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RESEARCH ARTICLE

SELF LIGATING BRACKETS- AN INHERENT LOCK FOR SECURING ARCHWIRES

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ABSTRACT

Self-ligating brackets are those type of brackets that do not require an elastic or wire ligature but have inbuilt mechanism that can be opened and closed to secure the archwire. Self-ligating brackets isgaining popularity over the year. Various advantagesfor these systems have been claimed.Self-ligating brackets have been reported for faster and more efficient treatments, which bought about curiosity to compare them to the conventional system. Unlike conventional appliances,self-ligating brackets do not require elastomeric or metal ligatures, better friction, torque expression, patient friendly and comfort, better maintaince of oral hygiene, faster alignment and space closure. This invention has bought about drastic change in the orthodontic mechanics.Therefore, the purpose of this literature review was to seek the latest studiesabout self-ligating brackets currently used in orthodontic treatments, confirming or correctingcurrent speculations.

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Introduction

The concept of self-ligation isn't conceptually a new intervention in the field of orthodontics and have been have been gaining popularity over the recent years. Self-ligating brackets (SLBs) use mechanically locking or sliding devices to close the slots, eliminating the need for wire or elastomeric ligatures. The first self-ligating bracket, the Russell attachment, was introduced by Stolzenberg[1]in the early 1930's which have been pioneered.

History

SLB was first developed in the 1930's, they have experienced a significant revival since the 1990s, with several new appliances being developed and others being refined and modified to suit the requirements of clinicians and patients

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The idea behind a ligature-free system was refined by Wildman, with the introduction of the Edgelok appliance in 1972 (Ormco, Glendora, California). The mechanism to ligate the archwire involved a labial sliding cap across the top of the archwire slot. When that vertical device was closed off, the bracket slot was converted into a four-wall tube (Berger, 1994; Rinchuse *et al*., 2007; Shivapuja *et al*., 1994). In 1975, Hanson developed the self-ligating bracket Speed (Fig.1) (Strite Industries Ltd., Ontario, Canada), which consists of a stainless-steel flexible spring, that exert pressure over the arch wire in the slot, allowing a constant activation upon thicker wires. Its stainless-steel spring was replaced by nickel titanium spring and is one of the most employed system, at present. Ten years later, "A" Company (Johnson& Johnson, San Diego, California) had launched the brackets Activa (Rinchuse *et al*., 2007; Shivapuja, 1994). Those cylindrical brackets presented a rigid curved wall, which opened and closed off, rotating towards occlusal-gingival direction. However, the commercialization of those brackets was suspended, due to the facility in which patients locked and unlocked the wall (Damon, 1998).

New models of self-ligating brackets are being manufactured: the brackets Time (Harradine, 2003; Henao, 2004)(American Orthodontics, Shebiyan, Wis) were made available in 1994. The aspect and activation were very much similar to Speed, wherein the flexible spring was curved and less rigid, even though it was 1q made with stainless steel. In 1996, the brackets Damon SL (Damon, 1998) (Ormco, Glendora, California) was marketed as passive self-ligating brackets with low or absence friction. This system was improved and then in 1999, Damon 2 was launched (Fig 2) as metallic brackets with a sliding wall, whose unlocking and locking occurred by means of a specific instrumental. Then following improvement, Damon 3 (Fig 3) were manufactured from a combination of a resinous composite reinforced by fiber glass and stainless steel Recently, Damon 3MX was presented (Fig 4) and Damon Q (Fig 5), which are entirely metallic brackets and more curved. Similar to Speed in concept and design, the brackets In-Ovation was been suggested by GAC®. Over the years, its dimensions were reduced and In-Ovation-R (Fig 6) was launched, where in the system keeps the wire passive during alignment and leveling, and as the dimensions of the arch are enhanced, the tight contact of the wire with the spring bracket makes it active.

The SmartClip (Rinchuse, 2007; Miles, 2007) (Fig 7) are self-ligating brackets very similar to the conventional ones. However, they present mesial and distal nickel titanium clips, which keep the wire passively inside the slots during the initial phases of the treatment. If necessary, the bracket becomes active, by the employment of ligatures. Due to the great acceptance and esthetic demand nowadays, lingual self-ligating brackets and esthetic self-ligating were designed to attend the necessities. Since 2001, lingual brackets with self-ligating system as Evolution (Fig 8) were designed. According to esthetical pattern, Oyster brackets were launched and manufactured employing fibre glass reinforced composite polymer. Nowadays, it was launched In-Ovation C (Fig 9), translucent ceramic self-ligating brackets.

