

EVALUATION OF DIASTEMA CLOSURE STABILITY IN ORTHODONTICALLY TREATED PATIENTS

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<https://doi.org/10.51847/Z4PbNU3139>

ABSTRACT

Evidence addressing the stability following a midline diastema closure is believed to be poor, and a paucity of research on this topic has been observed. The study aims to determine diastema closure stability in orthodontically treated patients who underwent a fixed or removable retainer. Forty individuals who received orthodontic treatment for diastema closure were identified using treatment records in orthodontic clinics of a private university hospital in Riyadh city, Saudi Arabia. Panoramic radiographs were taken at debonding stage (T1), and post-treatment follow-up examination (T2) was assessed for relapse. Diastema relapse was believed when the T2-T1 inter-incisor gap was more than zero. The type of retainer therapy post orthodontic treatment was also recorded. The relapse was measured using UNC 15 probe. A Chi-square test, Mann-Whitney U, and Kruskal-Wallis tests were applied to the data. A diastema relapse was deemed clinically significant when it measured 0.50 mm or more. Forty individuals treated for diastema by orthodontic treatment participated in this study. Of the study participants, 50% received a removable retainer while 20% received a fixed retainer, and 25% received both fixed and removable retainers. Diastema stability was observed in 82.5% of cases, while 17.5% showed relapse. Diastema stability did not differ across different retainers ($p=0.690$) and gender ($p=0.436$). Clinically significant relapse was found in six cases. The stability of orthodontically treated diastema closure using fixed and removable retainers was quite substantial.

Key words: Diastema, Orthodontic stability, Relapse, Retainer, Fixed, Removable.

Introduction

The maxillary midline diastema (MMD) is a space or gap between two central incisors [1]. It is common in primary and mixed dentition and is considered developmental in origin [2, 3]. The presence of diastema may affect the smile attractiveness [4] the dentofacial harmony and plays a role in the psychological and functional discomfort in patients [5, 6].

Several factors are implicated in the etiology of MMD, such as supernumerary teeth, anomalies of tooth position, and pernicious habits [7]. The most frequent cause is high labial frenum attachment, and frenectomy and frenotomy are commonly used to treat diastema due to high frenal attachment [8].

In most cases, minimally invasive resin-based composite restoration procedures are a valid and more conservative treatment option to close diastemas [9]. Nevertheless, the orthodontic approach is a desirable treatment plan. In comparison, it closes the diastema and eliminates other occlusal discrepancies [10]. Moreover, retention is considered an integral part of orthodontic treatment and its success; it demands the clinician's knowledge and the patient's compliance. Removable retainers are considered more hygienic, and patient cooperation is mandatory to avoid relapse.

In comparison, fixed retainers are considered more reliable

and usually bonded on the palatal/lingual surface of the teeth [11-13]. Since the patient cannot remove them, teeth can accumulate plaque if not appropriately cleaned. Hence, clinicians must reinforce patients' oral hygiene [14].

Lastly, there is scant information on the stability of midline diastema closure [2, 15], and a shortage in the literature of studies has been noticed. Therefore, this current study aims to evaluate the stability of inter-incisor diastema closure in the maxilla of orthodontically treated patients using fixed and removable retainers.

The null hypothesis would be no difference in the stability of the maxillary inter-incisor diastema closure in orthodontically treated patients using fixed and removable retainers.

Materials and Methods

Ethical approval

The research and innovation center of Riyadh Elm University, Riyadh, Saudi Arabia, formally approved the study (FUGRP/2021/239/567/541). The participants approved a signed consent form in Arabic stating to use data for research purposes.

Study design

This cross-sectional study was carried out among the patients who have completed their orthodontic treatment

followed by retainer therapy (fixed, removable, and combined) at an orthodontic division of the Riyadh Elm University Hospital, Riyadh, Saudi Arabia.

Study sample

A convenience sampling methodology was employed to select the study participants who have received Orthodontic treatment with a history of diastema in the orthodontic division of Riyadh Elm University Hospital. The sample was obtained retrospectively by screening 1643 files of orthodontic patients who received treatment in the Al-Olaya, Munasiya, and An-namuthajiya clinics. Each file was examined for the presence of diastema before treatment. Based on the following exclusion and inclusion criteria, all the potential patients were invited to participate in the study.

