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Comparative Evaluation of the Efficacy of Three Different Dental Materials in Sealing Furcation Perforation" –an in-Vitro Study

KEYWORDS: Dye leakage, dye extraction , MTA – Angelus, Biodentin, GIC ,furcation perforation

Dhanya Narasimhan	Priyadarshini Hegde	Mithra . N.Hegde
Post graduate student Department of Conservative dentistry and Endodontics, A.B.Shetty Memorial Institute of Dental Sciences, Mangalore	Professor Department of Conservative dentistry and Endodontics, A.B.Shetty Memorial Institute of Dental Sciences, Mangalore	Senior Professor and Head of Department of Conservative dentistry and Endodontics, A.B.Shetty Memorial Institute of Dental Sciences, Mangalore

ABSTRACT *Aim- To compare the sealing ability of Biodentin ,MTA Angelus, and GIC to repair furcation perforation when used with and without an internal matrix (collagen) | Materials and Methodology : Eighty extracted human mandibular first molars were divided into two control groups (n=10),and three experimental groups (n=20) according to the repair material used i.e Biodentine, MTA- Angelus and GIC . Each experimental group was divided into two subgroups (n=10) according to whether internal matrix was used or not before perforation repair. The efficacy f repair material was assess using dye extraction method using absorption spectrophotometer | Results: Biodentin with interal matrix (0.109) and MTA-Angelus(0.115) with internal matrix showed least dye leakage .GIC with(0.18)and without internal matrix(0.19) showed most dye absorbance . Biodentin (0.134) and MTA –Angelus (0.144) showed intermediate dye absorbance . | Conclusion :Collagen as internal matrix membrane improves the sealing ability of MTA and BIODENTIN which also have better perforation sealing ability than GIC*

INTRODUCTION

Perforations are endodontic mishaps that affect the prognosis of the root canal treatment. This is because presence of perforation leads to seeping of bacteria and their toxic products into periodontal and periapical tissues from the tooth causing microbial invasion into the supporting periodontium, inflammation , loss of attatchment and ultimately failure of the root canal treatment[1,2] . So it becomes essential to identify a material and a technique for perforation repair that ensures a good seal .

The requirements of an ideal perforation repair are[3] ,that is should have a good seal , be biocompatible , control the restorative from overfill or underfill .

Lemon (1992)[3] introduced the concept of Internal matrix in sealing perforation . It is basically any biocompatible material that helps contour the perforation repair material , helps control hemorrhage, not produce an inflammatory response and must be sterile or capable of being sterilized . Examples include demineralized bone, calcium phosphate materials , collagen etc[4] .

Mineral Trioxide Aggregate (MTA) has rapidly gained acceptance in dentistry since its introduction in 1993 by Torabinejad. MTA has shown to have good biocompatibility, lesser bacterial leakage[5] and improved adaptation to the cavity walls[6,7] However the disadvantage is its long setting time[4] . Of the two commercially available MTA (ProRoot and Angelus), according to the manufacturer MTA-Angelus has a shorter setting time (2 hours versus 10 minutes)

Biodentin by Septodont was launched in 2011 . It has a chemical composition based on the Ca_3SiO_5 – water chemistry similar to MTA, with improved physico-chemical properties like short setting time, high mechanical strength as compared to MTA[8]

GIC is a popular perforation material because it has a long standing history of use. It is cheap and easily available .

Thus this study aims to compare the sealing ability of Biodentin, MTA –Angelus and GIC in treating perforation repair with and without the use of an internal matrix using a dye extraction method.

MATERIAL AND METHODS

Eighty mandibular molar teeth were extraxted collected , stored and disinfected according to OSHA regulations. Access cavity preparation was made on the eighty molars .Molars were then amputated 3 mm below the furcation area by using a tapered diamond disc. A perforation was created between the orifices to the furcation area by using a high-speed long shank carbide round bur (2 mm in diameter). Every molar was then covered completely including cavity walls and pulpal floor with two successive layers of clear varnish. Molars were randomly divided into 3 experimental groups and 2 control as follows: (1) group 1, 20 molars in which perforations were repaired with Biodentin; (2) group 2, 20 molars in which perforations were repaired with MTA-Angelus; (3) group 3, 20 molars in which perforations were repaired with GIC ; (4) group 4, 10 molars in which perforations were left unsealed (positive control); and (5) group 5, 10 molars without perforation (negative control). The three experimental groups were further subdivided into :subgroup A - 10molarsin which no internal matrix was used, and subgroup B, 10 molars in which internal matrix (Collagen membrane, Periocol-GTR,Eucare India Ltd) was used. Molars were placed in test tubes containing cotton moistened with saline in an attempt to simulate clinical conditions. In subgroups A , Internal matrix (Collagen membrane) was adapted to the interradicular area by using hand pluggers . The repair of perforation was performed by mixing Biodentin, MTA Angelus, and GIC according to the manufacturers instruction. Moist cotton pellets was placed over the repair materials . Molars were kept in 100% humidity for 24 hours to allow materials to set. Molars were placed in vials containing 1ml

