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Original Article

Factors Influencing Post-Treatment Relapse in Diastema Closure

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ABSTRACT

Studies on the stability after a midline diastema closure were few, and the evidence supporting this claim is thought to be weak. This study sought to determine the stability of diastema closure in orthodontic patients who received a fixed or removable retainer. The orthodontic clinics at a private university hospital in Riyadh, Saudi Arabia, used treatment records to identify 40 patients who underwent orthodontic treatment for diastema closure. After treatment, a follow-up examination was performed to check for recurrence, and panoramic radiographs were collected at the debonding stage (T1). Relapse of the diastema was thought to occur when the T2-T1 inter-incisor gap exceeded zero. It was also noted what type of retainer therapy was used after orthodontic treatment. It was considered clinically significant when a diastema relapse measured 0.50 mm or greater. This study included 40 participants who received orthodontic treatment for diastema. 50% of the study participants were given detachable retainers, 20% were given permanent retainers, and 25% were given both. In 82.5% of instances, diastema stability was observed, while relapse occurred in 17.5%. Diastema stability was not affected by gender (P = 0.436) or various retainers (P = 0.690). Six instances had a clinically significant recurrence. Using both fixed and removable retainers, orthodontically treated diastema closure showed a significant level of stability.

Keywords: Diastema, Orthodontic stability, Relapse, Retainer, Fixed, Removable

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Introduction

The distance or gap between two central incisors is known as the maxillary midline diastema (MMD) [1]. It is thought to have a developmental basis and occurs often in both primary and mixed dentition [2, 3]. Diastema can impact dentofacial harmony and smile beauty [4] and contribute to patients' functional and psychological pain [5, 6].

The genesis of MMD is linked to several variables, including harmful behaviors, tooth position abnormalities, and extra teeth [7]. High labial frenum attachment is the most prevalent cause, and diastema caused by high frenal attachment is frequently treated by frenectomy and frenotomy [8].

In the majority of situations, a legitimate and more conservative therapeutic alternative for closing diastemas is minimally invasive resin-based composite repair techniques [9]. However, orthodontic therapy is a preferred course of action. It removes additional occlusal abnormalities and, in contrast, closes the diastema [10]. Furthermore, the effectiveness of orthodontic treatment is thought to depend on retention, which necessitates both patient compliance and the clinician's understanding. Removable retainers are seen to be more sanitary, and to prevent recurrence, patient participation is essential.

Fixed retainers, on the other hand, are thought to be more dependable and are often glued to the teeth palatal/lingual surfaces [11-13]. Because the patient cannot remove them, teeth might build plaque if not properly cleaned. Consequently, doctors must emphasize patients' oral hygiene [14].

Finally, there is a dearth of data in the literature and little information on the durability of midline diastema closure [2, 15]. Accordingly, the purpose of the present research is to assess the stability of inter-incisor diastema closure in the maxilla of patients receiving orthodontic treatment with both permanent and removable retainers.

Patients receiving orthodontic treatment with fixed and detachable retainers would have the same stability of maxillary inter-incisor diastema closure, according to the null hypothesis.

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 of 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 a UNC 15 probe. All data were recorded in an Excel sheet with the variables such as (file number, age, gender, TI, T2, type of retainer, relapse occurrence, and the relapse in mm.

Statical 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

40 post-orthodontic patients, with a mean age of 24.60 ± 7.07 mm years, participated in the research (10 men and 30 females). 20% of the patients had permanent orthodontic retainers, 30% had detachable ones, and 25% had both. Two patients did not, however, complete their retainer treatment. While 7 (17.5%) of

our sample experienced relapses ranging from 0-1 mm (mean amount of recurrence: 0.13 ± 0.32 mm), almost 33 (82.5%) of our sample had no relapse (stable). Six individuals (15%) experienced a clinically severe recurrence **(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										

Table 2 illustrates the relationship between retainer type and diastema stability and relapse. Relapses occurred in 3 (15%) of the orthodontic patients treated only with detachable retainers and in 1 (12.5%) of the patients treated with permanent retainers. At the same period, orthodontic patients treated with both fixed and detachable retainers experienced three (30%) relapses. No statistically significant difference was found when evaluating the relationship between the incidence of recurrence and various retainer therapies (P = 0.690).

