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RESEARCH ARTICLE

FURCAL PERFORATION REPAIR USING MTA & BIODENTINE™, AN IN VITRO EVALUATION USING DYE EXTRACTION METHOD

Fida N. Hassan[1], Dunia Al Hadi[2] and Saeed MH[3]

[1]Clinical Tutor, College of Dentistry, Ajman University of Science & Technology, Ajman, UAE
[2,3]Department of Restorative Dentistry, Ajman University of Science & Technology, Ajman, UAE

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ABSTRACT

Aim: The present in-vitro study was undertaken to evaluate the ability of White ProRoot MTA and BIODENTINE™ to seal furcation perforations In Molars using a Dye Extraction Leakage Model

Methodology: Forty-four extracted, human mandibular and maxillary first molars with minimal or no restorations and caries, and non-fused roots were collected and stored in saline until used. The molars were decoronated 3 mm above the cemento-enamel junction and the roots were amputated 3 mm below the furcation using a round disk bur using Ultimate XL (NSK) straight handpeice. A standardized access opening was made in each tooth, sticky wax was placed over the orifice of each canal, and the teeth were coated with two layers of red nail varnish. Perforation was centered between the roots using #2 carbide high-speed bur. The chamber and perforation were flushed with water and dried. Then the teeth were divided randomly into four groups. Materials were mixed according to the manufacture instructions. And the perforations were sealed as follows: Group 1 (n = 10) and group 3 (n = 10) repaired with BIODENTINE™. Group 2 (n = 10) and group 4 (n = 10) repaired with white ProRoot MTA. Two teeth with unrepaired perforations were used as positive controls and two teeth without perforations were used as negative controls. Then teeth were kept in saline for 24 hours to ensure the complete setting of the materials. Teeth were removed from saline and placed in petri dishes. Methylene blue dye was added to the access chambers of groups 1 and 2 . Groups 2 and 4 were immersed in dye to the CEJ. All samples were stored in methylene blue for 48 hour. After removal from the dye, teeth were rinsed under tap water for 30 min and varnish removed with a polishing disc and #15 blade. Each tooth was stored in a vial containing 2 ml of concentrated (65 %) nitric acid for 3 days. Vials were centrifuged at 14,000 rpm for 5 min. then 2 ml of the supernatant layer from each sample was transferred to plastic cuvettes. Samples were read by an automatic microplate spectrophotometer (Beckman, DU 520) at 550 nm using concentrated nitric acid as the blank

Result: The results showed That the mean of dye absorbance of BIODENTINE™ is less than ProRoot MTA in both Orthograde and retrograde directions. However, the statistical analysis demonstrates no significant difference in dye absorbance

Conclusion: Under the conditions of this study, white ProRoot MTA and Biodentin performed equally well as a furcation perforation repair materials. Key word: Instrumentation, Fracture load, root fracture

INTRODUCTION

Endodontic mishaps or procedural accidents are unfortunate occurrences that can occur during treatment. Some might be due to inattention to detail, whereas others are unpredictable (1). They can be instrument related accidents, parts of these are perforations, and mishaps related to obturation. Endodontic mishaps can be during any step during RCT like in diagnosis, access cavity preparation, instrumentation and obturation. Among all these complications, our concern was to furcal perforations which create a great challenge to treat them. Furcal perforations defined as mechanical or pathologic communications between the root canal system and the external tooth surface (2). They allow microorganisms to invade the supporting structures, triggering inflammation and a loss of attachment, which may ultimately compromise the prognosis of the tooth (3).

An ideal orthograde or retrograde filling material should seal the pathways of communication between the root canal system and its surrounding tissues. It should be nontoxic, has antibacterial properties, excellent biocompatibility, non-carcinogenic, insoluble in tissue fluids, dimensionally stable and promotes the growth of cementum, formation of bone, and non genotoxic (4, 5).

Corresponding author: **Fida N. Hassan*
Clinical Tutor, College of Dentistry, Ajman University of Science & Technology, Ajman, UAE

Several materials have been used to repair perforations like amalgam, zinc oxide eugenol cements (IRM and Super-EBA), glass ionomer cement, composite resins, resin-glass ionomer, hybridsand, and MTA.

Regarding MTA, since its introduction by Mahmoud Torabinejad in 1993, it was developed and recommended initially to treat perforations as the previous materials did not have the ideal characteristics.

