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Self-Ligating Brackets: A Review

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Self-ligating brackets are ligature less bracket systems that have a mechanical device into the bracket to close off the edgewise slot. These brackets secure passive or active ligation mechanism that ensures consistent full bracket engagement. Reduced friction between archwire and bracket allows more rapid tooth movement. This results in good control of tooth position through an adequately dimensioned bracket. A review of self-ligation in general has been highlighted in this article.

KEYWORDS: Self – Ligating brackets, Passive slide, Damon, SPEED, TIME

INTRODUCTION

Stainless steel ligatures apply high force. This increases the resistance to tooth movement during sliding mechanics with conventionally ligated brackets. Self-ligating brackets by minimizing the normal force caused by ligation decreases the resistance to sliding. Self-ligating brackets have an inbuilt metal labial face, which can be opened and closed.

Self-ligating brackets are of two types: Active and Passive.

Active self-ligating brackets actively apply a spring force on the archwire, until the archwire is completely seated in the slot., which is referred to as Homing action of the spring by Hanson. The aim of active ligation is to seat the archwire against the back of the bracket slot for rotation and torque control. SPEED⁶, Sigma, and Time2⁵, Quick2, In-ovation brackets⁵ have active clips.

Passive self-ligating brackets passively restrain the archwire in the slot. When the slide is closed, the lumen of the slot is full-size in active self-ligation, the energy to control rotations is primarily derived from the clip; in passive self-ligation, the energy is stored and expressed in the high-tech wires. Damon SL⁵, EdgeLok Wildman⁴, Twin Lock⁵, Opal, Clarity SL are self-locking brackets with passive slides.¹ The chronology of evaluation of the different self ligating bracket systems is shown in Figure 1.

The first self-ligating bracket, **The Russell attachment** (Figure 2), was developed by a New York orthodontic pioneer, Dr. Jacob Stolzenberg³, in the early 1935.

This bracket had a flat-head screw seated snugly in a circular, threaded opening in the face of the bracket. For the orthodontist, archwire changes were quick and simple. The horizontal screw could be loosened or tightened with a small watch-repair screwdriver to obtain the desired tooth movement. Loosening allowed bodily translation on a round wire, while tightening facilitated root torquing with a rectangular or square wire. Unfortunately, Russel attachment did not gain much popularity and virtually disappeared from the market.

In 1972, Dr. Jim Wildman of Eugene, Oregon, developed the **Edgelok bracket**⁴, which had a round body with a rigid labial sliding cap. A special opening tool was used to move the slide occlusally for archwire insertion. When the cap was closed over the archwire with finger pressure, the bracket slot was converted to a tube. The rigidity of this outer fourth wall rendered the bracket “passive” in its interplay with the archwire. Passive brackets are inherently imprecise in their ability to control tooth movements because of their total reliance on the fit between the archwire and the bracket slot. This means that tooth control is

compromised when undersize wires are used, although nickel titanium wires can be more accurate than stainless steel. The Edgelok was the first passive self-ligating bracket, and the first to enjoy any sort of commercial success (Figure 3).

A similar bracket, designed by Dr. Franz Sander of Ulm, Germany, was introduced two years later. The **Mobil-lock**⁵ in 1980 (Figure 4) required a special tool to rotate the semicircular labial disk into the open or closed position. As with the Edgelok, the passive outer wall transformed the bracket slot into a tube that loosely contained the archwire. Perhaps because of the simultaneous introduction of elastomeric ligatures, however, neither the Edgelok nor the Mobil-lock gained much of popularity.

At about the same time, Dr. Herbert Hanson of Hamilton, Ontario, was creating prototypes of a self-ligating bracket that by 1980 became the basic speed design. The **Speed Bracket**⁶ (Figure 5,6) features a curved, flexible “Super-Elastic Spring Clip” that wraps occlusogingivally around a miniaturized bracket body. The clip is moved occlusally using either a universal scaler at the gingival aspect of the bracket body or a curved explorer inserted into the labial window to permit archwire placement, then seated gingivally with finger pressure. The labial arm of the Spring Clip, which forms the flexible fourth wall of the bracket slot, not only constrains the archwire, but interacts with the archwire. This sets the speed (Spring loaded, Precision, Edgewise, Energy and Delivery system) apart from all other currently available self-ligating brackets as the only “active” design.

