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ORIGINAL RESEARCH

Effect of residual eugenol in root canals on adhesion of prefabricated light-transmitting endodontic posts cemented with composite resin

Efecto del eugenol residual en los conductos radiculares sobre la adhesión de endopostes lumínicos prefabricados, cementados con resina compuesta

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ABSTRACT

It has been reported in scientific literature, that eugenol inhibits polymerization of resin-based cements; this fact can influence retention of posts cemented upon this material. Recently, prefabricated resin posts reinforced with clear fibers have been introduced in the dental environment. The target of these new posts is twofold: the light used for polymerization can be transmitted to the resin cementing medium through the aforementioned posts, contributing thus to esthetic reconstruction and incidence decrease of endodontically treated teeth fractures. It has been shown that the use of a comprehensive acid-etch technique for extended time periods cancels residual eugenol effects in root canals on the light-transmitting posts and the resin used to cement them. In the present study 10 extracted teeth were subjected to root canal treatment. These teeth were sealed with gutta-percha points (cones) and zinc oxide-eugenol cement. For this endeavor, lateral condensation technique was used. Root canals were prepared with low speed burrs (as found in the endodontic-post system), to be then cemented with resin following the technique recommended by the manufacturer. Traction forces were applied until achieving dislodgement, at which point retention was assessed. **Results:** Retention of all samples was reflected into graphs. It could be appreciated that retention values among groups were unequal; it can therefore be established that no statistically significant difference was encountered. **Conclusion:** Residual eugenol did not interfere in post adhesion when an extended time acid etch technique was followed.

RESUMEN

Se afirma en la literatura que el eugenol inhibe la polimerización de los cementos a base de resina, esto puede influir en la retención de los postes cementados con este material. Recientemente los postes prefabricados de resina, reforzados con fibras transparentes, fueron introducidos a la odontología con el propósito de que la luz para la fotopolimerización se transmita al medio cementante de resina a través de ellos, contribuyendo así a la reconstrucción estética y disminuyendo la incidencia de fracturas de dientes tratados endodónticamente. Demostrando que empleando una técnica de grabado de ácido total por tiempos prolongados elimina los efectos del eugenol residual en los conductos radiculares sobre la retención de los postes translumínicos y la resina utilizada para cementar los mismos. Se realizaron tratamientos de conductos en 10 dientes extraídos, obturándose con puntas de gutapercha y cemento de óxido de zinc y eugenol, con la técnica de condensación lateral. Se prepararon los conductos con fresas de desobturación a baja velocidad, que se incluyen en el sistema de endopostes y se cementaron con la técnica descrita por el fabricante, utilizando resina de cementación. Se les aplicó fuerza traccional hasta lograr su desalojo y se midió la retención. **Resultados:** La retención de cada una de las muestras fueron graficadas, demostrando que los valores de retención entre cada grupo no eran iguales; por lo que se estableció que no existe diferencia estadísticamente significativa. **Conclusión:** El eugenol residual no interfiere en la adhesión de postes cuando se emplea una técnica de grabado ácido en tiempos prolongados.

Key words: Eugenol, retention, polymerization, etching acid, prefabricated posts, composite resin.
Palabras clave: Eugenol, retención polimerización, grabado ácido, endopostes prefabricados, cementos resinosos.

INTRODUCTION

Dental structures might become compromised by multiple causes such as caries, trauma, congenital dentin defects, internal resorption as well as iatrogenic and hydropathic causes.[1] These compromised teeth frequently present thin remaining

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wall structures which could not be reinforced with conventional materials. They eventually might require placement of a metal-cast endodontic post to be used as retention for the crown replacement. Nevertheless, this type of restorations entails the potential of eliciting wedge-like activities, which might, in turn, cause root fractures in cases when the system withstands functional dynamic loads.[2,3] An additional fact to consider is that placement of endodontic metal posts used to fill the root canal space can cause an unaesthetic gingival inter-phase giving a «metallic shadow effect». This effect might interfere with the restoration's final esthetic results.[2]

Introduction of materials able to adhere to the dentin structure have created the potential to reconstruct and rehabilitate lost dentin tissues and thus save severely damaged teeth which otherwise would have warranted extraction. To rehabilitate roots, a technique which used dentin acid etching combined with self-curing composite resin was introduced.

