Efficacy of microscopic surface patterning for reducing hospital environmental contamination

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INTRODUCTION

Environmental surfaces in the healthcare setting are frequently contaminated with pathogens that cause healthcare-associated infections (HAIs). Pathogens on these surfaces can survive and be transferred by touch despite efforts to reduce microbial contamination by disinfection and cleaning procedures. A surface technology that reduces microbial presence between cleaning episodes could decrease the risk of pathogen transmission and enhance existing environmental decontamination practices. In this study, an ordered, microscopic surface pattern called Sharklet™ was tested for its ability to reduce microbial contamination without the use of antimicrobial agents in a hospital setting.
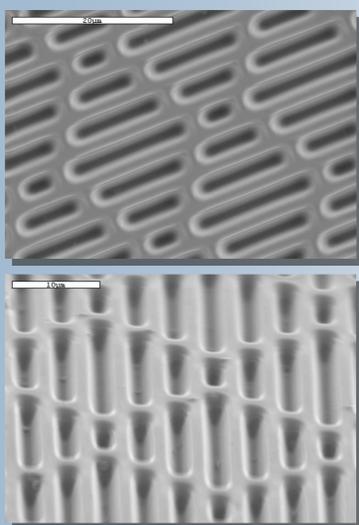
Scanning electron micrographs showing the Sharklet micro-pattern as used in the study. (Top) Top down view at 3000X with 20 micrometers scale bar. (Bottom) Perspective view at 3300X with 10 micrometers scale bar.

METHODS

Bacteriological Laboratory | Physician's bathroom | Corridor beneath room

Operating room | Corridor in front of pathology

Waiting room neurological nuclear medicine

- All surfaces sterilized with Biguacid Liquid (isopropanol and ethanol cleaner) at the start of the study
- Room temperature range: 22˚C - 30˚C
- Relative Humidity range: 20% - 100%

• Acrylic film with Sharklet™ micro-pattern was adhesively mounted onto 3A Composites DIBOND® wall panels (21cm x 125cm) and mounted in six locations in the hospital.

• In each location, four surfaces were evaluated: un-cleaned Sharklet test panel, un-cleaned DIBOND® control panel (with no Sharklet), Sharklet test panel cleaned once a week with detergent, and the un-cleaned wall as a second control.

• At defined time periods (1 week, 1 month, 3 months, and 6 months), agar contact plates (tryptic soy agar with neutralizers) were used to directly culture each surface to determine the quantity of viable microbes (CFU/plate).

• Additionally, the four surface types located in the physician's bathroom were artificially inoculated with *Staphylococcus aureus* at ~10^4 CFU/mL for 18 hours to confirm the results from the hospital study.

RESULTS

A total of 288 agar contact plates were enumerated over the six-month study to compare the effect of the Sharklet pattern on microbial contamination on hospital walls. Results showed a significant reduction in microbial contamination of test surfaces compared to control surfaces.

Sharklet (un-cleaned) | Wall (un-cleaned)

Sharklet (cleaned) | Dibond panel (un-cleaned)

Agar contact plates recovered from surfaces artificially inoculated with S. aureus and exposed for 18 hours in physician´s bathroom.

Total CFU's per panel (for all six locations)

Panel	After 1 week	After 1 month	After 3 months	After 6 months	Total
Sharklet (un-cleaned)	10	13	42	46	111
Dibond panel (un-cleaned)	22	18	36	126	202
Sharklet (cleaned)	9	5	46	42	102
Wall (un-cleaned)	54	928	77	125	1184

Mean colony counts per agar contact plate (CFU/plate)

	1 week	1 month	3 months	6 months	Overall
Wall (un-cleaned)	3.00	51.56	4.28	6.94	16.44
Sharklet (un-cleaned)	0.56	0.72	2.33	2.56	1.54
p-value	*0.0004*	*0.01*	*0.08*	*0.19*	*0.004*
Sharklet (cleaned)	0.50	0.28	2.56	2.33	1.42
p-value	*0.0003*	*0.01*	*0.15*	*0.17*	*0.004*

A two-tailed student´s t-test (assuming unequal variances) comparing the mean CFU/plate of both Sharklet panels (cleaned and un-cleaned) showed that the Sharklet surfaces were significantly less contaminated than the un-cleaned wall.

CONCLUSIONS

In this six-month hospital study, the Sharklet-patterned wall surfaces exhibited over 90% less microbial contamination than the un-modified wall. Additional experiments involving artificial contamination of surfaces also showed the same trends. The microbial counts on the cleaned and un-cleaned Sharklet surfaces were comparable, which suggests that the detergent cleaning did not have an adverse effect on the functionality of the surface. The Sharklet microscopic pattern represents a novel approach to reduce surface contamination without the use of antimicrobial agents in the healthcare environment.