ORIGINAL ARTICLE

Evaluation of Mandibular Arch Width Changes following Fixed Retention in Post Orthodontic Patients - a Randomized Clinical Trial

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ABSTRACT

Background: Retention is an integral phase in which teeth are maintained in their newly adapted position for which retainers are inserted. Retainers are generally of two types: removable and fixed. Fixed retainers are indicated in the mandibular arch for an indefinite period specifically in the non-extraction cases. Changes in intercanine and intermolar widths are valuable parameters to evaluate the stability. The objectives of this study were to assess and compare the mandibular intercanine and intermolar width changes following orthodontic treatment after insertion of two types of fixed lingual retainers for one year.

Methods: Total 54 subjects were recruited in which two types of fixed lingual retainers were inserted in the mandibular arch randomly. Intercanine and intermolar arch widths were measured by digital caliper of 0.01 mm accuracy. Data was analyzed by using Statistical Package of Social Sciences (SPSS V-21). Chi-square and independent t tests were used to compare baseline characteristics. Intercanine and intermolar widths were assessed and compared using independent t test, p-value ≤ 0.05 is considered as statistically significant.

Results: Intercanine width increased from baseline to T4 in both retainers. When mean differences of intercanine width were compared between two retainers significant differences were observed at T1, T2, T3 and T4 with significant p-values (< 0.05) and increased intercanine width with multistranded stainless steel wire (MSW) retainers.

Conclusion: Mandibular intercanine width increases significantly in post retention phase with multistranded stainless steel retainers. Thus, fiber reinforced composite retainers are more effective in preserving the arch width changes.

Keywords: Fixed retainer; Periodontium; Teeth.

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INTRODUCTION

The day when the braces are taken off is the day and call for celebration but that is not the end because it marks the beginning of the new phase and that is retention phase. Retention is an integral phase and is as mandatory as the treatment itself, which maintains the teeth in their newly adapted site for which retainers are inserted[1]. Retainers are generally of two types: removable and fixed[2]. Removable retainers can be easily removed by the patients and clinicians approving the maintenance of oral hygiene and can be worn on part time basis whereas fixed retainers are permanently bonded onto the surfaces of teeth and cannot be displaced by the patients. Fixed retainers are

indicated in the mandibular arch for an indefinite period specifically in the non-extraction cases because they prevent relapse in the long run[3,4]. Moreover they are esthetically pleasing, easily acceptable, provide greater stability, compliance free and causes no soft tissue irritation and speech problems although, they are technique sensitive and time consuming[5-7].

Knierim introduced the first fixed bonded canine-canine retainers in 1970[8], which were placed on the lingual surfaces of the mandibular six anterior teeth. They gained full recognition in post orthodontic patients in order to prevent the relapse tendency of lower anterior teeth. They reported wire distortion, difficulty in bending and decreased rigidity. They also evident increased risk of plaque deposition[9]. More recently, fiber reinforced composite (FRC) materials found their way into orthodontics[10]. These are based on fiber laminate technology, which involves the use of closely adapted layers of reinforcement fibers held in place by a thin resin-bonding layer. They offer adequate strength due to the incorporation of glass fibers into the composite resin ultimately results in better durability[11]. Their esthetic nature and biocompatibility are remarkable features. Literature supports that the changes in intercanine and intermolar widths are valuable parameters to evaluate stability[12,13]. Mandibular intercanine and intermolar widths are the reliable and flawless guide to constitute the muscular balance of the individual and are used to expand the arch width dimensions[14]. Moreover, controversy was found regarding the effects of extracting permanent teeth during orthodontic treatment on the changes of arch width dimensions and stability[15,16]. In a study, decrease in intercanine width was observed in non-extraction cases following orthodontic treatment in post retention phase[17].

Thus, arch width dimensions that are intercanine and intermolar widths are important parameters to assess the stability of the teeth in post retention phase following orthodontic treatment. Since, no study has been conducted yet to determine and compare the intercanine and intermolar between these two types of fixed retainers therefore, the objectives of this study were to assess and compare the mandibular intercanine and intermolar width changes following orthodontic treatment after insertion of two types of fixed retainers for one year.

