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"EFFICACY OF VARIOUS STERILIZATION PROTOCOLS FOR NI-TI ROTARY ENDODONTIC FILES"-AN EX VIVO STUDY

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Abstract

Sterilization is a process by which an article, surface or medium is freed of all microorganismsin either vegetative or spore state. Control of infection that spreads through various instruments used in endodontics is of utmost importance as a preventive measure for cross infection.The purpose of this study is to determine the effectiveness and various methods of precleaning and sterilization of endodontic files.Materials and methods: 105 used rotary ProTaper Ni-Ti files (Tulsa, DENTSPLY, U.S.A) were divided into 8 groups of 15 each and subjected to various methods of pre-cleaning and sterilization.After sterilization, the instruments were transferred into sterile test tubes containing todd-hewitt broth, incubated at 37°C for 72 hrs, and observed for bacterial growth. Results: Sterilization procedures were 100% effective for rotary files in groups B, C, D, E, and F. Rotary files used in group A,G & Control group showed evidence of bacterial growth. **Conclusions:** The results do not support the recommendation for the single use of endodontic files based on inability to clean files between uses. The majority of bacteria were eliminated from endodontic files after either ultrasonic cleaning or using a chemical disinfector.

Introduction

Infection control procedures are essential to prevent cross contamination in clinical practice. Diseases may be transmitted by indirect contact when dental instruments contaminated by one patient are reused for another patient without adequate disinfection or sterilization between uses.

Sterilization of instruments ensures that they are free of all microbial life including microbial spores.Rotary Ni-Ti Endodontic files have gained popularity based on their superior preparation of

canals compared to hand instrumentation.These files become contaminated with blood, saliva, necrotic tissue and pathogens. Hence, it is important to sterilize these instruments to minimize cross-contamination. However, the complex miniature architecture of these rotary endodontic files makes cleaning and sterilization difficult.Studies evaluating sterilization methods of these instruments reported that current methods of sterilization are insufficient to completely remove the biological debris from these instruments. Hence recommended that these instruments should perhaps be considered as single-use instruments.[1, 2]Although single-use instruments have been promoted as a strategy to prevent cross-infection of patients, resterilization of used instruments is still common as cost is a significant factor in the decision to reuse instruments. The practice of reprocessing used instruments is becoming more and more prevalent with the overall goal of saving money and decreasing environmental pollution[2].Used instruments must be thoroughly precleaned before sterilization, to remove debris, by either brushing or ultrasonic cleaning. Ultrasonic cleaning is much safer than hand scrubbing because it decreases the risk of puncture wounds. Ultrasonic cleaning can also be an effective and timesaving method of cleaning instruments.Centers for Disease Control and Prevention guidelines for infection control in Dental Health Care settings (2003) recommended single use of endodontic instruments[4].Van Eldik et al reported that steam sterilization eliminated all bacteria from endodontic files irrespective of the presence of biological debris[5].Smith et al study concluded that a large number (76%) of files collected from U.K dental community remained visibly contaminated after completion of sterilization[6].The results of Parashos et al study did not support recommendations for single use of endodontic files based on inability to clean files between uses [7].There is still much debate regarding the reuse of these rotary instruments in dentistry.This study had two main objectives. The first objective wasto determine the effectiveness of various methods of precleaning and sterilization of endodontic files.

The second objective was to compare the various methods of precleaning and sterilization of endodontic files.

Materials and Methods

- A total of 105 used rotaryProTaper Ni-Ti files (Tulsa, DENTSPLY, U.S.A) were used for this study.These files were divided into 8 groups of 15 each and subjected to the following cycles of pre-cleaning and sterilization. Control group comprised of 15 files.

Table 1:

Groups	Precleaning	Sterilization
A	Cleaned with brush & detergent liquid & rinsed with water.	Autoclaved at121° C, 15Lbs for 15 min
B	Cleaned with brush and detergent liquid & rinsed with water followed by ultrasonic cleaning for 5 minutes	Autoclaved at121° C, 15Lbs for 15 min
C	Immersed in 10% korsolex solution for 15 minutes and rinsed with water.	Autoclaved at121° C, 15Lbs for 15 min
D	Immersed in 10% korsolex solution for 15 minutes and rinsed with water followed by ultrasonic cleaning for 5 minutes.	Autoclaved at121° C, 15Lbs for 15 min
E	Cleaned with brush & detergent liquid & rinsed with water.	Immersed in 10% korsolex solution for 4 hours rinsed with water.
F	Cleaned with brush & detergent liquid & rinsed with water.	Immersed in 5% Quitanet solution for 60 minutes and rinsed with water.
G	Wiped with spirit soaked cotton	
H	No cleaning and sterilization procedure was done.	

