Canine Retraction and Anchorage Loss using Ceramic with Metal Slots and Stainless Steel MBT Pre-Adjusted Edgewise Brackets - A Comparative Clinical Study

Raj Shah[1], Tejashri Pradhan[2], Roopa Jatti[3], Parthiban K[4]

ABSTRACT

Introduction: Ceramic brackets are popular among adult patients who express a desire for more aesthetic appliances. The aim and objectives of this study was to assess the rate of canine retraction and anchorage loss using metal inserts ceramic and stainless steel MBT pre-adjusted edgewise bracket systems.
Material and Methods: Nine orthodontic patients who needed 1st premolar extraction and canine retraction bilaterally in the maxilla as a part of orthodontic treatment were selected. Each patient received 0.022" MBT pre-adjusted edgewise stainless steel brackets and ceramic brackets with metal slots on opposite canine teeth in the maxillary arch. Canine retraction was achieved on 0.019 × 0.025"stainless steel arch wire with elastomeric chain. Measurements were performed by direct technique from stone casts.
Results: The mean rate of retraction was 0.985 ± 0.105 mm/interval and 0.963 ± 0.109 mm/interval for MBT pre-adjusted edgewise stainless steel brackets and ceramic bracket with metal slots respectively. The average difference in the rates was 0.022 ± 0.07 mm/interval. There was no statistical significant difference in the rates between the two groups(p= 0.385). The mean anchorage loss was 0.69 ± 0.13mm for MBT pre-adjusted edgewise stainless steel brackets and 0.66 ± 0.31mm for ceramic bracket with metal slots The mean difference in anchorage loss was 0.03 ± 0.33mm. The difference in the amount of anchorage loss was also not statistically significant (P = 0.776).
Conclusion: Although the rate of canine retraction and anchorage loss between ceramic bracket with metal slot and MBT pre-adjusted edgewise stainless steel brackets showed a clinical difference, it was not statistically significant.

Keywords: Ceramic Bracket with Metal Slots, MBT pre-Adjusted Edgewise Stainless Steel Bracket, Rate of Retraction, Anchorage Loss

INTRODUCTION

The changes in the design of edge-wise bracket by Andrews led to improved and more consistent results with shorter treatment time and simplification of orthodontic techniques. During the last ten years a wide range of metal, plastic and now ceramic brackets, based on straight wire system have evolved and become available. One such system was MBT system which was introduced by Mclaughlin, Benett and Trevisi.[1]
Ceramic brackets are especially popular among adult patients who express a desire for more aesthetic appliances. However ceramic brackets move teeth less efficiently than do the metal brackets.[2] Studies have found that frictional resistance is significantly higher in ceramic brackets than in stainless steel brackets, for most wire size alloy combinations regardless of slot size.
Therefore, ceramic brackets with a metal slot system were introduced to incorporate the aesthetic properties of the ceramic brackets along with the less frictional properties of metal brackets.[2] However the frictional resistance between orthodontic wires and ceramic brackets with metal slot during actual or simulated tooth movement has never been fully investigated. Hence this study is being undertaken to evaluate canine retraction using ceramic bracket with metal slot and conventional PEA metal bracket systems. This study also compares the amount of anchor loss during canine retraction using ceramic bracket with metal slot and conventional PEA metal bracket system.

Objectives of the study

To determine the efficiency of metal insert ceramic brackets during canine retraction by comparison of:

- Rate of canine retraction using metal inserts ceramic and stainless steel MBT preadjusted edgewise bracket systems.
- Anchorage loss after canine retraction using metal insert ceramic and stainless steel MBT preadjusted edgewise bracket systems.

MATERIAL AND METHODS

The study was conducted on nine orthodontic patients who reported to the department of orthodontics and dentofacial orthopedics, KLE V.K.Institute of dental sciences, Belgaum. Patients who needed 1st premolar extraction and canine retraction bilaterally in the maxilla as a part of orthodontic

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How to cite this article: Raj Shah, Tejashri Pradhan, Roopa Jatti, Parthiban K. Canine retraction and anchorage loss using ceramic with metal slots and stainless steel MBT pre-adjusted edgewise brackets - a comparative clinical study. International Journal of Contemporary Medical Research 2018;5(9):I1-I6.

DOI: http://dx.doi.org/10.21276/ijcmr.2018.5.9.4

treatment were selected. All patients and parents were informed about the procedure that would be applied throughout the study and informed consent was taken. Each patient received two different brackets on opposite canine teeth within the maxillary arch. The canine brackets used in this study were 0.022 inch MBT pre-adjusted edgewise stainless steel brackets {Gemini – 3M Unitek} and ceramic brackets with metal slots {Clarity – 3M Unitek}.

