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Do alcoholic beverages interfere in the force of orthodontic elastics?

Bebidas alcoólicas interferem na força dos elásticos ortodônticos?

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Resumo

Objetivo: Avaliar os efeitos de diferentes bebidas alcoólicas sobre a força de decaimento de elásticos ortodônticos. **Material e método**: Em estudo laboratorial, foram testados 7 grupos de amostra, sendo: 1 grupo controle representado pela água destilada, e 6 experimentais: 2- Wisky, 3-Conhaque, 4-Vodka, 5-Cerveja, 6-Cachaça e 7-Vinho. Utilizou-se gabaritos para realizar a submersão das cadeias nas soluções de bebidas alcoólicas durante 30 segundos, uma vez ao dia nos grupos experimentais. A medição de força foi realizada com um dinamômetro digital em seis períodos diferentes 0, 1, 7, 14, 21 e 28 dias. **Resultado:** Não houve diferenças significativas entre os tratamentos nos momentos *baseline*, 7 dias, 14 dias e 28 dias. Foram observadas diferenças estatísticas entre o grupo 7 e os demais no momento 24 horas e entre o grupo 1 e os demais no período 21 dias. No período 28 dias não houve diferenças significativas no padrão de força entre todos os grupos ($p<0.05$) **Conclusão:** As bebidas alcoolicas não exercem influência na degradação da força dos elásticos em cadeia.

Descritores: Ortodontia corretiva; elastômeros; bebidas alcóolicas.

Abstract

Objective: To evaluate the effects of different alcoholic beverages on the decline in force of orthodontic elastics. **Material and method:** In a laboratory study, 6 groups of alcoholic beverages were tested. Control group (Group 1) was composed of distilled water. Experimental groups were Whisky (Group 2), Brandy (Group 3), Vodka (Group 4), Beer (Group 5), Sugar Cane Spirit/Rum (Group 6), Wine (Group 7). In the experimental groups, templates were used to enable elastics to be submerged in the alcoholic beverages for 30 seconds once a day. Force was measured with a digital dynamometer in six different time intervals: baseline, 1, 7, 14, 21 and 28 days. **Result:** There were no significant differences between the treatments in the time intervals: baseline, 7, 14 and 28 days. There were statistical differences between Group 7 and the others in the first 24 hours, and between Group 1 and the others after 21 days. After 28 days, there were no significant differences in the force pattern among all groups ($p<0.05$). **Conclusion:** Alcoholic beverages had no influence on the decline in force of the chain elastics.

Descriptors: Orthodontics, corrective; elastomers; alcoholic beverages.

INTRODUCTION

Orthodontic accessories used in corrective treatment, such as elastics, springs, loops, brackets, bands and wires act by mechanical force transmission to the teeth to move them to an adequate position[1,2].

The use of elastomeric chains, indicated for the correction of rotations and space closures in orthodontics, began in the 1960s[3-5]. Nevertheless, in spite of the important role of force transmission, they are still not considered ideal materials because they present a relevant decline in force that may cause a clinical problem, since orthodontic treatments act on the basis of the force of these accessories.

In the orthodontic literature, no ideal level of force for tooth movement has been stated, however, the rapid loss of force applied may make tooth movement inefficient in addition to requiring an increase in the number of activations of the appliances[6]. The gradual reduction in force of elastomers is linked to the time of activation, temperature of the oral medium and patients' diet[7,8].

Considering that the consumption of alcoholic beverages forms part of the diet of many patients undergoing orthodontic treatment, and that the action of alcoholic beverages on the mechanical properties of these elastics, such as the degradation of force over the course of time, is a topic hardly touched on in the literature, the authors' proposal in the present study was to evaluate the effects of different alcoholic beverages on the decline in force of orthodontic elastics.

MATERIAL AND METHOD

A total of seven groups were tested, and each of these groups was composed of a total of 15 orthodontic chain elastics. Initially, personalized templates were fabricated in polyvinyl chloride (PVC) tubes. Orifices were made in these, with a horizontal distance of 0.5 mm between them, for the purpose of inserting metal rods that served to support the orthodontic elastic chains. The interior of the tubes was filled with self-polymerizing acrylic resin in order to fix the rods.

The elastics used were of the short spacing type (Morelli, Sorocaba, Brazil). The elastomeric chains were presented in a single continuous chain, which was cut to a standard, so that each cut portion consisted of five links, with two links being used to fix the cut portion to the template. The elastics were placed and distended for a vertical distance of 23.5 mm (Figure 1a).

