

Contribution of EDTA and Shaping Technique in the Quality of Teeth Cleaning Infected: *In Vitro* Study

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Abstract

Study objective: The aim of our study was to compare the effectiveness of EDTA cleaning gel to 17% when combined with sodium hypochlorite (NaClO) to 2.5% during canal preparation, with respect to the use of NaClO alone. By using two preparation techniques, the manual technique using manual files steel and continuous rotation with the Hero-shapers system.

Materials and methods: The study was conducted *in vitro* on infected teeth, freshly extracted single rooted. All teeth were carefully cleaned and sectioned at the JCD.

On each tooth, a bacteriological sample was taken before and after treatment canal with sterile paper points and analysed according to microbiological standards.

The study was conducted on a total of 84 teeth randomly divided into 4 groups of 21 teeth each as follows:

The first group was prepared manually with steel instruments and received sodium hypochlorite at 2.5% as irrigating; the 2nd group was manually prepared with the instruments steel and received sodium hypochlorite at 2.5% associated with EDTA gel at 17% as irrigating; the 3rd group was prepared with rotary instruments Hero Shaper and received sodium hypochlorite at 2.5% as irrigating; the 4th group was prepared with rotary instruments Hero Shaper and received sodium hypochlorite at 2.5% associated with EDTA at 17% as irrigating. The results of bacteriological analysis were processed using Epi Info 3.3.2 software, retained significance index $p < 5\%$.

Results: 23% of germ eradication for the teeth of the first group, 56% for the 2nd group, 47% for the 3rd group and 68% for the 4th group.

Conclusion: The use of a chelating agent undeniably improves the quality of cleaning of the root canals, compared with the use of only sodium hypochlorite.

Keywords: Endodontic infection; Continuous rotation; Irrigation canal; EDTA

Introduction

The main goal of any endodontic treatment on an infected tooth is the elimination as complete as possible ductal contents (necrotic pulp, necrotic debris, smear layer, microorganisms ...), so as to achieve the closest possible level total aseptic [1].

This goal can only be achieved by the mechanical action of the instruments that ensure the shaping of the canal, combined with the chemical action of irrigation solutions. Sodium hypochlorite "NaClO" remains the solution of choice thanks to its solvent power and its antibacterial action; unfortunately it has no effect on the mineral fraction of the canal which is why it must imperatively be associated with a chelating agent either during canal preparation or in final rinse [2].

Endodontic instruments which are used, whether manual or rotating have a purely mechanical role to expand the canal, to optimize the penetration of irrigation solution and allowing it to act in depth and dissolve the existing canal content and the layer of smear layer (SM) is generated by the instrumental action [3]. SM is amorphous microscopic layer of 1 to 6 microns thick made mainly of mineralized dentin debris, necrotic debris from the pulp and microorganisms, this smear layer has the ability to be compacted in the dentinal tubules, to a depth of up to 60 microns. Its elimination is therefore essential to have a better quality cleaning and prevent secondary bacterial growth that could hinder the prognosis of endodontic treatment [4,5].

The aim of our study is to compare the degree root canal disinfection obtained after irrigation NaClO alone, or in combination with EDTA 17% gel, this by using 2 different root canal preparation techniques, the manual with instruments steel and the other rotary with Hero Shaper.

Materials and Methods

The study was carried out *in vitro*, over a period of three months. In total 84 single-rooted teeth freshly extracted, having a diagnosis as pulp gangrene with or without periapical reaction, were randomized into 4 groups of 21 teeth each. The first group was manually prepared and received only 2.5% NaClO as irrigating, the 2nd group was manually prepared and was irrigated with 2.5% NaClO associated with gel EDTA 17%, the 3rd group was prepared in continuous rotation and received only 2.5% NaClO as irrigating, the 4th group was prepared in continuous rotation and was irrigated with 2.5% NaClO associated EDTA gel at 17%.

Each tooth once extracted, immediately cleared of all traces of blood and tartar, the crown is then sectioned with a diamond disk. Near a beak benzene, a bacteriological sample was performed as follows: with a sterile syringe, is deposited inside the canal a few drops of sterile saline, using a K-file # 15, is catheterized the canal, while performing scraping movement at the walls, are successively introduced 2-3 paper spikes 15/100 to suck the canal contents, the spikes are immediately placed in a petri dish containing blood agar [6].