Inclusion criteria

1. Medically fit patients
2. Patients who had a diastema between their teeth of 0.5 mm or more that was closed with orthodontic treatment (Fixed or removable).
3. Patients with permanent canine eruption
4. Patients aged above 18 years

Exclusion criteria

Patients who had restorative treatment to close the diastema had periodontal diseases, or suffered a dental trauma were excluded.

Patients with absent anterior teeth, microdontia, congenital disorders of the maxilla, and mesiodens were excluded from the study.

Sample size calculation

The sample size was estimated, assuming 80% power of the study and a significance level of 0.05, to detect a relapse of 0.49 ± 0.68 mm in diastema, as reported in the previous study [16]. A minimum of 21 patients were estimated, rounded off to 20 for each group (fixed and removable retainer). Thus, a total of 40 patients were included in the study.

Measurement of diastema

Patients were requested to take a fresh panoramic radiograph during the recall visit to examine inter-incisal relapse. They were evaluated for T1 (time of debonding), T2 (time of recall), and the type of retainer used. Relapse was judged as gingivo-incisal separation of the adjacent maxillary central incisors. The relapse was measured clinically using UNC 15 probe. All data were recorded in an excel sheet with the variables such as (file number, age, gender, T1, T2, type of retainer, relapse occurrence, and the relapse in mm).

Statistical analysis

Intra-class correlation tests examined inter-examiner reliability at pre- and post-treatment data between examiners. Normality tests indicated the non-normal distribution of the data ($p < 0.05$). Descriptive statistics of

frequency distribution and percentages were calculated for the categorical variables. Similarly, mean, standard deviation, and median values were obtained for the continuous variables. A Chi-square test was applied to test the association between using the different retainers and the relapse. Finally, Mann-Whitney U and Kruskal-Wallis tests were applied to compare the amount of relapse among different genders and types of retainers. All the statistical analyses were undertaken to utilize IBM-SPSS (version 25, Armonk, NY: USA). A value of $p < 0.05$ was considered statistically significant for the tests.

Results and Discussion

A total of 40 post-orthodontic patients [(Males=10) and (Females=30)] with a mean age of 24.60 ± 7.07 mm years participated in the study. Half of the patients had removable orthodontic retainers, and 20% utilized fixed orthodontic retainers, while both removable and fixed retainers were used by 25% of the patients. However, two patients did not continue retainer therapy. Almost 33(82.5%) of our sample had no relapse (stable), whereas 7(17.5%) were presented with relapse that ranged between 0-1mm (mean amount of relapse: 0.13 ± 0.32 mm). A clinically significant relapse was observed in 6 (15%) patients (**Table 1**).

Table 1. Characteristics of the study subjects (N=40)

Variables	n	%	
Gender	Male	10	25.0%
	Female	30	75.0%
	Total	40	100.0%
Type of retainer	None	2	5.0%
	Removable	20	50.0%
	Fixed	8	20.0%
	Both	10	25.0%
Total	40	100.0%	
Relapse	Absent	33	82.5%
	Present	7	17.5%
	Total	40	100.0%
Age in years median, (mean±SD), Minimum-Maximum	22, 24.60±7.07, 18-46		
Relapse in mm (mean±SD), Minimum-Maximum	0, 0.13±0.32, 0-1.00		

Table 2. Association between retainer type and relapse

		None		Removable		Fixed		Both		p
		N	%	N	%	N	%	N	%	
Relapse	Absent	2	100	17	85	7	87.5	7	70	0.690
	Present	0	0.0	3	15	1	12.5	3	30	
	Total	2	100	20	100	8	100	10	100	
Fisher's exact test										

The association between retainer type and the presence of relapse and stability of the diastema are shown in **Table 2**. The orthodontic patients exclusively treated with removable retainers showed 3(15%) relapses, and those treated with fixed retainers demonstrated 1(12.5%). At the same time, 3(30%) relapse was found in orthodontic patients treated with removable and fixed retainers. When the association between occurrence of relapse and different retainer therapy was assessed, no statistically significant difference was observed ($p=0.690$).

