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Efficacy of two varieties of lingual bonded retainers using little's irregularity index- An in vivo study

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Abstract

Orthodontics involves the application of force which generates a cellular response leading to tooth movement. This force generates areas of compression and tension within the periodontium, allowing tooth movement when its limit has been reached. Once teeth have been moved to the desired position, maintaining them there becomes highly important. Certain teeth, among which are the lower lateral incisors, canines, and second premolars, tend to migrate toward their original position more frequently than other teeth. Studies that evaluated the longitudinal post treatment records have shown remarkable relapses especially within the alignment of the mandibular anterior teeth. The Little's Irregularity Index is a universally accepted index to accurately, easily and quickly quantity the extent of the lower anterior crowding.

Keywords: Lingual, Bonded, Retainers, Little's Irregularity Index.

Introduction

Retention is one amongst the controversies of recent orthodontics, with uncertainty being the only certainty. Retention has been defined by Moyers [1] as "the holding of teeth following orthodontic treatment in the treated position for the period of time necessary for the maintenance of the result" or by Riedel [2] as "the holding of teeth in ideal aesthetic and functional position."

The concept of retention was derived from four schools of thoughts.

For many years, orthodontists did not agree on the need for retention. In the 1800s, Kingsley [3] believed that the "occlusion of teeth" was the "most potent factor in determining the stability in a new position. Later in 1925, Axel Ludstrom [4] suggested

that the apical base was the foremost important thing in maintaining retention. Dallas McCauley [5] in (1944) indicated that transverse widths of canines and molars played a major role in maintaining retention. Tweed [6] and Grieve [7] followed with the opinions that the incisors must be upright and over the basal bone. In order to attain this, extraction of premolars were promoted for stability. Beam [8] quoting Dr. Angle stated that "the problem involved in retention is so great as to test the utmost skill of the foremost competent orthodontist, often being greater than the difficulties being encountered within the treatment up to the present point. Reidel [9] attempted to rationalize the problem and summarized his findings in three statements:

1. Teeth moved through bone by orthodontic appliances often have a tendency to return to their former positions;
2. Arch form, particularly mandibular arch form, can't be permanently altered by appliance therapy.
3. Bone and adjacent tissues must be allowed time to reorganize after treatment.

The proposed basis for holding the teeth in their treated position is to allow for periodontal and gingival reorganization; to attenuate changes from growth; to permit neuromuscular adaptation to the corrected tooth position; and to take care of unstable tooth position, if such positioning is required for reasons of compromise or esthetics. Retainer appliances are often broadly classified as removable appliance and fixed appliance. Removable retainers are usually utilized in orthodontic practice but the most disadvantage is that the effective of appliance is relied on patient cooperation. Fixed retainers are normally utilized in intra-arch instability and just in case that needs to obtain prolong retention. Various types of fixed retainers have been introduced, to minimize the need for patient compliance.

Aims and Objectives

To determine the efficacy of two types of lingual bonded retainers in treated cases of dental crowding using little's irregularity index- an in vivo study.

Objective

To compare the effectiveness of canine-to-canine lingual retainer bonded only to canines and another type of retainer bonded to each of the mandibular incisors and canines, in treated cases of dental crowding, using Little's Irregularity Index [10], over a retention period of 6 months.

Materials and Methodology

The subjects for this study were 60 patients who had completed their orthodontic treatment in Department of Orthodontics & Dentofacial Orthopedics, D. Y. Patil School of Dentistry, Navi Mumbai.

The inclusion criteria included:-

1. The patients had moderate or severe crowding (> 4mm), based on Little's Irregularity Index; at the beginning of the treatment.

2. Patients with a full complement of dentition with the exception of third molars or teeth extracted for orthodontic reasons.

The exclusion criteria were:-

1. Patients with multiple missing teeth
2. Patients with evidence of periodontal disease
3. Patients who received circumferential fiberotomies
4. Fixed prosthesis in the anterior sextant of the maxillary and/or Mandibular arch.

Grouping of Sample

The total sample of 60 patients was divided in to two groups A and B.

Group A of 30 patients were provided lingual bonded retainer of twisted ligature wire on mandibular anterior teeth from canine to canine bonded on all teeth. Group B of 30 patients were provided lingual bonded retainer of 0.028”inch stainless steel round wire adapted to the curvature of mandibular anterior teeth bonded only on the canines.

Timing of data collection

T0 – Lower anterior crowding measured on the pre-treatment casts

T1 – Lower anterior crowding measured on the post-treatment casts after debonding

T2 – Lower anterior crowding measured on the casts made after 6 months follow up.

Method of data collection

The Pre- treatment casts of patients with lower anterior crowding > 4mm were obtained.

