

## A SURVEY OF PATIENTS' EXPERIENCE WITH A DUAL ORTHODONTIC RETENTION PROTOCOL

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### Abstract

**Aim:** The success of retention protocols in preventing orthodontic relapse depends not only on the effectiveness of the appliances used but also on patient compliance. This study aimed to evaluate the effectiveness of dual retention protocol, which combines fixed retainers and removable retainers to be use only 15 minutes a week. Using a survey method, the long-term stability of the fixed retainer and the time-dependent changes in removable appliance use were examined. Additionally, patients' knowledge of the protocol and their adherence were assessed. **Materials and Methods:** Patients who had completed active orthodontic treatment and were managed with a dual retention protocol were identified and invited to participate in an online survey. Data from 278 participants were analyzed, focusing on the frequency and duration of removable retainer use, breakage rates of fixed retainers, and patients' knowledge regarding the retention protocol. Statistical analyses were performed using IBM SPSS Statistics version 22; descriptive statistics were calculated, and categorical variables were analyzed using the Chi-square and Fisher–Freeman–Halton exact tests, with significance set at  $p < 0.05$ . **Results:** Knowledge of the purpose of removable retainers was significantly associated with frequency of use. While 76% of participants lacking knowledge of the retainer's purpose reported non-use, this proportion was only 29.8% among informed participants. Removable retainer use declined over time; approximately 50% reported regular use in the first year, compared with only 4.3% after the third year. Fixed retainer breakage rates also increased over time, reaching 59.7% among the patients who had completed treatment 2–4 years earlier. **Conclusion:** The findings indicate that reduced motivation and insufficient patient knowledge may compromise adherence to the retention protocol. While the dual retention protocol offers a theoretically effective retention strategy, its long-term success is closely linked to patient education and sustained motivation. Surveys based on patient experience contribute to improving and personalizing retention strategies.

**Keywords:** Retention, Dual Retention Protocol, Removable Retainer, Fixed Retainer, Survey.

### INTRODUCTION

The aim of orthodontic treatment is to correct existing anomalies, establish ideal dental occlusion, achieve proper mastication, speech, and respiratory functions, provide satisfactory esthetics, and maintain treatment outcomes over time [1, 2]. Achieving ideal occlusion has a key role in ensuring post-treatment stability. However, even when ideal occlusion is obtained, relapse may occur if retention therapy is not applied at the end of treatment or if the retention protocol fails [3].

Orthodontic relapse is defined as the tendency of skeletal and dental structures to return to their original positions or to different positions [4]. The retention phase aims to prevent relapse and represents an essential component of orthodontic treatment. It represents a passive phase during which the teeth and surrounding tissues are stabilized [3, 4]. While retention was often discontinued after a certain period in the twentieth century, increasing evidence documenting relapse rates has led to the widespread acceptance of lifelong retention [5].

The success of orthodontic treatment depends not only on selecting the appropriate treatment method but also on choosing and implementing suitable retention strategies. Retention should be considered during diagnosis and treatment planning, and the most appropriate appliance should be selected according to the patient, the malocclusion and the type of treatment performed [4, 6].

Both, fixed and removable appliances, are widely used for retention in orthodontic treatment. After active treatment, fixed retainers bonded to the lingual surfaces of the anterior teeth are frequently preferred to retain anterior teeth, because they require less patient cooperation and do not create esthetic concerns. Removable appliances also provide specific advantages. The Hawley appliance allows improvement of interdigitation; clear retainers offer esthetic benefits and torque control; positioners provide additional protection following open-bite treatment; and wraparound appliances help prevent relapse after polydiastema treatment [7]. Depending on clinical philosophy, tradition, and country, clinicians may use fixed and removable appliances in different combinations [5].

At the Istanbul Okan University Department of Orthodontics, a dual retention protocol that combines fixed retainers and removable clear retainers, that allows lifelong sustainability, is employed. In addition to intercanine fixed retainers in both arches, intended to remain preferably lifelong, removable clear retainers are recommended to be used once a week for 15 minutes. The clear retainer is intended to measure any relapse within the dental arches, noticeably perceptible to the patient, in which case it should be worn consecutively for 7-10 nights, to correct the relapse. In cases of fracture or debonding of the fixed retainer, daily use of the removable retainer is advised, to prevent relapse until repair is completed. The first retention control visit is scheduled three months after treatment, followed by six-month follow-up visits. All instructions are provided both verbally and in written form.

