Revista Odontológica Mexicana
Facultad de Odontología
Vol. 19, No. 1 ● January-March 2015
pp 38-42
ORIGINAL RESEARCH

In vitro assessment of root canal leakage of two post-endodontic reconstruction systems

Evaluación in vitro *de filtración hacia conducto radicular de dos sistemas de reconstrucción post endodóncica*

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ABSTRACT

The aim of the present study was to assess the degree of microleakage observed when using two different post-endodontic reconstruction systems; this was achieved assessing penetration of a dye along restorations performed with endodontic posts and dual-cure resin cements. For the present study, 30 extracted, single rooted premolars were used. Root canal treatment was performed on the teeth which were later stored in bi-distilled water at 37 °C. Teeth were randomly allotted to three groups, all groups were comprised of 10 teeth. In two groups, post cementation was performed using the systems RelyX Fiber Post (3M ESPE dental products) and Parapost (Coltene-Whaledent). Samples were subjected to thermo-cycling and later immersed in methylene blue for seven days at 36 °C. After this, samples were subjected to a diaphanization process and were then analyzed under a microscope; penetration in millimeters was thus obtained. Results revealed that teeth treated with Parapost system exhibited lesser microleakage. Control group experienced the greater amounts of microleakage. Statistical analysis conducted with Donett test showed statistically significant difference between Parapost and RelyX systems. **Conclusion:** Parapost reconstruction system (Coltene-Whaledent) with acid-etch technique exhibited lower microleakage values. Results were statistically significant when compared to those obtained with the RelyX reconstruction system (3M ESPE dental products).

Key words: Endodontic post, microleakage, thermocycling.

RESUMEN

El objetivo de este estudio fue el de evaluar el grado de microfiltración en dos sistemas de reconstrucción post endodóncica, valorando la penetración de un colorante a lo largo de las restauraciones realizadas con endopostes y cementos duales de resina. En este estudio se emplearon 30 dientes premolares unirradiculares extraídos a los que se les realizó tratamiento de conductos y almacenándolos en agua bidestilada a 37 °C. Se distribuyeron los dientes en tres grupos de forma aleatoria, con diez dientes por cada grupo. La cementación de los postes se realizó en dos de los grupos, usando los sistemas RelyX Fiber post (3M ESPE dental products) y Parapost (Coltene-Whaledent). Las muestras fueron sometidas al proceso de termociclado y posterior inmersión en azul de metileno por siete días a 36 °C. Posteriormente se diafanizaron las muestras y fueron analizadas bajo microscopio, obteniendo los valores de penetración en milímetros. Los resultados mostraron que los dientes tratados con el sistema Parapost presentaron menor microfiltración. El grupo control mostró el mayor índice de microfiltración. El análisis estadístico con la prueba de Donett, mostró diferencia estadísticamente significativa entre los sistemas Parapost y RelyX. **Conclusión:** Se demostró que el sistema de reconstrucción Parapost (Coltene-Whaledent), el cual tiene una técnica de grabado ácido, reportó menores valores de microfiltración, siendo los resultados estadísticamente significativos con respecto a los obtenidos con el sistema de reconstrucción RelyX (3M ESPE dental products).

Palabras clave: Endoposte, termociclado, microfiltración.

INTRODUCTION

Endodontically treated teeth require reconstruction. One of these reconstruction treatments comprises placement of endodontic posts. These posts are devices which allow recovery of tooth tissue lost during the endodontic procedure as well as facilitate the reconstruction of the treated tooth.[1]

Currently, one of the most significant factors in endodontic treatment prognosis is the suitable restoration of teeth which have been subjected to root canal treatment.[2,3]

Techniques using endodontic posts are among current techniques used to reconstruct teeth after

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endodontic treatment. Endodontic posts can be cast (metallic), made of carbon fiber, glass fiber, tungsten fiber, porcelain, zirconia, or even made of combined materials. Presently, we can report that glass fiber posts are the most widely used in post-endodontic reconstruction. Specific cementation techniques are required in order to suitably place those posts. These techniques will encompass use of resin-based dual cement techniques. It has been established that resin-based materials suffer microleakage activities, which are intrinsic to the contraction caused by the polymerization of resin monomers.[2,4]

Dental research purports as one of its main targets to understand how a restoration material will behave with the passing of time. New techniques used to cement endodontic glass fiber posts are presently being discussed and analyzed. All endodontic post restorations systems have the main objective of simplifying technique applications and at the same time improving specific adhesion to tooth tissues. Therefore, the fact of conducting studies which will allow us to understand the behavior of these materials is vital to offer better treatment and be able to establish a long term prognosis based on scientific evidence.[5]

Factors which can significantly alter the restoration's clinical behavior are the geometric shape of the endodontic glass fiber posts as well as the chemical nature of cementing agents. A truncated conical shape with blunt tip constitutes the simplest geometrical shape applied to glass fiber endodontic posts. This shape facilitates placement of the post into the cavities shaped with the unblocking burrs. With current improvement of glass fiber endodontic posts, we can now find shapes of super-posed cones which improve mechanical retention to the cavity, nevertheless, their influence in microleakage through the restoration itself is yet to be determined.[6]

