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Intricate Assessment of Frictional Resistance Between Orthodontic Bracket and Archwire as Affected by Mouthwash Usages: An In Vitro Study

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ABSTRACT

Background: The sole aim of this study was to evaluate frictional resistance between the orthodontic bracket and archwire as affected by two commercially available types of mouthwash, i.e. ACT Braces Care Anti-cavity Fluoride Mouthwash and Listerine Cool Mint Antiseptic Mouthwash.

Materials & Methods: The study was completed on the in-vitro ideology. Forty-five extracted maxillary first premolar was included in the study. For the ease of study, samples were segregated into three groups of fifteen each. All teeth were mounted on self-cure acrylic resin over which stainless steel brackets bonded, and stainless steel wire was ligated. The first study group controlled wherein samples were immersed into artificial saliva. Group two and group three samples were immersed into ACT Braces Care Anti-cavity Fluoride Mouthwash and Listerine Cool Mint Antiseptic Mouthwash, respectively. Overall static frictional resistance was calculated by utilizing a universal testing machine.

Results: Statistical analysis was completed by statistical software Statistical Package for the Social Sciences (SPSS). The recorded data were subjected to appropriate statistical tests to obtain p values, mean, standard deviation, standard error an 95% CI. $P \leq 0.05$ was considered as statistically significant. Group III samples showed maximum Mean Frictional Resistance (1.87N) however, group II and group I samples showed considerably lesser values of Mean Frictional Resistance. Level of Significance (p-value) was reported to be significant for the samples of group II (ACT). Standard deviation was noted to be maximum in the samples of group II (ACT). It was 0.632 in group II; however; the standard error was minimum in this group (0.309).

Conclusion: Within the limitation of the study authors concluded that ACT Braces Care Anti-Cavity Fluoride Mouthwash has lesser static frictional resistance compared to Listerine Cool Mint Antiseptic Mouthwash. Therefore, in the vulnerable clinical circumstances, ACT Braces Care Anti-Cavity Fluoride Mouthwash should be wisely used for maintaining optimal oral health in orthodontic patients.

Keywords: ACT Braces Care Mouthwash, Listerine Cool Mint Antiseptic Mouthwash, Frictional, Resistance, Orthodontic Bracket.

INTRODUCTION

As we all know that sliding mechanics has attained high popularity among orthodontists in the recent past. In sliding mechanics, the wire slides throughout the brackets and tubes. The sliding resistance between the bracket slot and wire may affect tooth movement.[1,2] It is therefore very imperative to control the friction. This is also very crucial as sliding mechanics is one of the most

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significant factors for positive treatment results. The frictional force unfavourably affects the treatment procedure through decreasing or even inhibiting tooth movement, which may result in loss of anchorage.[3,4,5] The friction between the brackets and orthodontic wire during sliding mechanics causes problems like lessening of the applied force and tooth movement. Sometimes it also leads to the loss of anchorage. Consequently, many authors in the literature have concentrated on the factors that influence the friction. Primarily, there are two major factors that decide the amount of friction during sliding mechanics. First is the coefficient of friction between contacting surfaces, and second is the forces applied between those surfaces.[6,7] The method of ligation actually decides how firmly the wire is engaged inside the bracket slot. Therefore, it is straightly related to frictional resistance to sliding. Friction can be defined as a force that opposes or delays the movement of two bodies in contact. Sliding is responsible for a considerable amount of friction in the interface bracket/orthodontic wire. In orthodontics, friction has been implicated in reducing the rate and efficiency of sliding mechanics.[8,9,10] It has been shown that between 11% and 62% of applied force in fixed appliances is lost to friction. There are two types of friction: static and kinetic. Static friction occurs until the force is great enough to overcome the initial resistance to movement of the object; kinetic friction then opposes the continuation of the movement.[11,12] Hence; this study was designed to assess frictional resistance between the orthodontic bracket and archwire as affected by two commercially available types of mouthwash, i.e. ACT Braces Care Anti-cavity Fluoride Mouthwash and Listerine Cool Mint Antiseptic Mouthwash.