This protocol aims to provide an alternative solution to problems observed in commonly used retention approaches. By combining continuous retention with a fixed appliance and periodic self-monitoring with a removable retainer worn only once weekly for a short duration, ensures feasibility and longevity of orthodontic retention while, preventing relapse of incisors caused during debonding periods of the fixed retainer. This approach seeks to maintain stability while enabling early detection of potential changes.

The null hypothesis of this study was that no statistically significant relationship exists between patient compliance with the dual retention protocol (fixed retainer and removable clear retainer) and retention success. The aim of this study was to evaluate the

effectiveness of this dual retention protocol in patients during the retention phase. Through patient questionnaires, the longevity and comfort of fixed retainers, the duration and frequency of removable retainer use and changes in usage over time were assessed to determine how well the given instructions were understood and followed.

## METHOD

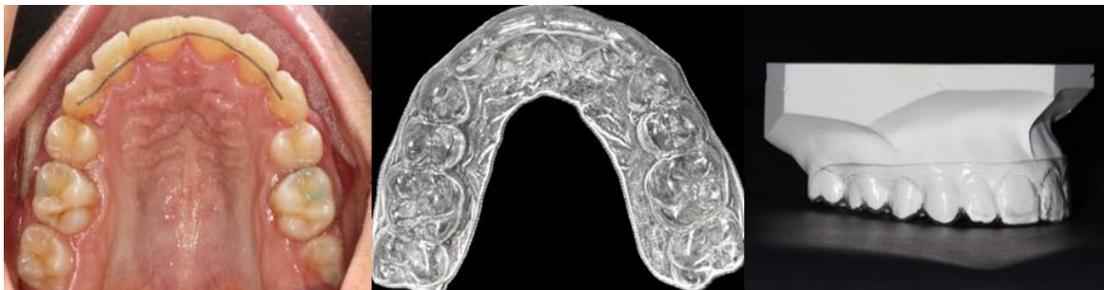
This study was designed as a cross-sectional clinical survey. Ethical approval was obtained from the Istanbul Okan University Ethics Committee (Decision No: 183, Date: 11.12.2024). The study was conducted in accordance with ethical principles, and participation was voluntary.

### Study Population and Sample Selection

The study was carried out at the Istanbul Okan University Dental Hospital, Department of Orthodontics, Doctoral Clinic. Patient records were reviewed to identify individuals who had completed orthodontic treatment and met the study criteria.

Hospital information systems were used comprehensively to identify eligible participants. All patient data were obtained from the digital hospital database system (Nucleus Hospital Information Management System). In addition, manually prepared lists created by clinicians that included patients who had completed treatment were also reviewed. These two data sources were cross-checked to verify patient information and to identify any missing records.

Individual patient files and post-treatment intraoral photographs were reviewed. Patients who had received the dual retention protocol and met the inclusion criteria constituted the study sample. (Figure 1)



