

## Sealing Ability of Biodentine as a Retrograde Filling Materials (A Comparative in vitro study)

**Makdad N. Chakmakchi**  
BDS, MSc, PhD, (Asst. Prof)

**Maha M. Yahya**  
BDS, MSc, (Lect.)

**Wiaam M.O. AL-Ashou**  
BDS, MSc, (Lect.)

**Dept of Conservative Dentistry**  
College of Dentistry, University of Mosul

**Dept of Conservative Dentistry**  
College of Dentistry, University of Mosul

**Dept of Conservative Dentistry**  
College of Dentistry, University of Mosul

### الخلاصة

**المقدمة:** ان عدم ملائمة الختم القمي هو من اهم اسباب فشلها. وان المادة المستخدمة يجب ان تمنع نفاذ المواد الملوثة من الانسجة المحيطة بالجزر. الاهداف: ان الغرض من هذه الدراسة كان لتقييم قدرة ال Biodentine كحشوة لقمة الجذر ومقارنة النتائج مع ال MTA و GIC. **المواد وطرائق العمل:** تم استخدام (34) سن مقلوع بعد و تهيئته وحشوه بمادة Gatta percha. تم قطع قمة الجذر وحفرها الى عمق 3 ملم . تم تقسيمها الى ثلاث مجاميع. الاولى تم حشوها بمادة Biodentine والثانية بمادة ال MTA والثالثة بمادة ال GIC فضلا عن مجموعتي السيطرة السالبة والموجبة. تم طلي الجذور كافة بصيغ الاظافر عدا قمة الجذر. وبعد غمر العينات بمادة الـ Fuch sine بتركيز 1% , تم تقطيع الجذور وحساب عمق اختراق الصيغ تحت المجهر بقوة تكبير 40 . : تم تحليل البيانات احصائيا. **النتائج:** اظهرت النتائج ان مادة ال Biodentine لها قدرة اكبر على منع التسريب المجهري عندما تستخدم لحشوة ذروة الجذر ولم يكن هناك فرق معنوي بين مادتي MTA و GIC. **الاستنتاجات:** ان مادة Biodentine افضل من مادتي MTA و GIC كحشوة لذروة الجذر, ولكن ماتزال هناك حاجة الى دراسته في الجسم الحي.

### ABSTRACT

**Aim:** Inadequate apical seal is the major cause of endodontic failure, the root end filling material used should prevent ingress of potential contaminants from periapical tissue. **Aims:** The purpose of this in vitro study was to evaluate the sealing ability of Biodentine (Septodont) when used as a root-end filling material and to compared the result with that of White Mineral Trioxide Aggregate ( MTA) and Glass Ionomer Cement (GIC). **Materials and Methods:** The root canals of (34) extracted human teeth were instrumented and obturated with gatta percha. Apexes were resected and cavities were prepared to 3mm depth. Teeth were divided randomly into three groups(n=10): first group was retrofilled with Biodentine, second with MTA, third group with GIC, and positive (n=2) and negative (n=2) control groups. Nail varnish was applied to all root surfaces except the tip of the root. Following immersion in basic fuch sine 1% , the roots were sectioned longitudinally and depth of dye penetration was evaluated by stereomicro-scope at 40X magnification. Data were analyzed using one way ANOVA and Duncan's multiple range test at P< 0.05. **Results:** In this study, biodentine was determined to be superior than MTA and GIC prevention apical microleakage when used as root-end filling. No statistical significant difference was observed between MTA and GIC. **Conclusions:** under the conditions of this in vitro study, despite some variation, Biodentine provides a better seal than MTA and GIC when used as retro filling, but along term in vivo study is required to prove it

**Key words:** Sealing ability, Biodentine, MTA, Retrograde filling material.

Chakmakchi MN, Yahya MM, AL-Ashou WM, Sealing Ability of Biodentine as a Retrograde Filling Materials (A Comparative in vitro study). *Al-Rafidain Dent J.* 2013; 14(3): 357-361.

**Received:** 24/4/2013

**Sent to Referees:** 28/4/2013

**Accepted for Publication:** 30/6/2013

### INTRODUCTION

Root-end filling materials are applied after surgical root canal treatment to achieve good apical seal that prevents engross of potential contaminants into periradicular tissue. Researchers have demonstrated that a proper apical seal is the most important factor for achieving success in surgical endodontics.<sup>(1)</sup>

Several root-end filling materials have been used including silver amalgam, gatta

percha, zinc oxide eugenol cements, glass ionomer, composite resins, calcium hydroxide cements, and Mineral Trioxide Aggregate (MTA).<sup>(2)</sup> MTA has been favored due to its higher biocompatibility and sealing ability over currently available root-end filling material. which has been demonstrated by both in vitro and in vivo studies.<sup>(3,4)</sup>

