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Slide Ligature: A Low Friction Ligation System.

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ABSTRACT

In orthodontic tooth movement, friction (static or kinetic) results from the interaction between an arch-wire and the sides of an orthodontic bracket and a ligature. The Slide ligature enables the archwire to apply the desired amount of force without the resistance of conventional ligatures, thus reducing treatment time and producing more stable results. This new product provides the orthodontist with new opportunities in managing friction, while increasing patient comfort and reducing treatment time during therapy

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INTRODUCTION

One of the primary goals in orthodontics is to provide the most efficient tooth movement and this quest for efficiency has inspired the development of countless materials in orthodontics aimed at increasing patient comfort and reducing treatment time. Conventional orthodontic treatment with fixed appliances involves the use of metal, ceramic or plastic brackets in combination with metal archwires and ligatures.

The efficiency of fixed appliances, however, depends on the frictional force delivered with respect to force applied. Friction being an important factor in clinical orthodontics can influence all stages of treatment including leveling and aligning, retraction of teeth, expression of active torque etc and high frictional forces can affect the treatment outcomes along with duration in a negative manner.

The factors that have been suggested to influence frictional resistance are bracket - arch wire combinations, arch wire material & dimension, bracket slot size, method of ligation, bracket width & interbracket distance, influence of oral functions and saliva. [1-4] Among them, method of ligation is an important determinant in the generation of friction. It has been proven in previous studies that elastic ligatures significantly contribute to friction compared to stainless steel ligatures. It has been proven that ligatures significantly contribute to friction when they exert a force against the archwire, pressing the wire against the bracket. The frictional resistance and the rate of tooth movement with sliding mechanics for space closure have shown to be affected by various ligation techniques and materials: [1,3-5]

Biomechanics:

In orthodontic tooth movement, friction (static or kinetic) results from the interaction between an arch-wire and the sides of an orthodontic bracket and a ligature [6,7]. The sum of classical frictional resistance and elastic binding is the resistance to sliding, which linearly increases with increase in bracket/archwire angulation, whereas the frictional resistance associated with the ligation force remains constant. A single elastic module approximately produces a ligation force of 50 to 150 g. Therefore to reduce the friction of ligation; various methods have been used such as stainless steel ligatures and self-ligating brackets. Stainless steel ligatures when used are time consuming to place and produce variable ligation forces. Certain self ligating bracket systems can lead to reduced treatment times and lower frictional resistance but they are more costly [1,5].

Every self-ligating bracket, whether active or passive, uses the movable fourth wall of the bracket to convert the slot into a tube. Several studies have demonstrated a significant reduction in friction with self-ligating brackets compared to conventional designs. This can help shorten treatment, especially in extraction cases, where tooth translation is achieved by sliding mechanics.

Self-ligating systems do have several limitations, however:

- Full expression of bracket torque is difficult to achieve.
- Clinical management is more problematic than with conventional brackets due to frequent failure of the clips.
- The brackets are bulkier and more expensive than other edgewise brackets.
- Oral hygiene is more difficult because of the brackets' complex geometry. [8]

It has been internationally accepted by the orthodontic community that the optimal force levels for orthodontic movement should be high enough to stimulate cellular activity without, on the other hand, obstructing the blood vessels of the periodontal ligament. Should this force be so intense as to cause obstruction, thus blocking the blood supply, the area involved will become hyaline. The vascular function in this area will have to be restored before teeth can start (or restart) to move. This whole process will eventually result in longer treatment time.

Reducing friction and being able to use really available light forces means:

- No ischemic areas
- Faster orthodontic movement

- More stable results
- Less discomfort -or none at all- for the patient as lighter forces cause less pain.

The Slide ligature enables the archwire to apply the desired amount of force without the resistance of conventional ligatures, thus reducing treatment time and producing more stable results.

Low-friction ligature system:

An innovative unconventional elastomeric ligature (Slide, Leone Orthodontic products, Italy) (FIGURE 1) has been introduced in the market with a promise of reduced friction compared to conventional ligatures. Slide ligatures are an innovative ligature made of a special polyurethane mix for medical use, manufactured by the injection molding technique. They were introduced in 2005, with a claim of lowering the levels of friction in treatment mechanics with preadjusted edgewise appliances. The ligature forms the fourth wall of the slot with its incisal and occlusal edge resting along the bucco-labial surface of the tie wings, permitting the bracket to slide over the archwire freely while transmitting most of the tooth-moving forces to the surrounding dentoalveolar structures. [1]



Figure 1: Slide Ligatures (Slide, Leone Orthodontic products, Italy)

The Slide ligature also forms a buffer between the brackets and the soft tissues, considerably improving patient comfort. Slide ligatures are specifically designed for use with STEP brackets, but are available in three sizes to fit any type of edgewise appliance, including ceramic brackets. To meet the demands of younger patients, the ligatures are manufactured in various colors (Figure 2).



