Dental Burs and Endodontic Files: Are Routine Sterilization Procedures Effective?

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ABSTRACT

Purpose: The complex miniature architecture of dental burs and endodontic files makes precleaning and sterilization difficult. Devising a sterilization protocol for endodontic files and dental burs requires care, and some have suggested that these instruments be considered single-use devices. One purpose of this study was to determine the effectiveness of various sterilization techniques currently used in dentistry for the resterilization of dental burs and endodontic files. The second aim was to determine whether new dental burs and endodontic files, as supplied in packages from the manufacturer, are sterile.

Materials and Methods: The sterility of new (unused) and used dental burs and endodontic files before and after various sterilization procedures was analyzed. New burs and files were tested immediately after removal from manufacturers' packaging, with or without prior sterilization. Burs and files that had been used in various dental offices were precleaned, packaged, resterilized and then tested for various pathogens. Each item was individually removed from the sterilization packaging, transferred by sterile technique into Todd-Hewitt broth, incubated at 37°C for 72 hours and observed for bacterial growth.

Results: Sterilization procedures were 100% effective for unused burs and unused files but were less than 100% effective for all other test groups. Contamination rates following sterilization ranged from 15% for one group of used burs ($p = 0.01$) to 58% for one group of used files ($p < 0.001$).

Conclusions: Dental burs and endodontic files, as packaged by the manufacturer, are not sterile and should therefore be sterilized before first use. The resterilization procedures tested here were not adequate, and more rigorous sterilization procedures are needed. If such procedures cannot be devised, these instruments should perhaps be considered single-use devices.

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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.[1] The process of sterilization is designed to render instruments free of *all* microbial life, including bacterial spores, which can be very difficult to kill.[1,2] Any procedure that eliminates bacterial spores will also kill viruses such as HIV, hepatitis C and hepatitis B.[1]

There are no degrees of sterility; rather, an instrument is sterile or it is not.[2] Resterilization of dental instruments for

reuse on another patient happens regularly in all dental clinics.[3] Resterilization is simply the repeated application of a sterilization procedure to an instrument or device to remove contamination, allowing for its use in treating multiple patients.[4] Dental burs and endodontic files are commonly treated in this way. These devices can become contaminated with blood, saliva, necrotic tissue and pathogens; therefore, if such devices are to be reused, it is important to ensure sterility and minimize any associated risk of cross-contamination of patients with dangerous pathogens.[3]

Precleaning and sterilization of some devices can be difficult because of their small size and complex architecture.[3] Endodontic files are slender, tapered instruments, about 25 mm long, with intricate topography and spiral cutting edges used for cleaning and shaping root canals during endodontic treatment.[5] Because of their size and shape, it is difficult to remove all biologic material during resterilization procedures.[3,5] Dental burs come in a variety of shapes and sizes, all with very complex and detailed surface features.

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 time-saving method of cleaning instruments, although it is not capable of removing all contamination.[2,3] The ultrasonic cleaner uses vibratory energy, carried as sound waves in the fluid, to create suction which in turn removes biologic matter from instruments.[6] Following any cleaning process, instruments should be given a final rinse to remove any debris left over from the cleaning solution.[2] The instruments are then ready for sterilization. Three methods of sterilization are currently in use: application of steam under pressure in a steam autoclave, application of dry heat in a sterilizing oven and sterilization by chemical vapour.[1] All of these methods have advantages and disadvantages. Steam sterilization is one of the most effective and safe methods. Steam sterilization can be used on packaged items because it penetrates fabric and paper, but it cannot be used on items that cannot tolerate heat or moisture. Both the dry heat and chemical vapour methods of sterilization can be used on packaged items with no risk of rust or corrosion, leaving the instruments dry upon completion.[1] Dry heat requires a lengthy sterilizing cycle and tends to damage most plastic items. Dry heat sterilizing equipment operates at extremely high temperatures and cannot be used to sterilize handpieces.[1]

This study had 2 main objectives. The first objective was to investigate the effectiveness of various sterilization procedures commonly applied to used burs and endodontic files. The second objective was to determine the sterility of new, unused burs and endodontic files.

Materials and Methods

The sterility of new and used dental burs and endodontic files before and after sterilization procedures was analyzed. Previously used burs and files were gathered from 4 different dental offices after they had been packaged and sterilized for reuse. Sterilization was conducted by the staff of these clinics. Sterilization procedures were carried out according to the protocols employed by each office, as the goal of this study was to see if the techniques currently being used are effective.

