Evaluation of Push-out Bond Strength and Marginal Adaptation of TotalFill Bioceramic HiFlow, TotalFill Bioceramic and AH Plus Root Canal Sealers in Mandibular Premolar Teeth with Single Canal: A Comparative in-vitro Study

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Abstract

PICO approach:

P: Population
Mandibular premolar teeth with single oval canal

I: Intervention #1
TotalFill Bioceramic HiFlow root canal sealer with single cone technique.

I: Intervention #2
TotalFill Bioceramic HiFlow root canal sealer with warm vertical compaction technique.

I: Intervention #3
TotalFill Bioceramic root canal sealer with single cone technique.

I: Intervention #4
TotalFill Bioceramic root canal sealer with warm vertical compaction technique.

C: Control
AH Plus root canal sealer with warm vertical compaction technique.

O: Outcome

Primary outcome:
Push-out bond strength

Secondary outcome:
Marginal adaptation.

Introduction

One of the decisive variables in the effectiveness of root canal therapy is the quality of root canal filling (Stoll et al., 2005). Three Dimensional obturation of root canal filling avoids reinfection by reducing coronal leakage, achieving a good apical seal, and entombing any lingering bacteria after chemomechanical debridement (Stoll et al., 2005; Sjögren et al., 1997).
The root canal filling is made up of two primary components: gutta percha and endodontic sealer. Endodontic sealers operate as a bridge between the gutta percha and dentinal walls, forming a fluid-tight barrier by sealing the master gutta percha cone and accessory cones, thereby shutting the accessory canals \cite{Salz2009, Kumar2011}. Ideally, the sealer aids in the retention of inert gutta percha in the pulp canal space. Ideal sealer features include simplicity of handling, non-toxicity, biocompatibility, no shrinkage while setting, efficient working time, hydrophilic, antibacterial capacity, and ease of retreatment \cite{Garcia2010, Sousa2006}.

To avoid the entry of microorganisms or their byproducts, which is the major cause of root canal treatment failure, sealer should completely adapt to the root canal wall so that no minute gaps are present coronally and apically, and deeper penetration of sealer into the dentinal tubules which prevents leakage thus preventing reinfection as entry of microorganisms and their byproducts is blocked \cite{Cobankara2004, Kim2010}.

Resin-based conventional root canal sealers have conventionally been used, AH Plus (Dentsply, DeTrey, Konstanz, Germany) is an epoxy resin-based sealer have been used because of their reduced solubility, better apical seal, micro-retention to root canal dentin and characterized by very low shrinkage and high dimensional stability, however, it has several drawbacks as cytotoxicity effect due to the minimal release of formaldehyde, poor adaptation to humid dentin due to silicone oil and other ingredients, and formation of voids \cite{Kim2019, Wang2018}.

Thus, better penetration, adaptation and adhesion of sealers has gained a continuous development and interest in research to reach the best clinical outcome for a successful treatment of root canals.

### Reagents

1. **TotalFill Bioceramic HiFlow (single cone obturation technique):**

TotalFill BC HiFlow sealer (FKG Dentaire SA, La Chaux-de-Fonds, Switzerland) is available in premixed preloaded syringe, dispensed directly into the canal via a disposable canal tip. Then the master cone size 40 taper .04 (TotalFill BC Point HiFlow, FKG Dentaire SA, La-Chaux-de-fonds, Switzerland) will be placed into the root canal system to the full working length and the excess core will be cut off using a heated Machtou Hand plugger, and access cavities will be sealed using Cavit provisional filling. (GC Gold Label-GC Fuji Japan)

2. **TotalFill Bioceramic HiFlow (warm vertical compaction obturation technique).**

Placing of the sealer will be as mentioned in I1, after ensuring fit of TotalFill BC Point HiFlow with sealer, Warm vertical compaction obturation will be done using EQ-V system (Meta Biomed Co., Cheongju, Korea), EQ-V Pack Tip (F 50/04) that pierces 4 mm short of working length will be taken, and the hot pre-fitted Machtou Hand plugger until size 4/100 (VDW GmbH, Munich) will be employed to compact the GP at the apical 4 mm. The obturation unit considered for heat source will be attuned to 200°C using EQ-V
Fill's. The back filling of the radicular canal will be performed up to 1 mm beneath the CEJ with TotalFill BC Pellets (FKG Dentaire SA, La-Chaux-de-fonds, Switzerland) and access cavities will be sealed using Cavit provisional filling. (GC Gold Label-GC Fuji Japan)