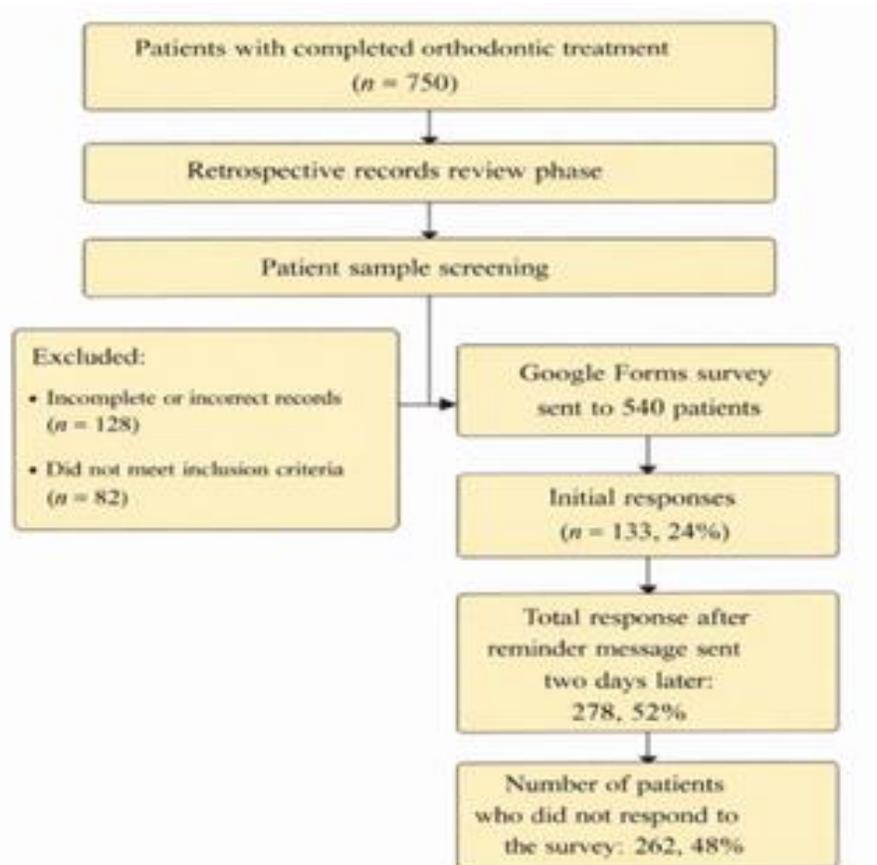
**Figure 1: Fixed retainer and removable retainer (clear aligner)**

The inclusion criteria were as follows:

- Being in the permanent dentition period
- Having completed fixed orthodontic treatment or clear aligner treatment
- Having received the dual retention protocol after treatment
- Absence of any mental or physical disability

## Questionnaire Development and Implementation

A digital questionnaire was prepared using Google Forms (Google Forms; Google LLC, Mountain View, California, USA) and sent to eligible patients via text message. Two days after the initial message, a reminder message was sent to participants who had not responded (Fig 2).



**Figure 2: Study flow diagram**

The first section of the questionnaire included information about the aim and scope of the study. Participants were informed that the collected data would be used solely for scientific purposes and that personal information would remain confidential. The questionnaire was structured so that only participants who approved the informed consent statement could proceed.

For adult participants, the informed consent statement declared that participation was voluntary and that withdrawal from the study was possible at any time without justification. For participants under 18 years of age, parental consent was obtained, and the guardian completed the questionnaire on behalf of the patient.

The questionnaire consisted of two sections and 10 questions. The first section included demographic and treatment-related questions:

- Age (under 16, 16–20, 20–30, 30–40, over 40)
- Gender (female/male)
- Duration of orthodontic treatment (less than 1 year, 1–2 years, more than 2 years)
- Time since treatment completion (less than 1 year, 1–2 years, 2–4 years, 5 years or more)

These questions aimed to classify participants into appropriate subgroups for analysis.

The second section included questions evaluating the dual retention protocol:

Participants were asked whether they had received retention instructions at the end of treatment and whether these instructions were provided in written form. Additional questions assessed their knowledge regarding the function of the fixed retainer and removable retainer.

Participants were asked whether their fixed retainer had ever fractured or debonded. This question aimed to determine the frequency of mechanical complications that could affect stability and patient satisfaction.

Regarding removable retainers, participants were asked about usage frequency (daily, once weekly, once monthly, or not used) and duration of use (0–6 hours, 6–12 hours, 12–24 hours). These questions aimed to evaluate patient compliance with the recommended protocol.

Participants who reported not using their removable retainer were asked to indicate the reasons. Options included discomfort, improper fit, esthetic concerns, speech difficulties, forgetfulness, loss of the appliance, dislike of use, hygiene concerns, fracture or wear of the retainer, and treatment fatigue. This multiple-choice question was designed to identify factors influencing compliance and to provide insight into potential improvements in retention strategies.

### **Statistical Analysis**

Statistical analyses were performed using IBM SPSS Statistics version 22 (IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated as frequencies. Qualitative variables were compared using the Chi-square test and the Fisher-Freeman-Halton Exact test when appropriate. A p-value of less than 0.05 was considered statistically significant.

