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Investigating the quality of different obturating techniques when filling experimental internal resorptive areas

Dental Science

KEYWORDS: internal resorption, Thermafil, JS Quick-Fill, Obtura, lateral condensation

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ABSTRACT

Aim: to investigate the quality of root fillings in experimental internal resorptive areas of root canals filled with different gutta-percha obturation techniques.

Material and methods: Root canals of sixty maxillary incisor teeth were filled using one of six different techniques: Thermafil, JS Quick-Fill, LC, and Obtura. Following root canal filling, the teeth were stored in an incubator at 370 C and 100% humidity for 7 days. After which the roots were divided at the level of the previous section and each root surface was photographed. Image analysis program was used to calculate the percentage of gutta-percha, sealer, and void in the internal resorptive cavities. All measurements were analysed statistically using One-way anova and unpaired't' tests.

Results: Obtura showed maximum sealing ability of experimental resorptive cavity followed by JS Quickfill, Thermafil, where as lateral condensation showed least in coronal section as well as apical section. By applying One Way Annova F Test, a high significance difference was observed at 0.1 % of significance for gutta percha, sealer, and voids in both coronal and apical section in Obtura, Thermafil, JS Quick Fill, and Lateral Condenation.

Conclusion: Obtura showed the maximum sealing followed by JS Quickfill and Thermafil, whereas Lateral Condensation showed the least sealing ability.

Introduction

In endodontic practice, procedural accidents such as furcal perforation may occur and affect the prognosis of root canal treatment. In an analytical study of endodontic failures, Ingle reported that perforations were the second greatest cause of endodontic failure and account for 9.6% of all unsuccessful cases.[1]

Ideally, to prevent bacterial contamination, perforations should be repaired as quickly as possible with biocompatible material. In a review article, Alhadainy discussed the ideal properties of a perforation repair material. It should be non-toxic, noncorrosive, nonstaining, sterile, have bacteriocidal or bacteriostatic properties, easy to manipulate, set rapidly, well tolerated by periradicular tissues, promote regeneration of periradicular tissues, dimensionally stable, nonresorbable, radiopaque, and remain unaffected by the presence of moisture or low pH levels.[2]

Numerous materials have been recommended for the repair of this iatrogenic accident including amalgam, indium foil, calcium hydroxide, tricalcium phosphate, cavit, zinc oxide and eugenol, hydroxyapatite,[1] glass ionomer, super- EBA cement, composite bonded restorations and decalcified freeze-dried bone.[3] However, none of these materials has been able to predictably reestablish the normal architecture in perforated furcation.

In 1990s, a new class of restorative material Mineral trioxide aggregate (MTA) was developed at Loma Linda University as a root-end filling material.[4]Its excellent biocompatibility has been evidenced in several favourable biologic process is namely, minimal toxicity and pulpal irritation, mild periapical inflammation, nonmutagenicity, cell adherence and growth, increased levels of alkaline phosphatase and osteocalcin, interleukine production(IL-6,IL-8), periodontal ligament attachment, cementum growth, and dentinal bridge formation.[5] Currently, Mineral trioxide aggregate is also being used in other clinical procedures such as apexification, repair of perforations nonsurgically and surgically, and in pulp capping with reversible pulpitis as described by Torabinejad et al.[6]

This in vitro study was undertaken to evaluate the ability of gray and white MTA to seal furcation perforations in mandibular molars using a dye extraction leakage method.

Materials and methods

An in vitro study was carried out in the Department of Conservative Dentistry and Endodontics, Subharti Dental College, Meerut to compare Gray and White Mineral Trioxide Aggregate as repair material for furcation perforation, in collaboration with Department of Central Research Centre, Subharti Medical College, Meerut, U.P. The samples were tested by a dye extraction method under spectrophotometer.

Sixty freshly extracted human permanent lower molars were collected and used for the study.Teeth selection criteria included lower molars with separate mesial and distal roots (no fused roots), minimal or no caries, no restoration and no fracture lines. All molars were decoronated 3mm above the cementoenamel junction and roots were amputated 3mm below the furcation area with diamond disc. A standardized endodontic access cavity was prepared in each sample by using Endo access bur followed by Endo Z for lateral extension and finishing of cavity walls. The prepared cavity irrigated with sterile saline. The samples were dried and sticky wax was placed over the orifices of each canal up to the root. The perforation was made with # 4 high speed round carbide bur while the tooth was hand held.

