A Covalently Bound Surface Coating of Methacryloyloxoydodecyl Pyridinium Bromide (MDPB) Reduces Microbial Surface Contamination in an in vitro Model

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Introduction

- Periprosthetic joint infection (PJI) is a devastating complication of orthopedic surgery, with even low levels of bacterial contamination on an implant surface sufficient to cause deep infection.
- Implants are often exposed to ambient bacteria prior to and during implantation, creating a window of vulnerability.
- Current countermeasures – systemic antibiotics, sterile technique, laminar airflow – do not fully eliminate surface contamination on the implant.
- A novel, non-eluting antibacterial surface coating using 12-Methacryloyloxydodecyl pyridinium bromide (MDPB) covalently bound to cobalt chromium molybdenum (CoCrMo) alloy was developed by Onkos Surgical to address this gap in contamination reduction.
- This coating mechanically kills bacteria in the operating room environment through membrane perforation.

Methods

- MDPB coated and uncoated (control) CoCrMo alloy coupons were tested using a modified ASTM E2149 dynamic shake flask assay.
- Six clinically relevant bacterial strains common to orthopedic oncology periprosthetic infections were tested: *C. acnes, E. cloacae, E. coli, MRSA, MSSA, and P. aeruginosa.*
- Antibacterial efficacy was determined by quantitatively comparing the reduction in colony forming units (CFU) on coated samples vs uncoated controls.
- Each organism was tested under its own protocol (PDR-21-VER series).

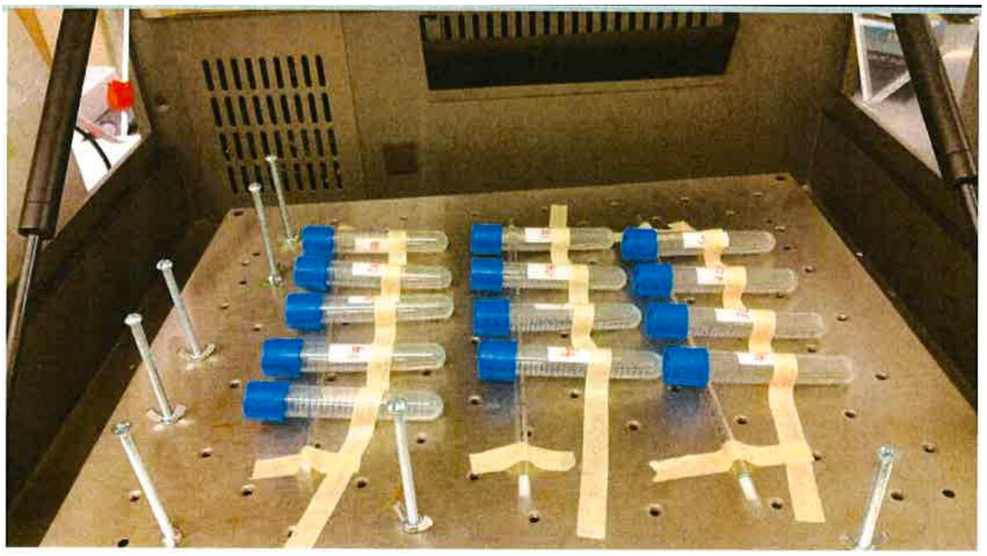

Figure 1. Culture tube arrangement in shaker incubator during modified ASTM E2149 dynamic contact assay.

Organism	Avg Control CFU/ml (Surface)	Avg Treated CFU/ml (Surface)	Surface Efficacy	System Reduction
C. acnes	3.94 E+3	0	100%	100%
E. cloacae	1.66 E+4	0	100%	100%
E. coli	4.08 E+3	0	100%	100%
MRSA	9.66 E+3	0	100%	100%
MSSA	1.31 E+4	0	100%	100%
P. aeruginosa	5.72 E+4	1.13 E+2	99.801%	99.95%

Table 1. MDPB surface coating efficacy by organism.

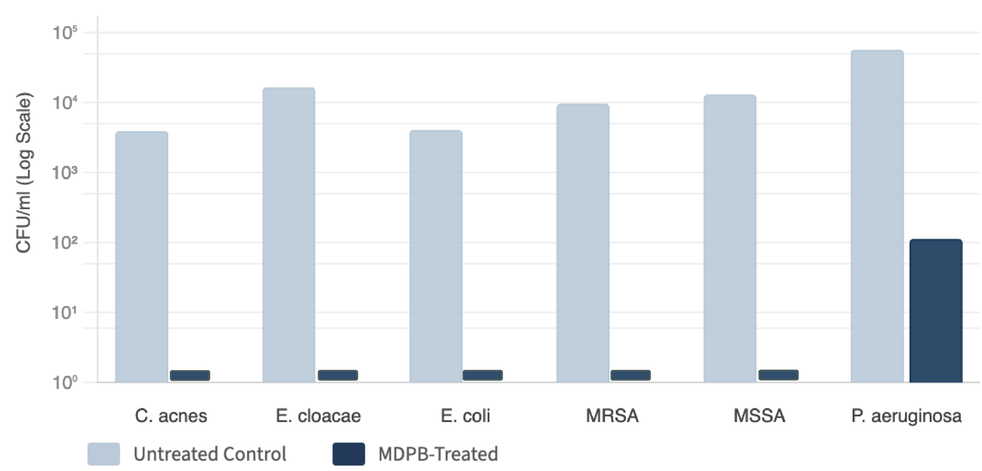

Figure 2. Log-scale surface CFU/ml: MDPB-treated vs. untreated coupons (modified ASTM E2149, n=6 per group).

Results

- MDPB-coated CoCrMo coupons achieved >99.999% efficacy against C. acnes, E. cloacae, E. coli, MSSA, and MRSA.
- P. aeruginosa showed >99.9% efficacy (99.95% reduction observed), meeting its acceptance criteria.
- All six bacterial species tested passed their respective acceptance criteria, demonstrating broad-spectrum antibacterial activity against both gram-positive and gram-negative organisms.
- The coating was demonstrated to be safe to mammalian cells in *ex vivo* experiments, supporting its biocompatibility for clinical use.

Conclusions

- MDPB surface coating consistently achieved >99.99% or greater reduction across all six clinically relevant bacterial strains tested, demonstrating robust broad-spectrum antibacterial efficacy.
- The mechanical mechanism mitigates concerns about antibiotic resistance development.
- MDPB surface treatment represents a promising adjunctive strategy to reduce bacterial contamination before implantation.