"A Comparative Evaluation of Canine retraction and Anchorage loss using Self-ligating and conventional MBT Pre-adjusted edgewise bracket systems – A Clinical Study”

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Abstract: The purpose of this clinical study was to compare the rate of canine retraction between self-ligating SmartClip (3M Unitek) and conventional (3M Unitek) MBT preadjusted edgewise bracket systems. Anchorage loss as a result of this movement was also evaluated. The study sample consisted of 8 adolescent or adult patients in whom first premolar extractions were indicated as a part of orthodontic treatment. Space closure was achieved on 0.019 x 0.022-inch stainless steel wire with 9mm (150gms) nickel-titanium closed coil springs (3M Unitek). The patients were recalled after every 4 weeks until 1 side had complete retraction of canine. Measurements were performed by direct technique from stone cast obtained before and at the completion of retraction with the help of digital vernier caliper. The rate of retraction and anchorage loss were evaluated. The results indicated that the mean rate of retraction was 1.1717 mm ± 0.13562 mm/interval and 1.1209 mm ± 0.13298 mm/interval for self-ligating and conventional MBT preadjusted edgewise brackets respectively. The average difference in the rates of retraction was 0.0508 mm/interval. There was no statistically significant difference in the rates between self-ligating and conventional brackets (p=0.060). The mean anchorage loss was 1.8375 mm ± 0.44381 mm for self-ligating bracket and 1.9500 mm ± 0.45591 mm for conventional bracket. The mean difference in anchorage loss was 0.1125 mm. The difference in the amount of anchorage loss was also not statistically significant (p=0.069).

Key Words: Self-ligating bracket, conventional bracket, rate of retraction, anchorage Loss.
INTRODUCTION

Orthodontic treatment with sliding mechanics involves a relative displacement of wire through the bracket slots and whenever sliding occurs, frictional resistance is encountered. Friction may stop tooth movement entirely and/or jeopardize anchorage. The magnitude, control and clinical significance of this frictional resistance are largely unknown. Up to 60% of the applied force is dissipated as friction which reduces the force available for tooth movement, such that an adequate translating force must be applied in order to overcome the frictional force. With increasing frictional resistance, proportionally greater forces would be required. It has been stated that friction was determined mostly by the nature of ligation and not by dimensions of different archwires. Friction is related to the applied normal force, which is influenced by the degree of tension of the ligature engaging the archwire into the slot and the coefficient of friction between the ligature and the arch wire material.

An approach to reducing friction has been to avoid using any form of ligation. This has been achieved by Self-ligating bracket systems. The first Self-ligating bracket, the Russell attachment, was developed by a New York Orthodontic pioneer, Dr. Jacob Stolzenberg, in the early 1930s. The mechanism of this revolutionary bracket was in stark contrast to the traditional approach of tying steel ligatures tightly around each bracket. It had a flat head screw seated snugly in a circular, threaded opening in the face of the bracket.

Self-ligating brackets are ligature less bracket systems that have a mechanical device, an active clip or a passive slide built into the bracket to close off the edgewise slot. Different bracket types with adjustable labial covers (Self-ligation brackets) have been manufactured that suggest such brackets generate less friction, and allows for faster sliding mechanics because the labial cover may not contact the arch wire and therefore eliminate one source of the normal force caused by pressure from conventional steel ties or elastomeric ligatures. It would then be expected that the Self-ligating bracket may reduce the overall treatment time.

To assess the efficiency and to examine the more recent bracket systems, this clinical study was conducted to compare and evaluate the rate of canine retraction and anchorage loss using self-ligating and conventional MBT pre-adjusted edgewise bracket systems tied with steel ligature wire.

AIMS AND OBJECTIVES OF THE STUDY:

To determine the efficiency of self-ligating brackets during segmental canine retraction by comparison of

- Rate of canine retraction using self-ligating and conventional MBT preadjusted edgewise bracket systems tied with steel ligature wire.
- Anchorage loss after canine retraction using self-ligating and conventional MBT preadjusted edgewise bracket systems tied with steel ligature wire.

