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EFFECT OF PERACETIC ACID ON ORTHODONTIC ELASTICS: AN IN VITRO EXPERIMENT

Efeito do ácido peracético nos elásticos ortodônticos: um estudo in vitro

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RESUMO

Objetivo: Este estudo teve como objetivo avaliar a elasticidade de elásticos ortodônticos após desinfecção e esterilização com ácido peracético 0,2%. **Materiais e métodos**: Neste estudo piloto in vitro, elásticos ortodônticos Morelli® e American Orthodontics™ nas cores cinza e cristal foram divididas em três grupos experimentais: Grupo 1, imerso em água destilada por 72 horas, Grupo 2, imerso em peracético 0,2% por 10 min (para desinfecção) e Grupo 3, imerso em ácido peracético 0,2% por 30 min (para esterilização). Após a imersão, os valores de resistência à tração dos elásticos foram analisados em uma máquina de ensaios universal (EMIC DL-1000) para avaliar a resistência, em Newtons, necessária para a ruptura dos mesmos. A normalidade dos dados foi avaliada pelo teste de Shapiro-Wilk e os dados dos diferentes grupos experimentais foram comparados pelo teste ANOVA. **Resultados**: Para ambas as marcas, não houve diferença estatisticamente significativa entre os grupos experimentais quanto à resistência à tração. **Discussão**: O estudo apresentou um método alternativo para a desinfecção e esterilização de materiais termossensíveis. **Conclusão**: Assim, podemos concluir que a desinfecção e esterilização dos elásticos ortodônticos com ácido peracético 0,2% não alterou seu módulo de elasticidade.

Palavras-chaves: Ácido peracético. Ortodontia. Desinfecção. Esterilização.

ABSTRACT

Aim: This study aimed to evaluate the elasticity of orthodontic elastics after disinfection and sterilization with 0.2% peracetic acid. **Materials and methods**: In this *in vitro* pilot study, Morelli® and American Orthodontics™ elastic bands in gray and crystal colors were divided into three experimental groups: Group 1, immersed in distilled water for 72 hours, Group 2, immersed in 0.2% peracetic acid for 10 min (for disinfection) and Group 3, immersed in 0.2% peracetic acid for 30 min (for sterilization). After immersion, the tensile strength values of the elastics were analyzed in a universal test machine (EMIC DL-1000) to evaluate the strength, in Newtons, necessary for their rupture. Normality of the data was assessed using the Shapiro-Wilk test, and data from the different experimental groups were compared using the ANOVA test. **Results**: For both brands, there was no statistically significant difference between the experimental groups regarding tensile strength. **Discussion**: This study presented an alternative method for the disinfection and sterilization of thermo-sensitive materials. **Conclusion**: Thus, it can be concluded that the sterilization of orthodontic elastics with 0.2% peracetic acid did not change their modulus of elasticity.

Keywords: Peracetic acid. Orthodontics. Disinfection. Sterilization.

INTRODUCTION

The standard method for sterilizing dental materials and instruments is moist heat in an autoclave. However, not all materials, such as orthodontic elastics, are resistant to the heat generated by this process. Therefore, other methods, such as chemical sterilization, are sometimes required[1-3].

Several chemical agents that are easy to handle, low in cost, fast action, and low in toxicity, with no residual effects have been developed[3,4]. Among them, 0.2 % peracetic acid has been widely evaluated. Ceretta et al.[5] analyzed the sterilizing properties of peracetic acid, showing that in contaminated dental materials, there was no proliferation of microorganisms after 20 minutes of immersion in the solution. The peracetic acid has germicidal, bactericidal, fungicidal, virucidal and sporicidal properties[3,6,7]. The Brazilian Ministry of Health[8] approved the product (Decree Number 122; 29/11/1993) as an efficient and safe microbicidal agent. Peracetic acid does not chemically react with glass but it does react with some plastics, including rubber and silicone, causing them to dry out or become rigid, depending on their porosity[3]. This characteristic may contraindicate the use of peracetic acid in certain circumstances, where either the elasticity or material property is likely to change, as is the case with orthodontic elastics.

