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Conventional Versus Self-Ligating Brackets

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By
Malak Akram Faisal Alhuwaizi

Supervised by:
Prof. Dr. Hayder Fadhil Saloom
B.D.S., M.Sc., Ph.D. (Orthodontics, UK)

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Certification of the Supervisor

I certify that this project entitled "**Conventional Versus Self-ligating Brackets**" was prepared by **Malak Akram Faisal Alhuwaizi** under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Prof. Dr. Hayder Fadhil Saloom
B.D.S., M.Sc., Ph.D. (Orthodontics, UK)
1/4/2022

Dedication

I would like to dedicate my humble effort to my supportive **Father and Mother.** Their affection, love, encouragement and prays at day and night made me able to succeed with honor.

Malak Alhuwaizi

Acknowledgment

First and foremost, praises and thanks to **Allah** Almighty for helping me fulfill my dream, for his blessings throughout my work to complete it successfully.

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ASLB	Active self-ligating bracket
CB	Conventional bracket
PSLB	Passive self-ligating bracket
RCT	Randomized clinical trial
SLB	Self-ligating bracket

Introduction

The concept of self-ligation is neither new nor lacking in documentation (Singh and Patil, 2018). Currently, the orthodontic market includes several different types of orthodontic brackets.

Self-ligating brackets (SLBs) were introduced on an industrial scale in the 80s and started then to be used worldwide. These brackets are being categorized in two different types according to the way the archwire is maintained within the bracket slot to active and passive SLBs. Active self-ligating brackets (ASLBs) are exerting an active force through a spring clip onto the archwire in order to maintain it in the slot, whereas passive self-ligating brackets (PSLBs) present an additional slide that once closed does not affect the slot lumen, nor exert an active force on the wire (Maizeray *et al.*, 2021).

Manufacturers and advocates of SLBs claim that they offer advantages over conventional brackets (CBs). The most advantageous features proposed with SLBs are reduced friction between the archwire and the bracket and full archwire engagement, resulting in faster alignment and space closure (Harradine, 2003 and 2008). In addition, it is believed that with self-ligation mechanics, greater arch expansion with less incisor proclination is achieved, and;therefore, fewer extractions are required to provide space to resolve crowding (Birnie and Harradine, 2008). Other claimed advantages of SLBs include less need for chairside assistance, shorter adjustment appointments, shorter overall treatment time, increased patient comfort, better oral hygiene, and increased patient cooperation and acceptance (Rinchuse and Miles, 2007; Harradine, 2008). Unfortunately, the literature provides conflicting findings with regard to these claimed advantages of SLBs.

There seems to be a decreased interest in SLBs in the USA, since 53% of American orthodontists have been using SLBs in 2020, compared to 63% in 2014 (Keim *et al.*, 2020). The equivalent figure in France was 37% in 2017 (Balteau *et al.*, 2021).

Aim of the Study

This project aims to have a brief review about the comparison between the clinical performance of conventional versus self-ligating brackets.

Chapter One: Review of literature

Fixed orthodontic appliances are the most commonly used appliances for orthodontic treatment in use today. As the name suggests they are bonded to the teeth and are not removable by the patients.

The component parts of a fixed appliance are orthodontic brackets, molar bands, archwires, ligatures (elastomeric, steel ties) and auxiliaries (power chain, active coil, and intermaxillary elastics).

1.1 Orthodontic brackets:

Current orthodontic treatment utilizes what are known as pre-adjusted edgewise brackets (Figure 1). This system was developed by Dr. Larry Andrews in the early seventies. In this system the brackets have in built features to control the labio-lingual, mesio-distal and inclination of the teeth. These in-built features are known as the prescription of the bracket. The torque prescription of the bracket is expressed when a rectangular orthodontic archwire is placed through the slots of the brackets on the teeth. Having brackets with the prescription built in minimizes, but does not eliminate the need for wire bending to achieve the ideal positions of the teeth (Wahab *et al.*, 2013).

