SELF-LIGATION:
BASICS, BIOLOGY & BUSINESS?
Is there a confluence?

Self-Ligation Brackets & their place in Contemporary Mechano-therapy – A Critique

Nikhilesh R Vaid
Consultant Orthodontist,
Breach Candy Hospital, Mumbai, India.

Prof, Dept. of Orthodontics,
YMT Dental College, NaviMumbai, India.

“You can fool some of the people all of the time, and those are the ones you need to concentrate on”

The greed & wrongdoing of financial institutions have already placed a huge burden on society, from which the world is recovering over the last few years. The fabric of Orthodontics is being challenged constantly due to the promotion of BRACKET DRIVEN ORTHODONTICS.

For most of the 20th century, there was little discussion on which bracket to use. Orthodontists decided on a bracket type and worked on it for many years, developing the necessary technical expertise to achieve results with the chosen bracket. Orthodontic companies over the last decade are introducing many bracket designs a year, leaving a contemporary clinician confused. These products are backed by tall, unsupported claims, a lot of which question the very basics of diagnostic, mechanical & therapeutic pillars that Orthodontics is based upon!!!

The fundamental questions for deliberation today are:
Isn’t there more to Orthodontics than a bracket?
Self-Ligation brackets have an arch-wire slot with an inbuilt Clip, Clamp or Cap (which is its self-ligating mechanism), for placement and removal of the arch-wire. The brackets that incorporate their own ligation system have existed since 1935 (The Russell Lock-Stolzenberg). However, their biggest impact has been in the last 15 years. With their rapid proliferation, has come a growing body of literature expounding and examining the claims made on behalf of these brackets.

This presentation aims to look at current hypothesis and evidence, by ruminating on the clinical performance of the product in the past, and predicts its future in clinical protocols.

SL CLAIMS: The Questions being asked?

Adherence to the tenets of EBO requires that, for any orthodontic intervention applied to a patient, 3 factors must be integrated: the relevant scientific evidence, the clinician’s expertise, and the patient’s needs and preferences. With respect to self-ligation, the current challenge for the clinician is to assess the merit of the assertions supporting the superiority of self-ligation brackets. Meeting this challenge requires knowledge of the strength of the evidence of these claims.

The AAO Council on Scientific Affairs (COSA) reviewed the strength of research evidence that claim superiority of SL Bracket systems to conventional brackets. The Questions studied were …

Does Lateral Expansion of the Dental Arch by SL Brackets “Grow “Buccal Alveolar Bone?

Is Lateral expansion of Dental Arches by SL Bracket Systems comparable with lateral expansion gained by RME followed by conventional edgewise treatment?

Is lateral expansion of the dental arch gained by SL Bracket Systems stable in the long term?

Are SL Bracket Systems more efficient and more effective than conventional ligation systems in treatment?
Do SL Systems provide lower clinical forces compared to conventional ligation?
Do patients treated with SL experience less pain during treatment?
Are conventional edgewise brackets less hygienic in treatment compared to SL?
Do SL brackets provide less friction between brackets and the arch wire?
Is there evidence for reduced friction in SL systems?

An analysis of literature showcasing answers to these questions throws up some interesting answers, which require concomitant comparisons with case reports and original research on the clinical terrain. The 3 “B”s that requires a confluence protocol are the “BASICS, BIOLOGY & BUSINESS” of Self Ligation.

Self-Ligation will be discussed as under:

S econds Saved
E fficiency in Treatment
L igature limitations & Hygiene
F riction: A Clinical Perspective!

L asting Finishes?
I n a name? All SL Brackets aren't the same!
G row Alveolar Bone?
A esthetics while using Ceramics!
T orque & Tip control: Mission Possible!
I nnovative Mechanics and Arch Wire Sequencing!
O ptimal for Practice Growth?
N o MARKETING gimmicks! Only SCIENCE.
The deliberation will encompass:

**Seconds Saved**  
*(Chair side Manouvres & SL Efficiency)*

A review of literature and findings of an original research (Kamat M, Vaid N & Vandekar M) comparing effective time for ligation of two different arch-wires using Conventional & Self Ligation Systems. Our findings comprehensively indicate chair-side efficiency with respect to both round and rectangular arch-wire insertion and removal with SL systems.

