

# Seal Materials as a Retrograde-Fill in an Ultrasonically Prepared Cavity

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## Summary

*The aim of the study was to evaluate the sealing quality of mineral trioxide aggregate (MTA), Super EBA and IRM cement in an ultrasonically prepared cavity using a dye penetrating technique. The experiment was carried out on 35 single rooted permanent teeth. Their roots were treated by a conventional "step back" technique and filled by a cool lateral condensation technique. After hardening in a physiological solution, root-ends were resectioned and a retrograde cavity 1.5 mm in diameter, 3 mm deep was prepared by an ultrasonic tip. MTA, Super EBA, IRM, filled ten samples and a control group of 5 samples were filled by amalgam. A dye was added to the samples, which were left in a testing rood. After reaching tooth transparency, results were noted by a stereomicroscope with the use of a calibrated scale on the ocular. Statistical results indicated that samples filled with MTA had least leakage in comparison to those filled with IRM and Super EBA cement.*

**Key words:** *Ultrasonic, Super EBA, IRM, MTA.*

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## Introduction

During the preparation of a retrograde cavity an attempt is made to smooth the surface area avoiding micro slits in the dentine walls of the root-tip. An ideal preparation could be defined as class I cavity at least 3mm deep, whose parallel walls follow the course of the root canal. Due to limited access, the root's anatomy and tooth's angulations it is dif-

ficult to achieve an appropriate class I preparation by a micro motor during the endodontic surgery.

In order to overcome such shortcomings ultrasonic tips were introduced, which in comparison to a classic micro motor have a number of advantages: facilitated access (the possibility of a horizontal root resection via a small bone crypt). Walls are more parallel and without the smear layer (1). Literature asserts that the efficiency of ultrasonic instruments

strictly depends on power regulation, as efficiency linearly increases with an increase in power.

Number of oscillations is not the only factor which has an impact on efficiency, but also the construction of the tip, especially its angulation and position of the curve (2). Thus ultrasonic instruments are used as a standard tool during the preparation of a retrograde cavity.

Throughout the history of dentistry numerous materials were introduced as root-end files among which amalgam was the one longest used (3). However on the basis of *in vitro* investigations, amalgam marginal leakage was much greater compared to other materials (4, 5), as it cannot bind to dentine. Due to shortcomings such as the initial leakage, secondary corrosion, contamination with tin, susceptibility to humidity, the need to undermine the cavity, discoloration of hard and soft tissues and dispersion of amalgam particles (6), an effort was made to replace it with new materials on the market such as IRM, Super EBA cement and MDA.

The aim of this study was to evaluate the sealing quality of MDA, Super EBA and IRM cement in an ultrasonically prepared cavity using a dye penetrating technique.

## Materials and methods

A sample of 35 single rooted permanent teeth was used in this experiment. Maxillary central incisors and canines from both jaws were used. Sex, age and reasons for extraction are not known. Prior to carrying out the experiment, teeth were kept in 10% formalin. After mechanical cleansing, the teeth were sterilized in an autoclave at 120°C pressure 300 kpa, and safe kept in a sterile physiological solution, to which thymol crystals (Sigma Ltd-Pool, England) were added at 37°C in a thermostat.

The crown was cut at the enamel- cement junction by a fissure diamond bur along with constant water cooling. Length of the root canal was estimated by inserting a Kerr reamer #15 (ISO #15) (Maillefer, Ballaigues, Switzerland). When the instrument's tip passes through the apical foramen, the Kerr reamer is retracted by 1 mm. The obtained length represents the working length. All root canals

were instrumented in the apical part up to K-reamer #40 (ISO #40) while the coronal part was instrumented up to #80 (ISO #80) using step back technique, whilst rinsing with a 2.5% aqueous solution of sodiumhypochloride (NaOCl), applying 10 mm per canal. The opening of the root canal was widened by Gates-Glidden Burs (Maillefer, Ballaigues, Switzerland) Nos. 3 &4. EDTA removed the smear layer formed on the walls of the root canal for 2 minutes. All samples were then rinsed in 2.5% NaOCl solution and dried by an air jet and paper points (Johnson&Johnson, Slough England).