MATERIALS & METHODS

The basic philosophy and concept of this study were based on in-vitro perception. Forty-five extracted maxillary first premolar was included in the study. All sample teeth were collected from the Department of Oral Surgery while the study was conducted in the Department of Orthodontics of the institute. Inclusion criteria of sample teeth included: teeth with no caries, teeth with no wasting diseases (attrition, abrasion, erosion, abfraction). Teeth with any kind of staining (intrinsic/extrinsic), fracture and congenital dental defect were excluded from the study. All selected teeth were stored in normal saline before the real execution of the study. For the ease of study, samples were classified into three groups of fifteen each. All teeth were mounted on self-cure acrylic resin block of cuboid shape. This was done to provide stability and strength to individual sample assembly during the testing procedure. The dimensions of acrylic blocks were kept constant and standard for all samples. Before mounting, all teeth were cleaned thoroughly with pumice. The orthodontic brackets (MBT system, 3M, MN, USA) were bonded at the centre of the clinical crown. Anabond Orthofix kit was used for adhesion purpose. This bonding procedure was preceded with etching with 37% phosphoric acid for 30 seconds. Stainless steel orthodontic archwire (0.019"X0.025") was ligated over the stainless steel brackets. A standards length of 4 cm of stainless steel orthodontic archwire was utilized for each sample assembly. The first study group controlled wherein samples were immersed into artificial saliva. Group one served as a control group. Group two and group three samples were immersed into ACT Braces Care Anti-cavity Fluoride Mouthwash and Listerine Cool Mint Antiseptic Mouthwash, respectively (Figure 1). All samples were kept in their respective solutions for fixed 90 minutes. Overall static frictional resistance was calculated by utilizing a universal testing machine (Instron Model 5692, Bharat Heavy Industries, India). The wire was pulled at a crosshead speed of 0.5 mm/min (5N). Care was taken to avoid introducing torsion into the test specimen. Data thus received was compiled in a table and subjected to basic statistical analysis. P-value less than 0.05 was considered significant ($p < 0.05$).

Fig 1: Group II And Group III Mouthwashes Used In The Study.

RESULTS

In this study, all noticeable findings and data were sent for statistical analysis using statistical software Statistical Package for the Social Sciences version 21 (IBM Inc., Armonk, New York, USA). The finalized data were subjected to appropriate statistical tests to obtain p values, mean, standard deviation, chi-square test, standard error and 95% CI. Table 1 shows sample distribution and groupings. Group I, II and III have artificial saliva, ACT and Listerine mouthwashes respectively. All three groups have 15 studied samples each. Table 2 exhibits fundamental statistical depiction with a level of significance assessment using Pearson chi-square test [for a group I, II, III]. Group III samples showed maximum Mean Frictional Resistance (1.87N); however, group II and group I samples showed considerably lesser values of Mean Frictional Resistance (graph 1). Level of Significance (p-value) was reported to be significant for the samples of group II (ACT). Standard deviation was noted to be maximum in the samples of group II (ACT). It was 0.632 in group II; however; the standard error was minimum in this group (0.309). Table 3 illustrates a comparison of frictional resistance among the three study groups using one-way ANOVA [for a group I, II, III]. The level of significance was found to be highly significant for the ANOVA test between the groups (0.001).

Table 1: Sample distribution and study groups.

Group	n	Mouthwash
I	15	Artificial Saliva (Control)
II	15	ACT
III	15	Listerine

Table 2: Fundamental statistical depiction with the level of significance assessment using Pearson chi-square test [for group I, II, III].

