

# Can the Root End Resective Surgery of Two Different Angles Affect the Apical Microleakage of the Retrofilling Material (In Vitro Study)

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## Abstract

**Introduction:** Endodontic surgery become essential to save teeth when the endodontic treatments are failed. It promote root canal debridement and insertion of retrograde filling to make sure tight sealing apically.

**Aim:** Compare the influences of two different resection angles (0 and 30 degree bevel angle to the long axis of the tooth) on the apical micro leakage by utilizing dye penetration technique.

**Methods:** 80 single rooted permanent teeth were amputated 3 mm from the apex at two different resection angles. Retrograde cavities were prepared and filled with Well-ROOT PT® and MTA BIOREP®. All specimens were immersed in 2% methylene blue dye for 24 hours. The specimens were cut longitudinally by microtome and photographed digitally using stereomicroscope. With the use of Kinovea program dye penetration area was measured. Two WAY Analysis of Variance (Two Way ANOVA) were used to analyze the result statistically at P<0.05.

**Results:** No group exhibited complete sealing of root-end zones. The group of MTA BIOREP® demonstrated statistical significant differences with 0 degree angle which showed less leakage.

**Conclusion:** MTA BIOREP® retro filling material with 0 degree angle of resection were significantly superior regarding apical microleakage compared with Well-ROOT PT®.

**Key words:** Apical surgery, Bevel angle of resection, Microleakage, Retro filling.

## Introduction

The aim of endodontic treatment is to get rid of bacteria from the root canal space and following formation of an efficient seal to impede subsequent penetration of microorganisms to the periapical areas. Traditional root canal treatment has been displayed to be successful in approximately 90% of cases while others reported that the rate of success vary between 85%-95%<sup>(1)</sup>.

Endodontic surgery is an option to evade teeth extractions when endodontic treatment or retreatment unsuccessful or is not achievable<sup>(2)</sup>.

Surgery involves apical exposure, root end resection, retrograde cavity preparation and root end

filling material insertion<sup>(3)</sup>, which ought to be adhere to the walls of the cavity supply a close-fitting seal against the bacteria and their toxins.

In addition, it must be radiopaque, stable dimensionally, non-resorb able, and importantly easy to manipulate<sup>(4)</sup>.

Apical resection is an essential part of the periapical surgery. The apical end is amputated so that to recognize the root canal and give access to the origin of infection. Apical root resection of 3 mm gets rid of an apical area with the highest occurrence of accessory canals and discloses the surface of the root within scope of visual examination and additional instrumentation<sup>(5)</sup>.

Various angles and instruments have been utilized to cut the root end throughout apical surgery. A 30 degree bevel angle is a choice to simplify insertion of the filling material, and may be suggested when handpiece is utilized for retrograde cavity preparation. Anyway, it can raise the apical leakage since the apical permeability of the dentinal tubules are greater disclosed by the bevel angle <sup>(6)</sup>.

In the other direction, the ultrasonic instruments seem as a choice for retrograde cavity preparations utilizing perpendicular apical resections. Anyway, these apparatus are highly prices, which can lessen their obtainability <sup>(7)</sup>.

This *in vitro* study assessed the outcome of various endodontic surgery bevel angles for two different retrograde filling materials on apical microleakage.

### Material and Methods

80 extracted single-rooted human permanent teeth were selected (excluding lower incisors), cleaned, disinfected and kept until required. Crowns were cut at the cemento-enamel junction utilizing a low-speed diamond disc (MEDIN, Nyon, Switzerland) underneath constant water irrigation to produce a standardized specimen length of 15 mm. Following the extirpation of the pulpal tissues using a barbed broach, working length was determined by visualization and size 15 K-file utilized and preparation of glide path up to the working length utilizing size 20 K-file. Shaping of the root canal by a manual Protaper files system (DENTSPLY, Switzerland) underneath irrigation with 5.25% sodium hypochlorite (CERKAMED MEDICAL COMPANY, Stalowa Wola, Poland). A final irrigation was achieved using 20% EDTA (Tehno Dent Co.Ltd, Belgorod region, Russia) and 5.25% sodium hypochlorite followed by normal saline. Then root canals were dried using sterile paper points, and obturation was accomplished utilizing matching gutta purcha and ProSeal root canal sealer (HunterLine Inc, Korea). A temporary filling material (Dent-a-cav, Willmann&Pein GmbH, Barmstedt, Germany) utilized to seal the access cavity, and specimens were then kept in normal saline for 1 week. The apical 3 mm part of the 40 roots specimens were amputated perpendicular to the long axis of the root (0 degree bevel angle) whereas the other 40 roots specimens were resected at 30 degree to the long axis (30 degree bevel