MATERIALS AND METHODS:

Eight orthodontic patients (5 female and 3 male) who needed first premolar extraction and canine retraction bilaterally in the maxilla as a part of orthodontic treatment were selected. The patients’ age ranged from 13 to 25 years. The patients selected, were undergoing orthodontic treatment in the Department of Orthodontics and Dentofacial Orthopedics, J. S. S. Dental College and Hospital, Mysore. Each patient received two different brackets placed on opposite canine teeth within the maxillary arc. The canine brackets used in the study were self-ligating (SmartClip) MBT preadjusted edgewise bracket, (0.022 inch Slot) on right side and conventional MBT preadjusted edgewise bracket, (0.022 inch Slot) on left side.

SELECTION CRITERIA:

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 and/or class II division 1 molar relationship.
- Canine retraction of atleast 3 mm was required.
- No previous orthodontic treatment has been taken by any of the subjects.

Exclusion Criteria:

- Patients with oral manifestations of disease or a chronic debilitating disease.
- Periodontally compromised patients.

DETERMINING RATE OF RETRACTION:

The rate of retraction was calculated as the distance traveled divided by the time required to complete space closure. This was recorded in millimeters per interval. An interval was defined as a 4-weeks period. The canines were retracted with Class I mechanics using 9mm (150gms) Nickel-Titanium (NiTi) Closed coil
The data obtained were subjected to statistical analysis. Descriptive statistics, Paired sample "t" test and Pearson’s correlation coefficient tests were applied to the results.

**Results:**

**Rate of retraction of the canine:** (Table I and Graphs I)
The maximum rate for the self-ligating bracket was 1.36 mm/interval and for the conventional bracket it was 1.24 mm/interval. The minimum rate was 1.0 mm/interval for the self-ligating bracket, and 0.91 mm/interval for the conventional bracket. The mean rate of retraction was 1.1717 mm ± 0.13562 mm/interval and 1.1209 ± 0.13298 mm/interval respectively. The average difference in the rates of retraction was 0.0508 mm/interval. There was no statistically significant difference in the rates between self-ligating and conventional brackets (P=0.060).

**Anchorage loss of molar:** (Table II and Graph II)
The self-ligating brackets maximum anchorage loss was 2.20 mm with a minimum of 0.8 mm and a mean of 1.8375 ± 0.44381 mm. The conventional bracket had a maximum anchorage loss of 2.45 mm, a minimum loss of 1.0 mm, and a mean loss of 1.9500 ± 0.45591 mm. The mean difference in anchorage loss between self-ligating and conventional bracket was 0.1125 mm. The difference in the amount of anchorage loss was also not statistically significant (P=0.069).

**Correlation of rate of retraction and anchorage loss for the self-ligating and conventional brackets.**
There was no statistically significant correlation between anchorage loss and the rate of retraction for self-ligating (P=0.887) and conventional bracket systems (P=0.820).

**Discussion:**
Self-ligating brackets have been developed in an attempt to better approximate the ideal properties by overcoming the limitation of steel and elastomeric ligatures in terms of comfort, efficiency, ease of use, discoloration, plaque accumulation and friction.

Numerous in-vitro studies have demonstrated a dramatic decrease in friction for Self-ligating brackets, compared to conventional bracket designs, with passive Self-ligating brackets showing less friction than active Self-ligating brackets. Such a reduction in friction can help to reduce overall treatment time, especially in extraction cases where tooth translation is achieved by sliding mechanics.

Interpreting the result of the present study, showed that there is small clinical difference in the rate of retraction between passive self-ligating and conventional preadjusted edgewise bracket tied with stainless steel
ligature; which may be due to the “reduction in friction” but it was not significant.