Inclusion criteria

Subjects who needed separate canine retraction and first premolar extraction as a part of orthodontic treatment, Subjects with permanent dentition and who demonstrated class I / class II div 1 malocclusions, Canine retraction of at least 3mm required and no history of previous orthodontic treatment.

Exclusion criteria

Patients with oral manifestations of disease or a chronic debilitating disease and periodontally compromised patients.

Armamentarium Required (Fig 1):

Ceramic canine brackets with metal slots (Clarity, 3M Unitek) (Fig4), Conventional PEA metal canine brackets (Gemini, 3M Unitek) (Fig3), Digital Vernier caliper {Mitutoyo Digimatic Caliper}, E-chains {Flexi chain – Encore} and Dontrix guage {Correx – Dentaurum}

Standardization for Obtaining Measurements (Fig 5):

To measure the movement of canine and molar, an acrylic palatal plug was made on maxillary arch. This plug was fabricated from acrylic with reference wires (0.019×0.025 inch stainless steel) embedded in the acrylic that extended to the cusp tip of canine and to the central fossa of the first molar. The initial model was used to make the plug, which was then fitted to the models taken every 4-weeks interval on completion of retraction of both canines.[3]

Determining Rate of Retraction (Fig 6):

Initial leveling and aligning was done using 0.016 niti wire and 0.017 × 0.025 niti wire as required, a continuous, passively fitted 0.019 × 0.025 inch stainless steel arch wire was used for canine retraction. The canines were retracted with Class I mechanics using e-chains (50gms) extending from the first molar to the canine bracket in maxillary arch. Measurements of canine retraction and anchorage loss were not made until leveling procedure was completed in all patients.

The rate of retraction was calculated as the distance traveled divided by the time required to complete space closure. This was recorded in millimeter per interval. An interval was defined as a 4-weeks period. Patients were seen at 4-weeks interval until retraction was completed.

Measurements were performed by direct technique from stone casts obtained before and at the completion of retraction at every 4-weeks interval with the help of digital vernier calliper. (fig 6a-6d). Vernier caliper was used to measure the maximum distance between the cusp tip of the canine and the reference wire placed on the tip of the canine before retraction at the end of every interval. The difference between the initial and 4-week interval measurements was calculated to give distance of retraction. This measurement was repeated three times and the mean value was taken.[3]

Determining Anchorage Loss (Fig 7)

Anchorage loss was recorded as the amount of movement in millimeters that occurred in the direction opposite to the direction of the applied resistance. Direct cast measurements were used rather than radiographs. This method was considered to be easier and accurate, and did not subject patients to excessive radiation exposure. Digital vernier caliper was used to measure the anchor loss from the central fossa of the molar to the tip of the wire originally placed. This super-imposition allowed for the direct observation of amount of molar protraction (anchorage loss).[3] The data obtained were subjected to statistical analysis. Paired sample "t" test was applied to the results.

RESULTS

The maximum rate of retraction for the conventional preadjusted edgewise bracket was 1.23mm/interval and for

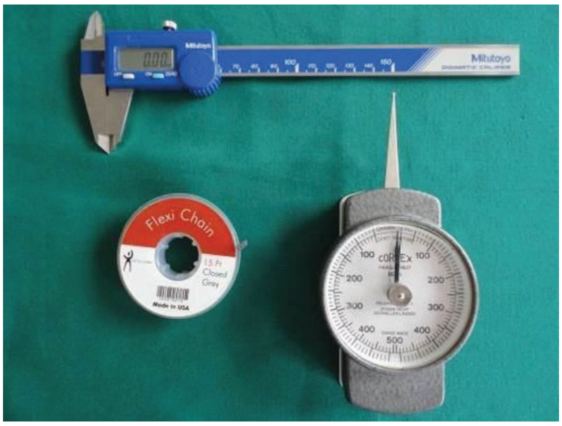


Figure-1: Armamentarium used for the study

	Paired Differences					
	Mean	Std. Deviation	Std. Error Mean	t	Df	Significance
SS - CM	0.0216	.0706301	0.0235	0.918	8	0.385

Table-1: Paired sample "t" test: {rate of canine retraction}

Brackets	Min.	Max.	Mean	SD	Mean diff.	t	DF	Significance
SS	0.5	0.9	0.69	±0.13				
CM	0.3	1.3	0.66	±0.31	0.03±0.33	0.295	8	0.776