Once the performed root canal treatment, the canal is thoroughly irrigated with saline solution to remove any trace of antiseptic. A second bacteriological sample is then performed using the same protocol. The petri dishes are then incubated for 48 h at 37°C in an anaerobic jar. A bacteriological study quantitative and qualitative referred was performed according to standard molecular microbiology [7,8]. Analysis of the results was performed with the software Epi-info3.3.2.

Results

We recorded 40.5% of total eradication of germs in manual technique, against 59.5% in continuous rotation (RC), (Tables 1-3) with more significant decrease in bacterial load for the latter (Figures 1 and 2).

Preparation technique	Total eradication of germs	Persistence of germs
Manual	40.50%	59.5%
RC	59.50%	40.5%
Total	100%	100.0%

Table 1: Percentage of germ eradication and persistence in manual technique and RC.

Quantitative aspect	Before treatment	After treatment	Total
-	0	43	43
+	3	25	28
++	6	0	6
+++	14	4	18
++++	63	14	66
Total	86	86	161

Table 2: Quantitative aspect of bacterial cultures before and after treatment in manual technique.

Quantitative aspect	Before treatment	After treatment	Total
-	0	56	56
+	2	18	18
++	5	0	5
+++	12	0	12
++++	55	0	55
Total	74	74	146

Figure 3: Percentage eradication and persistence of germs according to the preparation technique and method of irrigation.

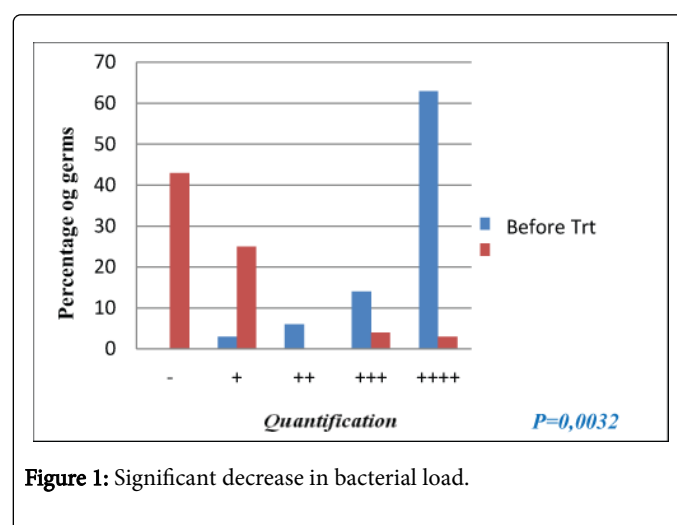


Figure 1: Significant decrease in bacterial load.

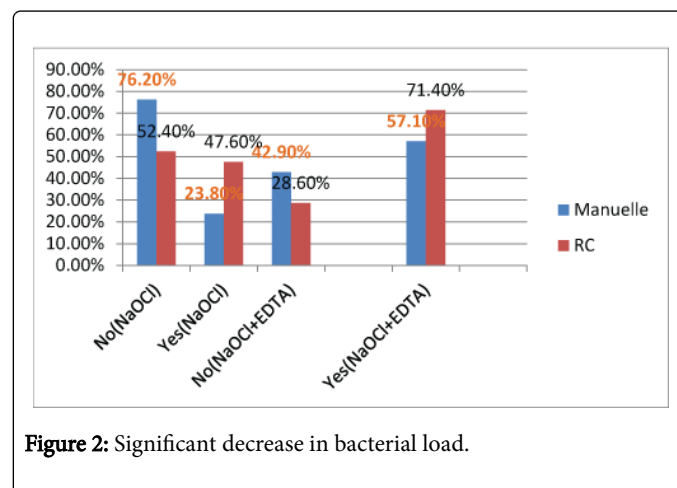


Figure 2: Significant decrease in bacterial load.

Considering the irrigation method, we obtained 23.8% of germs eradication for the teeth of the first group, 57% for the 2nd group, 47.6% in the 3rd group and 71.4% in the 4th group (Figure 3).

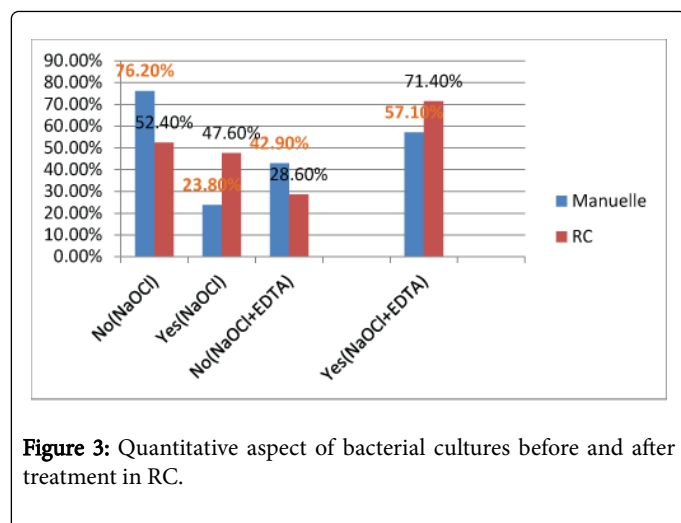


Figure 3: Quantitative aspect of bacterial cultures before and after treatment in RC.