## **RESULTS**

As shown in Table 1, a total of 278 participants completed the questionnaire. The distribution of treatment duration showed that 14.4% of participants had undergone orthodontic treatment for less than one year, 41.9% for 1–2 years, and 43.7% for more than two years. Regarding the time elapsed since treatment completion, 32.5% were in

retention for less than one year, 31.8% for 1–2 years, 24.2% for 2–4 years, and 11.6% for five years or longer.

At treatment completion, 94.9% of participants reported receiving retention instructions, and among those, 65.0% stated that the instructions were provided in written form. The majority of participants reported knowing the purpose of the fixed retainer (90.6%) and the removable retainer (91.0%). Fixed retainer debonding or fracture was reported by 46.6% of participants.

Regarding removable retainer use, 28.5% reported daily use, 27.1% once weekly use, 14.1% once monthly use, and 30.3% reported not using the appliance. Concerning daily duration of wear, 26.4% reported wearing the retainer for 0–6 hours, 36.8% for 6–12 hours, and 6.5% for 12–24 hours, while 30.3% stated that they did not use it.

When reasons for non-use were evaluated, the most frequently reported were “not liking to use it” (19.1%), forgetfulness (18.8%), and discomfort (17.7%). Other reported reasons included treatment fatigue (13.7%), joint or tooth pain (13.0%), improper fit (12.6%), appliance fracture or wear (7.2%), esthetic concerns (6.9%), speech difficulty (6.9%), and hygiene concerns (6.5%) (Table 1).

As shown in Table 2, there was no statistically significant difference in removable retainer use frequency according to whether post-treatment instructions had been provided ( $p=0.089$ ). However, wear duration differed significantly between groups ( $p=0.039$ ). Participants who received instructions showed a higher proportion of 0–6 hour daily wear (27.4% vs. 7.1%) and a lower proportion of non-use (28.9% vs. 57.1%) compared with those who did not receive instructions (Table 2).

**Table 1: Responses to the questionnaire items are presented as number and percentage**

Variable	Category	n	%
Treatment duration	Less than 1 year	40	14.4
	1–2 years	116	41.9
	More than 2 years	121	43.7
Retention duration	Less than 1 year	90	32.5
	1–2 years	88	31.8
	2–4 years	67	24.2
	5 years and over	32	11.6
Instructions given at treatment completion	Yes	263	94.9
	No	14	5.1
Written instructions provided (n=263)	Yes	171	65
	No	92	35
Knowing the purpose of the fixed retainer	Yes	251	90.6
	No	26	9.4
Fixed retainer debonding/fracture	Yes	129	46.6
	No	148	53.4
Knowing the purpose of the removable retainer	Yes	252	91
	No	25	9
Frequency of removable retainer use	Daily	79	28.5

	<b>Once weekly</b>	75	27.1
	<b>Once monthly</b>	39	14.1
	<b>Not using</b>	84	30.3
<b>Daily duration of removable retainer wear</b>	<b>0–6 hours</b>	73	26.4
	<b>6–12 hours</b>	102	36.8
	<b>12–24 hours</b>	18	6.5
	<b>Not using</b>	84	30.3
<b>Reasons for not using removable retainer*</b>	<b>I did not like using it</b>	53	19.1
	<b>Forgetfulness</b>	52	18.8
	<b>Discomfort</b>	49	17.7
	<b>I got tired of treatment</b>	38	13.7
	<b>It causes joint/tooth pain</b>	36	13
	<b>The retainer does not fit my teeth</b>	35	12.6
	<b>It broke/wore down</b>	20	7.2
	<b>Esthetic reasons</b>	19	6.9
	<b>Speech difficulty</b>	19	6.9
	<b>I did not find it hygienic</b>	18	6.5

n: number of participants; %: percentage

**Table 2: Evaluation of removable retainer use frequency and wear duration according to post-treatment instruction status**