III : TotalFill Bioceramic (single cone obturation technique):

The root canals will be obturated with master cone size 40 taper .04 (TotalFill BC Point, FKG Dentaire SA, La-Chaux-de-fonds, Switzerland) together with the BC Sealer (FKG Dentaire SA, La-Chaux-de-fonds, Switzerland) using the methods described in I1

IV : TotalFill Bioceramic (warm vertical compaction obturation technique):

The root canals will be obturated with master cone size 40 taper .04 (TotalFill BC Point, FKG Dentaire SA, La-Chaux-de-fonds, Switzerland) together with the BC Sealer (FKG Dentaire SA, La-Chaux-de-fonds, Switzerland) using the methods described in I2

Control : AH Plus (warm vertical compaction obturation technique):

AH Plus consists of a paste-paste system, which is delivered in two tubes and in a new double barrel syringe. AH Plus in tubes: will be mixed in equal volume units (1:1) of Paste A and Paste B on a glass slab or a mixing pad using a metal spatula until we get a homogeneous consistency. The canal walls will be coated with AH Plus using a Lentulo spiral (Dentsply, Maillefer, North America), by advancing it slowly to the apex running at a very low speed, The canals will be obturated with a 40 taper .04 gutta-percha cone (Meta Biomed Co., Cheongju, Korea), and Back filling of the radicular canal will be performed up to 1 mm beneath the CEJ with thermoplasticized meta gutta percha bars (Meta Biomed Co., Cheongju, Korea),using the methods described in groups 12 and I4.

Equipment

heated Machtou Hand plugger(VDW GmbH, Munich),EQ-V system (Meta Biomed Co., Cheongju, Korea), EQ-V Pack Tip (F 50/04),Lentulo spiral (Dentsply, Maillefer, North America),

Procedure

Preparation of samples:

To create an easy reference point for the working length (WL), decoronation of the teeth will be done with a high-speed fissure bur under copious water spray to standardize the length at 16 mm. Canal patency will be checked using K-file #10 (Dentsply, Maillefer, Switzerland). The WL will be determined by placing a #15 K-file (Dentsply, Maillefer, Switzerland) until it will be just visible at the apical foramen, from which 1 mm will be subtracted to determine the working length. Canals that will not allow the placement of a size 15 K-file into the apex or those wider than a size 20 K-file at the apex will be excluded.
**Root canal preparation:**

Root canal will be prepared using a crown-down technique with Race Evo (FKG Dentaire SA, La-Chaux-de-fonds, Switzerland) on a Rooter Universal motor (FKG Dentaire SA, La-Chaux-de-fonds, Switzerland) and will be inserted into the canal at speed 800-1000 rpm and torque 1.5 Ncm, until file R4 (size 40 taper 0.04).

After each instrument used, the canals will be irrigated using 2ml 2.5% sodium hypochlorite (Vensons, India) solution for one min using a 27-gauge, side-vented needle (NaviTip, Ultradent South Jordan, UT, US), then the canal will be rinsed with 2ml saline. After the preparation, the root canals will be rinsed with 2ml of 17% ethylenediaminetetraacetic acid (EDTA) (MD-Cleanser by Meta Biomed, Eagan, MN, USA) solution for 1 min to remove the residual smear layer. As a final flush, 5ml of saline will be used to remove remnants of EDTA.

After chemo-mechanical preparation, all the canals will be dried with absorbent paper points (Diadent Group International Inc, Chongju, Korea), a radiograph will be obtained to ensure proper master cone extension (size 40, taper 0.04). The specimens will be randomly divided into five groups.

**Troubleshooting**

**Time Taken**

**Anticipated Results**

**Prioritization of Outcome**

**Outcome**

**Method of Measurement**

**Unit of Measurement**

Primary outcome

Push-out bond strength

*(Delong et al., 2015)*

Push-out test /Universal testing machine

**Numerical**

megapascals (MPa)
Secondary outcome
Marginal adaptation

*(Shokouhinejad et al., 2014)*

Scanning Electron Microscopy
Numerical
Micrometers (μm)

References


