

RESEARCH PAPER

Comparison of Efficiency of Bonded retainers and Vacuum formed retainers- A Randomized Clinical trial

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Abstract

Background: Major goal of orthodontic treatment is long term stability of the corrected teeth after orthodontic treatment. After orthodontic treatment there is always chance of relapse. To prevent relapse several appliances are available as a retention device such as bonded fixed retainers, vacuum formed retainers, removable Hawley retainer, Begg's retainer. Now a days vacuum formed retainer has become more acceptable due to low cost, esthetic and easy fabrication.

Objective: The purpose of this study was to analyze the clinical success of bonded retainers with vacuum-formed retainers, as far as keeping up the consequences of orthodontic treatment in the lower arch as long as a year after debond.

Methods: This was a randomized clinical trial (RCT) carried out at the department of Orthodontics, Bangabandhu Sheikh Mujib Medical University, Dhaka. In the study a total of 40 subjects who had fulfilled the selection criteria were randomly allocated to one of two groups, receiving either a vacuum-formed retainer or a bonded retainer for the mandibular arch. Qualification criteria was patients approaching debond after treatment with preadjusted edgewise fixed orthodontic appliance whose pretreatment records and study models were accessible to confirm pretreatment labial segment crowding or spacing and who had clinically acceptable alignment after treatment. The principle purpose was to research the clinical adequacy of the 2 kinds of retainers regarding changes in incisor irregularity at one year of preservation of treatment outcome. The following measurements were documented at each time point (6 and 12 months) with a digital caliper: Little's irregularity index, intercanine width, intermolar width, arch length, extraction space opening.

Result: The two groups were very much coordinated as for age, sex, clinical qualities, and treatment plans. Four patients did not attend in the follow up period and the study finished up in 36 patients. There was a statistically significant difference between the groups for changes in Little's irregularity index and arch length. Vacuum-formed retainer group showed greater changes than the bonded retainer group (P value 0.035 and 0.022). There were also no statistically significant changes at any time for intercanine width and intermolar width.

Conclusion: Some relapse is likely after fixed orthodontic treatment regardless of retainer choice, and this is negligible in many patients after debond. Bonded retainers have a superior capacity to hold the mandibular incisor arrangement after orthodontic treatment than vacuum-formed retainers.

Trial registration: not done.

Keywords: Retainers; Retention; Relapse; Vacuum formed retainer; Bonded retainer.

Introduction

Orthodontic treatment deals with correction or improvement of the position of teeth and any disharmony in normal occlusion. After active orthodontic treatment maintenance of corrected teeth in ideal position is mandatory. Orthodontic retention

is the maintenance of teeth in the ideal position after active orthodontic treatment. Major goal of orthodontic treatment is long term stability of corrected teeth after orthodontic treatment. After orthodontic treatment there are always probabilities of return back of the teeth to their original position which is known as relapse.¹ Relapse may occur due to consequence of periodontal fiber's force around teeth. These forces have a tendency to retract teeth to their pretreatment position.² Post treatment relapse is the most common risk of orthodontic treatment. Planning for post retention stability should be part of the initial treatment

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plan and discussed with the patient before treatment, so that any relapse will not be a disappointment for either the clinician or patient.

Stability and relapse, in both treated and untreated malocclusions, have been studied over many years. The long-term results have been similar and not hugely optimistic. Sadowsky and Sakols followed patients on average for 20 years post retention and found that 9% had an increase in mandibular crowding when compared with pretreatment, and 73% had dental relapse.³ This previous research demonstrates that the only apparent guarantee of long-term stability is long-term retention. This is due to the variety of factors that are reported to affect tooth positions in both treated and untreated malocclusions. These include skeletal and soft tissue Growth, dental factors, treatment mechanics such as changes in arch form, length, width and treatment plan, final interdigation, and functional occlusion. A long term study has showed that 10 years after completion of orthodontic treatment only 30% to 50% of orthodontic patients effectively retain satisfactory alignment initially obtained.⁴ Little noted that only 10% of patients had maintained satisfactory mandibular incisor alignment at 20 years postretention.⁴ All patients must require undergoing a retention phase by using some type of retainers after completion of orthodontic treatment.⁵