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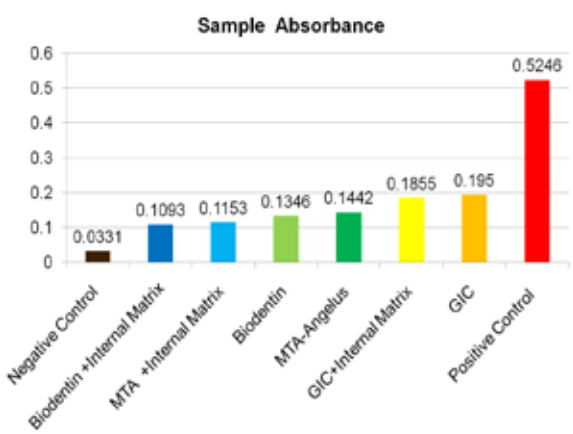
of concentrated (65 wt%) nitric acid for 3 days. Contents of vials were transferred to ependorf tubes which were then centrifuged at 14,000 rpm for 5 minutes (Centrifuge Eppendorf 5430 ,Centrifuge Rotors, Eppendorf ,North America) 200µl of the supernatant from each sample was collected and sample absorbance was read by an automatic microplate spectrophotometer (Nanodrop spectrophotometer JH Bio Innovations,Karnataka,India) . The difference in the light absorbance was statistically analysed by using one-way analysis of variance (One-way Anova). Tukey's test was used for pair-wise comparison between the means when analysis of variance test was significant. SPSS (Statistical Package for Social Science) software version 16 was used.Level of significance was set at p = 0.05

RESULTS

The results showed that positive control showed the highest mean dye absorbance (0.524).All the groups had statistically significant lesser dye absorbance than the positive control ($p<0.05$) GIC with and without internal matrix (0.18 and 0.19) showed maximum dye absorbance(ie most dye extraction) with no significant difference between each other Biodentin and MTA Angelus had dye absorbance values 0.132 and 0.144 respectively .The dye absorbance for the two groups was higher than Biodentin with internal matrix and MTA Angelus with Internal matrix (0.109 and 0.115) although not statistically significant. Biodentin with internal matrix (0.109) and MTA Angelus with internal matrix (0.115) had least dye absorbance (ie least dye extraction) GIC with and without internal matrix showed statistically significant more dye absorbance(more dye extraction) than the negative control ($p<0.05$)., Table 1 depicts a histogram showing the mean dye absorbance



DISCUSSION

Sealing ability of the repair materials and their extrusion into furcation areas are considered major problems when repairing furcation perforations [9,10] In this study perforation sealing ability of three popular dental material was evaluated using collagen matrix as barrier using dye extraction .

Several methods to evaluate leakage of perforation repair materials have been used including dye penetration[11] bacterial[12] fluid filtration[13]. Bacterial leakage studies do not simulate the conditions in the oral cavity, require long periods of observation time, and are labor-intensive[12]

Dye penetration methods assess the penetration of a dye through the repair material and relies on randomly cutting the root into two pieces to check for dye penetration without actually knowing the position of the deepest dye penetration[9] Dye extraction method method is a more reliable technique than dye penetration as it takes into account all absorbed dye by the samples[14]. It has been shown to be as effective as fluid filtration method while saving laboratory time[15].

In this study the internal matix material used was Periocol GTR (Eucare India Ltd). It is an indigenous collagen membrane . The rationale of using collagen is that collagen has hemostatic properties[16] can easily be manipulated and adapted to the root surface. It is bioabsorbable. Collagen has been found to be chemotactic for fibroblasts *in vitro*, a property that may enhance regeneration of periodontal ligament along the root surface[17]

The effectiveness of the use of internal matrix is controversial . While some studies [4,11,18,20,21,22] recommend the use of internal matrix to improve the seal of the perforation repair , some studies[10,19,21] claim that no difference exists when the perforation is repair with or without the matrix.

MTA has inherent superior sealing ability as demonstrated in several studies[23-25]. The superior sealing ability of MTA could be due to its hydrophilic nature, ability to adapt to cavity walls and expand while setting. Long hardening time of ProRoot MTA requires a two visit procedure for definitive treatment of the tooth. MTA Angelus does not contain calcium sulfate, which reduces its setting time to 10 min[2]. A recent study has shown that MTA-Angelus contains higher number of small particles than ProRoot MTA[26,27] MTA-Angelus I and s found to have good handling characteristics in addition to faster setting time; further, it is cost-effective[28,29].

Biodentine is present as a powder/liquid system consisting of tricalcium silicate, dicalcium silicate, calcium carbonate, CaO, and zirconium oxide as a radiopacifier [8.] The liquid consists of a hydrosoluble polymer. This hydrosoluble polymer (water-reducing agent) maintain acceptable flow properties with a low water/solid ratio[8]

The working time for the material is reported to be 6 minutes and the setting time of approximately 10 to 12 minutes. The study results showed that Sample absorbance value of Biodentin and MTA Angelus without the internal matrix was higher than when the materials were used with the internal matrix . Both the materials seemed to perform better with the internal matrix ,ie the dye extracted from them was lesser when the matrix was used. The presence of matrix seems to be necessary with to improve adaptation. This could be due to better adaptablilty of the material when a matrix is applied[4].In both types of samples ie with matrix and without matrix Biodentine sample absorbance was lesser than MTA- Angelus although it was not statistically significant

Restorative GIC is commonly used for perforation repair because it is relatively inexpensive and easily available. In our study this material showed the least sealing ability among the materials . This could be because the material is moisture sensitive[30]and all samples were kept in moist cotton dipped in saline to simulate oral condition . Also the internal matrix did not improve the resistence to dye penetration . This could be because GIC bonds chemically to the tooth via ion-exchange method[31] .The collagen matrix membrane extended to the perforation borders and so it seemed to reduce the dentine surface area for bonding with the GIC prevent the adaptation of GIC . Dye leakage could also be more in GIC because of shrinkage

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during setting of GIC[32] .This was not seen in the other two materials which are both hydrophilic and adapt well to moisture.

CONCLUSION

Within the limitations of our study we can conclude 1) Biodentin and MTA Angelus have good perforation sealing ability and they perform better when used with collagen GTR as internal matrix membrane 2)GIC performs significantly poor in comparison to the above two materials its use must be limited in sealing large perforations .

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