METHODS

The clinical trial was approved by the Institutional Review Board of Dow University of Health Sciences (Ref: IRB-941/DUHS/Approval/2017/162) and was registered under the protocol ID NCT03881813 (https://clinicaltrials.gov/). It was a parallel-group randomized clinical trial, multicentre study with a 1:1 allocation ratio, conducted at the department of Orthodontics, Dr. Ishrat-Ul-Ebad Khan Institute of Oral Health Sciences (DIKIOHS) and Dow Dental College (DDC) in Dow University of Health Sciences (DUHS) for the period of 17 months. The sample size was established from the previous study18 using PASS (V.11), two-sample proportion with 95% confidence interval and 80% power of test, with estimated population size of 60 in six months, calculated sample size was 54 (Figure 1). Non-probability (convenience) sampling technique was followed. The subjects were randomly divided into two groups via software generated randomization table.

All subjects were recruited based on the inclusion and exclusion criteria who agreed to visit after every three months for a follow-up of one year and were treated with fixed appliance (MBT 0.022 Unitek Gemini) orthodontic treatment. Purpose of the study was informed verbally to each subject and then consent was obtained by him or her or by his or her guardian. Subjects with non-extraction cases in the mandibular arch with moderate crowding and healthy periodontium were included however, subjects with absent or missing lower anterior teeth and presence of occlusal interferences were excluded from the study.

After selection of subjects debonding of the brackets and bands, deep scaling and curettage was performed for each individual. Prior to the bonding of fixed retainer, all composite remnants were removed and enamel surfaces were cleaned with tungsten carbide bur in slow speed hand piece. A single operator bonded two types of fixed lingual retainers in the lower arch from canine-canine to all the six anterior teeth. Group 1 subjects received fiber reinforced composite (FRC) retainers (INOD, U.P. Fiber Splint, 2mm) while group 2 (control group) subjects received multistranded stainless steel wire (MSW) retainers (0.0175 inch, All Star Orthodontics) .

In group 1 subjects, the mandibular anterior dental region was well isolated by cheek retractors, cotton rolls and suction tip. Inter canine distance was measured by dental floss and correct length of fiber ribbon was cut by scalpel blade. The ribbon was pretreated with adhesive primer (3M ESPE). Lingual surfaces of six anterior teeth were etched with 37% phosphoric acid gel (Meta Biomed) for 30 seconds, were washed sufficiently and air dried. Then adhesive primer (3M ESPE) was applied with applicator brush and light cured with a light emitting diode (Otholux; 3M) for 15 seconds on each tooth. It was followed by the application of flowable composite resin (3M ESPE). Eventually fiber ribbon was conformed to the lingual surfaces of six anterior teeth with plastic instrument, excess composite was removed and each tooth was light cured for 15 seconds. Further composite resin was applied with applicator for finishing. Finally, each tooth was light cured for 10 seconds. Oral hygiene instructions were delivered. Group 2 subjects who received multistranded SS retainer, same isolation