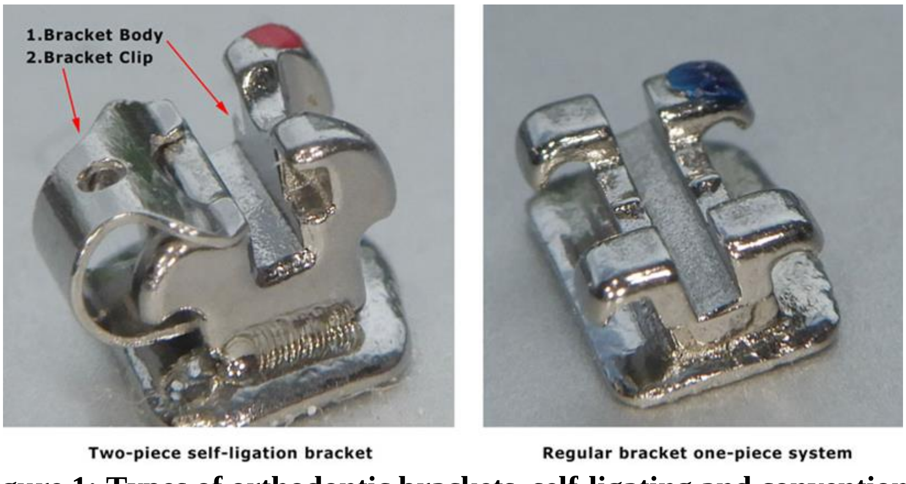

Figure 1: Types of orthodontic brackets, self-ligating and conventional (https://www.iosortho.com/).

1.1.1 Parts of an orthodontic bracket

According to Ludwig *et al.* (2012), the parts of an orthodontic bracket include (Figure 2):

a) Bracket Base: The base of the bracket is either an integral part of the appliance, or a separate component, which is joined to the wings with laser or soldering alloys. The bracket base connects the bracket to the tooth and therefore must have retentive elements such as mesh, undercuts, or other retentive features. Mesh design is critical for the retention of the bracket to be resistant to everyday masticatory forces on the one hand, but should still be capable of being debonded without damaging the enamel surface on the other.

b) Shape of the Base: An ideal base should follow the curvature of the respective tooth surface for a good fit. A precisely fitting base needs to take into account both the occlusal–gingival and also the mesio-distal curvature of the tooth surface. This is a challenge from the manufacturing point of view as a tooth surface is not built with a uniform curvature and a single radius like a circle.

c) Hook: Hooks are present on some orthodontic brackets. They are used for the attachment of auxiliaries such as coil springs and elastics.

d) Identification mark: Coloured dots or indentations are placed on the disto-gingival ties wings of brackets. This ensures that the brackets are placed in the correct orientation on the tooth.

e) Slot: This is the part of the bracket where the orthodontic archwire is placed. Orthodontic bracket slots are typically manufactured with a slot width of either 0.018 inch or 0.022 inch height.

f) Tie Wings: They are located at the corners of the bracket and they stand out beyond its base. Elastomeric or stainless-steel ligatures are placed around the tie wings of the brackets to secure the wire into the bracket slot.

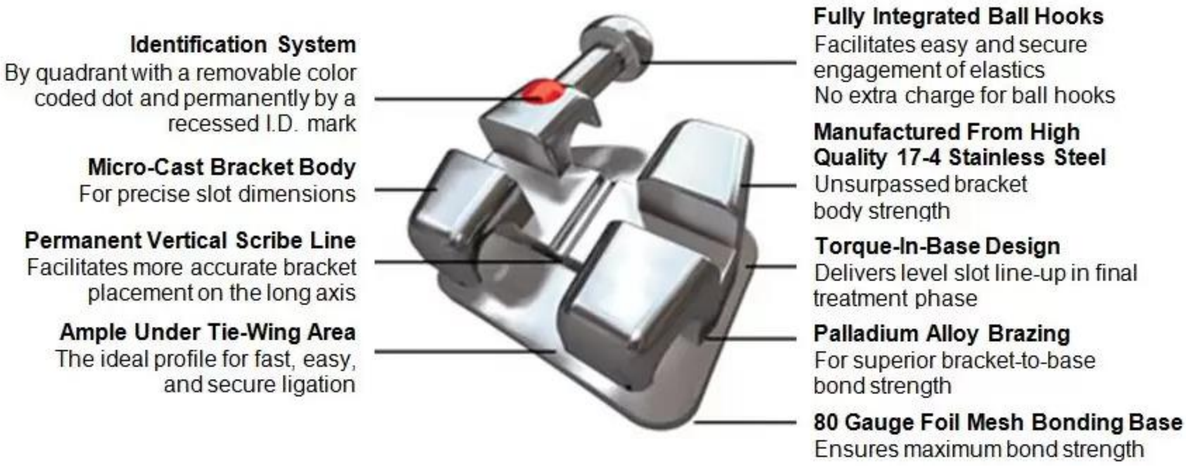

Figure 2: Components of a conventional bracket (https://thefamilyorthodontist.com).

