Keeping Environmental Surfaces Cleaner Between Cleanings: A Non-Kill Surface Technology for Decreasing Bacterial Attachment, Survival Time, and Transmission on Environmental Surfaces in the Healthcare Setting

Kenneth K. Chung MSE[1], Shravanthi T. Reddy PhD[1], Herbert J. Houck MS[2], Anthony B. Brennan PhD[3], Kenneth H. Rand MD[2]

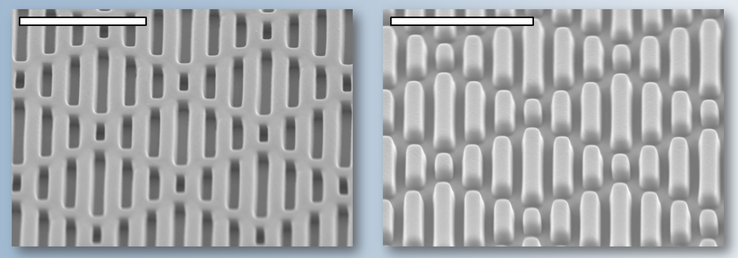
[1]Sharklet Technologies, Inc., Aurora, Colorado, USA

[2]Department of Pathology, Immunology, and Laboratory Medicine, University of Florida, Gainesville, Florida, USA

[3]Department of Materials Science and Engineering and J. Crayton Pruitt Family Department of Biomedical Engineering, University of Florida, Gainesville, Florida, USA

INTRODUCTION

Nosocomial pathogens readily contaminate and persist on environmental surfaces near patients in hospitals and can further be transferred by touch to hands or objects. The Sharklet micro-pattern has previously been shown to reduce bacterial colonization without the use of antimicrobial agents, offering a novel method to reduce surface contamination. This bench-top study was carried out to assess the ability for a micro-patterned surface to reduce bacterial attachment, colonization and transmission compared to un-patterned control surfaces.



The non-kill Sharklet micro-pattern is a surface modification that can be imprinted into a variety of materials, including silicone elastomer as depicted. Scanning electron micrographs of the micro-pattern with recessed grooves of varying lengths on the left and the alternate version of the Sharklet pattern with raised features on the right. Scale bars in both micrographs are 20 µm.

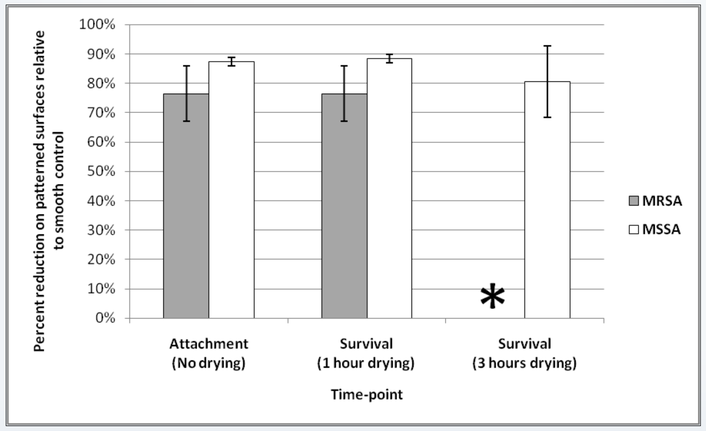
METHODS

Sharklet micro-patterned and control (smooth) surfaces were exposed to a single-species bacterial suspension for 30 minutes, followed by a saline rinse to remove non-adherent cells. Species tested included MRSA (ATCC 43300) and methicillin-susceptible *S. aureus* (MSSA, ATCC 6538). RODAC contact plates were used to recover attached cells immediately after rinsing for evaluation of bacterial attachment or after drying at room temperature for evaluation of bacterial survival. Experiments were carried out in duplicate for each strain type, and percent differences in colony counts between patterned and smooth surfaces were compared for statistical significance with a Student's t-test ($p<0.05$).

