RESEARCH ARTICLE ISSN: 2349-2678

Contents lists available at www.ijpba.in
International Journal of Pharmaceutical and Biological Science Archive
NLM (National Library of Medicine ID: 101732687)
Index Copernicus Value 2019: 71.05
Volume 7 Issue 1; January-February; 2019; Page No. 33-37

EFFECT OF RESIDUAL CALCIUM HYDROXIDE AND TRIPLE ANTIBIOTIC PASTE USED AS INTRACANAL MEDICAMENT ON THE PUSH OUT BOND STRENGTH OF BIODENTIN AND PROROOT MTA USED FOR APEXIFICATION OF SIMULATED OPEN APICES OF MAXILLARY ANTERIOR TEETH

Malik Sartaj*[1], Anum Maqbool [2], Mushtaq Mohammad Bhat [3], Riyaz Farooq[4], Aamir Rashid[5]

[1]Senior Resident, Department of Conservative Dentistry and Endodontics.

[2]Post Graduate scholar, Department of Conservative Dentistry and Endodontics.

[3]Post Graduate scholar, Department of Conservative Dentistry and Endodontics.

[4]Professor/Dean, Department of Conservative Dentistry and Endodontics .

[5]Associate Professor, Department of Conservative Dentistry and Endodontics.

ABSTRACT

For the complete disinfection of canals intra canal medicaments like calcium hydroxide and triple antibiotic paste are used in necrotic open apex roots in which apexification is to done by either MTA or Biodentin. Therefore, the aim of this study was to evaluate the effect on push-out bond strength of MTA and Biodentine by calcium hydroxide and triple antibiotic paste residues. One hundred fifty maxillary central incisor teeth with simulated open apices were divided into 4 experimental groups and a control group. Groups are divided as Group 1A as CH with Biodentin, Group 1B as TAP with Biodentin, Group 2A as CH with MTA, Group 2B as TAP with MTA and Group C as control group without any medicament and with both Biodentin and MTA. Push-out bond strength was evaluated for all samples using a universal testing machine and bond failure by steromicroscope. The bond strength was calculated in MPa and bond failure as cohesive, adhesive or mixed. Mean values and SD for push-out bond strength test were calculated and statistically analysed using one-way analysis of variance. P values less than or equal to 0.05 were considered to be statistically significant. Comparison of results showed that control group was significantly higher bond strength than both experimental groups, implying that both intra canal medicament residues negatively affect the bond strength of both Biodentin and MTA($p<0.05$).Intra group comparisons show that there is no statistically significant difference between the bond strength deterioration caused by CH or TAP.

Keywords: MTA, TAP

Introduction:

The purpose of endodontic therapy is to clean and disinfect the root canal system with subsequent filling to provide an impervious apical seal. The management of a young permanent tooth with pulp necrosis, either due to trauma or caries is exceptionally challenging as it will eventually cause cessation of root closure leading to large open apex at root end with thin and fragile dentinal walls.[1] The potential complications associated with endodontic treatment of these teeth include difficulties in achieving complete debridement and optimal sealing of the root canal system.[2] Previously calcium hydroxide has been broadly used to induce apexification at the root apex of immature teeth and /or may be used as intracanal medicament for disinfection.[3]But the recent approach is to form an artificial apical barrier by apical plug or matrix of various

**Corresponding author: Mushtaq Mohammad Bhat |*

biocompatible materials like MTA.[4]Set MTA provides a good seal and excellent marginal adaptation. However, apexification using MTA has some clinical disadvantages like prolonged setting time, manipulation, and handling difficulties.[4,5] Recently, new calcium silicate-based cements were introduced into the market. The first was Biodentine (Septodont,France), which is composed mainly of purified tricalcium silicate powder, small amounts of dicalcium silicate, calcium carbonate, and an opaque calcium chloride liquid.[5,6] Various intracanal medicaments are in vogue for apexification cases. Calcium hydroxide (CH) is the most widely used intracanal dressing in these cases due to its antibacterial and biological properties.[7,8] However long-term use of CH weakens tooth structure and increases susceptibility to fracture.[9] Also the complete removal of this intra-canal dressing from the root canal system is very difficult and almost all techniques used for its removal leave remnants in the canal. Since infections of the root canal system are regarded as polymicrobial (ie, consisting of different species of bacteria and other microorganisms), antibiotic combinations have also been suggested. Triple antibiotic paste (TAP) has been found to have antimicrobial properties and to be biocompatible.[10,11] It consists of ciprofloxacin, metronidazole, and minocycline in equal proportion.[12]These intracanal materials come in to contact with the root end filling material when they are used as intracanal medicaments. Therefore, the aim of this study was to evaluate the effect on push-out bond strength of MTA and Biodentine by calcium hydroxide and triple antibiotic paste residues.