The difference between conventional and self-ligating brackets lies in the way in which the archwire is engaged in the slot. In self-ligation, the bracket itself contains a clip or other mechanism, which is used instead of either elastic or metal ligatures (Figure 3). Ludwig *et al.* (2012) outlined some structural differences as below:

a) Bracket Body: In SLBs, the body of the bracket consists of the tie-wings and the bracket slot and houses the ligation mechanism. Self-ligating bracket bodies can be classified into either a tie-wing design or a block design. The former is the classic twin design. Brackets in the block design group do not allow additional elements to be attached over the archwire, and the body is simply used as the retention mechanism for the self-ligating complex. Either colored markers or laser etching are commonly used to identify the bracket and proper positioning.

b) Auxiliary Slots: Some brackets have additional slots to the main archwire slot, known as auxiliary slots. For these slots to be useful, they should be of minimum dimensions such as 0.016 × 0.016 (Quick, SPEED). The additional slots allow the use of a second force system, which can be useful if the main slot is already engaged. An additional slot is particularly useful for:

• Derotation of severely rotated teeth; a very thin flexible wire can be used for this.

• Alignment of ectopic or severely displaced teeth using piggyback" archwires.

c) Clips: With normal ligation techniques, either elastomeric or metal ligatures engage the archwire in the bracket slot. In self-ligation, this is achieved by the locking mechanism. A number of variations are available. Some slide in a vertical direction, and these locking mechanisms can be either rigid (Damon) or flexible (In-Ovation, Quick, SPEED), i.e. active or passive. A different approach involves " lids," as used in the Discovery SL and Opal systems. Other self-ligating methods use clips that are attached to the sides of the twin bracket, such as Smart Clip.

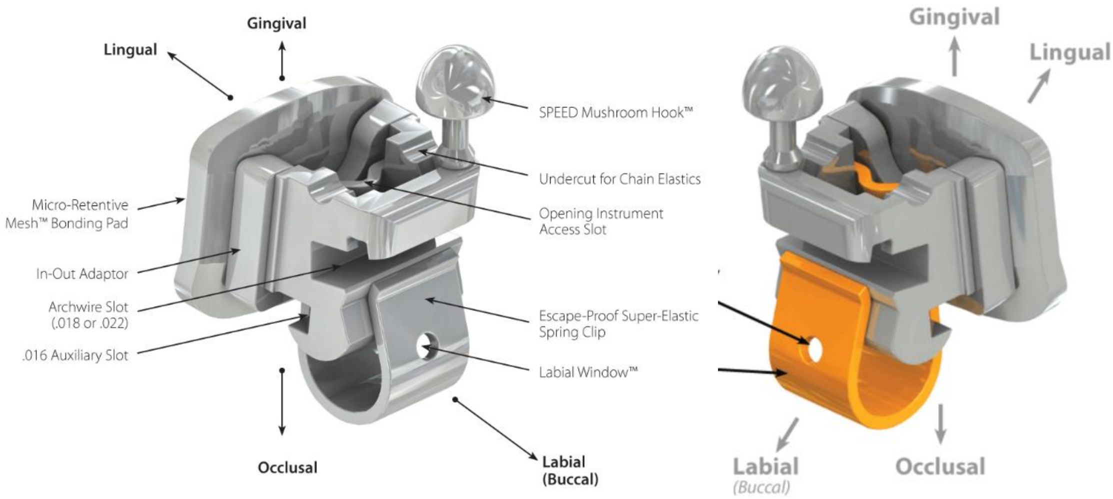

Figure 3: Components of a self-ligating bracket (http://speedsystem.com/).

1.2 Requirements for a self-ligating bracket:

According to Graber *et al.* (2017) SLBs should have the following requirements:

- It is very easy to open and close with low forces applied to the teeth during these procedures and with all archwire sizes and materials.
- It never opens inadvertently, allowing loss of tooth control.

