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Does The Different Types of Mouth Wash Affect The Force of Orthodontic Elastics ..?

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Abstract

Aim: To evaluate the effects of different types of mouthwash on the force of orthodontic elastics.

Materials and Methods: Five groups of orthodontic chain elastics were formed. First is the control group consisting of distilled water and four experimental groups: chlorhexidine mouthwash, fluoridated mouthwash, alcohol containing mouth wash and herbal mouth wash. The test groups were kept in artificial saliva at 37^0C and submerged in their respective type of mouth wash for 2 min twice a day. Force was measured on day 0, 1, 7, 14, 21 and 28.

Results: Statistical significant difference was found on day 1, 7, 14 and 21 respectively. No statistical significant difference was found on day 0 and day 28^{th}. Alcohol containing, fluoride contains mouth wash showed significant amount of force decay till day 14^{th} and 21st.

Conclusion: Alcohol containing mouthwash and herbal mouthwash show significant increase in force degradation of elastomeric chains.

Introduction

Light continous forces provides rapid tooth movement with least patient discomfort and minimal tooth mobility during orthodontic treatment.[1] Chain elastics are one of the active components of orthodontics which provide such type of forces and augments the archwire forces. Orthodontic elastics used in mouth, along with the application of force have a disadvantage that they undergo force degradation as soon as first day of use.[2]

Numerous studies have been caried out to investigate the effects of simulated saliva environments,[3] pH,[4] and thermocyclying[5] on force degradation and showed a significant decrease in force of elastics. Mechanical degradation effects are thought to be the primary cause of degradation of orthodontic elastics[6,7] but there is evidence of increased force degradation of elastics when exposed to various types of substances like ethanol,[8,9] artificial saliva,[10] lactic acid and citric acid.[11]

Oral hygiene and caries control are also important for successful orthodontic treatment. However, orthodontic brackets and wire may serve as a medium for plaque accumulation, thereby increasing the level of microorganisms in the oral cavity.[12]

Due to difficulty in maintaining oral hygiene in patients undergoing orthodontic treatment , patient education regarding oral hygiene care needs to be done. Mechanical plaque control needs to be supplemented by chemical plaque control measures in individuals who are unable to maintain oral hygiene.[13-15] The study regarding

action of different formulations of chlorhexidine on force degradation of orthodontic elastomeric chains showed no significant difference.[16]

The action of different types of mouth wash on mechanical properties of elastics like force degradation is hardly discussed in literature . Therefore , the aim of this study is to evaluate the effects of different types of mouthwash on the force of orthodontic elastics.

Materials and Methods

An in vitro study was carried out to test the force degradation of orthodontic chain elastics (3M company- Figure1) under the influence of four different mouth wash (chlorhexidine mouthwash, flouridated mouthwash, alcohol containing mouth wash, herbal mouth wash). Five groups of samples were tested and each group was composed of 18 orthodontic chain elastics. The samples evaluated were distilled water (control group; group 1), chlorhexidine mouth wash - Clohex (0.2% chlorhexidine gluconate) (group 2), flouridated mouth wash - Amflor (Amine fluoride) (group 3), alcohol containing mouth wash - Listerine (Alcohol) (group 4), and Herbal mouthwash - Hiora (Salvadora persica 5 gm) (group 5). In another five receptacles, one for each experimental group mentioned above, artificial saliva was reserved for immersion of the samples.

To fabricate the personalized templates, polyvinylchloride (PVC) tubes of 2.5 cm length were used, in which small orifices were made to insert the supporting rods (1mm thickness) for the orthodontic chain elastics. Self-polymerizing acrylic resin was injected into the PVC tube to fix the rods. The orifices were separated by a horizontal mean distance of 0.5 cm. On the test specimen, the elastics were put into place and stretched along a vertical distance of 23.5 mm. The elastics used were of the short-spacing type from 3M. As they are presented in a single continuous chain, the elastomeric chains were cut to a standard, so that a total of five links were left free, with two links being responsible for fixation onto the template (Figure 2).

