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Original Research

Efficacy of Different Techniques for Removing Debris from Endodontic Files Prior to Sterilization

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Abstract:

Background: Dental instruments, like endodontic files, are hardly disinfected. The aim of this study was to evaluate the efficacy of mechanical, chemical, and ultrasonic (in combinations or separately) techniques for removing debris from files, prior to sterilization.

Materials and Methods: Totally, 90 new endodontic files with size of 15, 25, and 40 (30 files of each one) were sterilized and one files of each one kept as negative control (NC) group. The rest of files (29 files of each size) were divided into five groups after endodontic therapies and prior to autoclaving: (Positive control [PC]: Without interventions, A: Cleaned with scouring sponge soaked in chlorhexidine 0.2%, B: Stored in Micro 10 enzyme, C: Subjected to Micro 10 enzyme in both conventional and ultrasonic way for 15 min, D: Decontaminated by Micro 10 enzyme with ultrasonic). Finally, the samples were observed under a metallographic microscope, and the data were analyzed by Tuckey, paired *t*-test, two-way ANOVA tests using SPSS software version 15 at a significant level of 0.05.

Results: Significant differences were observed in heads of the files among groups C and PC ($P = 0.02$), and high amount of debris were seen in the shafts of groups A and D ($P < 0.001$). The amount of remaining debris were significant in the shafts of sizes 15 ($P < 0.001$) and 25 ($P = 0.01$).

Conclusion: Using Micro 10 in both ultrasonic and conventional methods were acceptable for removing debris from the files. Furthermore, higher amounts of debris were found in the shafts and heads of files with lower sizes (15 and 25).

Key Words: Contamination, debris, endodontic files, ultrasonic

Introduction

Removing contaminations and irritate factors from the root canal are one of the basic goals in endodontic therapies. Using instruments, conveying remaining debris from other patients, not only does not help clinicians to eliminate the canals from contaminations, but also imposes new infections to patients.[1,2] Prion proteins and their way of transmission have been focused in many studies previously.[3-5] They are resistant to autoclaving, so dental pulps could be a source for contamination due to their nerves.[6,7] As dental instruments such as matrix bands, burs, endodontic files and are hardly disinfected,[8-10] trying to introduce a method to reach the optimum level of decontamination have been challenging recently.[11-15]

Vadrot and Darbord conducted a study to evaluate the efficacy of different sterilizations and disinfections. Their results indicated that using autoclave and 1 N sodium hydroxide for 15 min reduced the rate of prion transmission.[16]

Linsuwanont *et al.* compared the effects of different cleaning methods in Ni-Ti rotary files. They used 180 endodontic files in four methods of removing debris (brushing, immersion in NaOCl 1% for 10 min after brushing, immersion in NaOCl 10% for 10 min, and ultrasonic for 5 min, combination of all previous techniques). Their result showed that combination of all techniques was more effective.[17]

In another study, Parashos *et al.* used 36 endodontic files and observed the efficacy of debris removing in three ways (chemical, mechanical, and ultrasonic). They recommended using scouring sponge soaked by chlorhexidine 0.2% and empower enzyme for removing debris.[18]

In 2009, Aasim *et al.* assessed the effect of pre-soaking files in an enzymatic cleaner prior to ultrasonic cleaning. They claimed that there were no benefit in pre-soaking files and the optimum time for ultrasonic cleaning was between 5 and 10 min.[19]

As removing debris prior to sterilization seems important and using enzyme and ultrasonic technique are recommended by many authors;[18,20-22] the aim of this study was to evaluate the efficacy of mechanical, chemical, and ultrasonic (in combinations or separately and step by step) method for removing debris from endodontic files prior to sterilization.

Materials and Methods

In this observational-analytical study, 90 new endodontic files with size of 15, 25, and 40 (30 files of each one) (Dentsply Maillefer, Ballaigues, Switzerland) were sterilized and one files of each size assumed as negative control group (NC). The rest of the files (29 files of each size) were distributed among 29 dentistry students (Isfahan University of Medical Sciences, Dental School) randomly in the way that each student had one file of each size. After accomplishments of endodontic therapy by students, the files were collected and divided into following five groups:

Positive control (PC): One file of each size (3 files totally) were stored in autoclave machine for sterilization without any interventions.

Group A: Totally, 7 files of each size (meaning 21 files totally) were administered to scouring sponge, which were soaked in chlorhexidine 0.2% (Shahr Daru, Tehran, Iran), before subjecting in autoclave machine. The files were cleaned with the sponge by rotational movement in the way that all the flouts were involved.

Group B: Totally, 7 files of each size (21 files in total) were decontaminated like group A plus storing in Micro 10 enzyme (1/133) (Unident, Chêne-Bourg, Switzerland) in conventional way for 15 min before autoclaving.

Group C: Totally, 7 files of each size (meaning 21 files in total) were decontaminated like group A, but they were subjected to Micro 10 enzyme (1/133) in both conventional and ultrasonic (Mini Piezon, EMS Co., Domat, Switzerland) techniques for 15 min in each one before autoclaving.

