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Effect Of Moisture Level In Root Canal Dentin On Sealing Ability Of Three Different Types Of Sealers: An In-vitro Study

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Abstract
Adequate penetration of sealers in dentinal tubules reduce microleakage. For resin based sealers root canal should be kept moist and for nonresin ,dry. The aim of this study was to evaluate the clear-cut clinical steps on how to accomplish an ideal dentinal root canal surface.
Methods: Thirty six freshly extracted premolars with single canal were decoronated and instrumented by using hand files. The teeth were divided into 3 experimental groups of 12 teeth each and 2 control groups of 2 teeth each. Experimental groups were subdivided into 4 subgroups based on method used for moisture removal from prepared teeth.

a) Excess distilled water removed with paper points followed by 95% ethanol for 10 seconds.
b) Canals were blot dried until the last paper point appeared dry.
c) Canals were dried with vacuum adapter operating at low vacuum for5 seconds followed by 1 paper point for 1 second
d) Canals remained totally wet

Teeth of Gr 1 were obturated with ZOE based sealer , Gr 2 with Ca(OH)2 based sealer and Gr3 with AH26 (resin based sealer). Teeth were covered with 2 layers of nailvarnish and 1 layer of stickywax, except apical third and kept in 2% methylene blue dye for 7 days. After sectioning dye leakage was measured with the help of traveling microscope .Results : Gr 1 & 2 showed least leakage in condition a, Gr 3 showed least leakage in condition c & in condition d all groups showed maximum leakage, Gr 3 showed significantly less leakage ($p < 0.5$) than Gr1 & 2
Conclusions: for non resin based sealers final rinse with 95% ethanol for 10 seconds followed by removal of excess ethanol with paper points & for resin based sealers negative suction with help of needle syringe for 5 seconds followed by 1 single paper point for 1 second should be used. However, further studies should be performed to evaluate the effect of moisture in root canal dentin on the sealing ability of sealers, leading to the achievement of fluid impervious seal.

Key Words
Moisture level, non resin based sealer, resin based sealer, sealing ability.

Introduction:

It is important that materials used to obturate the root canal possess good sealing properties. An inadequate seal at the apex is said to account for 60% of failures of root canal therapy. To avoid this problem, a variety of sealers and cements have been tested in combination with gutta-percha for root canal obturation[1].

Moisture level in root canal dentin affects the sealing properties of the sealers because different sealers require different amount of moisture for their setting reaction.Moisture may inhibit, prolong,or accelerate the setting process of root canal sealers, which may result in higher leakage.

Grossman sealer, ZOE based sealer require dry conditions, a reduction of the sealing properties was reported for ZOE based materials under wet conditions[2].

Biocalex in the presence of moisture in the canal expands by upto 280%. This has the potential to create severe postoperative pain and vertical root fractures. Sealapex displayed significant sorption in a 100% humid atmosphere with volumetric expansion[3].

The hydrophilic characteristics of AH-26 might improve the penetration of sealer into moist dentin tubules[4],[5]. Manufacturers of resin based sealers recommend that the root canal walls be kept moist, not dehydrated, to take maximum advantage of the hydrophilic properties of the sealers, thus allowing for resin tag penetration and/or the formation of a hybrid layer.

However, we are not provided with clear-cut clinical steps on how to accomplish an ideal dentinal root canal surface for non-resin or resin based sealers.

Hence, this in-vitro study was designed to determine the apical sealing properties of root canal sealers; resin and non-resin based in instrumented root canals that had different levels of moisture, from dry to wet.

Materials And Method

Methodology

Selection criteria of teeth

Forty, non carious mandibular premolars were used. All the teeth were radiographed to exclude any teeth with more than one canal. Teeth were cleaned of organic debris and calculus and were stored in saline at room temperature until further use.

Amongst all 40 sectioned teeth, 36 comprised the experimental group and 4 comprised the control group. The experimental group was divided into 3 groups of 12 teeth each and the control group into two groups,positive and negative comprising of 2 teeth each.

The three experimental group were further subdivided into four subgroups based on method used for moisture removal after the root canal is prepared.

a) Excess distilled water was removed with paper points, and the canals were dried with 95% ethanol administered with a syringe. It was left in place for 10 second. Followed by removal of excess ethanol with paper points.

b) The canals were dried blot-dried with paper points until the last point appeared dry after removal.
c) The canals were dried with a vacuum adapter operating at low vacuum for 5 seconds and used in an up and down motion followed by one single paper point for one second.
d) The canals remained totally wet (flooded) with distilled water to see whether the moisture would be incorporated into the hydrophilic sealer in conjunction with displacement of excess water.

