DAMON SELF LIGATION BRACKET SYSTEM: A REVIEW

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Abstract
Self-ligating bracket systems are increasing in acceptance amongst orthodontists. This reflects their high quality engineering, improved reliability and relative ease of use. However, it might also be related to claims of superior function made by the manufacturers of these appliances. In particular, the Damon appliance system claims to offer significant advantages to both orthodontist and patient over conventional-ligation and other forms of self-ligated appliances. We have reviewed current literature relating to use of the Damon appliance system. There is some evidence to suggest this appliance may lead to reductions in chairside time for the orthodontist, particularly those experienced with this system, in comparison to conventional-ligation. There is no high quality evidence that treatment with the Damon appliance takes place more rapidly or leads to a superior occlusal or aesthetic result. Indeed, the best available evidence would suggest there is no difference in treatment outcome or time, at least in extraction cases.There is no evidence that treatment with the Damon appliance is more stable. Claims relating to improved clinical performance of the Damon appliance system are currently being made to orthodontists and patients that are not substantiated in the scientific literature.
Key words: Damon system, Self-ligation, Evidence, Treatment efficiency.

Introduction

In the period of time there is a variable transformation in orthodontics treatment; correction of severe crowding with the extraction modality is not the only option available for orthodontist. Now with the advancements in the bracket systems with the introduction of selfligating brackets and the temperature activated wires the non-extraction treatment for the reliving of the crowding is the best choice. Even though the exception do exist for this but most of the cases can be handled with conservative mode of treatment. Self-ligating brackets have imprinted their name in the history of orthodontics because of their time saving ability during appointment times, [1-2] very low friction [3-4] and increased efficacy of treatment [5-7]. The present article is report of one such case of severe crowding treated using self-ligating bracket system.

Damon Self- ligating are not new conceptually. Having been pioneered in the 1930s, the have undergone a revival over the past 30 years with a variety of new appliances being developed. A host of advantages over conventional appliances system have been claimed typically relating to reduced frictional resistance.

The most compelling potential advantages attributed to Damon selfligating baracket are a reduction in overall treatment time and less associated subjective discomfort. Preliminary retrospective research has pointed to definite advantages, with a reductionin overall treatment time of 4 to 7 months and a similar decrease in required appointments. Efficient orthodontic appliances result in successful and timely treatment. Efficiency is the keyword and is influenced by important factors like, biomechanics, chair time per visit, frequency of appointments and patients comfort.[8]

Since the mid-1970s the search for a bracket system for a bracket system with an ideal ligation and low friction resulted in renewed interest in the development of Damon self-ligating brackets.[9]

Damon selfligating bracket were designed to overcome the limitations of treatment with conventional bracket system and were looked on as a welcome evolution in this direction, commanding an ever-increasing market share and often said to represent the pinanacle of bracket technology.[10]

History and Development of Self-legating Brackets

1933 - Charles E. Boyd first introduced Boyd® band bracket a passive self-ligating system. In the same year Ford lock design was manufactured by Dee Gold Company of Chicago, Illinois and patented by James W. Ford. Production of this bracket was abandoned due to the high cost and bulk of the appliance. William F. Ford reintroduced the bracket in 1951 exclusively for Johnson twin wire technique. 1952 -Russell appliance, a passive bracket with a rigid sliding lock was introduced. 1953 - Schuster device was developed with a characteristic passive rigid locking pin. 1957 - Rubin device was introduced which had a passive rigid hinged plate. 1966 - Branson bracket was manufactured with a passive rigid rotational screw. Though innovations in the field of efficient brackets were progressed from as early as 1933, the commercial success and acceptance by the orthodontic fraternity was limited. After a few years of lull, renewed interest in SLB was shown by Ormco. 1971 - Edgelock® bracket designed by J. Wildman was manufactured by Ormco. It had a round bracket body with a rigid labial sliding cap. This received initial wide scale commercial success but soon lost its popularity due to disadvantages like inadequate rotational control, excessive bulk, inconvenience of opening and closing the slide. 1979 - Mobil-Lock® bracket (Forestadent, Germany) was developed by the University of Bonn. The Bracket had a passive rigid circular rotational disk turned with a screw-driver, covering part of the labial surface of the slot. The wire could be tightly or loosely engaged depending on the degree of rotation. Upper incisor brackets were redesigned with twin cams to overcome poor rotational control. Difficulty of access to open and close premolar brackets with the straight screwdriver along with disadvantages like design bulk lead to their poor acceptance commercially[11,12]. Mid-70's- "SPEED®" - Dr. Hanson conducted clinical design tests in collaboration with a Canadian aerospace manufacturer, Strite Industries Limited in an attempt to improve clinical efficiency of brackets. Sectioned pieces of watch springs from a local jeweller were fitted by Hanson on prototype bracket bodies welded to bands and placed on specific teeth to be tested. Successful tests of these "hand-made" prototypes led to a process of design optimization, which culminated into the wide scale clinical testing of machine-made prototypes[13].More than 600 patients underwent successful treatment between October 1977 and January 1980, confirming the design soundness of the concept of an active self-ligating bracket.[14] 1996 – "A" Company introduced the Damon® SL I The bracket had a thin metal cover that wrapped around the labial surface of the twin bracket body and tie-wings with convertible tubes[11]. The bracket had excessive bulk and limited tooth control with increased tendency to breakage[12]. 2000 - The TwinLock® bracket was modified by "A" Company/Ormco and the new metal injection molded bracket became commercially available as Damon® SL II [6].The design retained the vertical slide action and U-shaped spring to control the opening and closing, but placed the slide within the shelter of the tie wings. This eliminated the inadvertent slide opening and breakage thus increasing its popularity in clinical use. 2004 - Damon III® was developed by Ormco. This bracket had a few inherent disadvantages, thus the company made the necessary modifications and marketed in 2006 as Damon® MX 3[10]. 2004 – SmartClip®–3 M Unitek developed the new SLB with characteristic C-shaped Nitinol spring clips on either side of the bracket slot to retain the archwire. 2006 - Smartclip® 2 - 3M Unitek introduced the modified bracket with increased flexibility of the spring clips[12].

