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Wetter the Better: Comparative Evaluation of Wettability of 3 Different Root Canal Sealers on Dentin: An *in vitro* Study

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Original Research Article

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Abstract: Comparative evaluation of wettability of 3 different root canal sealers on dentin. 30 dentin blocks were prepared from single rooted maxillary anterior teeth. After storage and adequate cleaning protocol, they were surface treated with 17% EDTA (Glyde File Prep, Dentsply Maillefer, Ballaigues, Switzerland) Prime Dental Products) for 5 minutes. Following this, they were divided into 3 groups (n=10) for: Group I: AH Plus, Group II: Endo Sequence BC Sealer, Group III: MTA Fillapex. Controlled volume of each sealer was placed onto the dentin blocks using a customized wire loop. The contact angle in each case was measured using Dataphysics OCA Easydrop software on a dynamic contact angle analyzer for 1 minute. Readings will be analysed with suitable statistical tests. The contact angle values for AH Plus sealer were significantly lower when compared to the other two sealer groups. The wettability of AH Plus sealer on the root surface dentin was found to be better than Endosequence BC Sealer and Endoseal MTA.

Keywords: Contact angle, root canal sealer, wetting behaviour.

INTRODUCTION

The achievement of a fluid-impervious seal within the root canal system is important for the long-term success of an endodontic treatment [1, 2]. A fluid-tight seal will also stop bacteria and their products from entering the periapical tissues and thus prevent re-infection. Root canal sealers have been used along with solid core obturating materials to enhance the fluid-tight seal [3]. Solid-core root filling materials do not usually reach the irregularities of the root canal system such as the accessory and lateral canals, fins, ramification and deltas.

Therefore, root canal sealers are used along with the solid core obturating material to fill these irregularities [4].

This also aids in filling the empty spaces present between the core material and the root canal walls. Various root canal sealer formulations are available in the market, such as, zinc oxide eugenol based, epoxy resin based, MTA based root canal sealers, Bioceramic sealers etc.

AH Plus (Dentsply Detrey GmbH, Germany) is an epoxy resin based root canal sealer. It is considered as a "gold-standard" endodontic sealer and is frequently used as a control material for research purposes. It consists of a two-paste system that is biocompatible and has a good radiopacity [5]. Endosequence BC sealer (Brasseler, USA) utilizes the moisture naturally present in the dentinal tubules to initiate its setting reaction. Highly radiopaque and Hydrophilic sealer which forms hydroxyapatite upon setting and chemically bonds to dentin. Available as remixed ready-to-use injectable bioceramic cement paste and is used for permanent root canal filling and sealing. Advantages include the product has good flowability which makes it possible to completely fill the root canal system including accessory and lateral canals. It is eugenol-free and hence does not irritate the patient. It has a fast setting time of 12.31 min. It also had adequate film thickness, dimensional stability and a good sealing property. It has an antibacterial effect, is biocompatible and promotes hard tissue formation. EndoSeal MTA (Maruchi, Wonju, Korea) is a new MTA based material. It is premixed and pre-loaded in a syringe that allows direct application of the sealer into the root canal without requiring powder/liquid mixing. It is indicated for root canal filling, root perforation repair and pulp revascularization.

Contact angle test: Wettability of the root canal sealers influences its adaptability to the radicular dentin. Contact angle is a useful indicator for the wetting behaviour of any liquid tested. This angle is formed by a liquid at a three-phase boundary where a

liquid, gas and solid intersect. Low contact angle values (<90°) indicate good wetting characteristics of the liquid, whereas higher values (>90°) indicate a poor wetting [6].

The contact angle was calculated according to the Young's equation which can be expressed as: $\gamma LV \cos\theta = \gamma SV - \gamma SL$, where, γSL represents the surface tension between the solid and the liquid, γSV and γLV are the surface tension of the solid and the surface tension of the liquid in equilibrium with the air, respectively, and θ is the contact angle.

