ABSTRACT

Recently a mixture of a tetracycline isomer, an acid, and a detergent, combined in a product called MTAD has been suggested as a final rinse to remove the smear layer from the surface of instrumented root canals. The purpose of this study was to investigate the influence of MTAD and alternate use of EDTA and MTAD with NaOCl on the apical microleakage of obturated root canals. In this study 60 maxillary central incisors were decoronated at cemento-enamel junction. The roots were divided into six groups of ten teeth each according to irrigation regimens used during preparation of root canals as follows: Saline, NaOCl, MTAD, NaOCl / EDTA, NaOCl / MTAD, and NaOCl / EDTA / NaOCl. After cleaning and shaping, roots were obturated with gutta percha and Endofill root canal sealer using lateral condensation technique and incubated at 37°C for 48 hours. The roots were coated by nail varnish and immersed in india ink then rendered clear by using 10% nitric acid and methyl salcilate. Dye-penetration extent was measured using stereomicroscope. The results of this study showed that roots irrigated with NaOCl / MTAD had a significantly least mean extent of dye-penetration values compared with all irrigating regimen except NaOCl / EDTA. In conclusion the final rinse with either MTAD or EDTA following 2.5% NaOCl irrigation could reduce the root apical microleakage.

INTRODUCTION

The main objectives of root canal therapy are removal of diseased tissue, elimination of microorganisms present in the canals and dentinal tubules, and prevention of recontamination after treatment. The current techniques of root canal debridement produce smear layer and leave some areas of the root canal system completely untouched by the instruments.

The smear layer is formed of inorganic and organic substances, which include fragments of odontoblastic processes, microorganisms and necrotic materials. Whereas the smear layer itself may be infected, it also may protect the bacteria already present in the dentinal tubules from the action of the antimicrobial agents. Its removal from infected root canals may lead to better penetration of intracanal medications into the dentinal tubules and more effective disinfection of the root canal system.
The most popular and advocated irrigant is sodium hypochlorite (NaOCl). It has several properties that contribute to achieve chemical debridement of the root canal system. NaOCl has an antibacterial and lubricant effect, and has the capability of dissolving tissue remnants and flushing out loose debris but it does not remove the smear layer from the dentin wall. Currently, a combination of solutions such as ethylene diamine tetra-acetic acid (EDTA) and NaOCl is used to remove the smear layer from root canal walls.

Some Studies suggested that removal of smear layer reduces apical leakage after obturation. Even though the treatment with EDTA may leave a chelated layer of dentine at the dentine-root filling interface. Residual EDTA inside the dentinal tubules, which was measured to be up to 3.8% of the originally applied volume, may contribute additionally to ongoing demineralization, resulting in further increase of apical leakage. Residual EDTA also may interact with the sealer, which has been demonstrated with zinc-oxide eugenol containing sealers. Because of these limitations, a search for a better root canal irrigant is not stopping.

Various acids, ultrasonic instruments, and lasers have been tried to remove the smear layer. Recently a mixture of a tetracycline isomer, an acid, and a detergent, combined in a product called MTAD has been suggested as a final rinse to remove the smear layer from the surface of instrumented root canals. The experimental studies showed many favorable results of MTAD, as it has the ability of dissolving inorganic and organic content of dentin, and to remove the smeared layer completely. It also has been shown to have low degree of cytotoxicity.

The controversial suggestions about the effect of removal of smear layer on apical microleakage using different irrigating solutions may need more research to study their effect and to reach the most suitable regimen of irrigation. Accordingly this study was conducted to investigate the influence of MTAD and alternate use of EDTA and MTAD with NaOCl on the apical microleakage of obturated root canals.

**MATERIALS AND METHODS**

Sodium hypochlorite (NaOCl) at 2.5%, 17% EDTA, MTAD (Dentsply, Tulsa) were used in this study as intracanal irrigants. Sixty recently extracted human maxillary central incisors were used in this study. After cleaning they were rinsed and stored in thymol till time of experiment.

The crowns of the teeth were decapitated at the cemento-enamel junction with a diamond disk under water coolant. The roots were randomly divided into six groups of ten teeth each according to irrigation regimens used during preparation of root canals as follows:

**Group I:** (Saline) Irrigation with 1 ml saline was used after each file.

**Group II:** (NaOCl) Irrigation with 1 ml of 2.5% NaOCl was used after each file.

**Group III:** (MTAD) Irrigation with 1 ml of MTAD solution was used after each file.

**Group IV:** (NaOCl / EDTA) Irrigation with 1 ml of 2.5% NaOCl was used after each file followed by a final rinse with EDTA for 3 min at the end of instrumentation.

**Group V:** (NaOCl / MTAD) Irrigation with 1 ml of 2.5% NaOCl was used after each file followed by a final rinse with MTAD for 3 min at the end of instrumentation.

**Group VI:** (NaOCl / EDTA / NaOCl) Irrigation with 1 ml of 2.5% NaOCl was used after each file followed by irrigation with EDTA for 3 min and a final rinse with NaOCl for 2 min.