More recently, in 2011, septodont introduced its new Tricalcium silicate based restorative cement under the name of BIODENTINE™.

The sealing ability of MTA and other materials has been tested and evaluated by using dye penetration, fluid infiltration, protein leakage, bacterial leakage and dye extraction methods. Results from Most of these investigations indicated that MTA exhibits significantly less dye leakage in comparison to many other materials like Portland cement (6), Ketac Molar Easymix (7), IRM (8), and many different materials.

The aim of this study was to evaluate the sealing ability of white ProRoot MTA and Biodentine as a furcal perforation repair materials using a dye extraction Method as an in vitro microleakage study

MATERIALS AND METHOD

Forty-four extracted, human mandibular and maxillary first molars with minimal or no restorations and caries, and non-fused roots were collected and stored in saline until used.

The molars were decoronated 3 mm above the cemento-enamel junction and the roots were amputated 3 mm below the furcation using a round disk bur using Ultimate XL (NSK) straight handpeice

A standardized endodontic access opening was made in each tooth, sticky wax was placed over the orifice of each canal, and the teeth, including the pulpal floor, were coated with two layers of red nail varnish (Fig.1).

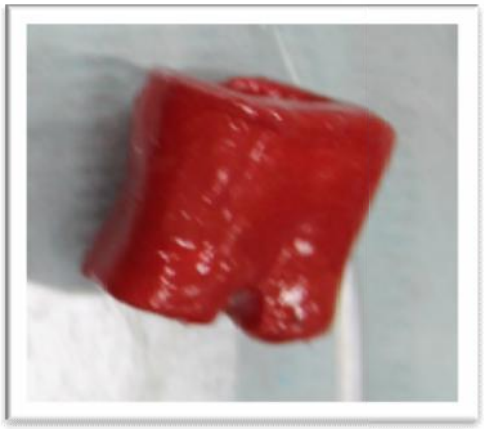

Figure 1 Nail varnish coating

Perforation was centered between the roots using #2 carbide high-speed bur. The chamber and perforation were flushed with water and dried, and then the teeth were divided randomly into four groups. Materials were mixed according to the manufacture instructions (Fig.2). The perforations were sealed as follows:

Figure 2 perforation repaired, Orthograde and retrograde views.

Group 1 (n = 10) and group 3 (n = 10) repaired with BIODENTINE™ (Septodont, France)
Group 2 (n = 10) and group 4 (n = 10) repaired with white ProRoot MTA (Lot # 03081235, Dentsply Tulsa Dental, Tulsa, OK).

Two teeth with unrepaired perforations were used as positive controls and two teeth without perforations were used as negative controls,then teeth were kept in saline for 24 hours to ensure the complete setting of the materials.

Teeth were removed from saline and placed in petri dishes. Methylene blue dye was added to the access chambers of groups 1 and 2. Groups 2 and 4 were immersed in dye to the CEJ. All samples were stored in methylene blue for 48 hour. After removal from the dye, teeth were rinsed under tap water for 30 minand varnish removed with a polishing disc and #15 blade. Each tooth was stored in a vial containing 2 ml of concentrated (65 wt. %) nitric acid for 3 days (Fig 3).

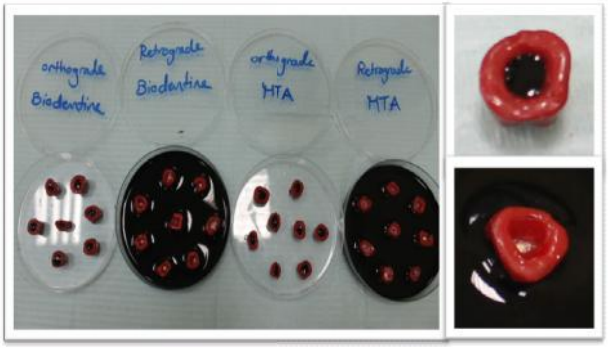

Figure 3 Teeth were kept in a 65% nitric acid for 3 days.

Vials were centrifuged at 14,000 rpm for 5 min (Fig 4). 2 ml of the supernatant layer from each sample was transferred to plastic cuvettes. Samples were read by an automatic microplate

spectrophotometer (Beckman, DU 520) at 550 nm using concentrated nitric acid as the blank (Fig. 5).

