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Comparison of Bond Strength and Apical Seal Obtained in Root Canals Prepared with a New Rotary System Endo Eze System and Obturated with Two Different Techniques

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ABSTRACT

The aim of the present study was to compare bond strength and apical seal obtained in root canals prepared with a new rotary system (Endo-Eze) and obturated with two different techniques (AH Plus sealer/ gutta-percha points and EndoREZ sealer/ EndoREZ points). Sixty freshly extracted mandibular first molars were used in this study. The distal root of each collected tooth was removed by tapered diamond stone mounted in high-speed handpiece. Mesio-buccal canals of teeth were cleaned and shaped by Endo-Eze system, then they were classified into two main groups of 30 each according to obturation materials used, Group (1): canals were obturated with lateral condensation using AH-Plus sealer and gutta-percha and Group (2): canals were obturated with lateral condensation using Endo-REZ sealer and Endo-REZ points. Within each group, samples were divided into 2 subgroups of 15 each according to assessment method, subgroup (A): 15 teeth were used for assessment of microleakage and subgroup (B): 15 teeth were used for assessment of push-out bond strength. Subgroup (C): 15 teeth were used for assessment of microleakage and subgroup (D): 15 teeth were used for assessment of push-out bond strength. Then subgroups A & C were further divided into 3 divisions according to storage time (immediately, one month and three months) after setting of the sealer. Assessment of microleakage was done by dye penetration test where 2 layers of nail varnish were applied to all the root surfaces except the apical 2 mm, then the apices of the teeth were immersed in 2 % methylene blue dye solution for 2 days. Examination for linear dye penetration was done using stereomicroscope. Assessment of bond strength was done by push-out test where compressive load was applied apico-coronally in order to push the filling material toward the larger diameter. The results regarding the microleakage showed that the immediate observation period in (AH Plus / gutta-percha) recorded the highest statistically significant leakage mean value while the lowest mean value was recorded in the 3 months observation period of Endo-Rez / Endo-Rez points. Regarding the push out bond strength, it was found that AH Plus /

KEYWORDS

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gutta-percha recorded greater bond strength mean value than Endo-Rez / Endo-Rez points. It was concluded that push-out bond strength was improved with AH-Plus sealer /gutta-percha than with EndoREZ sealer / EndoREZ points. EndoREZ sealer / EndoREZ points produced apical sealing comparable to that produced by AH Plus sealer / gutta-percha. Sealing ability was directly proportional with storage times up to three months.

INTRODUCTION

Apical leakage is considered to be a common cause for endodontic therapy failure and it is influenced by many variables such as : different filling techniques and materials, the physical and chemical properties of sealer and the presence or absence of smear layer.

Also the bond strength of root canal sealer to gutta-percha seems to be an important property for maintaining the integrity of the apical seal which can result in reducing apical microleakage.

In this study, Endo-Eze system was used for preparation of root canals. This system is based on Anatomic Endodontic Technology, and was designed to maintain the natural shape of the root canal during instrumentation.

Acceptable apical sealing has been found with epoxy resin-based sealers (AH-Plus). Although predictable clinical results have been reported with the use of gutta-percha and epoxy resin-based root canal sealers, there is increasing interest in the use of methacrylate resin-based sealers (EndoREZ) in endodontics, so the aim of this study was to compare bond strength and apical seal obtained in root canals prepared with a new rotary system (Endo-Eze) and obturated with two different techniques (AH Plus sealer / gutta-percha points and EndoREZ sealer/ EndoREZ points).

MATERIALS AND METHODS

Selection of teeth

Sixty freshly extracted mandibular first molars were collected. Removal of distal root of each tooth was done by tapered diamond stone. Mesio-buccal root canal curvature was measured according to schneider's method with curvature ranging from 15 ^{0} to 30 ^{0}. [1]

Root canal preparation

Sixty mesio-buccal canals of teeth were cleaned and shaped by Endo-Eze system. This system is based on Anatomic Endodontic Technology (AET). [2]

Classification of samples

Sixty mesio-buccal canals of mandibular first molars were classified into two main groups of 30 each according to obturation materials used :

Group 1: canals were obturated with lateral condensation using AH-Plus sealer and gutta-percha.

Group 2 : canals were obturated with lateral condensation using Endo-REZ sealer and Endo-REZ points.

Group 1 & 2 were divided into 2 subgroups of 15 each according to assessment method :

Group 1 :

Subgroup A : 15 teeth were used for assessment of microleakage.

Subgroup B : 15 teeth were used for assessment of push-out bond strength.