Figure 1 and 2

Figure 3

The templates enabled the elastomeric chain to be immersed in the artificial saliva solution during the 28 days of the laboratory study . An artificial saliva, 0.09% aqueous sodium chloride solution, was prepared by dissolving reagent-grade granular

sodium chloride in reverse osmosis (RO)–treated water having a resistance of 18 MV or greater (Figure 3).[17] The devices containing the activated elastic segments were kept immersed in artificial saliva at a controlled temperature of 37 ± 1 ^{0}C present in Incubator, ideal for reproducing conditions in the oral cavity. The chain elastics were removed from the beakers containing artificial saliva and were dipped in the corresponding mouth wash, leaving them immersed for 2 minutes [18] twice a day with an interval of 12 hours between

immersions. In the moments immediately before measurements, the devices were removed from the beakers, force measurements were taken, and they were then replaced in the beakers.

Six force measurements were taken during the experimental period at the following time intervals: initial 0, 1, 7, 14, 21, and 28 days. These measurements were taken with a Tensile Tester Machine (SM / CAL / 13 - 14 / 1706) (Figure 4). The elastic bands were held in a custom made jig (Figure 5).

The chain elastics were removed from the templates and placed on the custom made jig of Tensile tester machine , previously calibrated with regard to the distance of 23.5 mm of the templates. This guaranted greater reliability of the data obtained. After each measurement, the force measurer was set to zero, and the values were noted.

After all of the groups had been measured, the elastics were fixed on their respective templates and inserted in the receptacles of artificial saliva, which were put into the incubator. Adequate level of saliva was kept to insure that the elastics would be covered by this solution at all times.

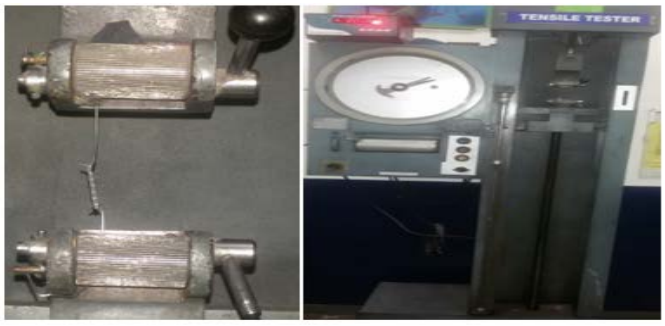

Figure 4 and 5

Statistical Analysis

The statistical analysis was performed using a commercially available software program SPSS version 20. The means and standard deviations were calculated using all the values for each group. One way analysis of variance (ANOVA) was used to analyze the difference among mean force decay in the 5 groups.

Further to know which group individually shows statistical difference with other groups on particular day post hoc Tukey test was applied.

Paired 't' test was applied to find out, at what day statistically significant changes begin to appear in force decay for particular group.

The confidence level was set at 95% and P value ≤ 0.05 considered to be significant.

Table 1: Mean and SD force of elastic in the different groups

Groups	Day 0	Day 1	Day 7	Day 14	Day 21	Day 28
Group 1	2.77 (0.3)	2.45 (0.2)	1.88 (0.3)	1.00 (0.0)	1.00 (0.0)	1.01 (0.09)
Group 2	2.71 (0.3)	2.40 (0.1)	2.05 (0.2)	1.10 (0.3)	1.03 (0.08)	1.00 (0.07)
Group 3	2.69 (0.3)	2.24 (0.1)	1.91 (0.03)	1.18 (0.3)	1.00 (0.0)	0.98 (0.06)
Group 4	2.62 (0.3)	1.05 (0.2)	1.05 (0.2)	1.00 (0.0)	1.03 (0.05)	0.98 (0.04)
Group 5	2.64 (0.3)	2.20 (0.05)	1.04 (0.08)	1.00 (0.0)	1.07 (0.09)	1.01 (0.05)

Figures in the parentheses is the standard deviation

Table 2: One way analysis of variance for significant changes within and between the groups according the time period

Day	F value	Sig.
Day 0	.579	.679
Day 1	272.75	.000*
Day 7	110.89	.000*
Day 14	3.162	.018*
Day 21	3.484	.011*
Day 28	.757	.556

* Significant change in force

Table 3: Tukey's test to test which group differs significantly according to time period

Day	Groups	Sig.
Day 1	Group 1 Vs Group 2	.852
	Group 1 Vs Group 3	.000*
	Group 1 Vs Group 4	.000*
	Group 1 Vs Group 5	.000*
	Group 2 Vs Group 3	.010*
	Group 2 Vs Group 4	.000*
	Group 2 Vs Group 5	.001*
	Group 3 Vs Group 4	.000*
	Group 3 Vs Group 5	.962
	Group 4 Vs Group 5	.000*
Day 7	Group 1 Vs Group 2	.103
	Group 1 Vs Group 3	.994
	Group 1 Vs Group 4	.000*
	Group 1 Vs Group 5	.000*
	Group 2 Vs Group 3	.242
	Group 2 Vs Group 4	.000*
	Group 2 Vs Group 5	.000*
	Group 3 Vs Group 4	.000*
	Group 3 Vs Group 5	.000*
	Group 4 Vs Group 5	1.000
Day 14	Group 1 Vs Group 2	.511
	Group 1 Vs Group 3	.05*
	Group 1 Vs Group 4	1.000
	Group 1 Vs Group 5	1.000
	Group 2 Vs Group 3	.770
	Group 2 Vs Group 4	.511
	Group 2 Vs Group 5	.511
	Group 3 Vs Group 4	.05*
	Group 3 Vs Group 5	.05*
	Group 4 Vs Group 5	1.000
Day 21	Group 1 Vs Group 2	.508
	Group 1 Vs Group 3	1.000
	Group 1 Vs Group 4	.676
	Group 1 Vs Group 5	.017*
	Group 2 Vs Group 3	.508
	Group 2 Vs Group 4	.999
	Group 2 Vs Group 5	.508
	Group 3 Vs Group 4	.676
	Group 3 Vs Group 5	.017*
	Group 4 Vs Group 5	.349

* Significant change in force

Results

When the groups were compared with one another on the same day, stastistical difference among the groups were found on 1st, 7th, 14th and 21st day. There were no stastical difference initially (day 0) and on 28th day (Table 1).

On day one, statistical difference was showed by group1 with group 3, 4 and 5; group 2 with group 3,4 and 5 ; group3 with group 4 and also by group 4 with group 5.

On day seven, statistical difference was showed by group1 with group 4 and 5; group 2 with group 4 and 5 ; group3 with group 4 and 5.

On 21st day, statistical difference was showed by group1 with group 5; group 3 with group 5.

When the groups were evaluated individually compairing the factor time, the force was statistically higher in the initial period (day 0) than that of all the other experimental periods (Table 2) .

Discussion

Orthodontic elastics are important sources of force transmission to the teeth and are therefore widely used in orthodontics. Nevertheless, these materials are not considered ideal, as the force they generate diminishes gradually during the activation period.[19,20] Therefore, various studies[21-23] have sought to establish the mechanical and environmental factors that contribute to the force degradation of different orthodontic elastics. Mouthwashes are commonly used by orthodontic patients; thus, it is vital to investigate how mouthwashes affect orthodontic devices.

In this study, the short chain elastic, without spaces between the links, was adopted, since this maintain a higher percentage of force over the course of time.[1]

In dry environment, the force decay is due to the stretching only because this makes uncoiled chain to slip past each other, these chains held by secondary bonds which are weak and cannot with-stand the stretching so rupture of these bonds lead to decrease in force delivered since only stretched chain can carry load. The number of the ruptured chain increases with time and end with braking of the primary bonds and appearance of permanent deformation which manifest as a decrease in the constancy of the force. [24-26]

When evaluated in a humid medium, the force degradation of synthetic elastic materials is significantly greater than it is when this is done in a dry environment; therefore, the chain elastic segments were kept immersed in artificial saliva. Because it concerns a simulation of the oral cavity, the temperature at which the elastics was maintained was 37 $\pm 1^0$ C, as this is the body temperature and also because it is known that temperature participates in the force degradation released by the elastics. Four weeks duration was selected because it coincides with the time interval frequently occuring between orthodontic consultations.[16]

The results of this study demonstrate that alcohol containing mouthwash, flouridated mouthwash and herbal mouthwash shows statistical significant increase in the amount of force decay of elastomeric chains.

Results of alcohol containing mouthwash (Listerine) agrees with the results of previous studies[27-30] showing that there was severe force decay during initial 24 hrs and till 14th day with hardly any significant change afterwards. Larrabee et al[31] had similar findings but there study also concluded that varying concentrations of alcohol has insignificant effect on rate of force dacay of elastomeric chains. Pithona et al [32] had controversial result, concluding that the use of Listerine mouthwash had no influence on the force degradation of elastomeric chains.

Herbal mouthwash (Hiora) is recently been used by many orthodontist because of its amazing results in controlling plaque. It is introduced to overcome the side effects of routinely used mouthwashes like chlorhexidine (eg : long term use of chlorhexidine mouth wash causes discolouration of teeth). Many studies[33,34] have concluded the effectiveness of herbal mouthwash (its main ingredient Salvadoora perisca) over different types of mouthwash. There is hardly any literature on effect of herbal mouthwash on force decay of elastomeric chains. In this study herbal mouthwash showed significant amount of force decay till 21st day. Different contents of this mouthwash may be responsible for its deleterious effect on orthodontic elastics.

Flouridated mouthwash (Amflor) use has an added advantage of caries prevention and remineralization of tooth. This study showed significant difference on the first day of study and thereafter no significant change was noted. Sarmad S Al Kasar[35] observed that the use of flouridated mouthwash causes force degradation of elastomeric chains. Ramazanzadeh BA et al[36] concluded that daily use of NaF mouth rinse does not affect force degradation of elastomeric chains, but for achieving higher force levels statistically significant changes were noted. The force degradation of elastic chain in flouridated mouthwash solution more than others could be due to fluoride ions present in solution. Von Frounhofer et al[18] state that exposure of Elastic Chain to

topical fluoride affect the elastic properties of elastic chain and increase the distraction of elastic chain required to deliver initial force.

Chlorhexidine mouthwash showed no statistically significant effect on force of elastomeric chain over the duration of 28 days. Pithon MM et al [16] showed that chlorhexidine had no significant influence on the force degradation of the chain elastics. .Chlorhexidin present in mouthwash solution may also play a role in increasing the degradation of elastomers, Evangelista et al [37] suggest that the aqueous component or the chemical substance in the disinfectant solution may plasticize or cause disruption of the intermolecular bonds and degradation of the elastomers. They also mentioned that in the process of storing elastomers in solution, water gets incorporated into the polymer, both water and detergents have a plasticizing effect on most polymers, which causes the polymeric chains to slip past each other, especially under load. The combination of the detergent and water would be an especially potent plasticizer. Insignificant difference between effect of mouth wash solution and artificial saliva may be due to short period of immersion in mouth wash (two minutes) that was not enough to show different effect from artificial saliva of normal .

Conclusions

1. Alcohol containing mouthwash, flouridated mouth wash and herbal mouthwash show significant increase in force degradation of elastomeric chains.
2. All five groups showed reduction in force of elastomeric chains when the factor of time was taken into consideration
3. Chlorhexidine does not act significantly on the force degradation of orthodontic chain elastics.

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