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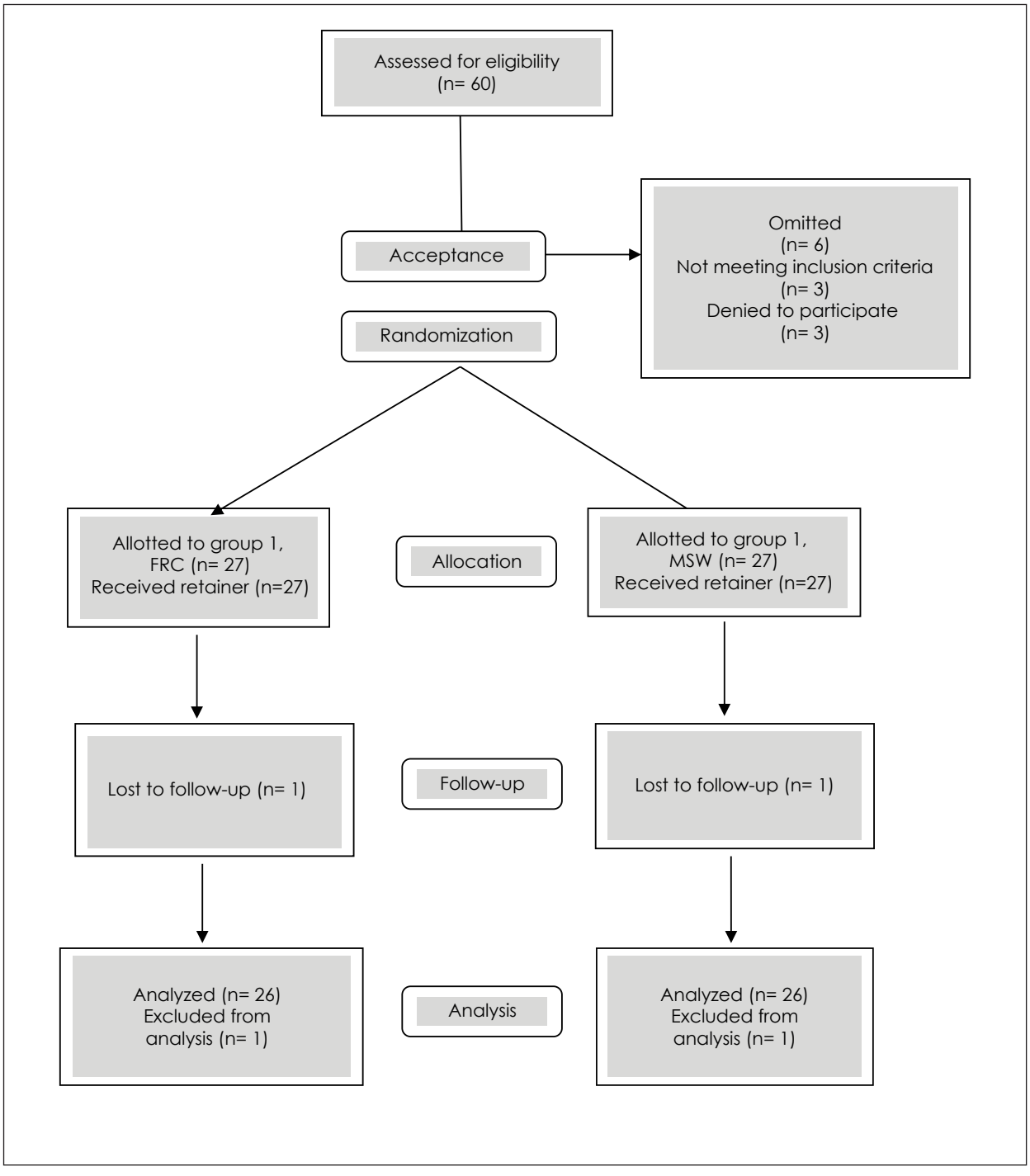

Figure 1: Flow chart showing allocation of subjects.

and bonding protocols were followed. After insertion of retainers, impressions were taken and models were poured. Intercanine and intermolar widths were measured using digital caliper of 0.01mm accuracy. Intercanine width was the distance from cuspal tip of right canine to the left while intermolar width was the distance from the mesiobuccal cusp tip of right permanent first molar to the left molar (Figure 2) Same measurements were repeated after every three months for a follow-up of one year. Data was analyzed by using SPSS V-21. Chi-square and independent t tests were used to compare baseline characteristics. Intercanine and intermolar widths were assessed and compared using independent t test, p-value ≤ 0.05 is considered as statistically significant.

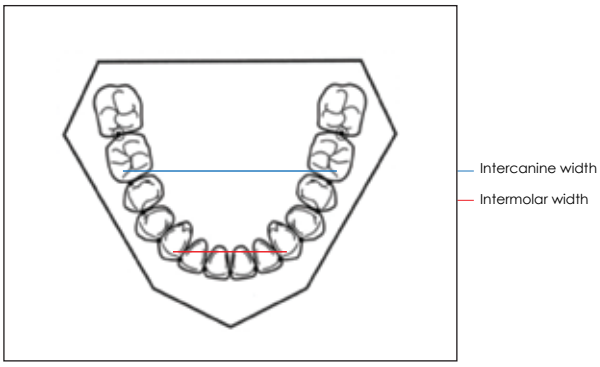

Figure 2: Arch width measurements.

