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Introduction

Dental handpieces pose a risk of cross infection due to ineffective inactivation of infectious material following clinical use¹. Cleaning and sterilization of dental handpieces is challenging, due to multiple internal components and lumens, which are difficult to access. A further limiting factor influencing achievement of sterilization conditions is the presence of oil used to lubricate internal components. The presence of oil is known to influence the D-value of microorganisms.

Aim

The aim of this study was to use a standard (BS EN ISO 11138-3:2009) biological indicator to investigate the effect of handpiece oil on kill-rates in dental handpieces undergoing steam sterilization.

Methods

- Spores of *G. stearothermophilus* loaded onto stainless steel wires (range of 5.8×10^5 - 3.5×10^6 spores, $D_{121} = 2.2$ min)
- Handpieces spray channels were inoculated with contaminated wires and 10 μ L of handpiece oil (W&H, Austria).
- Three different cycle profiles were programmed in a Biological Indicator Evaluation Resistometer (BIER vessel)
 - non-vacuum cycle (total cycle time 12 min 7 sec to 27 min 11 sec),
 - vacuum cycle 1 with one deep (45 mbar) pre-vacuum pulse (total cycle time 6 min 8 sec to 6 min 44 sec)
 - vacuum cycle 2 with ten small (900 mbar) pre-vacuum pulses (Total cycle time 5 min 9 sec to 7 min 57 sec)

Figure 1 Handpiece spray channels inoculated with contaminates wires

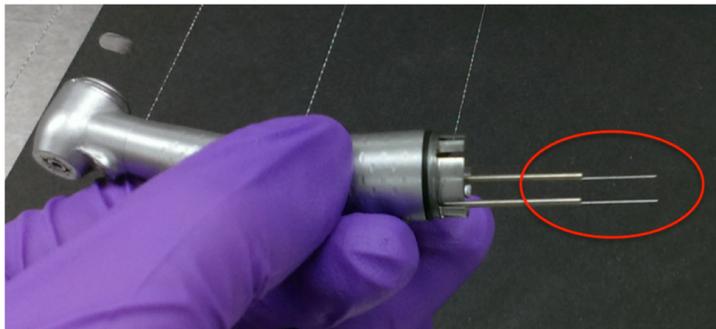


Figure 2 non-vacuum cycle profile; 134 C

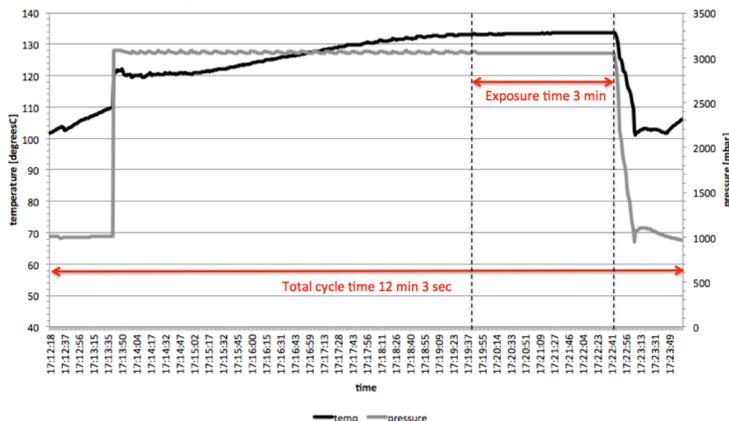


Table 1 Results of handpiece experiments in non-vacuum cycle (Hp = handpiece)

Growth of *G. stearothermophilus* spores on wires from handpieces in non-vacuum cycle (cfu/number of wires)

Mean cycle time 17 min 20 sec (N cycles = 3)

Hp 1 +oil	Hp 2 +oil	Hp 3 +oil	Hp -oil
0/6	0/6	0/6	0/6

Results

Spores were recovered by sonication of wires in PBS, filtration (0.45 μ m) and plating on Tryptone Soy Agar. Recovered counts were expressed as colony forming units. Four handpieces (TA-98 C LED, W&H, Austria) were run in each cycle tested and each cycle repeated in triplicate. No spores were recovered from inoculated handpieces in the non-vacuum cycle and vacuum cycle 2. BI were recovered from 4 out of 12 processed handpieces in vacuum cycle 1 with one pre-vacuum pulse. A range of 1 – 3 spores was recovered in 4/12 handpieces.

