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# COMPARATIVE EVALUATION OF SHEAR BOND STRENGTH OF COMPOSITE RESIN WITH MTA & BIODENTINE: AN IN VITRO STUDY

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## ABSTRACT

**Introduction:** MTA and Biodentine are the materials used as a retrograde filling, in perforation repair and as pulp-capping materials. The success of pulp-capping agent depends on restorative material that is used over it which provides improved coronal seal. Hence, material placed over MTA & Biodentine as a final restoration should plays a vital role. Immediate placement of composite resin over MTA & Biodentine to decrease appointment is the necessity of hour. So, we are evaluating bond strength of immediately placed composite resin with MTA & Biodentine. **Aim:** To compare and evaluate bond strength of composite resin with MTA & Biodentine. **Methodology:** Thirty samples were prepared and divided into 2 major groups – group 1 and group 2, each group contains 15 samples. They were designated for restoring composite resin over MTA & Biodentine with bonding resin respectively after 10 minutes. The samples were mounted in a square metal jig fill with auto cure acrylic resin. The samples were thermocycled for 48 hrs. The shear bond strength was determined using universal testing machine at 1mm/min speed.

**Result:** Composite resin–MTA groups showed significantly higher Shear Bond Strength values than the group made of Composite resin–Biodentine (P <.05). **Conclusion:** MTA showed higher shear bond strength scores compared to Biodentine when used with packable composite.

**KEYWORDS:** Biodentine, Composite resin, Mineral Trioxide Aggregate, shear bond strength.

## INTRODUCTION

Conservation of the tooth structure and good esthetics reveals a long sought after goal in restorative dentistry. In the past, exposed pulp was considered to be a doomed organ. With the advancement in vital pulp capping procedure, the emphasis shifted from the doomed organ concept to one of hope and recovery.[1] If the pulp is exposed, the long-term success and preservation of the vitality are endangered. Therefore, the treatment protocol of deep carious lesions for the preservation is a complicated task for the dental clinician and the treatment modalities must aim to preserve the pulp vitality to achieve the formation of a dentine bridge.[2,3,4] Initially calcium hydroxide was used in such treatments for the preservation of underlying pulp but has not been extensively accepted because of unpredictable results such as not adhering to dentin and dissolving over time and dentin bridges adjacent to the material containing multiple tunnel defects.[5] Thus, advanced dental biomaterials are being used instead of calcium hydroxide to maintain vitality of pulp.[6,8] Mineral Trioxide Aggregate (MTA, Pro Root MTA, Dentsply Tulsa Dental, Tulsa, OK, USA) is a cement which contains different oxide compounds (sodium- and potassium oxides, calcium oxide, silicon oxide, ferric oxide, aluminium oxide and magnesium oxide) and was introduced in dentistry by Torabinejad and White in the mid-1990s. MTA can be marked as calcium silicate cement, because its composition is similar to a refined Portland cement, which is available in most hardware stores, mixed with bismuth for radioopacity.[9,10] (Table 1) The use of mineral trioxide aggregate (MTA) in vital pulp therapy has gained popularity. It has been used as a potential material for furcation repair, internal resorption treatment, management of open apex, pulpotomy procedures, and capping of pulps with reversible pulpitis.[11-16]

Recently, a new bioactive calcium silicate cement, Biodentine (Septodont, St. Maur-des-Fossés, France), was launched as a dentine substitute. Biodentine consists of a powder in a capsule and liquid in a pipette. The powder mainly contains tricalcium and dicalcium silicate,

the principal component of Portland cement and MTA, as well as calcium carbonate. Zirconium dioxide serves as contrast medium. The liquid consists of calcium chloride in an aqueous solution with an admixture of polycarboxylate (Table 1). The powder is mixed with the liquid in a capsule in a triturator for 30 seconds. During the setting of the cement calcium hydroxide is formed. The consistency of Biodentine reminds of that of phosphate cement.[17]

The success of pulp capping agents depends upon the restorative material that is used over it, which can provide a better coronal seal and the placement as well as technique of the material. Quality of coronal seal is dependent on choice of material for coronal restoration and also adhesion between coronal restoration and the tooth structure, hence, the material that would be placed over MTA & Biodentine as final restoration is an important matter.[18] The aim of this study was to determine bond strength of composite resin with MTA & Biodentine.

