INFLUENCE OF FILLING PROCEDURES AND THE PARTIAL REMOVAL OF FILLING ON THE SEAL OF ROOT CANALS FILLED WITH GUTTA-PERCHA AND GLASS IONOMER CEMENT

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ABSTRACT

The purpose of the present study was to investigate the apical seal of root canals filled with Ketac Endo glass ionomer cement with a single point or multiple points and partial removal of fillings using drills with or without water cooling. Ninety-six single-root teeth were instrumented and filled with Ketac Endo and gutta-percha. The single point procedure was used in 48 teeth and the multiple point procedure was used in the other 48 teeth, without lateral condensation. After 72 hours, 16 teeth were randomly selected from each of the two groups and the fillings were partially removed with drills without cooling. The fillings from an additional 16 teeth were partially removed with water spray cooled drills. The fillings in the remaining teeth were not removed. All the teeth were partially protected with nail varnish and then dipped in Indian ink and finally cleared. The maximum linear leakage was measured under a binocular microscope with a micrometric eyepiece. There were no significant differences in leakage between any of the study groups, the root canals filled with the multiple point procedure had a seal similar to those filled with a single point. There was no difference between canals with fillings removed with or without water cooling and they did not have any more leakage than the root canals whose fillings had not been removed. Using Ketak Endo as a sealant, the multiple point procedure without condensation achieves sealing similar to the single point procedure. Partial removal of the fillings from these teeth, with or without water-cooling does not affect the seal.

Key words: *Apical leakage, endodontic filling, glass ionomer cement, partial removal, post preparation.*

INFLUENCIA DE LAS TÉCNICAS DE OBTURACIÓN Y DE DESOBTURACIÓN PARCIAL EN EL SELLADO DE CONDUCTOS OBTURADOS CON CEMENTO DE IONÓMERO VÍTREO

RESUMEN

El propósito de este trabajo fue investigar el sellado apical en conductos obturados con cemento de ionómero vítreo Ketac Endo con técnicas de cono único o conos múltiples y parcialmente desobturados mediante ensanchadores con y sin refrigeración.

Noventa y seis dientes unirradiculares fueron instrumentados y luego obturados con Ketac Endo y gutapercha. En 48 conductos se utilizó técnica de cono único y en los 48 restantes técnica de conos múltiples sin condensación lateral. Luego de 72 horas se seleccionaron al azar de cada uno de estos grupos 16 piezas que fueron parcialmente desobturadas con taladros sin refrigeración y otras 16 que fueron desobturadas refrigerando con rocío de agua, las piezas restantes no fueron desobturadas. Todos los dientes fueron protegidos parcialmente con esmalte para uñas, luego sumergidos en tinta china y finalmente diafanizados. La máxima filtración lineal fue medida en lupa binocular con ocular micrométrica.

La filtración no presentó diferencias significativas entre ninguno de los grupos estudiados, los conductos obturados con técnica de conos múltiples mostraron un sellado semejante a aquellos obturados con cono único y los desobturados con o sin refrigeración no se diferenciaron entre sí y no filtraron más que aquellos sin desobturar.

Usando como sellador Ketac Endo la técnica de conos múltiples sin condensación lateral tiene un sellado semejante a la de cono único. La desobturación parcial de estas piezas realizada con o sin refrigeración no afecta el sellado.

Palabras clave: *filtración apical, obturación endodóntica, cemento de ionómero vítreo, desobturación parcial*

INTRODUCTION

Glass ionomer cements (GIC) initially used for restorative dentistry, exhibit some properties that suggest they might perform as good endodontic sealants (1, 2). This material seems to bond chemically to the dentin in the root canal, which is an advantage for sealing (3, 4); it also has antibacterial activity on both aerobes (5) and anaerobes (4) and is biocompatible (7, 8, 9). We have also seen that GIC filled teeth have greater vertical fracture

strength (10). However, some disadvantages have been found in the endodontic use of GICs. In tests carried out with Ketac Endo (Espe, Seefeld, Germany) (KE) overfills have been noted (11) and greater difficulty for retreatment has been experienced (12). Furthermore, little research has been carried out on leakage in GIC filled root canals that were partially removed (13). Friedman et al. (11) found that the presence or absence of a post did not affect the success rate of teeth filled with KE. The purpose of the current study was to investigate the apical seal of root canals filled with KE glass ionomer cement, using the single point or multiple point procedures and partially removed with drills with or without water cooling.

MATERIALS AND METHODS

Ninety-six single root teeth were used, which had been extracted for various reasons. The teeth were cleaned and disinfected by placing them for 48 hours in 1% sodium hypochlorite. They were then washed with tap water and finally preserved in distilled water. Following preparation of the access cavity, the length of each canal was determined with a No. 15 file that was introduced until it was visible in the apical foramen. The apical limit of the preparation was established on the basis of this measurement, 1 mm short of the foramen. All the canals were instrumented manually with the anatomical step back technique described by Leonardo and Leal (14) irrigating throughout the process with 1% sodium hypochlorite. File numbers 45 to 55 were used to instrument the canal, and at the end of each instrumentation No. 15 file was passed through the apical foramen to ensure apical patency. Following this preparation, each root canal was irrigated with 17% EDTA solution, which was maintained *in situ* for 5 minutes. It was then rinsed with 10 ml of 1% sodium hypochlorite and finally dried with paper points. All root canals were filled with KE glass ionomer cement and gutta-percha. According to the filling and removal procedures, the teeth were classified as follows: Group 1. Canals filled with KE and single point procedure without removal. Group 2. Canals filled with KE and multiple point procedure without removal. Group 3. Canals filled with KE and single point procedure, partially removed with water-cooling. Group 4. Canals filled with KE and multiple point procedure, partially removed with water-cooling. Group 5. Canals filled with KE and single point procedure, partially removed without water-cooling. Group 6. Canals filled with KE and multiple point procedure, partially removed without water-cooling.

