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The effect of different types of mouth washes on the modulus elasticity of elastic ligature

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Abstract

The mouth washes are widely used for maintain oral hygiene for patient wearing fixed orthodontic appliances but had effect on the elastic ligature so it's important to measure the modulus elasticity of elastic ligature. This study was carried out to evaluate the effect of different type of mouthwashes on modulus elasticity of the elastic ligature. A 40 elastic ligatures were selected from commercially available clear elastic ligature, the elastics were adjusted on S.S brackets which were bonded to maxillary right first premolar by chemical composite, the elastic ligatures were divided into four main groups and each group had 10 elastics as follows: group A. 10 elastic ligatures were immersed in a pool distilled water at 37c instead of saliva. Group B. 10 elastic ligatures were immersed in bio fresh. Group C. 10 elastic ligatures were immersed in corsodyl. Group D, 10 elastic ligatures were immersed in parodontax. All samples were then tested to determine the modulus elasticity by instron machine. The Paradontax mouthwash group provided a higher value of mean of the modulus elasticity of the elastic ligature followed by distilled water and Corosydel groups. The biofresh had the least value of mean of the modulus elasticity. There were highly significant differences between control and Corosydel; and control and biofresh groups ($P \leq 0.01$). No significant differences, however, between control and paradontax groups ($P \geq 0.05$). In conclusion, the Paradontax mouthwash group had a great effect on the modulus elasticity of the elastic ligature. The biofresh had the least effect on the modulus elasticity.

Keywords: Elastic ligature; Modulus elasticity; Corsodyl

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Introduction

Steel brackets have good mechanical and function properties when compared to other types of bracket materials, their only apparent disadvantage are its metallic appearance that reduces its aesthetic property [1, 2]. Fixed orthodontic appliance is contemporary bonded appliance shows improved esthetic, design and oral hygiene.

The elimination of tooth separation at the beginning of treatment and closure of band spaces at the end of treatment are advantages of bonded appliance [3]. Fixed orthodontic appliances usually include brackets, bands and arch wires, the brackets can be defined as precisely fabricated orthodontic attachment made of metal, plastic or ceramic (introduced to meet the increasing demand for esthetic appliance) [4]. The use of metal brackets with retentive bases was first reported by

Mitchell in 1967. Although not as aesthetically pleasing as plastic, ceramic or fiberglass brackets, the stainless steel brackets were an aesthetic improvement over previously used band [5]. The most commonly used metal in the manufacture of brackets is austenitic stainless steel or American Iron Steel Institute (AISI) 304 steel, AISI standing for-American Iron and Steel Institute. The composition of AISI 304 has nickel 8%, Iron 71%, carbon <0.2% and 18% chromium However, metallic orthodontic bracket have demonstrated properties that are closer to the ideal , and used most frequently in fixed orthodontic treatment 6-8. Stainless steel brackets are rely on mechanical retention for bonding and the mesh base is a conventional method of providing this retention [9]. The base alloy is of a softer metal to facilitate easier debonding of the brackets, where as the tie -wing metal requires greater hardness in order to withstand the forces applied by the arch wires [10]. The adhesive is a substance capable of holding material together [11]. The principle of adhesive in dentistry dated back to 1955 when Buonocore reported that acids could be used as a surface treatment before the application of the resin [12]. Since traditional orthodontic bracket bonding system required the use of three –step procedure (etching, priming and an adhesive resin). Many types of bonding material are now available for bonding of orthodontic attachment and they could be chemically–cured, light- cured. Elastic ligature: their function is either generating force for tooth movement or ligating arch wire to the brackets [13]. The aim of the study was to measure the effect of different types of mouthwashes on the modulus elasticity of the elastic ligature.

