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Orthodontic pre-adjusted appliances and SLIDE ligatures: experimental evidence

Dr. Davender Kumar

Associate Professor Deptt. of Orthodontics and Dentofacial Orthopedics Pgids Rohtak Haryana

Corresponding author: dr.deven13@yahoo.co.in

ABSTRACT

Aim: It is important for the orthodontist to be familiar with the sliding resistance (SR) generated by the ligation method used during the space closure phase with sliding mechanics.. To determine new, experimental non conventional (slide) ligature demonstrates less friction in vitro when compared other ligatures.

Methods: Experimental in vitro were carried out to test the performance of the low-friction system with regard to assess the forces released by different bracket–ligature systems with bonded in iron plate mounted on an Instron machine

Results: The outcomes of experimental testing showed that the combination of the low-friction ligatures with the super elastic nickel-titanium and SS wires produced a significantly smaller amount of binding at the bracket/archwire/ ligature unit when compared to conventional elastomeric ligatures.

Conclusion: The biomechanical consequences of the use of low-friction ligatures were shorter duration of orthodontic treatment during the levelling and aligning phase, concurrent dent alveolar expansion of the dental arch, and the possibility of using biologically adequate orthodontic forces.

Key words: non-conventional elastomeric ligature; friction; self ligating bracket; stainless bracket.

INTRODUCTION

During sliding mechanics, one needs to understand the interplay of friction between brackets and arch wires, and to apply an appropriate force for obtaining an optimal biologic tissue response with efficient and desired tooth movement which is the ultimate goal in clinical orthodontics[2,5]. . Of all factors; wire material, cross section of wire used, type of ligation and use of self ligating brackets are the four most important factors which can be influenced by an orthodontist. The availability of a wide array of brackets, wires and ligatures have provided the clinician a multitude of combination for use during various stages of orthodontic treatment.

The ‘‘non conventional elastomeric ligature is used on conventional brackets to produce low levels of frictional resistance treatment mechanics with the pre-adjusted appliance. [13,4].

Recently, innovative ligatures manufactured with a special polyurethane mix by injection molding (Slide, Leone S.p.A., Firenze, Italy) were introduced. The ‘‘non conventional elastomeric ligature is used on conventional brackets to produce low levels of frictional resistance treatment mechanics with the pre-adjusted appliance. These modules have an excellent esthetic appearance and low friction, which make these modules very beneficial to the adult patients. The importance of the ligature in creating friction at the binding unit is emphasized indirectly by therapeutic approaches that avoid the use of any form of ligature like self-ligating brackets. [11]

This study was to evaluate various parameters that can be influenced by the clinician during different stages of orthodontic treatment in maintaining the low friction value using recently introduced wires and brackets.

- The aim of this study is to evaluate the resistance to movement of various arch wires through three types of conventional stainless steel brackets using SLIDE and silver mini module.

MATERIAL AND METHOD:

Present study was done in department of orthodontics to compare frictional resistance of three conventional stainless steel brackets ligated with silver mini module and SLIDE employing three commonly used wires in orthodontics(fig-1).

All the models were evaluated for static and kinetic friction which was measured on universal testing machine(model LR-100 K Lloyd, UK) in C.I.P.E.T. at Amritsar in Punjab.

- An experimental model (7x3.5x1 cm) reproducing the right buccal segment consisting of five stainless steel pre-adjusted edgewise brackets for second premolar, first premolar, canines, lateral incisor and central incisor was fabricated to study both kinetic and static attritions [10].
- All the brackets were ligated with the help of this Jig(o.021xo28'' ss wire)using 0.010'' stainless steel ligature wire and cured using an light cure adhesive**(Enlight ORMCO)**.
- Vertical height for all bracket slots were made similar using digital caliper. This was performed using an alignment fixture(fig-2), which ensured that the all the brackets were placed parallel to central placed bracket of each block at 8.5 mm distance and the bracket slot was right angled to the surface of each block. [9]
- The determination strength was done using universal testing machine (UTM) LLOYD.
- M/c Capacity = 100KN
- Max. Extension = 1200mm
- Speed Range = 0 to 500 mm/min

drawing force (p) recorded by the load cell on computer, represented the combined frictional resistance encountered at bracket- archwire interface.

