table 1. Demographic characteristics across the study groups

	Material	n	Sex	Age (year) Mean±SD	P*
Grup 1	0.0175" (≈0.44 mm) seven-strand SS (Ortho Technology, Tampa, Florida, USA)(Figure 1)	35	22 female 13 male	15.8 ± 1.8	
Grup 2	0.022x0.016" (≈0.56x0.41 mm) eight-strand dead-soft (Bond-ABraid, Reliance Orthodontic Products, Illinois, ABD)(Figure 2)	35	23 female 13 male	15.8 ± 1.6	0.431
Grup 3	0.038x0.016" (≈0.97 x 0.41 mm) Ortho Flextech (Ortho FlexTech®, Reliance Orthodontic Products, Itasca, USA)(Figure 3)	35	23 female 12 male	16.0 ± 1.4	
Grup 4	Fiber Reinforced Composite Retainer (StickTech, Turku, Finland)(Figure 4)	35	25 female 10 male	16.2 ± 1.6	

*One-way ANOVA test was used at 0.05 significance level.

SD, Standard Deviation.

with the lingual surfaces of all involved teeth and then transferred to the oral cavity using a silicone transfer tray. This approach was chosen to ensure passive adaptation, which has been found to be more difficult to achieve directly intraorally with this wire type due to its technique-sensitive nature and limited intraoral adaptability, as previously reported.¹³ Composite resin was applied to each tooth and individually light-cured. In groups 2, 3, and 4, the wires were adapted directly in the patient's mouth. The retainer wire was first bonded to the right canine, followed by passive adaptation across the remaining anterior teeth using a handpiece and dental probe to ensure a

precise fit. Dental floss was used to stabilise the wire during bonding. Composite resin was applied to each tooth sequentially and cured accordingly.

The patients were instructed to maintain good oral hygiene and to contact the clinic immediately in the event of retainer failure. All patients were reviewed for 1 year after the retainers were bonded. All measurements were performed by the same investigator (MS) using an intraoral scanning device (iTero Element™ 2, Cadent iTero; Cadent Ltd) at the following time points: at debonding of the brackets (T0), at the 3rd month (T1), 6th month (T2), 9th month (T3), and the 12th month (T4).

Little's irregularity index, intercanine width, and arch length measurements were performed using OrthoAnalyzer (3Shape, Copenhagen, Denmark) model analysis software to evaluate stability. Arch length measurements were calculated as the distance between the first molar tooth and the interincisal contact points. The intercanine distance was measured by the distance between the cusps of the canine teeth, and arch length was calculated by summing the distances from the mesial contact point of the first molar teeth to the midpoint of the mandibular incisal edges. Mandibular arch irregularity was measured as described by Little.² Both wire fractures and bonding failures (defined as separation from the adhesive) were recorded and analysed. The same measurements were conducted at the beginning of the treatment to determine initial standardisation and were repeated after 4 weeks on



Figure 1. ■■■■



Figure 2. ■■■■.

50 randomly selected digital models to determine intraexaminer reliability.

Statistical analysis

The statistical analyses for the study were performed using SPSS 27.0 (IBM InCorp, Armonk, USA). The descriptive statistics were presented as frequency (percentage) for categorical data and mean $\pm$ SD for numerical measurements. The conformity of continuous numerical measurements to normal distribution was checked by the Shapiro-Wilk test. One-way ANOVA test was used to compare groups and the repeated measure ANOVA test was applied

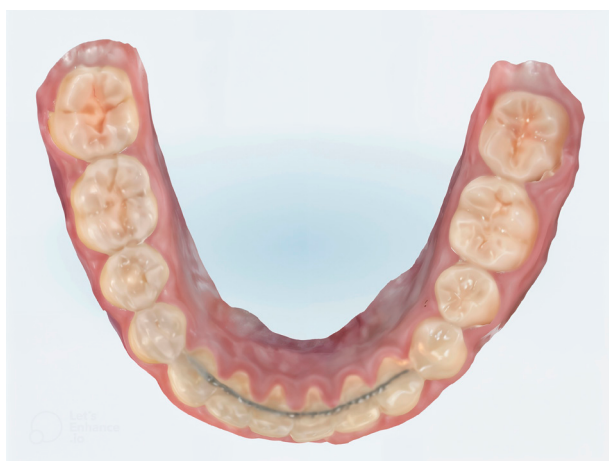


Figure 3. ■■■■.



