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Endodontic

EFFICACY OF TWO ROOT CANAL IRRIGANTS ON PUSH-OUT BOND STRENGTH OF VARIOUS SEALERS: AN INVITRO STUDY

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ABSTRACT **CONTEXT:**To evaluate and compare two irrigation regimens on push out bond strength of AH plus/gutta-percha and MetaSeal/gutta-percha**. METHODOLOGY:** Sixty single rooted human mandibular premolars were decoronated at the level of cementoenamel junction and standardized to a working length of 15mm . The root canals were cleaned and shaped using universal ProTaper rotary system and also were irrigated with 5ml of 3% NaOCL for 2 minutes after each instrument change.The final irrigation sequence were as follows, Group I:0.9% SALINE(control), Group II:OXUM,Group III: 17% EDTA. Each group is further subdivided into 2 subgroups. Subgroup A:AH Plus /Gutta percha& Subgroup B: MetaSeal /Gutta-percha. After obturation,roots were sectioned and subjected to Universal testing machine, to measure push out bond strength.The data were analyzed using ANOVA and Independent Student t tests. **RESULTS:** The mean push out bond strength between irrigants for both sealers showed that EDTA(Group II) having higher bond strength followed by Oxum(Group III) and saline(Group I) showed least at P<0.001 **CONCLUSION:**Oxum the commercially available super-oxidized water when used as irrigant showed significant smear layer removal when compared to EDTA.

KEYWORDS : AH Plus,Bond Strength,EDTA, Metaseal, Oxum

INTRODUCTION

The discipline of endodontics is governed by paradigms like clinical protocol, quality of instrumentation, effective irrigation, disinfection and obturation of the entire pulp space to achieve a three dimensional seal. Endodontic instrumentation using both hand and rotary instruments produces organic and inorganic debris that are embedded within a layer of amorphous tissue referred to as the 'smear layer'. So, for the removal of this formed smear layer, root canal irrigants which include both organic and inorganic solvents such as organic acids and chelating agents are used[1,2]

Sodium hypochlorite (NaOCl) is one of the prime endodontic irrigating solutions, well known for its tissue dissolving properties. However, its inability to dissolve inorganic contents promotes the use of an additional chemical agent with such properties.Goldman *et al*. reported that the most efficient method to remove the smear layer is by using NaOCl and ethylenediaminetetraaceticacid[3]

Thus, the removal of smear layer demands for combining the efficacy of multiple irrigants, as presently the dissolution of organic and inorganic debris cannot be established with one irrigating solution.One such widely investigated irrigant is super-oxidized water. It is one of most powerful antimicrobial agent available for use in both medical and dental field.They are electrochemically processed aqueous solutions manufactured from pure solutions which is rich in reactive oxygen species with neutral pH and longer half-life[1,4]

Endodontic literature has investigated the effect of endodontic irrigants on the bond strength of various types of root canal sealers. Epoxy resin-based sealers such as AH Plus sealer have been used most widely because of its acceptable physical properties, adequate biological performance, apical sealability, reduced solubility, and micro-retention to root dentin.MetaSEAL is a fourth generation polymethylmethacrylate-based resin sealer. It contains an acidic resin monomer 4-methacryloxyethyl trimellitate anhydride (4-META). There are claims that the sealer MetaSEAL bonds to gutta-percha, Resilon, and dentin as well. [3,5]

In order to have a sealer and the obturation perform to the best it is important to study the properties affecting it. The physical properties like bond strength, apical sealability influences the longevity of the endodontic treatment. Therefore the aim of the study is to evaluate and compare the efficacy of various irrigation regimens on push-out bond strength of AH Plus sealer and MetaSeal sealer.

MATERIALS AND METHOD

Sixty single-rooted mandibular premolar teeth completely formed apices, extracted for orthodontic reasons were used in the study. Teeth exhibiting only one canal which was confirmed by X-rays, no cracks or fracture after inspection under an operating microscope (×10), no dilaceration and calcification were included and immediately stored in a 0.9% thymol solution until use.

The teeth were decoronated at cementoenamel junction with diamond disc under water cooling to obtain a standardized length of 16 mm. Working lengths was established by subtracting 1mm from the root canal length followed by biomechanical preparation using Protaper nickel-titanium rotary instruments (Dentsply, Germany) to size till #F3/.06 taper. During instrumentation, 1 ml of 5.25% NaOCl was used at each change of file.The specimens were randomly divided into three groups of 20 samples each according to the final irrigation regimen:

Group I: saline (control)
Group II:Oxum
Group III: EDTA

Each irrigation protocol was done for 2 minute. Then, the root canals were finally irrigated with 5ml of distilled water to remove any precipitate.

