

A Comparative Study of Two Different Retrograde Filling Materials with Two Different Resection Angles in Apical Surgery on the Degree of Microleakage (In Vitro Study)

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ABSTRACT

Introduction: The goal of retrograde filling material is to create an efficient seal apically to prevent as much as possible the bacteria and its byproducts penetration from the canal of the root toward periapical area.

Aim: Evaluate the impact of different root end retrograde filling materials on the degree of micro leakage apically by using methylene blue dye penetration as an indicator.

Materials and Methods: Eighty permanent teeth (single root) were cut apically 3 mm at 2 different bevel angle. After that preparation of retro cavities were carried out and subsequently filled with filling materials of two types: Well-ROOT PT®, MTA BIOREP®. Samples placed in container filled with methylene blue stain for 1 day. Samples were prepared by dissecting using microtome and digitally viewed and photographed using digital camera connected to stereo-microscope. Micro leakage measured by utilizing Kinovea software to assess the degree of stain penetration in millimeters. The analysis of results statistically was performed by employing (Two Way ANOVA) at $P < 0.05$.

Results: Appearing from results that MTA BIOREP® groups exhibited less degree of micro leakage comparing to Well-ROOT PT® groups in a high statistical significant differences.

Conclusion: MTA BIOREP® root end filling material was considered to be better than Well-ROOT PT® in relation to sealing ability.

Key words: Apicoectomy, Retro filling, Resection angle, Sealing ability

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INTRODUCTION

A successful root canal treatment relies on total elimination of bacteria and its products from root canal. After that creation of tight close fit seal to prevent subsequent passage of bacteria and irritants from root canal system into periapical area [1]. In a situation where conventional endodontic treatment is failed or root canal retreatment is unsuccessful or unfeasible, endodontic surgery is needed to keep the tooth in place [2]. Apical surgery include flap

elevation, root tip exposure, root end cutting, retrograde cavity preparation and filling it with suitable and biocompatible retrograde filling material which grant fluid tight seal apically [3].

Because of various root anatomy variations resection of root apex is essential in endodontic surgery. These variations that can serve as treatment failure sources demanding removal of 3 mm apically and preparing of a retrograde cavity filled with retro filling material [4]. The requirements of any retrograde fillings should perfectly adherence to preparation wall, radiopaque, manipulated easily, non-resorb able, stable dimensionally, Biocompatible, nontoxic, promote healing and have antibacterial activity.

An introducing of various materials to serve these purposes in apical surgery like glass ionomers, zinc phosphate cements, zinc oxide eugenol cements, amalgam, composite, cavity, Super-EBA, intermediate restorative material, carboxylate cements, Mineral trioxide aggregate (MTA), Calcium aluminosilicate paste, and bioceramic reparative cement. However, there are no filling materials that fulfil all these mentioned requirements, therefore investigation studies are needed to determine a novel root end filling material [5-10].

This in vitro study designed to compare between two new root end filling materials (Well-ROOT PT®, MTA BIOREP®) to determine its efficacy of sealing ability.

MATERIAL AND METHODS

In this study eighty freshly extracted permanent teeth of single root carefully chosen (not including mandibular incisors, teeth with cracks or fractures). The teeth were cleaned, disinfected, and decoronated at cemento-enamel junction by using diamond disc (MEDIN, Nyon, Switzerland) under water coolant to produce a 15 mm length as a standard. After preparation of access cavities, the pulpal tissues were removed. Also, by using size 15 K file to assess working length followed by glide path preparation using size 20 K-file. By using manual type Protaper files (DENTSPLY, Switzerland) root canals were cleaned and shaped under 5.25% sodium hypochlorite irrigation (CERKAMED MEDICAL COMPANY, Stalowa Wola, Poland). Finally the irrigation was accomplished by 20% EDTA (Tehno Dent Co.Ltd, Belgorod region, Russia), 5.25% sodium hypochlorite then by normal saline.

A sterile paper points used to dry the canals to be obturated by suitable gutta purcha and canal sealer (Proseal, Hunter Line Inc, Korea). The access cavities were sealed by temporary filling material (Dent-a-cav, Willmann & Pein GmbH, Barmstedt, Germany) and stored in normal saline for 7 days.

