Micro-patterned surfaces for reducing bacterial migration associated with catheter-associated urinary tract infection

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Introduction: The current paradigm for device-related strategies to prevent catheter-associated urinary tract infection (CAUTI) has been to introduce antimicrobial agents impregnated in the catheter material. However, use of antimicrobial agents can lead to resistance patterns that make infections more difficult to treat. This study presents a unique non-kill, physical surface modification approach for inhibiting bacterial migration. The aim of this study was to prove the use of the Sharklet micro-pattern for a novel Foley catheter application. Sharklet micro-patterns were tested for the ability to inhibit migration of a strain of *Serratia marcescens* (ATCC 43821) isolated from human urine.

Materials and Methods:

Rods (16 French, 1-cm length) with and without the Sharklet micro-pattern (inverse and positive) in two different orientations were fabricated in silicone elastomer. Rods were autoclave sterilized and placed in Petri dishes between two TSA islands. Each rod was inoculated at one end with a 20 microliter droplet of ~10^8 CFU/ml *S. marcescens* in TSB. Dishes were incubated at 37˚C for 24 hours followed by assessment of migration based on observation of colonies on opposite agar island.

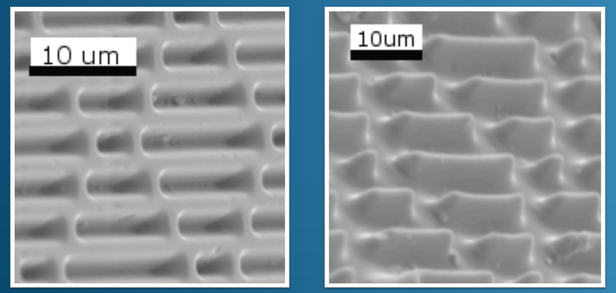


Figure 1: Inverse Sharklet pattern (ISK) left; Positive Sharklet pattern (SK) right.

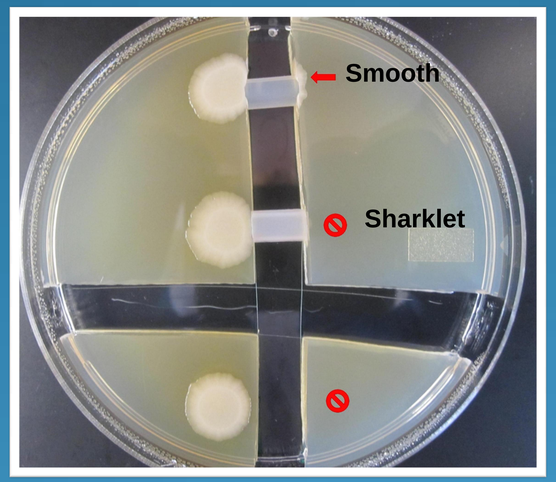
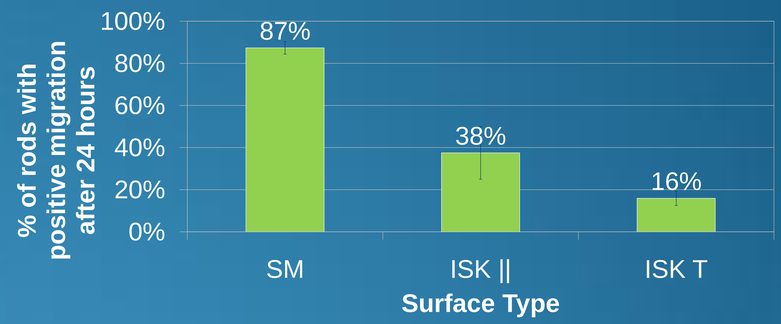


Figure 2: Image of one agar plate in the migration experiment. Two rods, one Sharklet and one smooth, are placed on a dry tract between two agar islands. The bottom islands are used as a negative control to confirm that migration does not occur over the dish surface.



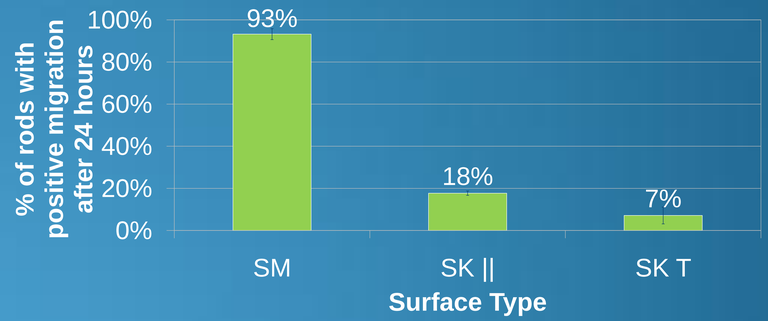


Figure 3: Inverse Sharklet pattern (ISK) results (top); Positive Sharklet pattern (SK) results (bottom), both compared to smooth (SM) un-patterned rods. Pattern is oriented perpendicular to direction of bacterial migration (T) or parallel (||) to the direction of migration.

Results: Sharklet micro-patterned rods demonstrated significantly decreased incidence of migration compared to smooth rods, with transverse orientation of the pattern performing most effectively.

Conclusion: The Sharklet micro-pattern demonstrated the ability to inhibit migration of *Serratia marcescens* through the use of physical surface modification alone. The results of this study suggest that modification of existing silicone Foley catheters with the Sharklet micro-pattern may prevent bacterial migration, with implications for reduced rate of bacteriuria and incidence of CAUTI. Future studies will address Sharklet's efficacy against other relevant uropathogens in an *in vitro* bladder model simulating bacterial migration along Sharklet-patterned catheter tube segments under conditions simulating an *in vivo* environment.

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