

ORIGINAL ARTICLE

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Effectiveness of the glass-bead sterilizer in ophthalmic instruments

ABSTRACT

Objective

To evaluate the effectiveness of the glass-bead sterilizer compared to the autoclave in inhibiting the growth of common ocular bacterial pathogens.

Methods

This is an experimental study involving the use of ophthalmic instruments (toothless and toothed forceps, Vannas scissors, McPherson forceps) that were inoculated with the test bacteria (*Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus pneumoniae*, and *Pseudomonas aeruginosa*). The instruments were assigned to group A (autoclave sterilization) and group B (glass-bead sterilization). Group A instruments were autoclaved for 30 minutes and then smeared directly into blood agar plates (positive control). Group B instruments underwent glass bead sterilization for 30 seconds, and a separate batch for 60 seconds. They were also smeared directly into blood agar plates. All blood agar plates were incubated for 48 hours and examined for bacterial growth. Chi-square test was used to analyze the data.

Results

No growth was observed for each type of bacteria after autoclave sterilization and glass-bead sterilization.

Conclusion

Glass-bead sterilization is as effective as autoclave sterilization for use in ophthalmic instruments.

Keywords: *Glass-bead sterilizer, Autoclave sterilizer, Disinfection*

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THE USE of sterile instruments is of utmost importance in a clinical setting especially in ophthalmic surgeries. There are several methods of sterilizing surgical instruments, most common of which is by autoclaving. Using moist heat, it is currently the gold standard for sterilization of ophthalmic instruments.

Chemical disinfection by glutaraldehyde and other related chemicals is a common method used in ophthalmic surgical missions in rural areas in the country. However, there have been anecdotal reports of endophthalmitis cases following use of instruments sterilized by this method. Thus, an alternative, effective method is needed, such as the use of glass-bead sterilizer.

The glass-bead sterilizer is a common method used in oral surgery and dental practice for chair-side sterilization of small hand instruments, especially endodontic files. Using dry heat, it can achieve sterilization within a few seconds.^{2, 4, 6, 8, 10, 13} *In vitro* studies have shown the efficiency of this method in acupuncture needles¹³ and podiatric devices. There are, however, no reports in the literature evaluating this technology in ophthalmic practice.

This study evaluated the effectiveness of glass-bead sterilization vis-à-vis autoclave. We specifically evaluated their efficacy against *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus pneumoniae*, and *Pseudomonas aeruginosa* as these organisms are among the commonly implicated bacterial eye infections.

METHODOLOGY

This is an experimental study performed at the microbiology laboratory of the Division of Pathology at St. Luke's Medical Center. The ophthalmic instruments used were toothless and toothed forceps (Hollywood Instruments, India), Vannas scissors (H-4240, Hollywood Instruments, India), and McPherson forceps (H-3338, Hollywood Instruments, India).

The pathogens tested were *S. aureus*, *S. epidermidis*, *S. pneumoniae*, and *P. aeruginosa*. One culture plate per bacterial species was prepared for inoculation. Each plate had several colony-forming units (CFU).

Prior to inoculation with the test bacteria, the ophthalmic instruments were autoclaved using the Hirayama HA-240MIV Automatic High Pressure Sterilizer for 30 minutes at 121° C and 15 psi.

Each instrument was inoculated with bacteria by directly smearing each instrument onto one CFU of each bacterial pathogen. Blood agar plates were then inoculated directly with these instruments. These plates served as the negative control for each pathogen.

The instruments were assigned to group A (autoclave sterilization) and group B (glass-bead sterilization). The ophthalmic instruments assigned to group A were autoclaved for 30 minutes. Blood agar plates were then

smeared directly with these instruments. These plates served as the positive controls.

The ophthalmic instruments assigned to group B were placed in the glass-bead sterilizer for 30 seconds, and a separate batch for 60 seconds. Blood agar plates were then smeared directly with these instruments.

All blood agar plates were incubated for 48 hours and examined for bacterial growth.

RESULTS

No bacterial growth was observed after 48 hours of incubation in both groups (Table 1). This was also true for the 30-second and the 60-second subgroups in group B.

Table 1. Growth of bacteria on blood agar media in each study group.

Bacteria	(Negative) Control	Group A	Group B	
			30 sec	60 sec
<i>S. aureus</i>	(+) growth	No growth	No growth	No growth
<i>S. epidermidis</i>	(+) growth	No growth	No growth	No growth
<i>S. pneumoniae</i>	(+) growth	No growth	No growth	No growth
<i>P. aeruginosa</i>	(+) growth	No growth	No growth	No growth

DISCUSSION

Our study demonstrated that the glass-bead sterilizer is as effective as the standard autoclave in sterilizing ophthalmic instruments inoculated with *S. aureus*, *S. epidermidis*, *S. pneumoniae*, and *P. aeruginosa* ($p = 0.046$). The absence of any bacterial growth after artificial contamination of the instruments demonstrated that the glass-bead sterilizer is capable of eradicating the pathogens tested in this study.

It takes approximately 20 minutes for the beads to heat up to 250° C. The unit is controlled by a thermostat, which continuously cycles the heater on and off, producing uniform heat (Product Information Sheet, PhytoTechnology Laboratories Inc., USA). The autoclave, on the other hand, has a sterilizing temperature range of 105 to 126° C. Thus, both techniques are effective forms of thermal sterilization. At these temperatures, there is irreversible denaturation of enzymes and structural proteins.

Artificial contamination of the instruments used in this study was performed by directly smearing stock cultures. This simulates actual practice wherein instruments may be accidentally contaminated during use. However, instruments tend to accumulate debris during use, which may serve as bioburden on the sterilization of instruments. In endodontic files, it has been shown that bioburden does not affect the sterilization method.^{9, 12} Still, other studies advocate wiping with or without alcohol prior to glass-bead sterilization in order to mechanically remove organic

debris and decrease the microbial load.^{1, 4, 6-7}

Our study showed that the glass-bead sterilizer could be used as a rapid and convenient method to sterilize directly contaminated instruments. Several reports have shown its efficacy with as brief as 10 seconds of exposure to preheated glass beads.¹³ Others report an interval of 3 minutes⁷ and 12 minutes.³ The manufacturers recommend its use for 10 to 15 seconds, but no more than 60 seconds. The potential of iatrogenic contact burns must be kept in mind when using the glass-bead sterilizer.¹¹ A cooling period of around two minutes should be allowed prior to the use of the sterilized instruments.

It must be qualified that only the part of the instrument touching the glass beads will be sterilized. Hence, it may be necessary to perform sterilization on both ends of the instruments. Alternatively, more glass beads can be placed in the sterilization chamber to cover a greater, if not the entire, surface area of the instruments. Thus, current available models of glass-bead sterilizers are best reserved for small instruments. Larger sterilization chambers to accommodate more glass-beads to disinfect an entire instrument are, of course, more advantageous as they ensure complete sterilization.

While the bacteria included in this study represent the clinically important pathogens, future experiments should also test *Bacillus cereus*, a heat-resistant, spore-forming bacterium. The glass-bead sterilizer has been shown to be effective against such spore-forming bacteria in dental instruments.^{2, 3, 5, 7-11, 13} Other significant microbes for investigation include Mycobacteria (tuberculous and other atypical species), fungi (Aspergillum and Candida), and viruses (Herpesvirus, Adenovirus). More complex culture media and isolation techniques would be required for these pathogens.

In conclusion, glass-bead sterilization appears to be as effective as autoclave sterilization for use in ophthalmic instruments. It is a rapid and convenient alternative to chemical disinfection for use in the office setting.

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