DEGRADATION OF FIBERGLASS POSTS TREATED UNDER DIFFERENT DISINFECTANTS: AN IN VITRO STUDY

Joel Andrés Morales Parra [1], Luis Felipe Barría Pérez [2]

Email address: joel.morales.p@gmail.com, luisfelipebarria@gmail.com

[1,2] School of Dentistry, Universidad Austral de Chile, Valdivia, Chile

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Abstract:

Purpose: Manufacturers' instructions of fiberglass posts recommend disinfestation of a post by the use of solvents before the cementation. Nevertheless, this procedure does specify neither the time of exposition, nor the graduation of that disinfectant. Although there are studies that have shown the decrease of the adhesion post-duct, the possible damage of the disinfestation in the ultra-structure of the post, and the characterization or the quantification of the release of the organic matrix have not been investigated. Therefore, the present study aimed to quantify and compare the released material from fiberglass post after disinfection.

Methods: For the quantitative analysis, posts were immersed at different times in: sodium hypochlorite 5%, ethanol 70%, ethanol 95%, or distilled water (control). The subsequent samples were collected. Then, samples were subdued to molecular absorption spectrophotometry (UV-visible ThermoSpectronic - Helios Gamma), getting the corresponding absorbance of each of these, which is characterized as a loss of material. This was compared to the absorbance of the molecule of Bis-GMA, which has its peak at 270 mm of wavelength. The data was analyzed with the software Vision 32. The qualitative analysis was done with scanning electron microscope (LEO 420).

Results: The concentration substances from the fiberglass posts were directly proportional with respect to the time of exposition to the three types of disinfectants. At 20 minutes, the concentrations of loss in the fiberglass post were significantly higher in 5% sodium hypochlorite (1,22E-2 grams) compared to 70% ethanol (0,23E-2 grams) and 95% ethanol (0,05E-02 grams). There was not a loss in the control group subdued to distilled water.

Conclusion: The present data suggests use 95% of ethanol for disinfection of fiberglass posts due to the lower degradation of fiberglass posts after disinfection when this solvent was used.

KEYWORDS: Damage, Degradation, Disinfection, Fiberglass posts, Scanning electron microscopy, Spectrophotometry.

Introduction

The resistance of the teeth under an endodontic treatment has been thoroughly studied, and many of its concepts are in continuous revision. The fiberglass posts (FP) are used in intraradicular restorations of teeth receving endodontic treatment. Fiberglass posts give a solid base to increase the mooring to get the prosthetic restoration, prevent the fracture of the teeth under endodontic treatment, and proportionate support and internal resistance (1).

The oldest references of prosthetic restorations in severely destroyed teeth date from the period of Tokugawa (1603-1867) in Japan. They created a dental Crown with black boxwood, which was very aesthetic in that time. During 1728, Pierre Fauchard inserted wood spikes inside the radicular channels of the teeth in order to improve the retention, but he failed due to the absence of resistance and absorption of the humidity in the mouth. In 1746, Claude Hounton published his design of the gold crown with an endopost made of the same material that was put in the radicular channel. Then, in 1747, Pierre Fauchard used gold and silver endoposts covered with an adhesive soften by

heat, a process called "mastic". In 1970, a new era of endoposts was born; the prefabricated metal endoposts that had different forms and length were introduced. Later, in 1987 in France, the first post made of carbon fiber was introduced, which was commercialized in 1990 in USA. Carbon fiber post offered less elasticity than metals or conventional alloys. It had characteristics similar to the dentin that gave more resistance to the fracture. It was demonstrated that the carbon fiber was more resistant than the prefabricated metallic posts and the post-core units. Subsequently, in order to improve the aesthetic, the fiberglass posts were created.

The post-core posts are used more scarcely due to the cost in comparison to the prefabricated ones. Besides, they demand more time to build, and they can cause damage to the dental structure since they can provoke more corrosion. However, they have a close relation with the dental structure and with the conformation of the radicular channel (2, 3). On the other hand, the prefabricated posts have an easier implementation, and they demand less time and less cost. At the beginning, prefabricated posts were just made of titanium and stainless steel. Nowadays, with the creation of different fibers, the structure and properties of prefabricated posts are similar to the natural dental structure, offering more success during restorations (2, 3).

The indicated protocol in the technical datasheet of the fiberglass includes the disinfestation of the post through different solvents. Nevertheless, this protocol does determine neither the time of exposition, nor the graduation of this disinfectant. It has been demonstrated that this disinfestation affects the adhesion of the fiberglass post during the restoration process (4). In spite of the fact that there are studies about this situation, the majority of them are focused in the capacity of adhesion post-restoration (5), and they do not consider neither the possible damage that the disinfestation provoke in the ultrastructure of the fiberglass post, nor the characterization and quantification of the release of the organic matrix.

