Comparative Evaluation of Push out Bond Strength of Latest MTA based Bioceramic sealer MTApex and Resin Based sealer –An in vitro study.

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ABSTRACT
Aim: To compare the dislodgement resistance of MTA based Bioceramic sealer (Ultradent MTApex) with an epoxy resin based sealer (AHplus)
Material:
Methodology: The root canals of 40 single-rooted human teeth were instrumented with F360 up to size 45.. All canals were obturated using matching gutta-percha cones according to the single-cone technique in combination with one of the mentioned sealers (n = 20 per group). After eight weeks of incubation (37 °C, 100% humidity), the roots were embedded in resin. Starting with a distance of 7 mm from the apex, four slices of 1 mm thickness were cut. Dislodgement resistance was measured using a universal testing machine and the push-out bond strength was calculated. Statistical analysis was performed using ANOVA and Student-Newman-Keuls-test
Results: Regarding the pooled data of all sections, the push-out bond strength of AH Plus was significantly higher than the push-out bond strength of MTA based Bioceramic sealer MTApex ($P < 0.05$).
Conclusion: The push-out bond strength of the investigated MTA-based Bioceramic sealer, MTApex was lower than of AH Plus.
Keywords: MTApex,Push out Bond strength, Rotary instrument.

Introduction

The secret to a successful endodontic procedure is to remove all bacteria and diseased or necrotic pulp tissue from the canal and to completely seal the canal space. This will stop the infection from continuing and/or the pulp cavity from becoming infected again.Therefore, to stop bacteria from entering from the oral environment, the root canal system must be perfectly sealed.The endodontic sealer creates a bacterially tight closure for the root canal. Push-out bond strength, also known as dislodgement resistance, is a crucial metric for assessing how well the root canal sealer adheres to the canal wall and core material.Bioceramic sealers based on MTA have superior physicochemical qualities.are more biocompatible and have demonstrated intriguing biological qualities in both in vitro and laboratory experiments.

Materials and Method:

Selection of teeth:

Forty maxillary central and lateral incisors with mature root apices and single canal extracted for periodontal reasons were used. Teeth with root caries, cracks on the root surface, curved roots and extremely calcified canals were excluded. Soft tissue and calculus were removed mechanically from the root surface.

Initial root canal treatment: To provide straight line access for instrumentation and obturation, a diamond disc was used to decoronate each tooth at the cementoenamel junction (CEJ). An ISO # 10 K-file was inserted until it reached the apical foramen in order to ensure proper access and assess the apical patency. To measure the working length, a 15K-file was inserted into the canal until it was visible at the apical foramen. The working length was then set 0.5 mm below this distance. Near the canal orifice, a circumferential "staging platform" was set up to provide a consistent working length (WL) of 15 mm in every tooth. A modified step back flare technique was used for cleaning and shaping.. Gates-Glidden drills in sizes 1-3 were used to flare the coronal third (Dentsply Maillefer). In order to prepare the canal, k-files (Dentsply Maillefer, Ballaigues, Switzerland) were used one after the other until the working length reached size 30. A step-back operation was then used in increments of 1 mm until the file size reached 50. Following the removal of each instrument, canals were irrigated alternately with 5.25% sodium hypochlorite (NaOCL) and 17% ethylenediaminetetraacetic acid (EDTA).

Root canal obturation: The root canal of each tooth was initially dried with paper points and obturated with MTApex(Ultradent),AHplus for respective groups. Two groups are made-

Group 1-AHPlus

Group 2-MTApex

The coronal access cavities of the specimens were sealed with temporary filling material (Cavit,DeTrey Dentsply). The appropriate sealing of the root fillings was confirmed using postoperative radiographs. All teeth were stored at room temperature for 30 days to allow complete setting of the sealer.