The Spring Clip, through elastic deflection, gently imparts a light, continuous level of force on the archwire, resulting in precise and controlled tooth movement. Hanson describes this as the “homing action of the spring”—the ability of the speed bracket to reorient itself three-dimensionally until the archwire is fully seated in the slot. Any subsequent rotation, tipping, or torquing, during tooth movement of any kind, results in a labial deflection of the spring that reactivates this homing behaviour.

In 1986, the self-ligating **Activa Bracket**⁷ in 1986 (Figure 7), designed by Dr. Erwin Pletcher, offered another alternative. The Activa bracket had an

inflexible, curved arm that rotated occlusogingivally around the cylindrical bracket body. The arm could be moved into a “slot-open” or “slot closed” position with finger pressure alone; once closed, the rigid outer wall of the movable arm converted the bracket slot into a tube. As with the Edgelok bracket, the passive configuration of the Activa bracket limited its interplay with the archwire. Drawbacks such as the ease with which patients could open the bracket and a large mesiodistal bracket width eventually led to its commercial demise.

In 1994, another self-ligating model entered the marketplace. Designed by Dr. Wolfgang Heiser of Innsbruck, Austria, the **Time2**⁵ (Figure 8,9) bracket is similar in appearance to the SPEED bracket but its design and mode of action are significantly different. About the size of a conventional bracket, the Time2 features a rigid, curved arm that wraps occlusogingivally around the labial aspect of the bracket body. A special instrument is used to pivot the arm gingivally into the slot-open position or occlusally into the slot-closed position. The stiffness of the bracket arm prevents any substantial interaction with the archwire, thereby rendering Time2 a passive bracket.

The **TwinLock bracket**⁵ (Figure 10), a second endeavor by Dr. Jim Wildman, was introduced in 1998. Its flat, rectangular slide, housed between the tie wings of an edgewise twin bracket, is moved occlusally into the slot-open position with a universal scaler. It then slides gingivally with finger pressure to entrap the archwire in a passive configuration.

Similar self-ligating bracket designs were introduced in 1996 and 1999 by Dr. Dwight Damon of Spokane, Washington.

Damon SL brackets⁵- Damon SL brackets (“A” Company, San Diego, CA;) (Figure 11) also became available in the mid-1990s and had a slide that wrapped around the labial face of the bracket. A tiny U-shaped wire spring lay under the slide and clicked into the two labial “bulges” on the slide to provide positive open and shut positions. These brackets were a definite step forward, but suffered two significant problems—the slides sometimes opened inadvertently and they were prone to breakage. Nevertheless, these brackets generated

a substantial increase in the appreciation of the potential of self-ligation.

Damon 2 bracket- Damon 2 brackets in 2000 (Ormco Corp.) (Figure 12) were introduced to address the imperfections of Damon SL. They retained the same vertical slide action and U-shaped spring to control opening and closing, but placed the slide within the shelter of the tie wings. Combined with the introduction of metal injection molding manufacture, which permits closer tolerances, these developments almost completely eliminated inadvertent slide opening or slide breakage and led to a further acceleration in the use of self-ligation. However, the brackets were not immediately and consistently very easy to open and this aspect of functionality is important to the new user.⁸

Damon 3 and Damon 3 MX brackets- Damon 3 and Damon 3 MX brackets⁵ in 2004 (Ormco Corp.) (Figure 13) have a different location and action of the retaining spring, and this has produced a very easy and secure mechanism for opening and closing. In addition, Damon 3 brackets are semi-esthetic. However, early production Damon 3 brackets suffered three significant problems: a high rate of bond failure, separation of metal from reinforced resin components, and fractured tie wings. These three problems all received rapid and effective investigation and correction, but illustrate that it continues to be a significant challenge for manufacturers to extrapolate from the experience with prototype brackets in the hands of skilled enthusiasts to subsequent full-scale production and the use by relative novices. It is interesting that such early difficulties did not prevent the enthusiastic adoption of these brackets. This was probably due to the greatly increased appreciation of what self-ligation could do and also to the greater willingness of manufacturers to invest in finding solutions.⁶⁰ The recently launched all metal Damon D3 MX in 2005 bracket has clearly benefited from manufacturing and clinical experience with previous Damon brackets.