		Post-treatment instructions given at treatment completion		p
		Yes (n=263)	No (n=14)	
		n (%)	n (%)	
<b>Frequency of removable retainer use</b>	<b>Daily</b>	77 (%29,3)	2 (%14,3)	0.089
	<b>Once weekly</b>	71 (%27)	4 (%28,6)	
	<b>Once monthly</b>	39 (%14,8)	0 (%0)	
	<b>Not using</b>	76 (%28,9)	8 (%57,1)	
<b>Daily duration of removable retainer wear</b>	<b>0-6 hours</b>	<b>72 (%27,4)</b>	<b>1 (%7,1)</b>	0.039*
	<b>6-12 hours</b>	99 (%37,6)	3 (%21,4)	
	<b>12-24 hours</b>	16 (%6,1)	2 (%14,3)	
	<b>Not using</b>	<b>76 (%28,9)</b>	<b>8 (%57,1)</b>	

Fisher Freeman Halton Exact test; \*p<0.05; n: number of participants; %: percentage

Values are presented as percentages; the group responsible for the significant difference is indicated in bold.

Removable retainer use frequency did not differ significantly according to active treatment duration (p=0.626), as detailed in Table 3. Among the reported reasons for non-use, esthetic concerns differed significantly across treatment duration groups (p=0.013). Participants treated for less than one year reported non-use due to esthetic reasons more frequently (17.5%) than those treated for 1–2 years (6.0%) or more than two years (4.1%), as presented in Table 3.

**Table 3: Evaluation of removable retainer use frequency and reasons for non-use according to orthodontic treatment duration**

		Treatment Duration			p
		Less than 1 year	1–2 years	More than 2 years	
		n (%)	n (%)	n (%)	
Frequency of removable retainer use	Daily	13 (%32,5)	37 (%31,9)	29 (%24)	0.626
	Once weekly	11 (%27,5)	30 (%25,9)	34 (%28,1)	
	Once monthly	5 (%12,5)	19 (%16,4)	15 (%12,4)	
	Not using	11 (%27,5)	30 (%25,9)	43 (%35,5)	
Reasons for not using the removable retainer	Discomfort	4 (%10)	23 (%19,8)	22 (%18,2)	0.366
	The retainer does not fit my teeth	5 (%12,5)	12 (%10,3)	18 (%14,9)	0.576
	<b>Esthetic reasons</b>	<b>7 (%17,5)</b>	<b>7 (%6)</b>	<b>5 (%4,1)</b>	<b>0.013*</b>
	Speech difficulty	4 (%10)	8 (%6,9)	7 (%5,8)	0.658
	Forgetfulness	6 (%15)	22 (%19)	24 (%19,8)	0.792
	I lost my retainer	4 (%10)	5 (%4,3)	7 (%5,8)	0.413
	I did not like using it	8 (%20)	23 (%19,8)	22 (%18,2)	0.939
	I did not find it hygienic	5 (%12,5)	6 (%5,2)	7 (%5,8)	0.246
	It broke/wore down	5 (%12,5)	8 (%6,9)	7 (%5,8)	0.358
	I got tired of treatment	6 (%15)	14 (%12,1)	18 (%14,9)	0.795
It causes joint/tooth pain	5 (%12,5)	12 (%10,3)	19 (%15,7)	0.469	

Chi-square test; \* $p < 0.05$ ; n: number of participants; %: percentage; Values are presented as percentages; the group responsible for the significant difference is indicated in bold.

As detailed in Table 4, a statistically significant association was observed between time since treatment completion and removable retainer use frequency ( $p = 0.001$ ). Daily use was highest in the group with less than one year of retention (43.0%) and decreased in the 1–2 year (27.3%), 2–4 year (14.9%), and  $\geq 5$  year (15.6%) groups. Non-use was more frequent in the 2–4 year (52.2%) and  $\geq 5$  year (50.0%) groups compared with the  $< 1$  year (17.4%) and 1–2 year (31.8%) groups. Among non-use reasons, speech difficulty differed significantly according to retention duration ( $p = 0.048$ ), with the 1–2 year group reporting a higher rate (12.5%) than the  $< 1$  year (3.5%) and 2–4 year (3.0%) groups.