Features of Self-ligating Brackets
(I)Based on the bracket archwire interaction

1. Passive self-ligating brackets
2. Active self-ligating brackets and
3. Interactive self-ligating brackets

1. ***Passive type***: The clip or rigid door does not actively press against the archwire. The increased clearance between the archwire and a passive slide results in increased play thus reducing friction (Figure 01). This promotes patient tolerance, enhances early and efficient aligning due to lower resistance to sliding.
Examples of the passive SLB - Boyd® band bracket; Schurter® device; Rubin® device; Branson® bracket; Edgelok® bracket; Mobil-Lock® bracket; Activa® bracket; Twin Lock® bracket; Smart clip®; Damon® 3MX; Praxis Glide® and Carrier® LX brackets.(Figure 1)

Figure 1: Passive SLB with round and rectangular wire

2. The ***Active SLB's*** have a spring clip that press against the archwires and are able to maintain a large amount continual contact between the archwire and the self-ligating mechanism[12,28]. The rigidity of the spring clip depends on the material properties, essentially the elastic modulus. The clips may be fabricated of alloys like Nickel-Titanium, stainless steel and elgiloy or Co-Cr-Fe-Ni alloy. The benefit obtained from the active clip lies in the capacity of it to store some of the force in it as well as in the wire. This ensures an extended range of labiolingual action and produces more alignment compared toa passive slide with the same dimension wire. Active self-ligating appliances allow closed interactions even with undersized wires, thus permitting better torque control. Additionally the frictional forces lower than those with elastomeric ligatures ties on a conventional tie-wing brackets.[12] Examples: *In-Ovation®; SPEED® and Quick® Brackets*. (Figure 2)

Figure 2: Active SLB with round and rectangular wire

3. ***Interactive SLB*** An interactive mechanism has the inherent capacity to interact selectively with different archwires in varying degrees depending on the amounts of force, friction and control that is required during various phases of treatment. The advantages of interactive SLB would includeminimal force and friction in the early stages of treatment, along with torque and rotational control in the middle and finishing stages of treatment and the capacity to achieve finishing details in a controlled manner in all three planes of space[25]. Example**:** *Time®* bracket.

(II) Self-ligating brackets are classified based on the Material:
Stainless Steel SLB: Rubin device; Branson® bracket; Edgelok® bracket; Mobil-Lock® bracket; Activa® bracket; Twin Lock® bracket; Smartclip®; Damon® 3MX; Praxis® Glide and Carrier® LX brackets; In-Ovation® ; SPEED® and Quick® Brackets; Philippe® 2D self -ligating lingualbrackets; 3D Torque-Lingual self-

ligating brackets; The Adenta® Evolution lingual bracket; In-Ovation®-L.
***Ceramic SLB**:* Clarity® SL, In-Ovation® C, Phantom®.

