The difference of 17% ethylenediaminetetraacetic acid irrigation material contact time of 60 seconds and 30 seconds toward of cleanliness of apical third root canal wall

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ABSTRACT

Root canal preparation is one important step in endodontic treatment, involves the cleaning and the shaping of the root canal debris. Root canal cleaning effectiveness depends on the preparation bio-mechanical and irrigation. Purpose of this study was to evaluate the cleanliness of apical third of root canal wall from of debris, with contact time of 17% EDTA irrigation material for 60 seconds and 30 seconds after root canal preparation using with rotary NiTi instruments. This quasi-experimental study was carried out invitro, with random sampling technique. The sample used was 20 central maxillary incisors that has been extracted, and divided into two experimental groups of 10 teeth each. The results were analyzed using student t statistics, showed that the average value of the debris of the two groups differed significantly. Contact time of 60 seconds of 17% EDTA showed cleaner root canal than the 30 seconds. The conclusion of this study was there were the differences of the cleanliness of apical third of the root canal with the 60 seconds contact time of 17% EDTA irrigation materials than 30 seconds contact time.

Key words: Contact time, EDTA, cleanliness of the canal wall

ABSTRAK

Preparasi saluran akar merupakan salah satu tahap penting di dalam perawatan endodontik, meliputi pembentukan dan pembersihan saluran akar dari debris. Keefektifan pembersihan saluran akar tergantung pada preparasi biomekanis dan irigasi. Tujuan penelitian ini untuk mengevaluasi kebersihan 1/3 apikal dinding saluran akar gigi dari debris, dengan lama waktu kontak bahan irigasi EDTA 17% selama 60 detik dan 30 detik setelah dilakukan preparasi saluran akar dengan rotary NiTi instrumen. Jenis penelitian ini adalah eksperimental semu yang dilakukan secara in vitro dan teknik pengambilan sampel dilakukan secara acak. Sampel yang digunakan adalah 20 gigi insisif pertama rahang atas yang telah dicabut, kemudian dibagi menjadi 2 kelompok percobaan masing-masing 10 gigi. Hasil penelitian yang diperoleh dianalisis dengan uji kesamaan dua rata-rata menggunakan statistik t student, menunjukkan nilai rata-rata debris kedua kelompok berbeda secara bermakna. Waktu kontak EDTA 17% selama 60 detik memperlihatkan hasil yang lebih bersih dibandingkan dengan 30 detik. Simpulan penelitian ini adalah waktu kontak bahan irigasi EDTA 17% selama 60 detik di dalam 1/3 apikal dinding saluran akar lebih bersih daripada waktu kontak 30 detik.

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Kata kunci: *Waktu kontak, EDTA, kebersihan dinding saluran akar*

INTRODUCTION

Root canal preparation is one of the important stages in the principles of endodontic treatment, involves the shaping and cleaning of the root canal from debris.[1,2] Root canal preparation results in the formation of smear layer attached to the surface of the canal wall.[2-5] Smear layer is a bacterial film that can inhibit the root canal disinfection and block the bonding between the root canal wall and root canal filling.[6] This layer will form two zones, the first layer with a thickness of 1-2 μm consists of organic material and dentin particles, while the second layer extends into the dentin tubule with a depth of 40 μm to form a larger dentin chips called the smear plug.[6,7]

Eliminating the smear layer produced root canal wall is more refined, so the ability of adhesion and closure of the root canal filling material, as well as the penetration of root canal filling material into the dentin tubule and lateral channels increase.[5,6,8] Cleaning of the smear layer is by applying irigation solution that is able to clean organic and inorganic debris with minimal toxicity for root canal preparation.[4,9]

Over the past 2 decades, endodotic experts stated that endodontic irrigation is one of the important thing in the success of endodontic treatment.[2,5,10,11] Root canal space that can not be cleaned mechanically, can be cleansed by means of irrigation.[10,12] The solution must be able to reach the apical part of the root canal to get the maximum capacity of an irrigation solution.[10] A single solution cannot act simultaneously and continuously in removing organic and inorganic tissue elements, therefore it needs to be in combination with the use of several types of irrigation solutions.[6]

Sodium hypochlorite has been used as an irrigation solution during root canal treatment, and demonstrated its ability to clean up organic debris and has antibacterial properties, but not effectively in cleaning smear layer produced during root canal preparation.[4,5,9,13] Irrigation materials ethylenediaminetetraacetic acid (EDTA) removes the smear layer but not effectively agains organic debris.[2,6,13] Combination of NaOCl and EDTA is widely recommended to clean the remaining pulp tissue and smear layer from the root canal wall surface.[2,5,9,13]