Group 2 :

Subgroup C : 15 teeth were used for assessment of microleakage.

Subgroup D : 15 teeth were used for assessment of push-out bond strength.

Then subgroups A & C were further divided into 3 divisions according to storage time (immediately, one month and three months) after setting of the sealer.

Assessment methods

A-Dye penetration

Two layers of nail varnish were applied to all the root surfaces except the last apical 2 mm. The apices of the teeth were suspended and immersed in 2 % methylene blue dye solution for 2 days. After that, the roots removed from the dye, washed under tap water and dried on a paper towel. Then, each specimen was grooved on buccal and lingual surfaces and splitted longitudinally through the apex in a direction parallel to the long axis of tooth into two sections by using bi-beveled chisel. [3]

Examination of the samples for linear dye penetration using stereomicroscope

Each half was fixed to a glass slide with sticky wax to examine the extension of dye penetration. The dye penetration was measured in millimeters from the apical foramen to the furthest point of the linear dye penetration using a stereomicroscope at ×10 magnification.

B- Push-out bond strength

Preparation of samples

The roots were embedded in epoxy resin. Each root was horizontally sectioned perpendicular to the long axis of the root using a water-cooled precision saw to obtain a section 2 mm ± 0.1 in thickness [4] from the middle third. Each section was measured using caliper. Both apical and coronal aspects of each sample were coded and photographed using a stereomicroscope and examined before testing to confirm a circular canal shape and that the sealer filled the entire canal space without voids. [5]

Push-out test

After mounting in loading fixture, each root slice was secured with sticky wax [6] to avoid the movement of the samples during testing to ensure uniform stress distribution. Each sample was subjected to compressive loading via a computer controlled universal testing machine with a load cell of 5 KN and data were recorded using computer software and loaded at a crosshead speed of 0.5 mm/min. Load applied by plungers size 0.6 mm diameter in an apical –coronal direction {Figure (1)} because of the convergence of the root canal sections in order to push the filling material towards the larger diameter. The selected diameter of the plunger was positioned so that it only contacts the filling to displace it downward. The maximum failure load was recorded in N and converted into MPa. The bond strength was calculated from the recorded peak load divided by the computed surface area (as calculated by the following formula).

Bond = F/ A

$\{ A = (\pi h (r_1 + r_2) \}$,

Where, π is the constant 3.14,

r1 apical radius, r2 coronal one,

and h is the thickness of the sample in millimeters.

Failure manifested by extrusion of filling material and confirmed by sudden drop along load-deflection curve recorded by computer software.

Statistical analysis

The data were collected, tabulated and statistically analyzed with one way analysis of variance ANOVA and pair-wise Duncan post-hoc tests.

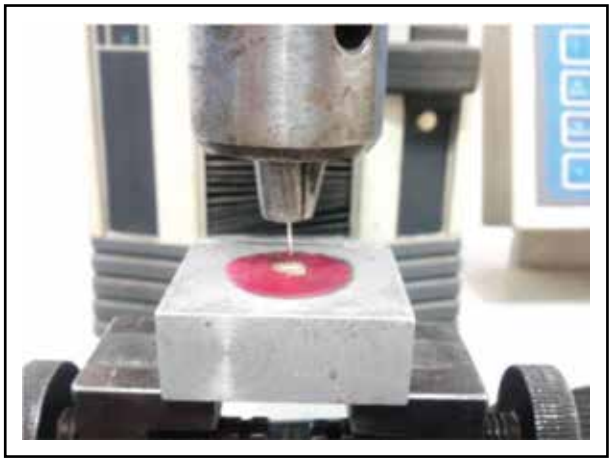


Fig. (1) Aphotograph showing 0.6 mm diameter plunger pushing the filling material downword in an apical to coronal direction at a crosshead speed of 0.5 mm / min.

RESULTS

Part I: Comparison of push-out bond strength of two different root canal sealers (Endo-Rez and AH-Plus) measured immediately after setting :

