بِسْمِ اللهِ الرَّحْمنِ الرَّحِيمِ

قَالُواْ سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا عَلَّمْتَنَا

إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ

صَدَقَ اللَّهُ الْعَظِيمِ

سورة البقرة آيه (٣٢)

Comparing Sealability and Adaptability of Dyract, MTA and BioAggregate in Repair of Furcation Perforation of Different Sizes

(In-vitro study)

Thesis

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By

Ali Youssef El Gendy

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SUPERVISORS

Dr. Angie Galal Ghoneim

Associate Professor of Endodontics
Faculty of Oral and Dental medicine
Cairo University

Dr. Reham Said Siam

Lecturer of Endodontics
Faculty of Oral and Dental medicine
Cairo university

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Dedication

To my mother, who offered me endless love and support throughout my life. (I hope this will complete the dream you had for me all those many years ago).

To my father and my sister with their patience and support.

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Introduction

Perforations constitute 9.5% of all endodontic complications. Such perforations result in the destruction of dentin root wall or floor along with the investing cementum creating a communication between the root canal system and external tooth surface. This communication compromises the health of the periradicular tissues and threatens longevity of the tooth. Root or furcation perforations can occur as a results of resorptive processes, carious lesions or iatrogenically.

Although root perforations may be repaired surgically, furcation perforations are inaccessible by surgical approach especially if the defect is situated lingually in a mandibular molar. Furcation perforations mainly larger ones, act like bottomless pits which need the proper control of the repair material in terms of extrusion prevention by the use of internal matrix against which the sealing material can be condensed.

Amalgam, calcium hydroxide, Cavit and glass ionomer cement have been reported for use in non surgical repair of furcation perforations. However, none of these materials have shown satisfactory results.

Other materials for perforation repair were investigated with better advantages including MTA and BioAggregate. MTA is considered as gold standard material in repair of perforations for displaying paramount advantages such as biocompatibility and osteoconduction ability. BioAggregate, is a newly developed bioceramic material that claimed to have the same indications for use of MTA and exhibits comparable technological characteristics to white MTA. Yet, the main disadvantages of MTA and BioAggregate are delayed setting time and non-self adhesiveness.

Polyacid modified resin composite materials overcome these drawbacks. Such advantage of polyacid resin composite materials (Dyract) over MTA and bioceramics can be an encouraging factor to be used in repair of perforations.

This necessitates shedding some light on the comparison between Dyract, MTA and BioAggregate in terms of two important criteria of ideal perforation repair materials which are the sealing ability and marginal adaptation quality.

Review of Literature

Furcation perforation can have a negative impact on the prognosis of the affected tooth. When left untreated, furcation perforation is followed by bacterial invasion, periradicular tissue inflammation, epithelial proliferation and eventual periodontal pocket formation[1-3]. Such chronic inflammatory reaction of the periodontium can lead to irreversible loss of attachment, alveolar bone loss or loss of teeth[4, 5].

The long term prognosis of a perforated tooth is dependent upon the perforation size, location, how long the perforation is exposed to oral contaminants and the ability of the repair material to seal the defect [3, 5].

Techniques and materials used in repair of perforations:

Kulkarni et al. (1997)[6] assessed the effect of calcium sulphate barrier on the extrusion and sealing ability of perforation repair materials. Access openings in a total of 64 recently extracted permanent molars were prepared and perforations were created in the pulpal floor with a # 2 round bur. Moist cotton pellets were passively placed between the roots in the furcation area to simulate moist clinical field. Perforations were repaired with either amalgam (group I), medical grade calcium sulphate as a barrier under amalgam (group II), glass ionomer cement (group III), or calcium sulphate barrier under light cured glass ionomer (group IV). Teeth were submerged in 2% methylene blue for a week at room temperature then washed and sectioned longitudinally in a mesiodistal plane for mandibular teeth and in a bucco-lingual plane for maxillary teeth. Dye penetration was evaluated under a stereomicroscope. Group I showed the statistically significant highest dye penetration (94.82%) while group III showed the statistically significant lowest dye penetration (18.02%). They concluded that the use of calcium sulphate as a matrix material provided successful barrier against over extension of repair material, though the sealing ability of amalgam and glass ionomer was significantly reduced by it. Also, glass ionomer cement over calcium sulphate was considered a better combination if the amount of extrusion and sealing ability of the materials are considered.