Materials and methodology

One hundred fifty maxillary central incisor teeth were collected from the Oral and Maxillofacial Surgery Department of our College. Teeth were cleaned of remaining tissue and calculus, and stored in 1% thymol solution. A 3 mm slice of each root tip was resected using a straight fissure bur under water cooling and working length was determined .Coronal access was made using no 4 round diamond bur. The canal was instrumented to the ISO #80K.To simulate immature teeth, the canals were instrumented with Peeso reamers (no 1–6) until a no. 6 Peeso (1.7 mm) could be passed 1 mm beyond the apex to simulate open apex. This is according to Cvek's stage 3 of root development.[13]Root canals were rinsed thoroughly with EDTA, NaOCl and distilled water and dried paper points. Specimens were divided into 5 groups of thirty each. In group 1A and group 1B sixty teeth were filled with calcium hydroxide (CalPlus) using a #25 lentulospiral in a low speed hand piece. In group 2A and 2B other sixty samples were filled with triple antibiotic paste in which equal amounts of metronidazole, ciprofloxacin, and minocycline were mixed with distilled water, with powder to liquid ratio of 3: 1 according to the study by Hoshino et al. [12]Thirty specimens were considered as controls and did not receive calcium hydroxide or TAP. The coronal openings of the canals were sealed with a small cotton pellet and temporary filling material (Cavit) to avoid leakage. In the control group, coronal access was directly sealed with Cavit without intracanal medicament. The specimens were stored at 37°C in 100% humidity for 3 weeks to simulate clinical conditions.[14,15] After 3 weeks, the temporary filling material and the cotton pellet were removed from the access cavities and intracanal medicaments were removed from the canal by light instrumentation using size 60 H stainless steel hand file that was introduced to the working length and gently manipulated to remove the paste. Intracanal pastes in all groups were rinsed with 10 ml 17% EDTA followed by 10 ml 2.5% NaOCl and a final irrigation with 5 ml saline solution. Subsequent to the procedures, the root canals were dried using paper points.[15]Biodentin is manipulated in amalgamator and then applied with an amalgam carrier and adapted to the canal walls in groups 1A and 1B using a prefitted hand plugger shorter than tooth length by 4 mm to obtain a 4 mm apical plug. Similarly MTA is mixed according to manufacturer recommendations and a plug of 4mm is adapted to samples in group 2A and 2B.In group 3 half of the samples were plugged with biodentin and the other half with MTA. Teeth were stored at 100% humidity and 37°C for 1 week to ensure complete setting of biodentin and MTA. After mounting specimens in acrylic resin, the apical third of the roots were horizontally sectioned to obtain 4mm slices using a water-cooled precision saw.

Push-Out Bond Strength Evaluation

Push-out bond strength was evaluated for all samples using a universal testing machine. Samples were placed on a custom-made slab with a hole in the centre which allowed the stainless steel needle of the testing machine to pass through freely once the bond between the filling material and the root dentin wall was broken. A stainless steel needle of 1 mm in diameter was used to apply a compressive load at a speed of 1 mm/min. The maximum load at which the specimen was dislodged was recorded in Newtons (N). The bond strength was calculated in MPa using the following formula:

Bond strength (MPa) = Bebonding force (N) /Surface area (mm^2)

Surface area is calculated by 2prh, where p=3.14(constant), r=0.9(half of pesso diameter at apex) and h=4mm (height of apical section).