Figure 4 Centrifuge

Figure 5 Spectrophotometer (Beckman, DU 520)

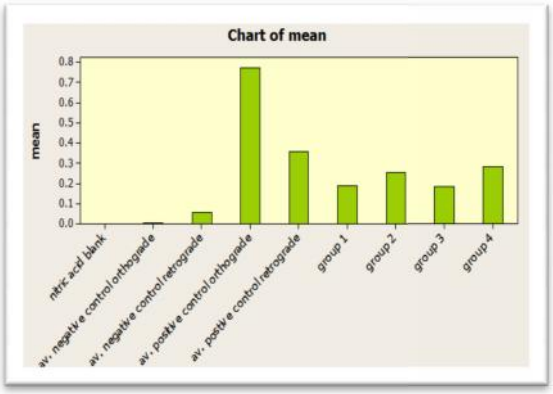

Figure 6 Results of dye Absorbance after repair of furcal perforation.

Statistical analysis

The collected data were analyzed using the statistical package SPSSversion 11.5. A two-way ANOVA was performed for each technique to compare groups.All statistical analysis was performed at 95% level of confidence.

RESULTS

The results showed that the mean of dye absorbance of BIODENTINE™ is less than ProRoot MTA in both Orthograde and retrograde directions. However, the statistical analysis demonstrates no significant difference in dye absorbance. (Fig 6).

Regardless the material used no difference was detected between orthograde and retrograde leakage.

DISCUSSION

The present study compared the sealing ability of two calcium silicate based materials (MTA and Biodentine) in orthograde and retrograde grade directions.

Negative control samples had low dye absorbance (0.030) close to that of blank (nitric acid), which showed absorbance of (0.00). This small difference can be attributed to the yellowish color of teeth, whereas blank is colorless. Positive control samples in which perforations were not repaired had the highest dye absorbance of all groups (0.566) denoting the accuracy of the technique (9).

The results of our study have shown less dye absorbance with Biodentine than white ProRoot MTA in both retrograde (means 0.189±0.14, 0.256±0.17) and orthograde directions (means 0.180 ±0.11,0.285±0.14) Respectively. However the study demonstratedno significant differences in sealing abilities of the two materials.

Several investigations were completed to determine the sealing properties of MTA. Gray and white ProRoot MTA performed equally well in sealing furcal perforations. There is no significant difference between the gray and white ProRoot MTA in sealing furcal perforations of extracted human molars (10). There was found no significant difference in saliva leakage between gray and white MTA when it was used as an orthograde root canal filling material as stated by Al-Hezaimi *et al*.(11).

Regardless the material used no difference was detected between orthograde and retrograde leakage. This is inconsistent with the results by Hamad *et al*. which had shown signficantly more leakage in orthograde direction when comparing grey and white MTA as furcation perforation repair materials (9).

Coronal microleakage of bacteria and their by-products is a problem in endodontics. It is an important factor influencing the long-term outcome of perforation repairs. Clinicians may consider the placement of a barrier material over a perforation repair for additional protection against coronal microleakage. This is mainly applies when using MTA which has undesirable physical and mechanical characteristics.

MTA has been developed and recommended initially because all the previous materials didn't have the ideal characteristics to treat perforations, despite of its many advantages, some drawbacks are still present, like the setting time of about 4 hours, which delays the placement of the fillings over it(12), Handling of the material, MTA prepared by mixing its powder with a sterile water in a 3:1 ratio, which means any difference in this ratio will compromise its properties(11), The compressive and flexural strengths are still considered weak to place the MTA as a coronal restoration and it is considered as an expensive material.

Biodentine is a new material and there are no published studies regarding sealing furcation perforation. In our study Biodentine showed comparable minimum leakage in retrograde and orthograde directions, MTA showed slightly more total

leakage without showing any statistically significant differences.

Biodentine a purified calcium silicate has superior mechanical, physical and handling properties comparable to most commonly used restorative materials it meant to be used as a temporary enamel restoration and permanent dentine restoration.

CONCLUSION

Under the conditions of this study, white ProRoot MTA and Biodentin performed equally well as a furcation perforation repair materials. The main drawbacks of (MTA) are the slow setting kinetics, complicated handling and high cost which rendered it a technique sensitive procedure.

Biodentin is a promising restorative material with less cost and better handling properties. Further studies are required to evaluate the clinical performance of this material.

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