**Table 4: Evaluation of removable retainer use frequency and reasons for non-use according to retention duration**

		Retention Duration				p
		Less than 1 year	1–2 years	2–4 years	5 years and above	
		n (%)	n (%)	n (%)	n (%)	
Frequency of removable retainer use	Daily	<b>37 (%43)</b>	<b>24 (%27,3)</b>	<b>10 (%14,9)</b>	<b>5 (%15,6)</b>	<b>0.001*</b>
	Once weekly	26 (%30,2)	25 (%28,4)	15 (%22,4)	5 (%15,6)	
	Once monthly	8 (%9,3)	11 (%12,5)	7 (%10,4)	6 (%18,8)	
	Not using	15 (%17,4)	28 (%31,8)	35 (%52,2)	16 (%50)	
Reasons for not using the removable retainer	Discomfort	15 (%17,4)	15 (%17)	11 (%16,4)	8 (%25)	0.741
	The retainer does not fit my teeth	10 (%11,6)	12 (%13,6)	11 (%16,4)	2 (%6,3)	0.537
	Esthetic reasons	8 (%9,3)	8 (%9,1)	2 (%3)	1 (%3,1)	+0.336

	<b>Speech difficulty</b>	<b>3 (%3,5)</b>	<b>11 (%12,5)</b>	<b>2 (%3)</b>	<b>3 (%9,4)</b>	<b>+0.048*</b>
	<b>Forgetfulness</b>	18 (%20,9)	16 (%18,2)	12 (%17,9)	6 (%18,8)	0.960
	<b>I lost my retainer</b>	<b>3 (%3,5)</b>	<b>3 (%3,4)</b>	<b>7 (%10,4)</b>	<b>3 (%9,4)</b>	+0.146
	<b>I did not like using it</b>	15 (%17,4)	16 (%18,2)	16 (%23,9)	6 (%18,8)	0.762
	<b>I did not find it hygienic</b>	<b>6 (%7)</b>	<b>5 (%5,7)</b>	<b>6 (%9)</b>	<b>1 (%3,1)</b>	+0.767
	<b>It broke/wore down</b>	7 (%8,1)	4 (%4,5)	4 (%6)	5 (%15,6)	+0.225
	<b>I got tired of treatment</b>	13 (%15,1)	13 (%14,8)	4 (%6)	8 (%25)	0.073
	<b>It causes joint/tooth pain</b>	<b>9 (%10,5)</b>	<b>14 (%15,9)</b>	<b>9 (%13,4)</b>	<b>4 (%12,5)</b>	0.767

Chi-square test; +Fisher Freeman Halton Exact Test; \*p<0.05; n: number of participants; %: percentage

Values are presented as percentages; the group responsible for the significant difference is indicated in bold.

Fixed retainer debonding or fracture did not differ significantly according to active treatment duration (p=0.080). However, a significant association was found between retention duration and fixed retainer debonding/fracture (p=0.003). The lowest rate was observed in the <1 year group (31.4%), whereas higher rates were observed in the 1–2 year (52.3%) and 2–4 year (59.7%) groups as presented in the Table 5.

**Table 5: Evaluation of fixed retainer debonding/fracture according to treatment and retention duration**

		Fixed retainer debonding/fracture status		p
		Yes n (%)	No n (%)	
Treatment duration	Less than 1 year	12 (%30)	28 (%70)	0.080
	1–2 years	57 (%49,6)	58 (%50,4)	
	More than 2 years	59 (%48,8)	62 (%51,2)	
Retention duration	Less than 1 year	<b>27 (%31,4)</b>	<b>59 (%68,6)</b>	<b>0.003*</b>
	1–2 years	46 (%52,3)	42 (%47,7)	
	2–4 years	40 (%59,7)	27 (%40,3)	
	5 years and above	15 (%46,9)	17 (%53,1)	

Chi-square test; \*p<0.05; n: number of participants; %: percentage

Values are presented as percentages; the group responsible for the significant difference is indicated in bold.

A significant association was also found between knowledge of the removable retainer's purpose and usage frequency as detailed in Table 6. (p=0.001). Among participants who reported knowing its purpose, 29.8% did not use the appliance, whereas 76.0% of those who reported not knowing its purpose did not use it.

**Table 6: Evaluation of removable retainer use frequency according to written instruction delivery**

Frequency of removable retainer use	Written delivery of instructions		p
	Yes	No	
	n (%)	n (%)	
Daily	53 (%31,0)	24 (%26,1)	0.277
Once weekly	48 (%28,1)	19 (%20,7)	
Once monthly	20 (%11,7)	13 (%14,1)	
Not using	50 (%29,2)	<b>36 (%39,1)</b>	

Chi-square test; n: number of participants; %: percentage; Values are presented as percentages; the group responsible for the significant difference is indicated in bold.