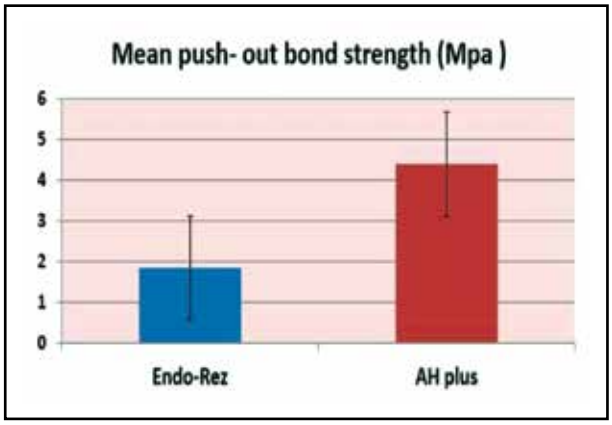
The highest mean value was recorded with AH-Plus (4.39 MPa), while the lowest value was recorded with Endo-Rez (1.83 MPa). Analysis of variance (ANOVA) found that there was a difference among the two tested groups ($p \leq 0.05$). Student's t test revealed that the difference between the tested sealers was statistically significant. (Table 1, Histogram 1)

Table (1) *Mean values, standard deviation and p value of push out bond strength (MPa) of two different root canal sealers (Endo-Rez and AH Plus) measured immediately after setting.*

	Endo-Rez	AH-Plus
Mean	1.838507	4.391569
SD	1.314701	3.929244
Min	0.163615	0.970851
Max	3.871018	13.49565
P value	0.0240*	

Part II : Apical dye penetration

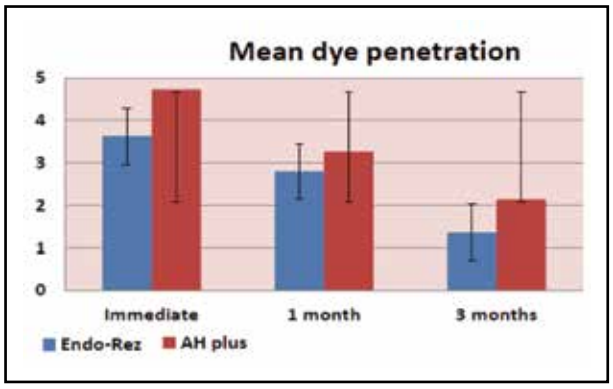
The greatest mean value of apical dye penetration was found at the immediate observation period with AH Plus (4.728±0.698),while the lowest mean value was recorded at 3 months observation period of Endo-Rez (1.368 ± 0.74113). Two –ways analysis of variance (ANOVA) test revealed that the difference between both root canal sealers at the different intervals was statistically significant ($p < 0.0001$). (Table 2, Histogram 2).



HISTOGRAM (1) Representing the mean values and standard deviation of push out bond strength of two root canal sealers (Endo-Rez & AH plus)

Table (2) *Mean values, standard deviation and p value of apical dye penetration of both root canal sealers (Endo-Rez and AH plus) at the different storage times.*

	Endo-Rez			AH-Plus		
	Immediate	1 month	3 months	Immediate	1 month	3 months
Mean	3.6762	2.7994	1.368	4.728	3.265	2.1408
SD	0.669123	1.502806	0.74113	0.698093	0.403594	0.81599
Minimum	2.651	1.477	0.48	3.87	2.803	0.789
Maximum	4.33 5.272		2.095	5.705	3.793	2.937
P value	<0.0001					



HISTOGRAM (2) Representing the mean values and standard deviations of apical dye penetration of both root canal sealers (Endo-Rez & AH Plus) at the different storage times.

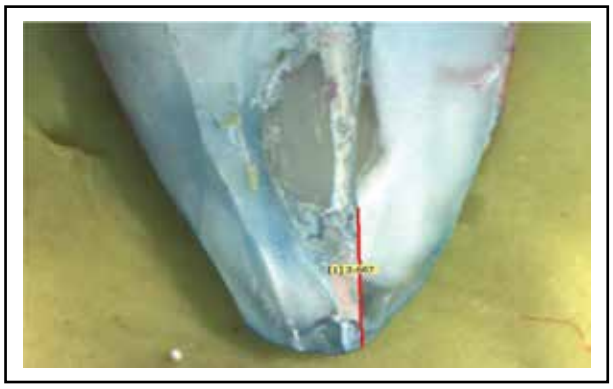


Fig. (2) A stereomicroscopic image of MB canal (magnification × 10) obturated with AH-Plus sealer and gutta-percha showing linear dye penetration (4.796 mm) immediately after setting of the sealer.