Figure 4. ■■■■.

for time-dependent measurements within the groups. A Bonferroni test was used as a post-hoc test for comparisons in which significant differences were determined. The Monte Carlo Exact chi-square test was used to analyse the gender of the participants, retainer wire breakage and adhesive separation. The intra-observer agreement was determined by the Intra-class Correlation Coefficient (ICC) test. A value of $p < 0.05$ was considered statistically significant in all analyses.

Results

The intraclass correlation coefficient was used to assess the reliability of the measurements. Intra-observer reliability was tested by repeated measurements on 50 randomly selected models. The second measurements were performed four weeks after the first measurements. The results ranged from 0.967 (95% CI = 0.967-0.992) to 0.986 (95% CI = 0.998-0.999) for the Little index, 0.935 (95% confidence interval=0.909-0.978) to 0.985 (95% CI = 0.999-1) for intercanine distance and 0.905 (95% CI = 0.816-0.955) to 0.986 (95% CI = 0.945-1) for arch length. According to these findings, it was considered that the intraobserver reliability was high.

The mean values of Little's index, intercanine distance and arch length measurements of the patients before treatment (T0) were compared. It is shown in Table II that there was no difference between the groups related to baseline values.

According to within group comparison, it was determined that the irregularity index increased

Table II. Comparison of Little's Index, intercanine distance and arch length measurements before treatment

	Mean±SD				P*
	Group 1	Group 2	Group 3	Group 4	
Little's index	4.64 ± 1.32	4.70 ± 1.14	4.74 ± 1.27	4.76 ± 1.14	0.478
Inter canine distance	26.60 ± 1.43	26.72 ± 1.24	26.56 ± 1.95	26.64 ± 1.52	0.519
Arch length	58.52 ± 3.21	59.98 ± 2.85	58.26 ± 3.50	57.80 ± 3.86	0.367

*One-way ANOVA test was used at 0.05 significance level.

G1: 0.0175 inches 7 strand stainless steel wire, G2: 0.016x0.022 inches Dead-soft wire, G3: 0.038 × 0.016 inches prefabricated Ortho FlexTech stainless steel wire, G4: Fibre reinforced composite retainer EverStick® Ortho.

SD, Standard Deviation.

Table III. Comparison of Little's index irregularity index measurements within time period and between study groups

	Mean±SD					p	Bonferroni
	T1	T2	T3	T4	T5		Post-hoc tests
Group 1	0.03 ± 0.02	0.09 ± 0.07	0.12 ± 0.12	0.13 ± 0.12	0.14 ± 0.13	0.001 *	T1-T2, T3, T4, T5T2-T5
Group 2	0.07 ± 0.09	0.26 ± 0.15	0.37 ± 0.22	0.52 ± 0.26	0.73 ± 0.35	0.001 *	All pairwise comparisons between time periods are significant
Group 3	0.03 ± 0.02	0.10 ± 0.04	0.16 ± 0.04	0.20 ± 0.05	0.24 ± 0.07	0.001 *	T1-T2, T3, T4, T5T2-T4, T5T3-T5
Group 4	0.05 ± 0.02	0.15 ± 0.06	0.27 ± 0.12	0.42 ± 0.19	0.70 ± 0.30	0.001 *	All pairwise comparisons between time periods are significant
p	0.412	0.001 *	0.001 *	0.001 *	0.001 *		
Bonferroni		G1-G2, G4	G1-G2, G4	G1-G2, G4	G1-G2, G4		
Post-hoc tests	—	G2- G3, G4	G2-G3G3-G4	G2-G3, G4G3-G4	G2-G3G3-G4		

*Significant at 0.05 level according to Repeated Measure ANOVA.

**Significant at 0.05 level according to One-way ANOVA, Post-hoc tests were performed by Bonferroni test, and the results were given by time period and group couples.