As a result of the survey, no statistically significant difference was found in removable retainer use according to gender or age.

## DISCUSSION

Orthodontic relapse continues to represent one of the fundamental challenges in clinical practice despite advances in treatment protocols and materials [3, 8–10]. The present study aimed to evaluate the effectiveness of a dual retention protocol applied during the retention phase and to analyze its clinical performance through patient-reported outcomes. Specifically, the durability and comfort of fixed retainers, the frequency and duration of removable retainer use, and the degree to which post-treatment instructions were understood and implemented were investigated. By integrating patient experience and behavioral data, this study sought to provide a more comprehensive evaluation of a protocol that has been routinely implemented at the Istanbul Okan University Orthodontic Doctoral Clinic.

Clinical observations indicate that once a fixed retainer debonds or fractures, teeth may relapse rapidly toward their original malocclusion, and this change is often detected late by patients [3, 9, 10]. This situation highlights the need for a secondary retention mechanism capable of temporarily compensating for fixed retainer failure. Moreover, protocols relying exclusively on removable retainers are frequently associated with low patient compliance, and lifelong retainer wear is difficult to maintain in daily practice. Therefore, this study was designed both to address these practical concerns and to systematically evaluate the dual retention protocol, which combines fixed and removable retainers but has limited scientific documentation.

The literature consistently emphasizes that long-term stability after orthodontic treatment depends not only on the success of active treatment but also on appropriate retention planning and patient compliance during the retention phase [5, 9, 11, 12]. Fixed and removable appliances each offer distinct advantages and disadvantages, and individualized retention strategies are recommended based on patient-specific needs [13, 14]. The findings of the present study support this individualized approach and further underscore the importance of structured patient education.

To date, few comprehensive investigations have examined combined retention protocols from a patient-centered perspective. Most existing studies focus primarily on clinicians' preferences and biomechanical outcomes. Therefore, this study contributes original data by exploring how patient knowledge, perception, and behavior influence the success of a dual retention strategy. Beyond testing the null hypothesis, the study also aimed to generate clinically meaningful insights grounded in patient-reported data.

The null hypothesis proposed that there would be no significant relationship between patient knowledge of the dual retention protocol and retention success. However, the results led to rejection of this hypothesis. Participants who demonstrated awareness of the function of the removable retainer reported significantly higher usage rates compared to those lacking such knowledge. This finding is not only statistically significant but also clinically relevant, suggesting that patient education directly influences retention behavior and long-term stability.

Data collection was performed through a combination of retrospective record screening and an online questionnaire. A total of 750 patients were screened through the Nucleus Hospital Information Management System and clinical records, and 540 eligible individuals received the survey via Google Forms. The response rate reached 51.5% (n=278), exceeding typical online survey response rates of 30–40% reported in the literature. The initial response rate of 24% increased substantially following a reminder message sent two days later, confirming the effectiveness of reminder strategies in digital data collection [15]. Limiting participation to individuals who provided informed consent enhanced ethical integrity and data reliability. The questionnaire included both demographic and behavioral questions addressing retainer usage frequency, fixed retainer complications, and the extent of post-treatment instruction delivery.

One limitation of the methodology is its reliance on self-reported data. Participants may not accurately recall usage patterns or may provide socially desirable responses [16]. Nevertheless, the relatively large sample size and structured questionnaire design aimed to minimize this bias. Another limitation is the absence of questions evaluating adherence to scheduled retention follow-up visits. In the dual protocol, follow-ups were recommended at 3 months and subsequently every 6 months; however, adherence to this schedule was not assessed. Edman Tynelius et al. emphasized that systematic follow-up is essential for long-term retention success [14]. Online surveys also present inherent methodological challenges. In particular, fewer participants responded to multi-option questions, such as reasons for not using the removable retainer. The lower response density for these items may have limited statistical power. Dillman et al. noted that participants often fail to carefully review all options in multi-response questions, potentially affecting data reliability [17].

