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COMPARATIVE EVALUATION OF PUSH-OUT BOND STRENGTH OF PROROOT MTA AND CALCIUM PHOSPHATE CEMENT IN FURCATION PERFORATION REPAIR : AN IN VITRO STUDY

Endodontics

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ABSTRACT

Aim: The aim of the study was to evaluate the push out bond strength of mineral trioxide aggregate and calcium phosphate cement when used in repairing furcal perforations with and without blood contamination in permanent molars.

Materials And Methods: A Total of 80 human extracted molars were collected and divided on the basis of perforation repair materials and blood contamination status (n=10).All the materials were subjected to universal testing machine to a load cell from 0N to 100KN at a crosshead speed of 1mm/min.

Statistical Analysis: The data obtained were subjected to stastistical analysis using two-way ANOVA.

Conclusion: The push out bond strength was maximum in MTA uncontaminated with blood and least for the CPC contaminated with blood. A significant difference was found between all the perforation repair materials.

KEYWORDS

MTA, CPC, furcation perforation, push-out bond strength, repair materials.

INTRODUCTION

Successful management of furcation perforations poses a challenge for a clinician[1]. Some procedures carry an inherent risk for complication or procedural accidents during access opening, shaping, and debridement[2]. One of these procedural accidents is endodontic perforation that will effect the prognosis of root canal treatment[3]. An endodontic perforation is an artificial opening in the tooth or its root, created by clinician during entry to the canal system or by biologic events such as pathological perforation or caries, those resulting in a communication between the root canal and periodontal tissue[4]. A furcation perforation refers to a mid- curvature opening into periodontal ligament space which is a worst possible outcome in root canal treatment[4].

An ideal perforation repair material should provide an adequate seal, be biocompatible, radiopaque, and easy to manipulate; induce osteogenesis and have adequate strength against which an intracoronal restorative material could be condensed and tolerates a moist environment[5]. Materials such as calcium hydroxide, amalgam, GIC, hydroxyapatite, MTA, Portland cement are commonly used to manage furcation perforation[6].

MTA, a calcium silicate –based material ,is currently the choice of material in perforation repair. It is bioactive silicate that seals well, even when the cavity is contaminated with blood and proved to have cementogenic properties[7] .Recently calcium phosphate cement has been introduced which can also be used as endodontic repair material[8].

MATERIALS AND METHODOLOGY

80 extracted mandibular molars with no caries and non-fused, diverging roots were used in the study. The teeth were visually inspected using magnification loupes. Teeth with cracks, open apices, root caries, or fused roots were discarded. The teeth were cleaned of debris and stored in normal saline till use.

A standard endodontic access cavity was prepared in each tooth. Teeth were decoronated 5mm above the pulpal floor and the roots were amputated 5mm below the furcation using a water-cooled diamond disk. A perforation was made in the furcation area from the external surface using a high speed long shank round bur #4.Caution was taken to centralize the perforation between the roots (Fig 1). The samples were embedded in a saline soaked sponge placed in a plastic cylinder. Cold-cure resin was applied to stabilize the root in place. An internal matrix of collaplug was placed and compacted beyond the perforation using hand plugger (Fig 2).

The samples were divided into two major experimental groups on the basis of the type of perforation repair material. Each group was further subdivide into four subgroups (n=10) on the basis of setting time and blood contamination status. Two subgroups from each experimental group (1b, 1d, 2b, 2d) were contaminated with freshly drawn human blood, immediately before the placement of repair material. The perforation site was filled with blood (Fig 3). The excess blood was absorbed with a damp cotton pellet. No other special attempts were made to clean the blood from the perforation walls. The remaining subgroups were not contaminated. All samples were repaired using the respective perforation repair material. (Fig 4).

Group I was repaired using proRoot MTA.MTA powder was mixed with the manufacturers supplied liquid until a thick consistency was obtained. The material was packed into the perforation site without any ultrasonic activation. Group 2 was repaired using Calcium phosphate cement (CPC), the material was mixed according to manufacturers recommendations. The freshly mixed CPC had a putty-like consistency and was packed in the perforations using a plastic filling instrument. Wet cotton pellet was placed over the perforations and the specimens were stored in 100% humidity ay 37°C.

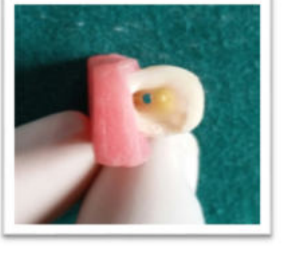


Fig 1.