angle) utilizing fissure bur SF-41(SinaliDent, China) underneath constant water irrigation. Afterward, the preparation of retrograde cavities to a depth of 3 mm of the 40 specimens (0 degree bevel angle) employing an ultrasonic diamond coated retrotip (E10D, Woodpecker Medical Instrument Co., Ltd., China) at medium power in agreement with the manufactures instruction, whereas the retrograde cavities of the other 40 specimens (30 degree bevel angle) prepared by employing straight fissure diamond coated bur (NO.1090, MICRODONT, BRAZIL) at a low speed underneath continuous water irrigation. The teeth samples were divided randomly into two major experimental groups of 40 each (20 roots of 0 degree and 20 roots of 30 degree bevel angle). The retrograde apical cavities in group 1 samples filled with (P) Well-Root PT® (Calcium Aluminosilicate Paste, VERICOM, Gangwon-DO, KOREA), while the retrograde apical cavities in group 2 samples filled with (M) MTA BIOREP® (Bioceramic Reporative Cement, ITENA, Paris, FRANCE) in agreement with manufactures recommendations. Subsequent to the retrograde filling process, the specimens were placed in an incubator in 100% humidity at 37°C for a week to make certain complete set of the retrograde filling materials. They were coated with three layers of nail varnish with various color for every group but at the apical 1 mm of the surface of resection, Following, they were soaked into 2 % methylene blue dye for 24 hours, and extra dye was eliminated by rinsing underneath running tap water for 1 hour. The teeth samples were inserted into an epoxy resin block and the samples were dissected longitudinally at the center of the sample into 2 halves using a Microtome (MTI Corporation, Richmond Ca, USA). The samples' micrograph were taken by using of a digital camera attached to a stereomicroscope (BLS 200, NTB series zoom, Italy) using 20X magnification and then transported to a personal computer in a JPEG format to be gathered and stored. Kinovea program 2018® (Version 2, Boston, USA) was employed to assess the extent of the linear stained area (dye infiltrated surface) along the junction between the wall of root canal and retrograde filling material in millimeters. (Figure 1,2).

Statistical analyses were performed utilizing the statistical Package for social Science (SPSS version 21, Chicago, IL, USA) including Descriptive statistics is Minimum, maximum, mean and standard deviation (SD)

whereas the inferential statistics is Two Way Analysis Of Variance (Two Way ANOVA) with Bonferroni test, partial eta square effect size and both Shapiro and D'Agostino normality tests., level of significance is at  $P < 0.05$ .