After the templates were ready, the elastomeric chains were submerged in an artificial saliva solution (Figure 1b). The laboratory experiment was conducted in a period of 28 days; the test specimens were kept immersed in artificial saliva at pH 6.5, in an oven (Splabor, São Paulo, Brazil), at a temperature of 37±1 °C, controlled by means of a digital thermostat and thermometer (Splabor, São Paulo, Brazil), as this is an appropriate temperature for reproducing the conditions of the oral cavity.

The samples being evaluated were immersed in the following media: distilled water (Group 1-control); Whisky: alcohol content 43º (Johnnie Walker Red Label, Edinburgh, Scotland) (Group 2), Brandy: alcohol content 42º (Dreher, São Paulo, Brazil) (Group 3), Vodka: alcohol content 40º (Smirnoff, São Paulo, Brazil) (Group 4), Beer: alcohol content 3.5% (Skol, Fortaleza, Brazil) (Group 5), Sugar cane spirit: alcohol content 43º (51, Pirassurunga, Brazil) (Group 6), Wine: alcohol content 13º (Reservado, Cruce Molina, Chile) (Group 7). In another five receptacles, one for each group mentioned above, artificial saliva was reserved for immersion of the samples.

The chain elastics were removed from the receptacle that contained artificial saliva, washed in distilled water, and dipped in the respective alcoholic beverage solutions, in which they remained immersed for 30 seconds once a day.

Six force measurements were taken during the experimental period of the study, at the following time intervals: 0 (baseline), 1, 7, 14, 21, 28 days. Immediately before being measured, the devices were removed from the receptacles, and the elastic chains were removed from the supporting rods. Force measurement was then performed. Afterwards the elastics were replaced on the test specimen rods, and put back into their respective receptacles. These measurements were taken with a digital dynamometer (Instrutherm DD-300, São Paulo, Brazil). The chain elastics were removed from the templates and placed on the dynamometer, previously calibrated with regard to the distance of 23.5 mm of the templates (Figure 1c). After each measurement, the force measurer was restarted and the values were noted on a control sheet.

After all the groups had been measured, the elastics were fixed on their respective templates, re-inserted into the receptacles of artificial saliva, which were then put into the oven (Splabor, São Paulo, Brazil). The level of saliva in the receptacle was verified every day, so that the elastics would be covered by this solution at all times.

1. *Statistical Procedure*

The analysis of variance (Anova) for repeated measures was used to determine intragroup differences as a function of the time factor, with the comparisons between pairs (time to time) being made by means of the t-test for paired samples. One-way Anova was used to verify intergroup differences in each specific time interval, with the multiples comparisons being made using the Turkey test. The level of significance adopted was 5%. All the analyses were performed with the statistical software program SPSS 16.0 for Windows (SPSS Inc, v.13, Chicago, IL, USA).

RESULT

Comparisons between treatments in the same time interval showed that there were no significant differences between the