Most challenging thing of orthodontic treatment is to retain the teeth position after orthodontic treatment. Retention is the holding of teeth following orthodontic treatment in the treated position for the period of the necessary for the maintenance of the result.¹ Retention is necessary to allow reorganization of the gingival and periodontal tissues affected by orthodontic tooth movement, to prevent unwanted movement as a result from growth changes, and to prevent the relapse tendency of teeth that have been moved to an inherently unstable position. Several retention devices are available to prevent relapse such as bonded fixed retainers, vacuum formed retainers, removable Howley retainers, Beggs retainer. Vacuum formed retainer which is also known as Essix retainer introduced in 1993 by Sheridan. Now a days vacuum formed retainer has become more acceptable due to low cost, esthetic and easy fabrication.⁶ Bonded fixed retainer consists of a small stainless steel wire bonded to the lingual or palatal surface of the teeth. Vacuum formed retainer is designed to completely encapsulate the whole teeth

and also superior part of the alveolus.⁷ Vacuum formed retainer was also well tolerated by patients.⁸ Patient must have good oral hygiene to prevent dental caries and demineralization of teeth due to use of vacuum formed retainer.⁹

Several studies were performed to analyze the effectiveness of different type of retainers. Several RCTs of short term stability of orthodontic treatment results have been published.^{8,10,11,12} This also demonstrated small but insignificant movement of the teeth on the second day after debonding . Patient wore their vacuum formed retainer only at night in this study. This regimen showed equal stability of treatment results following full time or part time wear of Vacuum formed retainers.¹¹ Vacuum formed retainers have been shown to be superior to Hawley retainer.⁸ There is one prospectively designed trial comparing bonded and vacuum-formed retainers up to 24 months after debond.¹⁰ In these studies, it was reported that a prefabricated positioner used as a retainer showed a statistically significant difference in its ability to maintain incisor positions after treatment (measured with Little's irregularity index).¹⁴ This study also compared with a vacuum-formed retainer or a bonded retainer after 6 months, but no statistically significant difference was found after 2 years.¹⁵ Edman Tynelius compared the effect of three different retention strategies on maintaining the outcome of orthodontic treatment of both jaws and showed that bonded retainers, vacuum formed retainers were effectively successful after 1 year and 2 years of retention.¹⁶ An RCT was performed to evaluate effectiveness of bonded and vacuum formed retainers.¹⁰ This study showed significant difference between two groups on changes in Little's irregularity index at 6 months period.

After orthodontic treatment there is high risk of relapse without retention phase. To prevent relapse, every patient requires stabilization with retainer after active orthodontic treatment. Most commonly used retainer is bonded fixed refiner and vacuum formed retainer. Bonded fixed retainer does not need patient compliance. It is difficult for the patient to notice if the retainer has become loose from a single tooth and also detect if this situation causes the tooth to move.¹⁵ Placement of bonded retainer is also time consuming and technique sensitive for some individual.¹⁸ Vacuum formed retainer is an esthetic, comfortable and inexpensive alternative to traditional bonded retainers.¹⁹ Now a day's vacuum formed retainer has

become more popular. Aim of this study is to compare effectiveness of bonded retainer with vacuum formed retainer up to 6 months and 12 months after debonding. No previous research regarding this topic was performed in this Bangladesh. The aim of this study was to analyze efficiency and compare the changes in a number of intra-arch variables between bonded fixed retainers and vacuum formed retainers from debond to 6 and 12 months and to determine whether one type of retainer is superior to the other in terms of maintaining the orthodontic results. So this study was done to compare the efficiency between bonded fixed retainer and vacuum formed retainer by comparing incisor irregularity and spacing at 6 months and 12 months of debonding.