Glass ionomer family of restorative materials have been used in root-end fillings. Their advantages are biocompatibility

and low toxicity, as well as they do not induce inflammatory responses. Their use as a conventional or root end-filling material is recommended because their good chemical adhesion to dentine.<sup>(5,6)</sup>

Biodentine™ with Active Biosilicate Technology™ was announced by dental material manufacturer in September of 2010, and made available in January of 2011. Biodentine is a calcium silicate based material used for crown and root repair treatment. Its uses include pulp protection, temporary closure, deep caries management, cervical filling, direct and indirect pulp capping and pulpotomy. On root, it has a place in managing perforations of root canals or pulp floor, internal and external resorption, apexification and retrograde filling material.<sup>(7,8,9)</sup>

Biodentine™ has indications similar to calcium silicate based materials e.g. MTA, manufacturer claimed that Biodentine™ is not mutagenic.<sup>(10)</sup> and that it can resist microleakage.<sup>(11)</sup> In summary, Biodentine™ is both dentine substitute and a cement for maintaining pulp vitality and stimulating hard tissue formation i.e. the formation of reactive or reparative (tertiary) dentin.<sup>(12)</sup>

The purpose of this in vitro study was to assess the sealing ability of Biodentine™ and to compare it with other common retrograde filling materials, MTA and Glass Ionomer Cement.

## MATERIALS AND METHODS

Thirty four single rooted, caries and restoration-free, extracted human lower premolars were selected and stored in distilled water prior to the study, the teeth were thoroughly cleaned, polished with a slurry of pumice and water in rubber prophylaxis cup at low speed. The teeth examined under stereomicroscope (Hamilton by AITAY International Italy) at magnification level of X40 and those with microcracks were excluded. Bucco-lingual and miso-distal radiograph were taken for determining canal morphology. The tooth crown was removed with diamond wheel saw (KG Sorensen SP, Brazil) mount in low speed handpiece with water coolant.

For each root access preparation was performed, working length was determined by inserting size 10 K-file into the canal until it appeared at the apical foramen. This length was measured and the working length was set 1mm short of this distance, then the root canals were cleaned and shaped using rotary ProTaper nickel titanium instrument (Densply, Swiss) to size F3 combined with

2.5% sodium hypochlorite irrigation solution.

The instrumented canals were dried with paper point (North Hamlin Avenue, Lincoln Wood, USA) and obturated with ordinary gatta percha cones (Dia Dent International CHO NGJU City, KOREA) and zinc oxide eugenol sealer (Dori Dent, Combit, Vienna Austria) using lateral condensation technique, after that the coronal and apical portion of the root sealed with soft wax, the teeth were then stored in 100% humidity in an incubator for seven days. The apical 3mm of each root was resected approximately 90 degrees to the long axis of the root using diamond wheel saw mount in low speed hand piece with water coolant. The root-end cavities were shaped as CI I cavity in thirty roots with low-speed round bur no.2 (Densply, Maillerfer) with water coolant to 3mm depth<sup>(13)</sup>, measured by periodontal probe, irrigated with saline and dried with absorbent paper points. After that the roots randomly divided into the three groups ten root in each:

**Group I:** ten specimens retrofilled with Biodentine™(Septodent).

**Group II:** ten specimens retrofilled with Mineral Trioxide Aggregate cement (MTA) (Angelus Dental Solutions, Goias Londrina PR Barazil).

**Group III:** ten specimens retrofilled with Glass Ionomer Cement (GIC) (Megadenta GMBLT Dental Product, Radeberg Germany).

The four remaining roots were prepared as follows; two roots with retro preparation receive no retrograde filling and was used as positive control; the other two roots without retro preparation and completely covered with sticky wax and used as negative control.

Mixing of the materials was done according to manufacturer instructions for Biodentine, liquid from the single-dose container was emptied into the powder-containing capsule and triturated by using capsule mixture for 30 second. The application of Biodentine™ was performed using ProRoot® MTA carrier tubes. For MTA, MTA liquid was gradually mixed with more and more MTA powder until a creamy consistency was achieved. GIC was prepared by taking one spoonful of Glass ionomer powder to which one drop of liquid added without squeezing the bottle and mixed for 15sec.

After complete setting of root end filling material, the root segments, were then coated with two layers of nail varnish except the tip of the root where the retrograde filling materials were applied, the teeth allowed to dry for 30 minutes. Then the specimens

maintained in distilled water for 7 days in an incubator. Then the teeth immersed in basic fuchsin 1% for 48 hours and incubated at 37°C. The samples were rinsed under tap water, and nail varnish was removed by scratching using scalpel, to clean the tooth and prevent imperfection of picture.