The Damon Philosophy

A full description of the Damon philosophy and treatment techniques are given by Damon.[15] The Damon philosophy is based on the principle of using just enough force to initiate tooth movement—the threshold force. The underlying principle behind the threshold force is that it must be low enough to prevent occluding the blood vessels in the periodontal membrane to allow the cells and the necessary biochemical messengers to be transported to the site where bone resorption and apposition will occur and thus permit tooth movement. A passive self-ligation mechanism has the lowest frictional resistance of any ligation system. Thus the forces generated by the archwire are transmitted directly to the teeth and supporting structures without absorption or transformation by the ligature system. The forces generated by elastomeric ligatures can have unwanted side effects on treatment progress.

Compared with conventional preadjusted edgewise appliances, it is suggested that the use of passive self-ligation results in a significant reduction in the:

- Use of anchorage devices because the frictional resistance generated by ligatures is not present. Srinivas[16] has demonstrated that passive self-ligating appliances use less anchorage than conventional appliances. This supports the reduction in the use of anchorage devices experienced by users of passive self-ligation.
- Use of intraoral expansion auxiliaries such as quadhelices or W-springs because the force of the archwire is not transformed or absorbed by the ligatures and the necessary expansion can be achieved by the force of the archwires.
- Need for extractions to facilitate orthodontic mechanics because alignment is not hindered by frictional resistance from ligatures and can therefore largely be achieved with small diameter copper nickel titanium archwires. Tooth alignment therefore places minimal stress on the periodontium as it occurs and so the possibility of iatrogenic damage to the periodontium is reduced.
- In addition, a passive edgewise self-ligation system provides three key features:
- Very low levels of static and dynamic friction.
- Rigid ligation due to the positive closure of the slot by the gate or slide.
- Control of tooth position because there is an edgewise slot of adequate width and depth.

Evidence for the Damon Philosophy

Archwire Placement and Removal

The speed of archwire ligation and release has been studied by a number of authors[17-20] and self-ligating brackets have been shown to take less time and also require less or no chairside assistance. Turnbull and Birnie[21] divided the archwires into four different groups in ascending order of size. They found that:

- The time taken to ligate archwires decreased with increasing archwire size. This was an unexpected finding; it might be expected that ligation of thicker wires might takes longer because of greater difficulty in obtaining full archwire engagement in the bracket. However, the difficulty of obtaining full archwire engagement in the bracket with thicker archwires was offset by the tooth alignment produced by earlier archwires.
- The time taken to open the Damon self-ligating brackets and to remove elastomeric ligatures was almost independent of archwire size.
- It took less time to ligate and releases an arch wire using Damon passive self-ligating brackets than with conventional brackets and elastomeric ligatures.

The Damon light force philosophy

The Damon treatment philosophy is based upon the concept of providing only the minimum or threshold force required to initiate tooth movement.[22] This is achieved by the Damon System, a combination of passive self-ligation and superelastic nickel titanium archwires. Together, this system is supposed to produce a low force–low friction environment, which facilitates more efficient tooth movement by ensuring that the teeth remain within an optimal force zone throughout treatment.[23] This theory is based upon the premise that low orthodontic forces help maintain the patency of periodontal ligament blood vessels and facilitate maximal cellular remodelling during tooth movement. This is broadly consistent with conventional thinking, light orthodontic forces are thought to be preferable because of their ability to induce frontal resorption rather than hyalinization and undermining resorption.[24] However, the precise relationship between force magnitude and orthodontic tooth movement is not fully understood and has been the subject of several hypotheses.[25] Whether a truly optimal orthodontic force exists, whereby a certain magnitude and temporal profile can produce maximal tooth movement throughout the dentition and without tissue damage or discomfort, is debatable.[26] Indeed, mathematical modelling has identified a wide-range of forces that can all lead to a maximum rate of tooth movement.[27] This is perhaps not surprising, given that orthodontic forces are not distributed evenly throughout the periodontal ligament and that basic anatomical differences within the dentition mean that different teeth will respond differently to external force application. Therefore, the concept of one appliance being able to produce a single, universal and optimal orthodontic force throughout the dentition is probably over simplistic.

Conclusion

There is currently some evidence to suggest that use of the Damon system appliance may lead to reduced chairside time for the orthodontist, and for the patient. There is evidence that pain experience during treatment is reduced. In the presence of identical archwire sequences there is no evidence that Damon system brackets can align teeth faster or in a qualitatively differently manner when compared with conventional-ligation. There is no high quality evidence that treatment with the Damon system appliance takes place more rapidly, or leads to a superior occlusal or aesthetic result. There is no evidence that orthodontic treatment with the Damon system appliance is more stable.

It is disingenuous to offer treatment with the Damon system appliance to any patients on the basis that it will be less painful, faster, preclude the need for extractions or give a better result.

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