Anchorage Loss Comparison in 0.022 and 0.018 Self Ligating Bracket Systems after Closing of Extraction Spaces with Sliding Mechanics

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ABSTRACT

Introduction: Anchorage is the resistance to unwanted orthodontic tooth movement and anchorage loss in orthodontics can be detrimental to treatment, an unfortunate result of various treatment procedures. This study aimed to evaluate the anchorage loss from preretraction to postretraction with sliding mechanics. This retrospective clinical study compared 0.022 and 0.018 self-ligating MBT bracket systems.

Materials and Methods: Based on the bracket slot size, a total of 28 patients were retrospectively divided into two groups of 14 patients each. Self-ligating (0.022" slot), mean age 19.14±2.12 years designated as Group I and self-ligating (0.018"slot) mean age 19.71 ± 1.80 years designated as Group II. At two intervals of time, T1: Preretraction and T2: Postretraction and space closure, standard study models were prepared. Anchorage loss in terms of maxillary and mandibular molar mesial migration, intercanine width, intermolar width and space closure was evaluated from preretraction and post space closure study models. To evaluate data, SPSS statistical programme 19.0 Version was used and to compare differences in mean scores between the two independent groups, independent t test was utilized.

Results: The mean value of anchorage loss for maxillary arch in Gr I was 0.68±0.20mm (1.93%) & in Gr II it was 0.73±1.38mm (2.13%) with the p-value of 0.573. For mandibular arch the mean value of anchorage loss in Gr I was 0.28±0.20mm (0.63%) & in Gr II it was 0.33±0.38 mm (0.83%), p-value 0.273. The findings of this research were that from T1 to T2, there was no significant substantial variation in anchorage loss between the two groups.

Conclusion: From preretraction to postretraction using sliding mechanics, no statistically significant difference was found in anchorage loss between 0.022 & 0.018 inch self-ligating bracket systems.

Keywords: Anchorage loss; Self-ligating brackets; Slot size; Study models

INTRODUCTION

Anchorage is the resistance to unwanted orthodontic tooth movement which is one of the most important factors in producing maximum esthetic, functional, and stable treatment results.[1] Anchorage control and planning has to be done at the diagnosis and treatment planning stage. Appliances like the transpalatal arch; Nance palatal button; lingual arches; headgear and temporary anchorage devices (TADs) are various intra and extra oral anchorage reinforcement devices.[1]

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Anchorage loss in orthodontics, can be detrimental to treatment, an unfortunate result of various treatment procedures like levelling, aligning, overjet reduction, space closure and is usually greater in the maxilla than mandible.[2] Hence it is imperative to select an appliance that promotes steady tooth movement and diminishes anchorage burden. Anchorage loss has been revealed to be affected by various therapy related factors like age, sex, growth, malocclusion type, molar angulation, crowding, overjet, extraction, non-extraction, extraction site, frictional resistance, tooth movement type, intraoral or extra-oral anchorage devices, force magnitude and type.[2,3] Control of anchorage is critical in extraction situations if therapeutic objective is to be met.

Self-ligating brackets don't need wire or elastic ligature, instead have integrated mechanism that could be opened or closed. A metal face to bracket hole that is opened or closed by tool or by fingertip is the mechanism used in the vast majority of designs.

Self-ligating brackets are claimed to provide benefits over traditional brackets with conventional ligation in terms of cross contamination elimination, full engagement without relaxation, reduced chair side and treatment time and reduced friction.[4] Using sliding mechanics with decreased friction the force required for moving teeth throughout orthodontic treatment will be reduced, lowering reciprocal force upon anchor teeth or units. Anchorage as well as physiologic tooth movement are claimed to be improved by these factors, however studies have not shown any generalized significant difference in treatment duration or outcome between self-ligating and conventional brackets.[5,6,7]

The self-ligating Smart Clip passive brackets (3M Unitek) which were utilized in this investigation have two C-shaped spring clips upon each side of bracket slot to hold archwire in place. For inserting or removing archwire, instrument or finger pressure is not delivered directly towards clip but to archwire, which delivers force for deflecting clips and therefore allows archwire insertion or removal.[8]

Purpose of the retrospective controlled clinical analysis was measuring anchorage loss from pretraction, i.e. after leveling and alignment till postretraction and space closure with sliding mechanics, comparing 0.022 & 0.018 self-ligating MBT bracket systems using study models.