Group 1: 0.0175 inches 7-strand stainless steel wire, Group 2: 0.016 × 0.022 inches Dead-soft wire, Group 3: 0.038 × 0.016 inches prefabricated Ortho FlexTech stainless steel wire, Group 4: EverStick® Ortho fibre reinforced composite retainer, T1: End of treatment, T2: 3 months post-treatment, T3: 6 months post-treatment, T4: 9 months post-treatment, T5: 12 months post-treatment.

SD, Standard Deviation.

Table IV. Comparison of intercanine distance measurements within time period and between study groups

	Mean±SD					<i>p</i>	Bonferroni
	T1	T2	T3	T4	T5		Post-hoc tests
Group 1	26.84 ± 0.97	26.81 ± 0.97	26.78 ± 0.95	26.76 ± 0.96	26.76 ± 0.98	0.817	—
Group 2	26.87 ± 1.50	26.67 ± 1.49	26.58 ± 1.51	26.52 ± 1.47	26.47 ± 1.47	0.001*	All pairwise comparisons between time periods are significant
Group 3	26.91 ± 0.98 ^a	26.88 ± 0.95 ^a	26.77 ± 0.96	26.71 ± 0.95	26.64 ± 0.94	0.001*	T1-T3, T4, T5, T2-T3, T4, T5T3-T4, T5T4-T5
Group 4	26.86 ± 1.05 ^a	26.81 ± 1.04 ^a	26.76 ± 1.06	26.62 ± 1.04	26.47 ± 1.05	0.001*	T1-T3, T4, T5, T2-T3, T4, T5T3-T4, T5T4-T5
<i>p</i>	0.328	0.001**	0.001**	0.001**	0.001**		
Bonferroni		G1-G2, G3, G4	All pairwise comparisons between time periods are significant	All pairwise comparisons between time periods are significant	All pairwise comparisons between time periods are significant		
Post-hoc tests	—	G2-G3, G4					

*Significant at 0.05 level according to Repeated Measure ANOVA.

**Significant at 0.05 level according to One-way ANOVA, Post-hoc tests were performed by Bonferroni test, and the results were given by time period and group couples.

Group 1: 0.0175 inches 7-strand stainless steel wire, Group 2: 0.016 × 0.022 inches Dead-soft wire, Group 3: 0.038 × 0.016 inches prefabricated Ortho FlexTech stainless steel wire, Group 4: EverStick® Ortho fibre reinforced composite retainer, T1: End of treatment, T2: 3 months post-treatment, T3: 6 months post-treatment, T4: 9 months post-treatment, T5: 12 months post-treatment.

SD, Standard Deviation.

significantly after the end of treatment in all groups ($p=0.001$). The post-hoc tests revealed that the change at all measured time periods was statistically significant ($p=0.001$) except for the changes noted in T2-T4 and T2-T5 periods in group 1. According to the between group

comparison, the values measured at T3, T4 and T5 time periods showed a significant difference between the groups. At the T3, T4 and T5 periods, the values obtained in group 2 and group 4 were significantly higher than in group 1 and group 3 ($p=0.001$) (Table III).

Table V. Comparison of arch length measurements within time period and between study groups

	Mean±SD					<i>p</i>	Bonferroni
	T1	T2	T3	T4	T5		Post-hoc tests
Group 1	58.88 ± 2.40	58.84 ± 2.39	58.80 ± 2.38	58.80 ± 2.36	58.78 ± 2.35	0.001*	All pairwise comparisons between time periods are significant
Group 2	59.30 ± 3.08	59.23 ± 3.10	59.20 ± 3.13	59.17 ± 4.17	59.15 ± 3.11	0.010*	All pairwise comparisons between time periods are significant
Group 3	59.04 ± 2.18	59.00 ± 2.14	58.96 ± 2.14	58.93 ± 2.12	58.92 ± 2.12	0.001*	T1-T3, T4, T5, T2-T3, T4, T5T3-T4, T5T4-T5
Group 4	58.30 ± 2.04	58.26 ± 2.03	58.24 ± 2.02	58.19 ± 2.02	58.18 ± 2.00	0.001*	T1-T3, T4, T5, T2-T3, T4, T5T3-T4, T5T4-T5
<i>p</i>	0.328	0.341	0.363	0.362	0.408		

