

Resterilization of Instruments Used in a Hospital-based Oral and Maxillofacial Surgery Clinic

• Nicholas J.V. Hogg, MSc, DDS •
• Archibald D. Morrison, DDS, MSc, FRCD(C) •

A b s t r a c t

Objective: The transmission of pathogens from one patient to another via contaminated devices has been a high-profile issue in infection control. Although single-use devices have been promoted as a preventative strategy, resterilization of instruments has been a common practice in dentistry. The purpose of this study was to investigate the rate of bacterial contamination of instruments resterilized for use in oral and maxillofacial procedures in a hospital-based clinic.

Methods: The experiment was a prospective randomized controlled study. The test group consisted of burs that had been used in surgical procedures. These burs were grossly debrided before being cleaned and gas sterilized in the central sterilizing department of the hospital. The burs were transferred in a sterile fashion into a culture medium selected to grow oral bacteria. The control group comprised new unused instruments treated in an identical fashion before culturing. All burs were incubated and monitored daily for 72 h.

Results: The rate of bacterial contamination in the test groups was significantly higher than in the control group ($p < 0.05$).

Conclusions: Reuse of instruments can be cost-effective if the safety of patients can be assured; however, there is increasing evidence that the sterilization process may not be completely effective. Consideration should be given to the classification of certain types of dental burs as single-use devices if sterilization cannot be guaranteed.

MeSH Key Words: cross infection/prevention & control; dental instruments; disinfection methods; equipment reuse

© J Can Dent Assoc 2005; 71(3):179-82
This article has been peer reviewed.

Sterilization of instruments ensures that they are free of “all microbial life including microbial spores which are the most difficult of micro-organisms to kill.”¹ If the sterilization process is effective in killing bacterial spores, it will also be effective against mycobacteria and all viruses, including herpes simplex virus, hepatitis and HIV.¹

Resterilization is “the repeated application of a terminal process designed to remove or destroy all viable forms of microbial life, including bacterial spores, to an acceptable sterility assurance level.”² Resterilization of instruments used on one patient for reuse on another has been common practice in dentistry and oral and maxillofacial surgery. Some instruments used in oral and maxillofacial and orthopedic procedures, such as bone drills and saws, are Class I

instruments as defined by the United States’ Food and Drug Administration and can be reused if sterility can be guaranteed.³ However, there is now evidence that the sterilization process is complex and that if strict adherence to an effective protocol is not followed, contamination of instruments may result.

In the past decade, single-use devices (SUDs) have been promoted in many dental and medical practices as a strategy to prevent the transmission of blood- and tissue-borne pathogens from patient to patient. This practice has also been influenced by high-profile legal cases that have brought the issue of SUDs to the attention of the media and the public.⁴ For example, in Toronto in 2002, a case involving a patient who contracted the hepatitis B virus via

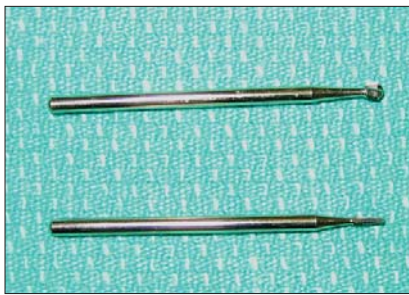


Figure 1: The 2 types of burs tested were the #701 fissure bur and the #8 round bur.



Figure 2: The instruments were placed into test tubes and stored vertically in racks in a 37°C incubator.