Materials and methods

In this study, 40 elastic ligatures were selected from commercially available clear elastic ligature, the thickness 0.9mm, circular cross section, the inner diameter 1.3mm, the outer diameter 3.1mm. The elastic ligatures were adjusted on stainless steel brackets which were positioned in the teeth by chemical composite. Elastic ligatures were selected from ortho matrix (OM), USA. The samples were divided randomly into four groups and each group had ten samples and these groups include: group A, ten elastic ligatures were immersed in pool distilled water at 37c instead of saliva. Group B, 10 elastic ligatures were immersed in bio fresh. Group C, 10 elastic ligatures were immersed in corsodyl. Group D, 10 elastic ligatures were immersed in parodontax. Metal brackets were bonded by chemical composite where the two equal amount of bonding material (base and catalyst) were mixed using spatula one end of the spatula was used for each paste to avoid cross contamination. According to manufacture instructions, a thin layer of primer was applied on the tooth surface and then mixed chemical composite was applied on the mesh surface of the metal bracket which was held by bracket holder. The bracket was then transferred and positioned in the tooth in its correct position on the middle third of the bucal surface occluso-gingivally at the highest contour mesio- distally. Any excess bonding material was carefully removed from around the bracket base by using dental probe before the material was set, the specimens allowed for bench cure for 10 minute.

Modulus elasticity of elastic ligature test

Modulus elasticity of elastic ligature test was accomplished using a instron testing machine (figure 1). The test was carried out in laboratory of the science and technology of Iraq science and technology of Iraq. 40 samples were divided into four groups. In group 1, the elastics ligatures were adjusted over stainless steel brackets and immersed in distilled water for 30 days at room temperature. After 30 days, the elastics ligatures were removed and then tested in Instron testing machine (figure 2). In second group, the samples were immersed in biofresh/distilled water for 12hour. After that, the elastics were dried for 5 second by syringe air and then immersed in biofresh for 1 minute. The cycle was repeated as 1 minute biofresh/12 distilled water at room temprature along for 30 days. Following that, the elastics were tested in instron testing machine. In third group,the samples were immersed in paradontax /distilled water for 12 hour. After that, they were dried for 5seconds by syringe air and then immersed in paradontax for 1minute and then dried by syringe air. The process was repeated for 30 daysand then tested. In group 4, the elastics ligatureswere immersed in corsodyle for 12 hoursand dried by syringe air for 5 seconds. After that, elastics were immersed in corsodyl for 1 minutefor 30 days and then tested in instron testing machine.

Figure1.
Instron machine

Figure 2.
Sample under test

Statistical analysis

Data were collected and analyzed using SPSS software by obtaining a summary of Mean, Standard deviation, Minimum, Maximum values. Among all samples, comparisons were taken using ANOVA and T tests.

Result

The mean, standard deviation, minimum and maximum values were demonstrated in table 1.

Table 1.

Descriptive statistics of tested groups

Groups	N	Min.	Max.	Mean	Std.
Distilled Water	10	545.51	682.21	611.81	48.20
Corosydel	10	380.35	600.47	506.04	78.12
Paradontax	10	500.49	750.56	647.50	64.65
Biofresh	10	355.30	550.43	476.76	71.48

The table 1 indicated that the Paradontax mouthwash presented a high value of mean of the modulus elasticity of the elastic ligature followed by Distilled Water and Corosydel while the biofresh had the least value of mean of the modulus elasticity of the elastic ligature. In addition, the T test was used for comparison between two groups (control and other groups). There were highly significant differences between control and Corosydel; and control and biofresh groups, however, no significant differences between control and paradontax groups as demonstrated in table 2.

Table 2.

T- Test between different groups.