MATERIALS AND METHODS

There were 28 participants in this research undergoing orthodontic treatment at a dental institute. The treatment planned was fixed appliance therapy with all four extractions. The reasons being more tooth material and arch length discrepancy and maximum anchorage requirement. The inclusion criteria were general good health, no systemic disease, permanent and periodontally sound dentition- probing depth less than 3mm, with no radiographic or computed tomographic evidence of bone loss. The exclusion criteria were root resorption, endodontic treatment, anodontia, dilacerated incisor roots, impacted canines, incomplete root formation and decayed or carious teeth. Selected patients' consent letter was taken for their voluntary participation as well as the institute's ethical board approval was also taken for this study. Ethical approval clearance was obtained from the Institute of Dental Studies and Technologies Ethical Board (Reference: IDST/ERBC/2017/05). The sample size was based on a power of 90% and α of 0.05.[9] The patients with Class I or mild Class II dental/skeletal relationships with crowding were allocated to the two groups of 14 each based on bracket slot size. The type of anchorage depends on the extent of crowding like absolute anchorage for severe crowding, maximum anchorage for large crowding, moderate anchorage for less severe crowding and minimum anchorage for mild crowding. In pretreatment samples mild dental Class II cases were divided equally between the two groups as they would require more anchorage loss in lower arch.

1. Group I: 14 patient of self-ligating (0.022" slot), mean age 19.14 ± 2.12 years, in which space closure was carried out with 0.019×0.025" stainless steel archwire with sliding mechanics (Fig 1 and 2).

2. Group II: 14 patients of self-ligating (0.018"slot), mean age 19.71 ± 1.80 years in which space closure was carried out with 0.017x0.025 inch stainless steel archwire with sliding mechanics (Fig 3 and 4).

En masse retraction on SS wire after leaving in situ for 4 weeks to express itself, was performed by steel hooks mesial to canine utilizing NiTi closed coil springs that provided a force of 100g on either side. All the cases were given TPA however during photography in one patient it was removed for patient's convenience and then reinserted again. Records collected for evaluation included study models during the following stages:

T1: Preretraction in Group I - after leveling and aligning upto 0.019×0.025 inch SS wire in 0.022" slot and in

Group II - after leveling and aligning upto 0.017x0.025 inch SS wire in 0.018" slot (Fig 1 and 3).

T2: Post retraction in Group I - after retraction and space closure on 0.019×0.025 inch SS wire in 0.022" slot and in Group II - after retraction and space closure on 0.017x0.025 inch SS wire in 0.018" slot (Fig 2 and 4).

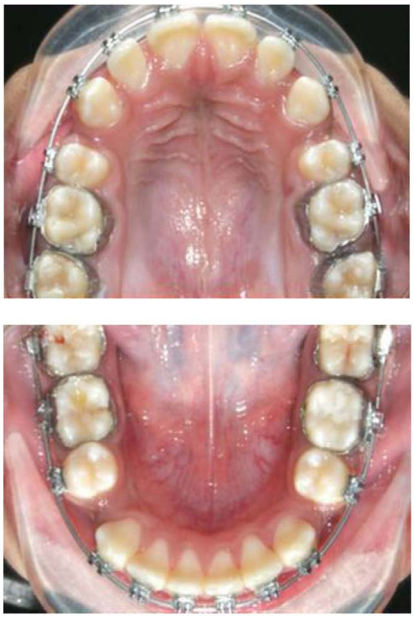

Fig 1: Preretraction Group I, subject treated with 0.022" self-ligating bracket system (sliding mechanics) 0.019" x 0.025" SS

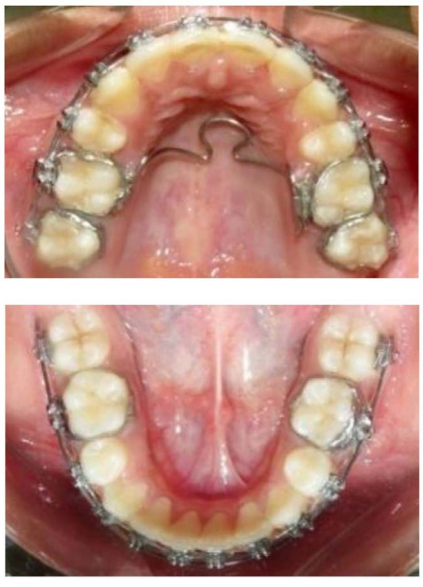

Fig 2: Postretraction Group I, subject treated with 0.022" self ligating bracket system (sliding mechanics) 0.019" x 0.025" SS