EDTA is the irrigation material used after root canal preparation. It is useful to open the dentin tubule, thereby allows obturating material reaching lateral canals.[5,9] Previous research showed existence of an aggressive effect on root canal wall causing erosion and degradation of peritubular and intertubular dentin.[9] Dentinal wall erosion may occur in prolonged irrigation with EDTA.[9] Some studies show that the effect on dentin depends on the length of contact time of EDTA. To prevent the effect of dentin demineralization caused by EDTA, the length of time of EDTA must be considered.[9] One milliliter of EDTA applied for 1 minute was reported to be effective to remove smear layer and open dentinal tubules if the liquid is in contact with the canal wall surface.[14,15] The purpose of this study was to evaluate the difference of 1/3 of apical root canal wall cleanliness on the length contact time of 60 seconds and 30 seconds using 17% EDTA irrigation materials.

METHOD

This study was a quasi-experimental study, in vitro, with 20 randomly taken samples. The populations were the extracted maxillary first permanent incisors with the following criteria: single-rooted teeth, root curvature ≤ 20°, fully formed apices, no fracture lines, no root resorption, no root surface caries, no endodontic treatment, and K-file #10 was able to pass the root tip.

Materials and equipments needed included: 20 maxillary first permanent incisors that meet population criteria, 2.5% NaOCl, 17% EDTA, the root canal lubricant, sterilized distilled water, paper cone, baseplate wax, plaster of paris, sterile cotton, 0.9% physiological saline solution, 20 pieces of small plastic containers, Endomotor *X-mart*, K-file #10, *Pro Taper* rotary file Sx, S1, S2, F1, F2, and F3, *Endobox, Endoblock,* tweezers, straight explorers, Chisel & mallet high speed handpiece, round diamond bur, fissure diamond bur, carborundum separating disk, Maxiprobe R #30, Glass bottle to soak teeth, a plastic box to

store the extracted tooth, ruler, black marker, microscope SZX12 stereo, plastic filling instrument, stop watch, measuring glass, tape, mixer, tags, *nierbeken*, and gloves.

Surface of the 20 sample root were cleaned beforehand using scalers, then soaked in physiological saline solution and washed under running water. Cementoenamel junction (CEJ) border was marked and cut used a carborundum separating disc.

Determination of the working length was measured by using the file SS #10, then each tooth was buried in the wax and white plaster. The root canal was shaped using a rotary nickel titanium *Pro Taper* file on X-mart machine using crown down technique, starting from file no. S1, S2, F1, F2, to F3. Prior to each file replacement, irrigation with agitation of 2 ml of 2.5% NaOCl for 15 seconds was carried out by Maxiprobe #30 attached to a syringe. Shaping process was conducted using 1 drop of lubricant EDTA peroxide on each file. After completion of the shaping, teeth were divided into 2 groups.

In group A, solution of EDTA was applied into the root canal and left in place up to 30 seconds. In Group B, solution of EDTA was applied in the same way for 60 seconds. At the last stage, the entire root canals (Group A and B) were rinsed with 2 ml NaOCl for 15 seconds, followed by 2 ml of sterile distilled water for 15 seconds, then dried with a paper cone F3. The orifice of each tooth was then covered with a sterile cotton pellet and each tooth was applied into the a sealed plastic container.

A line was drawn on all samples, to mark its buccopalatal, then scratches were made following the lines with a diamond fissure bur. The roots were cut into 2 parts by using a chisel and mallet. Each hemisphere of each tooth was selected and prepared for examination with a stereomicroscope.

Data were collected through checking the canal wall hygiene on the third apical (4 mm from the tip of apex) using a modified scoring method of Wu and Wesselink.[16] The images of each sample generated through stereomicroscope with 24 times magnification on the monitor screen was checked by using an area of grids calculated by using the formula. Point 0 on the grid was placed at the tip of the apex, the vertical line of the grid was placed parallel to the long axis of the tooth, and the 4 mm line parallel to the horizontal grid lines. Score of debris according to Wu and Wesselink[16] was rated with the certainty that each particle was expressed as the debris in the root canal. Scoring was determined as follows: Score 0, debris does not intersect horizontal line; Score 1, debris intersects horizontal line but it does not intersect vertical line; Score 2, debris intersects horizontal lines and intersects one vertical line; and score 3, debris intersects horizontal line and intersects two vertical lines.