Teeth were randomly divided in to four experimental groups of 15

samples each as follows:

- Group A: Repaired with White MTA
- Group B: Repaired with Gray MTA
- Group C: Perforation were left unsealed (positive control)
- Group D: Without perforation (negative control)

The samples were kept in 100% humidity at 37°C for 24 hrs in incubator. Methylene blue dye was applied inside the access cavity of each sample. Samples were stored at room temperature for 48 hrs. Molars were placed under running tap water for 30 minutes to remove all residues of methylene blue. All samples were then dried and nail paint was removed with a parker blade #15. The samples were placed in vials containing 1 ml of concentrated (65wt%) nitric acid for 3 days. Vials were centrifuged at 14,000 rpm for 5 minutes. 1000µl of the supernatant from each vial was transferred to a 96-well plate with micropipette. Absorbance was read by UV/Vis spectrophotometer UV100 at 550nm using concentrated nitric acid as a blank.

The results were tabulated using Microsoft excel sheets and subjected to statistical analysis.

Results

In this study, negative control samples had low dye absorbance (0.014%, ±0.010) close to that of blank nitric acid, which showed absorbance of 0.010%. This small difference can be attributed to the yellowish color of teeth, where as blank is colorless. Positive control samples in which perforation was not repaired had the highest dye absorbance of all groups denoting the accuracy of the technique.

White Mineral Trioxide Aggregate had dye absorbance (0.127%, ±0.0035) and Gray Mineral Trioxide Aggregate had dye absorbance (0.125%, ±0.0041). There was no statistical significant difference between White Mineral Trioxide Aggregate and Gray Mineral Trioxide Aggregate. (Graph 1 shows the mean value of dye absorbance of individual groups)

Discussion

In this study, White and Gray Mineral Trioxide Aggregate - Angelus was used as a perforation repair material. It is available in powder and liquid form. It was mixed according to the manufacturer's recommendations, on a clean glass slab with cement spatula. When mixture exhibited a thick creamy consistency, it was placed at the perforation site in increments by using the microapical placement system and condensed with finger pluggers without applying any undue force.

Although the methods for mixing and placing the cement were well standardized in this study, there is evidence that increased water to powder mixing ratio could account for increased solubility and porosity of the material. Because of the handling properties of MTA, it is likely that clinicians vary in the way they mix and place the cement. It is advised that manufacturers' recommendations for mixing be strictly followed to avoid decreasing the optimum properties of the material.[7]

Several methods to evaluate leakage of perforation repair material have been used earlier including dye penetration, bacterial penetration, and fluid filtration methods. The dye penetration technique has long been used in endodontics because of its ease of performance and the fact that it does not require sophisticated materials. This study followed an established protocol for dye extraction. Methylene blue was placed in nitric acid and evaluated with the spectrophotometer. Maximum optical density was read. Wu MK et al found that methylene blue was decolored by MTA obtained from Loma Linda University. They concluded the calcium oxide contained in MTA may react with water, form $Ca(OH)_2$ that decolors methylene blue, and that dye may be further diluted with cooling water used in sectioning teeth for a linear dye penetration study.[8]

Reports available regarding sealing ability, biocompatibility and tissue regenerating ability of MTAs, for examples, MTA- dentin interface and MTA marginal adaptation have been studied. Takashi Komabayashi et al showed that the geometry of small MTA particals (size- 1.5µm) made it possible to enter into open dentin tubules (2-5µm) in regards to size and shape. This might be an important mechanism to provide a hydraulic seal.

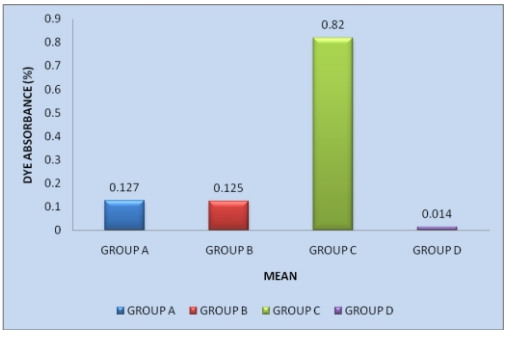
The results of this study have been in accordance with studies carried out by Douglas M. Ferris et al, Khalid Al-Hezaimi et al, Herbert et al, etc. They concluded that there was no significant difference between the two types of MTA in preventing leakage of F. nucleatum past furcal perforation repairs.[3,9,10]

Conclusion

Under the limitations of this study, it can concluded that both the White and Gray Mineral Trioxide Aggregate sealed similarly as a furcation perforation repair material. There was no significant difference between the Gray MTA and White MTA.

Legends for graphs:

Graph1: Shows Mean Value Graph of Individual Group



Graph1 : Shows Mean Value Graph of Individual Group:

Group A: Perforation Repaired With White MTA
Group B: Perforation Repaired With Gray MTA
Group C: Perforation Left Unsealed (Positive Control)
Group D: Without Perforation (Negative Control)

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