Group D: Totally, 7 files of each size (21 files in total) were decontaminated like group A, but they were subjected to Micro 10 enzyme (1/133) only in ultrasonic way for 15 min before autoclaving.

After autoclaving, the samples were observed under a metallographic microscope (×75) (Metallographic Laboratory of Sanati Isfahan University). The length of each file presumed as two parts of head and shaft equally from the middle. The files rotated 90° clock-wisely for four times in which all the circumferential of the files surface were observed under the microscope. At the end, scoring was done from 0 to 9 based on remaining residual debris and each file got 8 numbers (scores) (Figures 1 and 2).

The collected data were analyzed by Tuckey, paired *t*-test, two-way, and one-way ANOVA tests using SPSS software version 15 at a significant level of 0.05.

Results

The results of two-way ANOVA test showed no significant difference in heads of the files among groups A, B, C, and D ($P = 0.1$). Furthermore, the differences among file sizes were not significant ($P = 0.5$).

A significant difference was found among different file sizes ($P < 0.001$). Furthermore, Tuckey test clarified significances between groups A and C ($P = 0.03$); and size of 15 with 25 ($P = 0.02$) and 40 ($P < 0.001$). Furthermore, the results showed a significant difference in shafts among groups A, B, C, and D ($P = 0.02$).

The results of observing entire length of the files revealed significant difference among groups A, B, C, and D ($P = 0.02$) and different file sizes ($P < 0.001$). Tuckey test showed significant difference between groups A and C ($P = 0.001$) and size of 15 with 25 ($P = 0.03$) and 40 ($P = 0.001$).

Comparing groups with NC and PC groups

The results of two-way ANOVA and Tukey test showed a significant difference in heads of the files among groups C and

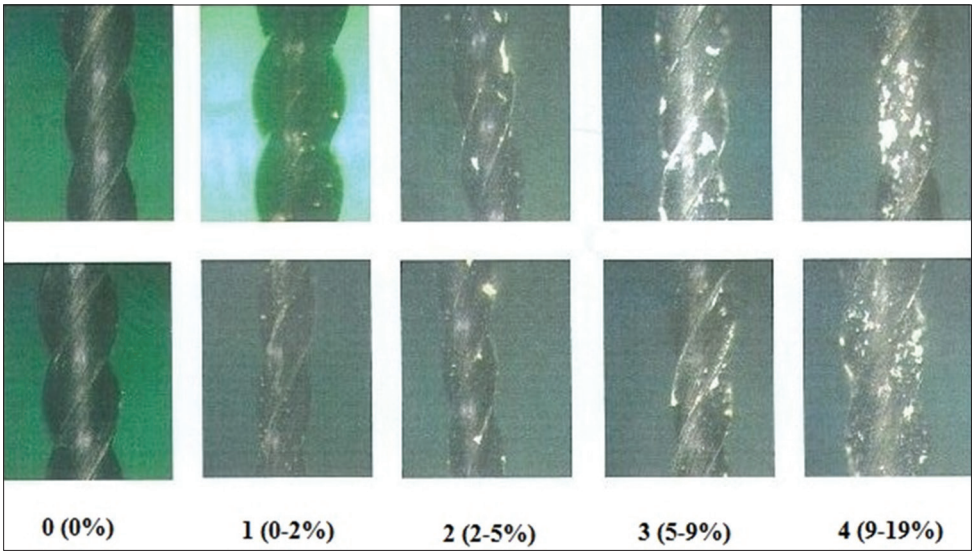

Figure 1: The scores (0-4) based on a percentage of remaining debris under observation of metallographic microscope (×75).

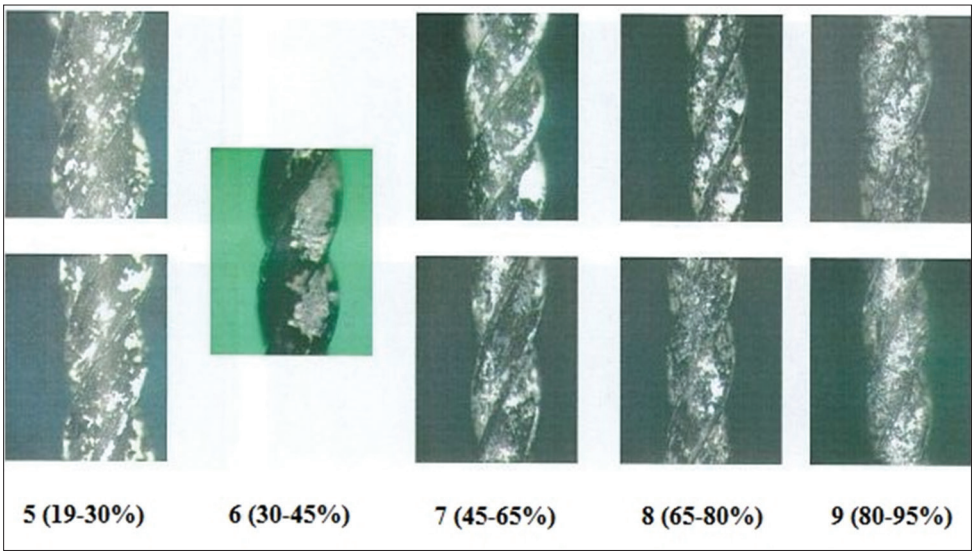

Figure 2: The scores (5-9) based on a percentage of remaining debris under observation of metallographic microscope (×75).