Figure 3 vacuum 1 cycle profile; 134 C 45 mbar pre-vac, 65 mbar post-vac

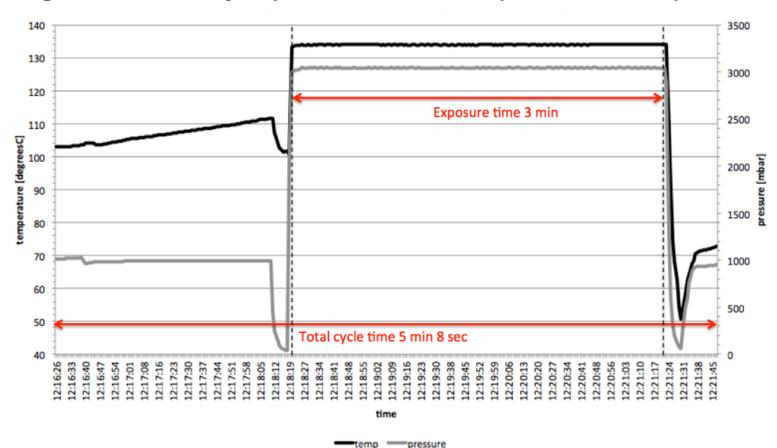


Table 2 Results of handpiece experiments in vacuum cycle 1 (Hp = handpiece)

Growth of *G. stearothermophilus* spores on wires from handpieces in vacuum cycle 1 (cfu/number of wires)

Mean cycle time 6 min 27 sec (N cycles = 3)

Hp 1 +oil	Hp 2 +oil	Hp 3 +oil	Hp -oil
2/6	3/6	2/6	1/6

Figure 4 vacuum 2 cycle profile; 134 C 10x900 mbar pre-vac, 65 mbar post-vac

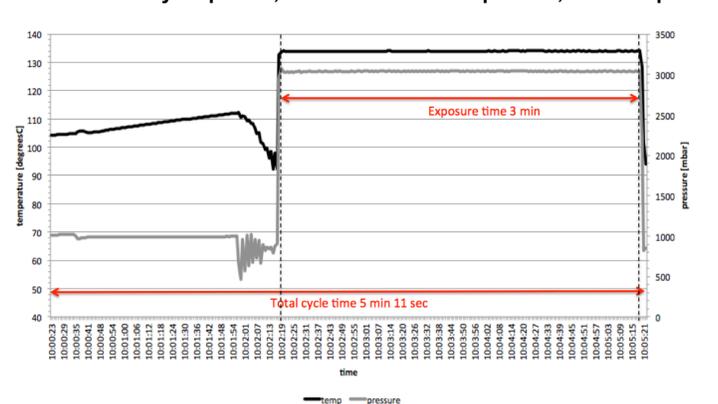


Table 3 Results of handpiece experiments in vacuum cycle 2 (Hp = handpiece)

Growth of *G. stearothermophilus* spores on wires from handpieces in vacuum cycle 1 (cfu/number of wires)

Mean cycle time 5 min 56 sec (N cycles = 3)

Hp 1 +oil	Hp 2 +oil	Hp 3 +oil	Hp -oil
0/6	0/6	0/6	0/6

Conclusions

- Spore survival influenced by number of vacuum pulses rather than depth
- Spore survival in the no-oil control highlights two contributing confounders;
 - Presence of oil in lumens may impair steam penetration
 - Design of vacuum cycle influences the outcome for handpiece lumens
- Limitation of study was that only one handpiece type was used; some handpieces may be more contaminated/challenging to reprocess than others
- This study emphasises the importance of detailed investigations into steam penetration of complex medical devices during validation and the potential erroneous assumptions that all steam sterilization processes are equally effective for all devices.

¹ Radcliffe et al. 2013, Hepatitis B virus transmissions associated with a portable dental clinic, West Virginia, 2009