For evaluation, each root was longitudinally sectioned with diamond sectioning disk through the middle of the retrofilling materials. The linear extend of dye penetration between the dentin surface and retrofilling material was measured using stereomicroscope at magnification power 40 x by two

observer in millimeter, the data were statistically analyzed using One- Way ANOVA (level of significance  $p \leq 0.05$ ), and Duncan's tests to determine statistically significant differences between groups.

**RESULTS**

The positive control teeth showed complete dye penetration where as negative control showed no dye leakage.

The result of one way ANOVA test (Table (1), Figure (1)) revealed that there was a significant difference among the groups ( $p \leq 0.5$ ).

Table (1) : One Way ANOVA Test For The Apical Microleakage Among The Experimental Groups.

	Sum of squares	Degree of freedom	Mean square	F	Sig.*
<b>Between groups</b>	0.525	2	0.263	3.712	0.038
<b>Within groups</b>	1.901	27	0.071		
<b>Total</b>	2.435	29			

\* sig: significant

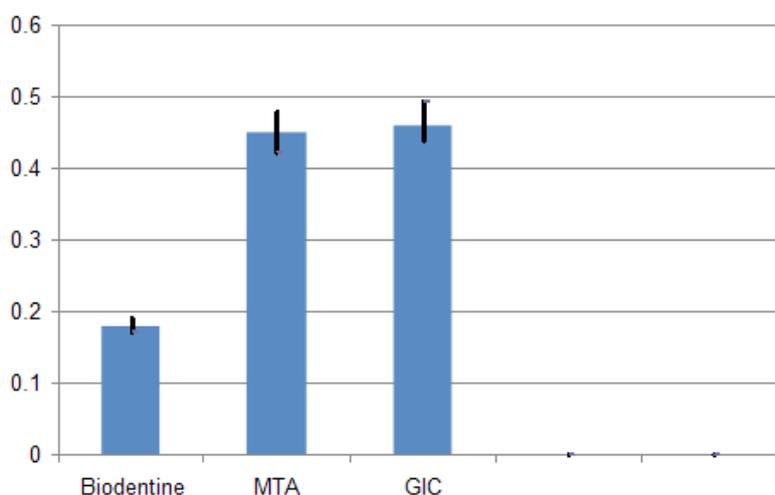


Figure (1) : Histogram illustrating the mean & standard deviation of Retrofilling materials in the study.

Duncan's multiple range test (Table (2)) showed that group I (Biodentine group) represent the lowest mean of dye penetration (0.18 ± 0.017 mm), the difference was statistically significant from group II (MTA) and

group III (GIC), which showed means of dye leakage of (0.45 ± 0.15 mm) and (0.46 ± 0.39) respectively. The difference was statically not significant between the last two groups as shown in Table (2).

Table (2) : Duncan's Multiple Range Test For the Experimental Groups

Group	Mean leakage (mm)	Standard deviation	Duncan's group*
<b>Biodentine</b>	0.18	0.010	A
<b>MTA</b>	0.45	0.029	B
<b>GIC</b>	0.46	0.021	B

\*Different letters mean significant difference.

Figure (2) showed picture of microleakage of different retrograde filling materials.



Figure (2) : microleakage of different retrograde filling material (a) Biodentine, (b) Glass ionomer cement (c) Mineral trioxide aggregate cement.

## DISCUSSION

The purpose of placing a root end filling material is to provide an apical seal which inhibits the leakage of irritants from the root canal system into the periradicular tissue.<sup>(14,15)</sup>

Leakage study used commonly to assess the suitability of potential root end filling materials. In the present study fuchsine dye was used to evaluate the leakage in apical portion, that is due to the molecular size of this material was comparable with that small bacterial metabolic product.<sup>(16)</sup>

The dye penetration method was used for assessing the degree of microleakage; because it inexpensive to use, has a high degree of staining and has a molecular weight even lower than that of bacterial toxins.<sup>(17,18)</sup>

Under the condition of this study despite some variations, there were statistical significant differences concerning the sealing ability of all tested materials.

In the present study the best sealing ability was obtained with Biodentine, these results agree with previous findings that show Biodentine seal better than other retrofilled material this may attributed to ability of Biodentine to form mineral tags in side the dentinal tubules.<sup>(19)</sup>

In our study the analysis of data did not show significant differences in level of dye penetration between MTA and Glass Ionomer cement, this in agreement with the result of Naitp T.(2004)., who concluded that glass ionomer cement appear as effective as other root end filling materials<sup>(20)</sup>.

Glass ionomer cement have several advantages for their use as retrograde filling material such as adhesiveness to tooth

structure and antimicrobial activities<sup>(21)</sup>.