RESULTS

Total 54 subjects were recruited from November 2017 to March 2018, out of which 2 were lost to follow-up (Figure 1). The mean age of the subjects were determined to be 21.5 ± 3.6 years with a mean range of 14-30 years. Mean age of subjects in group 1 (FRC) was found to be 20.88 ± 3.45 whereas, in group 2 (MSW) it was found to be 22.15 ± 3.68. There was no gender discrimination including 4 male and 22 female subjects in both groups. In group 1 (FRC) 21 cases were class I malocclusion treated and 5 cases were class II malocclusion treated whereas, in group 2 (MSW) 17 cases were class I malocclusion treated and 9 cases were class II malocclusion treated. It is found that age, gender and type of malocclusion have no significant effects on arch width dimensions (p-value > 0.05) (Table 1).

Table 1: Baseline characteristics of patients.

Variables	Group 1	Group 2	p-Value
Type of retainers			0.206
	FRC (n=26)	MSW (n=26)	
Age			
mean ± SD	20.88 ± 3.45	22.15 ± 3.68	
Gender			1.000
Male n(%)	4 (50.0)	4 (50.0)	
Female n(%)	22 (50.0)	22 (50.0)	
Malocclusion			
Class I	21 (55.3)	17 (44.7)	0.211
Class II	5 (35.7)	9 (64.3)	

Fiber reinforced composite (FRC); Multistranded stainless steel wire (MSW).

Intercanine width (IC) in group 1 (FRC) was determined to be 26.13 ± 1.55 at T0, 26.11 ± 1.56 at T1, 26.07 ± 1.54 at T2, 26.17 ± 1.70 at T3 and 26.21 ± 1.88 at T4 respectively. In group 2 (MSW) it was determined to be 26.25 ± 1.24 at T0, 26.96 ± 1.10 at T1, 27.19 ± 1.25 at T2, 27.36 ± 1.16 at T3 and 27.40 ± 1.15 at T4 respectively. It was revealed that intercanine width increases from baseline to T4 (Table 2). Increased intercanine width was observed with MSW retainers as compared to FRC retainers. When mean differences were compared between two retainers, significant differences were observed at T1, T2, T3 and T4 with significant p-values (< 0.05) (Table 2).

Table 2: Mean differences of IC (intercanine width) and IM (intermolar width) between two retainers.

Widths	Retainer	At Baseline	At T1	At T2	At T3	At T4
IC	**Fiber Reinforced Composite (FRC)**					
Mean ± SD			26.13 ± 1.55	26.11 ± 1.56	26.07 ± 1.54	26.17 ± 1.70	26.21 ± 1.88
	Multistranded Stainless Steel Wire (MSW)					
Mean ± SD			26.25 ± 1.24	26.96 ± 1.10	27.19 ± 1.25	27.36 ± 1.16	27.40 ± 1.15
***p*-Value**			**0.769**	**0.029**	**0.006**	**0.005**	**0.008**
IM	**Fiber Reinforced Composite (FRC)**					
Mean ± SD			43.26 ± 3.56	43.46 ± 3.44	43.34 ± 3.47	43.34 ± 3.44	43.30 ± 3.50
	Multistranded Stainless Steel Wire (MSW)					
Mean ± SD			43.57 ± 2.64	43.55 ± 2.62	43.48 ± 2.55	43.42 ± 2.65	43.38 ± 2.68
***p*-Value**			**0.725**	**0.910**	**0.874**	**0.929**	**0.929**

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Similarly, when intermolar width was evaluated in group 1 (FRC), it was found to be 43.26 ± 3.56 at T0, 43.46 ± 3.44 at T1, 43.34 ± 3.47 at T2, 43.34 ± 3.44 at T3, 43.30 ± 3.50 at T4 respectively. In group 2 (MSW) it was found to be 43.57 ± 2.64 at T0, 43.55 ± 2.62 at T1,43.48 ± 2.55 at T2, 43.42 ± 2.65 at T3 and 43.38 ± 2.68 at T4 respectively. It was observed that there is no significant increase from baseline to T4 in both types of retainers (Table 2). Similarly, there is no significant difference in the intermolar width between two retainers (p-value > 0.05).