Therefore, the aim of this study was to evaluate whether immersion in 0.2% peracetic acid, for disinfection or sterilization purposes, would alter the elastic properties and thus tensile strength of elastomeric ligatures.

MATERIALS AND METHODS

Elastomeric ligatures were divided into two experimental groups and a control group according the immersion protocol (n=120, 40 in each group). Each group was divided into four sub-groups according commercial brand (Morelli® - Sorocaba, SP, Brazil; and American Orthodontics™ - Sheboygan, USA) and color (gray and crystal) (Table 1).

Table 1 – Description of the experimental groups

Group	Subgroup	Solution of immersion	Time of immersion
Control group (CG)	1: Gray elastic Morelli	Distilled water	72 hours
	2: Crystal elastic Morelli		
	1: Gray elastic American Orthodontics		
	2: Crystal elastic American Orthodontics		
Disinfection group (DG)	1: Gray elastic Morelli	0.2% Peracetic Acid	10 minutes
	2: Crystal elastic Morelli		
	1: Gray elastic American Orthodontics		
	2: Crystal elastic American Orthodontics		
Sterilization group (SG)	1: Gray elastic Morelli	0.2% Peracetic Acid	30 minutes
	2: Crystal elastic Morelli		
	1: Gray elastic American Orthodontics		
	2: Crystal elastic American Orthodontics		

The elastics of Groups DG and SG were disinfected and sterilized with 0.2% peracetic acid (Voxilon®AN, São Paulo-SP, Brazil), respectively, according to the manufacturer's recommendations.

Group 1 elastics were immersed in distilled water for 72 hours, washed with distilled water and dried with sterile gauze. Groups 2 and 3 were immersed in 0.2% peracetic acid for 10 and 30 minutes, respectively, washed with distilled water and dried with sterile gauze. (Table 1)

After immersion, the experimental groups were tested for tensile strength (Newtons, N) in a universal test machine (EMIC DL - 1000, São José dos Pinhais,

Brazil) at the Post-Graduation Laboratory of the Federal University of Santa Maria (UFSM, RS) with a speed of 1mm/min. (Figure 1)

Figure 1 - Pull test on EMIC

Statistical analyses of the data were performed using SPSS 23.0 (SPSS Inc, Chicago, IL). Data were analyzed for normality using the Shapiro-Wilk test and ANOVA was used to explore any between group differences.

RESULTS

It is observed that for the Morelli® brand, when evaluating the gray color, there was no statistically significant difference between the 3 experimental groups (p=0.61). such condition is also perceived for the Morelli® crystal color, where no difference was observed statistically significant between groups (p=0.38). For the brand American Orthodontics™, when evaluating the gray color, no statistically significant difference between the 3 groups (p=0.40). The same happened for the crystal color groups, where there was also no statistically significant difference (p=0.16).

The data obtained for means, standard deviations, and minimum and maximum values for tensile strength in the three experimental groups are given in Table 2.

Table 2 – Post-immersion Tensile strength values of two brands of orthodontic elastics post-immersion.

	Mean (sd)	Min	Max
GC1	19,23 (3,33)[a]	12,45	22,98
GC2	16,1 (2,96)[b]	12,51	21,85
GC3	16,68 (1,1)[c]	14,89	18,83
GC4	19,37 (1,14)[d]	17,28	20,56
GD1	19,54 (0,9)[a]	12,65	21,66
GD2	18,36 (3,25)[b]	13,02	21,64
GD3	17,07 (0,88)[c]	15,26	18,13
GD4	19,87 (0,58)[d]	18,52	20,4
GS1	18,49 (0,87)[a]	12,65	21,66
GS2	16,69 (1,07)[b]	17,23	20,54
GS3	16,51 (0,81)[c]	15,43	17,96
GS4	19,11 (0,8)[d]	17,64	20,2

Mean values in each row with equal lowercase letters are not significantly different ($p > 0.05$).

