



Assessment of various mouthwashes on frictional resistance of orthodontic components: an in vitro (original research) study

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Abstract

Background and Aim: The ultimate aim of this in vitro study was to assess the effects of two commercially available mouthwashes (Listerine Total Care Alcohol-Free Anti-cavity Fluoride Mouthwash and ACT Total Care Mouthwash) on frictional resistance of orthodontic bracket and archwire.

Materials & Methods: Two popular commercially available mouthwashes Listerine Total Care Alcohol-Free Anti-cavity Fluoride Mouthwash and ACT Total Care Mouthwash were finalized for the study. Total forty five extracted teeth sample teeth (maxillary second premolars) were collected and stored in distilled water. Group 1 served as control group (artificial saliva) for sample immersion. Group 2 consisted of Listerine Total Care Alcohol-Free Anticavity Fluoride Mouthwash testing and Group 3 consisted of ACT Total Care Mouthwash testing. The orthodontic brackets were bonded on teeth by. All samples were kept in the particular medium and incubated at 37°C for 1.5 hour. All specimens were tested by universal testing machine for frictional resistance between orthodontic bracket and archwire.

Results: All findings and data were sent for statistical analysis using statistical software. Group 1 samples of artificial saliva (control) showed mean frictional resistance (Newton) 1.09 with standard deviation 0.827. Group 2 samples of Listerine Total Care Alcohol-Free Anti-cavity Fluoride Mouthwash showed mean frictional resistance (Newton) 2.03 with standard deviation 0.927. p value was highly significant. Group 3 samples of ACT Total Care Mouthwash showed mean frictional resistance (Newton) 2.14. p value was highly significant. P value was highly significant for the ANOVA test between the groups (0.002).

Conclusion: It was concluded that the measured frictional resistance increases with the usage of Listerine Total Care Alcohol-Free Anti-cavity Fluoride Mouthwash and ACT Total Care Mouthwash. On comparing with control group, they have increased the frictional resistance approximately two times. New long term studies with wider parameters also anticipated to validate present outcomes.

Key Words: Archwire, Bracket, Frictional Resistance, Listerine Total Care Alcohol-Free Anticavity Fluoride Mouthwash, ACT Total Care, Mouthwash, Orthodontics

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Introduction

The basic principle of orthodontics is primarily revolving around tooth movement mechanics. Other steps are usually alignment, space closure and other corrections. Orthodontic tooth movement is mainly achieved either frictionless way or with friction.^{1,2} Frictionless method predominantly involves closing loops. In friction modality, operator ensures easy sliding of archwire in the slots of brackets/tubes.^{3,4} This sliding is much more popular among orthodontists and clinicians due to its simplicity and economical nature. Researcher has shown that this apparent friction among various orthodontic components directly affects the freedom of movement.^{5,6} This is particularly true when patients are utilizing external agents like mouthwashes. Therefore it is deemed necessary to find out the exact effect of mouthwashes on the frictional resistance between arch wires and brackets. Literature is full all such studies in which these assessments have been done.⁷ Currently different advanced mouthwashes are available in the market particularly for orthodontic usage. Therefore, the sole aim of this in vitro study was to evaluate the effects of two commercially available mouthwashes (Listerine Total Care Alcohol-Free Anti-cavity Fluoride Mouthwash and ACT Total Care Mouthwash) on frictional resistance of orthodontic bracket and archwire.

Materials & Methods

This study was planned logically to assess the frictional resistance of orthodontic components after mouth wash usages. The basic ideology was to find out the extent of the effect of mouthwashes on these parameters. Two popular commercially available mouthwashes were selected for this study. They were Listerine Total Care Alcohol-Free Anti-cavity Fluoride Mouthwash and ACT Total Care Mouthwash. These mouthwashes are typically recommended for orthodontic patients. Total forty five extracted teeth sample teeth (maxillary second premolars) were collected

and stored in distilled water and studied purposefully. Teeth those extracted for orthodontic purpose were included in the study. Teeth with any developmental defects, anatomical defects, decayed were excluded immediately. Also teeth with any wasting tooth disease. Three study groups were made for evaluation and comparison purpose. Group 1 served as control group. It consisted of artificial saliva for sample immersion for testing (n=15). Group 2 consisted of samples to be immersed into Listerine Total Care Alcohol-Free Anticavity Fluoride Mouthwash (n=15). Group 3 consisted of samples to be immersed into ACT Total Care Mouthwash (n=15). All sample teeth were initially cleaned and made free from any attached soft tissue gingival remnants. All forty five sample teeth were mounted individually into cube (side 20 mm) of self cure acrylic resin (Lucitone 199 Repair Material). The orthodontic brackets (3M Unitek Gemini Metal Brackets) were bonded on sample teeth by the single operator. 3M Unitek Transbond XT was utilized for adhesion purpose of orthodontic brackets and archwires ligated accordingly. For testing purpose, a specimen set of 15 were put in the artificial saliva. Samples were kept separately in to separate containers. Similarly, second specimen set of 15 were kept into Listerine Total Care Alcohol-Free Anticavity Fluoride Mouthwash. Third specimen set of 15 were kept into ACT Total Care Mouthwash. All samples were kept in the particular medium and incubated at 37°C for 1.5 hour. After processing, the specimens were cleaned and tested by universal testing machine for assessment of frictional resistance between orthodontic bracket and archwire as per the guidelines of American National Standard/American Dental Association Specification No. 32 for orthodontic wires. Data was recorded and entered into statistical software for further analysis. P value less than 0.05 was considered significant (p< 0.05).

