TECHNOLOGY FOR BUSINESS

# STERILISATION OF DENTAL HAND INSTRUMENTS WITH SILICON PARTS PACKED IN SERVO–CASETTES

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## Aim of this study

Besides functionality the hygienic design of dental instruments needs to be taken into consideration in the product development. Especially cleanability of the new materials and points of contact between two materials may vary significantly compared to earlier product versions. Dental hand instruments are contaminated with oral microbes. These need to be destroyed during cleaning and sterilisation. In this study the efficacy of cleaning and sterilisation performed according to the instructions from National Agency for Medicines was tested for 3 different dental hand instruments with silicon parts; instrument 1 - LM 3 ES Explorer + silicone o-ring, instrument 2- Hu-Friedy Explorer EXD51, shank 31 + LM retro tagging with silicon sleeve, instrument 3 – Hu-Friedy Explorer EXD5, shank with 5 mm diameter + LM retro tagging shrink wrap; packed in 2 different Servo-cassettes; Servo 5 –cassettes and protected Servo 5E -cassettes (Fig. 1.).

## Test set-up

Dental hand instruments were soiled (for 30 min) with microbe solution containing yeast *Saccharomyces cerevisiae* (VTT C-00385T), bacterial spores (heat-shocked cells) *Bacillus subtilis* (VTT E-83178), Gram-negative bacterium *Escherichia coli* (VTT E-113164) and mould *Aspergillus niger* (VTT D-71006). A second test run was performed using bacteria causing dental caries; *Streptococcus mutans* (VTT E-011803T). After soiling instruments were placed in Servo-cassettes, washed in dish washer using the cleaning program for instruments and after that autoclaved at 134°C for 3 min. Live microbes were determined from both soiled and sterilised instruments using the culturing technique. The individual instruments were put into test tubes with PS buffer, whereas the cassettes were put into plastic bags with PS buffer. After mixing dilutions of PS buffer were plated on PCA (*E. coli*), PCA (*B. subtilis*), YM (*S. cerevisiae*), PDA (*A. niger*) and TSA (*S. mutans*) agar plates and incubated to allow the optimal growth of test microbes.

*Fig 1. Dental hand instruments used in the study. On the left: instrument 1 - LM 3 ES Explorer + silicone o-ring (up); instrument 2- Hu-Friedy Explorer EXD51, shank 31 + LM retro tagging with silicon sleeve (middle); instrument 3 – Hu-Friedy Explorer EXD5, shank with 5 mm diameter + LM retro tagging shrink wrap (below). On the right the two types of cassettes used; Servo 5 –cassettes and protected Servo 5E -cassettes.*

*Table 1. Results from sterilisation of dental hand instruments; detection is performed for whole instrument. Results are given in CFU (Colony Forming Units)/ instrument.*

| Nutrient plate | Microbe | culturing step | colony forming units/instrument instrument 1 | instrument 2 | instrument 3 |
|---|---|---|---|---|---|
| PCA | *Escherichia coli* | after soiling | $6 \times 10^7$ | $9 \times 10^7$ | $9 \times 10^7$ |
| | | After sterilisation in Servo 5 cassette | $< 1 \times 10^2$ | $< 1 \times 10^2$ | $< 1 \times 10^2$ |
| | | Servo 5E cassette | $< 1 \times 10^2$ | $< 1 \times 10^2$ | $< 1 \times 10^2$ |
| PCA | *Bacillus subtilis* | after soiling | $3 \times 10^7$ | $6 \times 10^7$ | $3 \times 10^7$ |
| | | After sterilisation in Servo 5 cassette | $< 1 \times 10^2$ | $< 1 \times 10^2$ | $< 1 \times 10^2$ |
| | | Servo 5E cassette | $< 1 \times 10^2$ | $< 1 \times 10^2$ | $< 1 \times 10^2$ |
| YM | *Saccharomyces cerevisiae* | after soiling | $1 \times 10^6$ | $1 \times 10^6$ | $6 \times 10^5$ |
| | | After sterilisation in Servo 5 cassette | $< 1 \times 10^2$ | $< 1 \times 10^2$ | $< 1 \times 10^2$ |
| | | Servo 5E cassette | $< 1 \times 10^2$ | $< 1 \times 10^2$ | $< 1 \times 10^2$ |
| PDA | *Aspergillus niger* | after soiling | $8 \times 10^5$ | $1 \times 10^6$ | $5 \times 10^5$ |
| | | After sterilisation in Servo 5 cassette | $< 1 \times 10^2$ | $< 1 \times 10^2$ | $< 1 \times 10^2$ |
| | | Servo 5E cassette | $< 1 \times 10^2$ | $< 1 \times 10^2$ | $< 1 \times 10^2$ |
| TSA | *Staphylococcus mutans* | after soiling | $1 \times 10^6$ | $1 \times 10^6$ | $1 \times 10^6$ |
| | | After sterilisation in Servo 5 cassette | $< 1 \times 10^2$ | $< 1 \times 10^2$ | $< 1 \times 10^2$ |
| | | Servo 5E cassette | $< 1 \times 10^2$ | $< 1 \times 10^2$ | $< 1 \times 10^2$ |

## Results

- The applied soiling method worked well since different instruments had all test microbes at the level above$10^5$ CFU/instrument.
- After washing and autoclaving live microbes could not be detected from any tested instruments or Servo-cassettes.
- Detection limit was 100 CFU/instrument and 1000 CFU/cassette in culture analysis performed immediately after the autoclaving. In all tested instruments no viable cells were detected after autoclaving.
- To ensure that microbes were killed during the autoclaving the instruments were further kept in the PS buffer over night at room temperature and re-analysed by culture. No live microbes were detected in any tested instrument. According to this additional enrichment step more than 5 log units of test microbes were killed from instruments and their silicon parts.
- During soiling procedure more than $10^7$ CFU *Bacillus subtilis* spores were attached on the instrument. After sterilisation process no *B. subtilis* –spores were detected in the instruments.
- After sterilisation process no test microbes were detected on Servo-cassettes.

Ref: VTT Customer report VTT-CR-03922-17

## SUMMARY

**All tested dental hand instruments with silicon parts had more than $10^5$ CFU microbes/instrument after the soiling. Soiled instruments were washed and autoclaved in Servo-cassettes. Thereafter no test microbes were detected from instruments (including silicon parts) and Servo-cassettes even after enrichment. During soiling step more than $10^7$ CFU *Bacillus subtilis* bacterial spores were attached on each instrument. After sterilisation procedure no *B. subtilis* –spores were detected in any of tested instruments and cassettes.**