Apical resection was done by cutting 3 mm of the 40 samples to the long axis perpendicularly (bevel angle 0 degree) while the remaining 40 samples were cut at (bevel angle 30 degree) by fissure bur (SF-41, SinaliDent, china) irrigated

by water. A 3mm depth retrograde cavities was prepared for a group of (bevel angle 0 degree) utilizing retrotip (E10D, Woodpecker Medical Instrument Co.,Ltd. China) diamond coated at a medium power ultrasonically, while the cavities of (bevel angle 30 degree) group prepared by a low speed diamond coated straight fissure bur (NO.1090, MICRODONT, BRAZIL) under irrigation by water.

The specimens were grouped randomly into 2 major study groups of forty each (twenty of 0 degree, twenty of 30 degree bevel angle). It has been used Well-Root PT® (Calcium Aluminosilicate Paste, VERICOM, Gangwon-DO, KOREA) (P) for filling the retrograde cavities of the first group, whereas the other cavities of the second group filled with MTA BIOREP® (Bioceramic Reparative Cement, ITENA, Paris, FRANCE) (M).

The specimens, then, putted in an incubator (humidity 100%, 37°C, 7 days) to ensure full set of the filling materials. Nail varnish (3 layers) used to coat the samples except 1mm from resection surface, then immersing in methylene blue stain (2%) for a day. Thereafter, the samples were rinsed for one hour under tap water and dried. Samples were embedded into epoxy resin blocks and longitudinally dissected into two parts by a Microtome (MTI Corporation, Richmond Ca, USA).

Samples were digitally viewed and photographed using digital camera connected to stereomicroscope (BLS 200, NTB series zoom, Italy) under magnification of 20x and the micrographs transported in a JPEG format to a computer to be saved. Micro leakage measured by utilizing Kinovea software 2018® (Version 2, Boston, USA) to assess the degree of stain penetration in millimeters along the interface between retrograde filling materials and the canal wall. (Figures 1 and 2).

Bevel angle 30 degree.

The results analyzed statistically by using (SPSS version 21, Chicago, IL, USA) involving Minimum, maximum, mean and standard deviation (SD) as a descriptive statistics. Also, an inferential statistics including (Two Way ANOVA) with Bonferroni test, partial eta square effect size and both D'Agostino and Shapiro normality tests at $P < 0.05$.

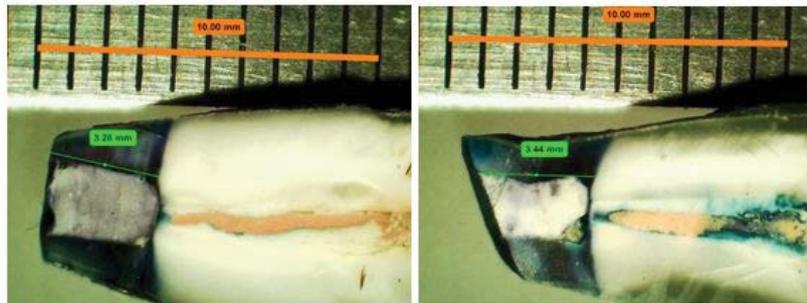


Figure 1: Stain penetrated area measurement of Well-Root PT®. A. Bevel angle 0 degree. B. Bevel angle 30 degree.

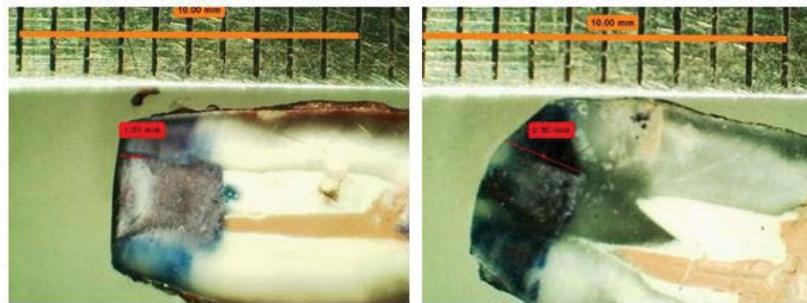


Figure 2: Stain penetrated area measurement of MTA BIOREP®. A. Bevel angle 0 degree. B. Bevel angle 30 degree.

