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Original Study

Evaluation of bond strength of a novel endodontic sealer to root canal dentin: an in vitro study

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ABSTRACT

Introduction:
An ideal endodontic sealer should be tacky when mixed, radiopaque, non-toxic, non-irritant, bacteriostatic, and easily retrievable. The endodontic sealers that are commonly used are zinc oxide eugenol (ZOE) sealer, calcium hydroxide sealer and more recently resin sealers. Resin based sealers are one such category that is gaining popularity due to it no eugenol formulation and chemical adhesion to the root surface. This study was conducted with the aim of comparing the bond strength of three different endodontic sealers to root canal dentin.
Materials and Methods:
The samples for this study consisted of sixty single rooted extracted teeth with completely formed apices. Access was opened, working length determined followed by biomechanical preparation with irrigation was performed. Samples Teeth were split into 3 groups: Group A – ZOE sealer, Group B – AH plus sealer, Group C – Xenon epoxyl plus sealer. Manipulation and application of the sealer was done based on the manufacturer's directives. All the sixty teeth were obturated based on the group criteria. After obturation each tooth was sectioned, and testing of its bond strength was carried out using the universal testing machine.
Results:
Group B and Group C had higher bond strength compared to Group A, but it showed no statistically significant difference between Group B and Group C.
Conclusion:
Push out bond strength was observed to be more in resin sealer groups in comparison with zinc oxide eugenol sealers.

Keywords: *Bond strength, Epoxy resin sealer, Push-out test, Resin sealers.*

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INTRODUCTION

A successful endodontic therapy depends on proper biomechanical preparation and achieving a hermetic seal with the obturating material. The most used obturating material in clinical practice is gutta percha. As gutta percha doesn't bond to the tooth structure, the use of endodontic sealer plays a crucial role to achieve the desired air-tight and fluid impervious seal.[1]

An ideal endodontic sealer should be tacky when mixed, radiopaque, non-toxic, non-irritant, bacteriostatic, and easily retrievable. Another important property of an endodontic sealer is the bond strength because it reduces the chances of dislodgement or detachment of the obturating material from the root canal space when subjected to masticatory forces.[2] At present no sealer satisfies all the ideal requirements of a sealer.

The frequently used endodontic sealers are ZOE sealer, calcium hydroxide sealer and more recently resin sealers. Though zinc oxide eugenol is widely used due to their therapeutic effect and antimicrobial property, two main demerits are cytotoxicity and tissue-irritating potency of the eugenol component and their lack of chemical adhesion to the root dentin surface.[3] This has led to the development of new and improved groups of sealers. Resin based sealers are one such category that is gaining popularity due to it no eugenol formulation and chemical adhesion to the root surface.[4]

The main objective of performing this research was to test the comparability of the bond strength of a new epoxy resin sealer- Xenon epoxyl plus to the conventional zinc oxide eugenol sealer and most used resin sealer- AH plus.[5]

Xenon epoxyl sealer is available as 2 paste system, base paste containing Bisphenol A epoxy resin, Titanium dioxide, Cabosil and catalyst paste containing Hexamethylene Tetra amine and Titanium Dioxide in mineral oil base. In this in vitro study, push out bond strength was chosen because while performing push out test the fracture happens corresponding to the resin border thus providing better evaluation of the bond strength.[6]

MATERIALS AND METHODS

The study consisted of sixty single rooted teeth with fully formed apices with no defects or fracture. The selected teeth were soaked in sodium hypochlorite to remove any organic debris and cleaned thoroughly using distilled water. Access opening was done for all the teeth and working length was determined by negotiating the canal using 10 k file until it was visualized at the level of apical foramen. Biomechanical preparation of all the root canals was done using 20 size k file until working length, after which cleaning and shaping was done rotary protaper until size F3, subsequently irrigation was done in between each file size using 3% NaOCl and saline. Then the canals were then flushed with 17% EDTA to eradicate debris and smear layer while final irrigation was done with saline for 1 minute.[7]

The teeth were then split into 3 groups of 20 teeth each depending on the sealer to be used for obturation.

1. Group A- ZOE sealer
2. Group B- AH plus sealer
3. Group C- Xenon epoxyl plus sealer

The sealers of the three groups were mixed based on the instructions by the manufacturer and the teeth in each group was obturated by coating 6% gutta percha points with their respective sealers. The coronal portion of the GP was sheared off and the access cavity was filled with ZOE cement.[8]

For the complete setting of the sealers, all the teeth were incubated at 37 C for 24 hours at relative humidity. After which, tooth sectioning into coronal, middle and apical thirds using diamond disk at low speed under continuous water irrigation was carried out. The middle third of each tooth was mounted on an acrylic block and was subjected to push-out test. Loading was checked using the Universal testing machine at a speed of 0.5mm/min until debonding of the sealer occurred.