In order to measure the Sharklet surface's effect on touch transference, sample surfaces exposed to MSSA were quantified for attached cells before and after these moist surfaces were touched with a gloved finger. Samples used for testing were flat films of either silicone elastomer (Dow Corning Silastic® T-2) or acrylic and were sterilized with 95% ethanol or ethylene oxide (EO) gas sterilization.

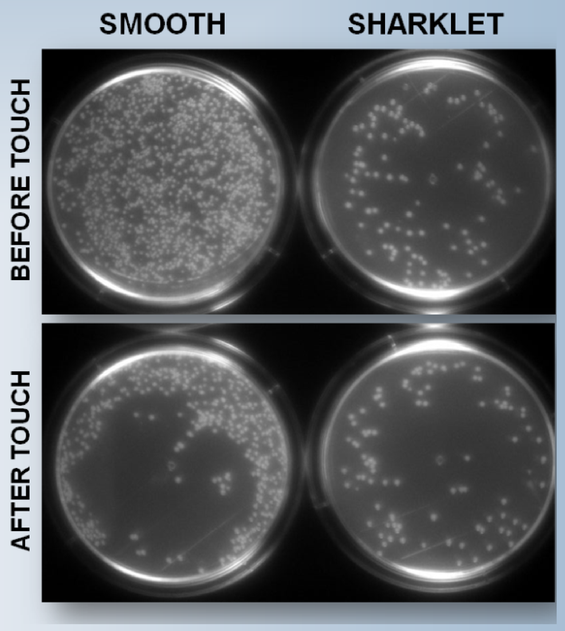
RESULTS

Sharklet micro-patterned surfaces demonstrated statistically significant ($p \leq 0.05$) reductions in bacterial attachment and survival compared to un-patterned control surfaces for all time-points with both MRSA and MSSA. This effect was observed regardless of differences in bacterial strains, inoculum concentration, and sample material. Additionally, there was a statistically significant reduction in surface-to-finger transference of MSSA off the micro-patterned surface compared to the smooth control surface. Similar experiments performed with an alternate version of the Sharklet pattern with raised features (made in the same silicone elastomer and acrylic materials) demonstrated reductions in bacterial attachment and survival with MRSA, VRE, *Pseudomonas aeruginosa*, and *Serratia marcescens* (data not shown here).



Compiled results for both strains of S. aureus *tested on the Sharklet micro-pattern (with recessed grooves) compared to smooth controls for attachment, one hour survival, and three hours survival (n=2). *No data obtained for MRSA at the 3 hour survival time-point. (*p< *0.05 for all data points).*

Bacterial Strain	*Time-point*	*Average Percent reduction on patterned surfaces relative to smooth control*
MRSA	Attachment (No drying)	76.5%
	Survival (1 hour drying)	76.5%
MSSA	Attachment (No drying)	87.4%
	Survival (1 hour drying)	88.4%
	Survival (3 hours drying)	80.6%



Representative photos of of RODAC plates from the touch transference experiment. Plates were touched to Sharklet surfaces (with recessed grooves) and smooth surfaces in acrylic material that had been inoculated with MSSA*. The top row of plates show the attached colonies prior to touch, with smooth on the left and Sharklet on the right. The bottom row of plates show attached colonies on each surface type after being touched with gloved fingertips. The Sharklet surface significantly reduced (*p=*0.047) the amount of bacteria transferred from surface to gloved fingertip.*

	SMOOTH	SHARKLET
Average Percent Transference from Surface to Fingertip	**67%**	**16%**

CONCLUSIONS

This study highlights the unique "quarantine-like" effect that the Sharklet micro-pattern has on microorganisms that come in contact with the surface; the pattern is associated with a decrease in bacterial survival and is less likely to transfer bacteria to fingertips by touch.

The Sharklet micro-patterned surface demonstrated reduced attachment when exposed to bacteria, reduced survival time of attached bacteria, and reduced surface-to-finger transference of attached bacteria. Sharklet micro-patterned surfaces introduce an environmentally-friendly approach to reduce the risk of transmission of human pathogens in the healthcare setting.

This work was financially supported by Sharklet Technologies, Inc.