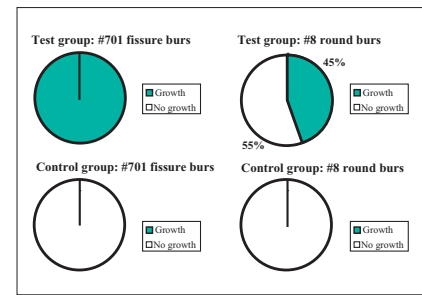


Figure 3: Bacterial contamination after culture in the 2 types of burs in the test group compared with the control group after 72 h of observation.

contaminated electroencephalogram electrodes resulted in a \$27.5-million settlement against the neurologist and hospital.⁴ SUDs are convenient and their use has become widespread in hospitals around the world. However, the use of disposable instruments does not come without a significant cost to the health care system as well as environmental concerns.⁵

Currently, numerous articles address the transmission of blood- and tissue-borne pathogens from one patient to another via contaminated devices.⁶⁻⁸ Many studies look at the bacterial and viral contamination of dental and medical instrumentation and the safety of sterilizing and reusing these instruments.^{9,10}

There have also been concerns over the possible transmission of prions by contaminated surgical instruments.⁶ The contact of endodontic files with the peripheral branches of the trigeminal nerve may present a risk of transmission of Creutzfeldt-Jakob Disease (CJD), although there is no evidence of transmission of CJD in dentistry.^{6,11}

Although SUDs have been promoted as a strategy to prevent cross-infection of patients, resterilization of previously used instruments is still common as cost is a significant factor in the decision to reuse instruments in dentistry and oral and maxillofacial surgery.¹² The practice of reprocessing used instruments is becoming more and more prevalent with the overall goal of saving money and decreasing environmental pollution.² Supporters of resterilization believe that the labelling of some devices as SUDs by manufacturers is done so that they can increase profits and avoid liability with regard to cross-infection of patients on whom their instruments are used.

Modern dental and medical equipment can be intricate and contain small lumens, as in endoscopic equipment, and therefore requires more rigorous procedures to ensure sterilization. Some instruments cannot be consistently and reliably sterilized; because of the risk of cross-contamination with these instruments, disposable devices became established in the health care industry. There is still much debate regarding the reuse of instruments in both dentistry and medicine.^{4,6-8}

The purpose of this study was to investigate the rate of bacterial contamination of instruments reesterilized for use in oral and maxillofacial procedures in a hospital-based clinic.

Materials and Methods

The test group consisted of 2 types of bone burs: #8 round burs and #701 fissure burs that had been used in a hospital-based clinic during surgical procedures requiring bone removal or re-contouring or sectioning of teeth (Fig. 1). The staff who worked in the clinic processed the burs initially; they grossly debrided the 2 types of burs before sending the instruments to the central sterilizing department (CSD) of the hospital. In the CSD, the burs were unpackaged and placed in an ultrasonic cleaner for 3 minutes to remove gross organic and microbial contamination. Following this, they were run through a washer-decontaminator station that flushed them with water heated to 98°C. The burs were then processed in a drying station and packed in paper and plastic peel-back packages before entering the gas sterilization cycle.

Gas vapour sterilization involved a gas mixture consisting of 10% ethylene oxide and 90% CO₂. The burs were subjected to a 1-h conditioning cycle, 3-h sterilization (55°C) cycle, 20-minute exhaust cycle, and a 12-h aeration cycle. The gas vapour sterilization process was monitored using physical, chemical and biological indicators. On completion of the procedure, the burs were transferred in sterile fashion into test tubes containing a culture medium selected to grow oral bacteria (Todd-Hewitt broth). The control group comprised new unused instruments treated in an identical fashion before culturing. All samples ($n = 160$) were then placed in an incubator maintained at 37°C (Fig. 2) to mimic body temperature. The burs were examined daily over 72 h to check for evidence of bacterial growth. Chi-squared tests were used to test for significant differences between the 2 groups and subgroups.

Table 1 Statistical analysis

Groups compared	X ² value	DF	p value
Test group (n = 80) vs. control group (n = 80)	87.870	1	p < 0.0001
Fissure burs, test group (n = 40) vs. round burs, test group (n = 40)	27.649	1	p < 0.0001
Fissure burs: test group (n = 40) vs. control group (n = 40)	76.050	1	p < 0.0001
Round burs: test group (n = 40) vs. control group (n = 40)	20.717	1	p < 0.0001

DF = degrees of freedom.