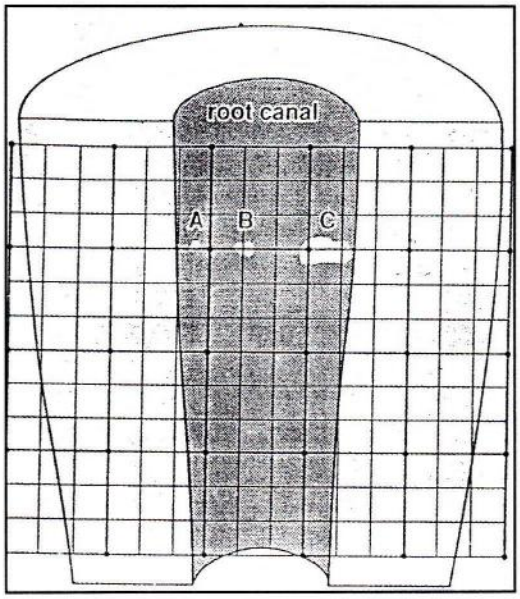

Figure 1. Scoring of debris in the root canal wall (Note: (*) was a number of squares with debris)

In the Figure 1, total score of debris in the root canal was: A was a score of 1; B was a score of 2; C was a score of 3, and the number of boxes in the root canal debris was occupied by A was 2 boxes; B was 4 boxes; and C was 4 boxes. Thus, the debris found on the canal wall was:

$$\frac{\text{Number of debris score in the root canal}}{\text{Number of * in the root canal}} = \frac{1+2+3}{10}\frac{6}{10} = 0.6$$

Averaged values of the cleanliness of root canal walls for each group was collected and the calculation of the debris generated by the two treatments was obtained. The average equality of two group of data was performed using the student t-statistic.

RESULT

The cleanliness of the canal wall on each tooth was checked at the apical third (4 mm from the tip of apex), two examples of the canal wall

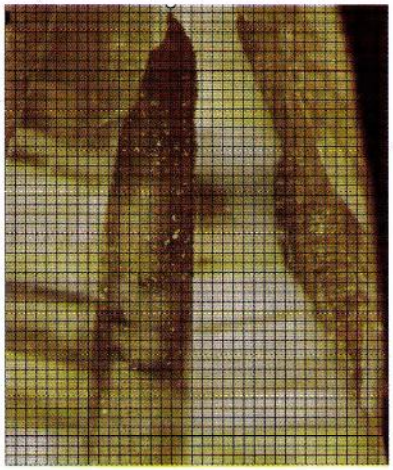

Figure 2. Stereomicroscope image of apical third of root canal that has been given a 17% EDTA for 30 seconds, with the debris: 9/66 = 0.14 (sample A3).

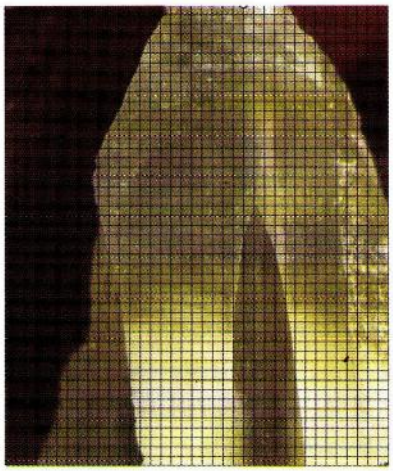

Figure 3. Stereo microscope image of 1/3 of apical root canal tooth that has been given a 17% EDTA for 60 seconds, with the debris: 1/16 = 0.06 (sample B9).

surface were visualized under by a stereo microscope was shown in Figure 1 and 2. Two pieces of the tooth samples represent each treatment. The value of debris of every tooth in each group was calculated twice by two different operators, the final result was the average value of the first and the second operator's result. The statistic calculations showed that the test results were significant, which mean that both kinds of treatment presents significantly different debris.

Application of EDTA for the 60 seconds and 30 seconds contact time gave an average value of 0.11 and 0.23 debris respectingly. This indicated the difference in apical third of root canal wall cleanliness at the 60 second and 30 second contact time of 17% EDTA. Visualization of debris reduction shown in the Figure 3.