Push-out bond strength (MPa) is calculated as Maximum load (N) divided by Area of adhesion of the root canal filling (A) (mm^2). The bonding (adhesion) surface area of each section was calculated using the formula: (pr1 + pr2) L, where L = H (r1 r2) 2 + h2; where p is the constant 3.14, r1 and r2 are the smaller and larger radii respectively, and h is the thickness of the section in millimeters.[9]

The values were tabulated and then the data analysis was made by means of one way ANOVA and post- hoc Tukey test.

RESULTS

Table 1: Push-out bond strength values (Mean ± SD, unit: MPa)

GROUPS	MEAN± SD
GROUP A	1.05 ± 0.47^{A}
GROUP B	3.84 ± 1.94^{B}
GROUP C	3.56 ± 1.33^{B}

Different letters denote significant difference between the groups. The mean test values of push-out bond strength for each of the groups are shown in table 1. The ANOVA test showed significance amid the different groups ($p<0.001$). Multiple paired evaluations showed that group B and group C had significantly advanced bond strength in comparison to group A. However, no statistically significant difference was observed between group B and group C.[10]

DISCUSSION

The major goal of endodontic therapy is twofold, one is to remove the diseased and damaged pulp and inorganic substances from the teeth and the second is to fill the root canal space with an inert obturating material which acts as a barrier for ingress of bacterial byproducts into the root canals. Gutta percha has been traditionally used as the obturating material, it does not bond to the tooth surface, so it is used in conjunction with a sealer like ZOE sealer, calcium hydroxide sealer and resin sealers to provide fill the imperfections and to achieve the fluid impervious hermetic seal.[11]

An adequate chemical bonding between the sealer and root dentin is essential to achieve a homogenous "monoblock" restoration.[12] Emphasizing these recent advances are focused more on developing adhesive resin sealers.

Zinc oxide eugenol sealer though conventionally used for a long time because of its excellent antimicrobial property, their use in clinical practice is declining owing to their cytotoxic effects in in vivo cell cultures and tissue irritating property when extruded into the periradicular tissues. Another main demerit of eugenol containing sealers is that the presence of eugenol inhibits the polymerization of resins and interfere with bonding.[13] So if using zinc oxide eugenol sealer for obturating cases, requiring fibre posts or composite core, the residual sealer must be completely removed, which is almost impossible, thus compromising the bond. This problem is overcome by using resin based sealer.[14]
Resin based sealers have superior properties of being eugenol free, high radiopacity, chemically interacting and bonding to the tooth structure, thus imparting strength to the root and enhancing fracture resistance and lower rates of water solubility.[15] AH Plus sealer is a 2 paste epoxy resin based sealer, containing Bisphenol A epoxy resin which due to its exceptional properties, such as low solubility, adhesion to dentin, less expansion and a super sealing capability is considered the gold standard.[16]

The outcomes of this research showed that the new sealer and AH plus sealer had higher bond strength when compared to ZOE sealer, however it showed no significant variance in the push-out bond strength between the resin sealer groups. This could be due to the capacity of the resin to infiltrate deep into the dentinal tubules due its increased flow and its ability to react with the exposed collagen to make covalent bonds.[17]

Similar results had been observed by Patil et al, who in his study had compared the bond strength of AH plus, Endorez and epiphany sealer, which concluded that AH plus epoxy resin sealer had superior bond strength.[18] On the contrary, Mahdi AA et al had said that no difference in push-out bond strength values was observed between AH plus, Endorez and Realseal sealers.[19]

Xenon epoxyl is also new epoxy resin based sealer that is recently introduced with similar composition of AH plus sealer. This study was done to access the performance of this Xenon sealer in comparison to the gold standard. Thus, Xenon epoxyl can also be used in similar manner as AH Plus sealer.[20]

CONCLUSION

From this study we conclude that the push out bond strength of ZOE sealers was lesser than AH plus sealer and Xenon epoxy sealer. From a clinical aspect, the present study result favors the use of Xenon epoxyl sealer as alternative or equivalent to AH plus sealer. However further need for study in vitro and in vivo are required to assess the bacterial leakage, biocompatibility, solubility, and removability in case of retreatment.[21]

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