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THE INFLUENCE OF DIFFERENT CANAL DRYING METHODS ON APICAL MICROLEAKAGE AN *IN VITRO* STUDY

Research Article

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ABSTRACT:

Objective: The aim of the present study was to compare the effect of different canal drying methods on apical microleakage using dye penetration method.

Materials and Method: 60 extracted teeth with single root canal anatomy were cleaned and sectioned at cement-enamel junction to maintain a standardized length of 17mm using a diamond disc. Cleaning and shaping of the samples were done with protaper universal rotary files. Teeth were divided into 4 groups based on different drying protocol i.e Absorbent paper points, Aspiration with syringe, 70% Isopropyl alcohol and Chair side made apical broach. After obturation with gutta percha and MTA fillapex as a sealer, coronal accesses were sealed with glass ionomer cement. After dipping in methylene blue dye, teeth were cut at 3mm, 6mm and 9mm levels from apex. Microleakage was assesed with dye penetration method and observed under stereomicroscope.

Statistical Analysis Used: Kruskal-Wallis and Wilcoxon signed rank tests.

Results: Isopropyl Alcohol showed minimum microleakage and Chairside made Apical Broach showed maximum microleakage.

Conclusion: Final rinse with alcohol is recommended to minimize microleakage.

Key words:
Paper points, Isopropyl Alcohol, syringe, Chair side made apical broach, MTA fillapex.

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Conflict of interest: None

INTRODUCTION: Three-dimensional obturation of root canal is the main objective of any endodontic treatment. The most commonly used core filling material is gutta percha 1. But it does not possess any natural adhesion to dentin so voids remain between gutta percha and the root canal wall. Therefore, root canal sealers are used to fill the irregularities and minor discrepancies between the core filling material and the canal walls 2. Root canal sealers are classified as zinc oxide eugenol based, calcium hydroxide based, glass ionomer based, silicone based, resin based and bioceramic-based sealers.

Bioceramic based sealers has been further categorized as Calcium silicate-based sealer, MTA-based sealer and Calcium phosphate-based sealers. In 2010, endodontic sealer based on MTA, MTA Fillapex was developed by Angelus (Londrina/Parana/ Brazil). MTA Fillapex sealer is available as a paste system and is composed of MTA, resins, bismuth trioxide, nanoparticulated silica and pigment. Manufacturers claim that this product is more stable than calcium hydroxide as it constantly releases calcium ions and maintains a pH which elicits antibacterial effects 3. The quality of adhesion between root canal dentin and sealer is affected by moisture condition of root canal before obturation. The moisture interferes with the setting of sealer by increasing its setting time. Moreover, it also prevents the entrance of sealer in to dentinal tubules 4. It has been seen that even after careful drying, the moisture still remains in the main root canal and lateral canals which adversely affects the seal between root

canal wall and obturating material and causes microleakage 5. Manufacturers of MTA Fillapex also claim that it works well in root canals that have some degree of residual moisture as it utilizes the moisture to initiate and complete its setting reaction because of its hydrophilic properties. The aim of the present in vitro study was to compare the effect of different canal drying methods on apical microleakage using dye penetration method.

MATERIAL AND METHOD: Freshly extracted human maxillary canines were collected from the Department of Oral and Maxillofacial Surgery, Guru Nanak Dev Dental College and Research Institute, Sunam.

From the collected teeth, sixty teeth with closed apices without any visible evidence of root fracture, cracks and external resorption were selected for the study. Pre-operative radiographs of all the teeth were taken to rule out any variation in canal anatomy. Surfaces of all the selected teeth were debrided of the adhering tissues using hand scalers and then disinfected by overnight immersion in 5% sodium hypochlorite solution. Then the teeth were stored in 0.9% normal saline at room temperature until further use. The anatomical crowns of all the selected teeth were removed by using diamond disc to obtain a uniform root length of 17 mm from the apex. The root canal length of all the teeth was determined by placing a no. 10 stainless steel K-file (Mani Inc., Japan) into the canal until the tip was seen flushing with apical foramen. From this canal length, 1 mm was subtracted and the length thus obtained was recorded as working length. Cleaning and shaping of root canals were performed with a ProTaper Universal rotary files in the sequence of S1, S2, Sx, F1 (20/0.07), F2 (25/0.08), F3 (30/0.09) to a size F4 (40/0.06) at speed 250 rpm and torque 1.5 N.cm. During cleaning and shaping, the canals were irrigated with alternate use of 5% sodium hypochorite (NaOCl) and 17% Ethylene diamine-tetraacetic acid (EDTA). A final irrigation was done with normal saline in order to neutralize the effects of sodium hypochlorite. Teeth were then divided into four groups of fifteen sample each based on different drying protocol after canal preparation:

1. Group I – After irrigation, canal of each tooth was blot dried with F4 paper points (ProTaper gold) until complete dryness of canal confirmed visually.
2. Group II - After irrigation, canal of each tooth was dried by aspiration with syringe. A syringe with 30 gauge needle was placed in the canal. The plunger of irrigating syringe was withdrawn and the bulk of the solution was aspirated. Canal was finally blot dried with F4 paper points (ProTaper gold).
3. Group III - After irrigation, excess moisture from each canal was removed with paper points. Then 30 gauge needle was carried to the working length. 70% Isopropyl alcohol was gently injected into the canal while slowly withdrawing the syringe from canal. Alcohol was left in the root canal for 10 sec. Canal was finally blot dried with F4 paper points (ProTaper gold).
4. Group IV - After irrigation, canal of each tooth was dried with chairside made apical broach wrapped with cotton. A 20 no. k file was selected to make an apical broach. It was marked to same length as working length by placing a rubber stop on it. Absorbent cotton was evenly wrapped upon the blade of the instrument with a clockwise rotating motion. The cotton-wrapped instrument was inserted into the canal and then rotated clockwise with slight pressure to reach the working length. Moisture was visible at the tip of instrument after removal from the canal. Procedure was repeated until cotton was seen completely dry.

After drying the canals, all the teeth were obturated with F4 gutta percha points and MTA based sealer (MTA- Fillapex Sealer, Angelus). It is available as an automix dual syringe. The automixed sealer was dispensed on a paper pad and master cone was coated with it and obturation was completed using single cone technique. Excess gutta-percha cone was seared off from the canal orifice using a heated ball burnisher. Radiographs were taken to assess the quality of obturation. The coronal access was sealed with GIC type IX. GIC was mixed in 3:1 P/L on mixing pad with plastic spatula. It was placed in access cavities with plastic instrument.

After complete setting of GIC, the samples were placed in an incubator for 7 days at 37°C and 100% humidity to allow complete setting of MTA Fillapex sealer. Coronal orifices of all the root surfaces were covered with two layers of nail varnish. All teeth were then immersed in methylene blue dye for 3 days.

All the prepared samples were sectioned horizontally at 3mm, 6mm and 9mm from apex using diamond disc in micromotor straight handpiece (NSK). The microleakage at interface of dentin and sealer was evaluated using stereomicroscope at 30x magnification by using the criteria (6) from 0 to 4.

0 - no dye penetration;

1 - Dye penetration in 1/4 of root canal wall

2 - Dye penetration in 1/2 of root canal wall (FIG 1)

3 - Dye penetration in 3/4 of root canal wall

4 - Dye penetration in all root canal walls (FIG 2).

The data thus obtained was compiled and put under statistical analysis.

OBSERVATION AND RESULTS: The results of our present study showed that overall minimum mean microleakage i.e 1.70 was obtained at the dentin–sealer interface in Group III (70% Isopropyl Alcohol group) whereas the overall maximum mean microleakage i.e. 3.15 was obtained in Group IV (Chair Side Made Apical Broach Group). The overall mean microleakage i.e 1.97 was obtained at the dentin–sealer interface in Group I i.e absorbent paper point group. The overall mean microleakage i.e 2.17 was obtained at the dentin–sealer interface in Group II i.e aspiration with syringe. When compared statistically using kruskal- wallis test, the difference in mean microleakage between all four groups was found to be highly significant ($p < 0.001$) (TABLE 1 & 2).

TABLE 1: STATISTICAL EVALUATION

DESCRIPTIVE VALUES								
Overall mean microleakage	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Gp 1. Absorbent Paper Point Group	15	1.9778	.84953	.21935	1.5073	2.4482	.33	3.00
Gp 2. Aspiration with Syringe Group	15	2.1778	.95008	.24531	1.6516	2.7039	.33	3.67
Gp 3. 70% Isopropyl Alcohol Group	15	1.7011	.81520	.21048	1.2597	2.1626	.67	3.00
Gp 4. Chair side made apical broach Group	15	3.1556	.61550	.15892	2.8147	3.4964	2.00	4.00
Total	**60**	**2.2556**	**.96720**	**.12486**	**2.0057**	**2.5054**	**.33**	**4.00**

TABLE : 2

OVERALL MEAN MICROLEAKAGE

Group	N	Mean	± SD	p value#
1. Absorbent Paper Point Group	15	1.97	0.84	**<0.001***
2. Aspiration With Syringe Group	15	2.17	0.95	
3. 70% Isopropyl Alcohol Group	15	1.70	0.81	
4. Chair side made apical broach Group	15	3.15	0.61	