The canals were dried using corresponding Protaper paper points (Dentsply, Malleifer). Gutta-percha protaper mastercone # F3 (Dentsply Maillefer) was lightly coated with sealer and inserted to the working length. Depending on the type of sealers used for the obturation each group was further subdivided into 2 subgroups(n=20): Subgroup A-AH Plus(DENTSPLY Maliefer, Switzerland)/ gutta-percha Subgroup B-MetaSEAL (Sun Medical Tokyo, Japan, Parkell Inc., Farmingda)/gutta-percha. In each group obturation was done using lateral compaction technique. The obturated specimens placed in 100% humidity for 48 hours to ensure complete setting of the sealer. After setting of the sealer, three horizontal sections of 2-mm thickness each were cut from coronal, middle and apical thirds of each root by using a water-cooled precision saw. Each specimens marked on its apical surface with a marker and the exact thickness of each slice was measured using a digital caliper.

Push-out bond test was performed by applying a compressive load on the filling material of sample placed from apical to coronal direction.The load was applied with a stainless steel cylindrical

plunger of 1mm diameter that provided the most extended coverage over the filling material without contacting the surrounding dentin of canal wall in an Universal testing machine (IISC,Bangalore), at a cross-head speed of 1mm/minute until bond failure occurred.

These debonding values (maximum load at which bond failure occurred) were used to calculate push-out bond strength in megapascals (MPa) according to the following formula:

Push-out bond strength (MPa) = Maximum load (N) / Adhesion area (mm2)

The adhered area of each test specimen was calculated using the formula for the conical frustum, i.e.,

Area = $\pi(R1 + R2)\sqrt{(R1 - R2)\,2 + H2}$, where, H = height of slice,R1 = internal radius of the greatest base, R2 = internal radius of the smallest base.

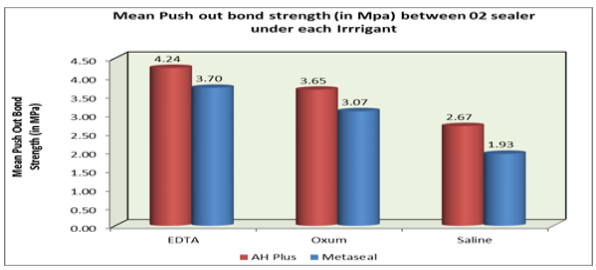
The data were tabulated and Statistical Package for Social Sciences [SPSS] for Windows, Version 22.0. Released in 2013. Armonk, NY: IBM Corp., was used to perform statistical analyses.Data presented as mean & standard deviation (SD). One-way ANOVA test was used to compare the mean push out bond strength (in MPa) between 3 irrigants for each sealer. Independent Student t Test was used to compare the mean push out bond strength (in MPa) between 2 sealers under each Irrigant.The level of significance [P-Value] was set at $P<0.05$.

RESULTS

The mean push out bond strength between different irrigants for AH plus sealer using one way anova test showed that EDTA (GROUP III)having higher mean Push out bond strength (in MPa) (4.24)than oxum (GROUP II) (3.65)at $P<0.001$.The mean push out bond strength between irrigants for METASEAL sealer to dentin showed that EDTA(Group III) having higher mean Push out bond strength (in MPa) (3.70) as compared to oxum (3.07) (Group II) at $P<0.001$. The multiple comparison of mean push out bond strength between 2 sealers under each irrigant using Independent Student Test showed that AH Plus sealer (Subgroup A) having higher push out bond strength than Metaseal(Subgroup B)under each irrigant (TABLE1)(FIG:1)

Comparison of mean Push out bond strength (in Mpa) between 02 sealer under each Irrrigant using Independent Student t Test

Irrigants	Groups	N	Mean	SD	Mean Diff	P-Value
EDTA	AH Plus	5	4.24	0.38	0.53	0.04*
	Metaseal	5	3.70	0.41		
Oxum	AH Plus	5	3.65	0.29	0.58	0.02*
	Metaseal	5	3.07	0.31		
Saline	AH Plus	5	2.67	0.22	0.74	0.002*
	Metaseal	5	1.93	0.31		



DISCUSSION

Adhesion of the root canal filling material to dentinal walls is a very desirable physical property and of paramount importance because it prevents fluid percolation between the spaces of obturation, minimizes the risk of filling detachment from dentin during restorative procedures or masticatory functions, ensuring intact seal and maintaining the integrity of sealer-dentin interface without being disrupted for long term clinical success of endodontic treatment.[2] Dentin surface treatment with different irrigation regimens may cause alteration in the chemical and structural composition of human dentin, thereby changing its permeability and solubility characteristics and hence affecting the adhesion of materials to dentin surfaces.[7]

In the present study, the bond strength of the tested obturation systems was found to be differently affected by the various irrigation regimens applied.