Table-2: Paired sample "t" test: {anchorage loss}

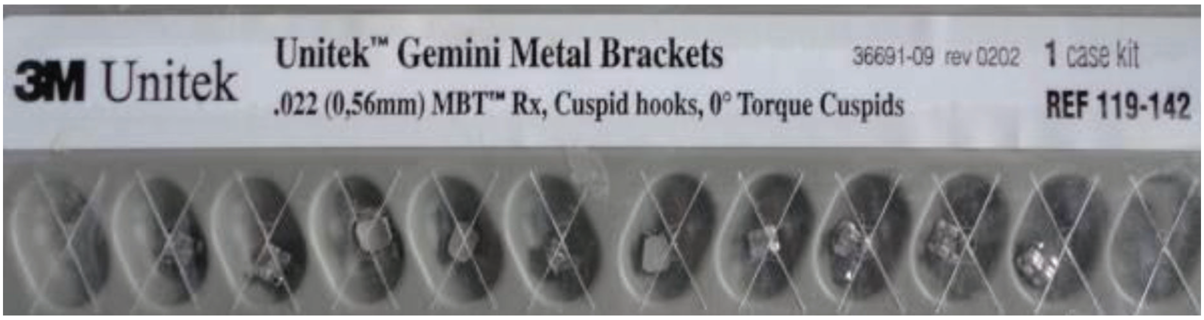


Figure-2: Conventional PEA Metal Brackets

Figure-3: Conventional Canine PEA Metal Bracket

Figure-4: Ceramic Canine Bracket with Metal Slot

Figure-5: Standardization for obtaining measurements

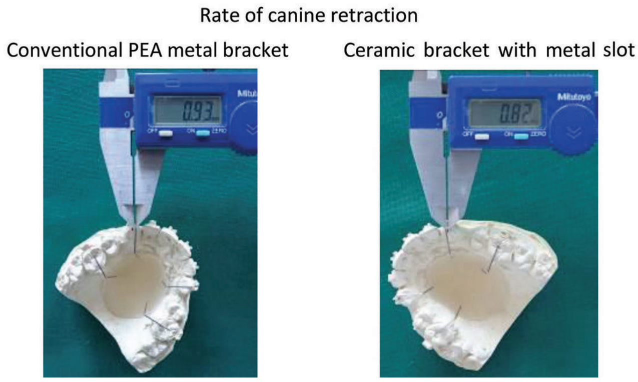


Figure-6a: Rate of canine retraction at the end of 1st interval

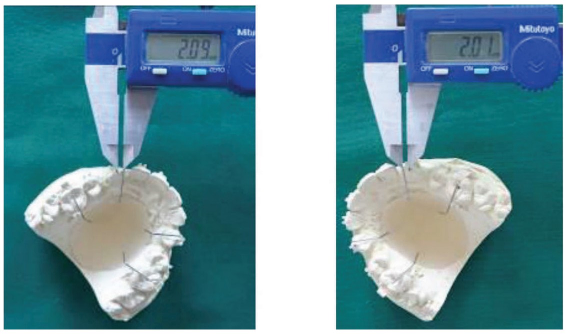


Figure-6b: Rate of canine retraction at the end of 2nd interval

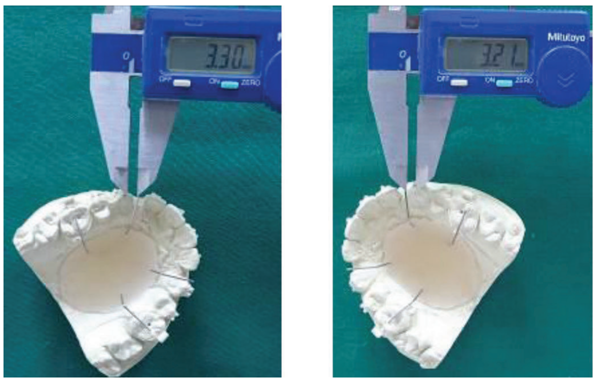


Figure-6c: Rate of canine retraction at the end of 3rd interval

the ceramic bracket with metal slots it was 1.21mm/interval. The minimum rate of retraction was 0.61mm/interval for the conventional bracket and 0.51mm/interval for the ceramic bracket with metal slots. The mean rate of retraction was 0.985 ± 0.105 mm/interval for conventional PEA metal bracket and 0.963 ± 0.109 mm/interval for ceramic bracket with metal slots.The average difference in the rates was 0.022 ± 0.07 mm/interval where the p value was found to be P = 0.385 which is not significant {$P \geq 0.05$} (table 1). Hence there was no statistical significant difference in the rates between the conventional brackets and ceramic brackets with metal slots.*Graph 1* – Graphically depicts the correlation of the rate of canine retraction for conventional PEA metal brackets and ceramic brackets with metal slots.