- It has a ligating mechanism that never jams or breaks or distorts or changes in its performance through the treatment period.
- It has a positively held open clip or slide position, so that the clip or slide does not obstruct the view of the bracket slot or the actual placement of the archwire.
- It is tolerant of a reasonable excess of composite material without obstructing the clip or slide mechanism.
- It is not significantly affected by buildup of calculus.
- It permits easy attachment and removal of all the usual auxiliary components of an appliance such as hooks without interfering with the self-ligating clip or slide.
- It has the performance expected of all orthodontic brackets in terms of bond strength, accuracy of slot dimensions, and smoothness of contour.

1.3 Properties of an ideal ligation system

The concept that brackets are ligated via tie-wings is so prevalent that it is worthwhile considering a list of ideal properties of any ligation system. This exercise puts in perspective any assessment of the benefits and difficulties with current self-ligating systems (Harradine, 2003). Ligation should:

1- Secure robust ligation: It is highly desirable that, once ligated, the system is very resistant to inadvertent loss of ligation. Wire ligatures are good in this respect, whilst elastomeric ligatures are inferior, especially if left for too long without being renewed. The force decay of elastomerics has been well documented (Taloumis *et al.*, 1997). Full engagement is a feature of self-ligation because a clip/slide is either fully shut or it is not. Unintentional partial engagement is not possible. There is no problem of decay of the ligature as with elastic ligatures. However, security of ligation will depend on the clip/slide being robust and not inadvertently opening.

2- **Full bracket engagement:** It is a large advantage if the archwire can be fully engaged in the bracket slot and maintained there with certainty. Wire ligatures do not stretch to an extent that engagement once achieved at ligation is subsequently lost, so they can meet this requirement. Elastomerics are worse, since they may frequently exert insufficient force to fully engage even a flexible wire and the subsequent degradation of their elastic performance may cause a significant loss of full engagement as the elastomeric stretches. Twin brackets with the ability to 'figure of 8' the elastomerics are a significant help in this respect, but certainly not a complete answer.

3- **Quick and easy to use:** This is a major weak point of wire ligatures and the principal reason for the enormous decline in their use. Maijer and Smith (1990) and Shivapuja and Berger (1994) have shown that wire ligation is very slow compared to elastomerics. In the latter study, the use of wire ligatures added almost 12 minutes to the time needed to remove and replace two archwires. This is the largest and very understandable reason why so few wire ligatures are now used.

4- **Low friction:** Wire ligatures are better than elastomerics; producing 30–50 per cent of the elastomeric friction forces in one representative study (Shivapuja and Berger, 1994); however,but the forces still reach undesirable levels relative to those that are ideal for tooth movement. Also, the force normal to the archwire produced by a wire ligature is probably very variable. This force has also been shown to be more variable for :elastomeric ligatures than for passive self-ligation (Thorstenson and Kusy, 2001).

5- **High friction:** It is also helpful under some circumstances if the ligation system can 'lock' a tooth to the wire to prevent unwanted movement of that tooth along the wire. When initially placed, an elastomeric in a 'figure of 8' configuration increases the friction by a factor of 70–220% compared to the ‘O’ configuration and this partially meets this requirement (Sims *et al.*, 1993).

6- **Easy attachment of elastic chain:** Some SLBs have dispensed with tie-wings. This makes attachment of elastic chain and if desired, elastomeric ligatures, inconvenient or impossible. The recently developed SLBs all have tie-wings.

7- **Assistance to good oral hygiene:** Elastomerics accumulate plaque more than tie-wires do and fluoride-releasing elastomerics have yet to reach reliably robust performance levels by way of compensation. The ends of wire ligatures are; however, an additional obstacle to oral hygiene.

8- **Comfortable for the patient:** Elastomerics are good in this respect, but wire ligatures require careful tucking in of the ends to avoid soft tissue trauma, and can occasionally be displaced between appointments and cause discomfort (Harradine, 2003).

As a summary, what is wrong with conventional ligation?

- Failure to provide and to maintain full archwire engagement.
- High friction.
- For elastomerics, the force (and therefore tooth control) decays and they are sometimes lost.
- Potential impediment to oral hygiene.
- Wire ligation is very slow.

Wire ties are secure, robust, enable full, partial or distant ligation, and have lower friction than elastomerics. Their largest drawback is the time required for ligation. Elastomerics are quick, but less good in every other respect. Neither method is ideal or nearly as good as a molar tube assembly, which is universally adopted as the ‘ligation’ of choice on posterior teeth. It is easy to find examples of the deficiencies of conventional ligation, but clinicians have become accustomed to tolerating these shortcomings (Harradine, 2003).

