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COMPARATIVE EVALUATION OF PUSH-OUT BOND STRENGTH OF MTA AND BIODENTIN AS PERFORATION REPAIR MATERIALS: AN IN-VITRO STUDY

Endodontics

Dr Tuba Siddiqui* BDS, Post Graduate Student, Department of Conservative Dentistry & Endodontics, Inderprastha Dental College & Hospital, Sahibabad. *Corresponding Author

Dr Anika Mittal BDS, MDS, Professor & HOD, Department of Conservative Dentistry & Endodontics, Inderprastha Dental College & Hospital, Sahibabad.

Dr Aditi Dhaundiyal BDS, MDS, Reader, Department of Conservative Dentistry & Endodontics Inderprastha Dental College & Hospital, Sahibabad.

Dr Vaibhav Kelkar BDS, Post Graduate Student, Department of Conservative Dentistry & Endodontics, Inderprastha Dental College & Hospital, Sahibabad.

Dr Mitali Jain BDS, Post Graduate Student, Department of Conservative Dentistry & Endodontics Inderprastha Dental College & Hospital, Sahibabad.

ABSTRACT

Aim: To compare the push-out bond strength of Mineral trioxide aggregate (MTA) and Biodentin for repair of furcal perforations.
Materials And Methods: Forty freshly extracted mandibular molars were collected and access cavities were made. Teeth were then decoronated 5mm above the pulpal floor and roots amputated 5mm below the pulpal floor using a water-cooled diamond disc. A perforation was made in the furcal area. Each sample was photographed coronally and apically using a stereomicroscope at 10x magnification and the samples were randomly divided into 2 major experimental groups of 20 samples each, based on the repair material used, which were: Group 1- MTA Angelus, Group 2- Biodentin. All the samples were stored in 100% relative humidity for 7 days in an incubator and tested under Universal Testing Machine.
Results: The push-out bond strength of Biodentin was greater than that of MTA Angelus.
Conclusion: Within the limitations of this study, it was concluded that the push-out bond strength of Biodentin was greater than that of MTA Angelus.

KEYWORDS

Biodentin, Mineral trioxide aggregate, push out bond strength

INTRODUCTION

Furcal perforation is usually seen as an undesired complication that can occur iatrogenically during opening of endodontic access cavities or exploring canal orifice of multi rooted tooth.They might also manifest as a result of caries or resorption. It is recommended to repair the perforation as soon as it is identified.[1] Any sort of detainment will allow bacterial access leading to complicated endodontic-periodontal lesion.[2] The main objective of perforation repair is to quickly seal the perforation area and provide optimal conditions for periodontal reattachment at that area.[3]

Mineral trioxide aggregate (MTA) is a calcium silicate based material which has been a suggested material for perforation repair. MTA has been used for endodontic applications since the early 1990s. However, MTA has exhibited certain drawbacks of long setting time and difficult handling characteristics. Various other materials based on calcium silicate have been developed, which aid to improve some MTA drawbacks.[4]

Biodentin is amongst those materials. It is calcium-silicate based material introduced in 2010 by Gillies and Oliver.[5] It constitutes tricalcium silicate, calcium carbonate, zirconium oxide, and calcium chloride. It goes about as a substitute for dentine. It has better mechanical properties other than its biocompatibility and bioactivity. The setting time of Biodentin is 10 to 12 minutes. This is because of calcium chloride, an accelerating agent present in liquid.

Push-out bond strength is a test which is used to analyse the interfacial shear strength developed amongst different surfaces. Adequate push-out strength is needed so as to bear the condensation force to which the repair material will be subjected to, during placement of an intracanal restoration.[6]

Therefore, this study was conducted to compare the push-out bond strength of two materials for repair of furcal perforations

Null hypothesis states that no significant difference was found in the pushout bond strength of Mineral Trioxide Aggregate and Biodentin.

MATERIALS AND METHODS

40 extracted mandibular molars were collected and were stored in normal saline. Teeth with cracks, fused roots or root caries were excluded from the study. In each tooth endo access bur was used for the preparation of endodontic cavity. Teeth were then decoronated 5mm above the pulpal floor and roots amputated 5mm below the pulpal floor using a water-cooled diamond disc. A perforation was made in the furcation area using a round bur no 4. Caution was taken so that the perforation lies in the center of the furcal area.

Since there could be a variation in the coronal and apical diameters of the furcal perforations within the same sample and amongst other samples, each sample was photographed both coronally and apically using a stereomicroscope at 10x magnification.

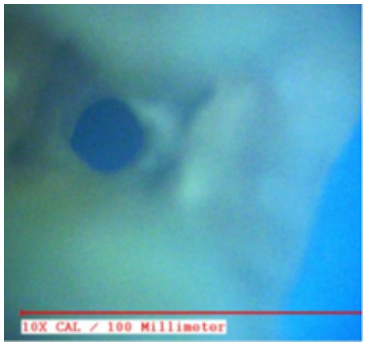

Figure 1: Stereomicroscopic Image Of Perforation At 10x

The samples were randomly divided into 2 major experimental groups of 20 samples each, based on the repair material used, which were:

Group 1- MTA (MTA Angelus, Brazil)
Group 2- Biodentin (Septodont, USA)

All the samples were kept in 100% relative humidity for one week in an incubator. One mm thick cylindrical stylus was positioned on the repaired perforation site of all the samples and then force was beared upon by Universal Testing Machine, at a cross head speed of 0.5mm/min in a coronal-apical diameter. The tip of the stylus was positioned so that it only contacted the repair material. The maximum

force (F) which was applied at bond failure was then recorded in Newtons. The pushout bond strength was calculated as follows (Unit: mega-pascal):

Pushout bond strength (MPa) = Force(N) / Lateral surface area (mm2)

Statistical Analysis

Pushout bond strength data was analyzed using one-way analysis of variance with the post hoc Tukey honest significant difference test. The comparative analysis was done by independent t test.

