POSTER PRESENTATION

Bactiguard®

In vitro and in vivo durability of a noble metal coating

Katrin Ljunggren, Billy Södervall & Tanny Bachrach
Bactiguard, Stockholm, Sweden

INTRODUCTION & AIM

Implant-related infections continue to pose a major clinical burden in orthopedic trauma surgery, particularly in high-risk fracture populations where bacterial adhesion and early biofilm formation can rapidly compromise treatment outcomes[1–3].
Novel surface technologies designed to reduce microbial adhesion must demonstrate long-term durability under both clinical handling and mechanical processing stress.

OBJECTIVE

To evaluate the durability of noble metal coated orthopedic implants:

- *In vivo*

Retrieval analysis of a coated intramedullary nail after 8 months in a patient

- *In vitro*

Assessment of surface modification integrity following repeated autoclave sterilization cycles

BACTIGUARD TECHNOLOGY

Noble metal alloy surface modification consists of:
- Gold (Au)
- Silver (Ag)
- Palladium (Pd)

Applied as a thin surface modification intended to reduce microbial adhesion while maintaining implant function (Figure 1).

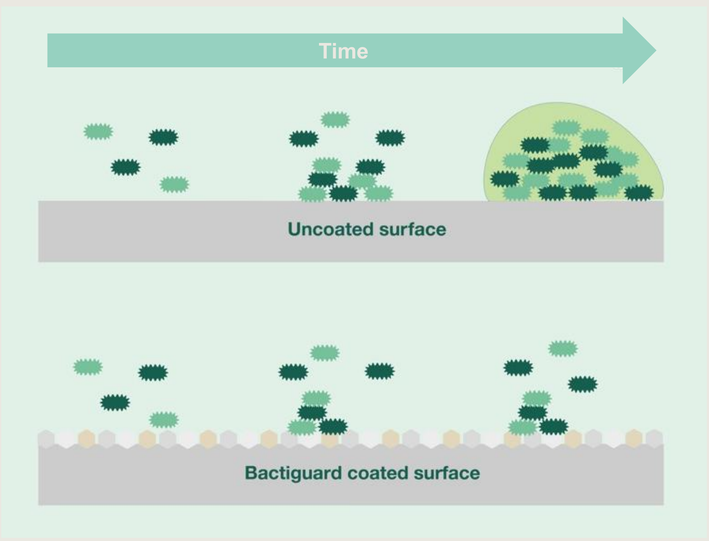

Figure 1: Schematic of microbial adhesion on uncoated vs. Bactiguard coated surface

METHODS

RETRIEVAL EVALUATION

Implant

Bactiguard coated tibial intramedullary nail retrieved after 8 months of clinical use

Analysis

Atomic Absorption Spectroscopy (AAS)
Quantification of silver surface concentration

Energy Dispersive X-ray Spectrometry (EDS)
Detection of surface modification metals

AUTOCLAVE DURABILITY STUDY

Sample preparation

Three Bactiguard coated tibial nails were cut into 55 ring-shaped samples using Computer Numerical Control (CNC) blade followed by polishing. The samples were then packed in sterilization packs with five pieces per package corresponding to one cycle group each and subjected to 0-50 autoclave cycles (121°C, 20 min). Silver surface concentrations were measured using Atomic Absorption Spectroscopy (AAS) after each cycle group (Figure 2).

