ASSESSMENT OF SELF-LIGATING BRACKETS

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Abstract
Self-ligating brackets are commonly used these days in orthodontic practice. A number of benefits like lessen treatment duration, quality of treatment etc. have been associated with the use of self-ligating brackets. The aim of the present article is to outline the different type of brackets introduced and the merits and demerits of each. Many studies suggest that Self ligating brackets have less anchorage requirements and have better rotational control on brackets. Thus they help in reducing treatment duration and improving treatment efficiency. While further refinements of self-ligating brackets are desirable and further studies essential, current brackets are able to deliver measurable benefit with good robustness and ease of use. .
Key Words: Self-ligation, brackets, friction, ligation.

INTRODUCTION

A self-ligating bracket utilizes a permanently mounted moveable component to secure the arch wire. Self-ligating brackets are commonly used these days in orthodontic practice. It was Stolzenberg[1] who first described a self-ligating edgewise bracket more than 70 years ago. The SPEED appliance used in the 1980s was the main self-ligating bracket to be generally used. The widespread of the In-Ovation-R(GAC) brackets and the Damon[2] (Ormco), has been a possible reason for introduction of similar systems by many manufacturers in an effort to advance with current trends. There have been a lot of assertions related to these brackets like reduced treatment time and quality of treatment. The purpose of this article is to provide an insight into the self-ligating brackets discussing about the various self-ligating systems available and the pros and cons associated with them.

DRAWBACKS OF CONVENTIONAL LIGATION

There are certain problems associated with the conventional ligating systems which resulted in the introduction of Self-ligating brackets. :

- Conventional ligation fails to provide a secure engagement of the arch wire resulting in reduced control of tooth movement.
- Friction is increased.
- Not able to achieve optimal force level due to force decay
- Displacement of wire with elastomeric ligatures can occur.
- There can be difficulty in maintaining oral hygiene with conventional ligatures.
- Conventional wire ligation is a time-consuming.

The limitations of traditional arch-wire ligation are common, but we have become adapted to these short-comings with Self-ligating bracket can overcome these problems.

ADVANTAGES OF SELF-LIGATING BRACKETS OVER CONVENTIONAL BRACKETS

Self-ligating brackets are better than the conventional brackets in many ways:-

- A more secure and complete archwire engagement can be seen.
- Less friction produced between the bracket and the archwire.
- Reduced chairside assistance is needed.
- Quick Archwire removal and ligation possible.

The merits mentioned above are universal to all self-ligating brackets although there can be a difference in various types of brackets in their ability to render these advantages clinically. In this article, we will discuss some of the proposed advantages which these brackets can provide, such as low friction and good control.

COMPLETE ARCHWIRE ENGAGEMENT AND LOW FRICTION

Friction in orthodontics can be defined as the resistance to movement when the bracket slides along an archwire. Various methods have been proposed to reduce friction in different bracket systems. In Begg's brackets, a loose fit exists between a round archwire and the bracket which reduces friction but also results in loss of full control of tooth position. Specific brackets with an edgewise slot have incorporated shoulders in the design so as to create a sufficient distance between the elastic modules and the archwire and thus reduce friction, but this type of design also reduces friction at the cost of reduced control. In order to provide sufficient force for full archwire engagement, elastomeric rings or ligatures has to be actively pressed against the wire which increases friction significantly. An elastic module cannot provide and maintain appropriate force to maintain the archwire fully in the slot without causing pressure on the archwire to an extent that significantly increases friction. With conventional brackets, an improvement in control is usually at the cost of an increase in friction, especially with elastic modules.[3] Self-ligating brackets have proven to be advantageous by overcoming these difficulties and providing predictable force levels with no loss of tooth control.[4]

ANCHORAGE CONSIDERATION IN SELF LIGATING BRACKETS

Tooth movement has been shown to some extent related to the level of force applied[5]. Ligation for individual teeth leads to rotation of tooth relative to the archwire

and then requires realignment. In a split-mouth study conducted by Srinivas6 canine retraction was carried out using sliding mechanics on 0.018"x 0.025" wire. On one side, Damon SL brackets were placed on the upper canine whereas the contralateral side had a traditional canine bracket. Significant canine retraction of 0.24 mm /month was seen on the side with Damon self-ligating bracket as compared with the conventional brackets. Average time reduction for canine retraction was 4 weeks. In addition, the anchorage loss observed was reduced by 0.3 mm on the Damon SL side. Also, canine rotation noticed on Damon side averaged 8° compare to 12° on the conventional bracket side. All the above findings suggest that the combination of reduced friction, better rotational control and anchorage preservation can be accomplished with self-ligating brackets.

Tooth movement becomes more predictable with less friction and reduced reciprocal forces. The force used by Srinivas[6] was 150 grams, which is lower force as originally suggested by Reitan[7] suitable for inducing an optimal histological response while retracting.

ALIGNMENT IN SEVERE CROWDING

Low friction combined with full archwire engagement is particularly useful in the cases with severe crowding and correction of severe rotations .This relationship between friction and rotation correction has been evaluated by Koenig and Burstone8 in their study. Low friction along with secure bracket engagement allows for rapid alignment of severely displaced teeth and provides full control. This feature of Self ligating bracket facilitates easy alignment of crowded teeth.

OBSTACLES WITH SELF-LIGATING BRACKETS

There are studies that support increase in the clinical effectiveness of self- ligating brackets.[6, 9, 10]Apart from the advantages; there are certain factors that have resulted in the hindrance of the extensive use of self-ligating brackets. The factors varied for different bracket designs.

EDGELOK BRACKETS- Edgelok brackets (Ormco) were the first self-ligating bracket to be produced in significant quantities. Problems included insufficient rotational control, bulkiness, and inconvenient opening and closing the slide.