Materials and Methods

The study was a randomized clinical trial (RCT) which was done in department of orthodontics, Bangabandhu Sheikh Mujib Medical University, Dhaka Bangladesh from July 2016 to June 2017. Sample size was calculated by using result of Edman et al.¹³ At 95 % confidence interval and 80% power sample size was calculated 16 in each group. To compensate dropout in follow up 20 patients were enrolled in each group. Patients who were treated with fixed orthodontic appliance and active treatment had completed, patients whose pretreatment records and study models were available to confirm the pretreatment labial segment crowding or spacing and patient had clinically acceptable alignment at the end of treatment were included in the study.

Patient who had undergone surgical treatment, Patients with poor oral hygiene during treatment, patients with a history of periodontal disease and Patient did not wish to participate were excluded from the study. Forty subjects were included in the study with the selection criteria and were divided into 2 equal groups (20 each); Group A and Group B by simple random sampling. Group A received bonded retainers and group B received vacuum formed retainers. Informed written consent was obtained from the participants.

At the end of the fixed orthodontic treatment after appliance removal (T_0) a set of alginate impression was taken for study models. The vacuum formed retainer was constructed from Essix Ace plastic (127 mm in length and width, 1.5 mm in thickness; Dentsply). Each vacuum formed retainer was fabricated by investigator under standardized conditions, using the same technique. This was fitted within two days with instructions for fulltime wear for the twelve months. For the bonded retainer group, the

teeth were polished with pumice and scaling was done. A flexible spiral wire (0.017 inch coaxial wire) was formed at chair side to fit passively against the mandibular labial segment from left first premolar to right first premolar as a fixed retainer. Etching was done by 37% phosphoric acid etch followed by copious washing, drying. Then application of Super Bond c&b (Self cure dental adhesive, Sun medical) was done. At follow up period a mandibular arch dental impression was taken with alginate at six months (T_1) and twelve months (T_2) to obtain plaster models for measurement purposes. When patients lost their retainers, new impressions and retainers were provided. When there was appliance breakage or loss, the patients were advised to attend the department where a new appliance was made; bonded retainers were repaired.

Little's irregularity index (LII) score, arch length, extraction space opening, intercanine width and intermolar width of mandibular arch was recorded on mandibular study model at debonding (T_0), 6 months (T_1) and 12 months (T_2) of retention period with digital calipers. The arch was viewed from above and the caliper was held parallel to the occlusal plane during data collection. Irregularities of the mandibular incisors were measured on the study models at T_0 , T_1 , T_2 using the method described by Little RM.¹⁴ Intercanine width was measured by the distance between the two canine cusp tips. If canine cusp tips were worn, middle of the surface was estimated. Intermolar width was measured as the distance between the mesiobuccal cusp tips of both mandibular first molars. Similarly, if the cusp tips were worn, middle of the surface was estimated. Arch length was measured at a point midway between the incisal edges of the central incisors, bisecting the line connecting the mesial marginal ridges of the left and right first permanent molars. Extraction space opening was calculated by measuring sum of the contact point displacement in extraction site. To avoid random error and intra operator difference in measurement, all data was collected by the investigator and reliability was checked by producing duplicate measurement of ten randomly selected models.

Data analysis was done with Statistical Package for Social Science (SPSS) for windows (version 20; IBM). Values of Little's Irregularity Index, arch length, inter canine width, inter molar width and extraction space opening were calculated. Arithmetic mean and standard deviation of each variable was calculated. The values of variable were not normally distributed. Mann-Whitney U test were used to compare vacuum formed retainer and bonded retainer groups in relation

to different variables. A p value of < 0.05 was taken to be statistically significant.