There are still several questions regarding the loss of material in the post when disinfesting and also about the variation of this loss of material between different disinfectants in different clinical times of exposition.

Therefore, the present study aimed to quantify and compare the released material from fiberglass post after disinfection by 5% sodium hyplochlorite, 70% and 90% ethanol. For this purpose, molecular absorption spectrophotometry (MAS) was used.

Materials and Methods

Quantitative characterization

In the present study, 78 RTD fiberglass posts (RTD, St. Egreve, France) of 19 mm length were used. 72 posts were divided in the three equal experimental groups of 24 posts. Each of these groups were subdued to a specific solvent: 5% sodium hypochlorite, 70% ethanol, and 95% ethanol, respectively. In the control group, which consisted of 6 samples, posts were processed in distilled water. All posts were immersed in Eppendorf tubes in the described solvents. The measurements were made at the following times: 1, 3, 5, 7, 10 y 20 minutes. Four measurements were made at each time in order to obtain average values. After filtration, 2 ml. of each solvent were collected using a micropipette in order to develop an absorbance of the released substances by comparing them to the calibration curve of the molecule Bis-GMA, which absorbance peak was 290 nm of length wave. This last procedure was done through a spectrophotometer (UV-visible ThermoSpectronic - Helios Gamma). The measurements were analyzed with the software Vision 32. Two-way ANOVA test was used to analyzed the data by the software PRISM 6 TRIAL (GraphPad).

Qualitative characterization

After this procedure, four posts (one from each group) were taken and were analyzed through scanning electron microscopy, using the SEM model LEO42.

Name	Type	Composition	Percentage of filling	Developer	Lot
Fiberglass post	1.4#	60-70% fiberglass	30%	RTD	16310 1104

Table 1. Composition of the fiberglass posts used in this study.

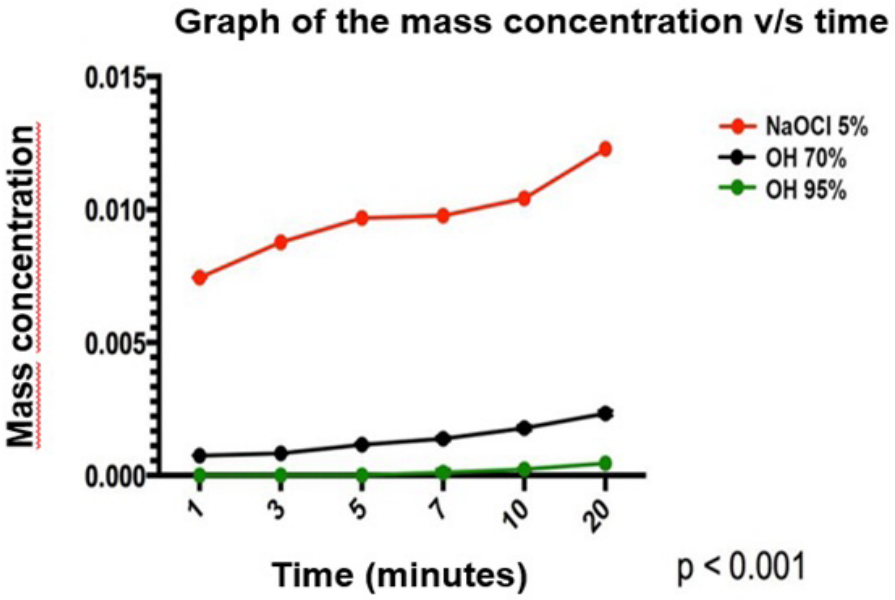

Figure 1: Degradation graphic of the organic material in mass concentration of grams (MEDIA+SD) v/s time in minutes of different solvents.

Results

Quantitative results: The released substances were found to be directly proportional with the time in the three types of disinfectants (Figure 1). At the end, at 20 minutes, the final concentrations of the released substances were significantly higher in 5% sodium hypochlorite (1,22E-2 grams) compared to 70% ethanol (0,23E-2 grams) and 95% ethanol (0,05E-02 grams). In each of the four measurements per experimental groups the standard deviation produced results minor to 0.001.

Qualitative results: The qualitative results are demonstrated in figure 2.

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Discussions

The clinical success of a resin post-core restoration depends not only on the type of composed resin, but also on the quality of the interface of the post-core, where the different materials are in minimal contact (6). The Longevity of a restoration is affected by the formation of a strong union between the composed resin and the fiber post, which can present variation according to the previous treatment in the post (7, 8, 9, 10).

The nature of Bis-GMA molecule (main component of the epoxy resin in fiberglass posts), composed by two rings that are highly hydrophobic; therefore, Bis-GMA molecule is soluble in polar solvents like the ethanol. The present data shows that the degradation of the fiber post in 70 % ethanol was directly proportional to the time. This could be attributable to the fluency of the 70 % ethanol (product of greater concentration of water, and phenomenon of transportation that creates this at the moment of being combined with alcohol), which can produce an inflammation in the fiberglass. This inflammation facilitates the appearance of solvents, which can react when mixed with the Bis-GMA molecule. This would be the responsible mechanism of extraction in the loss of resin that has not reacted in ethanol 70%, process that is more evident in NaClO. Therefore, the molecule of Bis-GMA is affected in concentrations of dependent alcohol, and not the fiberglass pole.