The following groups of instruments were tested in this study: new, unused and sterilized burs and files; new, unused and unsterilized burs and files; and used burs and files sterilized using a variety of techniques (**Tables 1** and **2**). Each group consisted of 40 items. There were many differences between the groups, such as methods of precleaning, type of packaging, length of sterilization cycle and type of sterilizer. Once collected, the sterilized items were stored at room temperature in dry conditions for no longer than 7 days before incubation. The burs and files were then transferred, using sterile technique, into individual sterile test tubes containing 3 mL of Todd–Hewitt broth. The samples were incubated at 37°C. The test tubes were examined every 24 hours for a total of 72 hours, and any signs of bacterial growth were documented. A colour change, cloudy broth and visible precipitate in the test tube were all considered indicative of bacterial growth. If the solution remained clear throughout the incubation period, the sample was considered sterile (**Fig. 1**).

Data were collected and tested for significant differences using Fisher's exact test.

Results

New items, as packaged by the manufacturer, were not sterile (**Tables 3** and **4**). However, sterilization procedures were 100% effective for unused burs (group B1) and unused files (group F1); no item in either of these groups showed contamination following the 72-hour incubation period.

All sterilization procedures performed on previously used burs and files were less than 100% effective (**Tables 3** and **4**). Of the burs in group B3, used burs that were resterilized using a Harvey Chemiclave, 15% were contaminated ($p = 0.01$). Among the endodontic files in group F3, treated with disinfectant and dry heat sterilization, 58% showed contamination ($p < 0.001$).

Several samples of bacterial growth from used and resterilized burs were subjected to gram staining; the resultant staining and bacterial structure appeared consistent with *Staphylococcus* (**Fig. 2**).

Table 1 Treatments applied for 5 groups of burs

			Sterilization		
Group	Ultrasonic	Other treatment	Packaging	Sterilizer	Cycle
New burs					
B1	5 min Neutra-Clean[a]	NA	Bagged bur block	Harvey Chemiclave 6000 autoclave (Alfa Medical, Hempstead, N.Y.)	20 min, 138 kPa, 132°C
B2 (untreated)	NA	NA	Individual bags	NA	NA
Used burs					
B3	5 min Neutra-Clean	Visible debris brushed off	Bagged bur block	Harvey Chemiclave 6000 autoclave(Alfa Medical)	20 min, 138 kPa, 132°C
B4	15 min Enzymax[b]	NA	Individual bags	Statim Steam Sterilizer (SciCan, Toronto, Ont.)	6 min, 130°C
B5	10 min Enzymax	NA	Bulk bags	Pelton & Crane Delta XL steam autoclave (Pelton & Crane, Charlotte, N.C.)	12 min, 216 kPa, 134°C

NA = not applicable; Neutra-Clean (Borer Chemie AG, Zuchwill, Switzerland); Enzymax (Hu-Friedy Manufacturing Co. Inc., Chicago, Ill.)
[a]*Sodium dodecylbenzenesulphonate.*
[b]*Bacterial protease and amylase.*

Table 2 Treatments applied for 4 groups of files

		Sterilization		
Group	Precleaning	Packaging	Sterilizer	Cycle
New files				
F1	Disinfected with Pathex[a] and visible debris brushed off	Bulk bags	Dry heat sterilizer (Henry Schein, Ottawa, Ont.)	30 min, 149°C
F2 (untreated)	NA	Packaged in cassettes with other new files	NA	NA
Used files				
F3	Disinfected with Pathex and visible debris brushed off	Bulk bags	Dry heat sterilizer (Henry Schein)	30 min, 149°C
F4	Wiped with Presept[b]	Individual bags	Statim steam sterilizer (SciCan)	6 min, 130°C

NA = not applicable; Pathex (Certol International Inc., Commerce City, Colo.); Presept (3M, St. Paul, Minn.)
[a]*o-Phenylphenol.*
[b]*Sodium dichloroisocyanurate.*

Discussion

The goal of instrument sterilization in dentistry is to protect patients from cross-contamination via instruments.[2] Careful consideration is required when devising a sterilization protocol for endodontic files and dental burs, and some have suggested that these instruments be considered single-use devices.[5] A single-use device is an instrument designed to be used on one patient only, and the packages for such devices carry a clear label stating that they are not to be resterilized.[4]

In a recent study conducted in a hospital setting, the authors determined that the cleaning protocol was not entirely effective for some of the instruments used in an oral and maxillofacial surgery clinic.[4] High rates of bacterial contamination were discovered following resterilization of bone burs by gas sterilization.[4] If sterilization

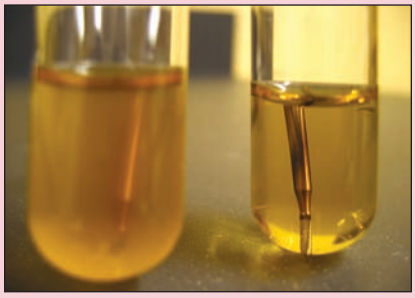

Figure 1: Presence of bacterial growth denoted by cloudy broth (left); sterile sample indicated by clear broth (right).