Results

There were 4 patients dropouts during the 12 month period and consequently the study included 36 patients at the end of the trial. Group A was received bonded retainers and group B was received vacuum formed retainers. Enrollment and follow up are shown in consort flow diagram. This was a randomized clinical trial (RCT) carried out at the department of Orthodontics, Bangabandhu Sheikh Mujib Medical University

(BSMMU), Dhaka. At first a total of 40 patients entered in the trial by selection criteria. Selected subjects were randomized to two equal groups either bonded fixed retainers (group A) or vacuum formed retainers (group B) by simple random sampling.

Mean age of group A was 19.1 years and mean age of group B was 19.3 years. Age range of the subjects in group A and group B was almost similar. Data were collected at debonding (T_0), 6 months (T_2) and 12 months (T_3) of follow up for two retention groups. The mean measurement of changes in Little's Irregularity Index score (LII), intermolar width, intercanine width,

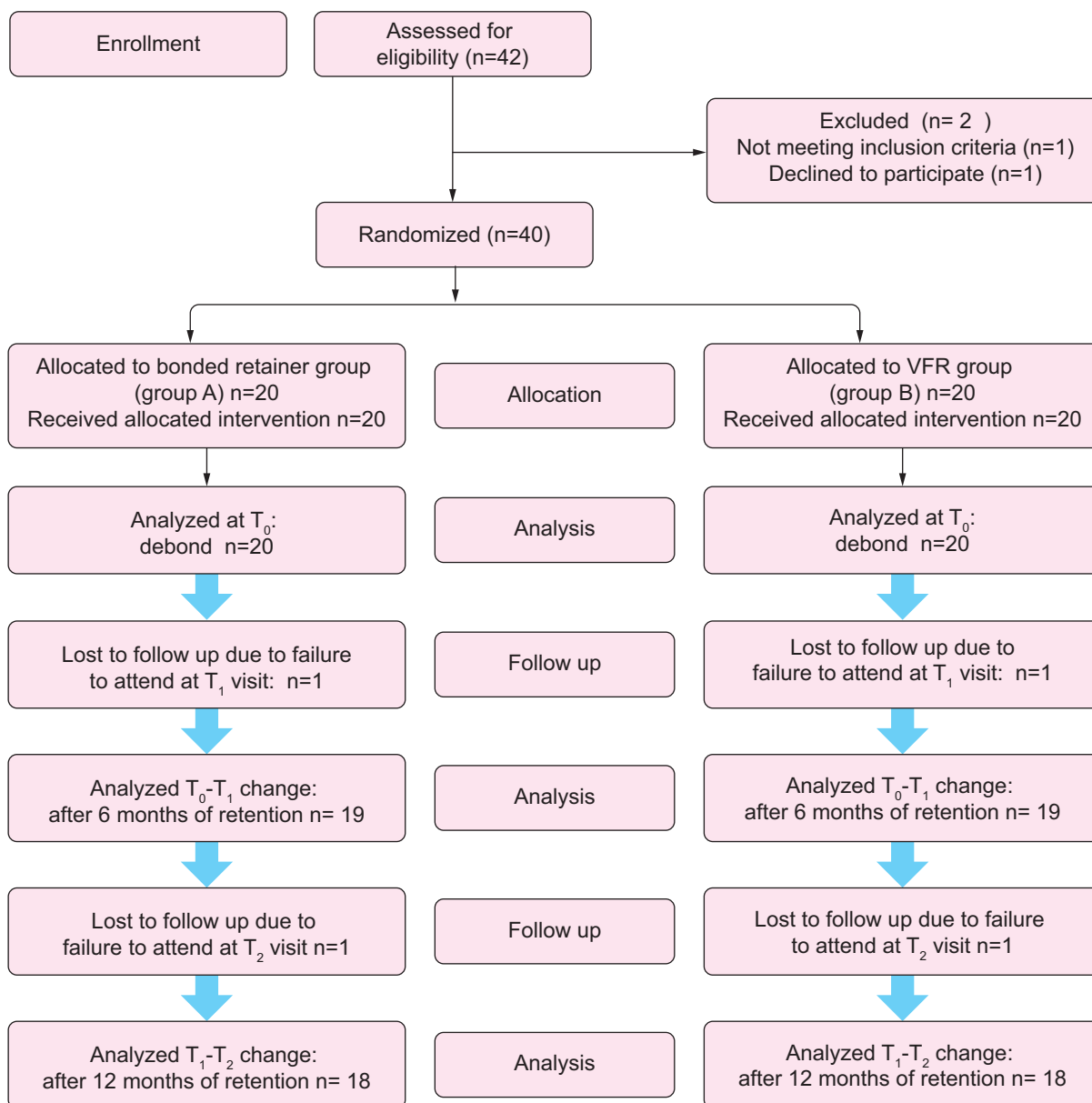


Figure 1: CONSORT diagram of subject flow the through the trial. The study ended with 18 subjects in each group.

extraction space opening was compared. There was a statistically significant difference between the changes observed among the groups at 6 months after debond (T_0-T_1) and at 12 months of retention period (T_0-T_2) for Little's Irregularity Index score ($p = 0.035$ and 0.00) and change in arch length ($p = 0.023$ and 0.00). The mean changes in Little's irregularity index, intercanine width, and arch length in the vacuum-formed retainer group were greater in this time period than in the bonded retainer group. The differences in the amount of change

observed in the T_1-T_2 period did not reach statistical significance. There was a more change in intermolar width was observed in the bonded retainer group at T_1-T_2 period. There was no significant difference at (T_0-T_2) period in change in intermolar width.