Table 3. Association between gender and relapse

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

Table 3 displays the proportion of relapses that occur in each gender. When the presence and lack of relapse were examined between orthodontic patients who were male and female, no difference was seen (P = 0.656). Only one orthodontic patient (10%) was male, while six orthodontic patients (20%) had 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-Walli's test.

There was no significant difference in the rate of diastema relapse between males and females (0.05 ± 0.16 versus 0.16 ± 0.35, P = 0.436), according to the Mann-Whitney U test. In a similar vein, the Kruskal-Wallis test revealed no discernible difference in the rate of diastema relapse between patients with detachable retainers (0.10 ± 0.26 mm), fixed retainers (0.13 ± 0.35 mm), and both kinds (0.23 ± 0.42 mm) (P = 0.557) on **Table 4**.

Diastema stability in orthodontically treated individuals has been a contentious issue in orthodontics. It is classified as a multifactorial malocclusion needing thorough inspection and diagnosis [17]. The present investigation discovered substantial stability among orthodontically treated individuals. In the present investigation, almost all of the female patients had post-orthodontic follow-up sessions. It is consistent with a prior investigation in which more females than males sought dental care since females were more receptive and eager to attend follow-up exams in our research [18].

Carruitero *et al*. study, which investigated 24 patients and showed no significant return of midline diastemas, is supported by the results of this investigation. The extraction of the maxillary first premolar before diastema closure therapy may be the cause [10]. Sullivan *et al*. also concluded that the maxillary diastema post-retention relapse was too little to be meaningful. A rise in maxillary incisor proclination, however, was the sole alteration linked to diastema relapse [19].

Another research by Morais *et al*. looked at 30 orthodontic patients who had Hawley's retainer used to close their diastema, and they found that 60% of them had relapsed. The extent of the diastema was also associated with overjet and relapse; nevertheless, only

15% of post-orthodontic cases with detachable retainers showed relapse since our research included patients with fixed retainers and both kinds of retainers. On the other hand, relapse was not thought to be caused by root parallelism [16]. The null hypothesis of the research is embraced since post-orthodontic patients treated with permanent and detachable retainers showed no discernible differences in diastema stability. Therefore, one may conclude that the rate of relapse seen in both types of retainers is about equal.

50% of orthodontic diastema closures relapsed, according to the Shashua *et al*. research [20]. This outcome contradicts the findings of our investigation. However, our analysis is consistent with Shashua *et al*. observation that there were no substantial variations in diastema relapse across sex distribution, age, treatment duration, and patients with or without aberrant frenum [20]. The stability of diastemas was therefore revealed to be significantly influenced by aberrant frenal attachments. Surgical procedures like frenotomy and frenectomy are essential to the effectiveness of diastema closure because diastemas caused by incorrect frenal attachment have a higher recurrence rate after orthodontic therapy [15]. Consistent with earlier research, Suter *et al*. found that frenectomy and orthodontic treatment are more probable to be necessary when a midline diastema is closed because of bulbous frenal attachment. The combination of orthodontic and surgical therapy proved to be more effective. For bigger diastemas, undergoing a frenectomy before the emergence of permanent canines may be recommended [17].

Contrary to previous research, our study contains drawbacks as well, including a small sample size that mostly consisted of female clinic follow-up patients. Therefore, a larger sample size is required, with a balanced proportion of male and female patients. For this reason, more research is necessary.

Conclusion

Based on the results, patients who received orthodontic treatment after retention showed greater than 80% diastema closure stability. In comparison to alternative retainers, the fixed retainer's diastema stability during the post-retention phase was noteworthy. The relapse rate was greater among females than males.

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Conflict of Interest: None

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