Chau et al. (1997)[7] evaluated the repair of furcation perforation using calcium phosphate cement. Forty extracted human maxillary and mandibular molars were used. After access preparation, perforations were prepared in the center of the pulp chamber floor using a #2 round bur in a high-speed handpiece. Teeth were divided into 3 experimental groups (n=10) and 2 control groups (n=5). Perforations in the experimental groups were repaired with calcium phosphate cement (CPC) (group1), light cured glass ionomer (group 2) or light cured glass ionomer placed over a CPC matrix (group 3). Teeth were then coated with two layers of nail polish and kept in 100% humidity and 37°C for 48h to allow for complete setting then immersed in India Ink for 48 h, dried, and sectioned longitudinally for dye penetration evaluation. Results showed that there was no significant difference in the mean extent of dye leakage among the three experimental groups. They concluded that the use of CPC, with its enhanced biocompatibility, potential for osteoconduction, and sealing ability, may improve the prognosis of teeth with furcation perforations.

Imura et al. (1998)[(8)] evaluated in vitro the sealing ability of various materials in the repair of furcation perforations in mandibular molars by measuring coronal microleakage with indian ink. Ninety extracted mandibular molars were embedded individually into plaster of paris blocks, with the roots surrounded by a simulated periodontal ligament of silicone. A standard coronal access opening was prepared, the root canal orifices were located and perforation was made with a size 012 round bur in a water-cooled high speed handpiece directly into the center of the floor of the pulp chamber. The ninety teeth were divided in to 4 experimental groups of 20 teeth each and 2 control groups of 5 teeth each. In the experimental groups; perforations were repaired with amalgam (group 1), resin composite (group 2), calcium sulphate as a matrix under resin composite (group 3), calcium hydroxide as matrix under resin composite (group 4). The teeth were coated with two layers of nail polish, leaving the access opening area uncovered, and immersed in indian ink for 4 days at 37^{o}C. The teeth were sectioned longitudinally and dye penetration measured from the coronal level of the repair material to the apical end of the perforation. The results showed that all experimental groups revealed dye penetration in varying degrees, but there was no significant difference amongst them. Calcium sulphate and calcium hydroxide matrix prevented over extrusion of composite resin when used under the repair material.

Salman et al. (1999)[(9)] evaluated the histological response to resorbable barrier (Atrisorb) when used as a matrix under a resin-modified glass ionomer (RMGI) sealant in the repair of furcation perforations in experimental animals. Thirty-six mandibular posterior teeth with absence of pre-existing periodontal breakdown in the furcation regions in six adult Labrador dogs were used. After anesthesia, pulp extirpation and filling of radicular canals with zinc oxide-eugenol cement, furcal perforations were made in 30 lower premolar teeth with a 1-mm diameter round bur in a conventional handpiece. The perforated teeth were randomly divided into two groups of 15 teeth each. In group 1, teeth were treated with RMGI alone and with resorbable barrier under RMGI in group 2. Six teeth without perforations served as negative controls. Pulp chambers of all teeth were filled with RMGI cement. Animals were sacrificed after 3 months. The teeth and the surrounding structures were processed for light microscopy. Results revealed that there were no significant differences found between histological evaluation for perforations repaired with RMGI alone and barrier under RMGI. They concluded that placement of a resorbable barrier did not result in superior healing for furcation perforations when compared with the use of resin-modified glass ionomer without such a barrier.

Jantarat et al. (1999)[(10)] compared the sealing ability of amaglam and ketac silver in the repair of furcation perforation with and without plaster of paris as a matrix. Seventy-six extracted lower mandibular molars were used. The root tips were resected 3 mm from the apex. After the teeth were prepared and root canals were obturated, a perforation was made in the pulpal floor. Teeth