Sealability and Healing Potentiality of Two Different Root-End Filling Materials

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Introduction

The objective of root canal treatment is to eliminate microorganisms from the root canal system and to fill the intracanal space to prevent bacterial colonization that could maintain or evoke an apical pathosis. However, several factors inherent to the endodontic procedures; such as perforations, instrument breakage, calcifications and anatomic anomalies can lead to treatment failure. In some cases, conventional endodontic treatment is not sufficient to solve the problem and a surgical endodontic intervention is required.

Resection of the root-end during peri-radicular surgery results in an exposed apical dentin surface bounded by cementum with a root canal at its center. After ultrasonic root-end preparation, a root-end-filling material is usually placed to seal the root-end cavity preparation. Placement of a root-end filling after root-end resection is mandatory to develop an apical seal. Furthermore, the orthograde gutta-percha filling alone is insufficient to support bone regeneration.

An ideal root-end filling material that fulfills all the needed requirements for endodontic surgery has yet to be found. In the past, different materials such as amalgam, intermediate restorative material (IRM), Super ethoxy benzoic acid (Super- EBA), glass-ionomer cement and composite resin were used.

Mineral Trioxide Aggregate (MTA), a refined “Portland cement,” was found to have less cytotoxic effects and better results with biocompatibility and microleakage protection, giving it more clinical success over traditional root-end filling materials. However, MTA has some drawbacks: handling is difficult, setting time is long, compressive and flexural strengths are much lower than those of dentin and it is quite costly.

Recently, Biodentine™ was introduced as a substitute to MTA. Biodentine offers similar properties to those of MTA where it is claimed to exhibit better consistency and faster setting time. The powder mainly contains tricalcium silicate, calcium carbonate, and dicalcium silicate, the principal components of MTA. The liquid consists of calcium chloride in aqueous solution with an admixture of polycarboxylate. During the setting of the cement, calcium hydroxide is formed.

Many studies tested MTA as a root-end filling material with high clinical outcomes. Concerning Biodentine as an endodontic repair material, the manufacturer claims that it has features that are superior to MTA.

Review of Literature

Success of endodontic treatment mainly relies on complete three dimensional sealing of the root canal system in order to achieve fluid tight seal. However, in certain clinical situations, resolution of periapical pathology through non-surgical approach is unsuccessful. In those situations, surgical intervention is the treatment modality of choice. The basic surgical procedure includes resection of root tip and periapical curettage.

An ideal root-end filling material would adhere and adapt to the walls of root-end preparation, prevent leakage of microorganisms and their toxins into the peri-radicular tissues, be biocompatible, be insoluble in tissue fluids and dimensionally stable and remain unaffected by the presence of moisture.

Part I: Sealing Ability of Root-End Filling Materials

Sealing ability refers to the material's ability to resist microleakage through its entire thickness.

Most endodontic failures occur as a result of leakage of irritants from pathologically involved root canals into the peri-radicular tissues; therefore, a repair material should provide a good seal to an otherwise unobturated root canal or improve the seal of an existing filling material. An adequate apical seal is a major factor for improving endodontic success.

Bates et al, [1] evaluated the sealing ability of MTA when used as root-end filling material. Seventy-six single-rooted teeth were used in this study. Teeth were allocated to three groups and filled with amalgam, Super-EBA and MTA. Teeth were instrumented and obturated. Root-end resection and root-end cavity preparation were performed in each root ultrasonically and retro-filled with the tested materials. Microleakage was evaluated using the fluid filtration method. The results showed that MTA revealed excellent sealing ability comparable with Super-EBA. Microleakage in the MTA group and Super-EBA group was significantly less than microleakage in the amalgam group.

Hachmeister et al, [2] tested the sealing ability and retention characteristics of MTA when placed as an apical barrier at a thickness of 1 mm or 4 mm with and without calcium hydroxide pre-medication in an open apex model. The barriers were challenged with bacteria exposure within a leakage model and displacement forces. In the leakage study, the results showed that 100% of MTA apical barriers showed bacterial penetration compared with 20% of MTA root-end fillings used as controls. The displacement study demonstrated a statistically significant greater resistance to force with a 4 mm thickness of MTA regardless of calcium hydroxide use.

Andelin et al, [(3)] tested the sealing ability of MTA after resection. Forty-six single-rooted teeth were used in this study. After cleaning and shaping, twenty root canals were obturated with MTA placed as root-end filling (Group 1). Another twenty root canals were obturated with gutta-percha and sealer (Group 2). The root-ends of the samples in group 2 received MTA as a root-end filling. The roots were placed in contact with India ink for 48 hours and examined for dye leakage. The results showed that there was no discernible leakage in teeth with resected MTA or those with MTA placed as a root-end filling. They concluded that resection of set MTA does not affect its sealing ability.

Tang et al, [(4)] used a modified Limulus Amebocyte Lysate test for the presence of endotoxin as a tracer and compared the sealing ability of Super-EBA, IRM, amalgam and MTA. One hundred and four single-rooted teeth were used. Teeth were instrumented and obturated. Root-end resection and root-end cavity preparation were performed in each root ultrasonically and retro-filled with the tested materials. Four root-end preparations received Obtura gutta-percha without sealer and served as positive controls. Another four roots were filled with sticky wax and served as negative controls. An additional four roots were prepared as blank controls. The results showed that MTA revealed less endotoxin leakage than IRM and amalgam and leaked less than Super-EBA.