SPEED BRACKETS[11]- SPEED brackets were introduced since1980's. Early brackets were associated with some problems such as easy distortion or displacement of the clips. Also, the brackets lacked tie-wings which hindered its popularity.

MOBIL-LOCK BRACKETS- Mobil-Lock brackets (Forestadent, Germany) were designed by Dr. Franz Sandor.These brackets possessed a rotating cam, which was turned with a "screwdriver," thus covering part of the labial surface of the slot. The wire could be tightly or loosely engaged by the degree of rotation of the cam. But because of their bulky design, limitedcontrol, difficulty opening and closing the slides, led to their limited acceptance.

ACTIVA BRACKETS[12]-Activa brackets ("A" Company) introduced in 1986, are now obsolete. These brackets possessed a rotating slide as result of which there was a concavity produced in the inner radius to the labial surface of the slot. This resulted in increased slot depth with small diameter wires limited labiolingual alignment with such wires.This limited co-operative interplay along with other deficiencies has led to its failure.

TIME2 BRACKET- The Time2 bracket (Adenta) was commercially available in 1995.

There were displacement and distortion of clips seen in earlier versions. This led to their reduced usage.

DAMON SL BRACKETS- Damon SL brackets ("A" Company) also became available in the mid 1990s and had a thin metal cover wrapping around the labial surface of the twin bracket body and its wings. These brackets were a step forward in design but were not successful due to its bulkiness, limited tooth control, inadvertent opening of the slides and were also prone to breakage. In a study conducted by Harradine9these problems were quantified. All these factors led to a negative effect on the adoption of these brackets.

DAMON 2 BRACKETS- Damon 2 brackets (Ormco Corp.) were introduced to overcome the imperfections of Damon SL. These brackets eliminated the unintended opening of the bracket slides and also the breakages associated with earlier versions, as a result of which they gained acceptance in the community. However, the brackets were not easy to open and offered difficulty to a new user.

DAMON 3 AND DAMON 3 MX BRACKETS- Damon 3 and Damon 3 MX brackets (Ormco Corp.) These brackets have come up with a very easy and efficient mechanism for opening and closing owing to the different location and action of the retaining spring. However, early production Damon 3 brackets offered three main problems: a poor bond strength resulting of bond failure, separation of metal from reinforced resin components, and fracture of tie wings. In spite of these difficulties, the bracket system was well accepted by the users. This is probably due to the greater advantages offered by the self-ligating brackets

SYSTEM R BRACKETS-System R brackets (GAC International Inc.), originally called In-Ovation brackets, is very similar in design with the SPEED brackets in conception and design, but of a twin configuration with tie wings. In 2002, smaller brackets which were introduced for the anterior teeth had narrower width which provided a greater inter bracket span. The bracket subsequently became known as System Because of the difficulty in viewing the gingival side of the clip, some of the brackets offer difficulty in opening. Excess composite at the gingival end can also hinder the openings of bracket. Recently released Quick brackets(Forestadent Bernhard Foerster GmbH) have tried to overcome this

difficulty by providing a labial hole or notch in the clip which can assist in opening of the bracket by insertion of a probe.

SMARTCLIP BRACKET-these brackets are retained with the help of 2 C- shaped springs on either side of the slot. The force for insertion and removal is applied to archwire and not directly to the clip, the pressure in the archwire deflects the clip allowing for insertion and removal of the wire. But with wider clinical application, it was found that the force applied for insertion and removal of wire as uncomfortable. So, in a modification, stiffness of the clips has been removed.

ADVANTAGES OR DISADVANTAGES OF AN ACTIVE CLIP

The increased clearance between wire and a passive slide generates lower forces and reduced friction with newer wires of low modulus of elasticity, it is possible to insert heavier wires and achieve the same working size archwires at the same number of visits.

Since their development, there has been a debate over self-ligating brackets whether they should have an active or passive self-ligating system. Active sel- ligating brackets provide a better control and with low dimension wire act as passive system only but with heavier archwires, the flexible clip is deflected and an active force is exerted on the wire. The higher friction levels produce are still lower than developed in the conventional ligating system. Proponents of passive self ligating brackets state that less friction is produced with these brackets.

Studies have consistently shown when a small sized wire is used passively; less friction is produced even with active clips. Therefore, low friction can be produced with smaller sized wires in active clips or the passive self-ligating system.

Although variable effects can be seen with both clip systems, it is difficult to assess the degree to which the differences between active and passive brackets affect clinical performance.

TREATMENT EFFICIENCY WITH SELF LIGATING BRACKETS

Today self-ligating brackets have emerged widely as a result of availability of more efficient appliances. The brackets available currently are more expensive than the conventional brackets but is said to be balanced by the cost of elastomers, ligatures which are not required in these systems.

Proponents of self-ligating brackets claim certain advantages in terms of treatment efficiency which include reduced chair side time, reduced treatment time, decreased patient visits and an overall reduction in treatment time.[13, 14]

Eberting and coworkers10 in their study have found an average reduction in treatment time of 7 months (from 30 to 25) and seven visits (from 28 to 21) for Damon SL cases compared with conventional ligation. The authors have suggested improvement in treatment efficiency with passive self-ligating brackets. The bracket types available today showbetter treatment efficiency as they are less prone to breakage, are convenient to open and close, have more effective slot dimensions.

CONCLUSIONS

- The worthwhile combination of low friction combined with full bracket engagement is a great advantage of Self-ligating brackets
- They are sufficiently sturdy and user-friendly.
- Remarkable reduction in average treatment time and anchorage has been reported.

As more and more orthodontists embrace the system of self-ligation, it is likely that due to the limitation of conventional ligation systems, they may become outdated soon.

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