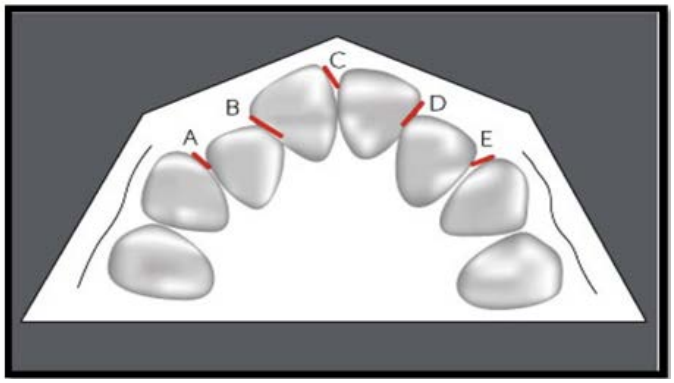

Figure 1: Little’s Irregularity Index

Group A - The initial lower anterior crowding (To) was measured using the Little’s Irregularity Index(Figure 1). The linear displacement (in mm) of the anatomic contact points of each mandibular incisor from the adjacent tooth anatomic point was measured using a vernier calliper and the sum of these five displacements represented the degree of lower anterior irregularity. Twisted ligature wire, SS, 0.009” was adapted to the curvature of the mandibular anterior teeth and then bonded on the lingual surfaces of the lower anteriors on all teeth from canine to canine including 30 incisors, using 3M Unitek TransbondTM XT light cure adhesive primer and paste at T1.(Figure 2)

The patient was recalled after 6 months (T2) and a mandibular arch impression was made in alginate and poured in Type 3 Dental stone.

Figure 2: lingual bonded retainer of twisted ligature wire

Group B - The initial lower anterior crowding (To) was measured using the Little’s Irregularity Index. The linear displacement (in mm) of the anatomic contact points of each mandibular incisor from the adjacent tooth anatomic point was measured using a vernier calliper and the sum of these five displacements represented the degree of lower anterior irregularity.

At the end of the treatment and after debonding, an alignate impression of the lower arch was obtained and poured in Type 3 dental stone. The lower irregularity index at T1 was recorded in the similar manner as mentioned above. 0.028” diameter stainless steel Round wire was adapted to the curvature of the mandibular anterior teeth and then bonded on the lingual surfaces of the lower anteriors only on the canines, using 3M Unitek TransbondTM XT light cure adhesive primer and paste at T1. (Figure 3)

The patient was recalled after 6 months (T2) and a mandibular arch impression was made in alginate and poured in Type 3 Dental stone.

Figure 3: lingual bonded retainer of 0.028”inch stainless steel round wire

Anterior alignment of the mandibular anteriors was assessed on these casts (T2) for Group A and Group B using the same irregularity index mentioned.

The amount of Irregularity at T2 was then subtracted from T1 casts to give the amount of irregularity change during the time when the patient was in the retention phase. (6 months)

Results and Discussion

Descriptive statistics with means and standard deviations were used to report the findings at T0, T1, T2.

The irregularity index values at all stages are shown in Table 1 (GROUP A) & Table 2 (GROUP B).

The mean irregularity index for the sample (GROUP A) was 6.68mm (SD, 3.0) at T0; it decreased to 0.14mm (SD, 0.12) at T1 and increased to 0.36mm (SD, 0.14) at T2. Results show maximum mean value at T0 followed by T2 and least at T1. This difference was statistically significant with p value < 0.05. (Table 3)

The mean irregularity index for the sample (GROUP B) was 5.77mm (SD, 1.5) at T0; it decreased to 0.17mm (SD, 0.12) at T1 and increased to 0.54mm (SD, 0.20) at T2. Results show maximum mean value at T0 followed by T2 and least in T1. This difference was statistically significant with p value < 0.05. (Table 3)

Table 4 shows graph for mean crowding in mm for Group A & Group B at different time intervals (T0, T1 and T2)

Table 1: Group A

Sn.	To (in mm)	T1 (in mm)	T2 (in mm)	T2-T1 (in mm)
1	6.2	0.1	0.2	0.1
2	7.3	0	0.3	0.3
3	10	0	0.3	0.3
4	4.2	0.2	0.3	0.1
5	4	0.1	0.4	0.3
6	5.3	0.4	0.6	0.2
7	17.6	0.1	0.6	0.5
8	11.2	0.1	0.2	0.1
9	4.8	0.3	0.7	0.4
10	4.2	0.3	0.4	0.1
11	5.2	0	0.1	0.1
12	4	0	0.3	0.3
13	5.1	0.2	0.4	0.2
14	8.2	0.3	0.5	0.3