The finding of present study suggested that glass ionomer cement was less effective as retrofilling material than MTA, this finding may be related to the possibility of expansion of MTA cement in humid environment during hardening time which last about 2 hours and 4 minutes, varies according to the density of the air entrapped during mixing and dampness of the receiving site.<sup>(22)</sup>

Although the result of this study showed that the Biodentine has the potential of being used as a root-end filling material because it provide a hermetic seal, direct extrapolation and relevance of dye leakage studies to clinical and practice application are questioned . Dye studies, however, are the easiest method to screen new restorative filling material, when a filling does not allow penetration of small molecules. It has the potential to prevent leakage of larger substances such as bacteria and their byproducts. Further studies are needed to determine the suitability of this material for in vivo use.

## CONCLUSIONS

The results indicated that Biodentine provides better seal as a retrofilling material than MTA and Glass ionomer cement. There was no significance difference in the sealing ability of MTA and Glass ionomer cement.

## REFERENCES

1. Hary FJ, Parkins BJ, Wengraraf AM. The success rate of apicectomy. Aretrosective study of 1,016 cases. Br Dent J.1980; 129:407-413.
2. Islam I, Chng HK, Yap AU. Comparison of physical and mechanical properties

- of MTA and protland cement. J Endod. 2006; 32:193-197.
3. Nakata TT, Bae KS, Baumgartner JC. Perforation repair comparing mineral trioxide aggregate and amalgam using an aerobic bacteria leakage model. J Endod. 1998; 24:184-186.
  4. Torabinejade M, Rastegar AF, Kettering JD, Pitt Ford TR. Bacterial leakage of mineral trioxide aggregate as a root-end filling material. J Endod. 1995; 21:109-112.
  5. Rosales J, Vallecillo M, Osorio R, Toledano M. An in vitro comparison of microleakage in three Glass ionomer cements used as retrograde filling materials. Int Dent J. 1996; 46:15-21.
  6. Gondim F, Zaia AA, Gomes B, Ferraz CC, Teixeira F, Sousa-Filho F. Investigation of marginal adaptation of root end filling material in root end cavities prepared with ultrasonic tips. Int Endod J. 2003; 36:491-500.
  7. Tran V. Microleakage of a new restorative Calcium based cement (Biodentine). Oral presentation PDF IADR, London 2010.
  8. Laurent P, Camps J, Demeo M. Indications of specific cell responses to a Ca<sub>3</sub> SiO<sub>5</sub>-based posterior restorative material. Dent Mater. 2008; 24:148-154.
  9. Han L and Okiji T. Uptake of calcium silicate-based endodontic materials into root canal dentine. Int Endod J. 2011; 44:1081-87.
  10. Harmand O. assessment of the genotoxicity Ames test (salomonella hyphimurium and E. Coli). Report RG EN RA EXT-RD 941055. biodentine scientific file, page 22.
  11. Tran V, Pran V, Colon P. microleakage of a new restorative calcium (Biodente) oral presentation, mentioned in the "biodentine publications and communications 2005-2010" by septodont (Dec. 202012), Page 64.
  12. Chong BS, Ford TPR. root-end filling materials: rationale and tissue response. Endodontic Topic, 2009; 11:114-30.
  13. Camilleri J, Montesin FE, Bradg K, Sweeny, Curtis RV, Pitt Ford. The constitution of mineral trioxide aggregate. Dent Mater. 2005; 21:297-303.
  14. Mattison GD, Von Franunhofer JA, Delivains PD, Anderson AN. Microleakage of Retrograde Amalgam. J Endod. 1985; 11:340-345.
  15. Smee G, Bonlanos OR, Morse DR. A comparative leakage study O-30 resin bonded ceramic, Teflon, amalgam and IKM as retro filling sealer. J Endod. 1987; 13:117-121.
  16. Kersten HW, Moorer WR. Particals and molecules in endodontic leakage. Int Endo J. 1989; 22:118-124.
  17. WU MK, Wesselink A. Endodontic Leakage Studies Reconsidered. Part I. methodology, application and relevance. Int Endo J. 1999; 26,37-43.
  18. Ahlberg KM, Assavanop P, Tary WM. A compariso of the apical dye penetration patterns in root-filled teeth. Int Endo J. 1999; 28:309-38.
  19. Tran V, Paradelle N, Colon P. Microleakage of a new restorative calcium based cement (biodentine) oral presentation, mentioned in the "biodentine publications and communications 2005-2010" by Septodont Dec. 2012, page 64.
  20. Naitp T. Study suggest alternative to amalgam as a retrograde filling material for apicectomy. Evidence Based Dent. 2004; 5:12-21.
  21. Siqueira J, Rocas IN, Abad E, Castro A, Gahyra SM, Favieri A. Ability of three root-end filling materials to prevent bacterial leakage. J Endod. 2001; 27:673-675.
  22. Torabinjad M, Watson TE, Pitt Ford TR. Sealing ability of mineral trioxide aggregate when used as a root-end filling material. J Endod. 1993; 19:591-595.