Results



All observable findings and data were sent for statistical analysis using statistical software Statistical Package for the Social Sciences version 22. The relevant data was processed by appropriate statistical tests to obtain p values, mean, standard deviation, chi-square test, standard error and 95% CI. Table 1 show about sample distribution and groupings. Table 2 exhibits Fundamental statistical illustration with level of significance evaluation using pearson chi-square test [n=15, for group I]. Group 1 samples of artificial saliva (control) showed mean frictional resistance (Newton) 1.09 with standard deviation 0.827, standard error 0.420

and p value 0.120. Group 2 samples of Listerine Total Care Alcohol-Free Anti-cavity Fluoride Mouthwash showed mean frictional resistance (Newton) 2.03 with standard deviation 0.927, standard error 0.320 and p value 0.001. p value was highly significant. Group 3 samples of ACT Total Care Mouthwash showed mean frictional resistance (Newton) 2.14 with standard deviation 0.720, standard error 0.560 and p value 0.020. p value was highly significant. Table 5 illustrates one-way ANOVA [for group I, II, III]. The level of significance was identified to be highly significant for the ANOVA test between the groups (0.002).

Table 1: Sample distribution and groupings

Group	Quantity	Mouthwash Medium
I	15	Artificial Saliva (Control)
II	15	Listerine Total Care Alcohol-Free Anticavity Fluoride Mouthwash
III	15	ACT Total Care Mouthwash

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Table 2: Fundamental statistical illustration with level of significance evaluation using pearson chi-square test [n=15, for group I]

Groups	Mean Frictional Resistance (Newton)	Std. Deviation	Std. Error	95% CI	Pearson Chi-Square Value	df	Level of Significance (p value)
Group I	1.09	0.827	0.420	1.02	1.736	1.0	0.120
*p<0.05 significant							

Table 3: Fundamental statistical illustration with level of significance evaluation using pearson chi-square test [n=15, for group II]

Groups	Mean Frictional Resistance (Newton)	Std. Deviation	Std. Error	95% CI	Pearson Chi-Square Value	df	Level of Significance (p value)
Group I	2.03	0.927	0.320	1.12	1.922	1.0	0.001*
*p<0.05 significant							

Table 4: Fundamental statistical illustration with level of significance evaluation using pearson chi-square test [n=15, for group III]

Groups	Mean Frictional Resistance (Newton)	Std. Deviation	Std. Error	95% CI	Pearson Chi-Square Value	df	Level of Significance (p value)



Group I	2.14	0.720	0.560	1.50	1.928	1.0	0.020*
*p<0.05 significant							

Table 5: Evaluation amongst the 3 study groups using one-way ANOVA [for Group 1,2 & 3]

Variables	Degree of Freedom	Sum of Squares Σ	Mean Sum of Squares $m\Sigma$	F	Level of Significance (p)
Between Groups	3	2.279	1.032	1.3	0.002*
Within Groups	18	3.188	0.125	-	
Cumulative	112.13	14.356	*p<0.05 significant		

Discussion

Literature has well evidenced that friction is an integral component between orthodontic archwire and different orthodontic brackets. Many researchers have experimented to evaluate and minimize these frictional forces so as to facilitate the sliding mechanism. It was also postulated by few researchers that this friction cannot be made zero however it can only be minimized by several measures. Geramy and colleagues have studied about Effect of sodium fluoride mouthwash on the frictional resistance of orthodontic wires. Their results showed that use of mouth wash usually increases the frictional resistance of orthodontic wires. These inferences were in accordance with our results. However study setups and component manufacturers were quite different.⁸ Zhou and associates also explored about effects of various coating methods on the mechanical, physical, and aesthetic properties of GUMMETAL archwires. They confirmed that mechanical, physical properties are liable to be changed under influence of any external factor. The results were highly predictable and comparable.⁹ Ogawa and coworkers have also studied about hydrogen absorption behavior of beta titanium alloy in acid fluoride solutions.¹⁰ Kapur and associates have experimented about frictional resistance in ceramic and metal brackets. They also demonstrated that mouthwash use increases the frictional resistance of archwires. These outcomes were highly predictable. Their inferences were somewhat similar to our study.¹¹ Many researchers in the literature have

also worked on the frictional resistance of archwire made by different metals like NiTi and other alloys. It was concluded by several researchers that composition of archwire has direct and potent effect on the frictional resistance with orthodontic brackets.¹²⁻¹⁶

Conclusion

Within the limitation of the study author concluded very significant inferences. Overall, the measured frictional resistance has been increased with the usage of both tested mouthwashes viz; Listerine Total Care Alcohol-Free Anti-cavity Fluoride Mouthwash and ACT Total Care Mouthwash. When compared to control group, they have increased the frictional resistance approximately two times. Among the two mouthwashes, ACT Total Care Mouthwash showed slightly higher frictional resistance compared to Listerine Total Care Alcohol-Free Anti-cavity Fluoride Mouthwash. Findings and recommendations of this study must be clinically correlated and applied judiciously. Other long term studies with wider parameters also expected to validate results.

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