15	5.9	0.2	0.3	0.1
16	6.2	0.1	0.3	0.2
17	4.3	0.3	0.3	0
18	8.5	0	0.4	0.4
19	7.3	0	0.2	0.2
20	5	0.2	0.3	0.1
21	5	0.2	0.4	0.2
22	4.5	0.3	0.5	0.2
23	10.2	0	0.3	0.3
24	5	0.2	0.2	0
25	11.5	0.1	0.3	0.2
26	6	0	0.3	0.3
27	4.8	0.3	0.7	0.4
28	8.2	0	0.4	0.4
29	6.7	0	0.3	0.3
30	4.1	0.3	0.4	0.1

Table 2: Group B

Sr. no.	To (in mm)	T1 (in mm)	T2 (in mm)	T2-T1 (in mm)
1	5.9	0.2	0.5	0.3
2	6.2	0.1	0.4	0.3
3	4.3	0	0.3	0.3
4	8.2	0.2	0.5	0.3
5	7.5	0.1	0.4	0.3
6	5	0.4	0.5	0.1
7	5	0.2	0.6	0.4
8	4.5	0.1	0.4	0.3
9	7.8	0.2	0.7	0.5
10	4	0.3	0.3	0
11	5.3	0.1	0.6	0.5
12	7.4	0.1	1	0.9
13	9	0.2	0.4	0.2
14	4.8	0.3	1	0.7
15	4.2	0.1	0.3	0.2
16	5.2	0.4	0.5	0.1
17	4	0.3	0.4	0.1

18	5.1	0	0.4	0.4
19	8.2	0.4	1.1	0.7
20	5.9	0.1	0.5	0.4
21	6.2	0.2	0.4	0.2
22	4.3	0.3	0.6	0.3
23	4.8	0	0.7	0.7
24	8.2	0.2	0.5	0.3
25	6.7	0.1	0.6	0.5
26	4.2	0	0.3	0.3
27	4	0.3	0.7	0.4
28	5.3	0.1	0.6	0.5
29	7.6	0	0.6	0.6
30	4.5	0.2	0.4	0.2

Table 3: Group Statistics

	Types	N	Mean	Std. Deviation	Std. Error	P- value
T0	Group A	30	6.6833	3.00816	0.54921	0.147
	Group B	30	5.7767	1.53907	0.28100	
T1	Group A	30	0.1433	0.12780	0.02333	0.358
	Group B	30	0.1733	0.12299	0.02245	
T2	Group A	30	0.3633	0.14499	0.02647	0.001
	Group B	30	0.5400	0.20611	0.03763	
T2- T1	Group A	30	0.2233	0.12780	0.02333	0.002
	Group B	30	0.3667	0.20734	0.03785	

T0 - Crowding in mm before orthodontic treatment

T1 - Crowding in mm at the end of the treatment at the time of debonding.

T2 - Crowding in mm after 6 months follow up.

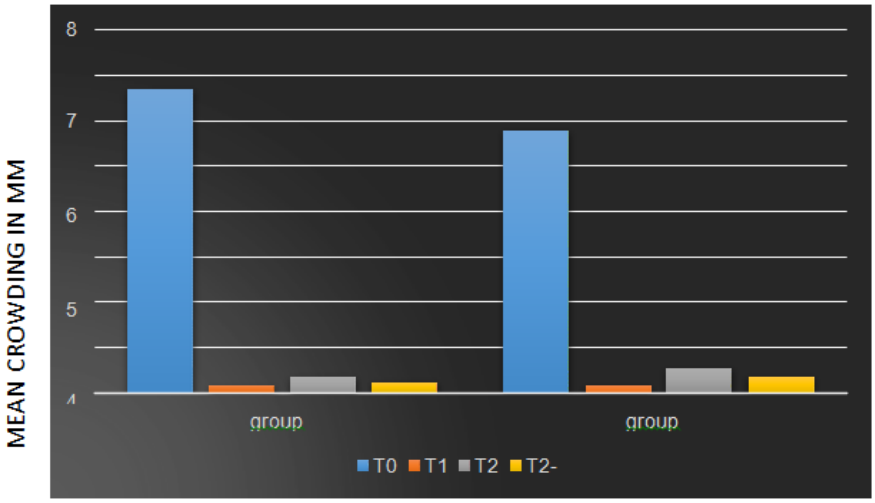

Figure1

Discussion

Over the years numerous studies (Bergstrom and Jensen, 1960; Sanin and Savara, 1973; Shapiro, 1974; Norderval et al., 1975; Johnson, 1977; Little and Riedel, 1989; Richardson, 1989; Little, 1990) have been conducted to assess the amount and type of post-retention changes in orthodontically treated cases. Studies have indicated that post-retention crowding and incisor irregularity increased more frequently in the mandible than in the maxilla. (Little1999)[11] At the completion of orthodontic treatment, retention is a requirement to help ensure that teeth stay in position. Currently all orthodontists provide their patient with some form of retention, the protocol differing significantly from one practitioner to another.