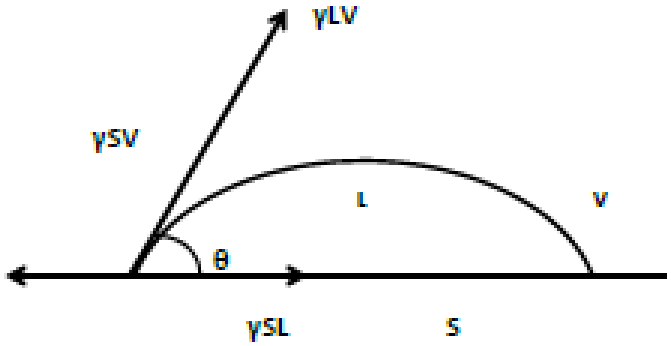

Fig: Schematic diagram of wettability calculation using Young's equation
(S=solid, L=liquid, V=air, γ=surface tension, θ=contact angle)

MATERIALS AND METHODS

15 single rooted maxillary anterior teeth which were extracted due to periodontal reasons were used for the study. Teeth were stored in saline and tissue remnants present on the root surface were cleaned using an ultra-sonic scaler (EMS Ivoclar Vivadent Ltd). Access cavities were prepared and conventional biomechanical preparation was done using 2% hand files (Mani, Inc Japan) and irrigation with 2.5% NaOCl and 17% EDTA. Decoronation and apical third resections of these teeth were done using a high speed diamond abrasive (Mani, Inc Japan) with water spray cooling. The remaining root segments were split into two, through the root canal with a diamond disk at low speed. The inner dentinal portions of the 30 halves obtained were smoothened with Sof-Lex discs (3M United States). The blocks were placed in an ultrasonic bath containing distilled water for 5 minutes to remove any extra-organic components (Fig-1A). After this, the dentin specimens were dried in a vacuum desiccator for 5 minutes (Fig-1B). The samples were randomly assigned to three experimental groups of 10 each.

1. Group 1-AH Plus
2. Group 2-Endosequence BC
3. Group 3-Endoseal MTA

Fig 1: (A) Ultrasonic Bath, (B) Vacuum Desiccator

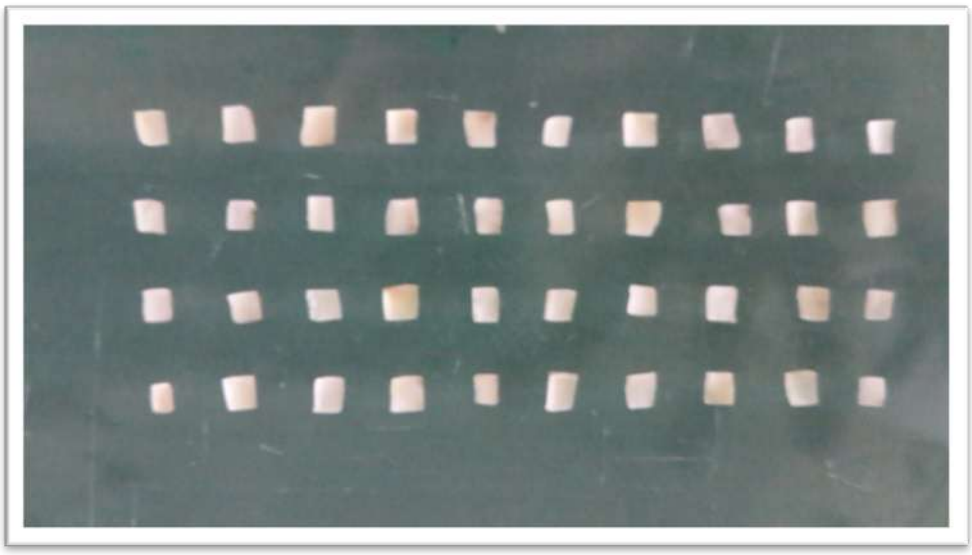

Fig-2: Dentin Blocks

Contact Angle Measurement

Dentin blocks (Fig-2) were positioned on a flat glass surface in the dynamic contact angle analyzer (Fig-3). Controlled volume droplets (0.1 mL) of each sealer was placed onto the dentin blocks. The contact angle in each case was measured using Dataphysics OCA Easydrop software on a dynamic contact angle analyzer for 1 minute.

Fig-3: Dynamic Contact Angle Analyzer

STATISTICAL ANALYSIS

The contact angle values obtained on each root dentin surface with different sealers were tabulated and the data were analyzed using Tukey's honestly significant difference (HSD) test. The level of statistical significance was set at 95% (P=0.05).

RESULTS

The mean values and standard deviation of the contact angles for each sealer on root canal dentin surface treated with various irrigating solutions is shown in Fig-4. Statistically significant lower contact angle values were recorded for AH Plus as compared to the other two sealers. The contact angle of Endosequence BC sealer and Endoseal MTA showed no statistically significant results.