**Efficiency in Treatment**

Several studies have investigated whether the hypothesis that lower friction enables more effective relative movement between arch wire and bracket, and hence more rapid tooth movement whilst the reliable tooth control prevents the need to waste time regaining tooth control. Retrospective case control studies have found greater treatment efficiency, In contrast more recent Randomized controlled trials have failed to show any such effect. The Possible reasons for the differences in findings in treatment efficiency studies are:

In RCT's:
* None has reported completed cases.  
* Arch wire control in later stages of treatment is also important with respect to total treatment time. Just studying leveling and aligning, is the incomplete picture!
* Factors such as case mix; appointment interval and arch wire sequence may not have been optimized for different SL Bracket Systems, but have been chosen to identical regardless of bracket type.

In Retrospective Studies:
* Groups may not have matched for type and complexity.
* Confounding effects have not been discussed, i.e.
*Unusual case mixes, i.e. more complex cases than average.

Ligature limitations & Hygiene

Enamel Decalcification as a sequale of multibanded orthodontic therapy is a huge area of concern. RCTs and Orthodontic literature have comprehensively proven based on quantitative plaque retention evaluation that SL Appliances promote reduced retention of oral bacteria. Pelligrini et all (2009) evaluated oral bacteria around SL Brackets and Elastomeric Ligation by Adenosine Triphosphate driven bioluminescence and comprehensively proved reduced plaque retention around SL brackets. Fadia D., Vaid N. & Vandekar M. also used disclosing agents, and evaluated using 3 different plaque indices, the effect of Different Ligation methods on OHM in Fixed Orthodontic Treatment (2012). SL Brackets were proven advantageous for OHM.

Friction: A Clinical Perspective!

Studies on Friction, comparing Frictional Resistance between SL & Conventionally Ligated Brackets (Ehsani et al –A Systematic Review) conclude that SL Brackets show excellent performance with smaller wires. However, with larger wires there wasn’t any difference. This is understandable and desirable, as increased control with larger arch wires requires rigidity and consequently requisite enhanced friction. Low friction has been thoroughly demonstrated in laboratory studies with designs of increased clinical relevance. Investigations by Kusy et all are particularly recommended reading for their exploration of the effectiveness of SL Brackets in reducing friction when arch wires are active in the slots, causing binding in addition to classical friction. A representative result of this work is that a passive SLB when compared to a conventional bracket, reduces the resistance to sliding
by 60 gms per tooth even in the presence of binding from MD tipping. Such work strongly supports the view, that though ligation is only one source of resistance to sliding, SL can reduce this resistance to a clinically significant extent.

The presentation will illustrate with clinical examples that faster tooth movement with SL is a combination of arch wire modulus, low friction and creative biomechanics. We infer that SL doesn’t necessarily result in lower forces, but can generate a higher percentage of desirable force and a lower percentage of undesirable forces, and it is this difference which can significantly alter the resulting tooth positions.

**Lasting Finishes?**

A fundamental question that definitely needs clinical deliberation is if teeth align in a different manner with SL appliances, and treatment times is shorter (unproven universally) then, are results with SL appliances stable enough.

We will demonstrate with clinical examples, a four year follow up of cases treated with different SL systems and mechanics, and compare stability patterns and concerns. Preliminary data does give encouraging information.

**In a name? All SL Brackets aren't the same!**

(Classification of Current SL Bracket Systems)

Conventionally SL Brackets have been classified as ACTIVE or PASSIVE.

ACTIVE SLBs allow arch wires to freely slide early in treatment, but actively get them bound up later in treatment. In PASSIVE SLBs arch wires are free to slide and “jiggle” in tubes in every phase of treatment akin to a four-walled tube.