1.4 Proposed advantages of self-ligating brackets:

Eliades and Pandis (2009) highlighted the proposed core advantages of SLBs to include:

1. Faster archwire removal and ligation: Several studies shows that self-ligation offers savings in chairside time compared to elastomeric ligation. A time saving of 1 to 2 minutes per archwire change is probably clinically significant.
2. More certain full archwire engagement: a solid, reliable and robust form of ligation which cannot break or suffer decay in its ligating force is a desirable characteristic of self-ligating brackets.
3. Less or no chairside assistance for ligation: archwire changes with SLBs were being done by a single-handed operator when compared with four-handed changing of elastomeric ligatures.
4. Low friction between bracket and archwire: wire ligatures produce substantially lower friction forces than elastomerics, much of the earlier work showed a dramatic reduction in friction with SLBs, especially those with passive slides.
5. Assistance to good oral hygiene: Bacterial accumulation has been proposed as a potential disadvantage of elastomeric ligatures. There is also some evidence that wire ligatures reduce bleeding on probing of the gingival crevice when compared with elastomerics, but as yet, there is no evidence to support the proposed microbiological advantages.
6. More comfortable treatment: It has been proposed that the lower forces and less friction will result in less discomfort for the patient. There is currently little evidence that self-ligation is beneficial in this respect.

1.5 Passive vs. Active Self-ligation:

Two pioneers marked the first steps of these brackets: Hanson started to commercialize his active SPEED™ self-ligating bracket from Canada in 1980 (Hanson, 1980), whereas Damon introduced his passive SLB in the US in the mid-1990s (Damon, 2005).

In active SLBs, Speed and In-Ovation brackets have a sliding spring clip, which encroaches on the slot from the labial aspect, potentially placing an active force on the archwire. Time brackets have a similar clip, but for closure it rotates round a tie-wing, rather than slides into place. These three brackets all have potentially active clips. In contrast, passive SLBs like Damon 2 and TwinLock brackets have a slide that opens and closes vertically, and creates a passive labial surface to the slot with no intention or ability to invade the slot, and store force by deflection of a metal clip (Figure 4). The intended benefit of storing some of the force in the clip, as well as in the wire is that, in general terms, a given wire will have its range of labio-lingual action increased and, therefore, produce more alignment than would a passive slide with the same wire (Figure 5) (Harradine, 2003).

1.5.1 During Levelling:

With thin aligning wires smaller than 0.018 inch diameter, the potentially active clip will be passive and irrelevant, unless the tooth (or part of the tooth if it is rotated) is sufficiently lingually placed in relation to a neighbouring tooth that the wire touches the active spring clip. In that situation, a higher total force will usually be applied to the tooth in comparison to a passive clip (Figure 6). Even if there is no significant clip deflection, there is still a force on the wire which would not exist with a passive clip because the active clip effectively reduces the slot depth from 0.027 inch (the depth of a Damon 2 slot) to approximately 0.018 inch, either immediately - if the clip is not deflected - or as the wire becomes passive if it is initially deflected. These figures are slightly complicated by the fact that the active clip does not reduce the slot depth to the same extent over the whole height of the slot - the clips on Speed, Time, and In-Ovation brackets impinge into the slot more at the gingival end than at the occlusal. Also, the slope of the clips varies with brackets from different manufacturers.

Figure 4: Self-ligating brackets with doors open (to the left) and closed (to the right). Active SLB (SPEED) in the top and PSLB (Damon Q) in the bottom (http://speedsystem.com/).

Figure 5: Passive and active self-ligating brackets (Samawi, 2014).

1.5.2 During space closure:

With 0.018 inch diameter wires, an active clip will place a continuous lingual force on the wire even when the wire has gone passive. On teeth that are whole or in part lingual to a neighbouring tooth, the active clip will again bring the tooth (or part of the tooth if rotated) slightly more labial than would have been the case with a passive clip.

