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Distribution of RoekoSeal Sealer Applied by Three Obturation Techniques

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A B S T R A C T

The aim of the study was to evaluate the distribution of Roekoseal Automix sealer using three different obturation techniques. Forty-five single-rooted extracted human teeth were prepared in a crown-down manner using ProFile instruments. After instrumentation the specimens were filled using Roekoseal Automix with the cold lateral condensation, Thermafil and Obtura II techniques. Each root was sectioned horizontally. Color images were obtained using a reflected-light microscope. The cross-sections were assessed by microscopy for distribution of the sealer. Root canals filled with cold lateral condensation technique had statistically significant (p=0.0001) more sealer in the apical portion in comparison to the apical portion of the specimens obturated with Thermafil and Obtura II techniques.

Key words: *sealer, obturation techniques, cross-section*

Introduction

The purpose of using root filling material is to completely fill the root canal as well as the accessory and lateral canals. The cold lateral condensation technique is one of the most widely accepted obturation techniques. However, its disadvantage is the fact that gutta-percha cones do not adapt to canal walls, particularly in the presence of irregularities in the canal. To overcome these difficulties, thermoplasticized gutta-percha techniques have been introduced. These include the warm vertical condensation technique, the injection system, and the coated carrier system. Injected thermoplasticized gutta-percha adapts more effectively to irregularities in the canal, thus replicating the root canal system[1].

Gutta-percha alone is not sufficient to obturate the root canal space and it is necessary to use a sealer with the majority of the filling techniques. The principal function of the endodontic sealer is to fill the space between gutta-percha and the root canal wall[2]. However, the areas filled by sealer are more vulnerable because gutta-percha is dimensionally stable whilst the sealer can dissolve over time[3]. Kontakiotis et al.[4] found that the thickness of the sealer layer influenced the sealing ability of root canal filling.

Materials based on polydimethylsiloxane have been introduced for obturation of the root canals. One of these is RoekoSeal (RSA) (Coltene/Roeko, Langenau, Germany) which, according to few studies[5–8], possesses excellent biocompatibility and sealing ability. Wu et al.[9] showed that RSA provided a consistent seal over a period of 18 months when the canals were filled by the single-cone technique. According to the manufacturer, RSA possesses good adaptability because of its marked flow ability and the fact that the material expands slightly on setting.

The purpose of the present study was to examine the distribution of RSA as a sealer using three obturation techniques: the cold lateral condensation technique, Thermafil and Obtura II.

Materials and Methods

Forty-five single-rooted human permanent teeth with mature apices extracted due to periodontal reasons were selected. After extraction the teeth were stored in 10% formalin. Prior to the experiment, the teeth were cleansed of extraneous tissue and calculus. Standard access

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cavities were prepared with a high-speed fissure drill (S 68535KR 090, Komet/Gebr. Barasseler, Lemgo, Germany) and water-cooling. The patency of each canal was confirmed by inserting a size-10 K-file (VDW GmbH, Munich, Germany) through the apical foramen (AF). The working length was determined by subtracting 1 mm from the AF. Root canals were prepared in a crown-down manner, using ProFile instruments (Dentsply-Maillefer, Ballaigues, Switzerland), in the following sequence: ProFile taper 06/30, 06/25 and 06/20; ProFile taper 04/20, 04/25 and 04/30; ProFile taper 06/25, 06/30 and 06/35.

During instrumentation RCPrep (Premier Products Company, Plymouth Meeting, USA) was used. After the use of each instrument the canals were irrigated with a 3% solution of sodium hypochlorite (NaOCl) using a 27-gauge needle (BD Microlane 3; BD, Drogheda, Ireland). The smear layer was removed with EDTA 15% for 3 min and final irrigation was performed with 5 ml of 3% sodium hypochlorite. All root canals were dried using paper points #30 (VDW GmbH, Munich, Germany). After the preparation had been completed, the roots were randomly divided into three groups of 15 specimens each. For obturation, RSA (Coltene/Roeko, Langenau, Germany) was used as sealer in combination with cold lateral condensation, Thermafil (Dentsply-Maillefer, Ballaigues, Switzerland) and the Obtura II system (Obtura Spartan, Ontario, Canada).

Group 1: RSA and the cold lateral condensation technique

A 0.04 taper master gutta-percha cone #30 (Dentsply-Maillefer, Ballaigues, Switzerland) was coated with the sealer, gently seated in the full working length, and laterally condensed with a finger spreader ISO 25 (VDW GmbH, Munich, Germany). Lateral condensation was achieved for each specimen using additional gutta-percha (Diadent, Almere, the Netherlands) cones ISO 25 and an endodontic finger-spreader ISO 25 (VDW GmbH, Munich, Germany). The tip of each additional cone was coated with the same sealer and inserted until the canal was tightly obturated. Excess gutta-percha was removed from the coronal cavity with Gutta Cut (Dentsply-Maillefer, Ballaigues, Switzerland) and the root canal filling was additionally condensed vertically with a hand plugger ISO 45 (Hu-Friedy, Berhard Quentin GmbH, Leimen, Germany).