Table 1: Mean, standard deviation, and comparison of the root end filling groups with respect to micro leakage values utilizing a Two Way ANOVA.

| Angles | Fillings | Min. | Max. | Mean | SD | Mean difference | F | P value | Partial eta square Effect size |
|--------|----------|------|------|-------|-------|-----------------|--------|----------|--------------------------------|
| 0° | P | 2.12 | 4.08 | 3.277 | 0.695 | 2.184 | 84.813 | 0.000 HS | 0.527 Large |
| | M | 0.34 | 1.95 | 1.093 | 0.533 | | | | |
| 30° | P | 2.57 | 4.09 | 3.457 | 0.447 | 1.8095 | 58.221 | 0.000 HS | 0.434 Large |
| | M | 0.26 | 3.67 | 1.647 | 1.133 | | | | |

HS=highly significant at p<0.01.
 Partial eta square=small (0.01-0.059), medium (0.06-0.139), large (>=0.14)
 P value=clinical significance
 Effect size=practical significance.

RESULTS

Descriptive statistical analysis obtained for stain penetration for each group is presented in Table 1. The results shade lights on that all cavities filled with retrograde filling materials showed microleakge with varying degrees. MTA BIOREP (M) demonstrated highly statistical significant differences compared with Well-Root PT (P) at 0 degree and 30 degree bevel angles as presented in Table 1.

DISCUSSION

The root end filling material must have a perfect sealing ability property to impede leakage of microorganisms and its toxins toward surrounding tissues. The success of endodontic surgery depends mostly on sealing ability of retrograde filling materials. More over

studies showed that the degree of microleakage determined by sealing ability of root end filling materials, bevel angle and depth of resection. Various materials have been utilized as a retrograde filling substances and the selection of these substances can be chose according to sealing ability, manipulating properties, biocompatibility and a clinical records of success. Methylene blue stain penetration technique was chosen to evaluate micro leakage due to high degree of staining, easy of manipulation and lower molecular weight than of microorganism’s toxins. In this study, we integrated stain penetration technique and the utilization of Kinovea program for more precise and standardization of micro leakage assessment of apical cavities. According to the conditions of this study, the results exhibited that the two materials showed micro leakage but

there was less leakage significantly higher with MTA BIOREP® than with Well Root PT®.

Because of MTA BIOREP ® filling material have almost comparable composition to that of traditional MTA so it's regarded to have efficient sealing ability and biocompatibility. These characteristics favor its use as a root end filling material which is motivate us to select it as one of the materials tested in this study.

The result of this study comes in agreement with the preceding studies of dye leakage which have been performed on MTA employing various kinds of stains. These outcomes harmonious with prior studies where MTA has been shown to be more desirable than other retrograde filling materials.

The hydrophilic characteristics and the creation of interfacial surface that placed between the dentinal wall and the filling material may allow the MTA BIOREP ® to have greater marginal sealing ability. It was established that further hydration of MTA powder may result in leakage decrease and compressive strength increase. Also the MTA has the ability to precipitate of hydroxyapatite crystals in the moisture presence which may be relevant in leakage decreasing afterwards. Another advantages including excellent adherence to the walls of retrograde cavity and low degree of solubility resulting micro leakage reduction [11-18].

In this study the MTA BIOREP® may show the hydroxyapatite crystals creation at the interface between retrograde cavity wall and filling material as a consequence the substance reveal superb bonding thus hindering the dye penetration and hence presented less micro leakage. Also it's believed that MTA BIOREP® is hydrophilic so it can undergo expansion during setting when it's placed in a humid environment that lessens the micro leakage.

CONCLUSION

Taking into account the restrictions of this study it can be concluded the followings:

The type of filling material and the resection angle influence the extent of apical microleakage.

Correctly prepared and handled MTA BIOREP ® filling material give us excellent results regarding micro leakage.

DECLARATIONS

Conflict of Interest the authors declare that there are no potential conflicts of interest related to the study.

SOURCE OF FUNDING

Nil.

ETHICAL CLEARANCE

This research has exemption as it a routine treatment (no new materials were used).

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