Fig 3: Preretraction Group II, subject treated with 0.018" self ligating bracket system (sliding mechanics) 0.017" x 0.025" SS

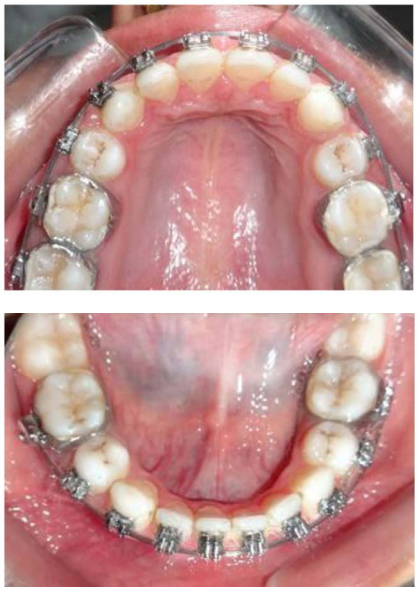

Fig 4: Postretraction Group II, subject treated with 0.018" self ligating bracket system (sliding mechanics) 0.017" x 0.025" SS

The study models were studied by single orthodontist to examine anchorage loss. The author was blinded to group allocation and analysis, and the intraexaminer errors were eliminated by randomly selecting 50 percent of study models 30 days after initial recording and repeating their measurements.

Assessment of Anchorage Loss:

Study models: The following measurements were made on preretraction as well as postretraction and

space closure casts utilizing digital caliper (Aerospace, China) having accuracy of 0.01mm. The figures of study models are combined with the clinical picture in Figures 5, 6 & 7.

Intercanine width, measured by canine cusp tip on one side to cusp tip on opposite side of maxillary and mandibular study models (Fig 5).

Intermolar width, measured by distobuccal cusp of first molar on one side to distobuccal cusp of first molar on opposite side of maxillary and mandibular study models (Fig 6).

Space closure, measured by canine cusp tip till distobuccal cusp tip of first molar on same side and by canine cusp tip till distobuccal cusp tip of first molar on the opposite side of maxillary and mandibular study models (Fig 7).[10]

Molar Anchorage Loss: The Amount of mesial migration of anchor teeth i.e. first molars in the maxillary arch was measured by the following method. Pre- as well as post-retraction study models were analyzed and compared for evaluating amount of anchorage loss. The following landmarks were identified and marked in pre- as well as post-retraction maxillary analysis models (Fig 8).

Anterior raphe point - The utmost discernable anterior point upon mid-palatal raphe. Posterior raphe point - The utmost discernable posterior point upon mid-palatal raphe. Rugae point - The utmost medial point of most distinct right and the left rugae. Molar mesiopalatal cusp tip - Tip of mesiopalatal cusp of the maxillary right/left permanent first molar. M1- Preretraction first molar mesiopalatal cusp tip. M2 - Postretraction first molar mesiopalatal cusp tip. R - Perpendicular to medial rugae point. XY - Mid-palatal raphe plane. All patients' pre- as well as post-retraction study models were marked. Measurements were made using mid-palatal raphe as reference line which was created by joining anterior as well as posterior points of the raphe. Proper superimposition using digital models was done by using generated mid-palatal raphe as reference plane and the rugae as reference points. On the mid-palatal raphe plane i.e. median line, perpendiculars were dropped from mesiopalatal cusp tip of maxillary permanent first molars of right and left respectively. The difference between preretraction distance M1 and post retraction distance M2 records was used to calculate the amount of mesial migration of first molars.[11] (Fig 8)

Fig 5: Inter canine width measurement on maxillary study model.

Fig 6: Inter molar width measurement on maxillary study model.

Fig 7: Space closure measurement on maxillary study model.

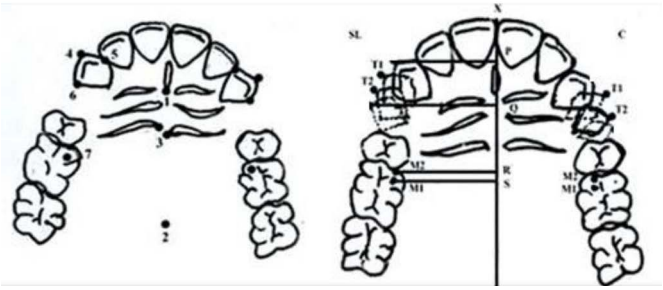

Fig 8: Measurement of the molar anchorage loss from mesiopalatal cusp tip of first maxillary molar to the mid palatal raphe plane bilaterally.