Group 2: RSA and Thermafil

An electric Thermaprep Plus oven (Dentsply-Maillefer, Ballaigues, Switzerland) was used to soften the gutta-percha on the Thermafil obturator #30 (Dentsply-Maillefer, Ballaigues, Switzerland) as recommended by the manufacturer. The correct size of the plastic core obturator was selected using the proper size of the verifier (Dentsply-Maillefer, Ballaigues, Switzerland). A small quantity of RSA was inserted into the root canal with K-file ISO 30 (VDW GmbH, Munich, Germany). The plasticized Thermafil obturator was then removed from the oven and inserted to the full working length of the canal. After cooling, excess plastic core material was cut with Thermacut (Dentsply-Maillefer, Ballaigues, Switzerland) and the gutta-percha was compacted vertically with a hand plugger ISO 45 (Hu-Friedy, Berhard Quentin GmbH).

Group 3: RSA and Obtura II

The Obtura II (Obtura Spartan, Ontario, Canada) system was used with the temperature set at 200 °C. The canal was coated with the sealer in the same manner as that used in the Thermafil group. The Obtura 25-gauge cannula tip (Obtura Spartan, Ontario, Canada) was placed into the canal 5 mm short of the working length and the thermoplasticized gutta-percha was injected passively into the canal. Hand pluggers ISO 45 (SybronEndo corporation, West Collins Orange, USA) were used for vertical compaction of the gutta-percha at the canal orifice.

After this step of obturation the access cavity of each tooth was obturated with Cavit (3M ESPE, Seefeld, Germany) and stored in an oven (37°C, 100% humidity) for seven days.

Assessment of root canal fillings

The teeth were embedded in epoxy resin cylinder and the specimens were cross-sectioned with a low-speed saw (Exakt BS 310 CP, Norderstedt, Germany) at a distance of 2, 8, 14 mm from the apical foramen under continuous water-cooling in order to prevent overheating. Images were obtained using an Axiolab camera (Carl Zeiss GmbH, Vienna, Austria). A reflected-light microscope (Carl Zeiss GmbH, Vienna, Austria) at 40x magnification was used. Distribution of the sealer was measured using a grid system (see Fig.1), based on the number of grid squares (grid spacing) in the filled area of the root canal. The presence or absence of sealer and the area of voids (AV) were noted, and these were deducted from the total average (%) of the filled area of the root canal.

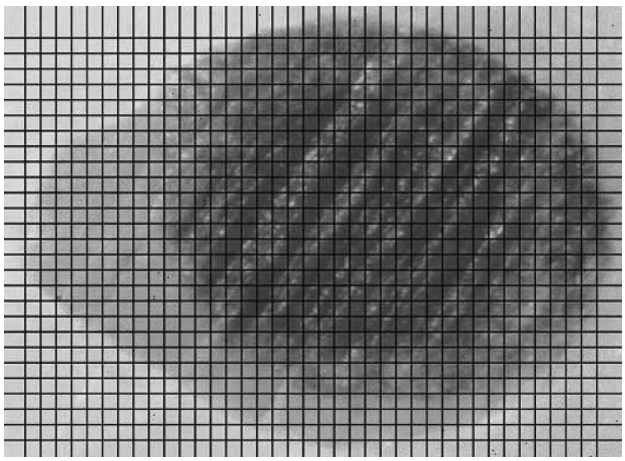

Fig. 1. Cross-section of tooth treated by the Thermafil technique, 8 mm from the apex. Distribution of sealer in the filled area of the root canal evaluated with the grid system.

Statistical analysis

A two-way ANOVA test and lsd post hoc test were performed for statistical analysis of the results. A level of significance was set at 5%.

Results

The results for the distribution of the sealer for the lateral condensation, Thermafil and Obtura II obturation techniques are shown in Table 1 and Figure 2. Comparing the distribution of RSA in the apical, middle and coronal portions of the root canals with each technique, significant differences between the apical and middle portions ($p=0.0001$), and the apical and coronal portions ($p=0.0001$) were observed in the lateral condensation group. No statistically significant differences were found in the distribution of the sealer in the apical, middle and coronal part of the root canals in Thermafil and Obtura II groups ($p>0.05$).

Root canals filled with cold lateral condensation technique had statistically significant ($p=0.0001$) more sealer in the apical portion in comparison to the apical portion of the specimens obturated with Thermafil and Obtura II techniques. In the middle portion, Obtura II technique showed statistically significant ($p=0.023$) more sealer than Thermafil obturation technique.

In all experimental groups, AV were rare and occurred in a very small number of specimens (1–3 specimens).

Discussion

Leakage of fluid along obturated root canals may occur through voids within the sealer or by its dissolution either in the interference between sealer and dentin or the sealer and gutta-percha[4]. A filling technique that creates a minimal amount of sealer and increasing the mass of the gutta-percha is preferred[10]. The present study was performed to compare the distribution of RSA sealer using three different obturation techniques.

