



## COMPARATIVE EVALUATION OF TENSILE BOND STRENGTH OF ENDODONTIC SEALERS TO DENTIN AND GUTTA PERCHA - AN IN-VITRO STUDY.

Dr. Omkar Eswara Babu Danda<sup>1</sup>, Dr. Lakshman Kumar CH<sup>2</sup>, Dr. Afroz Kalmee Syed<sup>3</sup>, Dr. Dasarathi A<sup>4</sup>, Dr. Haranath Danda<sup>5</sup>

<sup>1,2,3,4,5</sup> Private Practitioners, RVS Dental College, Coimbatore

Conflicts of Interest: Nil

Corresponding author: Dr. Afroz Kalmee Syed

DOI: <https://doi.org/10.32553/ijmsdr.v5i1.739>

### Abstract:

**Introduction:** The root canal therapy is done with the intention to seal it off from any fluid leaks, thus enhancing the longevity of the therapy. The seal between the obturating material and the dentinal walls of the root surface is done by the endodontic sealer. The sealer is designed in such a way that it has to mould itself with the curves and follow the shapes of the root dentinal wall.

**Aims:** To compare in-vitro the tensile bond strength of four different endodontic sealers to root dentin and Gutterpercha.

**Methods:** Thirty six single - rooted canine and premolar teeth with total apical formation were selected. Working length was determined after the crown portion was cut. BMP was done. Teeth were grouped as Group I: MTA- based sealer, Group II: Bioceramic Sealer, Group III: Calcium based sealer, Group IV: Epoxy resin based (AH Plus sealer). Sealers were manipulated according to the manufacturer protocol. Obturation was done using 4% gutta - percha. Later tensile strength test was done on the root slices of 2 mm thickness using universal testing machine. 6 mm in diameter Aluminum cylinders, were stabilized on the gutta-percha with small amounts of wax and were filled with one of the sealers. After setting each sealer, the drops of wax were removed and the tensile bond strengths of all the samples were measured using universal testing machine. The data was analysed using Tukey tests and ANOVA.

**Results:** Among the 4 groups highest bond strength was found in Group II (BioRootTMRCs) ( $P < 0.05$ ) and the least was Group I (MTA Fill apex).

**Conclusion:** Bioceramic sealer's tensile bond strength was highest followed by AH26, Sealapex and MTA- based sealer.

**Keywords:** Bond strength; BioRoot TMRCs Sealer; MTA Fill apex; AH Plus Sealer, Sealapex, tensile strength.

### Introduction:

The root canal therapy is done with the intention to seal it off from any fluid leaks, thus enhancing the longevity of the therapy. The seal between the obturating material and the dentinal walls of the root surface is done by the endodontic sealer.<sup>1</sup> The sealer is designed in such a way that it has to mould itself with the curves and follow the shapes of the root dentinal wall. It should also allow the proper placement of the obturation material in the canal.<sup>2</sup> Most commonly the sealers used in the endodontic therapy are resin- based sealers, calcium hydroxide, and zinc oxide eugenol. There has been however a continuous quest for newer root canal sealers.<sup>3</sup> There are newly introduced calcium silicate based sealers called Bioceramic sealer, Bio Root RCS. They are available as powder liquid composition. The powder constitutes Calcium silicates, Calcium phosphate monobasic, calcium silicate Zirconium oxide, Calcium hydroxide.<sup>4</sup> The most commonly used new variant of resin sealer is 'MTA Fillapex'. This MTA sealer is available in 2 paste system. It is a two paste system consisting of MTA, bismuth oxide, salicylate resins, pigments, silica nanoparticles. This sealer has been known to

possess a good ability to seal the root canal, along with possessing the antibacterial ability. There are also various notable properties of the sealer that make them a choice among the resin sealers like lesser solubility and good biocompatibility.<sup>5</sup>

AH Plus sealer and Sealapex sealer are the 2 varieties of root sealers. The first sealer has Calcium tungstate, Diepoxide, Zirconium oxide N,N-dibenzyl-5-Oxanonane-diamine-1,9 TCD-diamine1-adamantane amine. The sealapex has Barium sulphate, Calcium hydroxide, Titanium dioxide, Zinc oxide, Zinc striate.<sup>6</sup> The bond strength between the radicular dentin and the sealer can be evaluated with the use of the tensile test.<sup>7</sup> Tensile forces acting between two surfaces normally determine the bond strength between two materials.<sup>8</sup> Hence in this we conducted an in-vitro study to compare the tensile bond strength of endodontic sealers to dentin and Gutta Percha.