The conventional PEA metal bracket samples had a maximum anchorage loss of 0.9mm, minimum loss of 0.5mm and a mean loss of 0.69 ± 0.13mm. The ceramic with metal slot samples had a maximum anchorage loss of 1.3mm, minimum anchorage loss of 0.3mm and a mean loss of 0.66 ± 0.31mm. The mean difference between anchorage loss of conventional PEA metal bracket and ceramic bracket with metal slots was 0.03 ± 0.33mm (table 2). The difference in the amount of anchorage loss was also not statistically significant {P = 0.776}. *Graph 2* – Graphically depicts the correlation of the anchorage loss for conventional PEA metal brackets and ceramic brackets with metal slots.

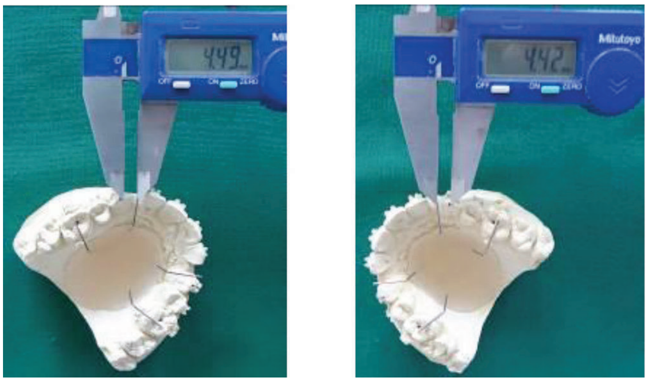


Figure-6d: Rate of canine retraction at the end of 4th interval

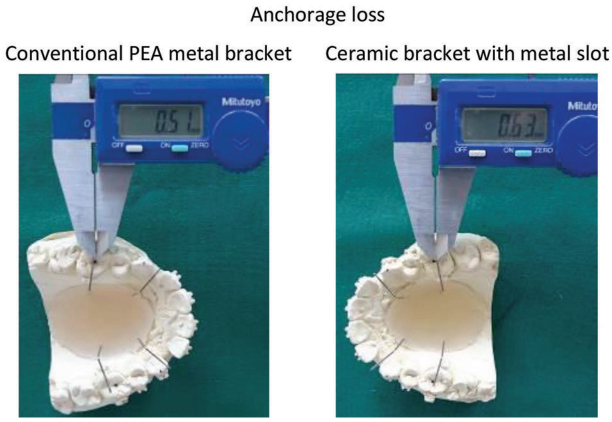


Figure-7: Anchorage Loss at the end of canine retraction

Intraoral photographs of canine retraction


Figure-8a:. Intraoral photograph at the end of 1st interval


Figure-8b: Intraoral photograph at the end of 2nd interval

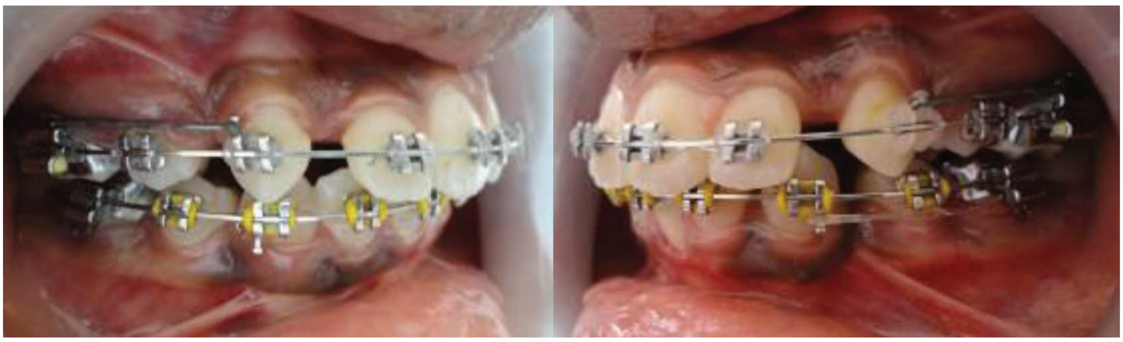
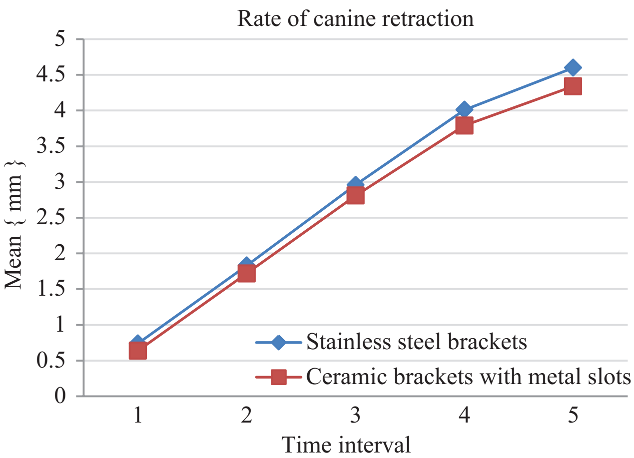
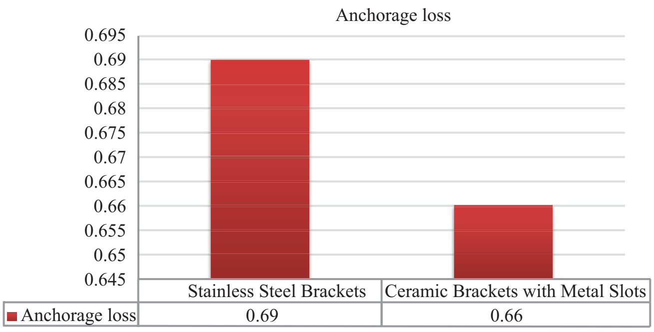


Figure-8c: Intraoral photograph at the end of 3rd interval

Figure-8d: Intraoral photograph at the end of 4th interval



Graph-1:



Graph-2:

DISCUSSION

The inability to form chemical bonds with resin adhesives, low fracture toughness and increased frictional resistance between metal archwires and ceramic brackets are the major disadvantages with ceramic brackets.[4] The advantage of having a stainless-steel slot was to minimize the increased friction that occurred as a result of the arch wires contacting ceramics.[4] The stainless-steel inserts, however did improve the strength and rigidity of ceramic brackets. Burstone and Grooves reported that the optimal force for individual tooth movement is 50-75gms.[5] The force selected for individual canine retraction in our study was 50 gms. Reitan[6] stated that the force application should be light, because this produces desirable biologic effects. This lighter force will produce less extensive hyalinized tissue that can be readily replaced by cellular elements.