Results

In the test group, 100% of the #701 fissure burs and 45% of the #8 round burs showed evidence of bacterial growth after 72 h of observation (Fig. 3). No instruments in the control group showed any evidence of bacterial growth after 72 h (Fig. 3). The bacterial growth on the dental burs was examined. The colony structure and Gram staining were consistent with the growth of streptococcus species. Chi-squared tests showed significant differences between the groups ($p < 0.05$) (Table 1).

Discussion

This study showed that the sterilization technique used in the hospital clinic and CSD was not effective in cleaning some of the instruments used in oral and maxillofacial surgical procedures. Surprisingly high rates of bacterial contamination were noted with both types of bone burs. All of the #701 fissure burs showed evidence of bacterial contamination after 72 h of observation.

Other studies have also shown that reuse of instruments is common and that cleaning of these instruments may not always be effective. For example, Lowe, Burke and others¹² conducted a survey of general dentists in Scotland and found that 93% of those who answered the survey reused matrix bands on multiple patients in their practices. Although 99% of respondents used a steam autoclave to sterilize instruments, they used a variety of presterilization cleaning methods, ranging from a pre-soak only to a combination pre-soak, ultrasonic cleaning and hand scrubbing. The importance of pre-cleaning instruments before steam autoclaving has been well reviewed.¹³

In a subsequent study, Lowe, Bagg and others¹⁴ looked at blood contamination of matrix bands; they collected used matrix bands and matrix band retainers from general dentists in the community. The instruments had been sterilized according to the regular protocol within each office, 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. These results show the benefit of ultrasonic cleaning before steam autoclaving as confirmed by other studies.¹⁵ The results are also similar to the present study in that they showed a high rate of contamination. The data confirm that there was a

failure of the sterilization process, and Lowe, Bagg and others¹⁴ agree with the possibility of using disposable systems to eliminate risks, although cost may be a deterrent to the widespread acceptance of this practice.

Endodontic files are another type of instrument that is commonly reused. In a survey of general dentists in the United Kingdom, Bagg and others¹¹ found that 88% of practitioners reused endodontic files. Smith and others⁶ compared used endodontic files that had been collected from general dental practices with files from a dental hospital, and found that 76% of the former were visibly contaminated when inspected under a dissecting microscope, as opposed to 14% of those from the dental hospital. These authors also concluded that the cleaning methods used were insufficient to remove the organic material on the endodontic files. They suggested that a cost-benefit analysis would be helpful in determining whether these files would be suitable for designation as single use.

The clinical applicability of studies that look at the risk of cross contamination as a result of using contaminated instruments depends on the amount of the pathogen transferred, the infectivity of the pathogen and host resistance.¹⁶ The ultimate outcome depends on the long-term course of the disease caused by the pathogen. Attention has been focused on bacterial infection, but as the oral cavity is a contaminated environment to begin with, the clinical applicability of the research is difficult to elucidate. There has been public concern over handpiece and waterline contamination issues as these topics were widely covered in the media. There have also been ethical studies looking at the issues of reuse and reprocessing and whether the patient is at risk from these practices.¹⁷ Resterilization is a controversial issue that has yet to be resolved.

This study revealed a high rate of bacterial contamination of rotary instruments despite pre-cleaning and gas sterilization in a hospital-based sterilization department. Other studies have shown that pre-cleaning and sterilization in dental offices may not be as effective at rendering instruments free from contamination as is commonly thought. Cost-benefit analysis may show that for some instruments it may be more cost-effective to use them once and discard them rather than attempt a cleaning and sterilization process that may not be effective.

Conclusions

Sterilizing instruments is a labour-intensive process that requires careful attention to detail. Reuse of rotary instruments can be a cost-effective measure in the practice of oral and maxillofacial surgery if the safety of patients can be assured. Yet there seems to be increasing evidence that the sterilization process may not be completely effective due to human, mechanical or microbial factors. Consideration should be given to the classification of rotary instruments as SUDs if sterilization cannot be guaranteed. ♦

Acknowledgement: Source of funding for this research: the John P. Laba Memorial Research Fund.