When thick rectangular wires are used, figure 4 shows that whatever the orientation of the rectangular wire, the clip places a diagonally directed lingual force on the wire, which does not contribute to any third order interaction between the wire corners and the walls of the bracket slot, which is the origin of torquing force (Figure 7). In fact, the need for an active clip to invade the slot reduces the available depth of one side of the slot and this means the rectangular wire is not fully engaged. This increases the ‘slop’ between the rectangular wire and the slot, and also reduces the moment arm of the torquing mechanism. Selective use of significantly higher palatal root torque values would be sensible in upper incisor brackets.

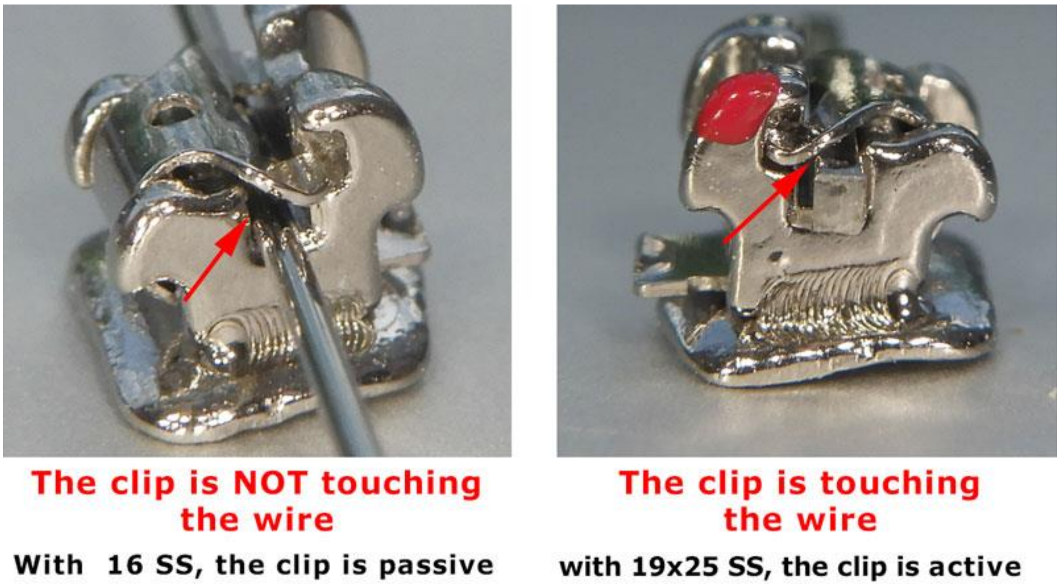

Figure 6: Active SLB with round and rectangular wire (https://www.iosortho.com/).

Figure 7: Diagram of a SPEED bracket with rectangular wire showing the reduced gingival slot wall depth and consequent reduction in torquing ability (Haraddine, 2003).

1.5.4 Overall advantages or disadvantages of an active clip:

It is probable that with an active clip, initial alignment is more complete for a wire of given size to a clinically useful extent. However, with modern low modulus wires it should be possible to insert thicker wires into a bracket with a passive clip and arrive at the working archwire size after the same number of visits, i.e. to store all the force in the wire, rather than dividing it between wire and clip. Once in the thick working archwire, the potential disadvantages of an active clip are increased friction and reduced torquing capacity in one direction. However, these higher friction forces are still much lower than those found with elastomeric ligatures on a conventional tie-wing bracket. Finally, there are the questions of robustness, security of ligation and ease of use.

A systematic review concluded that based on current clinical evidence from randomized clinical trials (RCTs), active SLB appears to be more efficient for alignment, while neither design shows an advantage for width change (Yang *et al.*, 2017).

1.6 Conventional Versus Self-Ligating Brackets:

According to orthodontic distributors, self-ligating brackets present many advantages: reduced friction, faster archwire changes, full archwire engagement in the slot, increased patient comfort and hygiene, reduced number of emergencies, reduced root resorption, reduced need of extractions due to arch expansion, faster treatments, reduced number of appointments, better results, higher efficiency (Maizeray *et al.*, 2021). However, when comparing SLBs with the traditional CBs there are many aspects to consider.

1.6.1 Friction:

Some studies have reported less friction with SLBs regardless of bracket angulation (Pizzoni *et al.*, 1998; Kim *et al.*, 2008; Cordasco *et al.*, 2009), while others have found that when tipping and angulation are accounted for, these brackets produce similar or higher friction compared with CBs (Bednar, 1991; Redlich, 2003). Furthermore, a systematic review concluded that, in comparison to CBs, SLBs maintain lower friction only when coupled with small round archwires in an ideally aligned arch (Ehsani, 2009). Sufficient evidence; however, has not been found to claim that SLBs produce lower friction with large rectangular wires in the presence of tipping and/or torque and in arches with considerable malocclusion (Figure 8). Furthermore, intra-oral masticatory forces can substantially reduce the friction with conventional ligation (Scott *et al.*, 2008; Juneja *et al.*, 2015).