Regarding removable retainer use, a substantial proportion of participants reported wearing the retainer for less than 6 hours per day. According to the clinic's dual retention protocol, removable retainers are recommended for at least 15 minutes once weekly under normal conditions and daily use in cases of fixed retainer failure. The reported usage patterns suggest general adherence to this protocol. However, a recent systematic

review indicated that a minimum of  $\geq 9$  hours of daily wear is necessary for optimal control of mandibular anterior irregularity and that compliance decreases over time. Thus, while short-term or intermittent use may be sufficient under certain clinical conditions, long-term stability may require stronger motivational strategies [18].

Instruction delivery was significantly associated with retainer wear duration. Participants who received post-treatment instructions were more likely to wear their retainers. Furthermore, individuals who understood the function of the removable retainer demonstrated markedly lower non-use rates compared to those who did not. This finding aligns with the Cochrane review by Littlewood et al., emphasizing the critical role of patient education in retention success [13], and is consistent with findings by Padmos et al. regarding the positive impact of clinical instruction on compliance [5].

Written instructions also influenced compliance. Retainer usage was higher among individuals who received written instructions compared to those who did not, supporting previous findings highlighting the importance of structured patient communication during retention [19]. Retention duration was inversely related to removable retainer usage. Participants within the first year post-treatment reported higher usage rates compared to those beyond three years. This trend suggests progressive motivational decline over time, a finding consistent with Pratt et al., who reported reduced compliance beyond the initial two-year period despite early high adherence due to esthetic advantages [11].

The fixed retainer debonding/fracture rate reported in this study (47.3%) was higher than previously reported rates of 27.7% [98] and 28.2% in a systematic review [20]. A likely contributing factor is the direct bonding technique used in the institution, which may introduce operator-dependent variability and bonding sensitivity [21].

A significant association was observed between retention duration and fixed retainer failure. The fracture rate increased from 31.4% within the first year to 59.7% at 2–4 years. These findings are consistent with meta-analytic evidence indicating increasing failure rates over time, reaching approximately 50% by six years [22]. Additionally, previous research reported that 42.1% of failures occur within the first six months post-treatment, with continued risk over time [23]. These data collectively underscore the importance of regular monitoring and reinforcement of patient education beyond the first year.

No statistically significant differences in removable retainer usage were found according to gender or age. Although females reported slightly higher daily usage rates than males, the difference was not significant. These findings are consistent with previous studies reporting no meaningful influence of gender on retainer compliance [11, 24, 25].

However, younger individuals (<16 years) demonstrated lower usage rates due to esthetic concerns and speech difficulties. Similar observations were reported by Gill et al., who emphasized that esthetic concerns may negatively influence compliance among younger patients [26]. The most frequently reported reasons for non-use included discomfort, speech difficulty, esthetic concerns, loss of the appliance, breakage, and hygiene concerns. These factors align with previously documented causes of retention failure in systematic reviews [13].

## CONCLUSION

The findings of this study led to the rejection of the null hypothesis, demonstrating that the effectiveness of the dual retention protocol, consisting of a fixed retainer combined with a removable retainer, is strongly associated with patient knowledge and compliance. Patient-reported findings indicated that a 15-minute weekly protocol was regarded as a practical, easily adoptable, and sustainable approach suitable for long-term, potentially lifelong use. A significant relationship was identified between awareness of the removable retainer's function and its regular use, with informed individuals reporting higher levels of adherence. Additionally, patients who received both written and verbal post-treatment instructions showed improved retention compliance. Fixed retainer failure rates were observed to increase over time, indicating that retention stability is influenced not only by appliance selection but also by longitudinal monitoring and patient engagement.

The absence of comparable protocols in the literature highlights the originality of this dual retention approach. The results suggest that the protocol is not only clinically implementable but also sustainable when supported by structured patient education and follow-up strategies.

## Recommendations

- Standardized patient education protocols, including both written and verbal instructions, should be implemented at the transition to the retention phase.
- Regular clinical follow-up systems should be reinforced, particularly after the first year of retention, to monitor fixed retainer integrity and ensure long-term stability.
- Future research should further evaluate the long-term outcomes of combined retention strategies and investigate methods to enhance sustained patient compliance.

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