Lui JL[1] mentioned authors such as Spalten RG, Landwerlen JR, Baraban DJ, Frederick DR, Linde LA, Plasmans PJJM and Malean JW. These authors have upheld and demonstrated the functionality of composite resins in systems used for the reconstruction of endodontically treatead teeth. Nevertheless, most endodontic sealers contain eugenol (2 metoxy-4 aliphenol). This substance is a eugenic or caryphillic acid, an oily liquid obtained from clove essence, it is locally antiseptic and sedative, and is used in dentistry. It can bear influence upon the retention of endodontic posts cemented with composite resin.[4-6]

In 1983, Phili L[7] (Boston University) mentioned that the reaction between eugenol and resin defied comprehension. In his research, he points out the fact that eugenol contained in cements alters resin polymerization.

Through time, it has been demonstrated that eugenol directly acts upon resinous components and inhibits their polymerization.[7,8] Nevertheless, Leinskar[9] & al, in 2002, concluded that materials containing eugenol could be safely used after performing suitable acid etching and using new generation adhesion agents. In 2001, Mayhew & al[5] used three types of endodontic sealing cements: two of them were without eugenol and the third was composed of eugenol and zinc oxide. They cemented intra-root posts with resinous cements. Results revealed that the cement containing eugenol did not alter the properties of resinous cement.[5,10] In that same year, Wolaneck[11] & al mentioned the fact that eugenol based sealing cements did not exert any effect upon the adhesive system used in their study. They furthermore stated that usage of a swab with chloroform or 75% alcohol was sufficient to neutralize the effect of eugenol.[11]

Recently, light-transmitting endodontic posts have been used to diffuse allogen light towards light-cured composite resin, which is used as a bonding medium between light-transmitting post and root dentin. These types of endodontic posts allow root reconstruction as well as reconstruction of part of the crown, ensuring thus continuity of the tooth's function.[12]

The aim of the present study was to demonstrate that use of a comprehensive acid etch technique for extended periods of time eliminated residual eugenol effects upon the retention of light-transmitting post and the resin used to cement them.

METHODS

20 single-rooted recently extracted human teeth were used for the present study. They were randomly divided into two 10-teeth groups (one control and one study group). Each sample had to comply with the following requirements: teeth had to be caries-free, present 20 to 22 mm crown to root length, and had to have been extracted due to periodontal problems or orthodontic treatments.

Samples were cleansed under tap water after extraction; they were then stored in distilled water to be kept moist and prevent dehydration. The container with samples was taken to an ambience device (Hanau, Buffalo USA) at 100% humidity and 37 °C to be kept in humidity and temperature conditions as close as possible to the mouth environment. Seven days later all samples were harvested.

The clinical crown of each sample was removed with a carbide burr; root length was then recorded. Root canal treatment was performed on experimental group teeth. Endodontic «K» type files (Maillefer, France) were employed, using the sequence up to number 55. Canals were sealed following lateral condensation technique using gutta-percha cones (SS White, Korea) and sealing cement based on zinc oxide and eugenol (Roth Root Canal Cement). Teeth in the control group were subjected to endodontic instrumentation up to file number 55, nevertheless, the canal was not sealed. All root canal treatments were performed by the same operator in the same day.

Samples were placed in a simulator with 100% humidity and at 37% C (Hanau, Buffalo, USA) for seven days, to be kept in moisture and temperature conditions as similar as possible to those present in the mouth, and thus allow for the final setting of the apical sealing material.

After this time elapsed, space was prepared for light-transmitting posts placement (Luscent Anchors Dentalus NY, USA). Burrs form the light-transmitting post system (Luscent Anchors, Dentalus NY USA) were used for both groups. A 3 mm apical sealing was observed.

Endodontic posts (Luscent Anchors Dentalus NY USA) were cemented on the same day and by the same operator. Before cementation all posts were cleansed with gauze impregnated with 96° GL ethylic alcohol, following manufacturer´s indication to dispose of fat residues. Preparation of teeth in both groups consisted of 37% ortho-phosphoric acid etching (Etchant 3M, Minnesota USA) for 60 seconds. Once the etching process was completed, the canal was cleansed with pressure-water for 60 seconds. Excess water was dried with pressure-air for 5 seconds. Canals and posts received two layers of adhesive (Single bond, 3M, Minnesota USA). Dual cement was mixed (Rely X, 3M, Minnesota, USA) and the canal was over-filled with the cement. The post was placed within the canal and excess cement was removed.

Prior to polymerization, the cement was subjected to 2 kg constant load pressure. The constant load device used in this experiment was developed at the Dental Materials Laboratory of the Graduate and Research Division, National School of Dentistry, National University of Mexico. A 20 second polymerization was undertaken so as to prevent post displacement within the canal. This was followed by a 120 seconds polymerization (as per manufacturer`s instructions) conducted with a halogen light lamp (Visilux II 3M, Minessota, USA) at 400 mW/cm^2.