1.6.2 Treatment Efficiency:

Studies on treatment efficiency have reported that on average, patients treated with SLBs finished their treatment 4 to 6 months sooner and had fewer appointments than did patients with CBs (Pandis *et al.*, 2007; Juneja *et al.*, 2015). Contrary to these findings, several studies found no clinically significant difference in treatment efficiency between SLBs and CBs in terms of treatment time, number of visits and treatment outcome (Miles *et al.*, 2006; Pandis *et al.*, 2006; Yorita, 2007; Scott *et al.*, 2008; Hamilton, 2008; Fleming *et al.*, 2010, DiBiase *et al.*, 2011; Johansson and Lundstrom, 2012; Machibya *et al.*, 2013; Lian O'Dywer *et al.*, 2016). While, Rohaya *et al.* (2012) and Songra *et al.* (2014) found that crowding correction was faster with CBs than with either the active or passive SLBs.

Two systematic review articles reported that there was no evidence to support the use of self-ligating fixed orthodontic appliances over conventional appliance systems (or vice versa). Furthermore, it was concluded that there is not sufficient evidence indicating that the orthodontic treatment is more or less efficient with SLBs than with CBs (Dehbi *et al.*, 2017; Tantidhnazet *et al.*, 2018).

1.6.3 Transverse Dimension:

To compare transverse dimension changes between SLBs and CBs, Atik (2014) and Celikoglu (2015) concluded that both SLBs and CBs had no significant differences. In initial mandibular alignment, both groups of brackets were increased in incisor inclination, intercanine width and intermolar width but no significant difference was noted. Therefore, it can be concluded that bracket type has little effect on development in changes of transverse dimension.

In a systematic review, it was concluded that based on the clinical evidence obtained from RCTs, SLBs do not show clinical superiority compared to CBs in expanding transversal dimensions, space closure, or orthodontic efficiency (Yang *et al.,* 2018).

1.6.4 Canine retraction:

In a systematic review, Tantidhnazet and co-workers (2018) studied four researches that compared the rate of canine movement between the use of CBs and SLBs. Only one of them (Burrow, 2010) reported that the rate of canine movement was statistically significant faster with CBs and suggested that the width of SLBs was narrower which leads to greater elastic binding and resistance to sliding. While the other three studies (Mezomo *et al.,* 2011; Wahab *et al.* 2013; Monini *et al.*, 2014) reported no difference between two types of bracket system. It can be concluded that the rate of canine movement with SLBs is not faster and maybe slower than that with CBs.

Malik *et al.* (2019) found insufficient evidence to suggest a significant difference in anchorage loss during canine retraction between the CB and SLB groups of four studies by meta-analysis.

1.6.5 Pain and discomfort:

Scott and co-workers. (2008), Atik and Ciger (2014) and Rahman *et al.* (2016) reported no difference of pain and discomfort between the use of self-ligating and conventional bracket systems when evaluating pain during initial archwire insertion (0.014" NiTi archwire). In contrast, Fleming *et al*. (2009) studied pain during removal of a 0.019 × 0.025" NiTi wire and insertion of a 0.019 × 0.025" stainless steel archwire and showed significantly more discomfort in SLBs. While, Rahman and colleagues (2016) recorded pain scores in a large sample size and showed statistically significantly more discomfort in the self-ligating group but did not reach clinical significance.

A more recent systematic review and meta-analysis of 12 RCTs found that passive SLBs and CBs are not significantly different in plaque control. SLBs and CBs are not significantly different in discomfort reduction at any of four time points (4 h, 24 h, 3 days and 7 days) (Yang *et al.*, 2017).

1.6.6 Root Resorption:

Ciğerim and Ozlek (2021) found that there is no difference between self-ligating and conventional bracket systems in terms of external apical root resorption. However, it was more common in males, adult patient and long treatment time.