*Significant at 0.05 level according to Repeated Measure ANOVA, Post-hoc tests were performed by Bonferroni test, and the results were given by time periods. Group 1: 0.0175 inches 7-strand stainless steel wire, Group 2: 0.016 × 0.022 inches Dead-soft wire, Group 3: 0.038 × 0.016 inches prefabricated Ortho FlexTech stainless steel wire, Group 4: EverStick® Ortho fibre reinforced composite retainer, T1: End of treatment, T2: 3 months post-treatment, T3: 6 months post-treatment, T4: 9 months post-treatment, T5: 12 months post-treatment. SD, Standard Deviation.

Time-dependent intercanine distance changes revealed by the within group comparison were found to be significant in group 2, group 3 and group 4 ($p=0.001$). According to the post-hoc tests, the changes in T1-T2 time intervals were found to be insignificant in group 3 and group 4, while the other changes in group 2, group 3 and group 4 were significant. According to the between group comparison, there was no significant difference between the groups at time T1 ($p=0.328$). There was a significant difference between group 1 and groups 2, 3 and 4 at time T2 and also between group 2 and groups 3 and 4 at time T2. There was a significant difference between all pairwise groups for the T3, T4 and T5 periods (Table IV).

Time-dependent arch length changes were significant in all groups ($p<0.05$). According to the post-hoc tests, there was a significant difference between the pairwise time periods for groups 1 and 2. In groups 3 and 4, there was a significant difference between all pairwise groups except for the T1-T2 periods. However, there was no significant difference between the groups at each time period ($p>0.05$) (Table V).

There was a significant positive relationship between the teeth separated from the adhesive and the the number of retainer wire fractures and bonding failures in the study groups ($p=0.046$). Moreover, the breakage of retainers across the study groups was found to be significantly different ($p=0.002$) in which

Table VI. Relation of separation from the adhesive, breakage and study groups

		N (%)				<i>p</i>
		Group 1	Group 2	Group 3	Group 4	
Separation from the Adhesive	No separation	33 (94.2%)	28 (80%)	30 (85.7%)	30 (85.7%)	0.046*
	Separation on 3rd month	1 (2.9%)	1 (2.9%)	3 (8.6%)	1 (2.9%)	
	Separation on 6th month	—	4 (11.4%)	1 (2.9%)	3 (8.6%)	
	Separation on 9th month	—	1 (5.7%)	—	1 (2.9%)	
	Separation on 12th month	1 (2.9%)	1 (2.9%)	1 (2.9%)	—	
Breakage	Yes	1 (5.7%)	4 (11.4%)	0 (0.0%)	9 (25.7%)	0.002*
	None	34 (94.3%)	31 (88.6%)	35 (100.0%)	26 (74.3%)	

*Significant at 0.05 level according to Monte Carlo Exact Chi-square test.

Group 1: 0.0175 inches 7-strand stainless steel wire, Group 2: 0.016 × 0.022 inches Dead-soft wire, Group 3: 0.038 × 0.016 inches prefabricated Ortho FlexTech stainless steel wire, Group 4: EverStick® Ortho fibre reinforced composite retainer.

a greater level of breakage was seen only in group 2 (11.4%) and group 4 (25.7%) (Table VI).

Discussion

The long-term maintenance of treatment outcomes remains a primary orthodontic challenge, particularly in the mandibular anterior region, where relapse is frequently observed despite prior successful alignment. Fixed lingual retainers are widely used due to their capacity to provide continuous retention without requiring patient compliance. However, the failure of these retainers is a multifactorial issue, often influenced by the material properties of the wire, its compatibility with the tooth surface, and the precision of the bonding procedure.^{13–15} In this context, evaluating the clinical performance of different retainer materials is crucial to guiding evidence-based selection and improving post-treatment stability.

Little's irregularity index remains a commonly used tool for evaluating post-treatment alignment, particularly in the mandibular anterior region. Its simplicity, reliability, and reproducibility makes it a practical choice in both clinical and research settings.^{2,16} In the present study, Little's irregularity index, intercanine width, and arch length were used together to assess the stability of the mandibular anterior segment.