Figure 2: Slide Ligatures in various colours (Slide, Leone Orthodontic products, Italy)

Slide ligatures can be used in cases where considerable leveling and alignment are required, as well as in patients who need sagittal or transverse expansion. The advantages of the system are especially evident in the early stages of orthodontic treatment, when the archwire can slide freely inside the tunnel between the bracket slot and the ligature. The system also enables the clinician to apply friction and reduced-friction mechanics simultaneously on the same archwire by using Slide ligatures only in particular segments [9, 10].

For example, during en masse space closure on a rectangular stainless steel archwire, Slide ligatures can be used in the posterior segments to reduce friction, while conventional ligatures are used in the anterior segment to maximize torque expression and control (Figure 3). Slide ligature can be a suitable alternative to conventional module because of their property of low friction, which allows for faster rate of retraction. It also reduces the anchorage loss which may be critical for maximum anchorage cases.



Figure 3: En masse space closure with slide ligatures

The changes in the transverse dimension and in the perimeter of the maxillary arch produced by low-friction system during levelling and aligning phases of fixed appliance therapy showed significant increase in the intercanine, interpremolar and intermolar width. The significant increase in the transverse widths of the maxillary arch led to significant increase in the maxillary arch perimeter with average treatment duration of only six months.

Slide technique:

- Take either a mosquito forceps or a Mathieu style instrument and with the Slide ligatures in the other hand clamp the instrument on one side of the Slide ligature. Make sure to clamp onto but not completely over the entire opening. Then start by attaching the loop farthest from the instrument, over the gingival wings of the bracket.
- Slowly pull toward the incisal wings of the bracket.
- Attach the Slide ligature to either the mesial or distal wing and slowly roll the instrument over to the remaining wing of the bracket.
- Open the instrument and remove from the Slide ligature. Move onto the next bracket (Figure 4).



Figure 4: Slide technique to engage the slide ligature

Once it is in place, it provides a passive ligature around the slot, leaving the wire free to slide and to fully transmit its force to the dental-alveolar structures. They are available in size small, medium and large, to fit the type of brackets they are employed with.

The new Slide ligatures' innovative shape also provides a buffer between brackets and soft tissues, thus considerably reducing the patient's discomfort generally associated with orthodontic treatment. Now "lock" the archwire inside the slot, turning a traditional 3-walled slot into a 4-walled "box" almost

completely friction-free where the archwire can slide freely. The clinician can take advantage of the considerable reduction in friction thus obtained to apply forces that are at once very light but effective: this means these light forces are actually available, as they do not have to overcome the effects of conventional ligatures.

These new ligatures are indicated in those cases where considerable levelling and aligning of the dental elements is required to correct a malocclusion, as well as in all those cases that require sagittal and transverse expansion. During the latter, the so-called "Frankel Effect" can be obtained, thus reducing the need for extractions. The benefits of this innovative product can be especially appreciated during the early stages of the orthodontic treatment, as it is during the levelling and aligning phases that the arch wire can flow freely inside the "tunnel" created by brackets slot and the Slide ligatures.

Furthermore, the new Slide ligatures allow to create along the same arch and at the same time, biomechanical solutions with friction or with low friction, without having to change the size or the shape of the wire. Depending on the situation and therapeutic stage, the orthodontist can use the new ligatures only in certain segments of the bracketed arch. For example, during a hypothetical space-closing phase (performed with any four wing Straight Wire bracket) in which a rectangular arch wire and elastic tie-backs are being used and in which we need to mechanically retract the whole anterior section, the use of the new ligatures in the posterior segments will constitute an advantage, allowing these segments to slide without meeting any strong friction. In the anterior segment, some conventional ligatures will have to be used in order to obtain maximum torque control.

CONCLUSION

The new Leone Slide ligature is a new instrument, easy to apply, that makes light and constant forces actually available and can be used without altering the existing clinical methodology. This new product provides the orthodontist with new opportunities in managing friction, while increasing patient comfort and reducing treatment time during therapy

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