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Full Length Research Paper

Comparison of two mechanical instrumentation techniques in reducing root canal bacterial population

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Microorganisms and their products play an important role in the pathogenesis of pulpal and periradicular diseases, so their elimination from root canal system as well as reinfection prevention are the main purpose of root canal treatment. This study was designed to compare the *in-vitro* efficiency of the Hero and M-Two rotary instruments in intracanal bacterial reduction. Fifty six human extracted teeth were divided into two equal experimental groups (n=25), Hero file as group 1 and M-Two file as group 2, and one control group (n=6). All samples were prepared by K-file No 20 and Gates Glidden No 2 and 3 before sterilization. The teeth were autoclaved and then were infected with *Enterococcus faecalis*. The experimental groups were instrumented either with Hero 4% or with M-Two files up to #30. To determine the level of remaining organisms, bacteria samples were collected after instrumentation. In the group 1, two samples and in the group 2, 12 samples represented complete elimination of bacteria. There was statistically significant difference between the two groups regarding the level of bacteria elimination (p<0/05). So using M-Two instrumentation technique reduces the intracanal bacteria more efficiently than Hero 4% instrumentation technique.

Key words: *Enterococcus faecalis* bacteria, Hero rotary file, root canal preparation, M-Two rotary file.

INTRODUCTION

Microorganisms and their products play an important role in the pathogenesis of pulpal and periradicular diseases (Kakehashi et al., 1965), so their elimination from root canal system as well as reinfection prevention are the main purpose of root canal treatment (Madison and Wilcox 1988; Sjogren et al., 1991).

Reducing the root canal bacterial count during endodontic treatment is accomplished by a combination of mechanical instrumentation, irrigation and antimicrobial medications (Shuping et al., 2000; Siqueira et al., 2000). Although all these procedures are important to obtain bacteria-free canals, instrumentation is the most important one (Bystrom and Sundqvist, 1981). In the modern endodontic practice, instrumentation with NiTi rotary files is an important part of the endodontic treatment. Many clinicians argue that such form of instrumentation allows for easier production of standardized root canal preparation (Kazemi et al., 1996; Rollison et al., 2002). Therefore, NiTi instrument flexibility provides superior debridement ability (Rollison et al., 2002).

Recently, a number of NiTi instruments have been introduced to the dentistry market. NiTi rotary files with different designs have different debridement ability. The Hero 642 (Micro-Mega, Besancon, France) file consists of a series of instruments of three apical diameters

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corresponding to ISO norms 20, 25, and 30/100th, combined, for each of these three diameters, with three tapers .06, 04, and 02 (Xu et al., 2005). M-two rotary file (VDW, Munich, Germany) has 4 instruments for all types of root canals, 15/.05, 20/.06, 25/.06 and 30/.05 (Azar and Mokhtare, 2011).

The aim of the present study was to compare the effect of two different instrumentation methods, M-Two rotary files and Hero rotary files, on intracanal bacterial reduction.

MATERIALS AND METHODS

In the present experimental study, 56 extracted human teeth with single canal were used. All teeth samples were decoronated at CementoEndodontal Junction (CEJ). Canals of all teeth were instrumented to 1mm short of the apical foramen to a size #20 hand K-file (Maillefer, Switzerland) and then the coronal part of canals were flared with gates gilliden (GG) no 2 and 3 (Maillefer, Switzerland).

In order to smear layer removal, irrigation with 17% EDTA (Vericom, Korea) and 5.25% NaOCl was done, each for 10 minutes. The teeth were then washed thoroughly out with distilled water. The teeth were transferred into sterile vials containing 50 ml of brain-heart infusion broth (BHI) and then were sterilized by means of autoclaving at 121℃ (15 psi pressure) for 20 min. After sterilization, the vials containing teeth were incubated at 37℃ for 24 h. 0.05 cc of *Enterococcus faecalis* (ATCC 29212) were added to the vials and incubated at 37℃ for 72 h. 6 root canals were used as control group. In this group the pulps were extirpated with hand K-file and Gates Gilidden (GG), but no instrumentation was done.

Group 1: 25 teeth were instrumented using Hero rotary file with TCM Endo, II (Nouvag AG, Goldach, switzerland) electric hand piece in a crown down manner. The proposed sequence by the manufacturer used for this study was the following:

1) Hero rotary file no 30 4% was used for one –third of working length.
2) Hero rotary file no 30 2% was used for half to two-thirds of working length
3) Hero rotary file no 25 4% was used for two-thirds of working length
4) Hero rotary file no 25 2% was used for full working length
5) Hero rotary file no 30 4% was used for full working length

Between every file change the canals were irrigated with approximately 0.5 ml irrigant, alternating 15 EDTA and 5.25% NaOCl (Thompson and Dummer, 2000).

Group 2: 25 teeth were instrumented using M-Two rotary file with TCM Endo system in a crown down manner. The proposed sequence by the manufacturer used for this study was the following:

1) M-Two rotary files no 30 5% was used for one –third of working length.
2) M-Two rotary files no 25 6% was used for half to two-thirds of working length.
3) M-Two rotary file no 20 6% was used for full working length
4) M-Two rotary files no 30 5% was used for full working length (Veltri et al., 2005).

Group 3: In 6 teeth as control group only irrigation with NaOCl and EDTA was performed. For bacterial sampling a sterile #20 hand file was inserted into the root canal and the canal walls were slightly touched circumferentially. A sterile paper point was placed in each root canal and allowed to be saturated, then the paper point was transferred into tubes containing 1 ml BHI, and incubated at 37°C for 48 h. Following serial dilution, droplets of 0.1 ml were cultured on bile squline plates at 37℃ for 24 h. Next day, all plates were evaluated for any possible sign of turbidity.