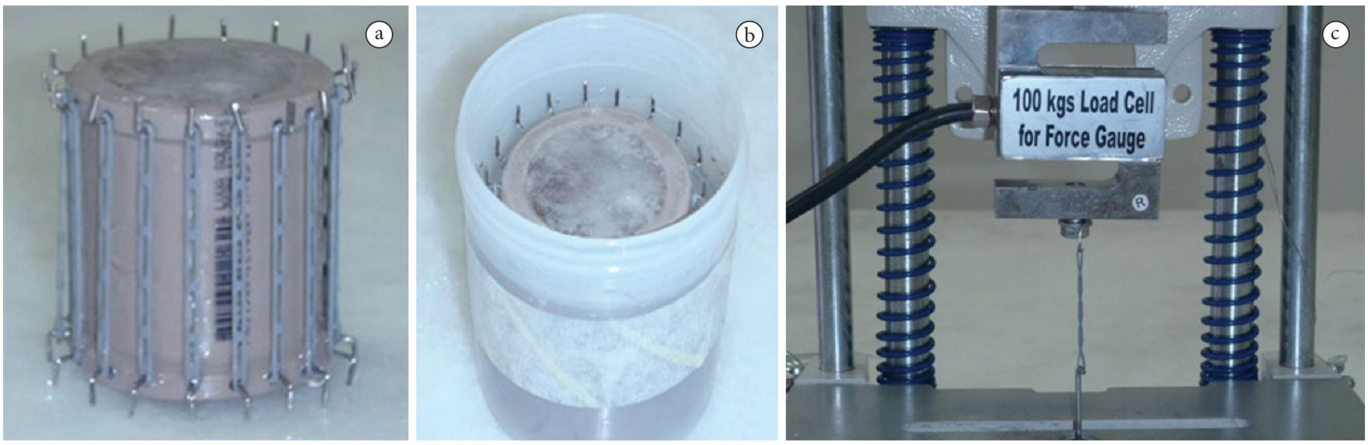

Figure 1. (a) Test specimen with stretched chain elastics. (b) Test specimen dipped in artificial saliva. (c) Digital dynamometer (Instrutherm DD-300), measurement of chain elastic.

treatments in the following time intervals: *baseline*, 7 days, 14 days and 28 days. However, statistical differences were observed in the time intervals of 24 hours and 21 days. In the period of 24 hours, the elastics treated with Sugar cane spirit presented a higher mean force than that of elastics receiving the control treatment. Whereas in the period of 21 days, the mean force of the control group elastics was higher than that of elastics receiving all the other treatments (Table 1).

When the treatments were evaluated individually, considering the time factor, it was observed that there was a significant reduction in force in all the experimental groups over the course of the trial. However, the pattern of decline in force in the groups treated with alcoholic beverages differed from that observed in the control group. While the force declined progressively in the control group up to the end of the experiment (28 days), the entire reduction in force in the experimental groups would occur up to the time of 14 days. In the group treated with wine it was also observed that there was no statistical reduction in force in the first 24 hours, contrary to that verified in the control group and other experimental groups (Table 1).

DISCUSSION

Orthodontic elastics are widely used in Orthodontics due to their capacity to transmit force, low cost, easy application, being relatively hygienic and because they do not need much cooperation from the patient[9,10]. However, they are not considered ideal materials due to the decline in force required for efficient tooth movement[11]. Several studies[6,7,12-14] have been conducted with the purpose of investigating mechanical and environmental factors that contribute to the degradation of force in orthodontic elastics. Santos et al.[2], in a study conducted in 2007, reported that elastomeric chains exposed to piquant foods, humidity and high temperatures presented greater deterioration in force than those exposed to only water, which is in accordance with the findings of Evangelista et al.[10] in 2007, who affirmed that factors such as chemical and salivary enzymes, and variations in temperature and pH, would be associated with relaxation and deformation of the polymer.

Alcoholic beverages and other liquids are frequently consumed in the daily diet, therefore, the influence of these drinks on the quantity of force emitted by elastomers could result in an alarming reality with respect to orthodontic biomechanics. According to Teixeira et al.[15], little is known about the effect of environmental factors, such as foods and drinks, on the property of force of elastomeric materials used. Whereas, Beattie, Monaghan[16] affirmed that although the degradation of orthodontic elastic materials has been studied, the majority of the experiments have been conducted in artificial saliva or air, and that few studies have evaluated them in more aggressive environments. For this reason it is essential to study whether beverages have any effect on this material, in order to in order to ensure that efficient orthodontic movement is performed.

To evaluate the force of elastics during the experimental period, a digital dynamometer (Instrutherm DD-300) was used. This equipment was used in a previous study by Pithon et al.[1], to evaluate the influence of chlorhexidine on the force released by chain elastics. It should be pointed out that while the measurements were made, the room temperature was maintain constant at 25Cº.

During exposure to the oral environment, elastomeric chains have a propensity for absorbing water and saliva, leading to collapse of the internal links, which may result in permanent deformation[17]. In a humid environment, the decline in force releasedby synthetic elastic materials is greater than it is in a dry medium[18]. Therefore, to achieve a simulation as faithful as possible of the conditions in the oral medium, and to reproduce these above-mentioned interactions, in the present study, the elastic segments were kept immersed in artificial saliva. The temperature at which the elastics were kept was 37±1 °C, and it was selected with the intention of reproducing the body temperature, in

Table 1. Means ± standard deviations of the force of elastics (N), according to the treatment and time of the experiment