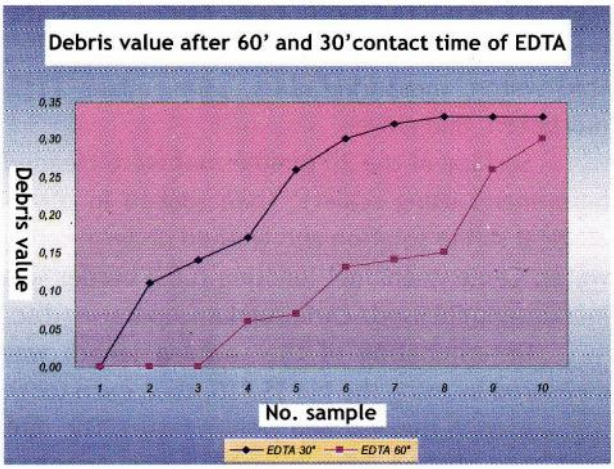

Figure 3. Diagram of debris value area of apical third of root canal (Note: black, 17% EDTA treatment applied for 30 seconds; pink: 17% EDTA treatment applied for 60 seconds).

DISCUSSION

Researchers and practitioners stated that successful endodontic treatment was supported by several factors, among which is the root canal irrigation.[3,5,10,17] Each root canal system has a space that was not able to reached by mechanical instruments, especially in the third apical. Effective irrigation is one of the solution that can be carried out to achieve root canal cleanliness especially in the apical third.[3,10,18] Previous researchers suggested that the combination of irrigation using sodium hypochlorite and EDTA gives a good results.[2,5] According to Surapipongpuntr et al.[14] sodium hypochlorite irrigation is known as the most preferred non-specific proteolitic solution because of its organic tissue dissolving properties, an antibacterial and lubrication effects. EDTA was one of the irrigation materials that effectively eliminate the debris accumulation in root canal preparation. In this study, an assessment of a cleanliness of canal wall on the apical third was obtained to calculates the debris after irrigation with 2.5% NaOCl, and EDTA 17% at length contact time of 30 seconds and 60 seconds.[14]

The result of the debris score in a sample group treated with EDTA solution for 30 seconds (A) was compared with a sample group for 60 seconds (B) showed significant value of debris. There was one of 10 samples in group A that has no debris on apical third of the teeth, whereas there were 3 of 10 samples in group B with no debris on the same particular areas.

Effectiveness of irrigation is related to the length of EDTA contact time, pH, and concentration. The recommended time for removal of smear layer was 1-5 minutes.[19] Teixeira et al.[16] suggested that the length of contact time with the EDTA solution on root canal wall may be varied, therefore there were several researches conducted nowadays to prove the effect of time in removing smear layer. The researchers suggested that the contact time of 10 ml of EDTA solution for 1 min was adequate to remove the smear layer and the contact time of 10 minutes led to excessive erosion of peritubular dentin and intratubular dentin.[15,20]

Teixeira et al.[16] suggested that removal of smear layer at the apical third region was quite difficult. But according to Nakashima et al.[18], the used of EDTA 30 seconds was quite good, although the smear plug in some specimens were noted. According to Surapipongpuntr et al.[14] irrigation with 1 ml of 17% EDTA for 1 minute quite adequately removed a smear layer, opened tubule, and produce a clean surface. From the current research, the results of 17% EDTA irrigation for 60 seconds showed the better results compared to 30 seconds, while only 3 of 10 samples showed free of debris. In general, all the sample with the contact time of 60 seconds showed a lesser value than those of the contact time of 30 seconds.

Teixeira et al.[16] showed that the association of EDTA and NaOCl irrigation solution has proven to be effective in smear layer removal formed during root canal preparation. The smear layer can lead to a leakage in the apical and coronal root canal after root canal obturation. This can be explained by Teixeira et al.[16] in his research that the removal of smear layer completely lead to sealer penetration into the dentinal tubule. Other researchers also pointed out that when the smear layer was removed, the sealer penetration into dentinal tubule couldn't be achieved.[6]

Effective use of EDTA on smear layer, causing decalcification of peritubular dentin and intertubular dentin, and leaving the threads of collagen around the dentinal tubule. According to Teixeira et al.[16] the use of NaOCl after EDTA dissolved the collagen strands and lead to more open dentinal tubule. In addition to the reasons above, the use of NaOCl after EDTA was completed would neutralize EDTA that much actively work on the root canal for 5 days. Demineralization of EDTA which is not neutralized may lead to the opening of apical constriction and the solution may get into the periapical tissues and damage the periapical bone.[6,21]

CONCLUSION

The differences in apical third of root canal wall cleanliness depends on the contact time of 60 seconds and 30 seconds of 17% EDTA irrigation material. Further research on the length of contact time of 17% EDTA of 60 seconds its strongly suggested and its association with dentin erosion.

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