Friction: The main advantage of SLB brackets is that reduced frictional resistance between the bracket slot and archwire. Several authors have quantified in various studies about the low friction. The placing of 'figure-of-eight' elastomeric ties increased friction by a factor of 70-220 per cent compared to the "O" elastomeric ties (Sims *et al*., 1993) Consequently, the device which dispenses the employment of these ligatures, certainly causes lower friction levels. Read-Ward and colleagues, evaluating the static frictional resistance of three different SLBs and one conventional bracket, found that increasing either archwire size or bracket/archwire angulation resulted in greater static frictional resistance for all bracket types, while the presence of saliva had an inconsistent effect (Read-Ward, 1997). In a study comparing self-ligating brackets—Time2, In-Ovation R, Speed, Damon3—Budd, Daskalogiannakis and Tompson (Budd, 2008) pointed out that Damon3 showed the lowest friction value. The outcome is intrinsically linked to the passive design of this system. More recent clinical studies support the view that resistance to bodily tooth movement by sliding has little to do with friction, but rather is largely a "binding and release" phenomenon that occurs in the same way with both conventional and self-ligating brackets (Burrow, 2009).

Oral Hygeine/Plaque Accumulation: In Fixed orthodontic appliances the patient's ability to practice good oral hygiene is restricted, creating microbial colonization where in many studies have found that there is increase amounts of Streptococcus mutans and lactobacilli in saliva and dental plaque during orthodontic treatment. Most of the patients bonded with self-ligating presented fewer bacteria in plaque. The outcomes are related to the archwire ligating method; in case of conventional ones, to the elastomeric ligatures, which retain higher levels of bacteria in plaque (Pellegrini *et al*., 2009). Pandis and colleagues in their study have found that SLBs do not have an advantage over conventional brackets with respect to the periodontal status of the mandibular anteriorteeth (Pandis *et al*., 2008).

Treatment Efficiency

In the previous studies by Harradine (Harradine, 2001) found the following:

- A very modest average time saving from a reduction in archwire placement/removal of 24 seconds per arch,
- A mean reduction of 4 months in active treatment time from 23.5 to 19.4 months,
- A mean reduction of four visits during active treatment from 16 to 12, and the same average reduction in Peer Assessment Rating scores for matched cases. Concerning the chair side time savings, Shivapuja and Berger (Shivapuja *et al*., 1994) concludes that when stainless steel wire ligatures are employed, a mean time of 8 minutes is spent for the positioning and removal of the wire. If elastomeric ligatures are employed, 2.3 minutes will be spent. If Speed self-ligating are employed, 0.7 minutes are required.

The ability to assure a safe and complete positioning of the arch into the slot of self-ligating brackets, concomitant to the employment of high technology arches, makes possible longer appointment intervals (Harradine, 2003; Damon, 1998). Hamilton and colleagues found that active SLBs appeared to have no measurable advantages in orthodontic treatment time, number of treatment visits, or time spent in initial alignment over conventional pre adjusted edgewise brackets, with both bracket systems averaging 15.7 months of treatment (Hamilton, 2008). Fleming and colleagues reported that bracket type did not influence the duration of treatment or the number of visits required.

Root Resorption: There are very less studies which support some differences of root resorption employing self-ligating brackets and the conventional ones. In study, Pandis *et al*. (2008) demonstrated a relation between the period of treatment and root reabsorption, but there were no differences between the groups treated with self-ligating or conventional brackets.The results obtained by Scott *et al*., (2008) who assessed changes in root lengths of mandibular incisors on periapical radiographs following arch alignment. The mean amount of resorption was slightly greater with the Damon 3 appliance (2.26 vs 1.21 mm), although the difference failed to reach statistical significance. Pandis *et al*. (2008) using panoramic radiographs, reported no mean difference in the amount of apical root resorption of the maxillary incisors with Microarch and Damon 2 systems.

Arch Alignment and Space Closure: Few clinical trials considered the efficiency of initial orthodontic alignment., among which One study was a three-dimensional measuring technique, making comparison unfeasible (Fleming *et al*., 2010).

