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To Evaluate And Compare The Pushout Bond Strength Of Two Different Endodontic Sealers- An In Vitro Study

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Abstract

Aim-The purpose of this study was to compare and evaluate the bond strength of two different endodontic sealers to root dentin using a pushout test .

Materials And Method-A total of thirty single rooted teeth with fully formed apices were chosen. Decoronation of teeth was done and the working length was determined. Instrumentation and irrigation were carried out. The teeth were divided into two groups based on the sealer used. Group 1: Mineral trioxide aggregate (MTA) based sealer (MTA Fillapex smart mix), Group 2: Calcium Hydroxide based sealer (Apexit plus sealer) The sealer was applied/used according to the manufacturer's instructions. Obturation was done with 6 percent guttapercha. Following which, each tooth was prepared for a pushout test using 2 mm thick root slices.

Result-The bond strength was found highest in Group 2 (APEXIT PLUS) compared to the other. Statistical analysis was done by two-way ANOVA and Newman-Keuls multiple post hoc.

Conclusion-The push-out bond strength of Apexit plus sealer was highest.

Keywords: Apexit plus sealer,MTA fillapex smartmix sealer,pushout bondstrength

Introduction

Dentistry can't be imagined without the use of sealers. The first sealer ZOE which was introduced in the year 1931. As of today, we are having many advances in the sealers such as Ultradent: EndoREZ Root Canal Sealer, Dentsply Maillefer: AH Plus Root Canal Sealer, Brasseler: EndoSequence BC sealer, Septodont: BioRoot RCS, Dentsply Sirona: Ribbon Seale and many more.

A root canal sealer (cement) is used in combination with the core root canal filling material, e.g. gutta-percha. The primary role of the sealer is to obliterate the irregularities between the root canal wall and the core material. Almost all of today's root canal filling techniques use a sealer to enhance the seal of the root canal filling.

The success of root canal treatment depends on the thorough debridement of the root canal system, the elimination of pathogenic organisms and finally the complete sealing of the canal space to prevent ingress of bacteria from the oral environment and spread to the periapical tissue[6].

Sealers are used to create a seal between the core material and dentinal walls. It should fill imperfections and increase adaptation of the root filling material to the canal walls

Root canal sealers that have traditionally been used include ZOE, calcium hydroxide, and resin based sealers. Newer root canal sealers are constantly being developed in order to provide better properties.

The sealers used in this study are - **APEXIT PLUS(Ivoclare) and MTA FILLAPEX SMART MIX(Angelus).**

APEXIT PLUS(Ivoclare) is a radiopaque, non-shrinking root canal sealer paste that is based on calcium hydroxide. It has an excellent tissue tolerance, easily flowable, convenient application a working time of 3hours, and a setting time of 2:15hours.

Composition of the base	
Calcium hydroxide / Calcium oxide	36.9
Hydrated collophonium	54.0
Fillers	9.1

Composition of the activator	
Disalicylate	47.6
Bismuth hydroxide/ Bismuth carbonate	36.4
Fillers	16.0

Mta Fillapex Smart Mix(Angelus)

Sealers containing MTA were developed by Torabinejad in the early 1990s, the first study on this material was published by Lee et al in 1993. MTA FILLAPEX SMART MIX(Angelus) is an automix bioceramic endodontic sealer based on MTA. It allows complete root canal filling including accessory and lateral canals. It provides tissue recovery and the lack of inflammatory responses are being optimized. Also, it does not cause tooth structure discoloration. With a working time of 23min and a setting time of 130min, it provides excellent handling property.

Evaluation of bond strength between sealer and root dentin is commonly carried out with this test, providing better evaluation of bond strength because here fracture occurs parallel to the resin interface1Thus the purpose of this study was to compare and evaluate the bond strength of different endodontic sealers.