Dr. Hogg is chief resident, department of oral and maxillofacial sciences, faculty of dentistry, Dalhousie University, Halifax, Nova Scotia.



Dr. Morrison is director of graduate training in oral and maxillofacial surgery, department of oral and maxillofacial sciences, faculty of dentistry, Dalhousie University, Halifax, Nova Scotia.

Correspondence to: Dr. Archibald D. Morrison, Department of Oral and Maxillofacial Sciences, Faculty of Dentistry, Dalhousie University, Halifax, NS B3H 3J5. E-mail: archie.morrison@dal.ca.

The authors have no declared financial interests.

References

1. Woods R. Sterilisation: Part 1. Instrument preparation. *FDI World* 1996; 5(2):7-10.
2. Dunn D. Reprocessing single-use devices — the ethical dilemma. *AORN J* 2002; 75(5):989-99.
3. Dunn D. Reprocessing single-use devices — regulatory roles. *AORN J* 2002; 76(1):100-6, 108-12.
4. Mackay B. No ban on reuse of single-use medical devices imminent. *CMAJ* 2002; 166(7):943.
5. Dunn D. Reprocessing single-use devices — the equipment connection. *AORN J* 2002; 75(6):1143-58.
6. Smith A, Dickson M, Aitken J, Bagg J. Contaminated dental instruments. *J Hosp Infect* 2002; 51(3):233-5.
7. Linsuwanont P, Parashos P, Messer HH. Cleaning of rotary nickel-titanium endodontic instruments. *Int Endod J* 2004; 37(1):19-28.
8. Heeg P, Roth K, Reichel R, Cogdill P, Bond WW. Decontaminated single-use devices: an oxymoron that may be placing patients at risk for cross-contamination. *Infect Control Hosp Epidemiol* 2001; 22(9):542-9.
9. Lewis DL, Arens M. Resistance of microorganisms to disinfection in dental and medical devices. *Nat Med* 1995; 1(9):956-8.
10. Lewis DL, Arens M, Appleton SS, Nakashima K, Ryu J, Boe RK, and others. Cross-contamination potential with dental equipment. *Lancet* 1992; 340(8830):1252-4.
11. Bagg J, Sweeney CP, Roy KM, Sharp T, Smith A. Cross infection control measures and the treatment of patients at risk of Creutzfeldt Jakob disease in UK general dental practice. *Br Dent J* 2001; 191(2):87-90.
12. Lowe AH, Burke FJ, McHugh S, Bagg J. A survey of the use of matrix bands and their decontamination in general dental practice. *Br Dent J* 2002; 192(1):40-2.
13. Woods R, Amerena V, David P, Fan PL, Heydt H, Marianos D. Sterilisation: Part 2. Heat and chemical sterilisation. *FDI World* 1996; 5(3):13-6.
14. Lowe AH, Bagg J, Burke FJ, MacKenzie D, McHugh S. A study of blood contamination of Siqueland matrix bands. *Br Dent J* 2002; 192(1):43-5.
15. Rutala WA, Gergen MF, Jones JF, Weber DJ. Levels of microbial contamination on surgical instruments. *Am J Infect Control* 1998; 26(2):143-5.
16. Kohn WG, Collins AS, Cleveland JL, Harte JA, Eklund KJ, Malvitz DM. Centers for Disease Control and Prevention. Guidelines for infection control in dental health care settings — 2003. *MMWR Recomm Rep* 2003; 52(RR-17):1-67.
17. Ball CK, Schafer EM, Thorne D. Reusing disposables: same old story — more characters added. *Insight* 1996; 21(3):77-84.

Got an opinion? Discuss this article in the CDA Members' Forum at www.cda-adc.ca/forum. Not sure how to log in? It's as easy as...

1. Go to the Web address provided above
2. Type in your password
3. Choose a topic and start "chatting".

Don't know your password? Forgot your password?

Online instructions are provided to help you retrieve that information. Or contact CDA at 1-800-267-6354, between 8 a.m. and 4 p.m. EST, e-mail: reception@cda-adc.ca.