### Material and Methods

Thirty six single- rooted extracted maxillary and mandibular human canine and premolar teeth with matured apices and without the fractures or root defects were included in the present study. The teeth

were sectioned at the CEJ at low speed using a diamond cutting bur. Normal saline was used to store the sectioned roots. Protaper hand instruments were used to negotiate the canal and the canal was enlarged and shaped to the size of F3. The instrumentation was done 1mm short of the root apex with the help of the radiograph. 3% sodium hypochlorite was used as irrigation and with the final irrigation done with 'ethylene diamine tetra acetic acid 17%' and saline. The teeth were then preserved in normal saline till further categorised into 4 GROUPS.

Group I: MTA- based sealer (MTA Fill apex Angelus, Londrina, Brazil)

Group II: Bioceramic Sealer (BioRootRCS)

Group III: Calcium based sealer (Sealapex)

Group IV: Epoxy resin based (AH Plus sealer)

In Group I (MTA Fill apex), the self- mixing tip with the syringe is used to mix the sealer. Later GP cone of size 30 with taper 0.04 placed to working length that is coated with sealer. Excess length of the GP point is burned to the orifice level. 2 hours is the setting time for the sealer according to the manufacturer's instructions. Later the tensile strength is checked for.

In Group II (BioRootRCS), the canal is filled upto two- thirds using the syringe tip that's provided. Later the obturation with the matching GP cone was done and the remaining cone out of the root at the cej trimmed with the bur. 4 hours is the setting time for the sealer according to the manufacturer's instructions.

In Group III (Sealapex), the two paste system is manipulated according to the instructions of manufacturer and a homogenous mix is attained. Sealapex was applied to the full length of the root canal. Later the gutta- percha point was done to working length measured. Setting time was forty five minutes.

In Group IV (AH Plus), the two paste system is manipulated according to the instructions of manufacturer and a homogenous mix is attained. A creamy homogenous mixture was obtained. After thorough drying of canals AH Plus sealer was applied, tips of dry disinfected gutta- percha points dipped into the AH Plus sealer and placed up to the working length. Setting time is 8h.

Temporary Filling Material was used to fill the coronal portion of the teeth and stored at 95% relative humidity and 37°C for 24 h. Using a hard tissue microtome the teeth were sectioned horizontally into

thick slices of 2 mm. 'The filling material was loaded with a 1- mm diameter cylindrical stainless steel plunger, and should provide almost complete coverage over the main cone without touching the canal wall. Loading was performed on a universal testing machine at a speed of 0.5 mm/ min until deboning occurred. The load was applied in an apical- coronal direction to avoid any interference because of the root canal taper. The bond strength value in megapascals (MPa) was computed by dividing the maximum load needed to dislodge the filling material in Newton's by the interfacial area (mm<sup>2</sup>).'<sup>9</sup> Finally, 36 specimens were tested for each group of sealers. Each sample was fixed to the universal testing machine (Zwick, 1494, Germany). At this point the tensile bond strength of the sealant to gutta-percha was measured at a cross-head speed of 1mm/min and using a 20kg load cell. The maximum load (gm.) at tensile failure divided by the cross- section of bonded area (28.26 mm<sup>2</sup>) was expressed as tensile bond strength in MPa.<sup>8</sup>

## Results

Two- way ANOVA and Tukey tests multiple post hoc tests were done for the statistical analysis. there was a statistically significant values noted between the groups, by using Statistical Package for the Social Sciences (SPSS), SPSS 21.0 (IBM Corporation, USA) with the  $p < 0.05$  as significant. The highest bond strength among the groups was found in Group II (BioRootRCS). The lowest bond strength was found in Group I (MTA Fill apex). Statistically significant difference was also noted among the 4 groups. More of cohesive or mixed failures was observed by the stereomicroscopic evaluation of the specimens.

**Table 1:** comparison of the tensile strength among the 4 sealer groups.

GROUPS	MEAN	SD
Group I	15.73	3.16
Group II	49.1	6.68
Group III	32.05	4.84
Group IV	35.65	5.57

## Discussion

Root canal therapy is done to remove the microorganisms from the teeth. This is attained by proper BMP i.e., cleaning and shaping of the root canal. This helps in single block configuration.<sup>10</sup> The most common obturating material is Gutte percha, however it does not bond to Dentinal walls. The obturation with an adept sealer helps in attaining a fluid seal in the root canal. The root canal sealer helps

in filling the imperfections, increase adaptation of the root filling material to the canal walls.<sup>8</sup> For the past few years, the adhesion of endodontic sealers to the obturation material and the dentin has been of interest.<sup>8,9,10</sup>

The clinical success of the root canal therapy depends on the Bond strength of the sealer between the GP, and the radicular dentin. A good Bond strength of the sealer helps in decreasing the detachment from dentin of the GP during restorative procedures. Later during the masticatory function also the good sealer will prevent the dislodgment of the GP cone from the root. The bond between the endodontic sealer and canal walls may be by the micromechanical adhesion or the frictional retention.<sup>11</sup>

The bond strength of BioRootRCS, AH Plus and Sealapex may be improved with the use of final rinse of EDTA as after NaOCl. The smear layer may be removed by these irrigants thus exposing the collagen of the radicular dentin. Thus establishing the resin tags into the radicular dentin.