The use of fixed bonded retainers dates back to 1965[12] where first round or rectangular wire were used , then the twisted stainless steel wire , followed by the introduction of multistranded wires and now recently the resin fiberglass strips.

The effectiveness of bonded retainers has been proved many times over the years by the various studies conducted.

Jon Artun et al[12] in their study observed that permanent retainer bonded to just the canines showed minor changes in the alignment as compared to retainer bonded to all anterior teeth.

Similar results were observed by Stormann I. and his collegues [13] wherein they too concluded that tooth position with canine-to-canine retainers showed a decent degree of stability while the canine-and-canine retainer induced frequent relapse of incisors not bonded to the retainer similar to our study. Thus in our study Group A was canine-to-canine lingual retainer bonded to each of the mandibular incisors and canines and Group B was a canine-to-canine bonded only to canines, in treated cases of dental crowding

The mean irregularity index for the sample (GROUP A) was 6.68mm (SD, 3.0) at T0; it decreased to 0.14mm (SD, 0.12) at T1 and increased to 0.36mm (SD, 0.14) at T2.

The mean irregularity index for the sample GROUP B was 5.77mm (SD, 1.5) at T0; it decreased to 0.17mm (SD, 0.12) at T1 and increased to 0.54mm (SD, 0.20) at T2.

The results thus indicated that the relapse tendency of the incisor was more for Group B type of permanent lingual bonded retainer.

Similarly in the year 1994, a study carried out by Sadwoksky et al[14] where a sample of 22 previously treated orthodontic cases was studied to evaluate long-term stability. They too concluded that the mandibular anterior segment demonstrated relatively good alignment at the long-term stage, which may be a reflection of prolonged mandibular retention. Long-term stability of treatment results has got to be considered in reference to aging, periodontitis, caries, and various sorts of dental restorations. With these factors in mind, and in reference to the duration, effort and price invested in orthodontic therapy, the selection of a follow-up period of a minimum of 5 years after completed retention seems reasonable when stability of orthodontic treatment is evaluated [15].

Ardeshna (2011) [16] designed a clinical study where the efficacy of innovative fiber-reinforced thermoplastic (FRP) bonded orthodontic retainers was evaluated. Seventy-six canine-to-canine retainers were placed in 56 patients by using the acid-etch technique over a 34-month period. They were evaluated for clinical acceptability to function as a retainer, structural integrity of the FRP, and integrity of the bonding. With the results that were achieved, the authors concluded FRP retainers could be a viable alternative to metal retainers.

Comparing a round retainer wire and muiltistranded wire retainer bonded as a permanent retention, Al-Nimri et al [17] concluded that after 12 months of retention period multistrand wire retainers were better at maintaining incisor alignment than single span, round wire retainers while more plaque accumulated on the distal surfaces of the lower anterior teeth in subjects with multistrand wire retainers than in subjects with round wire retainers.

Recently in 2017 Jeanett Steinnes[18] conducted a study to evaluate the stability of orthodontic treatment outcome and retention status of 7 or more years after active treatment in relation to posttreatment or postretention time, sort of retention appliance, and duration of retainer use. In 67 patients either no retention, only removable, only fixed or both removable and fixed in the maxillary arch and no retention and only fixed in the mandibular arch was administered. The results suggested that fixed canine-to-canine retainers seem effective to maintain mandibular incisor alignment, whereas in the maxilla a fixed retainer may not make any difference in the long term.

Limitation of this study is the duration for which the study was carried out for 6 months. It could be evaluated for longer post treatment duration to better evaluate its efficacy as a permanent bonded retainer.

Conclusion

The main objective of this study was to compare the effectiveness of canine-to-canine lingual retainer bonded only to canines and another type of retainer bonded to each of the mandibular incisors and canines, in treated cases of dental crowding, using Little's Irregularity Index, over a retention period of 6 months.

Regarding the maintenance of the achieved alignment of the mandibular anterior region, it was concluded that Twisted ligature wire (Type A) bonded on the lingual surfaces of all the lower anteriors (canine to canine including incisors) was effective in stabilizing the orthodontic treatment results in most patients. Because the stability of the alignment can be

negatively influenced by failures of the bonded retainer, the incidence of failures can be minimized as much as possible by paying attention to bonding procedures. It is also important to ask the patient to report a failure immediately in order that a repair will be made as soon as possible.

Twisted ligature wire bonded to all anterior teeth was also found to be slightly superior in retaining crowding correction, as compared to rigid wire bonded to all mandibular canines.

This study can be carried forward by comparing canine to canine lingual bonded retainer with either other retention techniques, removable or essix or with other kinds of lingual bonded retainer materials

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