Applying the four main conditions described above, Gr 1a,b,c,d were filled with gutta percha and ZOE based sealer, Gr 2 a,b,c,d with Ca(OH)2 based sealer and Gr 3 with resin based sealer (AH 26) using lateral condensation technique. The sealers were used according to the manufacturers's recommendations and were inserted into the root canal with the help of the master cone followed by accessory cones according to the protocol. The obturated roots were stored at 37°c and 100% humidity for 7 days to allow for complete setting. The roots were coated with 2 layers of nail varnish and 1 layer of sticky wax except for the apical 1 mm. For positive controls 2 roots were instrumented were neither obturated nor coated with varnish or sticky wax. Negative controls were coated entirely with nail varnish and sticky wax including the access opening. The specimens were immersed in a 2% methylene blue dye solution (ph 7.4) for 7 days at 37°c. After removal, they were rinsed with ditilled water and stored at 37°c at 100% relative humidity. All specimens were sectioned to the apex of roots. The extent of dye penetration was measured with the help of traveling microscope. **Figure 1**

Results

The mean apical leakage and standard deviation for each moisture condition and for each material are shown in **Table 1**.

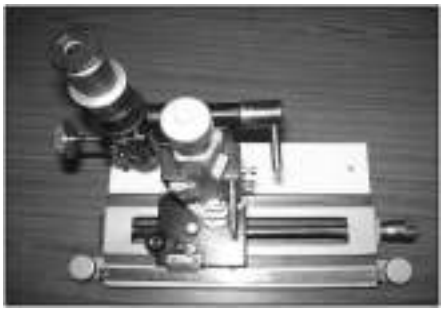

Fig.1 : Travelling Microscope

There was no statistically significant difference ($p > 0.5$) between Gr1 and Gr2 when moisture conditions a-d were compared; dye leakage was significantly less in cond.a. However , when condition a and condition d were compared with cond .b and c, reduced leakage for AH-26 was significant for the cond. band c ($p<0.05$). Furthermore , dye leakage for AH-26 under cond.c was significantly less than for cond.b ($p<0.5$). The negative controls showed no evidence of leakage, whereas the positive controls had leakage along the entire length of the canals.

Discussion

Different assays have been performed to evaluate leakage, including dyes, radioisotopes[6], bacteria and an electrochemical technique. Previous studies revealed a good correlation between dye penetration and other leakage evaluation methods [7],[8]. The results of the study demonstrated that the moisture condition of root canals at the time of obturation and the type of sealer that was used had a significant effect on microleakage.

ZOE based sealers have shown a significant decrease in their physical properties when contaminated with moisture because of their high solubility[9], especially in the early stage of setting reaction. The results of this study also demonstrared that moist canals greatly affect the sealing capacity of grossman's sealer (ZOE based sealer), especially when the moisture condition in the canal is high. In contrast, the absence of moisture in the group treated with ethanol resulted in less microleakage. This is in agreement with Kuhre and Kessler[10] and Hosoya et al[11], who showed that optimum sealing conditions were obtained when totally dry canals were filled with gutta-percha cones and ZOE based sealer.

Acroseal (CaOH2 based sealer)[12] shows high solubility as compared with AH-26 (resin based sealer)[13]. In our study also acroseal showed less leakage in cond.a and cond. b as compared to cond.c and cond.d.

Table 1 : Mean Values ± Standardizations Of Apical Dye Penetration (Mm) Under Different Moisture Conditions (A-d) By (Group 123)

Material	Total n	Condition A	Condition B	Condition C	Condition D
Group 1	12	4.33 mm	5.33 mm	9.46 mm	14.33 mm
Group 2	12	1.40 mm	2.62 mm	3.14 mm	4.14 mm
Group 3	12	4.18 mm	3.82 mm	1.28 mm	4.20 mm

In AH26 the hydrophilicity allows penetration of resin tags and the formation of a hybrid layer in moist conditions, resulting in micromechanical interlocking. Leakage in root canals with moist condition (Cond. c) was significantly less in comparison with the other conditions.With the use of a luer adapter under low vacuum for 5 seconds followed by a single paper point for 1 second, the dentin was favorably conditioned for the sealer.

In Cond. b , where only paper points were used until the last appeared dry on removal resulted in greater degree of dryness with in the canals. Whether clinically there is a difference between moist condition b and c needs to be determined in a controlled study.

Root canals subjected to cond. d showed a higher degree of leakage. In these canals, water can apparently not completely be displaced in spite of the hydrophilic properties of the sealers. Zmener O also reported that excess water can inhibit polymerization of methacrylate- based resins[14]. In vitro leakage experiments should be regarded as an important technique when analyzing sealers, yet a reliable clinical correlation should be viewed with caution. However, this study is reported on short term (7 days) leakage values, which might change over longer time periods.

Conclusions

For non resin based sealers final rinse with 95% ethanol for 10 seconds followed by removal of excess ethanol with paper points & for resin based sealers negative suction with help of needle syringe followed by one single paper point for one second will provide an ideal dentinal root canal surface.

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