GAC In-Ovation brackets⁵- These are very similar to the SPEED bracket in conception and design, but are of a twin configuration. They are a good, robust design, and no breakage of the clips has been personally experienced or reported. Some relatively minor disadvantages in bracket

handling are apparent. First, some brackets are hard to open. This is unpredictable, but more common in the lower arch where the gingival end of the spring clip is difficult to visualize. Excess composite to the gingival of lower brackets can be hard to see and may hinder opening. Secondly, these brackets are extremely easy to close inadvertently before the archwire is in position and the downwards direction of closure makes this more likely in the lower arch. Thirdly, the security of closure of the flexible clip can be overcome by some rectangular nickel-titanium wires, which can cause spontaneous opening of the clip. Lastly, it is possible—as with the Damon2 bracket slides—to incompletely open the clip and discover the need for the final fraction of opening through difficulty with removing a thicker archwire. These minor reservations may well be reduced by further bracket development. In 2002, smaller brackets for the anterior teeth became available—In-Ovation R (Reduced) (Figure 14). This narrower width is very welcome in terms of greater inter-bracket span. In-Ovation brackets have an active clip. In-Ovation C (Ceramic) is now available with partial ceramic face for better esthetics.

Smart clip⁵- In 2004, 3M Unitek introduced the SmartClip™ (Figure 15) self-ligating bracket, which is different from other self-ligating brackets in that it does not have a slide or clip to hold the wires. Instead it contains a nickel-titanium clip on each side of the twin bracket that locks in the wire. The archwire is inserted by using finger pressure to push it past the flexible clip. Remove requires a special instrument from 3M Unitek™.

Opal (Ultradent)- The Opal bracket (Figure 16) is a passive bracket which was manufactured in year 2004. It consists of a translucent fiber-reinforced composite polymer. It has a smooth and rounded one-piece design with an integrated lid mechanism for self-ligation. Opening occurs with a special instrument from the incisal direction. The Opal bracket is very smooth and gentle on the soft tissues and is initially highly esthetic. It is reasonably easy to position and has very easy to read, good markings. Bracket loss is a common occurrence. In addition, opening of this bracket can be difficult and elastomeric chains are difficult to place. Cleaning of the brackets is best undertaken by a hygienist or other dental health-care professional. The bracket discolors easily.

Opal M (Ultradent)- The Opal M bracket (Figure 17) is a passive bracket and is produced using the metal injection molding technique (MIM) and was manufactured in 2006. The molding is followed by sintering. The bracket is very smooth, as the edges are nicely rounded, and it has a "lid" that covers the slot. Opening is from the incisal, using a specially designed instrument.

Quick 2 (Forestadent)- The Quick bracket (Figure 18) is an active bracket. It is a one-piece construction using metal injection molding (MIM), followed by sintering. The elastic clip is made from a chromium-molybdenum alloy. This bracket can be opened with a specially designed instrument either from the gingival or labial aspects. The clip mechanism is easy to operate. The disadvantages of this bracket are mainly esthetic; as with all metal brackets, it may not meet patients' highest requirements.

Clarity SL (3M Unitek)- The Clarity SL bracket (Figure 19) is a passive system that consists of a ceramic body and was manufactured in year 2007. This has a metal slot incorporated in the ceramic base to improve the frictional characteristics. As in the SmartClip bracket, the self-ligating mechanism consists of a NiTi clip that is fixed to the mesial and distal aspects of the twin bracket. Special tools are available for inserting and removing archwires. The Clarity SL bracket can be placed in the same way as its conventional-ligation counterpart. No additional training or experience are necessary. Ligation and removal of very rigid and heavy archwires can be uncomfortable for the patient.

Advantages of self-ligating brackets

1. Decreased resistance to sliding decreases the overall treatment time.¹⁰
2. Minimizes chair side time due to less time-consuming archwire changes.⁹
3. Precise control of tooth translation.
4. Hygienic (Wingless design easy to clean).¹¹
5. Esthetic and comfortable to the patient.

Disadvantages of self-ligating brackets

1. High cost.
2. The possibility of clip damage.
3. In addition, self-ligating brackets usually have smaller bases and transverse dimensions, what may be the reason for frequent debonding – in particular on premolars and molars.

CONCLUSION

This article reviews some of the self-ligating systems that are going to replace the cumbersome ligating systems in future. At the same time these are little expensive which can be weighed against the many hours of clinical time they save.