Statistical analysis

Statistical analysis was performed by SPSS software package version 13.0 for windows (SPSS Inc., Chicago, USA). Quantitative data are presented as mean standard deviation (SD), while qualitative data are demonstrated as frequency and percent (%). Mann-Whitney U test and chi-square test were used for comparison. P value less than 0.05 was considered statistically significant.

RESULTS

Reduction of bacterial count and percentage of debridement data are shown in Table 1. Both techniques were effective in the reduction of bacterial count in root canals (colony-forming unit (cfu)<10^5 and cfu=0) (Robson and Heggers 1970).

In group 1, 3 specimens were found bacteria free after preparation (cfu=0) and 12 specimens had bacterial reduction (cfu<10^5). In group 2, 14 specimens were detected bacteria free after preparation with less than 100%reduction in 6 specimens (cfu<10^5).

Statistically significant (p=0/00) differences, in bacterial count reduction, between two instrumentation techniques was observed. M-two rotary files showed better ability in the elimination of bacterial count compared to Hero rotary files.

DISCUSSION

The cleaning ability of Ni-Ti instruments, regarding completely different finding, has been the matter of debate among researchers. In the present study the apical preparation for both techniques was standardized into size 30. These two techniques for rotary instrumentation were selected among current systems, which by design remove different amounts of dentin (Aydin et al., 2007).

The removal of bacteria by Ni-Ti instrumentation was evaluated by Dalton et al. (1998); no significant difference in the bacterial reduction between rotary instruments and hand K-files of the similar size preparation was found. In the same way, comparison of the root canal instrumentation with profile GT files and hand –files of the same apical preparation by Siqueira et al. (1999) showed no difference in bacterial reduction, between two methods.

E. faecalis, which is often associated with persistent apical periodontitis, was chosen as the test organism for this research, because it can readily infect the dentinal tubules (Haapasalo and Orstavik, 1987) and this

Table 1. Number of cleaned and infected plates after instrumentation of the root canals using the different files.

Groups		Elimination of bacterial count cfu=0	Reduction of bacterial count cfu<10^5	cfu>10^5	Total
Hero 4%	Number of plate	3	12	10	25
	% within system	12%	48%	40%	100%
M-Two	Number of plate	14	6	5	25
	% within system	56%	24%	20%	100%
Total	Number of plate	17	18	15	50
	% within system	34%	36%	30%	100%

cfu: colony-forming unit.

micro-organism is difficult to be eliminated and causes some problems in the endodontic treatment (Jett et al., 1994; Kayaoglu and Orstavik, 2004).

Same size apical preparation and different coronal tapering has been applied in this study. The main finding is the ability of M-two rotary system to reduce the amount of intracanal bacteria more effectively compared to Hero rotary system.

In Colak study (Colak et al., 2005), they compared the cleaning ability of Hedstroem files, Giromatic and Hero instrumentation techniques with each other. They found all instruments are able to reduce the bacterial colony count in the root canal, significantly. However, these techniques were not meaningfully different in their ability to reduce intracanal bacteria level.

Sequeira et al. (1999) investigated elimination of *E. faecalis* for evaluation of the cleaning ability similar to our study. Based on their findings, apical enlargement is more important than coronal tapering in bacteria reduction. They compared greater taper files (0.06 mm/mm) with conventional taper NiTiflex- hand files (0.02), no significant difference was observed in bacteria reduction. Further apical instrumentation with the conventional files to reach a larger size was significantly more effective than application of the greater taper files, formerly mentioned study highlights. This finding was in consistent with that of Orstavik et al. (1991), which showed that, as larger the root canal preparation as higher the efficiency in the root canal infection level reduction.

In Aydin et al. (2007) study, they used Hero and Protaper instruments with different tapering for cleaning the root canals. As in our study, apical preparation was standardized to a size 30. They found no statistically meaningful difference between two techniques. It was expected that the more aggressive removal of dentin (Protaper) would eliminate more bacterial and lead to lower bacterial counts in samples. However; this was not concluded in this study. They supported the concept that the size of apical preparation is more important than coronal tapering, in the intracanal bacteria reduction (Orstavik et al., 1991; Baugh and Wallace, 2005).

In contrast to former research results, the superiority of M-Two #30 with tapering 5% to Hero #30 with tapering 4 % is highlighted in our study. This may be explained by the properties of M-Two rotary files. They have maximum space for removal of dentinal debris and also the distance between the cutting blades increases from the instrument tip to the shaft of file. This prevents the instrument to be pulled into the canal and allows for efficient removal of debris in a coronal direction and prevents the file getting jammed in the canal (Khalilak et al., 2009).

In Schafer study (Schafer et al., 2006a, 2006b), comparison of the cleaning effectiveness of M-two, K3, and Race nickel-titanium rotary instruments was evaluated. They found M-two instrument achieves significantly better results.

In another research (Schafer and Oitzinger 2008), the M-two and RaCe files displayed significantly greater penetration depths into the root canals compared to Profile and FlexMastrer instruments; supporting the higher efficiency of M-two files in the canal debridement. In Burklein study (Burklein et al., 2011), they compared cleaning effectiveness of two rotary systems (M-two and Protaper). Based on their finding, using M-Two instrument compared to Protaper, results in a better canal cleaning. This means file design may be more important than tapering characteristic in the canal cleaning.

Our finding support the idea of the superiority of M-Two rotary files compared to Hero instruments, in the mechanical reduction of bacteria population in root canals. However, further *in-vitro* and *in-vivo* studies are advised.

Conclusion

Considering all limitations of this study, chemo-mechanical preparation using rotary files is effective in the reduction of *E. faecalis* from the root canal system (Siqueira et al., 2010), although application of M-Two

rotary files showed more root canal bacteria reduction compared to Hero rotary files.

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