## MATERIALS AND METHODS

Thirty Cylindric acrylic blocks with a hole (5 mm in diameter and 2 mm in height) were prepared. MTA and Biodentine were mixed according to the manufacturers' instructions, and then the holes were filled with these materials using a spatula and covered with a wet cotton pellet. The acrylic blocks were randomly allocated into 2 groups (fig. a) according to their filling with MTA and Biodentine, (n = 15). All prepared surfaces were polished with 400-grit paper for 60 seconds to create a standard layer. One step self-etch adhesive (Xeno V) is applied after 10 mins (fig. b). Composite resin were applied over MTA & Biodentine. By means of plastic cylinder with height 2mm& 5mm diameter (fig c). The samples were were thermo-cycled for 48 hours (fig d), and SBS (Shear Bond Strength) was tested for failure using a knife edge blade in a universal testing machine (Shimadzu, Model AGS-X 5 kN; Shimadzu Corporation, Kyoto, Japan) with a crosshead speed of 1 mm/min (fig e). Data obtained were recorded and analysed by using unpaired t test at significance level of $P<0.05$.

## RESULT

The mean SBS values and standard deviations of the groups are presented in Table 2.

Composite resin– MTA groups showed significantly higher SBS values than the group made of Composite resin– Biodentine ($P <.05$).

| Figure | Description |
|---|---|
| **Figure: a** | Acrylic Blocks |
| **Figure: b** | One step self-etch adhesive applied |
| **Figure: c** | Composite resin were applied over MTA & Biodentine |

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|---|---|
| | by plastic cylinder with height 2mm & 5mm diameter |
| **Figure: d** | samples were thermo-cycled for 48 hours |
| **Figure: e** | SBS tested for failure using universal testing machine |

## DISCUSSION

Over the years, MTA has been used in various clinical applications in general dentistry, such as for furcation repair, internal root resorption, Retrograde filling material, pulpotomy procedures, and direct and indirect pulp capping and might be used in atraumatic restorative treatment.[19] In recent years, new materials (ie, Biodentine) have been proposed. These materials have a similar chemical composition like MTA and can be used in all cases in which MTA is used. Besides the biocompatibility, bioactivity, and remineralization properties of pulp capping materials, the bond strength of these materials to filling is an important factor to be considered. Proper bonding of composite resins to pulp capping biomaterials produces the adhesive joint, which is capable of spreading stress relatively evenly over the entire region of the bond.[20]

Bayrak et al compared the SBS of composites using different adhesive systems to MTA and found that 1-step self-etch adhesive (Adper Prompt L-Pop; 3M ESPE, St Paul, MN) showed an SBS value of 5 MPa.[21] Atabek et al reported that the SBS value of a composite using 1-step self-etch adhesive (All Bond SE; Bisco Inc, Schaumburg, IL) to MTA was 13 MPa.[22] Odabas et al evaluated the SBS of different adhesive systems to Biodentine & reported that the SBS of these materials varied between 15 and 19 MPa.[23] Mustafa et al compared SBS of a Self-adhering Flowable Composite and Flowable Base Composite to Biodentine was 1.69 MPa.[24]

In the present study, the SBS value of a composite using 1-step self-etch adhesive to MTA and biodentine were 1.88 Mpa and 0.70 Mpa respectively. The different results obtained from different studies may possibly arise from differences in the method used. In the current study, the surfaces were polished with 400-grit paper for 60 seconds to create a standard layer. However, in previous studies, the surfaces were neither rinsed nor polished and resulted in rough surfaces that might have increased the bond strength.[24]

Masaki et al, evaluated the SBS of composite to MTA which was increased when placed after 10 minutes because moist curing helps setting reaction of MTA.[25] Gancedo-caravia et al, evaluated the push out bond strength of composite to MTA which was more when placed after 10 minutes.[26] Odabas et al evaluated the SBS of composite to Biodentine after 2 time

intervals (ie, 12 minutes and 24 hours) and obtained an increased SBS value for the 24-hour period.[23] Bachoo et al reported that the initial setting reaction of Biodentine takes approximately 12 minutes after mixing the powder and the liquid.[27] In the present study, Composite is placed over MTA and Biodentine after 10 minutes so as to allow hardening of the materials.