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COMPONENT NAME	CHEMICAL NAME	FUNCTION
PASTE A		
Salicylate resin	Methyl Salicylate Butylene Glycol Colophony	Ionic polymer formation
Bismuth Trioxide	Bismuth Trioxide	Radiopacity
Fumed Silica	Fumed Silicon Dioxide	Filler
PASTE B		
Fumed Silica Titanium Dioxide	Fumed Silicon Dioxide Titanium Dioxide	Filler Pigment
Mineral Trioxide Aggregate (40%)	Tricalcium silicate Dicalcium Silicate Calcium Oxide Tricalcium Aluminate	Active ingredient and responsible for ionic polymer formation
Base resin	Pentaerythritol Rosinate P - Toluenesolfonamide	Plasticity Plasticity

Materials And Method-

Thirty extracted single-rooted premolar human teeth were selected which were devoid of any defects like root defects, fractures, and with matured apices were taken for this study. Each tooth was sectioned at the cemento-enamel junction with a low speed diamond blade, and the roots were then stored in normal saline. The root canal was negotiated with a size 10 stainless steel endodontic file until visualized at the apical foramen. Working length was determined by taking radiographs up to 1 mm short of apical foramen with K-type file. All canals were instrumented to the working length using protaper instruments till size F3. Canals were irrigated with 3% NaOCl solution and saline throughout instrumentation. Final irrigation consisted of 3 ml of 17% ethylenediaminetetraacetic for 1 min followed by 5 ml of saline. The roots were stored in normal saline and divided into two groups based on the sealer used.

GROUPING
GroupI - Gutta-percha with MTA FILLAPEX SMARTMIX sealer
Group II - Gutta-percha and APEXIT PLUS sealer

Coronal, middle and apical cross sections were prepared of 1mm thickness and then send for Universal Testing Machine to evaluate the pushout bond strength

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Rotary files

Gutta-percha cones

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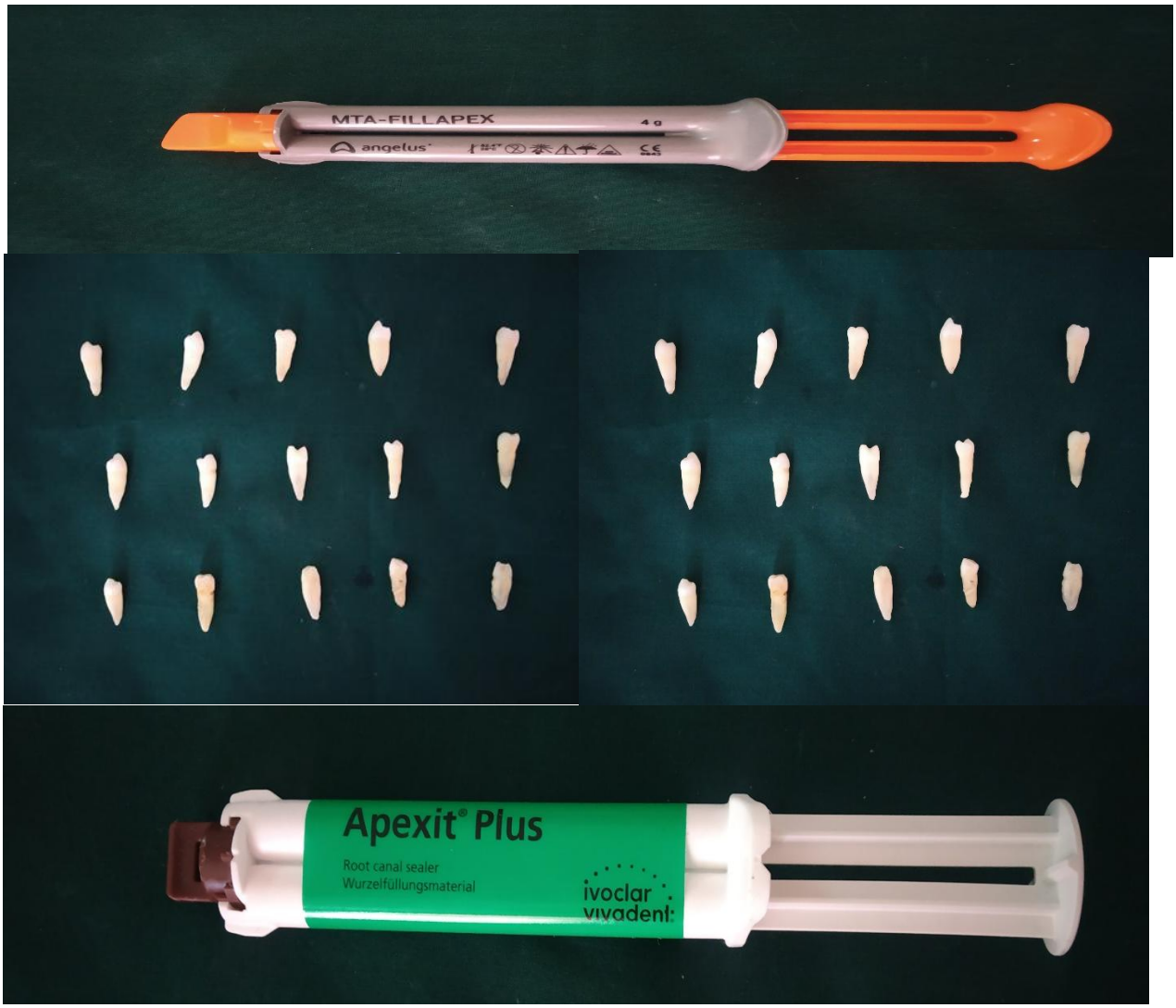