Lingual retainers are designed for long-term use, but wire breakage can still occur due to interdental deformation and composite cracks.¹⁷ Therefore, selecting the appropriate wire type is essential for the long-term success of fixed retention. Previous studies have reported that thicker wires, which are more resistant to fatigue, tend to have lower fracture rates.^{18,19} In the present study, the 0.038x0.016 inch Ortho FlexTech wire (group 3) had the greatest cross-sectional dimension and showed no instances of breakage. The dead-soft wire (group 2) broke four times, and the multi-strand stainless steel wire (group 1) broke once. Fibre-reinforced composite retainers (group 4) had nine fractures, possibly due to water absorption and composite abrasion. It has been shown that changes in fibre volume due to water uptake can compromise mechanical strength. Consistent with these observations, several studies have reported lower clinical success rates for fibre-reinforced retainers compared to multi-stranded stainless steel wires.^{4,9,20,21} The present results corroborate these findings.

Bonding failures of fixed retainers are often associated with insufficient composite coverage, occlusal or mechanical abrasion, and long-term exposure to intraoral conditions. While occlusal forces typically affect specific contact areas, tooth brushing abrasion can cause more generalised wear of the composite surface. Previous studies have demonstrated that

composite resin abrasion increases proportionally with brushing frequency.^{19,21} In the present study, bonding failures were observed most frequently in group 2, which may be partially explained by the reduced resistance of the dead-soft wire to movement and associated microfractures at the adhesive interface. To minimise technique-related factors, all bonding procedures were performed by a single investigator who had undergone clinical calibration and followed a standardised protocol for composite application.

Consistent with previous reports, fibre-reinforced retainers exhibited higher failure rates than multi-stranded stainless steel wires. Nagani et al. reported bonding failure rates of 42.94% for fibre-reinforced retainers and 31.41% for multi-stranded stainless steel retainers, with adhesive separation as the most common issue.⁴ Similarly, Tacken et al. observed a 51% failure rate over two years for fibre-reinforced retainers, compared to only 12% for stainless steel retainers.⁹ In the present study, although the overall failure rates were lower, 5.7% for the multi-stranded group and 14.3% for the fibre-reinforced group, this may partly reflect the study methodology, as failures were calculated per patient rather than per tooth, unlike Nagani et al. These results support previous concerns about the long-term reliability of fibre-reinforced composite retainers.

After one year of retention, intercanine distance decreased by 0.08, 0.40, 0.25, and 0.39 mm in groups 1, 2, 3, and 4, respectively. These findings are consistent with previous studies which monitored intercanine width changes during the retention period.^{22,23} Groups 2 and 4, which showed higher relapse levels based on Little's irregularity index, also exhibited greater reductions in intercanine distance, suggesting a relationship between arch width maintenance and anterior alignment. Although reductions in arch length were also observed, they were not clinically significant and remained in line with the existing literature.^{24,25} When all data were evaluated, groups 1 and 3 were statistically more effective in maintaining post-treatment stability compared to groups 2 and 4.

Studies have reported that tooth irregularity must be 2-3.5 mm to be noticeable by patients.²⁶ After one year, the increase in Little's index was 0.66 mm for the dead-soft wire group, 0.11 mm for the seven-stranded wire group, 0.21 mm for the Ortho FlexTech

group, and 0.65 mm for the fibre-reinforced group. The dead-soft wire group had the highest irregularity change at 0.66 mm. Based on these findings, no clinically significant relapse was observed.²²⁻²⁴

The present study has limitations. Patient compliance affects fixed retainer effectiveness due to its reliance on good oral hygiene. Poor hygiene can lead to plaque accumulation, which can affect the results. While hygiene education was provided, not all patients adhered consistently. A one-year follow-up may be insufficient to assess long-term stability, and factors such as inadequate saliva secretion and bruxism may affect retainer success, thereby limiting generalisability.

Conclusion

To maintain lower incisor stability after orthodontic treatment, it is recommended that stainless steel retainer wires be applied due to their durability and fewer bonding failures. Additionally, it should be considered that fibre-reinforced composite retainers may be less successful at the one-year follow up period.

Conflict of interest

The authors declare that there is no conflict of interest.

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