RESULTS

The results on study models were similar as those found on cephalograms using Pancherz's technique.[12] In Pancherz's technique, all preretraction and post space closure cephalograms were traced based on Pancherz analysis, then superimposed for calculating changes in recorded points. The records had been evaluated and data were transferred to excel sheets.

Statistical Analysis

Statistical analysis for the study done for 2 stages:
T1 - Preretraction
T2 - Postretraction & space closure

Excel 2007 and SPSS (statistical programme for social sciences) 19.0 Version were used to input as well as evaluate the data for this research. Mean along with SD were among statistics utilized for describing data, unpaired/independent t test was utilised for comparing the difference in average score among two independent groups. The significance threshold for this investigation was set at p≤0.05.

Assessment of Anchorage Loss:

Study Models

a) Inter canine width: (p = 0.059 and p = 0.066)
b) Inter molar width: (p = 0.992 and p = 1.000)
c) Space closure: (p = 0.714 and p = 0.785)
d) Mesial Migration of First Molar: (p = 0.573)

The mean and standard deviation were tabulated (Table 1, 2; Fig 9). When comparing between two groups using Independent t test, no significantly substantial variation was observed.

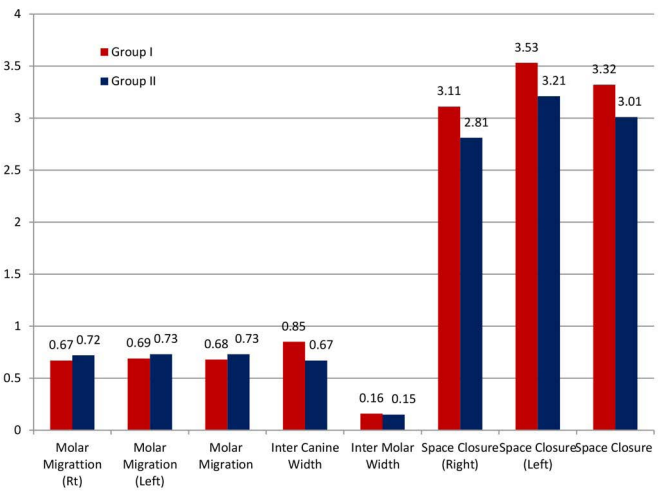

Fig 9: Anchorage loss on maxillary study models in millimeter. Group I Red; Group II Blue.

Table 1 : Anchorage Loss On Maxillary Study Models In Millimetre

Study Models (T2-T1) Tooth	Group I-022" Mean Change ±SD (% Change)	Group II-018" Mean Change ±SD (% Change)	P value
Molar Migration (Rt)	0.67±0.20 (1.91%)	0.72±0.38 (2.11%)	0.574
Molar Migration (Left)	0.69±0.20 (1.95%)	0.73±0.37 (2.15%)	0.528
Molar Migration	0.68±0.20 (1.93%)	0.73±1.38 (2.13%)	0.573
Inter Canine Width (Increase)	0.85±2.65 (3.02%)	0.67±0.86 (1.86%)	0.059
Inter Molar Width (Decrease)	0.16±0.78 (0.31%)	0.15±1.00 (0.30%)	0.992
Space Closure (Rightt)	3.11±1.36 (12.19%)	2.81±1.87 (11.21%)	0.785
Space Closure (Left)	3.53±1.50 (14.02%)	3.21±1.53 (12.95%)	0.643
Space Closure	3.32±1.43 (13.10%)	3.01±1.70 (12.08%)	0.714

Table 2: Anchorage loss on mandibular study models in millimeter

Study Models (T2-T1) Tooth	Group I-022" Mean Change ±SD (% Change)	Group II-018" Mean Change ±SD (% Change)	P value
Molar Migration (Rt)	0.27±0.20 (0.62%)	0.32±0.38 (0.82%)	0.274
Molar Migration (Left)	0.29±0.20 (0.64%)	0.33±0.37 (0.84%)	0.228
Molar Migration	0.28±0.20 (0.63%)	0.33±0.38 (0.83%)	0.273
Inter Canine Width (Increase)	0.75±2.55 (2.66%)	0.57±0.76 (1.58%)	0.056
Inter Molar Width (Decrease)	0.06±0.68 (0.12%)	0.05±.90 (0.10%)	0.892
Space Closure (Rightt)	2.11±1.36 (11.19%)	1.81±1.87 (11.21%)	0.685
Space Closure (Left)	2.53±1.50 (13.02%)	2.21±1.53 (11.95%)	0.543
Space Closure	3.11±1.36 (12.19%)	2.81±1.87 (11.21%)	0.614