Treatment	Time						p-Value*
	Baseline	**24 hours**	**7 days**	**14 days**	**21 days**	**28 days**	
Control	0.81±0.10^{a}	0.60±0.11$^{bc\ A}$	0.63±0.08^{b}	0.55±0.05^{c}	0.59±0.06$^{bc\ A}$	0.50±0.04^{d}	< 0.001
Whisky	0.79±0.09^{a}	0.57±0.07$^{b\ A}$	0.58±0.08^{b}	0.48±0.07^{c}	0.48±0.06$^{c\ B}$	0.48±0.06^{c}	< 0.001
Brandy	0.79±0.11^{a}	0.62±0.09$^{b\ AB}$	0.59±0.07^{b}	0.49±0.05^{c}	0.50±0.06$^{c\ B}$	0.53±0.07^{c}	< 0.001
Vodka	0.79±0.07^{a}	0.57±0.06$^{bd\ A}$	0.58±0.07^{b}	0.52±0.06^{c}	0.50±0.06$^{c\ B}$	0.50±0.07^{cd}	< 0.001
Beer	0.78±0.08^{a}	0.61±0.12$^{b\ A}$	0.58±0.09^{b}	0.53±0.09^{bc}	0.50±0.09$^{c\ B}$	0.49±0.06^{c}	< 0.001
Sugar cane spirit	0.77±0.09^{a}	0.71±0.07$^{b\ B}$	0.56±0.08^{ce}	0.49±0.06^{df}	0.48±0.06$^{df\ B}$	0.51±0.07^{ef}	< 0.001
Wine	0.71±0.11^{a}	0.66±0.08$^{ab\ AB}$	0.60±0.10^{b}	0.47±0.06^{c}	0.47±0.05$^{c\ B}$	0.50±0.06^{c}	< 0.001
p-Value†	0.157	< 0.001	0.281	0.100	< 0.001	0.610	

*Anova for repeated measures. †One-way Anova. ^{abcdef}Values with different superscript lower case letters indicate significant differences in each treatment, according to time (Student's-*t* test for paired samples). ^{AB}Values with different superscript capital letters indicate significant differences in each time, according to treatment (Turkey's test).

addition to bearing in mind that elastic chains are highly sensitive to thermal variations and their properties are changed according to temperature[15,19]. De Genova et al. confirmed this in a study in which he concluded that elastomeric chains submitted to a thermal environment ranging from 15° to 45 °C retained their force better than those submitted to a constant temperature of 37 °C[20].

Teixeira et al.[15] conducted an in vitro study in 2008, and observed the decline in force of elastomeric chains with treatments of Coca-Cola, phosphoric acid and citric acid after 3 weeks. The present study occurred in a period of 4 weeks, because this is the time interval most frequently observed in orthodontic offices, with regard to consultations[1,21]. The size of elastic chains adopted in this study was the short elastic chain, considering that there are differences in the forces exerted by the segments of long and short chains, when stretched over the same distance, so that the segment of the short chain without space between the links has shown higher values of force over the course of time[14,15].

In 2012, Dittmer et al.[22] reported that the expected reduction in the level of initial force during the first 24 hours after the extension of the elastic chains is 50% to 70%, and 30% to 40% of the initial level of force after 28 days. This partly coincides with the results found in this study, in which it was possible to observe that there was a statistical reduction in force in the first 24 hours, both in the control and experimental groups, except for the group treated with wine, and that the entire reduction in force in the experimental groups occurred in up to 14 days.

In the elastomeric chains observed by Teixeira et al.[15], there was greater reduction of first in the first 24 hours. They found that the degradation in force evaluated in the Coca-Cola, phosphoric acid and citric acid media did not present variation in force according to the immersion and treatment in the different media.

In the present study the results demonstrated that the elastics submitted to treatment with alcoholic beverages presented statistical differences between treatments only at the time intervals of 24 hours and 21 days. The group treated with wine showed no statistical reduction in the percentage of force in the time interval of 24 hours, contrary to all the other experimental groups and the control. Furthermore, in the experimental groups, the reduction in force occurred in up to 14 days, whereas the control group elastics presented a gradual reduction in force up to 28 days, and at 21 days, presented a higher mean force than elastics subjected to all the other treatments.

In spite of the pattern of decline in force in the groups treated with alcoholic beverages having differed from that observed in the control group at the end of the experiment in the time interval of 28 days, there were no significant differences between the treatments. Although there was a difference in the values between the groups in two time intervals, the results obtained pointed out that alcoholic beverages have no significant influence on the decline in force of chain elastics.

CONCLUSION

Based on the results found in this study, it may be concluded that:

The alcoholic beverages did not promote loss of force in the chain elastics.

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CONFLICTS OF INTERESTS

The authors declare no conflicts of interest.

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