

# An Elaborate Review on Self-Ligating Bracket System

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## ABSTRACT

With the evolution of orthodontic techniques, the concept of self-ligation is positively received by practitioners all over the world. A self-ligating bracket system is one which does not include the use of elastics or ligature wires. They have an inbuilt mechanism or spring or gate that can be opened and closed by using an instrument or fingertip to keep the arch wire in place. These are four walled rectangular brackets unlike the three walled conventional brackets. The self-ligating brackets have a lumen into which the arch wire of minimum force is engaged. Throughout the treatment a very low force is used. The main benefit of this technique is that the arch wire and bracket have very little friction, allowing for efficient and appropriate tooth movement. It minimises the amount of orthodontist appointments while also improving patient comfort. These are mostly employed in borderline extraction cases when the arch might expand due to the bracket system. As a result, extractions could be avoided in such circumstances. These are classified as active or passive. Current self-ligating brackets appear to be beneficial and are easy to use.

**Key words:** Self-ligating brackets, Arch wire, Force, Friction, Active, Passive

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## INTRODUCTION

Orthodontics as a speciality has evolved through time since its inception in the beginning of the twentieth century [1]. The stability of teeth that have been corrected is inconsistent and not predictable. Therefore, retention of the orthodontic alignment poses to be a task. Follow up studies of cases that have been treated showed a high chance of relapse several years post treatment, though a good correction in the dentition can definitely be obtained. The explanation for this relapse is complicated because it might be due to a number of reasons. Inter-canine width, rotation of the mandible, eruption of the third molar, gingival tissue influence, or treatment modalities are some of them. According to some researchers, the very mild forces provided by the self-ligating bracket systems may lead to a more physiological tooth movement. Thus, a more sustainable tooth movement is achieved by the self-ligating bracket system [2].

Stolzenberg first introduced a self-ligating edgewise bracket more than seventy years back and the current multiplication in the number of bracket designs depicts only a small number of the types that have been patented ever since [3]. These brackets do not need modules or ligature wires to secure the arch wire; instead, they feature an internal mechanism, such as a spring or gate, that may be opened and closed by an instrument. The bracket slot on this device has a metal face that may be opened and closed with a tool or an instrument or fingertip in the vast majority of designs [4]. These are four-walled rectangular brackets with a large lumen or space that is passively ligated with a low-force arch wire and particular expanded arch forms that are utilised in the correct order during treatment. During each stage of treatment, the objective of self-ligation is to use the least amount of force possible. This assists in inducing optimal tooth mobility by improving the physiologic response of the periodontal ligament and neighbouring supporting hard and soft histologic components. Several common orthodontic gadgets are available [5]. It is fair to say that the clinical popularity of the self-ligating bracket system has surpassed the data to support all of the claimed benefits. The majority of recently launched technology in modern orthodontic therapy for both children and adults are targeted towards shorter orthodontic treatment times,

less postoperative discomfort, and better periodontal health (Figure 1).



Figure 1: Self-ligating brackets.

LITERATURE REVIEW

History

The SLB system is not new in the branch of orthodontics. They have been evolving as early as the early 20<sup>th</sup> century.

The Russell attachment was developed in the mid-1930 s as a way to improve clinical efficiency by shortening the ligation time (Table 1) [6-8].

Table 1: Depicts the evolution of Self-Ligating Brackets (SLBs).

Bracket	Year
Russell lock	1935
Ormco edgelok	1972
Forestadent mobil-lock	1980
Strite Industries speed	1986
"A"company activa	1996
Adenta time	1996
"A"company damon sl	1998
Ormeo twin lock	2000
Ormco" a"co. Damon 2	2000
Gac in-ovation	2001
Gestenco oyster	2002
Gac in-ovation r	2002
Adenta evolution lt	2004
Ultradent OPAL	2004
Damon 3	2004
3 m unitek smart clip	2005
Ormco damon 3 mx	2006
Ultradent OPAL metal	2006
Forestadent quick	2006
Lancer praxis glide	2006
Class 1 Ortho organisers carrier lx	2006

Philosophy of the self-ligating bracket system

Traditionally in cases with crowded arches majority orthodontists would plan extraction without hesitation. Currently many orthodontists around the world are realizing the incredible impact the self-ligating system can have on these cases. There are three major pillars of the self-ligating system philosophy, these include:

**Face driven treatment planning:** According to this philosophy facial treatment planning, utilizing the physiologically adaptive mechanics should be the primary focus. The treatment plan is determined by assessing the long-term effects on profile and arch width,

as well as face support. The treatment mechanics must be designed in such a way that they do not overpower the biologic system. The teeth are moved in a physiologic position adapted by the orofacial skeleton and musculature.