DISCUSSION

Maintaining and preserving the arch length of mandibular dentition after treatment is the greatest challenge faced by the orthodontists. Pronounced changes in arch width results in relapse of the dentition and affects the stability. Though removable retainers are frequently used, fixed retainers are popular specifically for lower anterior teeth[19]. Multistranded stainless steel wire fixed lingual retainer bonded to lingual surfaces of all anterior teeth is routinely used however increased flexibility and wire distortion results in increased movement of teeth. Increased chair side time during bonding is another drawback of its use[20]. Fiber reinforced composite retainers are introduced recently in orthodontics. Their increased rigidity causes limited tooth movement and is biocompatible. They also provide bar effect and excellent three-dimensional control[21]. In this study, these two types of fixed lingual retainers were inserted in lower anterior teeth and arch length changes were evaluated after every three months for one year.

When base line demographic variables were compared between the two retainers, it was found that differences in age, gender and type of malocclusion were insignificant between both groups. Hence, these factors did not affect the results of our study. Increase in intercanine width was significant with multistranded stainless steel wire retainers as compared to fiber reinforced composite retainers, which reflects the increase in irregularity of dentition. These findings suggest that fiber reinforced composite retainers are more effective in sustaining the stability of the teeth. It is due to the increase in deformation because of flexibility in multistranded stainless steel wire[22]. Furthermore, multistranded stainless steel wire is a small diameter wire that causes uncontrolled tooth movement ultimately resulting in significant changes in arch width. Other possible factors are pretreatment crowding, change in arch form during treatment, type of malocclusion treated and length of treatment duration[23]. Previous literature strongly supports that treatment philosophy plays a prime role in arch width changes[19,20], therefore solely non-extraction cases were included in this study to minimize the bias. Previous studies reported the decrease in intercanine width in the post retention phase which is contrary to our findings[22,24]. These studies concluded that the intercanine width always have a tendency to return back to their pretreatment state.

Intermolar width remains stable in both types of retainers in our study. This finding was in accordance with the finding of Aksu et al[13]. The possible reason of stable intermolar width in our study is the recruitment of non-extraction cases, which mainly corrects malocclusion by altering arch width of the anterior teeth. The strength of this study includes, that this study is a randomized clinical trial and allocation of subjects through randomization minimizes the risk of selection bias. Although blinding was not possible for the interventions given, as they were visible on the surfaces of the teeth, blinding was done for the outcome assessment, which minimizes the observation and detection biases. Moreover, it is a multicenter study, which involves the recruitment of subjects from different areas, thus sample of subjects is representative and the results are assumed more reliable and generalized. However, limitations include small sample size, which could not be increased as the study is conducted on post orthodontic patients after completion of treatment; therefore, it was difficult to convince the patients to come for the follow up visits. It is recommended to compare arch width changes among extraction and non-extraction groups with increased follow-up duration of at least two years in future to achieve improved results and it would be a fascinating prosecution.

CONCLUSION

Intercanine width plays a dynamic role in determining the stability and success of the orthodontic treatment. Mandibular intercanine width increases significantly in post retention phase with multistranded stainless steel retainers. Thus, fiber reinforced composite retainers are more effective in preserving the arch width changes and maintains the stability of the lower dentition.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS APPROVAL

This clinical trial was approved by the Institutional Review Board of Dow University of Health Sciences (Ref: IRB-941/DUHS/Approval/2017/162) and was registered under the protocol ID NCT03881813

(https://clinicaltrials.gov/) according to the CONSORT statement of the updated guidelines for reporting randomized clinical trials.

PATIENT CONSENT

Written consent was taken from all participants prior to writing of manuscript. For all subjects under age 16 years, written consents were obtained from parents/ guardians.

AUTHORS' CONTRIBUTION

NIN is a principal investigator and a major contributor in data collection, manuscript writing and literature search. IA is a co-investigator assisted in the selection of title, analysis and interpretation of data. SZ is a co-investigator and a major contributor in statistics.

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