In study, final rinse with distilled water was performed, as it was observed that the use of NaOCl as a final rinse resulted in reduced resin bond strength because it oxidizes the dentinal matrix that inhibits the polymerization process of resins.[3]

The utilization of sodium hypochlorite (NaOCl) irrigant in endodontics is justified by its undeniable importance as a result of both its wide-spectrum antimicrobial activity and its properties as an organic tissue solvent. However, it is known to be highly irritant to the periapical tissues, mostly at high concentrations and it is unable to remove the smear layer by itself, as it dissolves only organic material. Ethylenediaminetetraacetic acid (EDTA) is effective at dissolving inorganic material, including hydroxyapatite; on the other hand, it has little or no effect on organic tissue and it does not possess antibacterial activity.[8] Thus most of the commonly used irrigants have only few desirable properties.

By virtue of the known drawbacks of all endodontic irrigants, developing improved irrigating solutions for endodontics remains an area of great interest.[6]Super Oxidized Solution is an electrochemically processed aqueous solution manufactured from pure water and sodium chloride. During this electrolysis process reactive species of oxygen and chlorine are formed.These released reactive species creates an unbalanced osmolarity, so that it damages the integrity of the cell membrane, then reacts and denatures the lipids & proteins of single cell organisms. This is because of a direct result of the osmolarity difference between the ion concentrations of the solution and single cell organism. Multicellular organisms are not prone to such osmolarity changes.[4]The main advantage of this super-oxidized water is that it is stable and has a longer shelf life. It mainly contains oxidized solution (H2O) and hypochlorous acid, hydrogen peroxide, ozone, chlorine dioxide, sodium hydroxide, sodium carbonate and sodium chloride.

Among the irrigants, 17% EDTA demonstrated the highest push-out bond strength values followed by OXUM with both the sealers. This could be attributed to the fact that 17% EDTA effectively removed the smear layer that allowed the penetration of the resin into the open dentinal tubules, hence, creating an efficient micro-retention.[3]

Hashem *et al.*[7] and Neelakantan*et al.*[10] found out that the surface treatment with 17% EDTA favors the adhesion of resinous AH Plus.

However, the difference between 17% EDTA and oxum was statistically significant, whereas oxum showed significant differences with saline. Based on the present study, it has shown that oxum when used as an irrigant, cleans the root canal surfaces in a clinically significant manner and removed the smear layer.

Group 1 saline showed significantly lowest bond strength values because the smear layer was left intact. This was in concurrence to the previous study performed by Eldeniz*et al.* wherein smear layer removal enhanced the bonding ability of sealer.[9]

Among the two sealers, the highest push-out bond strength values were shown by AH Plus followed by MetaSEAL with all the irrigants,and the differences between two of them were statistically significant.

The possible reason for the higher values of AH Plus could be attributed to its inherent volumetric expansion property that resulted in the formation of a covalent bond between sealer and exposed amino groups of root dentin by an open epoxide ring that showed photopolymerization.[3]

In a study Rahimi *et al.* [11]found out that epoxy resin-based sealers showed higher bond strength values when compared to dimethacrylate-based sealers.

MetaSEAL presented inferior bond strength values when compared with AH Plus.Theoretically, methacrylate resin-based sealer forms hybrid layers to dentin and gutta-percha. However, this hybrid layer was either thin or incomplete or nonexistent when observed in self-adhesive MetaSEAL sealer.[12]This might have resulted in the gap formation and subsequent bond failure.Similar findings were observed by Lawson *et al.*[13]

CONCLUSION

The bond strength of root canal sealers to dentin is important for maintaining the integrity of the seal in root canal filling, thus

preventing any bacterial ingress from the oral cavity and periradicular tissues that might cause post treatment complications.

This study clearly demonstrates the superior efficacy 17% EDTA and OXUM on the bond strength of AH Plus Within the limitations of the present study, Oxum the commercially available super-oxidized water proved to be equally effective in smear layer removal when compared to EDTA. However it may be worthwhile to investigate further, the effect of oxum alone as a root canal irrigant to evaluate its effect on smear layer and on dentine.

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