Original Research Article

Comparative evaluation of marginal adaptation of two root end filling materials in root end preparation done with diamond points and ultrasonics - An in vitro SEM study

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A B S T R A C T

Objectives: The aim of the present study was to evaluate the marginal adaptation of two bioceramic root end filling materials in root end preparation done with diamond points and ultrasonics under scanning electron microscope.

Materials and Methods: 56 single rooted extracted human teeth were collected and decoronated to create a standardized length of 14mm and were then endodontically treated. The treated tooth were resected 3mm from the apex at 90 degree angle to long axis of the tooth. The samples were then randomly divided into two groups, group I and group II of 28 samples each. Group I and group II were further divided into subgroup A and subgroup B of 14 samples each. Root end preparations in subgroup A of both the groups were done using ultrasonic tips and in subgroup B of both the groups root end preparations were done using diamond points and In Group I all the root end preparation were filled with MTA(Angelus) and in group II with Biodentine.

The apical portions of the roots were then sectioned to obtain 1mm thick transversal sections, scanning electron microscopy was used to determine the adaptations of the root end filling materials with the dentin. Two way Anova and Tukeys Multiple Posthoc test was used for statistical data analysis.

Results: Lowest mean marginal gap of 0.46 micron meter seen with Group II (a) and highest marginal gap of 0.83micron meter seen with Group I (b), which were statistically significant (P<0.05).

Conclusion: Biodentine group, root end preparation done using ultrasonics showed best marginal adaptation than all the other tested groups.

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1. Introduction

Newer inventions in techniques, equipment along with newer material has made endodontic surgery a preferred treatment modality in clinical situations where periradical pathology cannot be resolved by initial endodontic therapy or non surgical root canal treatment.¹

Surgical procedure involves exposure of the root apex, root end resection, root end cavity preparation followed by insertion of root end filling material.²

Properties of a root end filling material play a very critical role in determining success of periradicular surgery. They seal apical region to avoid bacterial infiltration and their products from periradicular tissues to root canal system.³,⁴ Gartner and Dorn explained the relation between clinical success and properties of an ideal rootend filling material, namely biocompatibility with the tissue fluids, dimensionally stability in the presence of moisture, apical sealing abilitity and physical properties.⁵,⁶

Throughout dental history wide varieties of rootend materials have been developed such as amalgam, glass ionomers, composite resins, zinc oxide eugenol cement,
groups, group 1 and group 2 of 28 samples each. Group
handpiece and a diamond disc under constant water spray.
perpendicular to the long axis of the tooth with a high-speed
quality of obturation. Cavities were sealed with cavit.
the filling materials. Radiographs were taken to confirm the
an incubator at 37°C.
guttapercha and AH plus sealer.
canals were then obturated using thermoplastic size
Switzerland) cleaning and shaping of canals was done,
titanium rotary system ((Dentsply, Maillefer, Ballaigues,
of about 14mm. pulp was extirpated, using nickel
junction to standardize the working length of specimens
root caries.
In this study, 56 freshly extracted human mandibular
premolar teeth that were extracted for orthodontic and
periodontal reasons were selected under protocol approved
by the human research ethics committee. Teeth were
initially disinfected by 5.25% sodium hypochlorite for 5
hours followed by storage in saline. Inclusion criteria was
single rooted mandibular premolar teeth, radiographs were
taken to rule out extra canals, calcifications, resorptions and
root caries.
Crowns were decoronated above cemento-enamel
junction to standardize the working length of specimens
of about 14mm. pulp was extirpated, using nickel
titanium rotary system ((Dentsply, Maillefer, Ballaigues,
Switzerland) cleaning and shaping of canals was done,
canals were then obturated using thermoplastic size
dguttapercha and AH plus sealer.
Then the teeth were wrapped in wet gauze and placed in
an incubator at 37°C for 24 hours for complete setting of
the filling materials. Radiographs were taken to confirm the
quality of obturation. Cavities were sealed with cavit.13
Apical three millimeters of roots were resected
perpendicular to the long axis of the tooth with a high-speed
handpiece and a diamond disc under constant water spray.
The samples were then randomly divided into two
groups, group 1 and group 2 of 28 samples each. Group
1 and group 2 were further divided into subgroup A and
subgroup B of 14 samples each. Root end preparation in
subgroup A of both the groups were done with ultrasonics
and subgroup B with diamond points of dimension 3x1mm.
Both the materials were mixed according to
manufacturer’s instructions and cavities were filled using
MTA carrier. In group I all the root end preparation were
filled with MTA(angelus) and in group II with biodentine.
All the restored samples were allowed to set at room
temperature for 24hours.
The apical portions of the roots were then sectioned
to obtain 1mm thick traversal sections. The samples
were examined under 100x and 500x magnification using a
scanning electron microscope (SEM) to determine
adaptations of the root end filling materials with the dentin
in micron meters. The gap area was measured using
software Image J.14
The values collected was analysed using two-way A nova
and Tukeys multiple post hoc test.
3. Results
The scanning electron microscope of transverse sections of
root end filled teeth showed marginal gaps at dentin -rooted
filling interface (Table 1(Figures 1 and 2 ).
kolmosorov-smirnov test indicated data is normal and all
variables follow a normal distribution therefore the
parametric two-way A nova and Tukeys multiple post hoc
procedures were applied.
Comparison of two groups (I, II) and two sub groups
(A, B) with respect to marginal gaps by two-way ANOVA
showed, between the main group there is significant
difference seen (p= 0.0001). Lowest mean marginal gap of
0.46 μm was found in group II with sub group A followed
by Group II with subgroup B 0.53 μm, followed by Group
I with subgroup A 0.69μm and Group I with subgroup B
0.83μm. Group I subgroup B have the largest marginal gap
and poor adaptation among all the groups.
Tukeys multiple post hoc procedures was carried out to
compare the marginal gaps between Two Groups (I, II) and
two sub groups (A, B) which revealed significant differences
between all the groups(p<0.05).