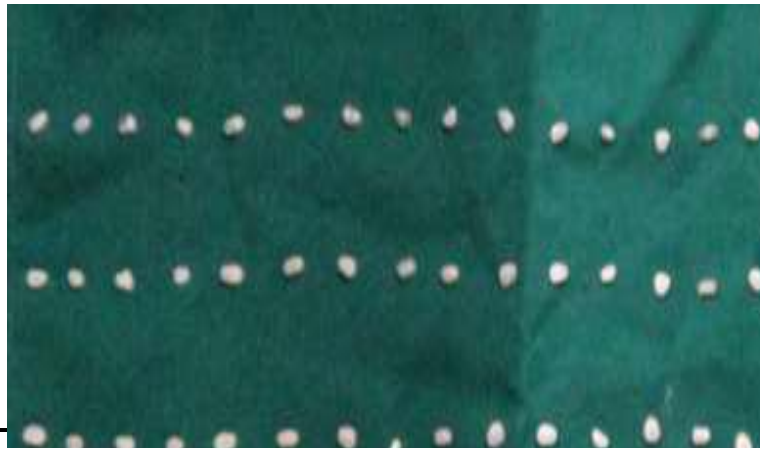

Horizontal sections of teeth

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Horizontal sectioning of coronal, middle and apical region

Push out bond strength examination using UTM

Results-

The data entered in MS-Excel and STATA 14.2 software was used for statistical analysis. The comparison of MTA FILL APEX and APEXIT PLUS was done using Mann-Whitney U test. The statistical significance value was taken as $p<0.05$

Endodontic sealers	Mean±SD	Range
MTA FILL APEX		

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CORONAL	1.05±0.97	0.21-3.51
MIDDLE	1.49±0.95	0.14-3.21
APICAL	2.23±1.32	1.03-5.52
APEXIT PLUS		
CORONAL	1.93±1.36	0.52-5.96
MIDDLE	2.16±1.37	0.55-5.85
APICAL	3.27±1.21	0.34=5.10

Endodontic sealers	**z-score**	**p-value**
Coronal (MTA FILL APEX vs. APEXIT PLUS)	-1.34	0.047
Middle (MTA FILL APEX vs. APEXIT PLUS)	-0.892	0.032
Apical (MTA FILL APEX vs. APEXIT PLUS)	-1.59	0.015

The analysis was performed on observations recorded from 30 teeth, 15 teeth in each group. The highest bond strength was observed in apical region from Apexit plus in comparison to MTA fill ($p<0.05$). Also, there was statistical difference observed between MTA fill apex and Apexit plus at coronal and middle regions ($p<0.05$).

Discussion

Because of the poor adhesiveness of gutta-percha, the use of sealers has been considered mandatory. The major function of a root canal sealer is to fill imperfections and increase adaptation of the root filling material to the canal walls, failing which the chances of leakage and failure increase[2,3,4,5]

Bond strength reduces the risk of filling detachment from dentin during restorative procedures or masticatory function, ensuring sealing and, as a result, clinical success of endodontic treatment. The bond (sealer and canal walls) may be beneficial in maintaining the integrity of this critical interface between dentine and cementum via frictional retention or micromechanical adhesion. The force is applied in the apicocoronal direction to avoid any interference caused by canal taper during filling material dislodgement.

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