Failure mode analysis

Following the push-out test, the samples were viewed at 20X magnification so that the failure types could be determined. The failure type was classified into three categories as adhesive failure if it is between cement and dentin, cohesive failure when it's within cement and mixed failure which includes cement and dentin together.

Statistical analysis

Statistical software SPSS (version 20; SPSS Inc., Chicago, Illinois, USA) was used to carry out statistical operations. Mean values and SD for push-out bond strength test were calculated and statistically analysed using one-way analysis of variance. P values less than or equal to 0.05 were considered to be statistically significant. Multiple pairwise comparisons were performed using Chi square test.

Results

Results push-out bond strength values MPa were presented in Table 1 and the type of bond failure as analysed by stereomicroscope were presented in Table 2.

Table 1: Showing push-out bond strength in different groups

Groups	N	Bond Strength(MPa)	SD	P value
Group 1A	30	23.35	5.36	p>.05
Group 1B	30	20.11	6.24	
Group 2A	30	38.5	5.41	p>.05
Group 2B	30	31.24	7.2	
Group3(Control)	30	49.4	6.24	P<.05

Table 2: Showing type of failure

Groups	N	Cohesive failure	Adhesive failure	Mixed failure
Group 1A	30	10	14	6
Group 1B	30	13	14	3
Group 2A	30	8	14	8
Group 2B	30	8	13	9
Group3(Control)	30	10	8	12

The results of bond strength showed that the with both intracanal medicaments tested i.e. calcium hydroxide (CH) and triple anti biotic paste (TAP), MTA has higher bond strength than biodentin, although there is no significant difference between the bond strengths of two materials. Pairwise comparisons showed that control group was significantly higher bond strength than both experimental groups, implying that both intra canal medicament residues negatively affect the bond strength of both Biodentin and MTA ($p<0.05$).Intra group comparisons show that there is no statistically significant difference between the bond strength deterioration caused by CH or TAP. Stereomicroscopic evaluation shows that there occurs primarily an adhesive failure between filling material and dentin wall in experimental groups whereas in control group there occurs cohesive or mixed type of bond failure.

Discussion

Pulp necrosis and incomplete root development are commonly seen problems in immature permanent teeth due to trauma or decay. Medicaments are used as an aid to improve the predictability and prognosis of endodontic treatment in such cases.[16,17] In the present study, extracted maxillary central incisors with apical preparations to simulate open apices were used as the experimental model. In most of the such cases, mineral trioxide aggregate (MTA) and similar newer calcium silicate-based cements like biodentin are used to fill the apical third for apexification and provide excellent sealing.[17]Pretreatment of dentin with either irrigants or medicaments have been shown to influence the bond strength of these silicate based cements.[18] Despite irrigation, complete removal of TAP and CH has been reported to be difficult. So the present study was undertaken with the aim to evaluate the effects of the these two intracanal medicaments used in open apex cases for disinfection on push-out bond strength of MTA and biodentin used for apexification of these cases. The results of our study indicate that residual medicaments decrease the bond strength of both MTA and Biodentin. The results of our study are in concordance with those of Topcuoglu et al.[19] and Tugba Turk et al. [20]The MTA group showed significantly higher push-out resistance values than those of the Biodentin group, which are contradictory to results of Tugba Turk et al. [20] and Guneser et al.[21]In the present study, adhesion of cement to CH-treated dentin was greater than the adhesion of cement to TAP-treated dentin. This improvement was attributed to the conversion of CH to calcium carbonate or to the reaction of MTA with residual CH. Thus, in the present study, favourable results from the CH-treated group may be related to the Ca^{2+} ions supplied by the residual CH, which was previously suggested to improve the adhesion of MTA.

Conclusion

In the present study, intra canal medicaments seemed to decrease the bond strength of MTA and biodentin. MTA appeared to have higher bond strength when compared with biodentin, regardless of the medicament type used.

