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An *in vitro* comparative evaluation of shear bond strength of biodentine and MTA

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Abstract
Aim: This study evaluated the shear bond strength of biodentine and MTA.
Material & Methods: Cylindrical samples were constructed for testing for physical properties. After then, the test samples were subjected to 3-point bending test at 5 time intervals, 48 hours, 1 week, 1 month and 6 months. Data was analyzed using 3 way analysis of variance (ANOVA) and Tukey's test.
Results: There is statistically significant difference between MTA and Biodentine, the bond strength values of biodentine was greater when compared to MTA.
Conclusion: Bond strength of material plays important role in clinical practice. According to results of our study Biodentine had better bond strength when compared to MTA. In cases of perforation seal, root end filling or as a base material biodentine can be recommended over MTA.

Keywords: Biodentine, MTA, Bond strength

Introduction

After introduction of MTA in 1990's, its been widely used for repairing perforations, as a root end filling materials, for direct and indirect pulp capping agents and shown with high success rates [1, 2, 3]. Beside a long setting time another draw back of MTA is low compressive and flexural strength when compared with dentine [4]. Hence MTA can not be used in stress bearing areas [5]. where as Biodentin is bioactive calcium silicate-based cement that has been used as a 'dentin substitute'. This active material penetrates through dentinal tubules and leads in crystallize interlocking in dentin and aids in better mechanical properties of dentin. Biodentine has been widely used in endodontic repair and pulp capping in restorative dentistry and it has been reported in literature that its physical and handling properties is superior when compared to MTA [6]. Various types of cements are used for both permanent and temporary cementation. Each cements have different mechanical and biological characteristics [7, 8].

Compressive strength and flexural strength of biodentine is higher than other calicium silicate cements and its more comparable to dentine [9, 10]. Materials used as base or build up material should provide adequate seal and should also withstand masticatory forces. hence, the bond strength of materials is an important criteria clinically.

Hence the purpose of this study was to evaluate shear bond strength of biodentine and MTA.

Materials and Methods

Materials	Manufacturer
Tricalcium-Silicate Cement	Biodentine ® (Septodont, Saint Maur des Fosses, France)
MTA	ProRoot MTA (Dentsply Tulsa Dental,USA

80 human third molar teeth were stored in sterile saline directly after extraction and stored at 37 degree celsuis for 24 hours. The molar teeth were embedded in a cold curing resin and it was ground with sandpaper to expose the dentine surface. Polyether rubber impression material was used to make mould that was placed over dentin samples and was completely filled with test materials. The dentine samples was rinsed with distilled water and air dried and the test materials are placed on the dentine surface. Both the test materials such as biodentine and MTA were strictly handled according to manufacturers instructions.

25 specimens were produced from every test materials and stored in distilled water at 37 degree Celsius for 24 hours before sujected to shear bond testing at intervals of 48 hours, 1 week, 1 month and 6 months and the shear bond strength was evaluated with universal testing machine.

Results

The samples were assigned in to four groups as follows:

Group I: samples from both the test materials {Group A Biodentine (n=10) and Group B MTA (n=10)}subjected to shear bond testing at intervals of 48 hours

Group II: samples from both the test materials {Group A Biodentine (n=10) and Group B MTA (n=10)}subjected to shear bond testing at intervals of 1 week

Group III: samples from both the test materials {Group A Biodentine (n=10) and Group B MTA (n=10)}subjected to shear bond testing at intervals of 1 month

Group III: samples from both the test materials {Group A Biodentine (n=10) and Group B MTA (n=10)}subjected to shear bond testing at intervals of 6 months.

Materials used in this study are

The values of shear bond strength and statistical evaluation in different duration and with in groups are given in table 1 and 2. at all observation periods MTA showed lesser bond strength when compared to biodentine. The shear bond strength of MTA and Biodentine increased significantly compared to the 48 hours observation period ($p < 0.05$).

Table 1: Comparison of bond strengths between biodentine and MTA in different durations.

Duration	groups	MEAN (MPa)	p-value
48 Hours	Biodentine	7.9750	0.001
	MTA	3.8500	
1 Week	Biodentine	9.6980	0.003
	MTA	7.7720	
1 Month	Biodentine	11.2160	0.002
	MTA	10.1050	
6 Months	Biodentine	11.6120	0.001
	MTA	9.9494	

Table 2: Comparison of bondstrengths within the groups in different durations using repeated measure of ANOVA:-

Groups	Hrs 48	1 week	1 month	6 months	p-value
Biodentine	7.97(1.35)	9.69(0.48)	11.21(0.69)	11.61(0.72)	0.001
MTA	3.85(0.92)	7.77(1.56)	10.10(0.70)	9.95(0.59)	0.001

Discussion

By definition, bond strength is a interfacial adhesion between substrate and material, which is intermediated by an adhesive layer. But in clinical cases this is often not a case and instead failures can occur in bond material, the substrate or both. Studies have been reported in dental literature stating that largely failures were cohesive that is with in the cement rather than at the inter facial area [11-14].

According to the results of the present study, there were statistically significant difference between MTA and Biodentine, the bond strength values of biodentine was greater when compared to MTA. The reason may be due to biomineralization ability of biodentine [14]. The smaller particle size and uniform components might have a role in better interlocking of biodentine with the dentin.

Bonding of biodentin and MTA to dentine

The exact mechanism of adhesion of Calcium Silicate Cements to dentine can be due to chemical bond or micromechanical anchorage via cement tags in the dentinal tubules [15-18]. After placement of MTA on dentine, hydroxyapatite crystals nucleate and grow and fill the microscopic space between MTA and the dentine surface. Initially this seal is mechanical. Over a period of time, the reaction leads to chemical bonding between hydroxyapatite and dentine [18]. Whereas, Biodentine induce denaturation and permeability of the organic collagen component of interfacial dentine [15]. Recent studies have reported that biodentine showed formation of intra tubular tags in "mineral infiltration zone" [15]. This zone can be comparable to the interfacial layer formed between dentine and MTA [19].

In contrast Gjorgievska *et al*. Reported that the migration of ions into dentine was not shown for Biodentine [19]. Hence, the adhesion of biodentine is more micro mechanical and not based on ion exchange. Nevertheless, Biodentine have shown good adaptability toward dentine [19]. The shear bond strength is attributed mainly on the different particle sizes of Biodentine and MTA which in turn affects the penetration of materials into dentinal tubules. Small particles of biodentine may contribute better interlocking with the dentine that can promote cohesive failure in the filling materials rather than failures in the interface [14].

Conclusion

The results of this study showed statistical difference between biodentine and MTA in their shear bond strength. When material used as a base, root end filling or perforation seal it should provide adequate seal to prevent leakage and remain in the place without dislodging on oclussal forces or during application of restorative materials providing good adhesive properties to dentin. Hence the bond strength of materials used plays an important role in clinical practice. As described in multiple studies Biodentine expressed better results when compared to MTA, hence can be recommonded. However *in vivo* studies can be suggested for better understanding of the materials.

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