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Title: In search of the ideal implant coating: Measuring osseointegration of titanium implants coated with antimicrobial biomaterials

Authors: Christopher D. Hamad, Zeinab Mamouei, Nicholas V. Peterson, Joseph K. Kendal, Christopher M. Hart, Rahul Sobti, Jack W. Pearce, Parsa Asachi, and Nicholas M. Bernthal

¹Department of Orthopaedic Surgery, University of California, Los Angeles, Santa Monica, CA, USA

Background:

Periprosthetic infection and aseptic loosening are important and common modes of endoprosthetic failure in orthopaedic oncology. Advances in implant engineering include implant coatings aimed at promoting osseointegration and preventing infection. In this study, we investigate osseointegration of two implant coatings: Bactiguard® (Zimmer Biomet, Warsaw, IN) and an iodine eluting coating. Bactiguard® is an FDA approved coating currently used on urinary catheters to prevent infection. It consists of three noble metals: silver, gold, and palladium that generate a pico-current dispersion force that prevents microbial adhesion.

Questions/Purposes:

Does Bactiguard[®] or an iodine eluting coating on titanium implants affect temporal osseointegration in a murine model of knee arthroplasty?

Methods:

A 6 x 0.8mm titanium pin was implanted retrograde into the distal femur of 10-week-old C57BL/6 mice. Mice were randomized to receive three implants: uncoated titanium, Bactiguard[®], and eluting iodine. Animals were sacrificed at 2 and 4 weeks, and femurs were disarticulated, and soft tissue was removed. There were 5 mice in each group at each time point (N=30). Femurs were embedded in a resin block with the distal aspect exposed for "push-in" testing. An Instron hydraulic press was calibrated and used to quantify the force necessary to "push-in" the titanium implant, disrupting the bone-implant interface. Peak values were recorded for each implant from curves in Figure 1.

Results:

Push-in forces for titanium, Bactiguard[®], and iodine eluting implants were 40.8N, 47N, and 58N, respectively at 2 weeks (Figure 2). Push-in forces for titanium, Bactiguard[®], and iodine eluting implants were 70.5N, 63.2N, and 76.8N, respectively at 4 weeks (Figure 2). At 2 weeks, iodine has the highest push-in force and improves osseointegration compared to uncoated titanium (p=0.02). There was no significant difference between Bactiguard[®] and uncoated titanium at 2 weeks (p=0.7). Iodine and Bactiguard[®] did not significantly affect osseointegration of implants compared to uncoated titanium at 4 weeks (p=0.7 and p=0.56, respectively). Iodine appears to promote osseointegration at 2 weeks compared to uncoated titanium and has no significant effect at 4 weeks. Bactiguard[®] has no significant effect on osseointegration at 2 or 4 weeks.

Conclusion:

To decrease the incidence of implant failure, it is necessary to identify an implant coating with intrinsic antimicrobial activity and the ability to promote osseointegration. In this murine model of knee arthroplasty, an iodine eluting coating improved osseointegration at 2 weeks, but Bactiguard[®] did not have a significant effect on osseointegration at either 2 or 4 weeks, as assessed by "push-in" force required to disrupt the bone-implant interface.



Figure 1). 2 week "push-in" curves for A) uncoated titanum, B) Bactiguard[®], C) and iodine eluting. 4 week "push-in" curves for D) uncoated titanum, E) Bactiguard[®], F) and iodine eluting.



Figure 2). Average push in force in Newtons (N) for uncoated titanium, Bactiguard[®], and Iodine eluting implants at 2 and 4 weeks.