



A COMPARATIVE EVALUATION OF EFFICACY OF FIVE DIFFERENT PROCEDURES IN ELIMINATION OF BIOLOGICAL DEBRIS ON ROTARY ENDODONTIC INSTRUMENTS BEFORE STERILIZATION- AN IN-VITRO STEREO-MICROSCOPIC STUDY.

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ABSTRACT

Aim- this study was done to evaluate the efficacy of five different procedures on elimination of biological debris on rotary endodontic instruments before sterilization.

Materials and Method- totally twenty-five rotary endodontic files after clinical use for cleaning and shaping were taken in the study. They were divided into five groups each containing five files in accordance with various cleaning procedures used. Detection of debris on files was done using rhodamine B stain with the help of stereomicroscope.

Statistical analysis used: results were analyzed using Kruskal-Wallis Chi- Square test.

Results: the mean value of maximum biological contamination was highest in Group 2(files immersed in 2% glutaraldehyde solution) and lowest in group 5(files which were cleaned using brush).

Conclusions: endodontic instrument which were cleaned manually using nylon brush were found to be more efficient.

KEYWORDS : Pre-cleaning, Rotary Endodontic Instruments, Biological Debris, Cross-infection.

INTRODUCTION:

Cross infection has always been an important issue in every dental clinic and hospital. Cleaning and shaping is the important step of every root canal treatment. This is done using hand and rotary instruments which are frequently reused in number of patients.^{1,2} Endodontic files should always be cleaned, disinfected and sterilized effectively, as root canal instrumentation often leads to collection of debris on the flutes of these files.¹ Direct or indirect contaminations results in transmission of infections from one person to another.³

Studies have shown the transmission of prions from contaminated instruments.¹ These prions are said to be resistant to autoclaving, thus dental pulps due to the presence of nerves in them could be a source for contamination.^{4,5} Rotary instruments made up of nickel-titanium are designed such that they tend to accumulate lot of debris between their flutes which are always unreachable for cleaning.⁶ This increases the chances of cross contamination from patient to patient.

Considering these points, the present study was undertaken to evaluate the efficacy of five different cleaning procedures in elimination of biological debris on endodontic instruments before sterilizing them.

MATERIALS AND METHODS:

Total twenty-five new rotary endodontic files were collected. These files were taken for this study only after their clinical use for cleaning and shaping. Selection criteria included used, contaminated, non corroded, non deformed and unbroken rotary endodontic files.

These twenty-five files were randomly divided into five groups, each containing five files-

Group 1- included five files which were immersed in 17% liquid EDTA for ten minutes and wiped using 2X2 size gauze.

Group 2- included five files which were immersed in 2% glutaraldehyde for ten minutes and wiped using 2X2 size gauze.

Group 3- included five files which were immersed in 5.25% sodium hypochlorite solution for ten minutes and wiped using 2X2 size gauze.

Group 4- included five files which were immersed in 3% sodium hypochlorite for ten minutes which was heated till 40 degree Celsius and wiped using 2X2 size gauze.

Group 5- included five files which were brushed manually using nylon

brush for twenty strokes.

Immersion of files in disinfectant solution can be seen in figure 1A. All these rotary endodontic files from all the groups were then finally rinsed with distilled water for five minutes and then dried. After the completion of cleaning procedures, these rotary endodontic instruments were then stained by immersing them in Rhodamine B dye for 24hours (figure 1B). These files were later rinsed in distilled water for five minutes and allowed to air dry in an endodontic stand before visualizing them under stereomicroscope.

All the files were then visualized under the stereomicroscope at 20X magnification. Debris on the files were examined at three levels that are coronal, middle and apical, as well as on four sides. For this, files were first mounted on an acrylic block of square cross-section to provide stable platform to place them under stereomicroscope. The debris seen on the files were scored as below:

Score 1- organic film (file covered with a thin unstructured layer)

Score 2- slight staining (single separated particles of debris seen scattered over the surface of the file)

Score 3- moderate staining (particles of debris seen as a continuous layer over the surface of the file)

Score 4- high level of staining (flutes of the file are thoroughly covered with debris all over)

This criteria of debris classification is same as given by Syed Ziauddin et al.⁹ Examination of files mounted on acrylic block was done at three levels and on four sides by sequential rotation through 90 degrees, which gave twelve measurements for each sample. Figure 1C shows stereomicroscopic image of rotary file with stained residual biological debris present on it. The minimum value which could be found was zero (clean surface with no organic material present) and the maximum was 48 (surfaces of the files were wholly contaminated with debris). All the measurements were added up and calculated value of each file was then converted into percentage value. This percentage value was then called as mean percentage of maximum biological contamination(MBC).

Statistical analysis for the data was then carried out using Kruskal-Wallis test. Table 1 and table 2 represents the mean percentage of

maximum biological contamination among all the five the groups.

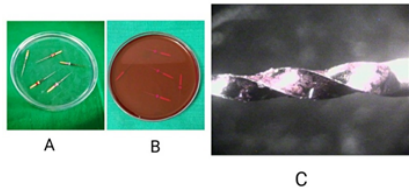


Figure 1

A: showing rotary files immersed in disinfectant solution
 B: showing rotary files immersed in Rhodamine B dye
 C: Stereomicroscopic image showing residual biological debris on the flutes of the rotary file

Source of support: Praj Laboratories, Pune, Maharashtra for Stereomicroscope.