TABLE 1
MEAN DISTRIBUTION OF SEALER IN THE ROOT CANAL FOR ALL TECHNIQUES

	$\overline{X}$	SD	Valid N
LC apical	0.200743	0.160261	15
LC middle	0.03167	0.0182	15
LC coronal	0.037471	0.032545	15
OBT apical	0.040213	0.02407	15
OBT middle	0.061224	0.035623	15
OBT coronal	0.027153	0.021955	15
TH apical	0.014098	0.015507	15
TH middle	0.012126	0.014024	15
TH coronal	0.024231	0.031538	15
All Groups	0.049881	0.079265	135

LC = lateral condensation, OBT = Obtura II, TH = Thermafil, $\overline{X}$ – arithmetic mean, SD – standard deviation

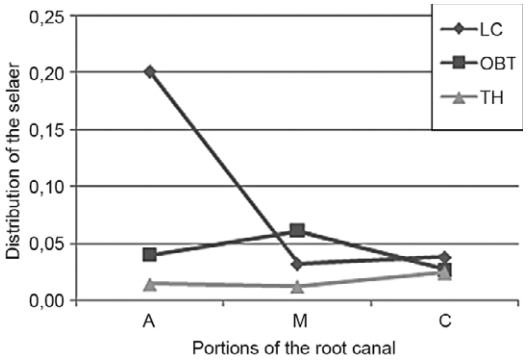

Fig. 2. Results for the distribution of the sealer for all three obturation techniques at A-apical (2 mm from the apex), M-middle (8 mm from the apex) and C-coronal (14 mm from the apex) portion of the root canals.

Obturation techniques are largely dependent on the preparation technique and better results regarding leakage were found with canal preparation using rotary nickel-titanium instruments[11], like Profile instrumentation technique used in the present study.

The group filled with RSA sealer and the cold lateral condensation technique had a higher amount of the sealer in the apical portion of the root canals among tested techniques although RSA filled the space between gutta-percha cones as well as the space between gutta-percha and the dentin wall. Sealer film thickness and the gutta-percha component are of particular relevance when the apical filling is analyzed. The apical root filling should provide an adequate seal, especially due to numerous lateral and the accessory canals which are present in the apical third. The results of the present study do not concur with those obtained by Facer & Walton[12] who, using the cold lateral condensation technique and Roth's Sealapex and AH 26, found that the sealer neither filled the space between gutta-percha cones nor formed a continuous layer between gutta-percha and the canal wall. The authors[12] explained this phenomenon as follows: when gutta-percha is laterally condensed and closely adapted to the dentin wall the sealer is squeezed out and, consequently, gutta-percha is in direct contact with the canal wall. This creates voids at the interface between gutta-percha and dentin. The difference between our results and those obtained by Facer & Walton[12] can be explained by the fact that RSA has better flow properties and a lower surface tension; thus the material resists displacement during condensation.

In canals filled with RSA and Obtura II, there was no difference in the amount of sealer in the apical, middle or coronal portion.

The Thermafil system group produced the lowest amount of the RSA sealer in the apical portion when compared to cold lateral condensation technique and Obtura II in the middle portion of the root canals. The results of this study confirmed that the presence of the sealer can help to offset shrinkage of thermoplasticized

gutta-percha associated with gutta-percha phase transformation which may produce a gap between the filling and the dentin wall. DeDeus et al.[13] determined the percentage of gutta-percha mass using Thermafil, System B and lateral condensation, and found the greatest percentage of gutta-percha filled area in the Thermafil group.

The results of this study indicates that the sealer thickness depends of obturation technique and Thermafil and Obtura II can reduce the sealer component in the apical portion in comparison to cold lateral condensation, while Thermafil can reduce the sealer component in the middle portion compared to Obtura II technique.

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DISTRIBUCIJA KORIŠTENJA ROEKOSEAL PEČATA U TRI OBTURACIJSKE TEHNIKE

SAŽETAK

Cilj ovog istraživanja bio je procijeniti distribuciju Roekosealer Automix pečata koristeći tri različite obturacijske tehnike. Pripremljena su 45 izvađena zuba s jednim korijenom, okrenutih krunicom prema dolje, koristeći se ProFile instrumentima. Nakon instrumentacije, uzorci su ispunjeni Roekoseal Automix pečatom s hladom lateralnom kondenzacijom, Thermafil i Obtura II tehnikama. Svaki korijen seciran je horizontalno. Slike u boji dobivene su mikroskopom reflektirajuće svijetlosti. Distribucija pečata dobivena je mikroskopiranjem poprečnim seciranjem. Kanali korijena ispunjeni tehnikom hladne lateralne kondenzacije imali su statistički značajno (p=0,0001) više pečata na apikalnom dijelu u usporedbi s apikalnim dijelom uzoraka koji su ispunjeni Thermafil i Obtura II tehnikama.