**Mild forces:** With great caution, treatment pressures which are just strong enough to activate cellular function by not overriding the periodontium and orofacial muscular complex have been employed. By attempting to match treatment mechanics with the body's natural low-force systems, this physiologic adaptation is a paradigm change for most physicians. The Copper Niti wires which are used in the self-ligating system exhibit super

elasticity and/or shape memory in various degrees. A part of the unusual nature of this wire is that its unloading curve is different from its loading curve. This implies that the force delivered is not the same as the force applied to activate it. The force supplied by copper Niti wire may be altered during clinical usage almost entirely by releasing and retying due to this variation in loading and unloading curves.

**Bracket design:** The SLBs consists of a four walled structure as compared to the three walled structure of a conventional readjusted edgewise bracket. This provides for minimum friction and thereby enhancing tooth movement [9].

### Classification

The orthodontic bracket can be split into three varieties based on how the arch wire loads the bracket: active SLBs, passive SLBs and interactive SLBs:

**Passive SLBs:** The arch wire is seated into the bracket slot and fastened using a sliding or locks mechanism. There is no direct force which is exerted on the wire by the brackets; rather, they control the three dimensional positioning of the tooth by deforming a high-elastic alloy, with very little friction between the arch wire and the slot. Damon series (Damon 3, Damon 2, Damon Q, and Damon XL) and 3 M Smart clip self-ligating brackets are a few examples of passive self-ligating bracket systems (Figure 2) [10].



Figure 2: Passive SLBs.

**Active SLBs:** The arch wire is inserted in the bracket slot, and the spring piece or the lock-tongue provides a steady and mild force. This push enables the teeth in achieving the required torque and positive axis. The friction between the bracket and the arch wire, on the other hand, is somewhat higher than a passive self-ligating bracket and slightly lower than that of a normal ligature bracket. GAC's In-Ovation bracket, TOMY's bracket, and the Speed bracket are all examples of self-ligating brackets.

**Interactive SLBs:** With changes in the dimensions of the wire and the movement of the teeth, the action between arch wire and bracket slot switches between active and passive modes. The passive mode is employed in early therapy since it has minimal levels of orthodontic force

and also reduced friction. During the middle and late stages of orthodontic therapy, the appliance is in an active mode, allowing for excellent control of torque and angulation. The Time 2 and Time 3 self-ligating brackets from AO, as well as the Quick SLBs, are examples of this type of self-ligating bracket (Figure 3) [11-14].



Figure 3: Interactive SLBs.

### Arch wire sequencing

#### Light round wire phase

**0.014" Copper NiTi Initial arch wire:** These wires are used at the initiation of the treatment, levelling, development of arch form, and arch wire preparation

**0.016" Copper NiTi:** in severely crowded adult cases it is used occasionally as second arch wire that have not yet been prepared for the second phase arch wire.

#### High tech edgewise phase

**0.016 × 0.025" Copper NiTi wire:** These are placed in upper and lower arches and are well aligned. In case of difficulty in engaging this wire, a 0.014 × 0.025" wires can be used instead.

**0.014 × 0.025" Copper NiTi wire:** It is considered to be a great transition wire. These wires are frequently used in lower arches with short inter-bracket distance and crowded arches.

**0.018 × 0.025" Copper NiTi wire:** It is used as a Follow-up arch wire in case 0.014 × 0.025" Copper NiTi wire is used. It is an excellent transition wire used when the working SS wire is to be placed.

**0.017 × 0.025" Copper NiTi wire:** It is used with 20° of anterior torque and reverse curve of spee. It is also excellent in cases of class II division 2 or simply where intrusion is desired, utilise the same wire size but without the anterior torque.

**0.019 × 0.025" Copper NiTi wire:** It is also used with 20° of anterior torque and reverse curve of spee. It is also used in difficult division 2 cases and also poses to be an excellent follow up wire. In cases of simple intrusion the same size wire without anterior torque should be used.

#### Major mechanics phase

**0.019 × 0.025" stainless steel wire:** It is used for maintaining arch integrity. It is used for closure of spaces and anteroposterior discrepancy. 0.016 × 0.025" stainless steel wire is used in lower arch when more slot play is

desired. If all of the torques is satisfactory, a nice finishing arch wire can be used in the lower arch.

### Finishing phase

The functional arch wires are usually left in place and used to complete the case, 0.019 × 0.025" or 0.017 × 0.025" TMA arch wires are ideal choices if further bending or torqueing of arch wires is required to complete the treatment [15].

### Indications

- Space for alignment of crowded teeth
- Borderline extraction cases
- Improvement in facial profile
- Maintains accurate relationship between both arches
- Correction of an increased overjet
- Correction of an increased overbite or deep bite.