Push out Bond Strength Technique: Under persistent water chilling, the roots were vertically immersed in acrylic resin (Technovit 4071, Heraeus Kulzer, Hanau, Germany) and sectioned horizontally using a 0.25 mm low-speed saw (Leitz, Wetzlar, Germany) between 7.00 mm and 11.75 mm from the apex. As a result, the middle third of the root was represented by four slices that were 1 mm thick. This resulted in a total of 80 specimens each group. A one-way ANOVA power calculation was used to determine the sample size (power = 0.8; effect size = 0.25; significance level = 0.05; number of groups = 2). The entire set of four specimens per root was thrown away and replaced with a new set obtained from an additional encased tooth in the event that sectioning of the teeth showed an oval canal, a canal with isthmuses, or voids in the obturation.The supervisor coded the specimens for the dislodgement resistance measurement and mode of failure evaluation; only the supervisor knew which groups the coded specimens belonged to. To enable the canal infill material to fall out of the canal once it was dislodged, the specimens were put in a metallic jig with a hole underneath. The filling's gutta-percha core was subjected to a vertical load using a standard-sized plunger with a 0.6 mm diameter tip.To guarantee an even distribution of the load on 60% to 85% of the gutta-percha cone diameter without reaching the sealer phase of the root canal filling, the plunger tip's diameter was measured in accordance with the gutta-percha point diameter at a distance of 6 mm from the tip.The vertical load was produced by applying it apically to the coronal direction.by a universal testing machine(Lloyd LF Plus, Ametek, Berwyn, Pennsylvania, USA) at a speed of 1 mm per minute. A program (Nexygen, Ametek, Berwyn, Pennsylvania, USA) created a graph of the applied load, and when the graph indicated a sudden drop in load, it automatically identified that the bond had failed. Newton (N) was used to record this failure load.The truncated cone formula $M = (R + r) \cdot \pi \cdot m$ was used to determine the lateral surface of each specimen's root canal. Next, each specimen's push-out bond strength was determined and reported in N/mm2, or MPa.

Statistical Analysis

Statistical analysis of POBS values was performed using ANOVA and Student-Newman-Keuls-post-hoc-test ($p < 0.05$) as data were distributed normally according to the Kolmogorov-Smirnov test ($p < 0.05$).

Results

All specimens had measurable adhesion to the root dentin and no premature failure occurred. Pooling the data of the four sections, AH Plus revealed significantly higher dislodgement resistance than MTApex sealer ($p < 0.05$).

		Overall		10.75-11.75mm from apex		9.5-10.5mm from apex		8.25-9.25mm from apex	7-8mm from apex
S.No	**Group**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	Mean SD	Mean. SD
1.	AHPLUS	7.03a	2.41	6.12a	1.48	6.37a	1.74	7.01a. 1.80	8.62a. 3.42
2.	MTAPEX	2.3	1.3	1.96	1.2	2.08	1.25	2.76. 1.3	2.44. 1.43

Discussion

The current findings showed that the tested materials performed noticeably differently from one another. AH Plus, an epoxy resin sealer, outperformed MTApex in terms of bond strengths to root dentine.AH Plus is regarded as the gold standard root canal sealer and its superior performance has been extensively proven in endodontic literature.A covalent connection formed between exposed amino groups in the collagen network and an open epoxide ring is mostly responsible for the adhesion of AH Plus sealer.Its lengthy setting time linked to creep capacity also contributes to AH Plus's robust sealing performance and mechanical interlocking with root dentine.Furthermore, it might be said that AH Plus exhibits a high degree of molecular cohesion, which translates into a strong adhesion property.

In order to enhance the biological and physicochemical characteristics of root canal sealers, including their bioactivity and setting time, hydroxyapatite has been added to their composition.The results of the current investigation showed that the addition of this component to experimental sealers had no effect on dentine bond strength. It's possible that there wasn't enough hydroxyapatite in the MTApex catalyst paste to affect its push-out values.

Conclusion

Within the limitations of this study (extracted teeth, age of patient, in-vitro study), the push-out bond strength of the investigated MTA based sealer was lower than the push-out bond strength of AH Plus.

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