Table 1: representing mean value of maximum biological contamination

Group	Mean of maximum biological contamination	Std. Dev	Min	Max	Kruskal-Wallis Chi-Sq	P value
1	7.2	0.4034	21	22	173.3	<0.001*
2	12	0.451	33	38		
3	1.2	0.4621	1	3		
4	0.4	0.3025	0	2		
5	0	0	0	0		

*denotes significant difference

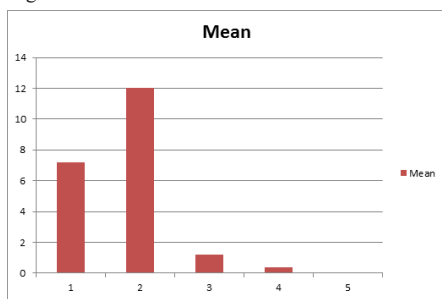


Table 2: graph showing level of maximum biological contamination among the groups

RESULTS:

After the stereomicroscopic examination and statistical analysis, it was seen that Group 2 files showed maximum biological debris present on their surface followed by Group 1, Group 3, Group 4 and Group 5. The mean value of maximum biological contamination(MBC) for entire Group 1 was 7.2%, Group 2 was 12%, Group 3 was 1.2%, Group 4 was 0.4% whereas for Group 5 it was 0%. The outcome of this study reveals that the instruments in Group 2 that is 2% glutaraldehyde showed highest level of contamination whereas instruments in that of Group 5 which were brushed manually showed zero contamination.

When mean values of MBC were tested it was found that there was statistical difference in the mean values between all the cleaning procedures applied [$\chi^2 = 173.3$; $p < 0.001$]

DISCUSSION:

The results of this study resembles to previous similar studies done on the presence of residual debris on instruments which are frequently used again and again in root canal treatment, and it confirms that there is very high probability of contamination while reusing the instruments from one patient to another patient.⁷

Instrumentation of root canals using Ni-Ti rotary instruments results in removal of large quantity of smear layer and debris which are need to be eliminated from the surface of the instrument. Cleaning of endodontic instruments is at times difficult because of their complex designs and small sizes. All the instruments which are to be re-used from one patient to another must be pre-cleaned always prior to

sterilization to halt cross-contamination via instruments. If used rotary endodontic files are not sterilized immediately which is not always possible, then it results in drying of the debris engaged in them. As we know ultrasonic bath is also one of the method of cleaning endodontic instruments, but few studies have also shown that ultrasonic cleaning alone, is also not completely effective in eliminating dried residual debris from the instruments.^{10,11} This debris stay adhered to the flutes of the files even after ultrasonic cleaning, autoclaving, glass bead sterilizer, etc and thus results in cross infection when used in new patient. Aasim et al. in his study have found calcium hydroxide adhered on the flutes of two files which were used to transport calcium hydroxide into the canal even after ultrasonic cleaning.¹¹ In addition to this, ultrasonic cleaning is also affected by number of factors like the type of debris to be cleaned, the type and amount of chemical solution chosen, time of the exposure to cavitation, water quality, loading procedures, availability of the ultrasonic bath, etc.

Therefore, this study have evaluated the efficiency of five simplest cleaning procedures to produce rotary endodontic files which are microscopically clear of biological debris. Four different disinfectants that are 17% liquid EDTA, 2% glutaraldehyde, 5.25% sodium hypochlorite and 3% sodium hypochlorite heated to 40 degrees along with one manual brushing technique have been used to pre-clean the used rotary endodontic files. Rhodamine B dye was used to stain the files because it is a fluorescent dye. Debris stained by this dye is easily detectable. Sodium hypochlorite and 17% liquid EDTA have been used in this study as they have a better tissue dissolving ability, thus helps in dissolving the organic matter. Few studies have shown that at less concentration heated sodium hypochlorite removes debris more efficiently than unheated sodium hypochlorite at higher concentrations and thus acts as a good tissue dissolving solution.⁸ 2% glutaraldehyde is a strong disinfectant and fixative. It also acts on microorganisms by killing them and altering their protein compounds as well. It is been used in cleaning endodontic instruments since many years.

This present study has shown a lot of difference among all the five different cleaning procedures used. Poor cleaning was observed in Group 2 that is 2% glutaraldehyde followed by Group 1 that is 17% liquid EDTA. The most efficient method found for pre-cleaning rotary endodontic files was Group 5 that is manual brushing, with highest MBC values showing files completely free of debris under stereomicroscope. Next to Group 5 (manual brushing) was Group 4 (that is heated sodium hypochlorite till 40 degrees) followed by Group 3 (5.25% unheated sodium hypochlorite). Soaking files in sodium hypochlorite resulted in loosening and dissolution of the organic debris on the flutes of the files, where heated sodium hypochlorite worked more efficiently in comparison to unheated sodium hypochlorite. Ultimately this study proves that mechanical brushing technique is the most simple, uncomplicated, quick and absolutely efficient method of pre-cleaning the rotary endodontic instruments prior to sterilization.

CONCLUSION:

Autoclaving the reusable instruments has always appeared efficient in eliminating disease transmission caused by microorganisms of dental pulp but have found to be less efficient in eliminating prion proteins.⁷ So, considering many of these points its concluded that pre-cleaning of the endodontic instruments is equally important to remove residual debris along with the sterilization process.

Hence, the study proves that mechanical cleansing using nylon brush for minimum of 20 strokes prior to sterilization is the most appropriate method in removal of debris which is considered to be potential biological risk factors for patients. Therefore, each dental personnel should bring into practice this effortless and quick method of pre-cleaning the instruments in order to prevent processing errors and cross-infections amidst patients.

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