Fig-1:-Slide Ligatures And Silver Mini Modules

Fig-2: Bonding Procedure With Fabricated Zig

- Result: A student t – test was applied to investigate the effect of wire alloy and section frictional resistance. This was done to evaluate the mean, median, standard deviation, t- value, and p- value for all the inter-bracket groups. Further unpaired t- test was applied on the values of static and kinetic friction which were obtained when wires were drawn through all the brackets. The mean, standard deviation t- value, and p –value were calculated for all the inter-wire groups. The level of significance was set at $p<.05$.

When all wire are compare individually to each bracket then in victory series (3m) both static and kinetic frictional force was highest for TMA and lowest for SS followed by Ni-Ti.

When ligated with silver module produced higher friction as compared to slide ligature. Among the CEL in all brackets ormco produced higher friction force while 3M bracket produced lower friction among both type of ligation. Static friction of ormco brackets was higher (5.4633 uN) while the lower was for 3M brackets when compared with SLIDE and Silver Mini Module.

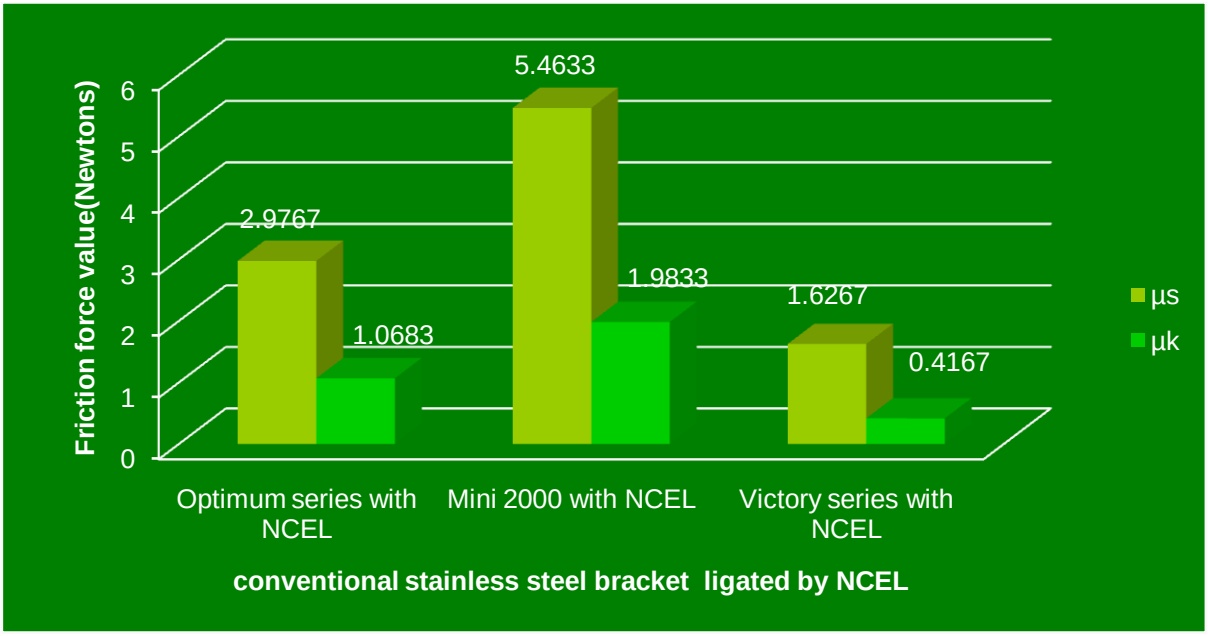
Table-1: Statistical comparisons of Static and kinetic friction of conventionally ligated brackets

Variables	Number of observations	Static friction MEAN	kinetic friction MEAN
Optimum-series (orthoorganiser) With CEL	3	13.9967	4.9950
Mini 2000 with CEL (Ormco)	3	12.2433	5.1183
Victory series(3M) with CEL	3	10.5433	3.9383
Nickel titanium	3	10.65	3.56
Stainless steel	3	11.93	4.30
TMA	3	14.46	5.79
016''	3	10.93	3.6
.019X.25''	3	13.19	5.05

Table-2: Statistical comparisons of Static and kinetic friction of non conventionally ligated brackets.