### Specific requirements for a self-ligating bracket

An ideal procedure of self-ligation should provide a system that is not only rapid and secure but also delivers minimum resistance to the orthodontic tooth movement relative to the arch wire. It should be robust and have the property to ensure full bracket engagement of the arch wire. The self-ligating bracket system must have minimal frictional resistance between the wire and the bracket slot, as well as be a rapid process and simple to operate. It should be convenient to attach an elastic chain to it, and it should eventually aid in proper dental hygiene and be pleasant for the patient [16-18].

The requirements are that:

- It must be convenient for opening and closing of the brackets with minimum forces acting on the teeth throughout these procedures irrespective of the sizes of arch wire and materials.
- It should not open accidentally, leading to a loss in tooth control.
- It should feature a ligation system that does not break, distort, jam, or impair the efficiency during the treatment.
- It features an open clip or slide position that is secured in place so that the clip or slide does not hinder the visibility or proper access of the bracket slot or the real arch wire installation.
- It should be able to withstand a considerable amount of composite material without the clip or sliding mechanism becoming clogged.
- It must not significantly get affected by build-up of calculus.
- It must contribute to the rapid attachment and removal of any auxiliary parts of appliances, such as E-chains, tie-backs and lace-back ligatures, without causing any damage to the self-ligating clip or slide.
- It facilitates the installation and removal of posts, hooks, and numerous other bracket auxiliaries. The employment of modules or alternate traction methods directly to a bracket is commonly considered

significant with the security of self-ligation than with a traditional ligation.

- It must have the performance expected in terms of accuracy of slot dimensions, smoothness of contour and bond strength [19].

### Advantages

- It has an active or passive ligation mechanism that assures complete bracket engagement every time.
- The friction between the wire and the bracket slot is reduced, allowing for smoother and faster tooth movement.
- A properly dimensioned bracket allows for good tooth position control.
- Decreased chair side assistance.
- Faster removal of arch wire and ligation.
- Better patient acceptance, provides greater patient comfort.
- The overall anchorage demands are reduced.
- Quicker alignment and more certain closure of space.
- There is a lower frequency of soft-tissue lacerations, which is also linked to better dental hygiene [20,21].

### Is orthodontic treatment faster with self-ligating brackets

In the laboratory, self-ligating brackets have proven to exhibit lower friction than conventional brackets with modules, according to several research articles.

### Discussion

Damon discussed how his Damon brackets are used clinically claiming that the minimal friction is a key aspect in offering more efficient treatment. Reduced friction *in vitro*, on the other hand, may lead to quicker alignment of misaligned teeth and a shorter treatment period in the clinical set up. In one of the initial clinical trials which was done to check the treatment efficiency, researchers discovered a four-month decrease in duration of treatment and four visits during active therapy. A different case study found that when Damon SL cases were compared to conventional ligation, treatment duration was reduced by six months and seven visits on average. These studies back up the idea that SL brackets improve treatment efficiency by a clinically meaningful amount [22-26].

### CONCLUSION

The prevalence and severity of malocclusions, as well as gender, socioeconomic class, and ethnic origin, also the availability of new orthodontic appliances and orthodontic treatment funding, all influence the demand for orthodontic therapy. Fixed orthodontic appliance therapy works mainly on the correction of mal posed teeth by applying mild and continuous forces on teeth by arch wires through orthodontic brackets. SLBs are not new conceptually, having been established in the 1930 s. Over the past 30 years they have undergone a revival with the emergence and establishment of a variety of new appliances that were being produced. It is broadly



classified into two main heads, active and passive. This classification is made on the basis of the property of the bracket slot-wire interaction i.e. whether they encroach the slot lumen or not. The main philosophy on which the self-ligating system revolves is the mild forces and low friction provided by the arch wire-slot play which in turn leads to a physiologic tooth movement. The self-ligating system has recently gained immense popularity because of its overall reduction in treatment time and also due to its advantage over conventional edge wise systems. They also claim to provide lesser discomfort to the patient and enhance periodontal health, provides with superior torque expression, and more favourable arch-dimensional change.

The community health practices mainly throw light on the central principle of prevention. The orthodontists generally do not prefer to use power arms because of the additional attachments and also discomfort to the patient. The forces applied act on the arch wire level. The self-ligating brackets which are currently available offer a critical combination of low friction and secure complete bracket-slot engagement, as well as being sufficiently strong and more compliant to the patient thereby providing potential benefits of this bracket. The major benefits of self-ligation are now proven and available easily. These advancements have the potential to significantly reduce total treatment duration and perhaps anchoring needs, particularly in situations needing massive tooth movements. Though additional research and developments are needed and further studies are in the works, the current self-ligating brackets provide with various quantifiable benefits with appropriate robustness and ease of use. Oral health is integral to overall health.

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