1.6.7 Microbial Colonisation:

Regarding the microbial colonisation around the brackets, the difference between conventional and SLBs is inconclusive as found by a recent systematic review (Pamar *et al.*, 2021). Also, a very recent systematic review article concluded that there were no significant differences between self-ligation and elastomeric ligation for biofilm formation in patients wearing multi-bracketed fixed orthodontic appliances. Stainless steel ligation may accumulate less biofilm than elastomeric ligation; however, the clinical significance of the difference could not be evaluated (Skilbeck *et al.*, 2022).

1.6.8 Torque Expression:

Al-Thomali *et al*. (2017) studied 87 researches and concluded that the conventionally ligated brackets presented with highest torque expression compared to SLBs. However, a minor difference was recorded in a torque expression of active and passive SLBs.

1.6.9 Cost:

Currently available SLBs are more expensive than most good quality tie-wing brackets. A modest balancing factor is the cost of elastic ligatures, which are, of course, not required. However, it may save time (an expensive commodity) as SLBs have been reported to save chairside time by faster archwire placement/removal, reduction of treatment time and number of visits (Tantidhnazet *et al.*, 2018).

Summary:

In summary, in 2010, the American Association of Orthodontists' Council on Scientific Affairs reported that there was either no evidence or weak evidence to support most of the claims indicating that SLBs systems provide superior treatment efficiency and efficacy (Marshall *et al.*, 2010). Therefore, it is possible that the popularity of these bracket systems results from effective marketing and advertisement (Prettyman *et al.*, 2012).

Very recent systematic reviews and network meta-analysis article on RCTs investigating treatment duration, number of visits, alignment rate, rate of space closure, perception of discomfort during the initial phase of treatment, pain experience during wire insertion or removal, bond failure rate, time to ligate in or to untie an archwire, periodontal indices, occlusal outcomes, transverse arch dimensional changes and root resorption; concluded that the vast majority of the studied variables did not show any significant differences between the three types of brackets. The most significant findings were that it was quicker to insert and remove archwires with SLBs compared to CBs, and it was more painful to insert and remove an 0.019×0.025” stainless steel wire in/from SLBs compared to CBs. The major difference between active and passive SLBs was that alignment was 10 days faster with active self-ligating braces compared with passive self-ligating braces even if treatment duration between them was not significantly different. However, the meta-analysis contradicts most of the promotional statements put forward by the distributors (Wagner *et al.*, 2020; Maizeray *et al.*, 2021).

Chapter Two: Discussion

The original motive when developing the earlier self-ligating brackets was to speed the process of ligation. The combination of low friction and secure full archwire engagement can conserve anchorage for three reasons:

- With low friction, the net tooth-moving forces are more predictably low and the reciprocal forces correspondingly smaller. Although the evidence shows that the relationship between force level and tooth movement is complex, it does support the idea that lower forces per unit root area lead to more anchorage.
- Lower net forces deflect archwires less and, therefore, facilitate release of binding forces between wire and bracket, enhancing sliding of brackets along a wire.
- Individual teeth—for example, canines—can be retracted separately along an archwire and thus potentially reduce the overall anchorage demands by reduction of the root area of teeth to be moved at any one time, but with none of the potential disadvantages of other methods of separate canine retraction, e.g. loss of rotational control. Following such separate canine retraction, the low friction of SLBs then permits the sensible use of sliding mechanics to retract incisors, even though there will now be a minimum of three brackets distal to the remaining space through which archwire sliding must occur.

The other situation in which the combination of low friction and secure full engagement is particularly useful, is in the alignment of very irregular teeth and the resolution of severe rotations, where the capacity of the wire to slide through the brackets of the rotated and adjacent teeth significantly facilitates alignment. Low friction, therefore, permits rapid alignment and more certain space closure, whilst the secure bracket engagement permits full engagement with severely displaced teeth and full control, whilst sliding teeth along an archwire. Modern, low modulus wires substantially enhance the ability to harness these benefits.

Chapter Three: Conclusions and Suggestions

The SLBs may be preferred during the initial stage of treatment based on the shorter adjustment appointments and faster initial treatment progress they provided. On the other hand, the CBsmay be preferred during the finishing and detailing stages of treatment.

As all the systematic reviews have pointed out that SLBs do not show clinical superiority compared to CBs in expanding transversal dimensions, space closure, or orthodontic efficiency, CBs may be preferred over SLBs because they are cheaper and result in fewer emergency appointments.

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