Variables	Number of observations	Static friction(uN)	kinetic friction(uN)
Optimim series with NCEL (Orthoorganiser)	3	2.9767	1.0683
Mini2000 NCEL(ORMCO)	3	5.4633	1.9833
Victory series With NCEL (3M)	3	1.6267	.4167
Nickel titanium	3	.99	00
Stainless steel	3	3.04	.65
TMA	3	6.03	2.43
016''	3	.99	00
.019X.25''	3	4.53	1.54

Relationship of three different conventional stainless steel bracket ligated with NCEL.



DISCUSION

In orthodontic sliding mechanics, the magnitude of friction is mainly determined by the type of bracket, arch wire and mode of ligation.

Friction is a factor in all forms of sliding mechanics such as canine retraction in to an extraction site and in leveling and alignment where the wire must slide through brackets and tubes.

The amount of freedom of movement of the bracket relative to the archwire appears to greatly affect results. In present study the stainless steel bracket ligated with SLIDE had lower level of friction value when compared to the stainless steel bracket with CEL. Evaluating against any stainless steel conventional bracket, Ni- Ti wire produced the lowest friction, while beta – titanium wires produced higher friction Our result with 0.019X.025'' archwire shows that when archwire /bracket alignment is carefully controlled, the friction generated at the model- wire bracket that interface is significantly affected by ligation method.

When considering the clinical implication of our results , it is important to remember that the effect of ligation on the total resistance to sliding decrease as bracket/archwire angulations increase. However, a low friction ligation method contribute to appliance efficiency and might have clinically important advantages over self-ligating brackets as in previous studies[2,4,7].

SLIDE showed levels of friction that were significantly lower than those produced by CL during sliding mechanics for all type of wire tested. The amount of both static and kinetic friction was minimal for NCNL. The ligation methods had significantly influence on friction . For every wire size , SLIDE - ligated stainless steel bracket had lesser friction than elastomeric ligated steel bracket .The friction increased with an increase in wire size when ligated non conventionally. [1,5]

The use of 016'' nickel – titanium wire with stainless steel brackets showed that frictional force were virtually absent for the NCEL. This data for the NCEL are in agreement with the previous results for passive self-ligating brackets[4,3].

On the basis of the results of this study, the innovative elastomeric ligatures produced significantly lower level of frictional forces than silver mini module, so the new ligatures may represent a valid alternative to passive self-ligating brackets when minimal amount of friction is desired'[10].

From a clinical perspective, the aim to keep the friction force as low as possible and ideally to eliminate them together. Sliding mechanics occurs predominately during space closure and this needs to be carried out on wire that was sufficient stiffness to prevent its distortion and subsequently tilting of the adjacent teeth into space. For this reason, space closure is normally undertaken on stainless steel and probably on TMA archwire'[12].

In present study the NCEL showed levels of friction that were significantly lower than those produced by CEL during sliding mechanics with rectangular/round wire. The amount of static and kinetic frictional force exerted by the NCEL were minimal when compared to CEL. During mechanotherapy that involves sliding mechanics, friction at the bracket- wire interface may prevent the attainment of optimal force in the supporting tissues. Hence orthodontist need to know precisely the level of force required to overcome the friction and produce optimal biological response for predictable tooth movement. [11,7]

In conventional stainless steel brackets have higher coefficient of friction when used along with TMA wires, these wires should be avoided while using sliding mechanics. It is also conformed to the previous study by Tidy (1989) reported resilient wires produced more friction and should not be used for sliding along the brackets.

CONCLUSION

Rround wire had lowest fiction value and ss wire produced highest friction followed by TMA. For rectangular wire least frictional was observed in 0.019x.025'' among all type of ligation. For all type of ligation and brackets friction increased with increase in wire size dimension. With all the brackets types and wire size, elastomeric ligation generated greater friction in comparison with NCEL.

On the basis of the result of this study ,the innovative elastomeric ligatures produce significantly lower levels of frictional forces than conventional elastomeric modules , so that new ligatures may represent a valid alternative to passive self ligating brackets when minimal amount of friction is desired.

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