The sealant was prepared following the manufacturer's instructions and carried into the canal with gutta-percha points and an in and out motion. For the single-point filling procedure, a gutta-percha point that reached the working length and was slightly resistant to removal was selected, the sealant was placed in the canal with the same point using an in and out motion. A master cone was selected for the multiple point procedure and used in the same way as in the previous group. As many of the accessory gutta-percha points covered in sealant as possible were introduced into the canal in no more than 30 seconds without lateral condensation. The cavity of each tooth was cleaned by eliminating the excess gutta-percha with a hot plugger and the remains of the sealant with a dry cotton pellet. The cavity was then filled with Cavit G (ESPE, Seefeld, Germany). The teeth thus prepared were kept at 37°C and 100 % humidity for 72 hours to allow the materials to set.

The fillings were then partially removed using modified Peeso's drills (Largo, Maillefer, Ballaigues, Switzerland) leaving, as accurately as possible, a 4 mm residual filling. This procedure was carried out with a low speed micromotor, used intermittently. The working time was 10 seconds and the resting time was also 10 seconds. Where water-cooling was used, it was applied continuously throughout the working time using water spray from the triple syringe of the dental office equipment. When the partial removals had been completed, the access cavities were again sealed with Cavit G and the tooth surface was covered with two layers of nail varnish, except for the apical 3 mm. The teeth were then dipped in Indian ink for 48 hours and the container was shaken three times a day to favour dye penetration. The teeth were then cleaned with tap water, the nail varnish was removed with ketone and the teeth were cleared following the procedure proposed by Robertson et al. (15). All aspects of the teeth thus prepared were observed with a binocular microscope (Olympus SZ 40) and the maximum linear leakage was measured with a micrometric eyepiece. The data were analysed using the Kruskal-Wallis non-parametric test and Dunn's multiple comparison.

TABLE 1. Linear apical leakage (in mm)					
Group	**N**	**Mean**	**S.D.**	**Minimum**	**Maximum**
1	16	0.1	0.4	0	1.45
2	16	0.7	1.0	0	2.88
3	16	0.4	0.4	0	1.40
4	16	0.5	0.7	0	2.15
5	16	0.4	0.7	0	2.50
6	16	0.7	0.8	0	2.39

RESULTS

The results are shown in Table 1. There were no significant differences between any of the study groups. The seal of the root canals filled with the multiple point procedure was similar to that of the canals sealed with a single point. There was no difference between the fillings partially removed with water-cooling and those removed without water-cooling, neither did they leak more than the fillings that had not been removed.

DISCUSSION

Various procedures have been proposed to evaluate leakage in endodontic fillings. Most frequently employed are those using bacteria (16) or staining (13). In order to visualize and measure dye penetration, other procedures such as cross-section (17), longitudinal section (18), root section and root diaphanisation have been used (13). The dye used in this study was Indian ink. The teeth were then cleared following the procedure described by Robertson et al. (15), which allows leakage to be observed in all aspects of the tooth. According to some authors, the adhesive strength of glass ionomers can be increased by pre-conditioning dentin (19). In a study of the adhesive strength of glass ionomer cement to the wall of the root canal treated with different conditioning solutions, Weiger et al. (20) observed greater adhesion when EDTA and sodium hypochlorite solutions were used alternately. On the basis of this study, it was decided that the root canals should be washed with these solutions, that have also been extensively tested as endodontic irrigants (14). One of the drawbacks of endodontic fillings with GIC is the difficulty of removing this material from the canal both partially when space for a post needs to be created (21), as well as totally, when retreatment is necessary (12). It is reasonable to think that filling procedures that deliver more gutta-percha to the canal could facilitate these procedures. A larger mass of gutta-percha should also reduce leakage. Wu et al. (22) noted that reduced thickness of the KE layer improves its sealing capacity. Leakage in KE fillings has been studied with lateral condensation procedures, with varying results (23, 24). When glass ionomer cements are used as restoration material, rapid mixture and immediate insertion without further manipulation are unequivocal requirements to ensure their adhesive capacity is not altered (19). Although it is true that Ketac Endo has been modified to extend the working time, it is reasonable to think that even in this case, adhesion will be enhanced with less manipulation. It was thus decided to use the multiple point procedure without lateral condensation. This procedure did not, however, result in a better seal than the single point procedure. This could probably be due to the fact that the gutta-percha was not placed under pressure, and the reduction of the thickness of the cement layer was thus not significant. In order to facilitate removal and improve the seal of endodontic fillings with GIC it will be necessary to experiment with procedures that will allow more gutta-percha to be delivered to the canal without excessive manipulation.

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