Discussion

In our study, the results obtained with the RC, are higher compared to those obtained with the manual technique, the relative success could be attributed to technology of continuous rotation, to a better quality of preparation, which would, better access to the apical region, particularly critical, while improving the distribution of the irrigation solution [9].

Multiple works were carried out, to know the impact of the technical preparation of root canal flora. According Haikel Y [10], 35% of the endodontic surface is not contact of the instrument, whether manual or rotary. Tan and Messer [11] compared the quality of cleaning the apical three millimeters using the Ni-Ti instruments in continuous rotation, with important conical shapes and steel hand instruments; they concluded that none of the two techniques was completely effective in cleaning the area. Chafer et al. [12], after instrumentation of curved root canals, *in vitro*, in continuous rotation or with hand tools steel, have found non-instrumented areas with persistent debris in all parts of the canal regardless of the preparation procedure.

A more recent study [13], showed that there was no difference between manual instruments "limes H" and MTwo system used in continuous rotation, as for their ability to clean the coronal third, middle and apical; same conclusion in the study Reddy JM et al. when they compared the protaper system and hand files in Ni-Ti [14].

In our study, bacteriological analysis revealed a decrease in bacterial load in the art continuous rotation compared to the manual technique, however, these results are not very conclusive, given the small sample size, especially since we used as teeth mono-radicular whose anatomy and much easier compared to multi-rooted.

Trope M and Debelian G [15] evaluated the antibacterial effectiveness of large diameter apical RC, using sodium hypochlorite as irrigant, they found that 100% of mandibular single radiculées premolars were free of bacteria, well as 91% of mesial buccal roots of mandibular molars, such diameters apical were not possible to obtain with steel files, which they believe explains the results.

But most authors agree that the decrease in bacterial load depends more on the quality of the preparation that the tools used to achieve the desired shape. In fact, according to these authors, the quality of

debridement decreases in cervical portion to the apical portion with a non-significant difference in reducing the bacterial load [16].

The combination of EDTA gel in sodium hypochlorite during the root canal shaping, has considerably improved the quality of disinfection for the 2 techniques.

We went from 23.8% of total eradication of germs to 57% for the manual technique and 47.6% to 71.4% for continuous rotation, however, the statistical results are not significant ($P > 0.005$).

The role of EDTA during the canal preparation is well established, eliminating the smear-layer, it allows an increase in the permeability of dentinal tubules, the antiseptic action of hypochlorite will operate more deeply, where bacteria will nestle, furthermore one recognizes EDTA certainly a small but existing bactericidal action [17]. Bystrom and Sundqvist [18] had already obtained better results by combining NaClO with EDTA, that using the only NaClO.

Other more recent studies have been conducted to see the effect of EDTA on the quality of cleaning of root canal walls. Guo X et al. [19] demonstrated in their work, that the use of NaClO 3% heated at 60°C in combination with EDTA 17% was sufficient to remove the layer of SM even without technical final irrigation.

Kuruvilla A et al. [20] compared the effect of EDTA to 17%, with 7% maleic acid and etidronic to 18% on the quality of cleaning of root canals, they concluded that these three agents were able to eliminate the SM layer at the 3 third of the canal, however, with a superior effect to maleic acid to 7% at the apical 1/3 of the canal.

Conclusion

The use of a chelating agent such as EDTA undeniably improves the quality of cleaning of the root canals, compared with the use of only sodium hypochlorite, and this, regardless of the sample preparation technique.

The quantitative aspect of the bacterial strains grown in our specimens has not been evaluated in colony forming units (CFU), but by visual assessment of the proportion of each strain present in the same sample before and after treatment, this by the same microbiologist as follows:

- (-) No presence of germs.
- (+) Presence of the strain in a proportion of 25%.
- (++) Presence of the strain in a proportion of 50%.
- (+++) Presence of the strain in a proportion of 75%.
- (++++) Presence of the strain in a proportion of 100%.

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