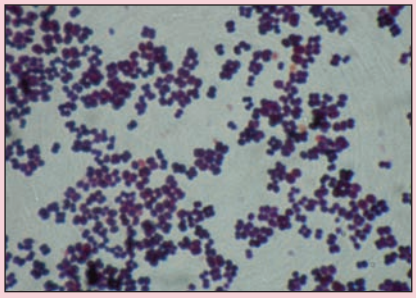

Figure 2: Gram staining demonstrates bacterial growth on a used bur that was resterilized.

Table 3 Results of testing for contamination of burs

Group	No. (%) burs contaminated
B1	0 (0)
B2	17 (42)
B3	6 (15)
B4	14 (35)
B5	21 (52)

See Table 1 for description of groups.

Table 4 Results of testing for contamination of files

Group	No. (%) files contaminated
F1	0 (0)
F2	18 (45)
F3	23 (58)
F4	5 (12)

See Table 2 for description of groups.

in a hospital setting is not completely effective, then sterilization in dental offices may not be as adequate as once thought.

In the United Kingdom, concern has been raised over the potential transmission of prions by endodontic files because these devices come into contact with the peripheral branches of the trigeminal nerve. Of particular concern is the iatrogenic transmission of variant Creutzfeldt-Jakob disease, one of the transmissible spongiform encephalopathies.[5,7] The risk of transfer of this disease in dentistry is currently unknown; however, animal studies have shown that these prions can be transmitted via the oral cavity.[7] Even if the risk of disease transmission is minimal during endodontic procedures, the high frequency of root canal treatments could increase the possibility of an adverse event.[5,8,9] This is one example of why it is so important to ensure that resterilization procedures are effective. Treating endodontic files as single-use devices would eliminate this potential risk.

Smith and others[5] found that a large number (76%) of files collected from the U.K. dental community remained visibly contaminated after completion of the sterilization process. This is additional proof of unsatisfactory sterilization methods.

The results obtained in the current study reinforce the conclusion that several of the methods of resterilization employed in the dental community are unsatisfactory. In this experiment, 5 techniques of resterilization were tested and found to be inadequate. Rates of contamination ranged from 15% of the items in group B3 to 58% of those in group F3. There are many variables to consider with each resterilization technique, and these variables account for the differences in results. Given the many variables, it is, for the most part, impossible to directly compare the techniques. However, the goal of this study was not to determine which technique was most effective and why; rather, the aim was to determine if the techniques being used today are effective.

The sterilization techniques were 100% effective for only 2 groups: the new burs and files that were sterilized before first use (groups B1 and F1, respectively). Group B1 can be directly compared with group B3 (used burs), because the sterilization technique used was the same, the only difference being that the used items in group B3 had visible debris and were brushed manually before packaging. None of the items in group B1 were contaminated following sterilization, but 15% of the burs in group B3 were contaminated following the same procedure ($p = 0.01$). Similarly, group F1 can be directly compared with group F3 (used files), for which the identical sterilization technique was used. In group F1, none of the items were contaminated, but in group F3, 58% of the items were contaminated after the resterilization procedure ($p < 0.001$). By comparing these groups, it becomes apparent that perhaps the problem with the sterilization procedures is the method employed to remove gross debris from the burs and files, rather than the

method of sterilization. This relates back to the small size and complex surface architecture of these items. If the organic debris can be physically removed from these items, it is possible to sterilize them. Groups B1 and F1 had no organic contaminating debris and were rendered 100% sterile by the procedures outlined in **Tables 1** and **2**.

The other objective of this study was to determine if new burs and files are sterile when they are purchased from the manufacturer. To satisfy this objective, new burs and files (groups B2 and F2, respectively) were incubated in nutrient broth using the same technique as for the other groups. Following incubation, 42% of the burs in group B2 were contaminated, and 45% of the files in group F2 were contaminated. This indicates that these instruments are not sterile at time of purchase and should be sterilized before first use.

Conclusions

Sterilization procedures were successful for burs and files that had not been previously contaminated by organic debris. This was demonstrated by the groups of new burs (B1) and new files (F1) that were sterilized before first use. However, dental burs and endodontic files are not sterile when purchased and should be cleaned and sterilized before use.

Routine sterilization procedures for previously used burs and files were not effective, and further research is warranted to devise an effective sterilization protocol. Future studies should focus on determining the best method of precleaning these devices. If such procedures cannot be devised, perhaps the instruments should be considered single-use devices. This would reduce the risk of transmission of all infectious agents, including prions.[5]

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