(Table III) showed the comparison of mean measurement for two retention groups at debonding (T_0), 6 months (T_1) and 12 months (T_2) of follow up. Data were expressed as mean \pm SD and analyzed by Mann-Whitney U test. *=significant

Table I: Demographic and clinical characteristics of the patients at the time of enrollment (T_0)

characteristics	Group A (n=18) No. (%)	Group B (n=18) No. (%)
Age(years)	19.1	19.3
Sex	Male	4(22.2)
	Female	14(77.8)
Class i	4(22.2)	4(22.2)
Class ii div1	8(44.4)	9(50.0)
Class ii div2	2(11.1)	3(16.7)
Class ii div2	2(11.1)	3(16.7)

Table II: Extraction summary of the subjects in the mandibular arch

Type of treatment	Group A	Group B(n=18) No. (%)
Extraction	(n=18)	2(11.1)
Non extraction	No. (%)	16(88.9)

Table III: The mean measurements (mm) of changes of variables at debonding (T_0), at 6 months (T_1) and 12 months (T_2) of follow up for the two retention groups (n=36)

	Group A Mean \pm SD (n=18)	Group B Mean \pm SD (n=18)	p value
Little's Irregularity Index score (LII)			
Change LII (T_0-T_1)	0.45 \pm 0.12	0.70 \pm 0.47	0.035*
Change LII (T_1-T_2)	0.20 \pm 0.41	0.40 \pm 0.59	0.225
Change LII (T_0-T_2)	0.65 \pm 0.07	0.92 \pm 0.08	0.00*
Arch length			
Change (T_0-T_1)	0.27 \pm 0.15	0.43 \pm 0.24	0.023*
Change (T_1-T_2)	0.30 \pm 0.16	0.32 \pm 0.23	0.783
Change (T_0-T_2)	0.57 \pm 0.11	0.75 \pm 0.09	0.00*
Intercanine width			
Change (T_0-T_1)	0.09 \pm 0.21	0.18 \pm 0.08	0.083
Change (T_1-T_2)	0.25 \pm 0.34	0.35 \pm 0.28	0.342
Change (T_0-T_2)	0.34 \pm 0.10	0.42 \pm 0.09	0.76
Intermolar width			
Change (T_0-T_1)	0.18 \pm 0.06	0.22 \pm 0.14	0.273
Change (T_1-T_2)	0.25 \pm 0.17	0.20 \pm 0.45	0.662
Change (T_0-T_2)	0.40 \pm 0.09	0.45 \pm 0.08	0.091
Extraction space opened up			
Change (T_0-T_1)	0.08 \pm 0.01	0.07 \pm 0.01	0.654
Change (T_1-T_2)	0.06 \pm 0.02	0.06 \pm 0.01	0.732
Change (T_0-T_2)	0.07 \pm 0.01	0.08 \pm 0.02	0.832