However, this classification is incomplete in many respects. We look at a plethora of bracket designs prevalent in the world and propose classifications based on
*Bracket Design
CAP Brackets: Damon, Swing, Carriere etc
CLAMP Brackets: Empower, Speed, Innovation etc
CLIP Brackets: Smart Clip

*Slot Width
TWIN SLBs: Smart Clip, Empower, Innovation
UNI SLBs: Damon, Swing, ten Brook Axis

The Clinical relevance and performance of each of these designs will be discussed.

Grow Alveolar Bone?

Self-Ligating Bracket Manufacturers have made claims that have, at times, raised pertinent questions about biologic realities that can be altered by an appliance. These claims have been the subject of one of the biggest controversies in contemporary orthodontics. Dr Dwight Damon proposes that teeth align in a qualitatively different manner, producing less incisor proclination and more lateral expansion than conventional ligation. This pattern of tooth movement has been attributed to a qualitatively different interaction of forces. In particular, it is suggested that the applied forces are so low that the lips can compete with and restrain incisor proclination. Additionally it has been proposed that the tongue position may alter in response to this expansion and possibly assist it in the tooth movement. The stability of such lateral expansion obtained by SLBs is very weakly supported by low-level evidence that has not been independently confirmed.

Aesthetics while using Ceramics!

Discolored Elastomeric Ligatures with Ceramic Brackets have raised pertinent questions about the actual existence of Ceramic Brackets in orthodontic treatment delivery protocols on the inconspicuous appliance
We have comprehensively analyzed this phenomenon on the VAS through patients and fellow professionals, and found Ceramic SL a viable and effective medium of orthodontic treatment delivery amongst the “aesthetic vestibular appliance” systems.

Torque & Tip control: Mission Possible!

A criticism of SL bracket systems by cynics often is with respect to control of the second and third order. It’s important to deliberate them separately.

Torque Control: Are SLBs less effective in delivering torque?

This hypothesis has been advanced and is probably based on the belief that the labio-lingual forces between the base of the bracket and a ligature system are a significant additional source of force couple, adding to the couple between the upper and lower bracket walls. This situation is not straightforward and is probably influenced by various factors.

*Conventional ligation can apply high labio lingual forces, but can also permit incomplete aw engagement, resulting in more slop and decreased torque effectiveness.
*Active SLBs invade Bracket Slot and might be expected to place effective torque at smaller level “slop “angles than Passive SLBs. However, clinical studies do not subscribe to this notion, probably in our opinion due to inequality of the roof and floor of the slot of the conventional Active SLB resulting in torsion of an undersized Rectangular Arch wire in the slot. Thus, there is a detectable difference in planned and achieved torque control.
*Pandis et al have also documented in a study of 105 patients no difference in torque control between conventional and Passive SLBs.
*In routine Clinical practice, the appropriate choice of bracket prescription and arch wires might eliminate
torque control inequalities to a great level. The more recent increased availability of choices of torque prescriptions in SLBs would be expected to strengthen this conclusion.

*We have experienced no difficulty obtaining torque control with a plethora of SLBs, which will be showcased as clinical examples and data. A Finite Element study with different SLBs (Vaid N & Vandekar M) also corroborates our clinical findings that torque control is indeed “mission possible”!

However a disadvantage of low friction with Passive SLBs is unwanted MD movement of AWs through brackets, which leads to unwanted spaces if strategies are not in place to counteract this effect.

Tip Control

Before we initiate a discussion on Tip Control with SLBs its imperative to reiterate that all SLBs are not identical with respect to Slot Width, which determines Contact angle and subsequently Tip Control. Slot width is an area that we consider extremely critical to Tip or second order control, especially when a lot of SLB systems are proponents of increasing inter bracket distance by reducing this parameter in bracket design. We compare SLBs based on a new terminology “Full Control” and “Loose control” Brackets (Bennett). The ill effect of “loose control” bracket design as affecting Tip Control with differential arch wire and slot geometries will be discussed.

Innovative Mechanics and Arch Wire Sequencing!

The transition from Conventional to SL involves a curve that looks at Biomechanics and Clinical Protocols from a differential perspective.