REFERENCES

1. Matasa CG. Self-engaging brackets: passive vs. active. *The Orthodontic Materials Insider*.1996;9:5-11.
2. Nigel Harradine. Self-ligating brackets available at <http://www.excellenceinorthodontics.com> accessed on 09-09-2016.
3. Stolzenberg J. The Russell attachment and its improved advantages. *Int J Orthod Dent Children* 1935; 21: 837-40.
4. Gottlieb EL, Wildman AJ, Lang HM, Lee IF, Strauch EC Jr. The Edgelok bracket. *J Clin Orthod*. 1972;6: 613-23.
5. Harradine N. The History and Development of Self-Ligating Brackets. *Semin in Orthod*.2008;14 (1): 5-18.
6. Hanson GH. The SPEED system: a report on the development of a new edgewise appliance. *Am J Orthod*. 1980;78(3):243-65.
7. Harradine NWT, Birnie DJ. The clinical use of Activa self-ligating brackets. *Am J Orthod Dentofac Orthop* 1996;109:319-28.
8. Damon DH. The Damon low friction bracket: a biologically compatible straight-wire system. *J Clin Orthod*.1998;32:670-80.
9. Maijer R, Smith DC. Time saving with self-ligating brackets. *J Clin Orthod*.1990; 24: 29-31.
10. Khambay B, Millett D, Mc Hugh S. Evaluation of methods of archwire ligation on frictional resistance. *Eur J Orthod*.2004;26:327-32.
11. Türkkahraman H, Sayin MO, Bozkurt FY, Yetkin Z, Kaya S, Onal S . Archwire ligation techniques, microbial colonization, and periodontal status in orthodontically treated patients. *Angle Orthod*.2005.75:231-6.

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LEGEND

Bracket	Year
■ Russell Lock	1935
■ Ormco Edgelok	1972
■ Forestadent Mobil-Lock	1980
■ Orec SPEED	1980
■ A company Activa	1986
■ Adenta Time	1994
■ A company Damon SL	1996
■ Ormco Twin Lock	1998
■ Ormco /ACo.Damon 2	2000
■ Gentenco Oyester	2001
■ GAC In-Ovation	2002
■ GAC In-Ovation R	2002
■ Adenta Evolution LT	2002
■ Ultradent Opal	2004
■ SDS Ormco Damon3	2004
■ 3M Unitek SmartClip	2004
■ SDS Ormco Damon MX	2005
■ Class One Carriere SLB	2005

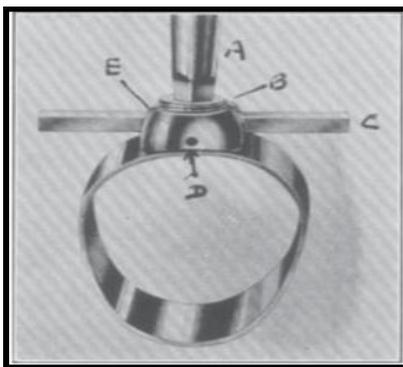


Figure 2: Russel Attachment A. a key, B. a nut, C. archwire in slot ,D. hole passing through vertical section of attachment ; E. Slot.

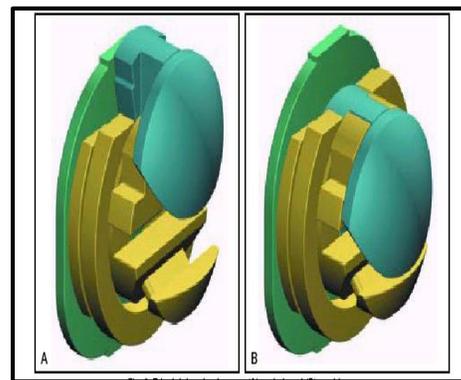


Figure 3: Edgelok appliance (A) Opened (B) Closed positions.