DISCUSSION

Due to decreased friction with lack of binding of ligatures upon wire, earlier claims had connected self-ligation to some advantages like lower forces and moments as well as greater rates of tooth movement[4], but most published trials do not show superior efficiency of self-ligating brackets regardless of type or ligation mechanism.[5,6]

In the present study gain in intercanine width was observed in both maxillary and mandibular arches in both the groups (Table 1, 2; Fig 9) but there was no significantly substantial variation from T1 to T2 between two groups. More intercanine width increase in maxillary and mandibular arches was observed in self ligation group I with 0.022" slot (mean = 0.85+2.65 mm,0.75+2.55 mm) i.e. 3.02%, 2.66% and less intercanine width increase was observed for self ligation group II with 0.018" slot (mean = 0.67+0.86 mm, 0.57+0.76 mm) i.e. 1.86%, 1.58%.

According to Pandis N et al[5] there was increase in intercanine widths in mandibular arch related to crowding correction irrespective of bracket group which is in agreement with the present study.

This might be because lower canines were simultaneously displaced distally in a greater section of arch when being retracted after extraction of first premolars. Following the distalization of upper canines, similar rise was predicted and/or it might be attributed to greater malposition and lack of space.

Reduction in intermolar widths was noticed in maxillary and mandibular arches in both the groups (Table 1, 2; Fig 9) but there was no significantly substantial variation from T1 till T2 between the groups.

More decrease in intermolar width in maxillary and mandibular arches was observed in self ligation group I with 0.022" slot (mean = -0.16+0.78 mm,-0.06+.68 mm) i.e. 0.31%, 0.12% and less decrease was observed in self ligation group II with 0.018" slot (mean = -0.15+1.00 mm,-0.05+.90mm) i.e. 0.30%, 0.10%. It's possible that extraction patients' molars have shifted forward into a smaller portion of arch.

Several studies investigated efficiency of self ligating brackets in comparison with traditional brackets. No statistically substantial variation was observed among two groups regarding occlusal indices & arch dimensions.[13-16]

According to Kim E, Gianelly AA[17] there was increase in intercanine width post treatment which is in agreement with the present study. When Machibya FM et al[18] conducted a retrospective cohort study comparing orthodontic patients treated by self-ligating Smart Clip brackets (3MUnitek) with those treated with traditional preadjusted Victory series brackets (3M Unitek), they found that neither treatment time nor anchorage loss were affected with bracket type. This research also found that kind of bracket utilised had no statistical affect on anchorage loss.

Moreover, there was no significantly substantial variation between two groups from T1 to T2 in terms of mesial migration of molars in both arches in current investigation (Table 1, 2; Fig 9). For both arches, the molars had varied amounts of mesial movement. The maxillary molars moved mesially while mandibular molars were mostly stable showing minimum mesial migration. These findings are consistent with those of other researchers[19,20] and are particularly relevant when stringent anchorage control is major concern. When using MBT appliance, it seems that controlling anchorage is essential from the beginning. For both self-ligating groups, the loss of anchorage was greater in maxilla than the mandible; this might be explained by the maxilla's lower density of bone when compared to the mandible.[21,22] Because the maxilla has more anchorage loss than mandible throughout orthodontic treatment, more effort must be exerted to maintain anchorage stability in the maxilla.

According to Agrawal V et al[23], there is no significant variation in amount of anchor loss between the standard (3M Unitek) MBT preadjusted edgewise bracket system and the self-ligating Smart Clip (3M Unitek) MBT system. According to Yassir YA et al[24], bracket slot size does not influence maxillary molar anchorage loss during orthodontic treatment. The conclusions of both these studies are in agreement with this study.

CONCLUSION

There was anchorage loss, an increase in intercanine width, and a decrease in intermolar width in both groups and in both arches. No significant substantial variation was found in the intercanine width & intermolar width from T1 to T2 between the two groups.

Finally, there was no statistically significant variation observed in anchorage loss with sliding mechanics when comparing 0.022" & 0.018" slot self-ligating MBT

bracket systems from preretraction to postretraction & space closure.

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Conflicts of interest
Nil

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