Groups	t	P-Value	C.S
Distilled Water (control) - Corosydel	3.803	0.004	$P \leq 0.01$ (HS)
Distilled Water (control) - Paradontax	1.293	0.228	$P \geq 0.05$ (NS)
Distilled Water (control)- Biofresh	4.196	0.002	$P \leq 0.01$ (HS)

Discussion

The present study was undertaken to find out the effect of daily exposure to some types of mouthwashes that have been used to improve the hygiene of orthodontic patients. Many factors can affect the behavior of rubber elastic including elastic ligature , among these are: Stretching, wet condition ,thickness of elastic, temperature , time , PH of environment and the and the viscosity of media .In this study, after deforming the elastic to a fixed strain and at constant temperature, the measuring of the modulus elasticity of the elastic ligature as a percent from force remaining was considered to be more meaningful than actual force values that have been recorded for a given experimental study. About the simulations of oral cavity conditions in laboratory studies had not accurately predicated such as relaxation characteristics of elastic ligature. *In vivo*, besides other factors which affect the modulus elasticity involving environment difference mastication, tooth brushing, enzymes, thermal changes, and food interaction. These factors probably change the properties of the elastic ligature in a way that cannot stimulant *in vivo* experiment (Anderson and Bishara (1970) [14] concluded from studies that to simulate mouth condition, elastics are best tested in water at 37 C°. There is no statistical significant difference between the conditions mentioned above and the same materials tested under saliva at 37 C°. Therefore our discussion and explanation for the study finding will be stressed and concentrated through some of these factors. The percentage of modulus elasticity was rapid and high at the 3 hrs and continues slowly till the end of the experiment time at 4 weeks (672 hrs) in all media. The decrease in the modulus elasticity at each time intervals occur due to exposure of the elastomer to water led first to weakening of intermolecular force and subsequently to chemical degradation. Huget *et al*, (1990) [15] and Baty *et al*, (1994) [16] stated that the reduction of load requirement after one day storage and seven days of water storage may be the result of water sorption and the concurrent formation of hydrogen bonds between water molecules and macromolecules, it appears that absorbed water functioned initially as plasticizer, and there by facilitated slippage of molecules or elastic segment past other molecules or segment so when water molecules enter the elastic the fill inter molecular spaces and cause swelling of elastic ligature. The leaching out of the some element from elastic after immersion in water due to its susceptibility to hydrolysis, lead to increase their space, this agreed with Brantley *et al* (1979) [17] who found that water decreased of the modulus elasticity progresses. Regarding the effect of time, stretching and humidity on modulus elasticity of Elastic Ligature, these three factors had the same effect on elastic ligatures whether they exist as each one alone or they exist together, actually existing more than one would cause faster and extensive effect.

The type of elastic (ISO) showed that time of exposure was a significant factor in this study. after the first 3 hours the most significant decrease in the modulus elasticity was occurred, as the time proceeded the modulus of elasticity would be become slower for the type (ISO) More over showed that in every media the modulus elasticity have been changed significantly with time. Clinical observation showed that the elastomeric material are permanently elongated and under plastic deformation , this deformation is related to amount of time as well as the amount of the stretch give to the materials (Wong, 1976) [18]. Modulus elasticity with time resulting from the viscous behavior of elastomers. the applied load cause the polymer molecules to slippage over each other that lead to viscous behavior which is slow and irreversible because primary covalent bonds were begin stretched or when force applied lead to individual polymer molecules can stretched and uncoil and this elastic behavior is quick and reversible this uncoiling required little force since only weak secondary bonds were being broken within molecules (De Jenova *et al*, 1985[19] and Stevenson and Kusy, 1994) [20]. In addition to time and stretching factors , all testing media apparently affect the magnitude of residual modulus elasticity compared with the initial modulus elasticity, this can be explained by elastomeric materials are altered in the presence of moisture by water sorption that facilitate slippage of molecules or polymer chain past one another decrease the modulus elasticity process of these materials (Andersen and Bishara, 1970 [14], Brantly *et al*, 1979 [17]. In contrast to Bales *et al*, (1977) [21] who found modulus elasticity relationship for most of the products tested was found to be markedly affected by a wet environment but this had a comparatively small effect on most synthetic products . From the current study, it is concluded that had the Paradontax mouthwash group had a great effect on the modulus elasticity of the elastic ligature. The biofresh had the least effect on the modulus elasticity. It is recommended to use different types of mouthwashes and elastic ligature to assess their effect on force degradation of elastic ligature.

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