Roughened gutta-percha has shown to increase the bond strength of sealers to gutta-percha in the studies of Lee et al<sup>12</sup> and Jeffery and Saunders<sup>13</sup>. Higher bond strengths were hence shown by Lee in their study when compared to our study due to roughened GP.

Shear bond strength was evaluated by Tagger et al.<sup>14</sup> A bond strength of 5.7 MPa was obtained for AH26. Higher values of Shear bond strength as compared to tensile bond is generally shown hence. In the study done by Lee et al,<sup>12</sup> shear bond strength of Sealapex was 0.22 Mpa, that is concordance with the present study.

In the present study, the highest bond strength was shown by BioRootRCS compared to all other sealers with a statistically significant difference ( $P < 0.05$ ). It could be attributed to the self-adhesive nature, that is formed by the chemical bond with dentine. BioRoot RCS has a bioactivity with calcium release, strong alkalizing activity and apatite-forming ability, and adequate radiopacity.<sup>15</sup> Low adhesion of MTA plus may be due to the low adhesion property of its 'tag-like structures to root canal dentin'. MTA Plus in direct contact with fluids exhibited partial decalcification of calcium silicate hydrate in contact with the solution, microcracking and leaching of calcium hydroxide. Interaction with a physiological solution resulted in inhibition of hydration.<sup>16</sup>

## Conclusions

Within the limitations of the present study, BioRoot RCS (Bioceramic Sealer) showed the highest tensile bond strength while MTA Fillapex showed lowest bond strength among all the four groups.

## References

1. DeLong C, He J WKT effect of obturation technique on the push-out bond strength of calcium silicate sealers. *JE* 2015;41:385-8.
2. Barbizam JV, Trope M, Tanomaru-Filho M, Teixeira EC TFB strength of different endodontic sealers to dentin: P test. *JAOS* 2011;19:644-7.
3. Shokouhinejad N, Hoseini A, Gorjestani H SAT effect of different irrigation protocols for smear layer removal on bond strength of a new bioceramic sealer. *IEJ* 2013;8:10-3.
4. Pawar S S et al *J of CDN-D* 2014 V 17.
5. Ehsani M, Dehghani A, Abesi F, Khafri S GSE of apical micro-leakage of different endodontic sealers in the presence and absence of moisture. *JDRDCDP* 2014;8:125-9.
6. Srinidhi V. Ballullaya et al., Stereomicroscopic Dye Leakage Measurement of Six Different Root Canal Sealers *Journal of Clinical and Diagnostic Research*. 2017 Jun V-11(6): Z-Z, Skidmore LJ, Berzins DW *BJA in vitro* comparison of the intraradicular dentin bond strength of R and gutta-percha. *JE* 2006;32:963-6, Sealapex sealer Calcium hydroxide Barium sulfate Zinc oxide T dioxide Z striate 6.
7. Skidmore LJ, Berzins DW *BJA in vitro* comparison of the intraradicular dentin bond strength of R and gutta-percha. *JE* 2006;32:963-6.
8. Khedmat S, Sedaghati M. Comparison of the Tensile Bond Strength of Four Root Canal Sealers. *J Dent Tehran Univ Med Sci*. 2006;3(1):1-5.
9. Vaidya M. "Comparative Evaluation of Push out Bond Strength of Different Endodontic Sealers: An In Vitro Study." 2019;18(1):59-62.
10. Fossum A. Influence of Endodontic Sealers on Dentin Strength in Endodontically Treated Teeth. 2019;
11. Shaalan OO, Abou-Auf E, Farid El Zoghby A. Clinical evaluation of self-adhering flowable composite versus conventional flowable composite in conservative Class I cavities: Randomized controlled trial. *J Conserv Dent*. 2018;21(5):485-90.
12. K.W. L, M.C. W, J.J. C, D.H. P. Adhesion of

- endodontic sealers to dentin and gutta-percha. *J Endod* [Internet]. 2002;28(10):684–8. Available from: <http://www.embase.com/search/results?subaction=viewrecord&from=export&id=L35524347>
13. Jeffrey I SWA investigation into the bond strength between a root canal sealer and root-filling points. *IEJ*.
  14. Tagger M, Tagger E, Tjan AH BLS bond strength of endodontic sealers to gutta-percha. *JE* 2003; 29:191-3.
  15. Siboni F, Taddei P, Zamparini F, Prati C, Gandolfi MG. Properties of BioRoot RCS, a tricalcium silicate endodontic sealer modified with povidone and polycarboxylate. *Int Endod J*. 2017 Dec;50 Suppl 2:e120–36.
  16. Camilleriet al T setting characteristics of M plus in different environmental conditions *IEJ* 2013 ; 46(9):831-40.