Discussion

The study was a randomized clinical trial to investigate the clinical effectiveness of two retainer types at maintaining incisor alignment in the mandibular arch up to 12 months after completion of orthodontic treatment. Retention of anterior teeth is very important from an esthetic point of view as the patient want to maintain proper alignment of the incisors and canines.

Success of a retainer couldn't be checked on this by itself. Other variable were chosen since they demonstrate the dependability of the treatment results and the adequacy of a maintenance technique. These estimations were intercanine width, intermolar width and extraction space opening. These have been routinely utilized in numerous past studies to check efficacy of retainers. One favorable position of the randomization procedure is that it endeavors to guarantee that confounding variable, for example, pretreatment abnormality or crowding, pretreatment malocclusion and treatment decision are similarly partitioned among the groups so that the groups are equivalent in all regards aside from intervention type. Right now, randomization functioned admirably, and the 2 groups were all around coordinated. The age range of the patients in the bonded retainers group and vacuum formed retainers group was practically typical. There were progressively female subjects in the study; this is a typical event in orthodontic treatment.⁵ There was likewise a higher extent of Class II Division 1 malocclusions, and this can be clarified by the more prominent predominance of this malocclusion in the population. In contrast to the discoveries of past studies, not all subjects showed changes in Little's irregularity index over a year after debond.³ The study results were similar with the result of the study of O'Rourke et al.¹⁰ No patient had a Little's irregularity index score more than 3.5 mm following a year of maintenance period. A score under 3.5 mm has been regarded to be clinically satisfactory.¹⁸ Our detections for the vacuum-formed retainer group were like those of Rowland and sadowsky.^{8,3} Our outcomes additionally recommend that for at half year after debond the bonded retainer is better than a vacuum-framed retainer in keeping up arrangement of the mandibular incisors. Different reasons might be insufficient fitting of the vacuum-framed retainer, breakage or displacement of the

bonded retainer to stay in situ, and retainers fails to prevent relapse.¹⁹ There was no significant difference in the change in intercanine width over the study time between the 2 groups, however this investigation demonstrated that the bonded retainer has less change related to vacuum formed retainer. The entire change was little, and it wasn't probably going to be noted clinically. This is like the study of Renkema, who detailed that intercanine width was very much retained with bonded retainers.⁵ Edman Tynelius likewise revealed a negligible change in intercanine width in the bonded retainer group.¹² As contrasting to this, Thicket and Power detailed that intercanine width was all around kept up by a vacuum formed retainer for a half year and 1 year.²⁰ In the one year post treatment, there was more notable increase in intermolar width related with the bonded retainer group in T₁-T₂ period. This might be because of the bonded retainer doesn't reach out to the molar area; subsequently, retention depends on the interdigitation of the molar region. The movements were slight in the two groups, and we concluded that the intermolar width was commonly all around kept up in both retainer types; this agrees with the findings of other comparative investigations.^{12,13,21} Arch length changes was more prominent in the vacuum-framed retainer group, it was significant in a half year of follow up period; a clarification for the discrepancy could be identified with patients consistence to the prescribed post retention instruction follow and maintenance.

Conclusion

Based on the methodology applied in this study, and according to the results obtained and applied to the statistical analysis, it may be considered reasonable to conclude that there was a significant difference in incisor irregularity changes at 12 months after deboning between the groups. Thus, the null hypothesis can be rejected. Bonded retainers are more effective in their ability to maintain incisor alignment in the mandibular arch at 12 months after debond of fixed appliances when compared with vacuum-formed retainers.

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