References

1. Whittle M. Apexification of an infected untreated immature tooth. J Endod 2000;26:245-7.
2. Sheehy EC, Roberts GJ. Use of calcium hydroxide for apical barrier formation and healing in nonvital immature permanent teeth: a review. Br Dent J 1997; 183:241–246.
3. Andreasen JO, Flores MT. Injuries to developing teeth. In: Andreasen JO, Andreasen FM, Andersson L, editors. Textbook and color atlas of traumatic injuries to the teeth. 4th ed. Copenhagen: Munksgaard; 2007. 542–576.
4. Pawar AM, Pawar SM, Pawar MG, Kokate SR. Retreatment of endodontically failed tooth with wide-open apex using platelet rich fibrin membrane as matrix and an apical plug of Biodentine. Eur J Gen Dent 2015;4:150-4.
5. Saghiri MA, Garcia-Godoy F, Gutmann JL, et al: Push-out bond strength of a nano-modified mineral trioxide aggregate. Dent Traumatol 2013; 29: 323–327.

6. Guneser MB, Akbulut MB, Eldeniz AU: Effect of various endodontic irrigants on the pushout bond strength of Biodentine and conventional root perforation repair materials. J Endod 2013; 39: 380–384.
7. Kokate R, Pawar Ajinkya M. An in vitro comparative stereomicroscopic evaluation of marginal seal between MTA, glass ionomer cement and Biodentine as root end filling material using 1% methylene blue as tracer. Endodontology 2012; 1:36–42.
8. Kawashima N, Wadachi R, Suda H, Yeng T, Parashos P. Root canal medicaments. Int Dent J. 2009;59(1):5-11.
9. Banchs F, Trope M. Revascularization of immature permanent teeth with apical periodontitis: new treatment protocol? J Endod. 2004;30:196–200.
10. Kusgoz A, Yildirim T, Er K, Arslan I. Retreatment of a resected tooth associated with a large periradicular lesion by using a triple antibiotic paste and mineral trioxide aggregate: a case report with a thirty-month follow-up. J Endod 2009;35: 1603–6.
11. Taneja S, Kumari M. Use of triple antibiotic paste in the treatment of large periradicular lesions. J Investig Clin Dent 2012;3:72–6.
12. Hoshino E, Kurihara-Ando N, Sato I, et al. In-vitro antibacterial susceptibility of bacteria taken from infected root dentine to a mixture of ciprofloxacin, metronidazole and minocycline. Int Endod J 1996;29:125–30.
13. Ron AC, Karthik J, Pai VS, Vedavathi B, Nadig RR. Fracture resistance of simulated immature teeth rehabilitated with different restorative materials: A three-dimensional finite element analysis. Endodontology 2017 ;29:11-9.
14. Akcay M, Arslan H, Yasa B, Kavrık F, Yasa E. Spectrophotometric analysis of crown discoloration induced by various antibiotic pastes used in revascularization. J Endod 2014;40:845-8.
15. Arslan H, Capar ID, Saygili G, Uysal B, Gok T, Ertas H, et al. Efficacy of various irrigation protocols on the removal of triple antibiotic paste. Int Endod J 2014;47:594-9.
16. Abbott PV. Medicaments: aids to success in endodontics. Part 1. A review of literature. Aust Dent J 1990;35:438-448.
17. Siqueira JF Jr, Lopes HP. Mechanisms of antimicrobial activity of calcium hydroxide: a critical review. Int Endod J 1999;32:361- 369.
18. Mandeep K, Harpreet S, JS Dilon, Munish B, Meenu. MTA versus Biodentine: Review of Literature with a Comparative Analysis. Journal of Clinical and Diagnostic Research. 2017 Aug, Vol-11(8): ZG01-ZG05
19. Topcuoglu HS, Arslan H, Ak¸cay M, et al. The effect of medicaments used in endodontic regeneration technique on the dislocation resistance of mineral trioxide aggregate to root canal dentine. Int Endod J. 2014;46:688 695.
20. Tugba Turk & Aleš Fidler (2016) Effect of medicaments used in endodontic regeneration technique on push-out bond strength of MTA and Biodentine, Biotechnology & Biotechnological Equipment, 30:1, 140-144,
21. Guneser MB, Akbulut MB, Eldeniz AU. Effect of various endodontic irrigants on the push-out bond strength of biodentine and conventional root perforation repair materials. J Endod. 2013;39:380 384.