Fig 2.

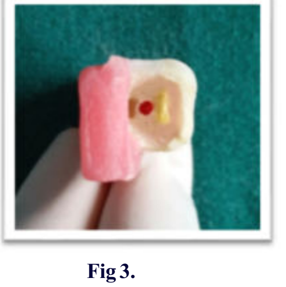


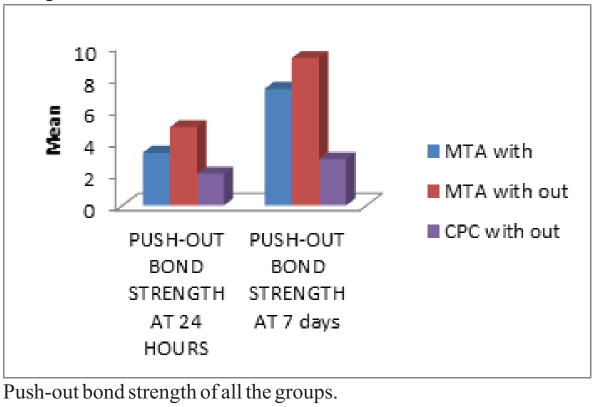
Fig 3.

Fig 4.

After 24h, samples from group 1a,1b, 2a, and 2b were subjected to push-out bond strength measurement. A 1mm-thick cylindrical stylus was attached to the testing apparatus of universal Instron testing machine. The stylus was placed over the perforation repair material and an apico- coronal force was applied. The samples were stressed to failure at a crosshead speed of 1mm/min. The push-out bond strength measurement was based on the methodology described in previously published studies. The remaining samples were subjected to push-out bond strength measurements after 7 days. The values of push-out bond strength were recorded for statistical evaluation .The data were statistically analysed using two-way analysis of variance (ANOVA) test.

RESULTS

The push-out bond strength of all the groups is presented in Fig 5. There was a significant increase in the push-out bond strength of samples with increase of setting time (from 24 hr to 7 days), irrespective of the repair material and contamination status. In both materials an increase in debonding time from 24 hrs to 7 days resulted in an increase in bond strength, which is in consistent with the results of studies carried out by Sluyk et al & Vanderweele et al. In both the materials, contamination with blood significantly decreased bond strength.



Push-out bond strength of all the groups.

DISCUSSION

A perforation, irrespective of location or etiology, hampers the prognosis of endodontic therapy. This mechanical/pathological communication between root canal system and external tooth surface should be sealed with a biocompatible material as soon as possible[5]. The bond strength of furcation perforation repair material to dentine is important for maintaining the integrity of the seal in the furcation area. A furcation perforation repair material should have adequate strength against which intracoronal restorative material could be condensed safely .To assess bond strength, the push-out test is an efficient and reliable method, where a gradually increasing pressure is applied to the material until debonding occurs[6].

In the present study, Pro root MTA was used in group I as perforation repair material. MTA has the property to simulate the cementoblasts to produce matrix for cementum formation and is biocompatible with the pariradicular tissues, thus showing a superior sealing ability when used for perforation repair[9]. After placement of MTA hydroxyapatite crystals nucleate & grow, filling the microscopic spaces b/w MTA & the dentinal wall, initially this seal is mechanical with time diffusion-controlled reaction between the apatite layer and dentin leads to chemical bonding[10]. The blood contamination causes fewer hexagonal crystal formation and general lack of needle-like structure in the mature MTA, as they were rounded and less angular due to which the push-out bond strength of MTA decreases.

Calcium phosphate cement was used in group II, CPC is a mixture of two calcium phosphate compounds. When this is mixed with an aqueous solution it sets into a hard mass, the end product being hydroxyapatite which is the mineral part of vertebrate bone[8]. It has osteogenic properties setting time –Approximately 20 min. The cohesive property makes it suitable to seal a bleeding perforation site, also imparts high surface tension to the mixed cement[11]. Poor mechanical properties of CPC are the main disadvantage of this material. One of the main reasons for the weakness of these materials is their porosity, which makes it easier for micro and macro cracks to run throughout the mass. The pores are approximately 8 to 12 µm in diameter, and after the cement is set, about 43% of the mass is porous[12].

CONCLUSION

Within the limitations of the study, it was concluded that the push-out bond strength of pro Root MTA was significantly greater than CPC. Calcium phosphate cement with its properties of biocompatibility and osteoconduction may be used as a barrier material and not a repair material for furcation perforations.

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