THE ROSS M1 STERILIZATION IMPACT ON THE EMERGENCY REUSE OF DISPOSABLE DENTAL INSTRUMENTS AND 3D PRINTING MATERIALS

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Naval Medical Research Unit (NAMRU) San Antonio plays a vital part within Navy Medicine Research & Development (NMR&D), supporting medical readiness to ensure warfighter lethality.

Objectives/Aims

To aid in medical and military readiness, the ROSS M1 portable ozone sterilizer was tested on its effects on disposable dental instruments and 3D printing materials. In a large-scale combat operation where there could be disruption to the supply change it could be vital to be able to reuse disposable instruments as well as 3D print tools and components. Determining the ability to disinfect these types of instruments is crucial to maintaining medical and military readiness.

Methods

Disposible Instruments: Sterile-i-pak dental tools were inoculated with 1.2 x10^9 cells of MRSA for 1 h, dried for 15 min, and sterilized. Each run contained a chemical indicator and a biological indicator. Following the sterilization run, sterilized instruments, and the controls were placed in media and placed in a 37°C shaking incubator overnight. The following day, the OD 600 was read.

3D Printing Materials: The effects of ozone sterilization on the mechanical properties of Surgical Guide (SG) resin, polylactic acid (PLA), and acrylonitrile butadiene styrene (ABS) were compared. Using three-point bend and fatigue tests, properties like maximum load force and stiffness (Young's modulus) were measured. Fatigue testing was also performed on the 3D printing materials.

Results

For the disposable dental instruments, the subsequent OD 600 readings revealed no growth on the ozone-treated instruments. Four runs resulted in a statistically significant result compared to the positive control (p=0.0001) using an unpaired t-test.

The results for 3D materials showed that even after nine cycles, ozone sterilization did not degrade the maximum load force and stiffness properties compared to untreated controls with a statistical significance of alpha 0.05. In contrast, a single steam sterilization cycle drastically weakened them. In cyclical fatigue testing, SG resin, PLA, and ABS performed equal to or better with ozone, than the control group.

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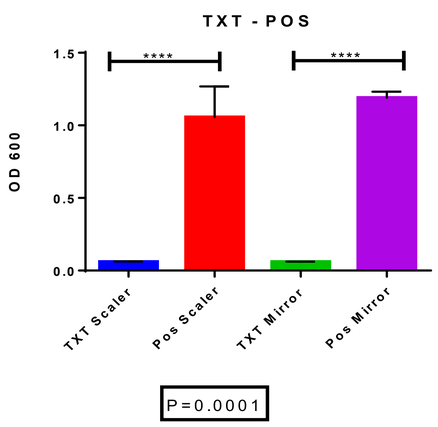

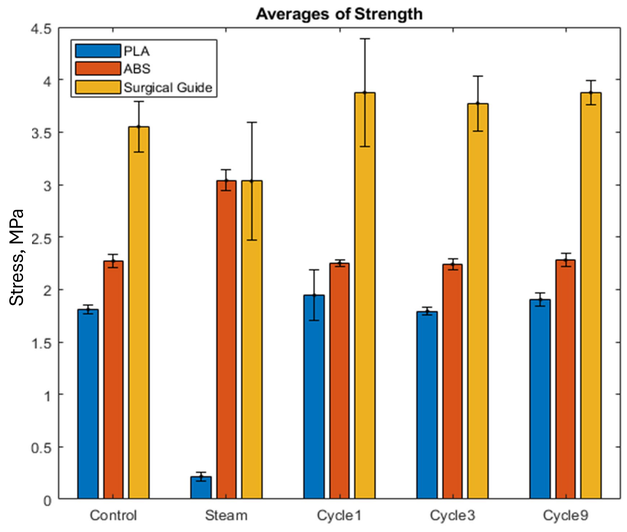

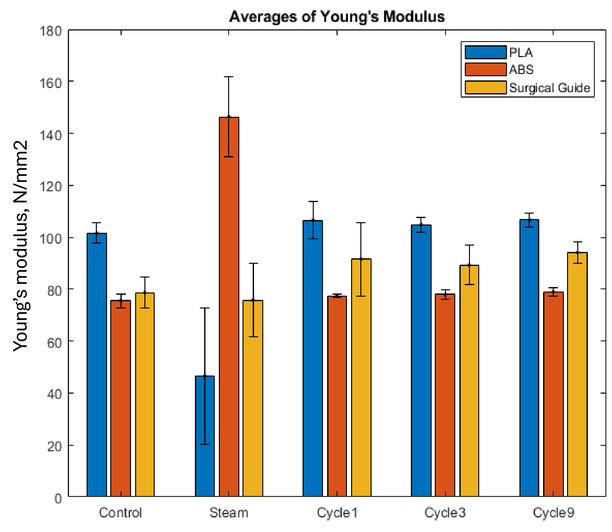

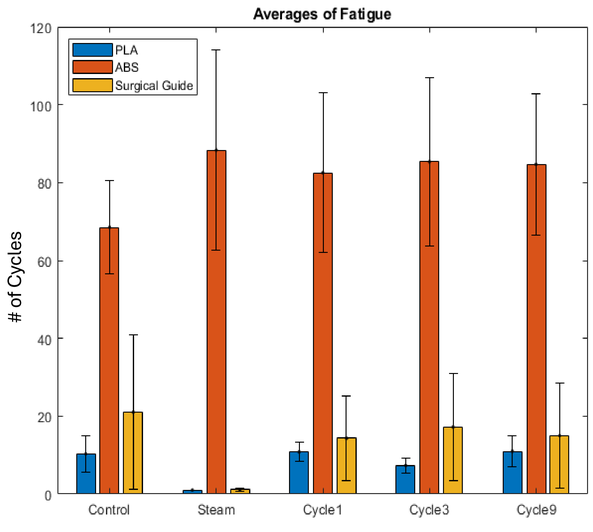

Conclusions

The ROSS M1 portable ozone sterilizer can repeatedly sterilize disposable and 3D-printed dental instruments, extending their useful lifespan in areas with limited supply chains. Crucially, ozone sterilization does not diminish the mechanical properties of the tested 3D printing materials compared with the control group. While proven to reduce bacterial loads of S. aureus, P. aeruginosa, A. baumannii, and S. sonnei in previous studies, future studies should challenge a wider variety of 3D-printed materials against ESKAPE and fungal pathogens to determine the full scope of use and point of failure. A usability study is in progress which will supply pertinent end user data.

SteriO3 ROSS M1 Ozone Sterilizer

Future Directions

The primary next steps for this study would be to challenge the ROSS M1 with:

- 3D Printed instruments
  - Challenge with fungal and other bacterial strains
  - Test mechanical properties of the 3D printed instruments after exposure to sterilization gas
- More complex dental and surgical instruments (such as items with hinges)
- Evaluate the life of the battery
- Run the sterilizer outside in field conditions
- Work on suggested improvements from the usability study
  - Rubber stopper
  - Quick connects

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