DISCUSSION

The Brazilian Ministry of Health[8] has stated that some plastic materials, including rubber and silicone, suffer from dryness or rigidity after immersion in 0.2% peracetic acid. This study demonstrated that 0.2% peracetic acid had no effect on the tensile strength of orthodontic elastics in one single immersion. Rather, our results support those of Losito et al.[9], who found no change in the tensile properties of rubber after disinfection and sterilization with acidic agents.

In orthodontic clinical practice, elastics are typically exposed to air, fluids (spittle) and droplets. Moreover, patients are provided with the elastics in amounts exceeding the number required, increasing the risk of cross-contamination. Thus, disinfection of

orthodontic elastics is of paramount importance, however not all clinical resources are sterilized or disinfected because of their intolerance to heat. Our study presented an alternative method for the disinfection and sterilization of thermo-sensitive materials, such as orthodontic elastics, using a chemical agent, 0.2% peracetic acid[3], without risk of altering material elasticity.

After analyzing and describing the results, it was found that there was no difference statistically significant between the different experimental groups, for the tests of tensile strength.

The results of this study corroborate those of Fracaro et al.[10], where the authors reported that there was no change in some materials, including rubber, plastic or silicone, compared to disinfection and sterilization with acidic agents.

It is ratified, according to Dourado[4] that disinfection is of paramount importance, since that orthodontic elastics exposed to oral fluids can contaminate them and consequently to all professionals who will manipulate them, causing infections crusades. Monteiro et al.[11] reported in their study that not all resources used in the offices undergo sterilization or disinfection, as they cannot be submitted to the heat. The present work presented an option for disinfection and sterilization of orthodontic elastics, thermo-sensitive materials, due to the possibility of reducing the levels of contamination, without altering its modulus of elasticity.

In orthodontic clinical practice, elastics are stored in a storage box of acrylic. When the patient is asked to choose the color of the orthodontic elastic, the box is open and are exposed to fluids and air droplets. Furthermore, the elastics orthodontics are usually presented in a quantity greater than necessary for the use on a patient. This means that, each time the box is opened, different types of microorganisms proliferate on elastics, with a high risk of cross-contamination.

Thus, the use of 0.2% peracetic acid would be an essential indication for assist this process.

The peracetic acid used for disinfection purposes must have a concentration of 0.2%, being placed in a contamination-free plastic or glass container with cover also decontaminated, so that changes do not occur in its properties. Dental instruments/materials, already clean and dry, must be subjected to immersion in acid for a period of 10 minutes. Afterwards, they must be removed and washed under running water, dried with clean compresses and kept in a clean and with good ventilation. For chemical sterilization purposes, the product must be placed in an

closed container as described for disinfection. The difference will be the time of immersion. For sterilization, the period will be 30 minutes, and when the instruments/materials are removed from the solution, this must be done with the aid of a sterile tweezers to avoid contamination. Washing should be carried out with a solution sterile saline, or sterile water or dry with sterile swabs. You instruments/materials must be kept in sterile places, so that they do not come into contact with contact with the external environment, preferably inside a sterile envelope, or metal boxes sterile[12].

Finally, how can orthodontic elastics favor the proliferation of infections crosses, due to handling and difficulty in sterilization, 0.2% peracetic acid becomes a safe and effective alternative for disinfection and sterilization.

Despite being a pilot study, in vitro, it is essential for practices, as the tests laboratories are also necessary for decision-making and standardization. Like this, it is essential to expand the sample size of the experimental groups, as well as carry out more studies with this theme, so that the results are extrapolated, for the safe clinical practice.

However, further investigations with longer immersion periods are required.

CONCLUSION

This study suggested that one single immersion for the purposes of disinfection and sterilization with 0.2% peracetic acid did not alter the tensile strength of orthodontic elastomeric ligatures.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest.

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