| Group Subgroups | N  | Mean | SD  | SE  | CV  |
|-----------------|----|------|-----|-----|-----|
| Group I with Subgroup A | 14 | 0.69 | 0.13 | 0.03 | 18.62 |
| Group I with Subgroup B | 14 | 0.83 | 0.28 | 0.07 | 33.64 |
| Group II with Subgroup A | 14 | 0.46 | 0.22 | 0.06 | 48.51 |
| Group II with Subgroup B | 14 | 0.53 | 0.18 | 0.05 | 33.78 |

4. Discussion
The aim of root end filling is to prevent movement of
microorganisms and their byproducts from root canal into
Fig. 1: SEM image under 500x magnification: MTA (Angelus) used as root end filling materials in which root end cavity was prepared by ultrasonic retrotip used (A-C) and root end preparation done with diamond point (D-F).

Fig. 2: SEM image under 500x magnification: Biodentine used as root end filling material in which root end cavity was prepared by ultrasonic retrotip used (A-C) and Root end preparation done with diamond points (D-F).

periapical tissues and vice versa. Properties of a root end filling material are very critical in determining success of periradicular surgery.5,15

According to Gartner and Dorn an ideal material to seal root end cavities should; be biocompatible with the tissue fluids, dimensionally stable, the presence of moisture should not affect its sealing ability, be radiopaque to be recognized on the radiograph, prevent leakage of microorganisms and their by products into periradicular tissues.5

Numerous materials have been suggested as root end filling materials, In this study MTA (angelus) and Biodentineas root end filling materials were used as root end filling materials.

Mineral trioxide aggregate (MTA) was pioneered by Torabinejad at lomalinda university in 1993. Major constituents are tricalcium silicate, tricalcium aluminate, tricalcium oxide, bismuth oxide, calcium carbonate. It has favorable properties suitable for an root end filling material such as excellent sealing ability, biocompatibility, good compressive strength (67Mpa), insoluble in fluids once set, radiopacity and antibacterial effect on some facultative bacteria (freshly mixed and 24 h set ) and C. albicans.1,5

It shows the formation of calcium-phosphate precipitation at the interface. This interface layer reduces the risk of marginal percolation and gives promising long-term clinical success. Despite high clinical efficacy there are some issues which prevented clinicians to use it in many cases, major ones being, long setting time which might contribute to leakage, surface disintegration, loss of marginal adaptation and low compressive strength.12 Hence MTA angelus was introduced.

MTA (Angelus) was introduced in 2001 which contained 80% Portland cement and 20% bismuthoxide. In this restorative material, the calcium sulfate had been removed to reduce the setting time (17 minutes). MTA (Angelus) is compatible with the human body, has no mutagenic properties, does not cause apoptosis and also has antimicrobial properties and acceptable cytotoxicity, better handling properties and faster setting time.5,15

Biodentine™ (Septodont, Saint- Maur-des-Fosses, France) it share mode of action as calcium hydroxide but does not have its drawbacks. powder mainly contains tricalcium and dicalciumsilicate, the principal component of Portland cement, as well as calcium carbonate. Zirconium dioxide serves as radiopacifier. The liquid consists of calcium chloride in aqueous solution with and mixture of polycarboxylate.5,10

The liquid contains calcium chloride as an accelerator and a hydrosoluble polymer that serves as a water reducing agent. The setting period of the material is 9–12minutes. The material is characterized by the release of calcium when in solution. Tricalcium silicate based materials are also defined as a source of hydroxyapatite when they are in contact with synthetitc tissue fluid. The sealing ability of Biodentine is most likely through the formation of tags the calcium and silicon ion uptake into dentin leading to the formation of tag-like structures in Biodentine was higher than MTA(angelus), during setting of cement calcium phosphate is formed.5,11