Figure 1: Chronology of self-ligating brackets

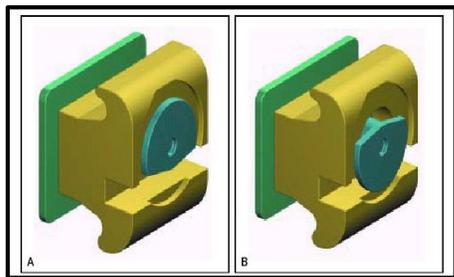


Figure 4: Mobil-lock (A) Opened (B) Closed

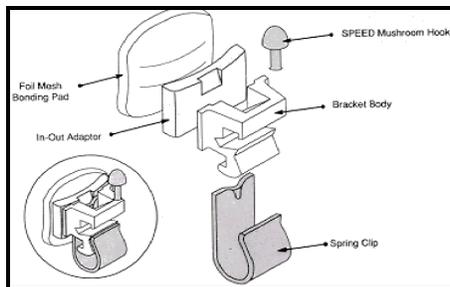


Figure 5: Parts of Speed Bracket

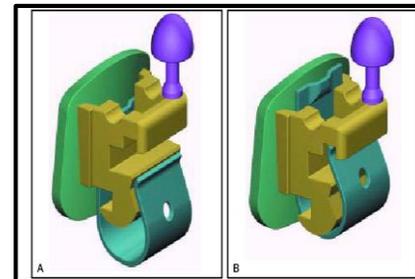


Figure 6: Speed Bracket (A) Opened (B) Closed positions

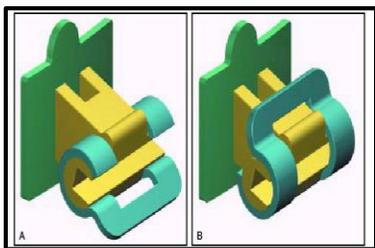


Figure 7: Activa bracket (A) Opened (B) Closed positions

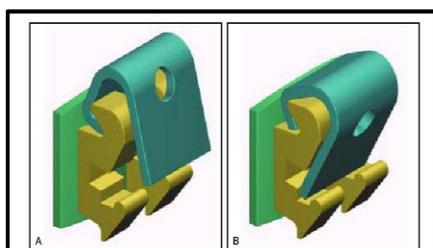


Figure 8: Time2 bracket (A) Opened (B) Closed positions.

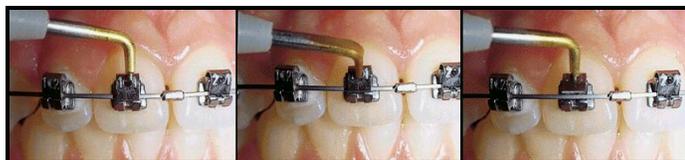


Figure 9: Opening of spring clip of a time Self-ligating bracket with a special instrument.

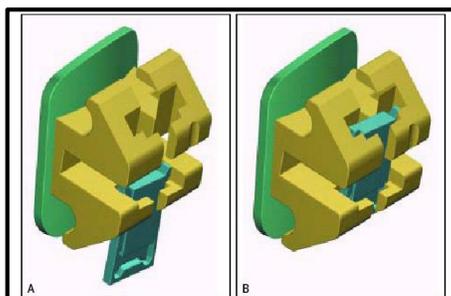


Figure 10: TwinLock bracket (A) Opened (B) Closed positions

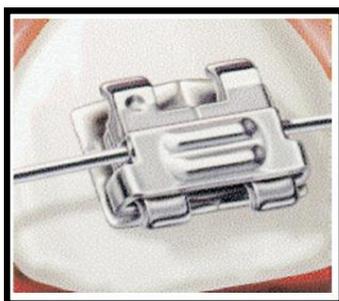


Figure 11: Damon SL bracket



Figure 12: Damon 2 bracket

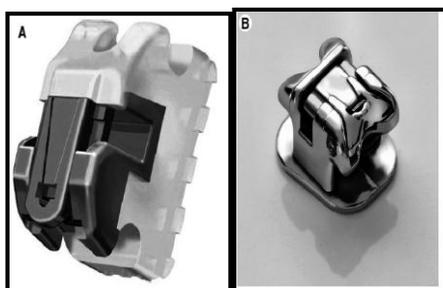


Figure 13: TwinLock bracket (A) Opened (B) Closed positions



Figure 14: Damon SL bracket

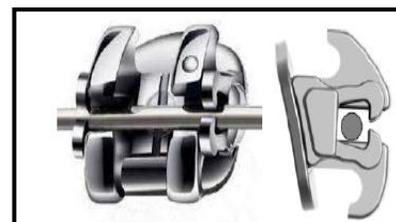


Figure 15: Damon 2 bracket

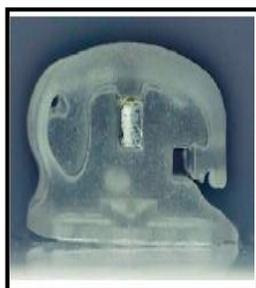


Figure 16: Opal bracket



Figure 17: Opal M bracket



Figure 18: Quick 2 bracket



Figure 19: Clarity SL brackets.