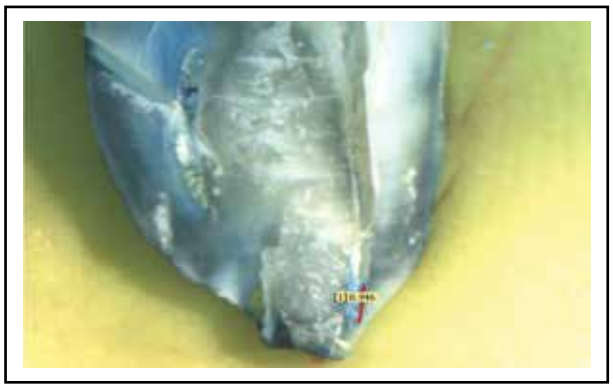


Fig. (3) A stereomicroscopic image of MB canal (magnification × 10) obturated with Endo-REZ sealer / EndoREZ points showing linear dye penetration (0.946 mm) 3 months after setting of the sealer.

DISCUSSION

Microleakage of the root canal had been defined as the passage of bacteria, fluids, and chemical substances between the tooth and filling material of the root canal. [7]

The dye penetration method was chosen for microleakage assessment in this study as it is easy to accomplish and do not require sophisticated materials [8]. Methylene blue dye was used because it was easy to manipulate, had high degree of staining, had low molecular weight and high penetration ability [9]Assessment of microleakage was evaluated immediately, one month and three months after setting of sealers as it is important to assess leakage after some time and not just immediately after sealing, because any seal needs to be lasting to be clinically effective. [10]

Push-out bond strength test was chosen in this study for evaluating the bond strength between dentin and root canal filling materials. This method allowed accurate standardization of specimens and evaluation even when bond strengths were low, also, it had an additional advantage of allowing the assessment of bond strength at several root levels. The advantage of this method over tensile and shear strength tests were that it was less sensitive to small variations amongst specimens and to variations in stress distribution during load application and that it was easy to align samples for testing. [5]

A section of mid-root dentin was prepared for push-out bond strength evaluation. The apical part of the root not chosen because the diameter of the plunger larger than the size of the filling at this area. The samples were mounted in an apical to coronl direction during testing to avoid any constriction interference due to root canal taper. [5]

In the present study, apical dye penetration was recorded with the two tested groups, with improvement in sealing with Endo-REZ sealer / Endo-REZ points. The reduction in apical dye penetration was found at the different storage times

up to three months significantly ($p < 0.05$). these results are in agreement with the results of other investigators. [10, 11]

Improvement of the sealing ability of Endo-REZ may be attributed to the " monoblock " which is created by deep penetration of the sealer into dentinal tubules and chemical bond between EndoREZ sealer and resin coated EndoREZ gutta-percha points. [12] In contrast, the conventional gutta-percha filling pulled away from AH-Plus sealer, whereas the sealer remained against the dentin wall with its resin tags penetrating the dentinal tubules. This gap between gutta-percha and sealer may be critically important for microleakage in AH-Plus experimental group. [10]

These were in disagreement with other study[13] which showed that the mean apical leakage of Endo-REZ was higher than that for AH-Plus. This may be due to use of Endo-REZ sealer with conventional gutta-percha while in the present study obturation was done with EndoREZ sealer and EndoREZ points.

In the results of this study, leakage values were found to be decreased with storage time up to three months for both experimental groups, these were in agreement with (Bouillaguet et al. 2008) [14] who showed that leakage of AH-Plus 1ms4environment over time may have facilitated its better long term sealing ability. In addition, gutta-percha by itself has a tendency to improve the root canal seal because of expansion over time. [15]

These results were in disagreement with other study [16] which found that leakage increased with storage time, while another atudy found that there was no effect of time on leakage. The conflicting in results of microleakage of different investigation may be due to different irrigants applied to remove smear layer, type of the sealer used, technique of obturation employed and the method performed to evaluate microleakage. [17]

In the present study, mean push-out bond strength was greater with AH-Plus / gutta-perch group than with EndoREZ / EndoREZ points significantly ($p < 0.05$). These results may be attributed to better penetration of AH-Plus sealer into micro irregularities of root canal dentin because of its creep capacity, long setting time, and high flow rate which increases the mechanical interlocking between sealer and root dentin [18]. the present results are in agreement with results of other investigators.

Bond strength evaluations have become popular to determine the effectiveness of the adhesion of dental materials to root canal dentin. However, resistance to microleakage may be more important for endodontic applications than bond strength [19]. Even if a material has relatively low bond strength to dentin, it may be a good obturating material if it is effective in preventing microleakage. [20]

CONCLUSION

Within limits of the current study, we can conclude the following :

1. Push-out bond strength was improved with AH-Plus sealer / gutta –percha than with EndoREZ sealer / EndoREZ points.
2. ndoREZ sealer / EndoREZ points produced apical sealing comparable to that produced by AH-Plus sealer / gutta-perch.
3. Sealing ability was directly proportional with storage times up to three months.

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