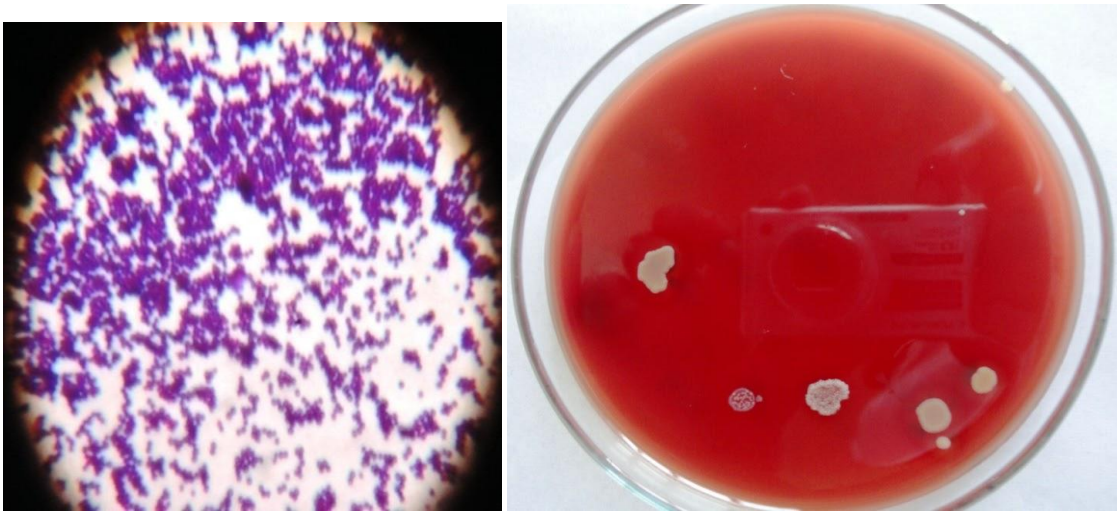
After sterilization, the instruments of each group were transferred by sterile technique into sterile test tubes containing todd-hewitt broth, incubated at 37°C for 72 hrs, and observed for bacterial growth. A colour change, cloudy broth and visible precipitate in the test tube were considered indicative of bacterial growth. If the solution remained clear throughout the incubation period, the sample was considered sterile.

Fig 1:

Sterile broth Cloudy broth

Then the groups were transferred to culture media to identify the pathogens.Several samples of bacterial growth from used files were subjected to gram staining, the resultant staining and bacterial growth appeared consistent with staphylococci and streptococcus.Confirmation of contamination was obtained by using compound microscope at 100X magnification.

Fig 2:



Results:

After the various sterilization protocols, group A, 66.6% of the rotary files showed evidence of bacterial growth after 72 hours of observation.Instruments in the group G & control group showed 100% evidence of bacterial growth after 72 h. However, sterilization procedures were 100% effective for rotary files in groups B, C, D, E, and F, none of the files in these groups showed contamination following the 72-hour incubation period.

Table 2:

Groups	No of files contaminated	% of sterilization success
A	5(15)	66.6%
B	0(15)	100%
C	0(15)	100%
D	0(15)	100%
E	0(15)	100%
F	0(15)	100%
G	15(15)	0%
H	15(15)	0%

Discussion:

The goal of instrument sterilization is to protect patients from cross-contamination.Re-using these instruments without proper sterilization leads to cross-infection and is a major issue in the dental health care. Although there is considerable evidence that endodontic files can be