Table 3. Association between gender and relapse

	Relapse	Male		Female		P
		N	%	N	%	
	Absent	9	90.0	24	80.0	0.656
	Present	1	10.0	6	20.0	
	Total	10	100.0	30	100.0	

The association between the occurrence of relapse between genders is shown in **Table 3**. No difference was found when the presence and absence of relapse were compared between male and female orthodontic patients ($p=0.656$). Only 1(10%) male and 6(20%) female orthodontic patients showed diastema relapse.

Table 4. Comparison rate of relapse (in mm) among different genders and types of retainers

		Mean	SD	Mean Ranks	p
Gender (n=40)	Male	0.05	0.16	18.85	0.436*
	Female	0.16	0.35	21.05	
Type of retainer (n=38)	Removable	0.10	0.26	18.78	0.557§
	Fixed	0.13	0.35	18.56	
	Both	0.23	0.42	21.70	

*Mann-Whitney U test, §Kruskal-Wallis's test.

The rate of diastema relapse between males and females did not differ significantly (0.05 ± 0.16 versus 0.16 ± 0.35 , $p=0.436$), as shown by the Mann-Whitney U test. Similarly, patients who had removable retainer (0.10 ± 0.26 mm), fixed (0.13 ± 0.35 mm), and both types (0.23 ± 0.42 mm) of retainers did not demonstrate any significant difference in the rate of diastema relapse ($p=0.557$) as shown by Kruskal-Wallis test (**Table 4**).

Diastema stability in orthodontically treated patients has been a controversial topic in orthodontics. It is considered a multifactorial malocclusion requiring careful examination and diagnosis [17]. The current study found significant stability in orthodontically treated patients. In this study majority of female patients attended post-orthodontic follow-up appointments. It is in line with the previous study in which more females than males sought dental treatment

since females were more responsive and willing to attend follow-up examinations in our study [18].

This study's findings corroborate Carruitero *et al.*'s study, in which 24 patients were examined, and no significant relapse of midline diastemas was found. It could be attributed to the extracted maxillary first premolar before the treatment of diastema closure [10]. Similarly, Sullivan *et al.* concluded that the post-retention relapse of maxillary diastema was too small to be considered significant. Yet, the only change associated with diastema relapse was an increase in maxillary incisor proclination [19].

Another study by Morais *et al.* examined 30 orthodontic patients treated for closure of diastema using Hawley's retainer and showed 60% of cases with relapse. However, in this study, only 15% of post-orthodontic cases wearing removable retainers demonstrated relapse since our study included patients who wore fixed retainers and both types of retainers; moreover, the severity of the diastema correlated with relapse and overjet. Contrarily, root parallelism was not considered a factor in relapse [16]. The null hypothesis considered in this study is accepted since there was no significant difference was observed stability of diastema in post-orthodontic patients treated with removable and fixed retainers. Hence it can be argued that the amount of relapse observed in both types of retainers is almost similar.

The study by Shashua *et al.* reported a 50% relapse in orthodontic diastema closure [20]. This result is in contradiction to our study results. However, Shashua *et al.* reported no significant differences in diastema relapse across sex distribution, age, treatment duration, and patients with or without abnormal frenum [20], which agrees with our study. Hence it was found that abnormal frenal attachments play a significant role in the stability of diastemas. Diastemas produced by improper frenal attachment exhibit increased relapse following orthodontic treatment, so surgical techniques such as frenotomy and frenectomy are crucial elements of the success of diastema closure [15]. In line with previous findings, Suter *et al.* observed that the closure of a midline diastema due to bulbous frenal attachment is more likely to require frenectomy followed by orthodontic treatment. The combination of both surgical and orthodontic treatment was found to be more successful. Performing frenectomy before the eruption of permanent canines might be indicated for larger diastemas [17].

Unlike other studies, our study also has limitations, such as a small sample size that included mainly female follow-up patients to the clinics. Hence there is a need to increase the total sample size with a balanced number of male and female patients. Therefore, further studies are warranted.

Conclusion

1. More than 80% of the diastema closure stability was

observed in orthodontically treated post-retention patients.

2. The stability of diastema during the post-retention phase was significant in the fixed retainer compared to others.
3. Females had a higher relapse rate compared to males.

Acknowledgments: Authors would like to thank the research and innovation center of Riyadh Elm University for supporting and granting this study.

Conflict of interest: None

Financial support: None

Ethics statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Research and Innovation Center of Riyadh Elm University (FUGRP/2021/239/567/541).

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