The degradation of the organic matrix of fiberglass posts could affect the adhesion of the fiber post in the radicular channel. This is an area that has not been explored, since there are not studies that consider this loss of material as a cause of failures in the strength and adhesion properties.

It is important to note that, in the present study, only the amount of release Bis-GMA from fiberglass posts were evaluated. Therefore, further studies are required to investigate the amount of other released substances from fiberglass posts.

Conclusion

The present data suggests superiority of 95% ethanol over 70% ethanol or 5% sodium hypochlorite for disinfection of fiberglass posts due to the lower degradation of fiberglass posts during disinfection when 95% ethanol was used.

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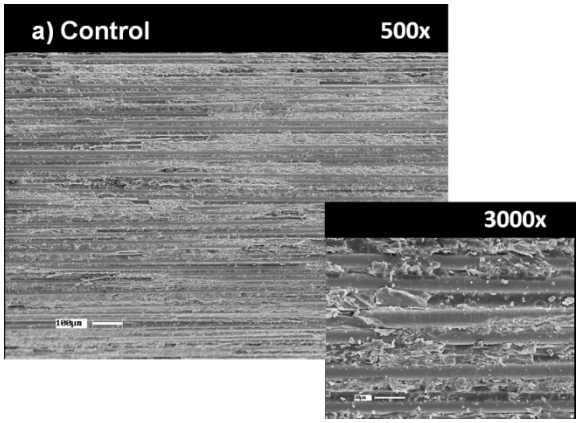
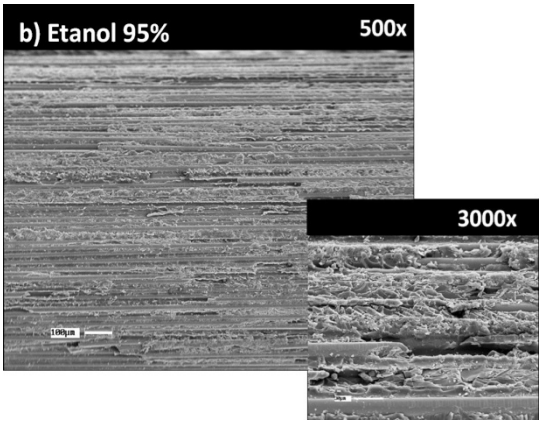
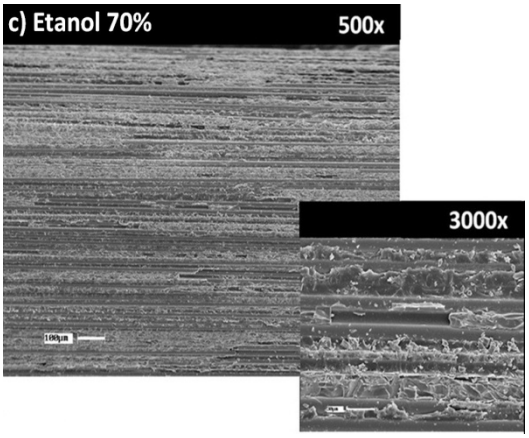


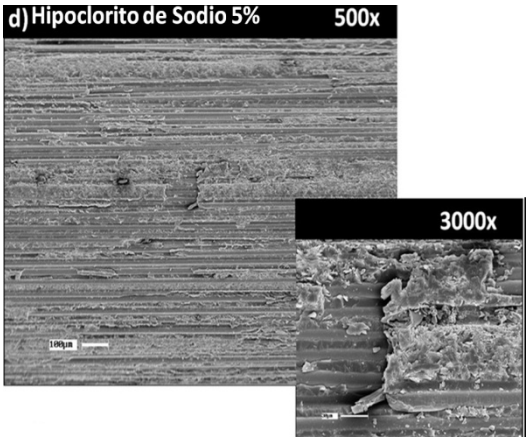
a) Control fiber post without modifications in its original state. 500x a smooth surface. 3000x there are not fibers exposed, since they are covered with epoxic resins.



b) Fiber post in ethanol 95%. 500x it is observed little irregularities in the organic matrix. 3000x crystal structure slightly affected (raising).



c) Fiber post in ethanol 70%. 500x The raising of the matrix is more noticeable. 3000x major damage.



d) Fiber post in sodium hypochlorite 5%. 500% it is seen more degradation. 3000x the structural damage is noticeable.

Figure 2. Photographs of scanning electron microscopy SEM (500x and 3000x) in three minutes of exposition.

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