The results of the present study indicated that there was variability among the subjects. This was noted with the time intervals, the rate of retraction and the anchorage loss. This can be attributed due to the biologic response, and the individual variation in tissue reaction. The results of the prior studies concluded that the individual variation in metabolic response was so great, that it overwhelmed any differences caused by the force magnitude. And also there was a large variation between patients, which precludes the formation of simple theories regarding force and anchorage. This indicated that the variable in metabolic response and not the magnitude of the force is accounted for the major source of variation. It is generally considered valid that higher forces produce more rapid movement than lighter forces, probably only within the individual patient.

The initial force application should be light, because this produces desirable biologic effects. This lighter force will produce less extensive hyaline tissue that can be readily replaced by cellular elements. It was estimated that a force between 100 and 200 gms would be efficient for canine retraction and the duration of applied force is far more influential than its magnitude, i.e. that light forces acting for at least 4-6 hours have greater effect on the dentition than heavy forces which are sustained momentarily. Also it is stated that 150 to 250 gms of force for maxillary canines and 100 to 200 gms of force for mandibular canines is appropriate for translatory movement. Therefore, in the present study the force selected for canine retraction to close extraction space was 150 gms with the help of Nickel-Titanium (NiTi) Closed coil springs.

“Anchorage loss” is the term traditionally used for mesial movement of molars in the sagittal plane. In the present study anchorage loss was determined in the maxillary arch alone because the anterior palatal vault could be used as a stable reference point. In the present study 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.

The mean difference in anchorage loss found in present study between self-ligating and conventional PEA bracket was not statistically and clinically significant. Previous studies has shown that 5% to 50% of the total extraction space can be taken up by an anchor unit made up of the first molar and the second premolar when used to retract canine.

A correlation test was performed for the anchorage loss and rate of retraction for both bracket system i.e. self-ligating and conventional MBT preadjusted edgewise bracket system. There was no statistically significant correlation between anchorage loss and the rate of retraction for either bracket system.

CONCLUSION:
The following conclusion can be drawn from this study:
• There was no significant difference in the rates of canine retraction between self-ligating and conventional MBT preadjusted edgewise bracket systems.
• The difference in anchorage loss between self-ligating and conventional MBT preadjusted edgewise bracket systems was also not significant.
LEGENDS OF FIGURES

Fig 1: Initial model with palatal plug and reference wires before canine retraction

Fig 2: Final model with palatal plug and reference wires after canine retraction

Fig 3: Magnification illustrating anchorage loss
**LEGENDS OF TABLES**

Table I: Mean rate of retraction

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Minimum (mm/interval)</th>
<th>Maximum (mm/interval)</th>
<th>Mean (mm/interval)</th>
<th>S.D.</th>
<th>Std. error mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-ligating bracket</td>
<td>8</td>
<td>1.00</td>
<td>1.36</td>
<td>1.1717</td>
<td>0.13562</td>
<td>0.04795</td>
</tr>
<tr>
<td>Conventional bracket</td>
<td>8</td>
<td>0.91</td>
<td>1.24</td>
<td>1.1209</td>
<td>0.13298</td>
<td>0.04702</td>
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</table>

Table II: Mean anchorage loss

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Minimum (mm)</th>
<th>Maximum (mm)</th>
<th>Mean (mm)</th>
<th>S.D.</th>
<th>Std. error mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-ligating bracket</td>
<td>8</td>
<td>0.80</td>
<td>2.20</td>
<td>1.8375</td>
<td>0.44381</td>
<td>0.15691</td>
</tr>
<tr>
<td>Conventional bracket</td>
<td>8</td>
<td>1.00</td>
<td>2.45</td>
<td>1.9500</td>
<td>0.45591</td>
<td>0.16119</td>
</tr>
</tbody>
</table>

**LEGENDS OF GRAPHS**

Graph I: Mean rate of canine retraction self-ligating and conventional bracket

Graph II: Mean anchorage loss self-ligating and conventional bracket
BIBLIOGRAPHY:


