CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES
SJIF Impact Factor: 7.187
http://doi.org/10.5281/zenodo.4249161

Avalable online at: http://www.iajps.com *Research Article*

EFFECTS OF DIFFERENT MOUTHWASHES ON THE ORTHODONTIC NICKEL-TITANIUM WIRES

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Article Received: September 2020 **Accepted:** October 2020 **Published: November** 2020

Abstract:
Introduction: *Currently, more adult patients are seeking orthodontic treatment, and there is an increasing demand for improvement in the esthetic quality of orthodontic appliances.* ***Objectives:*** *The main objective of the study is to analyse the effects of different mouthwashes on the orthodontic Nickel-Titanium wires.* ***Material and methods:*** *This descriptive study was conducted in De'montmorency College of Dentistry, Lahore during June 2019 to January 2020. The data was collected into two groups, one was control group and 2nd was study group. Three different types of mouthwashes were used in this study.* ***Results:*** *The results of the two-way ANOVA showed that the fluoride treatment caused a significant reduction in NiTi wires and a significant increase in the coated wires (P = 0.000). The Aqufresh mouthwash produced a statistically significant increase in the NiTi and coated wires and a significant decrease in the SS wires compared to the control group (P < 0.05). The sensodyne mouthwash significantly increased the value of the NiTi wires and reduced in the SS and coated wires (P < 0.05).* ***Conclusion:*** *It is concluded that all mouthwashes caused a significant decrease in the stiffness of wires. All mouthwashes changed the loading and unloading forces and surface morphology of different wires, which could have an impact on the mechanical properties of these wires during orthodontic treatment.*

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Please cite this article in press Amjad Liaqat et al, ***Effects Of Different Mouthwashes On The Orthodontic Nickel-Titanium Wires.,*** *Indo Am. J. P. Sci, 2020; 07(11).*

INTRODUCTION:

Currently, more adult patients are seeking orthodontic treatment, and there is an increasing demand for improvement in the esthetic quality of orthodontic appliances. This problem is partially solved by the introduction of esthetic brackets and coated wires. One of the most important aspects of a successful orthodontic treatment is the maintenance of good oral hygiene and caries control. Compromised oral hygiene can lead to enamel demineralization and decay [1]. Orthodontists should recommend that patients regularly use the products containing fluorides, such as mouthwashes and gels, in addition to the daily use of fluoride toothpaste during orthodontic treatment to prevent tooth decay. Fluoride mouthwashes are available in 0.05% and 0.2% fluoride concentrations that are prescribed daily or weekly by orthodontists to improve the level of oral hygiene during treatment. Therefore, orthodontic wires can be continuously exposed to fluoride [2].

Literature indicates that individuals with malaligned teeth are more prone to periodontal problems owing to the difficulty in accessing areas hence crowding of teeth creates hinderance in maintaining proper oral hygiene [3]. Patients with such crowding who are more susceptible to dental caries might benefit from the additional use of fluoride mouth rinses in addition to regular brushing. Patients experiencing orthodontic treatment are prone to caries and periodontal disease since the presence of a fixed appliance may compromise the efficacy to maintain ideal oral cleanliness [4]. There is some proof that an everyday use of fluoride mouthwash will decrease the danger of tooth decay and gum disease during treatment with fixed braces. The success of orthodontic treatment apart from other factors depends on the sliding mechanism between the wires and brackets. Corrosion of these wires owing to any stimulus increases friction [5]. This friction provides higher resistance to sliding and can ultimately prolong the treatment duration. Nickel-titanium (NiTi) is one of the most commonly used wire materials in orthodontic treatment. Generally, these wires are considered corrosion resistant because of a protective passive film, titanium oxide (TiO2) which is formed on these NiTi wires. This layer shields the wire from corrosion and other environmental effects. Corrosion may occur if this layer is compromised due to any factor which can create a reducing environment in the oral cavity [6].

Objectives

The main objective of the study is to analyse the effects of different mouthwashes on the orthodontic Nickel-Titanium wires.

MATERIAL AND METHODS:

This descriptive study was conducted in De'montmorency College of Dentistry, Lahore during June 2019 to January 2020. The data was collected into two groups, one was control group and 2nd was study group. Three different types of mouthwashes were used in this study. The solutions were 0.05% sodium fluoride (NaF) mouthwash (**Oral-B, Germany**), **Aquafresh**® Extra Fresh Daily Mouthwash Fresh Mint and **Sensodyne** Long Lasting Senstivity Care Mouth Wash. Distilled water (DW) was used as control group. The wire in each group were immersed in their respective solutions and incubated at 37°C for 1.5 h. This time was equivalent to 3 months of one1-minute daily application of these mouthwashes. After this time, all the specimens were removed from the solutions and rinsed with water.

Statistical analysis

The data was collected and analysed using SPSS version 19. All the values were expressed in mean and standard deviation.

RESULTS:

The results of the two-way ANOVA showed that the fluoride treatment caused a significant reduction in NiTi wires and a significant increase in the coated wires ($P = 0.000$). The Aqufresh mouthwash produced a statistically significant increase in the NiTi and coated wires and a significant decrease in the SS wires compared to the control group ($P < 0.05$). The sensodyne mouthwash significantly increased the value of the NiTi wires and reduced in the SS and coated wires ($P < 0.05$). A two-way ANOVA was used for the effect of different mouthwashes on the wires and on the mean values of forces in different intervals during the loading and unloading.

Table1. The mean of corrosion percentage in NiTi wires

Mouthwash	corrosion percentage Mean±SD		Number of holes	
	NiTi	SS	NiTi	SS
Oral-B	6.18±0.91	3.07±0.978	6.6±0.848	4.4±0.282
Aqua fresh	5.40±0.75	5.30±4.330	9.7±3.252	5.4±1.97
Sensodyne	6.35±1.076	3.33±1.101	6.6±1.97	4.8±3.11
DW	4.48±0.418	2.03±0.908	6.6±0.848	4.2±0.565

Table 2. A comparison between different mouthwashes and control groups in NiTi wires

Mouthwash	Comparison	corrosion percentage		Number of holes	
		Mean Difference(I-J)	**Sig. (p-value)**	**Mean Difference(I-J)**	**Sig. (p-value)**
Oral B	Aqua fresh	0.78	0.82	-3.100	0.586
	Sensodyne	-0.16	0.99	0.0000	1.000
	DW	1.70	0.29	0.0000	1.00
Aquafresh	Oral B	-0.78	0.82	3.1000	0.586
	Sensodyne	-0.95	0.72	3.10	0.58
	DW	0.91	0.74	3.10	0.58
Sensodyne	Oral B	0.16	0.99	0.00	1.00
	Aqua fresh	0.95	0.72	-3.10	0.58
	DW	1.87	0.25	0.00	1.00

DISCUSSION:

Stiffness is an important parameter in determining the mechanical properties of wires. The stiffness of orthodontic wires can be assessed using a three-point bending test, which evaluates the load-deflection properties of a wire; those properties are considered the most important parameters in determining the biological nature of tooth movement [7].The advantages of this test are good stimulation of clinical application, reproducibility, and providing information on the behavior of the wires when subjected to vertical and horizontal deflections [8].

In general, the three-point bending tests produce load-deflection diagrams with upper loading and lower unloading curves. The force needed to engage the wire in the bracket is shown in the loading curve, and the force delivered to the teeth during the alignment stage of orthodontic treatment is represented by the

unloading curve. The vertical difference between the two curves is the combined effect of material hysteresis and the effects of friction between archwire and bracket. The modulus of elasticity determines the elastic stiffness and the performance of orthodontic archwires [9].

Elayyan *et al*. stated that in dry conditions, the 0.016 inchcoated wires produced significantly lower loading and unloading forces than uncoated control wires with the same nominal size. The authors were certain that this was due to the smaller diameter of the NiTi arch wires inside the coated wires, which compensated for the thickness of the coated layer; their position accords with the results of a study conducted by da Silva *et al*. The results from our study are also in agreement with these studies although we tested our specimens after they were immersed in different solutions. We observed lower forces produced by coated wires in all intervals of loading and unloading with different mouthwashes, in comparison with NiTi wires [10].

CONCLUSION:

It is concluded that all mouthwashes caused a significant decrease in the stiffness of wires. All mouthwashes changed the loading and unloading forces and surface morphology of different wires, which could have an impact on the mechanical properties of these wires during orthodontic treatment.

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