A

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Group 1 (AH Plus)	10	41.80	53.30	47.2500	4.25160
Group 2 (Endosequence BC)	10	81.30	97.30	90.8100	5.03332
Group 3 (Endoseal MTA)	10	101.00	115.00	108.5700	5.59048
Valid N (listwise)	10				

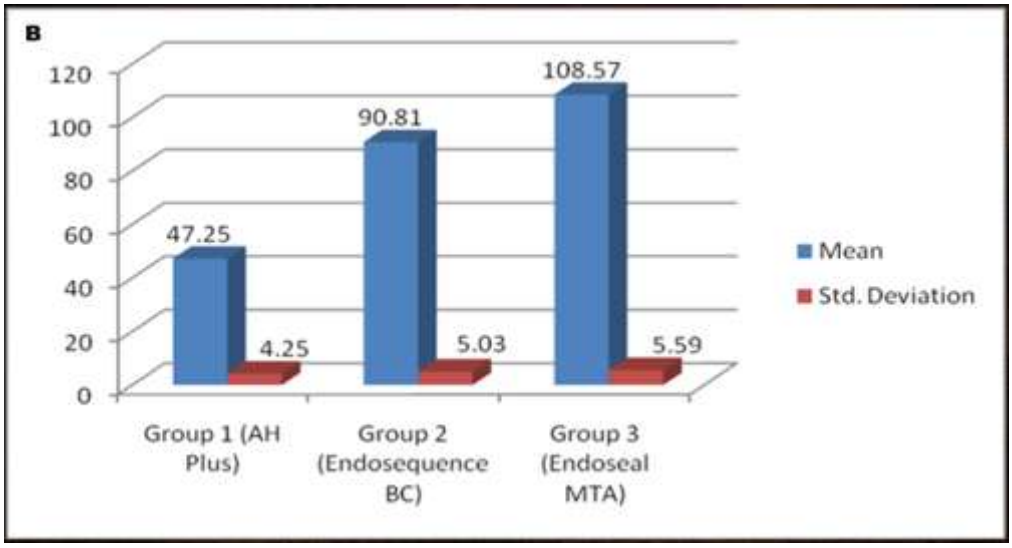

Fig-4: (A and B) Mean and standard deviation of the contact angles for each sealer

DISCUSSION

A bio-compatible filling material is required to achieve a three dimensional sealing of the entire root canal space for the success of endodontic treatment. The most common material used for filling of the root canals is gutta percha in combination with an endodontic sealer which are essential components of root canal obturation to establish a fluid-tight seal.

The main functions of a root canal sealer include: Sealing off voids, accessory canals and multiple foraminas, forming a bond between filling core and the root canal wall. Sealers also acting as lubricant while facilitating core placement and entombing any remaining bacteria [7].

The use of dynamic contact analyzer in this study was in accordance to the study conducted by Evangelos *et al.*, It allowed us to record the contact angle not just at the time of placement of the drop, but also follow the changes (if any) in this angle over a period of 1 minute. AH Plus sealer was shown to wet the root dentin surface better than the other two experimental sealers tested. Due to the statistically significant lower contact angle values it has better ability to penetrate into the micro-irregularities [8]. A study conducted by Kontakiosis *et al.*, to compare the contact angles of three different types of root canal sealers—Roth 801, AH26, and RSA RoekoSeal. The results of the study concluded that conventional root canal sealers (Roth 801 and AH26) may passively have the potential for better wettability of dentin and gutta-percha surfaces than that of silicone-based sealers (RSA RoekoSeal and Gutta-Flow) [9]. A study was conducted by Muralidhar *et al.*, to evaluate and compare the wetting behavior of three different root canal sealers on the root canal dentin surface. They found that the contact angle values for AH Plus sealer were significantly lower when compared to the other two sealer groups [10]. Endosequence BC Sealer uses bioceramic nanotechnology which allows for extremely fine particle sizes of less than 2 microns. This gives the material a far lower viscosity when compared to Endoseal and could be responsible for its comparatively lower contact angle values. "While most of the bioceramic based root canal sealers claim to have superior flow, literature has not supported their claims" [11]. Endoseal MTA available in a premixed injectable paste implying the use of a single consistency in a variety of applications including both as a sealer and a root repair material. This is in contrast to Endosequence which allows for a separate putty consistency, i.e. Endosequence RRM, for use in perforation defects. As such, this single and comparatively more viscous consistency of the Endoseal could explain its high contact angle readings. Lee *et al.*, in 2017 tested 3 bioceramic and 3 resin based sealers to evaluate their flow. They found AH Plus to have the best flow

followed by Endoseal and Endosequence BC sealer [12].

CONCLUSION

The wettability of AH Plus sealer on the root surface dentin was found to be better than Endosequence BC Sealer and Endoseal MTA.

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