PC ($P = 0.02$). However, the differences among file sizes were not significant ($P > 0.05$).

The results showed a significant difference in shafts between groups PC with A, B, C, D, and NC ($P < 0.001$). In contrast, the differences among file sizes were not significant ($P > 0.05$).

The results of observing entire length of the files revealed a significant difference between groups PC with A, B, C, D, and NC ($P < 0.001$). The differences between groups A and C was significant too ($P = 0.04$). However, the differences among file sizes were not significant ($P > 0.05$).

At the end, all the data of groups A, B, C, and D were compared with groups PC and NC by using One-way ANOVA and the result showed significant difference in the heads ($P = 0.02$), shafts ($P < 0.001$), and entire lengths ($P < 0.001$).

The result of remaining debris by paired *t*-test (Table 1) showed a high amount of debris in the shafts, especially in groups A ($P < 0.001$) and D ($P < 0.001$). Furthermore, the amount of remaining debris (Table 2) were significant in the shafts of sizes 15 ($P < 0.001$) and 25 ($P = 0.01$).

Table 1: The mean score of remaining debris between groups in heads and shafts.

Groups	Heads	Shafts	Difference between heads and shafts	*P*-value
A	1.83	2.87	1.03	0.00
B	1.88	2.14	0.26	0.36
C	1.44	1.76	0.32	0.24
D	1.70	2.67	0.97	0.00
PC	2.67	6.75	4.08	0.05
NC	1.41	2.66	1.25	0.01

PC: Positive control, NC: Negative control

Table 2: The mean score of remaining debris between different file size in the heads and shafts.

File size	Means in the heads	Means in the shafts	Mean difference between heads and shafts	*P*-value
15	1.85	3.13	1.28	0.00
25	1.65	2.30	0.65	0.01
40	1.71	2.12	0.41	0.81

PC: Positive control, NC: Negative control

Discussion

The present study tried out to evaluate both mechanical and chemical methods of removing debris from the endodontic file step by step and individually.

Group A: As the results showed, the shafts and the entire length of files represented significant differences in comparison with PC group, which indicates the positive efficacy of this method.

In Parashos *et al.*'s study, mechanical techniques for removing debris were compared. Scouring sponge, which were soaked in chlorhexidine 0.2%, showed the best results. In that study, the efficacy of each stage did not observe separately, and the results were reported in a combination of chemical and ultrasonic methods, but the present study tried to evaluate the efficacy, separately.[18]

In another study, Linsuwanont *et al.* compared both mechanical and chemical techniques. Their result showed that the files, which were cleaned by a nylon brush showed higher contamination than those cleaned ones with a combination of mechanical and chemical methods.[17] The result of the present study confirmed insufficient mechanical removing of debris too.

Group B: In this group, both mechanical and chemical removing were used, and lower amount of remaining debris were observed in comparison with group A, but no significant difference was established. Furthermore, a lower amount of debris were found in larger sizes.

Linsuwanont *et al*. stated higher impacts of debris removing with both mechanical and chemical materials were reported,[17] too.

Parashos *et al.* claimed that empower enzyme is useful for removing debris.[18] Another difference with that study is in the type of enzymes. In the present study, Micro 10 was used instead of Empower as it contains surfactant and anti-corrosion substances besides four enzymes for removing organic debris.

Group C: In this group ultrasonic was used besides chemical and mechanical techniques. The shafts and the entire length of files showed a significant difference compared to group A, which indicates the positive efficacy of this method.

Linsuwanont *et al*. reported a decrease of remaining debris in ultrasonic and immersion methods (together) in comparison to only immersion technique.[17] In that study, brushing with immersion and ultrasonic showed 100% debris removal, but in the present study, the results did not reach to 100% success. That might be due to different observing methods with different accuracy (using metallography vs. staining).

Group D: In this group, ultrasonic with Micro 10 showed lower removing of debris than group C.

Two other studies compared ultrasonic with thermal disinfector[23] and wash disinfector.[24] Their results reflected the higher capability of ultrasonic than other methods. In the present study, PC group was defined to make more decisive comparisons. A significant difference was recognized between group C and PC in the files' heads, which showed high efficacy method in group C.

In all the groups as the size increased the remaining debris decreased, which would be due to larger floats and easier removing of debris. Also, more amount of debris in the shafts might be due to encountering with tight canal space in the apical.

Conclusion

With limitations of *in vitro* studies, it can be concluded that using Micro 10, in both ultrasonic and conventional, was acceptable for removing debris from the flouts of the endodontic files. Furthermore, the reaming debris was more in the shafts than head especially in files with lower sizes (15 and 25).

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