One of the advantages inherent to almost all reconstruction systems with glass fiber endodontic posts is the possibility of having in the same working kit unblocking burrs, different gauges of endodontic posts as well as cements and adjuvants required to undertake an effective application of the reconstruction system according to manufacturer's instructions. There are reconstruction systems with different techniques which include acid-etch and self-etch. According to each manufacturer, similarities and differences will be found among all these reconstruction systems.[7]

Cements based on the chemical nature of the resins are presently materials preferred for use in reconstruction systems involving fiber glass endodontic posts. From the endodontic perspective, analyzing the behavior of these cements within the root canal becomes a priority, since long term follow-up of treatment evolution will generally be parallel to the behavior of the prosthetic reconstruction performed.[8,9]

The purpose of the present *in vitro* study was to assess the amount of microleakage suffered by post endodontic reconstruction systems based on adhesive dentistry principles. The present study will assess dye penetration along restorations performed with endodontic posts and resin dual cements, and will present the hypothesis that traditional system of acid etch will exhibit lesser microleakage.

MATERIALS AND METHODS

30 recently extracted (maximum six months) mandibular premolars were selected. All organic tissue was removed from root and crown areas. Samples were examined with bucco-ingual and mesio-distal oriented X-rays. Teeth were discarded when they exhibited more than one root canal, incomplete apical formation, obstructed root canals or evidence of internal resorption. An attempt was made to find samples with similar diameter, longitude and root anatomy.[10]

Three groups comprised of 10 teeth each were created, teeth were randomly allotted to each group. All teeth within the sample were subjected to root canal treatment; vertical condensation technique and Sealapex cement were used (resin based endodontic cement, SybronEndo USA).[7,10]

Once teeth were prepared and filled, the coronary portion of the samples was removed with carbide disk and profuse irrigation. The remaining root portion measured 14 mm after the cutting process, it also measured 7-9 mm in both mesial-distal and vestibular-lingual directions.[10-12]

Group one was selected as control group. Teeth belonging to that group were only subjected to root canal treatment. Root access was left uncoated.[13]

Group two: Teeth belonging to group two were subjected to root unblocking process with RelyX Fiber post system (3M ESPE dental products).

Group three: Teeth belonging to this group were subjected to the Parapost system (Coltene-Whaleadent). Teeth were unblocked to 11 mm length using burr number 5. Paracore cement was used (Coltene-Whaledent) according to manufacturer's instructions. Samples were stored in bi-distilled water at 37 °C.

Following post cementation, twin X-rays were taken in order to corroborate the application of the reconstruction system.[11]

After this, teeth in all three groups were coated in the root portion with fast-drying nail polish, leaving the coronary portion uncoated. (Saeed Moradi, 2009). Groups were immersed in 2% methylene blue solution for seven days at constant 37 °C ± 2 °C temperature (Lester C. Reid 2003). 24 hour later, all three groups were subjected to a thermo-cycling process of 500 cycles. Each cycle spanned one minute distributed as follows: 20 seconds at a temperature of 10 °C ± 5 °C, 20 seconds allowed for translation and 20 seconds at 55 °C ± 5 °C. Samples were later stored in bi-distilled water for 12 hours.[6,12,13] When 12 hours had elapsed, the enamel coating of the root portion was totally removed. A double zero set of curettes (HuFriedy brand) was used as well as ultrasound (Varios 350, NSK Japan) with abundant irrigation. All three groups were subjected to a diaphanization process *(Figures 1 and 2)*. Samples were examined with a microscope at 10x, (MΦў 1.14 Russia) at a 10x augmentation in order to assess dye penetration into the glass-fiber post reconstruction system. Obtained values were expressed in millimeters. One single operator undertook all measurements.

RESULTS

Table I shows results for control and test groups when using reconstruction systems Parapost and RelyX. All samples exhibited microleakage *(Figures 1 and 2)*.

RelyX system (3M dental products) was used in group 2. This group exhibited greater microleakage values when compared to values of group 3 where Parapost (Coltene-Whaledent) reconstruction system was used *(Figures 1 and 2)*.

According to obtained values and ANOVA statistical analysis, significant differences could be observed within microleakage tests *(Tables II to IV)*.

Table I. Microleakage of different groups expressed in millimeters.

Control group	Parapost	RelyX
9.2 mm	1.2 mm	7.2 mm
10 mm	3.3 mm	4.5 mm
10 mm	2.35 mm	3.3 mm
10 mm	2.1 mm	3.1 mm
10 mm	2.8 mm	2.3 mm
9.5 mm	3.1 mm	2.2 mm
9.4 mm	2.4 mm	3.3 mm
10 mm	2.5 mm	5.4 mm
10 mm	4.5 mm	4.3 mm
9.45 mm	2.8 mm	4.6 mm

DISCUSSION

In the present study, reconstruction systems were used in teeth previously subjected to root

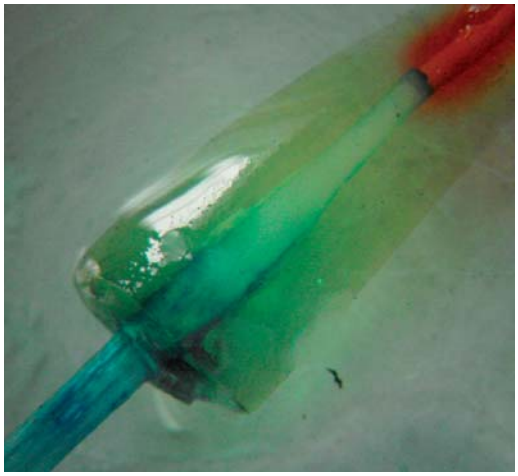

Figure 1. RelyX system endodontic post (3M ESPE dental products) exhibiting microleakage through the dentin-post inter-phase.