Prepared samples were stored in the Hanau body simulator (Hanau, Buffalo USA) so as to allow total cement polymerization and to keep samples in temperature and humidity circumstances as similar as possible to the oral cavity, that is to say 100% humidity and 37 °C.

Afterwards, posts were subjected to gradually increasing traction loads at a 1 mm/min speed, until the dislodgement of the post. This load was exerted with the universal device for mechanical tests, with a McMesin cell developed at the Dental Materials Laboratory, Graduate and Research School, National School of Dentistry, National University of Mexico. Before undertaking cementation, post conductometry of all samples was recorded. Contact surfaces between root and post were calculated according to the formula: (£=F/A), where F = to maximum force used at the moment of dislodgement, measured in Newtons, and A = the area of the post in contact with the canal's dentin. The area was calculating by coating with tinfoil the post area in contact and by recording its weight in grams. After this a 1 cm^2 square tinfoil was weighed. With these data (weight of tinfoil sections) the area was calculated by a simple rule of three.

RESULTS

The proportional limit of each sample (transition point of a material when passing from plastic to elastic state) (Graph 1) was analyzed with a one-way variance analysis test (ANOVA). Results distribution was as follows: (Graph 2).

For the control group, mean was 121.708, with 54.170 standard deviation and 17.130 variation coefficient. The experimental group exhibited a mean of 136.988, standard deviation of 50.984 and variance coefficient of 16.123. These data, analyzed with the Turkey-test, showed they were not statistically significant (p=0.524) (Table I).

Resistance to dislodgement of each sample (detachment) was analyzed with a oneway ANOVA test (Graph 3). Result distribution was as follows (Graph 4): For the control group, mean was 415.732 with 173.142 standard deviation and 54.752 variation coefficient. The experimental group exhibited 414.328 mean, with 153.691 standard deviation and 48.601 variation and 48.601 variation coefficient. These data, analyzed with 153.691 standard deviation and 48.601 variation coefficient. These data, analyzed with the Turkey test, showed they were not statistically significant. (P=0.985) (Table I).

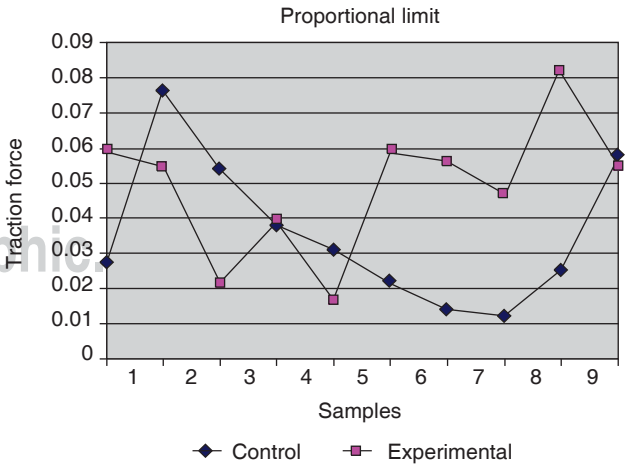

Figure 1. Comparison of proportional limit in each sample between control group (eugenol-free) and experimental group (containing eugenol).

DISCUSSION

Comparison of sealer cements with or without eugenol for retention of resin-cemented endodontic posts has been studied in scientific literature with conflicting results.[10]

In 1984, Goldman,[10,13] based on his research, informed of high retention values achieved with resin cements in cases when they were used with zinc phosphate or glass ionomer sealers. Similar results were reported by Chan in 1993, as well as Tjan and Schwartz in 1992 and 1998.[4,10] In these studies they informed of substantial retention loss in resin-cemented posts, in those cases where canals were contaminated with eugenol.

Nevertheless, Standlee and Capute, in 1992[10,12] reported variable results when using resin cements in teeth filled with eugenol-containing sealers.

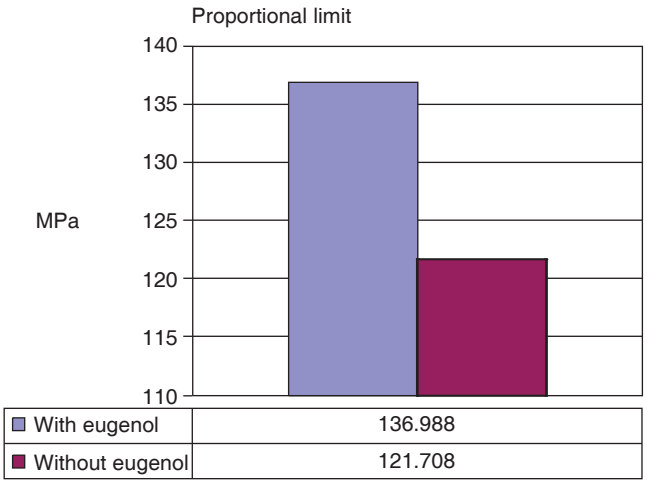

Figure 2. Comparison of proportional limit between control group (eugenol-free) and experimental group (containing eugenol).