The working length of all roots was visually determined by subtracting 1 mm from the length of a size 15 K-file (Dentsply, Maillefer, Ballaigues, Switzerland) at the apical foramen. All roots were prepared at the coronal two thirds using size 2-4 Gates Glidden burs (MANI, INC, Japan) followed by apical preparation using step-back technique to the size 50 K-file. Final flush of root
canal of all groups were performed with 5 ml distilled water to remove any traces of irrigants and dried with paper points. The roots were obturated with gutta percha and Endofill root canal sealer using lateral condensation technique and the root canal orifices were filled with Cavit and then were kept in an incubator at 37°C and 100% humidity for 48 hours to ensure complete setting of the sealing cement.

Assessment of Apical microleakage

Dye penetration and clearing Technique

The external surfaces of all roots were coated by two successive layers of nail varnish except the apical 2 millimeters. The roots were held vertically with the help of meshwork in a plastic box containing 2 mm depth of India ink, so that only the apical 2 mm of each root were immersed in the dye. The roots were left in the dye for three days, after which they were removed, washed and the nail varnish was removed with scalpel. The roots were subjected to decalcification using 10% nitric acid for 3 days, followed by washing with tap water to remove remaining acid. After that, the roots were dehydrated in increasing alcohol concentrations (60, 70, 80, 90 and 100%) and immersed in methyl salicilate, to render it transparent, until the time of image analysis. The binocular stereomicroscope (Olympus Zoom Stereomicroscope, Sz 40-45, Japan) were used to measure extent of dye-penetration up to the most coronal mark in millimeters (at magnification of X20). The data were collected and subjected to statistical analysis using ANOVA and LSD tests.

RESULTS

The apical microleakage was presented as mean extent of dye-penetration in millimeters. Roots irrigated with NaOCl / MTAD had the least mean extent of dye-penetration values (1.5 mm ± 0.577). In increasing order, it was followed by NaOCl / EDTA (2.440mm ±0.702), MTAD (2.888mm±1.059), NaOCl (3.125 ±0.85), Saline (3.570±1.1) and finally NaOCl / EDTA / NaOCl with the highest extent of dye penetration(3.760mm ± 0.898) Fig. (1) One way ANOVA test showed significant difference among groups (p < 0.05). LSD test showed significant difference between group V and groups (I, II, III and VI). The test also showed significant difference between group IV and group VI. Representative photographs of the extent of dye-penetration in each group are shown in (Fig. 2).
DISCUSSION

Recently, an alternative endodontic irrigant containing 3% doxycycline, 4.25% citric acid and 0.5% tween 80 detergent is being commercialized as Biopure MTAD. This irrigant is recommended to be used as the final rinse after initial rinsing with NaOCl. Based on extensive, well-conducted studies, MTAD has been shown to be a clinically effective, biocompatible, and a less erosive endodontic irrigant with potential sustained antibacterial activity.

Accordingly, this study was conducted to investigate the influence of MTAD and alternate use of EDTA and MTAD with NaOCl on the apical microleakage of obturated root canals. The clearing technique used in this study for evaluating apical microleakage showed a good three-dimensional view of the root canal system; so that, measuring the apical leakage of ink around the filling was facilitated and comparison between the groups using different irrigating regimens became easier.

The results of apical microleakage indicated that root canals irrigated with NaOCl / MTAD results in the least leakage among all regimens used. This reduction in leakage may be attributed to increased surface contact between the dentin and the sealer, and penetration of obturation materials into the open dentinal tubules. This proper adaptation may be related to previously proved very high capability of MTAD in removing the smear layer. Also, the presence of lubricant (Tween 80) as a part of MTAD gives MTAD low surface tension which improves the intimate contact of irrigants with the dentinal walls of the root canal system even in the apical third. However, there was no significant difference of apical leakage between root canals irrigated with NaOCl / MTAD and root canals irrigated with NaOCl / EDTA. This lack of difference in leakage value may be related to that both MTAD and EDTA showed almost complete removal of smear layer.

The results of previous studies were in accordance with our finding. They indicated that root canals irrigated with NaOCl between each instrument and EDTA as final rinse has less apical microleakage than those irrigated with either saline or NaOCl. Also, several studies of coronal microleakage indicated a reduction of leakage using EDTA or MTAD as a final rinse following NaOCl.

In contrast to our results, other investigators showed that there is no significant improvement in microleakage after removal of smear layer. Timpawat and coworkers are the only investigators who have reported that removal of the smear layer has adverse effect on microleakage of obturated root canals. These conflicting results might be because of differences in types of sealers and obturation techniques, means of producing a smear layer, and the diversity of methodologies used to assess microleakage under various laboratory conditions.

On the other hand, canals irrigated with NaOCl / EDTA / NaOCl showed maximum leakage values. This may be attributed to the action of EDTA which is not selective for the smear layer. Its demineralizing effect also acts on the walls of root canals and these demineralized matrices produced by EDTA are removed by NaOCl when used as a final rinse. This procedure inadvertently creates highly irregular, eroded canal dentin surface which may prevent proper adaptation of the filling material to the canal wall. Under the condition of this study, the final rinse with either MTAD or EDTA following irrigation with 2.5% NaOCl could reduce the apical microleakage of obturated root canals.

REFERENCES