predictably sterilized even in the presence of biologic debris, the cleaning of instruments to remove microorganisms and biological debriseffectively eliminates the majority of microorganisms. Very little information is available in the literature with reference to efficient cleaning protocols for rotary endodontic files.Studies evaluating sterilization methods of these instruments recommended that these instruments should perhaps be considered as single-use instruments.[1,2]However in developing countries it may not be financially feasible to use rotary Ni-Ti files as single use instruments.Therefore, repeated use of these instruments carries with it a risk that infectious agents will be transmitted. To eliminate this risk, the instruments should be cleaned thoroughly, Improvement of the decontamination methods used in routine dental practice and the adoption of a combination of mechanical, chemical and ultrasonic cleaning methods as a standard protocol can provide complete cleaning of biological debris from endodontic instruments (Linsuwanont et al. 2004, Parashos et al. 2004).There is no consensus regarding a standard sterilization protocol for these Ni-Ti rotary files.This study is an attempt to develop a sterilization protocol, which is simple, quicker and more predictable using less expensive and easily available materials.Plastic brushes are recommended for cleaning Ni-Ti instruments to avoid roughing of instrument surface. Korsolex which contains gluteraldehyde in 2% concentration is effective as a disinfectant and sterilizing agent against bacteria and viruses. Quitanetplus (Septodont) is an aldehyde free solution, which is bactericidal, fungicidal, sporicidal, virucidal and biodegradable. In this study out of 4 methods of steam sterilization and 2 methods of cold sterilization & one method (Group A) found not to be very effective method of sterilization , which is in accordance with the study done by Susan et al[1].In a study, done by Lowe, Bagg and others looked at blood contamination of matrix bands; they collected used matrix bands and retainers from general dentists. The instruments were sterilized according to the regular protocol, which included steam autoclaving after pre-cleaning. They found that 34% of hand scrubbed and 4% of ultrasonically cleaned matrix bands had evidence of blood contamination, and blood was detected on 32% of hand scrubbed and 3% of ultrasonically cleaned matrix band retainers. The results show the benefit of ultrasonic cleaning before steam autoclaving as confirmed by the present study[8].The UK Department of Health risk assessment for variant CJD (vCJD) has categorized dentistry as ‘low risk’ for the potential transmission of vCJD (Letters et al. 2005, Smith et al. 2005). However, it is clear that infection is possible because endodontic interventions are frequent, endodontic instruments might come into direct contact with the pulpal and periodontal tissues and peripheral branches of the trigeminal nerve, and their inadequate cleaning might present a risk of transmission of infection (Smith et al. 2002).The results obtained in the current study reinforce that several methods of sterilization

employed in the dental community are unsatisfactory. There are many variables to consider with each sterilization technique, and these variables account for the differences in results. However, the goal of this study was to determine which technique was most effective and to determine the techniques being used today are effective.Glutaraldehyde has a broad spectrum of activity, a fast rate of kill and has been classed as a chemosterilizer. Borick (1968) defined gluteraldehyde as a chemical agent which, when utilized properly, could destroy all forms of microbial life, including bacterial and fungal spores, tubercle bacilli and viruses. Asbacterial spores are the most difficult to kill of all microbial forms, however, he concluded that sporicides could be considered synonymous with chemosterilizers. Thus glutaraldehyde exhibit excellent sporicidal activity and the duration of sterilization is about 9-10 hrs at room temperature. It is non-corrosive, nontoxic and an added advantage is its low cost.

Conclusion

Within the limitations of this study the following conclusions can be drawn:

The following methods are found to be effective in sterilizing Ni-Ti rotary instruments.

1. Cleaning with brush and detergent liquid & rinsed with water followed by ultrasonic cleaning for 5 minutes.
2. Immersing in 10% korsolex solution for 15 minutes and rinsing with water, followed by autoclaving.
3. Immersing in 10% korsolex solution for 15 minutes and rinsing with water, followed by ultrasonic cleaning and autoclaving are effective methods of sterilization.
4. Cold sterilization with Korsolex and Quitanet plus solutions also is an effective method of sterilization.

References:

1. Archie Morrison, Susan Conrad. Dental Burs and Endodontic files:Are Routine Sterilization Procedures Effective. JCDA 2009; 75(1):39-39d.

2. A. Smith, M. Dickson. Contaminated dental instruments. J Hosp Infect 2002; 51(3):233-5.

3. Nicholas J.V.Hogg,Archibald Morrison. Resterilization of Instruments Used in a Hospital-based Oral & Maxillofacial surgery clinic. JCDA 2005; 71(3):179-82.

4. DA Van Eldik, PS Zilm. A SEM evaluation of debris removal from endodontic files after cleaning and steam sterilization procedures. Aust dent journal 2004; 49(3):128-35.

5. Kubersood, L.Lakshminarayan. Effect of cleaning and sterilization procedures on Ni-Ti Rotary files-An SEM and EDS study. Endodontology:34-4.

6. P.Parashos, HH Messer. A Cleaning protocol for rotary nickel-titanium endodontic instruments. Aust dent journal 2004;49(1):20-7.

7. J.Popovic,J.Gasic, Evaluation of biological debris on endodontic instruments after cleaning and sterilization procedures. IEJ 2010; 43:336-41.

8. Lowe AH, Bagg J, Burke FJ, MacKenzie D, McHugh S. A study of blood contamination of Siqveland matrix bands. *Br Dent J* 2002; 192(1):43–5.