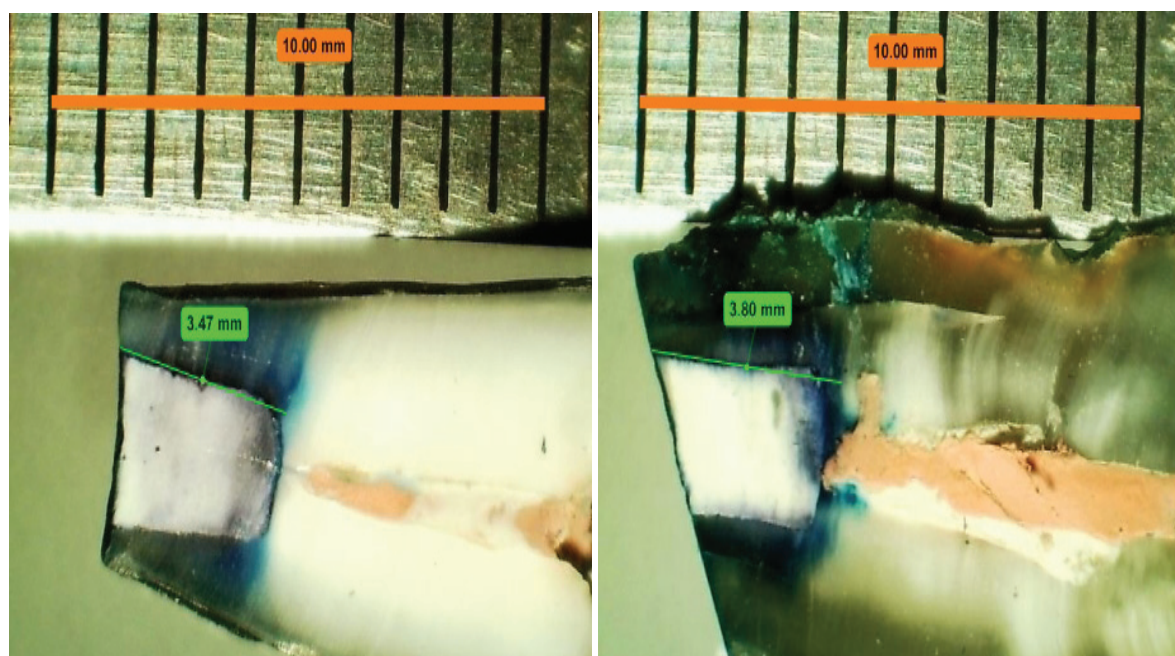
## Results

Means and standard deviations acquired for dye penetration in every group are shown in Table 1.

**Table.1: Mean values, standard deviation, and comparison of the groups with regards to microleakage value using Two Way ANOVA**

Fillings	Angles	Min.	Max.	Mean	SD	Mean diff	F	P value	Partial eta square Effect size
P	0°	2.120	4.080	3.277	0.695	0.179	0.573	0.451 NS	0.007 Small
	30°	2.570	4.090	3.457	0.447				
M	0°	0.340	1.950	1.093	0.533	0.554	1.979	0.022 Sig.	0.067 medium
	30°	0.260	3.670	1.647	1.133				

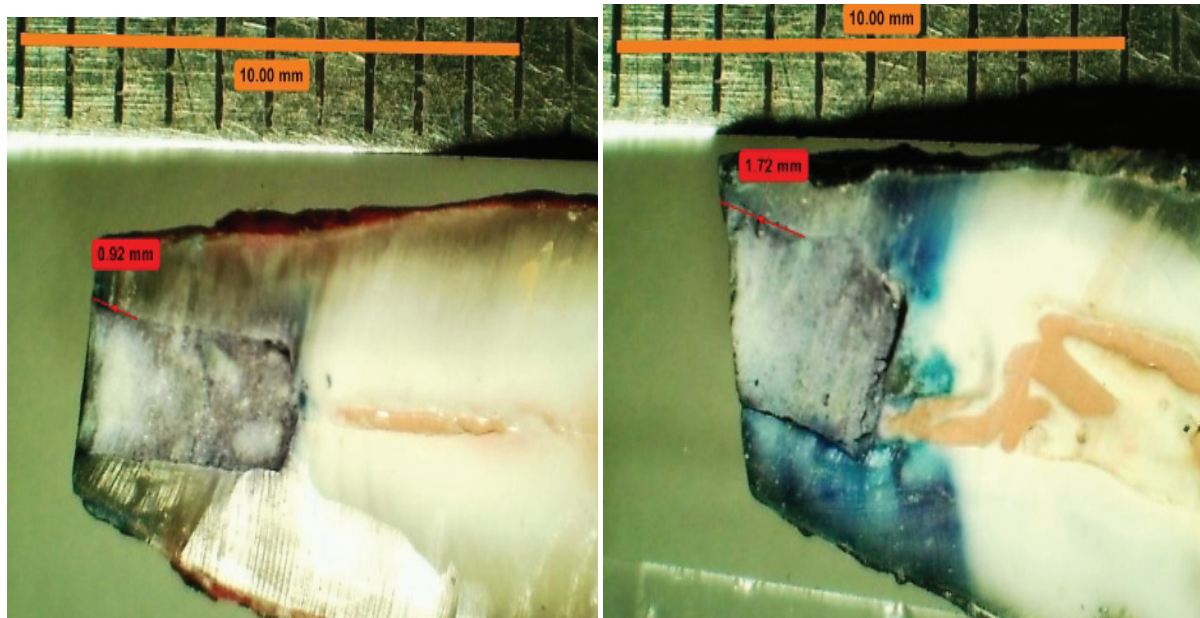
NS=not significant at  $p > 0.05$ , Sig=significant at  $p < 0.05$