In the present study the marginal adaptation of both the filling materials are influenced by the root end preparation technique. In all the samples which were filled with either biodentineneor

MTA (angelus), ultrasonically root end prepared samples showed less leakage values when compared to those prepared with diamond points which is similar to results found in previous studies. This can be attributed to the condition of cavity surface left after the preparation technique.4,5

Cavities prepared with diamond points are left with greater amount of debris and smear layer in comparison to those prepared with ultrasonic tips. smear layer prevents complete contact between filling material and cavity walls hence explaining the greater leakage observed with both root end filling materials in cavities prepared with diamond points compared to ultrasonically prepared cavities.15
5. Conclusion

Biodentine group with root end preparation done using ultrasonics showed best marginal adaptation than all the other tested groups.

Root end preparation done using ultrasonics showed better marginal adaptation than diamond points for both filling materials.

6. Conflict of Interest

The authors declare that there are no conflicts of interest in this paper.

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References

1. Torabinejad M, Smith P. Comparative investigation of marginal adaptation of MTA and other commonly used root end filling materials. *J Endod*. 1995;21:295–9.

2. Shipper E, S Grossman E. Marginal adaptation of MTA compared with amalgam as a root-end filling material: a low vacuum (lv) versus high vacuum (Hv) SEM study. *Int Endod J*. 2004;37:325–36.

3. Kokate SR, Pawar AM. An Invitro comparative stereomicroscopic evaluation of marginal seal MTA, Glass Ionomer cement and Biodentine as root end filling materials using 1% methylene blue as tracer. *Endodontontology*. 2012;24:36–42.

4. Astrup II, Knutsson CH, Osen TB. Biodentine as a root - end filling. *universitetet I Tromsø* 2012;p. 1–27.

5. Chandra PR. Comparative Evaluation of Marginal Adaptation of BiodentineTM and Other Commonly Used Root End Filling Materials-An Invitro Study. *J Clin Diagn Res*. 2014;8(3):243–5. [doi: 10.7860/jcdr/2014/7854.3173].

6. de Lange J, Putters T, Baas EM, van Ingen J. Ultrasonic root-end preparation in apical surgery: a prospective randomized study. *Oral Surg, Oral Med, Oral Pathol, Oral Radiol, Endodontol*. 2007;104:841–45. [doi: 10.1016/j.tripleo.2007.06.023].

7. Shradha HL, Brijet B. Comparative study of sealing ability of different rootendfilling materials by dye penetration. *HOF*. 2011;3(2):31–4.

8. Galhotra V, Sofat A, Pandit I, Gambhir RS, Srivastava N, Gugnani N, et al. Comparative evaluation of microleakage of various retrograde filling materials: An in vitro study. *J Nat Sci, Biol Med*. 2013;4(2):403–8. [doi: 10.4103/0976-983X.121411].

9. Aggarwal V, Singla M. Comparative evaluation of push-out bondstrength of ProRoot MTA, Biodentine, and MTA Plus in furcation perforation repair. *J Conserv Dent*. 2013;16:462–5.

10. Reddy SS. Sealing Ability of Four Root End Filling Materials: A GlucosePenetration Leakage Study. *Adv Hum Biol*. 2013;3(2):11–8.

11. Gottmann JL, Saunders WP, Nguyen L, Guo YJ, Saunders EM. Ultrasonic root-end preparation Part I. SEM analysis. *Int Endod J*. 1994;27:318–24. [doi: 10.1111/j.1365-2591.1994.tb01642.x].

12. Khandelwal A, Karthik J. Sealing ability of mineral trioxide aggregate and Biodentine as the root end filling material, using two different retro preparation techniques - An in vitro study. *Int J Contemp Dent Med Rev*. 2015;.

13. Radeva EN, Uzunov T, Kosturkov D. Microleakage Associated With Retro-Grade Filling After Root End Resection (In Vitro Study). *J IMAB - Ann Proc (Scientific Papers)*. 2014;20(3):578–83. [doi:10.5272/jimab.2014.20.3.578].

14. de Oliveira M, Weber JB, Costa AT, Konrath F, Dedavid B. Marginal Adaptation of Root-end Filling Materials: An In vitro Study with Teeth and Replicas. *J Contemp Dent Pract*. 2009;10(2):75–82. [doi:10.5005/jcdp-10-2-75].

15. Mohan M, De N. Assessment of apical seal obtained after irrigation of root end cavity with MTAD followed by subsequent retrofilling with MTA and Biodentine: An in vitro study. *J Conserv Dent*. 2015;18(2):132–5.

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