As the cuspid teeth were retracting satisfactorily, it can be concluded that the force delivery of 50 gms is adequate to initiate the necessary bony responses.[5] Friction is a factor in sliding mechanics, such as during the retraction of the teeth into an extraction area when the arch wire must slide through the bracket slots and tubes. When friction prevents the movement of the tooth to which the bracket is attached, the friction can reduce the available force by 40%, resulting in an anchorage loss.[7] In the present study direct cast measurement were used rather than radiographs. This method was considered to be easier and accurate and did not subject patients to excessive radiation exposure.[8]

When typical ceramic brackets are used, as the bracket binds on the arch wire, it creates notching which further increases friction and reduces sliding efficiency. This slows down the distal movement of the cuspid and defers all the retraction force to the posterior teeth resulting in loss of anchorage.[9] High friction is due to the roughness of the bracket interface which slows the sliding of the arch wire through the ceramic bracket. This clinical problem can be managed by using ceramic brackets with smoother slot surfaces i.e. by incorporating metal slots.[4] The ceramic bracket with metal reinforced slot had a lower frictional force value than did the traditional bracket and it seems to be a promising alternative to solve the problem of friction.[10] The wide spread application of ceramic brackets with metal slot systems in orthodontics practice awaits further follow up with more sample size and in issues concerning friction, different aligning wires, overall treatment time and patient comfort which needs to be investigated. However more studies are necessary to allow the orthodontist to use this accessory safely and efficiently

CONCLUSION

The rate of canine retraction and anchorage loss between ceramic bracket with metal slot and conventional PEA metal brackets showed a clinical difference although it was not statistically significant. Refinements in ceramic brackets by incorporating metal slots have reduced frictional resistance for more efficient and desired tooth movement, the ultimate goal in clinical orthodontics. Metal – insert ceramic brackets are not only visually pleasing, but also a valuable alternative to conventional stainless steel brackets in patients with aesthetic demands.

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Source of Support: Nil; **Conflict of Interest:** None

Submitted: 07-07-2018; **Accepted:** 25-08-2018; **Published:** 07-09-2018