**Figure 1 (A,B). Measurement of dye infiltrated area of Well-Root PT®. A. 0 degree bevel angle. B. 30 degree bevel angle.**

Based on results, retrograde cavities were not entirely sealed in each of the groups. There were no significant differences statistically between the two angles of Well-Root PT (P) whereas there were significant differences between the two angles of MTA BIORP (M) as shown in Table 1.





**Figure 2 (A,B). Measurement of dye infiltrated area of MTA BIORP®. A. 0 degree bevel angle. B. 30 degree bevel angle.**

## Discussion

In endodontic treatment failure cases the apical surgery must be limited to situations in which a non-surgical method is not possible or has failed <sup>(8)</sup>.

When imperfect or failed root canal filling is the reason of endodontic failure, and the canal is coronary approachable and negotiable, surgical therapy is not regarded the treatment of option <sup>(9)</sup>.

The aim of providing an effective retrograde seal after apical surgery is to create an effective barrier among the root canal system and the periapical tissues. The interaction among preparation techniques of root end and materials employed in retro filling process is an essential aspect for treatment success <sup>(10)</sup>.

The sealing capability of retro filling material, the depth and plane of resection are essential determining factors in the microleakage degree. Sufficient preparation of root-end is an essential part for success of treatment <sup>(11)</sup>.

The results exhibited that microleakage raised with increasing the angles bevel from 0° to 30°. Resecting at 30° bevel angle involve disadvantages like dentinal tubules opening, exposure of dentinal tubules regarded to attend a potential vector for apical permeability <sup>(5, 12)</sup>.

The results agree with with Gilheany <sup>(13)</sup>, Shabnam <sup>(14)</sup>, Gagliani <sup>(15)</sup> who established that the leakage significantly rose when the angle of the resection raised from 0 degree to the long axis of the root to 30 degree. The microleakage surrounding the retro filling material was not the solely predisposing cause to apical leakage, in this case, therefore the apical leakage could have been analogous in the two angles for the similar retrograde filling. Therefore, apical leakage may be a result of the microleakage surrounding the retrograde filling and the bevel angle degree.

The using of ultrasonic tips in retrograde cavity preparation of 0° bevel angle can to some degree influence the outcomes of this study. Higher success rates clinically had been shown when preparation of root-end was carried out utilizing ultrasonic tips instead of traditional rotary burs <sup>(6, 16, 17)</sup>.

Ultrasonic tips express numerous advantages in retrograde cavity preparation in comparing to rotary burs preparation, involving smaller disclosure of dentinal tubules, lower risk of perforation, excellent retrograde filling material retention, and lesser the necessity of root resection bevel. Also, smaller retrograde cavities with greater conservation of dental tissues, a cavity preparation that is best placed into the root channel, and a superior preparation of anatomical difficulties, like. an

isthmus (16, 18).

## Conclusion

With regards to the restrictions of this study it can be concluded that :

1-The apicoectomy bevel angle and the root end preparation type influence the degree of microleakage.

2-0 degree bevel angle is regarded the preferred angle in apical resection.

## 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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