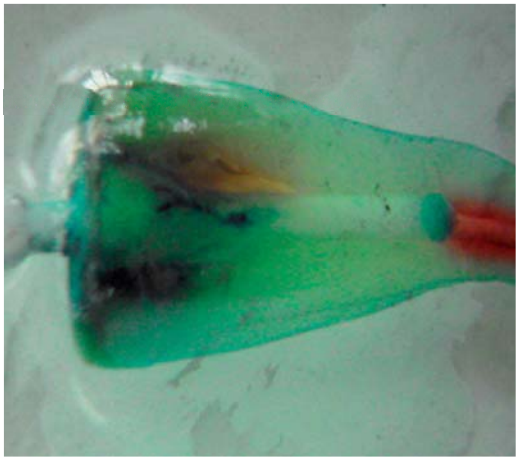

Figure 2. Parapost system endodontic post (Coltene-Whaledent). Microleakage can be observed through the dentin-post inter-phase.

Table II. Statistical analysis among experimental groups.

Group	Average	Standard deviation	CV
Control group	9.755	.123	-
Group 2 parapost	4.01	.161	.161
Group 3 RelyX	2.705	.351	.341

Table III. One factor variance analysis.

Groups	Count	Sum	Average	Variance
Grupo Control	10	97.55	9.755	0.10580556
RelyX	10	27.05	2.705	0.73802778
Parapost	10	40.1	4.01	2.33433333

Table IV. Variance analysis.

Origin of variations	Sum of squares	Degrees of freedom	Average of squares	F	Probability	Critical value for F
Among groups	281.3685	2	140.68425	132.7975	1.06858	3.35413082
Within groups	28.6035	27	1.059388889			
Total	309.972	29				

canal treatment. They were filled with gutta-percha and calcium hydroxide based sealer; these are the materials most recommended to be used in the clinic. None of the reconstruction systems achieved microleakage prevention; all specimens showed dye penetration into the restoration in different degrees. A clinical operator can partially control the following factors; root canal morphology, real volume of root canal preparation, presence of dentin debris, distribution of filling cement and adhesive systems, endodontic obturation technique[14] and the possibility of totally removing the endodontic sealing cement.[15] In the present study, we were able to control the following factors: tooth diameter, tooth length, presence of one single canal as well as thickness of used endodontic posts. Other factors which were outside the influence of the operator during use of reconstruction systems were: presence of dental tubules obstructed by dentin debris, irregularities of root canals after preparation to place endodontic posts and finally, thickness of root canal walls after preparation of the space to receive endodontic posts.[16]

Dr. Bachicha, in 1998, compared fluid microleakage along metallic posts and carbon fiber posts. The aforementioned posts were cemented with different materials, exhibiting thus microleakage variations according to the cement used during post endodontic reconstruction. In the present study, two types of dual-cure resin cements were used. Dual-cure cement RelyX embodies a system of acid etching and adhesive application in one single step. This system exhibited greater microleakage indexes than the other tested system, Parapost. Parapost system presents a step-by-step adhesion system, where acid etching and adhesive placement are independent endeavors. This system exhibited lower microleakage values.[7]

In 2006, Dr. Rogic Barbic assessed microleakage indexes of different adhesive systems applied to reconstruction systems based on glass fiber posts. In this study, Fuji brand cement (glass ionomer) and Variolink II cement (resin based cement) exhibited the lowest microleakage values. Based on the aforementioned, in the present evaluation, it was decided to use two reconstruction systems based on dual-cure resin cements.[12]

In the present study, the method to assess microleakage in the tooth-restoration inter-phase was to subject all samples to a thermo-cycling process, and to immerse them later into methylene blue solution. The process of microleakage has been assessed with different methods, which vary from the use of dyes to use of radioactive isotopes, or even in some studies, bacterial cultures have been used as well as protein tracers derived from the same cultures.[16] The advantages of adhering to a thermo-cycling technique with later sample immersion into dyes is the fact of being able to analyze relatively rapidly the effect of the laboratory work on the samples. Additional factors favoring this laboratory technique are the similitude to real circumstances of the oral cavity as well as ease to replicate the study for later analysis of other system of post endodontic reconstruction.

CONCLUSIONS

After methodology observed in this research study, it was established that Parapost reconstruction system, (Coltene-Whaledent), based on acid etch

technique, exhibited lesser microleakage values. These results proved to be statistically significant when compared to values obtained with RelyX (3M ESPE dental products) reconstruction system.

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