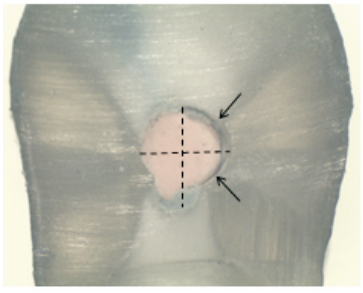

Fig 1: Showing Microleakage Between Dentin And Selaer On Two Walls

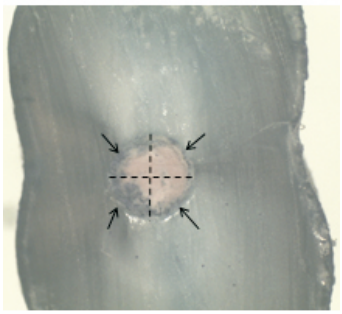

Fig 2: Showing Microleakage Between Dentin And Selaer On All The Walls

DISCUSSION: Gutta-percha and root canal sealers are used for root canal obturation to create a hermetic seal between the root canal system and the periapical tissues [7]. The root canal sealer is used to fill the discrepancies between the gutta percha and dentinal wall. It also fills the lateral and accessory canals, isthmuses and irregularities in the root canal system. Although many factors are associated with endodontic success or failure but presence or absence of moisture in the radicular dentin during the obturation process is one of the major factor. The bond strength between the sealer and the dentinal walls is affected by the presence of moisture which leads to the microleakage and eventually failure of root canal treatment [8].

Moisture level in root canal dentin affects the sealing properties of the sealers. Moisture can inhibit, prolong or accelerate the setting process of root canal sealers which can result in higher microleakage [9].

Tasdemir et al. (2014) 10 reported that an optimal amount of water is required to suspend the collagen fibrils, leaving space for penetration of the hydrophilic sealer such as calcium silicate-based sealers. Thus, it may be advantageous to leave canals slightly moist before obturating with hydrophilic sealer.

Zmener et al. (2008) 11 also reported that hydrophilicity of sealers allows better penetration of resin tags and the formation of a hybrid layer, resulting in micromechanical interlocking and increasing quality of sealing ability.

Asawaworarit et al. (2016) 12 concluded that MTA Fillapex contains calcium oxide which reacts with water to form calcium hydroxide which dissociate into calcium and hydroxyl ions. The calcium ions react with the carbon dioxide in the tissues and form calcium carbonate granulations presenting as calcite crystals. The MTA hydration forms a sticky calcium silicate hydrate gel that improves the sealing ability of MTA Fillapex over time by reducing marginal gaps

and porosities and increase the retention of the cement.

Bruno Piazza et al. (2018) 8 found that MTA Fillapex sealer showed higher intra-tubular penetration than AH Plus sealer. According to them, MTA Fillapex has smaller particle size and different composition which enables greater flowability and facilitates penetration into the dentinal tubules.

Nagas et al. (2012) 5 observed that the maximum bond strength is exhibited in moist conditions rather than extreme dry and wet conditions. Excessive moisture present in dentinal tubules may decrease the monomer conversion due to entrapment of water droplets with in the sealer dentin interface, leading to incomplete resin polymerization and decreased bond strength to dentin. Similarly, excessive dessication as in dry canals remove the water residing inside the dentinal tubules which also hamper effective penetration of hydrophilic sealers and thus compromise the quality of adhesion. Overall, the totally dry and totally wet conditions should be avoided in the clinical situation.

Thiruvenkadam et al. (2016) 13 found that alcohol reduces the surface tension of root canal sealers, irrigants and the root canal system and increases the fluid flow into the dentinal tubules. Moreover, alcohol evaporates after spreading into the dentinal tubules, leaving canals dry.

Engel et al. (2005) 14 stated that 70% isopropyl alcohol contains 30% water so it causes insufficient dentinal dehydration and leaves some degree of residual moisture in dentinal tubules.

Dias et al. (2014) 15 found that canals dried with isopropyl alcohol showed significantly higher bond strength to various sealers than canal dried with paper points. They suggested that isopropyl alcohol due to lower polarity, promoted less removal of the water from dentinal tubules and enhance the dentin wettability.

The results of present study show that final rinse of isopropyl alcohol decreased the microleakage at dentin/sealer interface. Thus, canal drying is a critical step and sealers should be selected according to drying protocol.

CONCLUSION: From the results of the present study "The influence of different canal drying methods on apical microleakage- an in vitro study" following conclusions can be drawn:-

1. Microleakage was observed in all the groups irrespective of any canal drying method.
2. Final rinse with isopropyl alcohol is recommended to minimize microleakage.

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