In 1998, Schwartz[10,12] informed there was no statistically significant difference in retention of resin-cemented endodontic posts when endodontic sealers either with or without eugenol were used. Bergeron in 2001[13] reported a significant retention increase in endodontic posts when eugenol-free sealers were used (AH26) in comparison with eugenol-containing sealers (Roths's sealer).

Anthony HL[4] in his research conducted in 1992, demonstrated the fact that eugenol significantly decreased retention of Parapost cemented with Panavia resin, excepting cases when canals were cleansed with ethylic alcohol or 37% ortho-phosphoric acid was used for one minute. They informed there was no difference among control group and groups in which alcohol and etching acid were used.

Results in the present study supported Leirskar's[6] theories: that is to say that in cements used for apical sealing, using a suitable acid etch technique , together with 6th generation adhesive materials, residual eugenol effects result counteracted. This supports the theory that eugenol-containing cements did not alter resinous cement`s properties as was shown by Mayhew[5] and Wolaneck[11] in their experimental work conducted in 2001. Furthermore, the aforementioned authors declare that usage of a cotton-ball soaked in 75% alcohol or chloroform was sufficient to neutralize the residual eugenol effect within the canal, therefore, eugenol effect on polymerization of cementing material was inhibited.

Christensen mentioned the fact that resin-based cements and pre-fabricated endodontic posts are used by dentists because of their adhesion, resistance and ease of usage.[5]

CONCLUSION

Use of an acid etching technique for one minute neutralizes the effect of eugenol. Nevertheless, this

Table I. Comparison among samples of control group (eugenol-free) and experimental group (containing eugenol); maximum, minimum, average and standard deviation.

	Minimum	Maximum	Average	Standard deviation
Proportional limit Control group	0.012	0.076	0.036	0.021
Proportional limit Experimental group	0.017	0.082	0.049	0.019
Dislodgement resistance Control group	0.035	0.117	0.071	0.025
Dislodgement resistance Experimental group	0.047	0.134	0.103	0.028

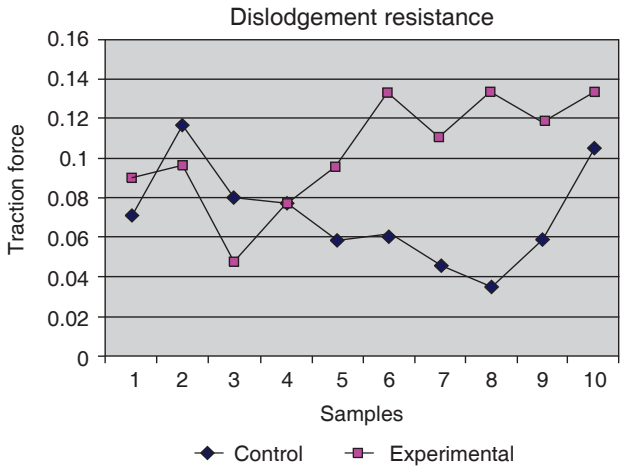

Figure 3. Comparison of dislodgement resistance between control group (eugenol-free) and experimental group (containing eugenol).

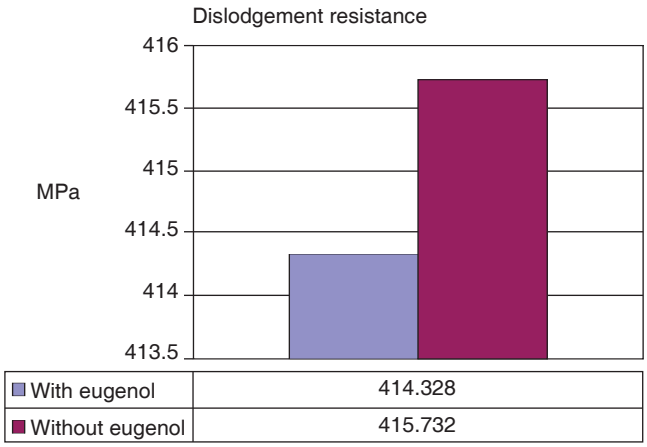

Figure 4. Comparison of dislodgement resistance between control group (eugenol-free) and experimental group (containing eugenol).

does not bear any effect upon the polymerization process, adhesion or retention of resin-cemented light-transmitting endodontic posts. We can therefore declare that chemical formulation of sealer cements does not bear any significant effect upon retention of resin-cemented posts.

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