The samples were filled by the cool lateral condensation technique using standardized guttaperchas (Maillefer, Ballaigues, Switzerland). AH Plus filler (Dentsply, DeTrey, Konstanz, Germany). Guttapercha stick which corresponded to the width of the final K-reamer by which the apical part was instrumented was dipped in the paste. The apical-coronal movement of gutta-percha equally distributed the paste along the canal and squeezes out air bubbles. A guttapercha stick was inserted up to the previously determined depth. Thereafter a manual plugger # was inserted into the canal. (Anataeos, Munich, Germany). Master gutta-percha was pressed epically and on the side. After removing spreader extra gutta-percha no. 25 was added in the newly formed space. The technique was repeated until the spreader would not enter the coronal part of the canal for more than 2 mm. Surplus gutta-percha was removed by a manual instrument that was initially inflamed. The filling was additionally condensed by a cool plugger. Once filled, samples were immersed in a sterile physiological solution with thymol crystals for 15 days at 37°C until complete hardening.

### Preparation of the retrograde cavity

An ultrasonic apparatus PIEZON Mater 400 (EMS, Nyon, Switzerland) with frequency of 32KHz and its integrated system for cooling (distilled water) or irrigation was used when preparing the retrograde cavity.

Root ends were resected by a fissure bur that was perpendicular to the longitudinal axis of the tooth. A 3 mm deep and 1.5 mm wide retrograde cavity was accomplished by an ultrasonic tip. The cavity depth was controlled by a finger plugger, marked at 3mm length by a waterproof felt pen.

Of the total 35 samples a sample of 10 were filled with MTA, Super EBA cement and IRM while 5 samples were the control group and were filled with amalgam.

Samples were kept in a sterile physiological solution for 15 days at 37°C.

Each tooth was singularly placed in a testing rod with the addition of a dye (Drawing ink blu-Rotring GmbH Hamburg, Germany). Storing it for a period of 7 days. The samples were rinsed by water jet and the varnish removed by a scalpel. The "clearness" process was then carried out by demineralising the teeth in 5% nitric acid for 24h, dehydrating them in 80% ethylalcohol for 24h, in 90% ethylalcohol 3 times, each for a period of 1h and in absolute ethyl alcohol for 1 hour. Finally the samples were immersed in methyl salisilate (Sigma, Deisenhofen, Germany). The stereomicroscope (Zeiss/SV6, Jena, Germany) records penetration of the dye and data in mm is obtained by a calibrated scale on the ocular.

## Results

Descriptive measures of dye penetration on the examined material in an ultrasonically prepared cavity are presented in Table 1. Figure 1 shows a minor leakage is with MTA and relatively high leakage with amalgam (Control group). MTA shows an approximate symmetric distribution and a left asymmetric distribution with IRM and Super EBA.

## Discussion

Materials used for retrograde seal of cavities are often used as part of periradicular endodontic surgery. Failures which occur are mainly linked to irregular preparation of the retrograde cavity and to the characteristics of the material used. This study evaluates the seal quality of 3 materials for a retrograde seal: Super EBA, IRM, MTA.

MTA showed the best seal, although no significant statistical differences were determined between the other two materials.

MTA is a material, with a powder made up of fine hydrophilic particles 3-calciumoxid, 3-calciumsilicate, 3-calciumaluminat, and silicateoxid.

In a smaller amount it consists of other mineral oxides that affect its chemical and physical characteristics. Due to high pH value of MTA, like calcium hydroxide it also has an affirmative effect. MTA in contact with periradicular tissue forms a fibrous connective tissue and cement, causing low inflammation. Regeneration with a new cement is a unique phenomena, which is not apparent in other materials for root filling (7, 8).

The mechanism of cement formation by MTA is not completely clarified. It is possible that MTA activates on cementoblasts producing matrix required for cement formation. Its disadvantages are difficult handling and prolonged hardening time (2). After initial hardening the material is kept in a sterile physiological solution for 15 days, during which MTA hydration and decrease in leakage may occur. The limitation of MTA is the prolonged hardening time up to 4h (8), which hinders its use during an endodontic surgical procedure, although it is claimed to have good characteristics for facilitating periapical tissue healing.

Sutimuntanakul and associates (9) compared dye penetration for 5 materials and obtained best results with Super EBA cement in ultrasonically prepared cavities. Super EBA is a zinc-oxid eugenol, reinforced by aluminum oxide with the addition of orthobenzoic acid allowing a decrease of eugenol in the material and thus causing it to be less aggressive (10).

This cement has a neutral pH value and low melting properties. Its disadvantage is limited ability for manipulation due to faster hardening time. Super EBA, also has no capability of dentine adhesion, i.e. the capability to chemically bind to dentine (11). Results are confirmed by Bondra et al. (12) and O'Conner et al. (13). They reported that Super EBA cement was statistically a better close than amalgam and composit. In their investigation Bondra et al did not determine statistically significant difference between IRM and Super EBA porosity.

Results of this investigation confirm those of Bondra et al.