Clinical Tips and Tweaks with respect to Cap, Clamp and Clip Designs will be discussed.

The parameters of critical importance are:
Establishing Control before initiating a force system with Clamp Brackets

Use of Tandem Arch wires in Clip and Cap Brackets for Rotational Control

An Arch Wire Sequencing that should involve a Standard Protocol to improve efficiency

An Attempt should be made with smart sequencing to use the fewest arch wire changes possible

A thorough understanding of the “Variable Modulus Concept” is important to use lighter wires, and fewer SS arch wires.

Progression to be made to next AW only when existing ones are passive.

SS arch wires to be placed with no deflection, and only after equivalent NiTi is passive.

Understanding that SL Bracket Systems are not always low force systems is important. Studies by Baccetti and co workers and use of creative devices like OSIM by Badawi et al help understand this phenomenon.

With any given wire the lack of friction raises the net force on irregular teeth; however, the highly significant corollary is that with a suitably low force wire in an irregular arch, SL can still produce effective tooth moving forces and these forces are combined with low unwanted forces on adjacent teeth (Baccetti 2009). It is these unwanted forces, which can resist or adversely change the direction of tooth movement. This difference in the combination of desirable and unwanted forces requires further experimental confirmation, but is probably a distinctive feature of SL, which is less obvious than the combination of low friction and good control, but is equally significant.
Optimal for Practice Growth?
(Is the use of SLBs a Smart Business Decision?)

As literature makes references to advantages with respect to SL, the moot question that we pose, is “Can a bracket really make a difference to the QUALITY OF LIFE of an Orthodontist?”

For a country that has Orthodontic Education, which is second to none in the world, the missing links in our performance indicators are Management skills and Efficiency Protocols.

An evaluation of data as affecting our tryst with Self Ligation will be discussed.

No MARKETING gimmicks! Only SCIENCE.
(THE HARD TRUTHS BEHIND THE SKEPTISCM SURRONDING SL SYSTEMS)

The reason why it has taken so long for SL to gain acceptance is the blatant unproven marketing claims made by manufacturers, which tend to focus way from the real issues with respect to these bracket systems.

The deficiencies in existing brackets, the quality of results and lack in uniformity of protocols are other reasons that have delayed the commonplace of Self-ligation amongst us.

As we ruminate the future of SLBs, the ideal bracket design should incorporate the following features:
* Have a spring clip and a passive slide
* Should be a combination bracket
* Should have the ability to be conventionally tied
* It should have a passive slide initially and a spring clip later for 3D Control, which should be at the Orthodontists discretion.
* It should be a twin bracket that can be differentially ligated.

Orthodontic Success is a combination of Appliance systems, Mechanics and Strategic planning, and over emphasis on an appliance component needs to be vigilantly understood.
SELF-LIGATION...HAS THE TIME COME?
As we evaluate current evidence on SL systems, it’s important to understand and accept what we really know, what we probably do, and what we don’t.
As we indulge in some crystal gazing, including some predictions about SL in the future, we come up with some observations:
*On the research front, it can be predicted that equipment like OSIM (Badawi) will show the clinical complexity of bio mechanical configurations, and that SL does offer differential and more desirable forces compared to conventional ligation.
*On treatment efficiency terrain, RCTs will continue to fail to show that SL has an advantage (Harradine), however if independent funding and research persists, it will eventually show that some malocclusions treated with particular brackets, wires & treatment intervals, SL would be more efficient!
*From a clinical practice perspective, there is a possibility that SL might become the conventional form of ligation. At the lowest denominator, this will be driven by the speed, convenience and neatness of the ligation mechanism, which in fact was the original reason for their development. The other currently established advantages will add to the clinician’s appreciation of these brackets and exploration of the wider hypothesis will be fascinating to observe and take part in.

As we embark on “Orthodontics Next-Gen”, we owe it to our patients to bring an enthusiastic, yet informed and critical scrutiny of ideas and developments in orthodontics. As we view Self Ligation from this perspective, it’s pretty certain that... “SL is an idea whose time has come”