Parameters	Mean Frictional Resistance (Newton)	Std. Deviation	Std. Error	95 % CI	Pearson Chi-Square Value	df	Level of Significance (p value)
Group I	1.02	0.487	0.977	1.96	1.983	1.0	0.08
Group II	1.21	0.632	0.309	1.89	1.546	2.0	0.01*
Group III	1.87	0.494	0.832	1.43	1.690	1.0	0.06

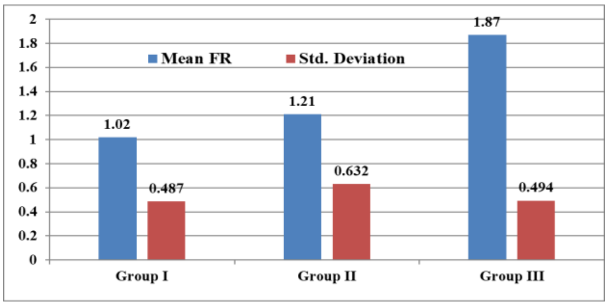
***p<0.05 significant**

Table 3: Comparison of frictional resistance among the 3 study groups using one-way anova [for group I, II, III].

Parameters	Degree of Freedom	Sum of Squares ∑	Mean Sum of Squares m∑	F	Level of Significance (p value)
Between Groups	3	6.890	1.984	5.960	0.001*
Within Groups	49	19.946	0.356	-	
Cumulative	521.87	22.908	-		

***p<0.05 significant**

Graph 1: Mean frictional resistance (fr in newton) & std. Deviation.



DISCUSSION

By definition, friction is a force that resists the motion of two objects in contact. Friction has been reported in the orthodontic literature as early as 1960's. Tooth movement can take place when the applied forces sufficiently conquer the friction at the bracket slot-archwire interface.[13,14,15] High levels of frictional force between the bracket slot and the archwire may cause binding between the two components. These phenomenons usually result in little or no tooth movement. Literature has well evidenced that knowledge about the significant factors allows the control of the sliding resistance.[16,17,18] Several interrelated parameters affect the evaluation of friction rates such as the oral atmosphere factors, wire and bracket size, wire and bracket material, surface characteristics, type of ligation, and direction and magnitude of the force. The sliding mechanics is the most frequent mechanics among orthodontic works. Friction is one of the most imperative dominant factors in this machine as it has undesirable effects on sliding.[19,20] On the other hand, appropriate oral hygiene has always been a huge concern for both patients and practitioners. With the ever-advancing straight wire technologies, several clinical problems also evolved. Bracket-wire friction affects the sliding movements of the teeth space closure or canine retraction. Metallic deterioration type of defects on the surface of the orthodontic appliance has clear influence both static and kinetic friction.[21,22] Static friction is the force needed to start a movement, whereas kinetic friction is the force needed to maintain movement once started. In the presence of friction during orthodontics, tooth movement apparently occurs as a sequence of very short steps or jumps rather than as a smooth, continuous motion.[23,24] Friction has a significant role in clinical orthodontic therapies. The friction going on between archwire and bracket during sliding can noticeably lessen the rate of intended tooth movement and create an unwanted movement of the anchor teeth.[25,26] Our study was planned to evaluate frictional resistance between the orthodontic bracket and archwire as affected by two commercially available types of mouthwash, i.e. ACT Braces Care Anti-cavity Fluoride Mouthwash and Listerine Cool Mint Antiseptic Mouthwash. Authors have drawn few very imperative results.

CONCLUSION

Within the limitation of the study, the authors concluded that ACT Braces Care Anti-cavity Fluoride Mouthwash has lesser static frictional resistance compared to Listerine Cool Mint Antiseptic Mouthwash. Therefore in the vulnerable clinical circumstances, ACT Braces Care Anti-cavity Fluoride Mouthwash should be intelligently used for maintaining optimal oral health in orthodontic patients. Our study results must be considered as suggestive for presuming prognosis for similar clinical conditions. However, we expect some other large scale studies to be performed that might further establish a certain standard and concrete guidelines in these perspectives.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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