Figure 1. Speed bracket

Figure 2. Damon 2 bracket

Figure 3. Damon 3bracket

Fig. 4. Damon 3MX bracket

Fig. 5. Damon Q bracket

Fig. 6. In-Ovation R bracket

Fig. 7 – Smart Clip bracket

Fig. 8 - Evolution Bracket

Table 1. Slb Evolution

Bracket	Year	Manufacturer
Edgelok	1972	Ormco
Mobil-lock	1980	Forestadent
SPEED	1980	OREC/Strite Industries
Activa	1986	"A" Company
Time	1994	Ormco
Damon SL	1996	Ormco/ "A" Company
TwinLock	1998	Ormco
Damon 2	2000	Ormco/ "A" Company
Oyster	2001	Gestenco
In-Ovation	2002	GAC
In-Ovation-R	2002	GAC
Evolution LT	2002	Adenta
Opal	2004	Ultradent
Damon 3	2004	Ormco
SmartClip	2004	3M Unitek
Damon MX	2005	Ormco
Carriere LX	2005	Ortho Organizers
Quick	2006	Forestadent
Praxis Glide	2006	Lancer
System-C	2006	GAC
In-Ovation L	2006	GAC
Opal Metal	2006	Ultradent
Clarity SL	2007	3M Unitek
Vision LP	2007	American Orthodontics
Discovery SLB	2007	Dentaurum
Lotus	2008	Ortho Technology
SmartClip SL3	2009	3M Unitek
Damon Q	2009	Ormco
Damon Aesthetic	2009	Ormco
QuicKlear 2nd Generation	2009	Forestadent
TenBrook T1	2009	Ortho Classic
Nexus Metal	2010	Ormco
Nexus Clear	2010	Ormco
BioPassive 3rd Generation Passive SLB	2010	Forestadent
Agility Passive Self Ligation System	2010	ODP

The other studies where a two dimensional measurement; one among was a split-mouth design allowing consideration of just four mandibular contact points. Alignment efficiency was assessed in the mandibular archin all cases, with four studies confined to the lower anterior region and one study considering the arch from first molar to first molar (Fleming *et al*., 2010). Miles *et al*. (2006) Scott *et al*. (2008) and Miles (Miles, 2007) followed similar treatment protocols with alignment efficiency assessed using Little's irregularity index in the mandibular arch recorded at similar intervals. Scott *et al*[20] assessed changes in the irregularity index 8 weeks after appliance placement; Miles, (2007) and Miles *et al*. (2006) both assessed residual irregularity 10 weeks and 20 weeks after placement of appliances. Only one study considered the rate of orthodontic space closure (Miles *et al*., 2006) at intervals of 5 weeks until complete space closure was achieved. This study had an inadequate sample size, with 4 of 18 subjects (22%) failing to complete the study. Posted archwires were used on both sides; therefore, tooth movement on one side may not have been independent of the other.

Torque: Various factors influence the torque expressions such as bracket design, wire/slot play (engagement angle), mode of ligation, bracket deformation, wire stiffness, magnitude of wire torsion and dimension, and wire edge beveling. Clinical factors such as initial tooth inclination, tooth anatomy, and bracket positioning are also factors involved in torque expressions. Morina and colleagues, compared the torquing capacity of active and passive SLBs with that of metallic, ceramic, and polycarbonate edgewise brackets, found that Fascination 2 ceramic brackets registered the highest torquing moments[23].When torquing the. 022" brackets with. 019" × .025" stainless steel archwires, the authors observed the least torque loss with the ceramic and Ultratrimm stainless steel brackets. Self-ligating, polycarbonate, and certain metallic brackets demonstrated almost seven times less torquing moments after insertion of .019" × .022" stainless steel wires into .022" slots, as well as 100% more torque loss compared to the ceramic bracket (Morina *et al*., 2008).

Cost and Patient Comfort

SLBs' main advantage is that there is elimination of ligature wires which makes them more superior to conventional edgewise brackets in terms of soft-tissue injuries and techniques. Because of its ligature less feature makes the chair side time less compared to conventional brackets. Currently self-ligating brackets are more expensive than most good quality tie wing brackets. Pain and discomfort experienced by patients was comparatively less compared to conventional brackets.

Conclusion

This advancement, brought about a drastic change in the treatment efficiency, stability, patient comfort and helps in maintaining good oral hygiene. The main advantages of self-ligation are now established and readily available. These developments offer the possibility of significant reduction in average treatment time and in anchorage requirements.

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