MTA exhibited higher SBS values than the Biodentine to the composites. It was reported that etch-and-rinse adhesives can increase the SBS of composites to MTA.[11,21,22] However, Neelakantan et al found that 1-step self-etch adhesives showed higher SBS to MTA than2-step self-etch adhesives and etch-and-rinse adhesives.[28] Odabas et al found that 2-step self-etch adhesives exhibited higher SBS to Biodentine than 1-step self-etch adhesives and etch-and-rinse adhesives.[23] Saravanapriyan et al, found that Microleakage of MTA is superior than Biodentine.[29] Kaup et al, reported that ProRoot MTA showed a significantly lower solubility than Biodentine.[30]

Within the limitations of this in vitro study, it is concluded that MTA and CEM might be used as pulp capping materials (for direct pulp capping, indirect pulp capping, atraumatic restorative treatment, and sandwich/laminate techniques) because they show higher SBS than Biodentine.

## REFERENCES

1. Cox CF, Bergenholtz G, Heys DR, Syed SA, Fitzgerald M, Heys RJ. Pulp capping of dental pulp mechanically exposed to oral microflora: A 1-2 year observation of wound healing in the monkey. J Oral Pathol, 1985; 14(2): 156-68.
2. Barthel CR, Rosenkranz B, Leuenberg A, Roulet JF. Pulp capping of carious exposures: treatment outcome after 5 and 10 years: a retrospective study. J Endod, 2000; 26: 525–8.
3. Dammaschke T, Leidinger J, Schafer E. Long-term evaluation of direct pulp capping–treatment outcomes over an average period of 6.1 years. Clin Oral Investig, 2010; 14: 559–67.
4. Ford TR, Torabinejad M, Abedi HR, et al. Using mineral trioxide aggregate as a pulpcapping material. J Am Dent Assoc, 1996; 127: 1491–4.
5. Nowicka A, Lipski M, Parafiniuk M, et al. Response of human dental pulp capped with biodentine and mineral trioxide aggregate. J Endod, 2013; 39: 743–7.
6. Aguilar P, Linsuwanont P. Vital pulp therapy in vital permanent teeth with cariously exposed pulp: a systematic review. J Endod, 2011; 37: 581–7.