RESULT

Result: Table 1 shows, the mean ± Standard deviation of Push out bond strength (MPa) of MTA, Biodentin are 10.78 ±1.551, 18.00 ±1.349 respectively and on applying independent t- test, mean difference of Push out bond strength (MPa) MTA vs Biodentin (7.228), groups is highly significant *(P<0.01)*. Table 2 shows the comparison of mean and Standard deviation of push out bond strength (MPa) of two groups by independent t test. The Push out bond strength (MPa) of Biodentin is significantly higher than MTA group. (Figure 2)

Table 1: Distribution Of Mean And Standard Deviation(S.D.) Of Push Out Bond Strength (MPa) Of Two Group.

	Group	N	Mean	Std. Deviation	Std. Error Mean
PUSH OUT BOND STRENGTH (Mpa)	MTA	20	10.78	1.551	.347
	BIODENTIN	20	18.00	1.349	.302

Table 2: Comparison Of Mean And S.D. of PUSH OUT BOND STRENGTH(MPa) Of Two Groups By Independent T Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	P value	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
PUSH OUT BOND STRENGTH (MPa)	.455	.504	-15.726	38	.000	-7.228	.460	-8.159	-6.298

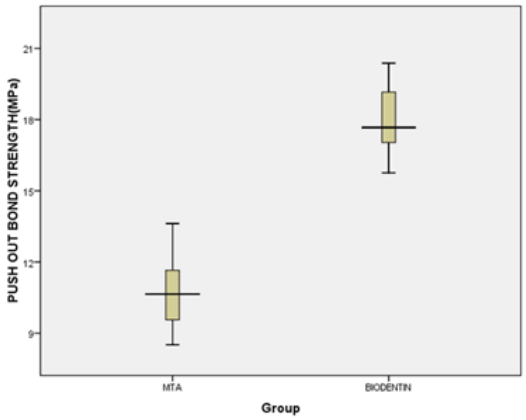

Figure 2

DISCUSSION

A perforation, disregarding its location or cause, affects the prognosis of endodontic therapy.[7] Thus this perforation site must be sealed as soon as possible. A furcation perforation repair material must have sufficient strength against which intracoronal restorative material could be condensed safely.[8] To determine the bond strength, the push-out test is a logical and reliable method, where a gradually increasing pressure is applied to the material until debonding occurs.

In this study, MTA was used in Group 1. MTA has the property to revive the cementoblasts to produce matrix for cementum formation and is biocompatible with the periradicular tissues, thus exhibiting higher sealing ability when used for perforation repair.

A recently introduced calcium silicate-based material, Biodentin was used in Group II to repair the perforation. MTA has a long setting time of 165 ± 5 min. Addition of CaCl2 has shown to decrease its setting time. CaCl2 has a negative effect on the compressive strength of MTA. Biodentine is a CSM-based material that has polycarboxylate-based hydrosoluble polymer system described as “water reducing agent” to reduce the overall water content of the mix, along with CaCl2 as a setting accelerator. The combined effect reduces the setting time to 12 min and increases the compressive strength. Because of its high compressive strength, manufacturers recommend Biodentine to be used as an interim restoration or as dentine substitute under composite restorations, apart from other endodontic uses. Its pH is alkaline and is a biocompatible material.[9]

In this present study, the push-out bond strength score for BD was maximum. According to the study conducted by various authors, it was ascribed to the ability of biodentin to form tag-like structures, which increased the resistance to dislodgement forces. Han L and Okiji T (2013) revealed that calcium and silicon ion intake into dentin resulting in production of tag like structures in Biodentin was greater than MTA. The biomineralization capability of biodentin and the higher uptake of calcium and silicon ions into dentin as compared to MTA could explain the higher bond strength of Biodentin to dentin. Guneser et al demonstrated that Biodentine showed significantly higher bond strength than MTA, and exposure to various endodontic irrigants did not affect this finding negatively.

The results are in concordance with Akcay H., *et al.* (2016) who had evaluated the push-out bond strength of MTA and Biodentin in the absence or presence of blood contamination after a setting period of 1 week. They observed that in the absence of blood contamination, Biodentin had a significantly higher bond strength than MTA. In the presence of blood, the strength decreased with Biodentin having significantly higher strength than MTA.[10]

Conjointly, the results are in accordance with Nagas E., *et al.* (2016) who had assessed the effect of medicaments on the push out bond strength of Proroot MTA and BD resulting in Biodentin a significantly higher push-out strength than MTA after a period of 1 week.[11]

Additionally, the results are similar to those of Guneser MB., *et al.* (2013) who studied the effect of Irrigants on the Push out Bond Strength of Biodentin and Conventional Perforation Repair Materials and observed a significantly higher strength for Biodentin than MTA after a period of 48 hours.[12]

Limitations

The sample size is limited which might have affected the results.

CONCLUSION

Within the limitations of this study, it was concluded that the push-out bond strength of Biodentin was the highest. When compared with MTA, the push out bond strength of MTA was significantly lower than Biodentin.

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