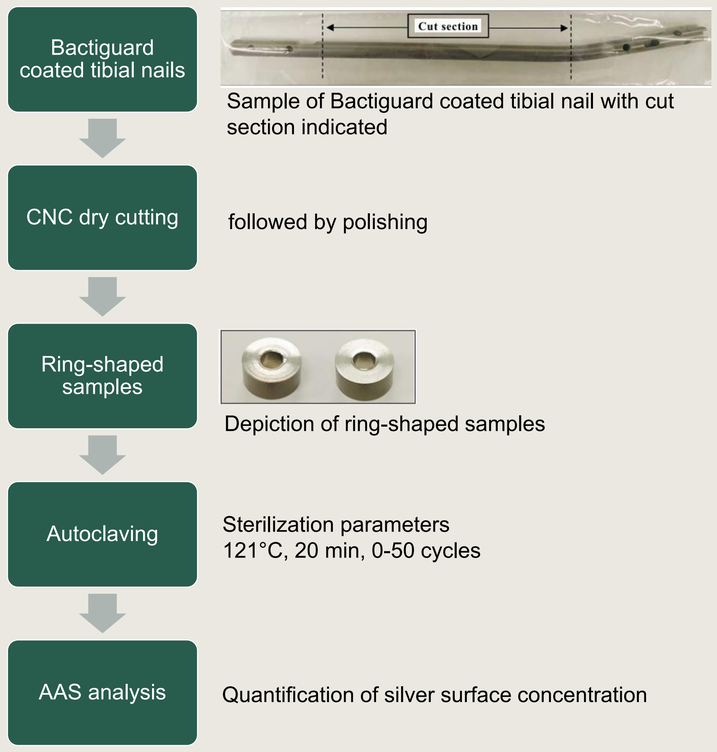

Figure 2: Workflow of *in vitro* durability testing

RESULTS

RETRIEVAL ANALYSIS

Silver surface concentration

Values remained within established technology specifications despite visible surface scratches

Metal identification

EDS spectra obtained identified:
- Silver (Ag)
- Gold (Au)
- Palladium (Pd)

along with expected substrate alloy elements:
- Titanium (Ti)
- Vanadium (V)

All surface modification constituents remained present after prolonged clinical use (Figure 3).

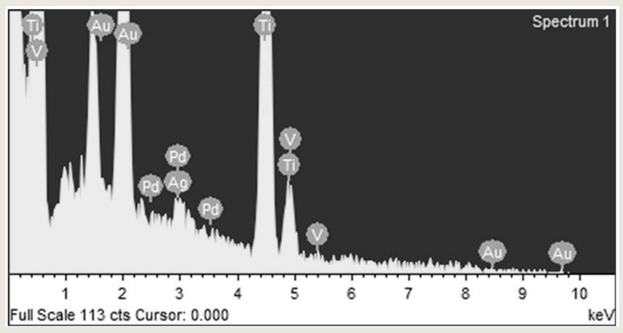

Figure 3: EDS spectrum confirming the presence of Ag, Au and Pd following clinical use

AUTOCLAVE DURABILITY

Silver surface concentration after repeated sterilization

- Silver surface concentration remained within the target technology specification after up to 50 autoclave cycles
- For up to 35 autoclave cycles, silver surface concentrations remained within the range of concentrations measured for the unautoclaved controls (Figure 4)

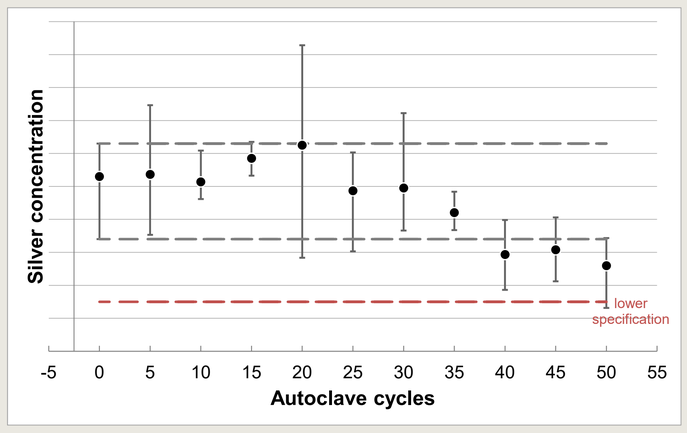

Figure 4: Silver surface concentration following up to 50 autoclave cycles

KEY FINDINGS

IN VIVO

- Nobel metal surface modification remained detectable after 8 months in patient
- Silver content remained within specification
- Ag, Au and Pd were all identified on the retrieved implant surface

IN VITRO

- Silver surface concentration fulfilled specification after up to 50 autoclave cycles
- No evidence of loss of surface modification

CONCLUSIONS

Taken together, the *in vitro* and *in vivo* data show that the Bactiguard noble metal technology remains on the implant surface after extended clinical use and after repeated autoclave exposure. All quantitative measurements fall within established material specifications. Demonstrating this level of surface stability supports its characterization as a durable surface modification rather than a transient treatment. It provides a basis for continued exploration under a range of clinical use cases applicable to trauma and other orthopedic applications where it may serve as part of the clinicians' infection risk reduction strategies.

Bactiguard AB

Vasagatan 11
111 20, Stockholm
Sweden

Tel: +46 8 440 58 80
info@bactiguard.com
www.bactiguard.com

REFERENCES

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