7. Asgary S, Eghbal MJ. Treatment outcomes of pulpotomy in permanent molars with irreversible pulpitis using biomaterials: a multi-center randomized controlled trial. Acta Odontol Scand, 2013; 71: 130–6.
8. Mestres G, Aguilera FS, Manzanares N, et al. Magnesium phosphate cements for endodontic applications with improved long-term sealing ability. Int Endod J., 2014; 47: 127–39.
9. Camilleri J, Montesin FE, Brady K, Sweeney R, Curtis RV, Pitt Ford TR. The constitution of mineral trioxide aggregate. Dent Mater, 2005; 21: 297–303.
10. Dammaschke T, Gerth HUV, Züchner H, Schäfer E. Chemical and physical surface and bulk material characterization of white ProRoot MTA and two Portland cements. Dent Mater, 2005; 21: 731–8.
11. Tunç ES, Sönmez IS, Bayrak S, Egilmez T. The evaluation of bond strength of a composite and a compomer to white mineral trioxide aggregate with two different bonding systems. J Endod, 2008; 34(5): 603-5.
12. Naik S, Hegde AH. Mineral trioxide aggregate as a pulpotomy agent in primary molars: An *in vivo* study. J Indian Soc Pedod Prev Dent, 2005; 23(1): 13-6.
13. Torabinejad M, Chivian N. Clinical applications of mineral trioxide aggregate. J Endod, 1999; 25(3): 197-205.
14. Karabucak B, Li D, Lim J, Iqbal M. Vital pulp therapy with mineral trioxide aggregate. Dent Traumatol, 2005; 21(4): 240-3.
15. Attavar SH, Nadig P, Sujatha I. Management of open apex with mineral trioxide aggregate: 2 case reports. Int Dent Med J Adv Res., 2015; 1: 1-4.
16. Sonarkar S, Purba R. Bioactive materials in conservative dentistry. Int J Contemp Dent Med Rev., 2015; 2015. Article ID: 340115, 2015. doi: 10.15713/ins.ijcdmr.47.
17. Dammaschke T. Direct pulp capping. Dentist, 2011; 27(8): 88–94.
18. Patil Pranav1, Chandak Manoj, Manwar N U, Ikhar Anuja D, Patel Aditya S, Patil Jayakumar. Comparative Evaluation of Effect of Two Different Bonding Systems on Shear Bond Strength of Composite and Compomer to Mineral Trioxide Aggregate: An In Vitro Study. Journal of International Oral Health, 2015; 7(10): 93-95.
19. Yesilyurt C, YildirimT, Tasdemir T, Kusgoz A. Shear bond strength of conventional glass ionomer cements bound to mineral trioxide aggregate. J Endod, 2009; 35: 1381–3.
20. Oskoee SS, Kimyai S, Bahari M, et al. Comparison of shear bond strength of calciumenriched mixture cement and mineral trioxide aggregate to composite resin. J Contemp Dent Pract, 2011; 12: 457–62.

21. Bayrak S, Tunc ES, Saroglu I, Egilmez T. Shear bond strengths of different adhesive systems to white mineral trioxide aggregate.
22. Atabek D, Sillelioglu H, Olmez A. Bond strength of adhesive systems to mineral trioxide aggregate with different time intervals. J Endod, 2012; 38: 1288–92.
23. Odabas ME, Bani M, Tirali RE. Shear bond strengths of different adhesive systems to biodentine. ScientificWorldJournal, 2013; 2013: 626103.
24. Mustafa Altunsoy, Mehmet Tanrıver, Evren Ok, & Ebru Kucukyilmaz. Shear Bond Strength of a Self-adhering Flowable Composite and a Flowable Base Composite to Mineral Trioxide Aggregate, Calcium-enriched Mixture Cement, and Biodentine. J Endod, 2015; 41: 1691–1695.
25. Masaki Tsujimoto, Yasuhisa Tsujimoto, Atsushi Ookubo, Takanobu Shiraishi, Ikuya Watanabe, Shizuka Yamada and Yoshihiko Hayashi. Timing for Composite Resin Placement on Mineral Trioxide Aggregate. J Endod, 2013; 39: 1167–1170.
26. Gancedo-Caravia L, Garcia-Barbero E. Influence of humidity and setting time on the push-out strength of mineral trioxide aggregate obturations. J Endod, 2006; 32: 894–6.
27. Bachoo IK, Seymour D, Brunton P. A biocompatible and bioactive replacement for dentine: is this a reality? The properties and uses of a novel calcium-based cement. Br Dent J., 2013; 214: E5.
28. Neelakantan P, Grotra D, Subbarao CV, Garcia-Godoy F. The shear bond strength of resin-based composite to white mineral trioxide aggregate. J Am Dent Assoc, 2012; 143: e40–5.
29. Saravaapriyan et al. Biodentine versus Mineral trioxide aggregate versus immediate restorative material for retrograde root end filling: An in vitro study, J Dent (Tehran), 2014; 11(2): 143-149.
30. Kaup et al. An in vitro study of different material properties of Biodentine compared to ProRoot MTA. Head & Face Medicine, 2015; 11: 16.