

## CORROSION AND TISSUE REACTION TO THREE GUIDE WIRES (MP35N, L605 & 316L) IN COMBINATION WITH A CONVENTIONAL 316L STAINLESS STEEL CANNULATED SCREW

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**INTRODUCTION:** Cannulated screws, along with guide wires, are commonly used for a variety of orthopaedic indications, but typically for fractures in cancellous regions. Breakage or bending deformation of the guide wire is a clinical concern. Therefore it would be advantageous to use Co-Cr alloys such as MP35N and L605 in these applications as the occurrence of breakages would be reduced. However, if the Co-Cr alloy should break in situ, galvanic or crevice corrosion cannot be ruled out. Therefore, we designed an experiment to determine if galvanic or crevice corrosion occurred in the *in vivo* environment. Implant devices were designed to replicate a clinical situation where dissimilar metals could potentially form a galvanic couple.

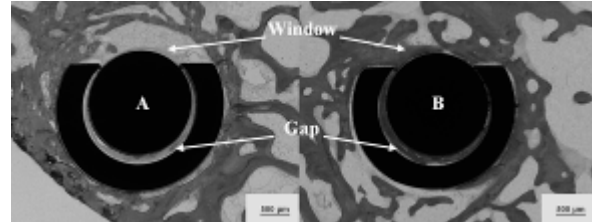
**METHODS:** Custom-made implants were developed (fig 1). In all cases the screw was 316L stainless steel while the guide wire (centre component in fig 1) was interchanged between 316L (control), MP35N and L605. The cannulated part of the screw had a conical shape. This construct was considered to imitate a cannulated screw with a broken guide wire remaining in situ.



**Fig 1:** The design of the implants to test crevice and/or galvanic corrosion.

Samples were implanted into the distal femur and proximal tibia of Swiss mountain sheep for both 1 and 6 months. Post mortem samples were analysed using Scanning Electron Microscopy (SEM; n=8 per group) and histological analysis (n = 8 per group). Both SEM and histological analysis was performed at multiple areas along the length of the screw to determine if the crevice size had an effect on the cellular infiltration and corrosion.

**RESULTS:** From SEM analysis of the screws and guide wires, no visible signs of corrosion were observed at either time point or for either group. However, there were mechanical manufacturing marks and tissue residues after enzymatic cleaning were visible on all samples.



**Fig 2:** A) 316L guide wire after 1 month implantation showing limited bone re-growth into the drill hole created for placement of the implant; B) L605 Co-Cr alloy guide wire after 6 month implantation showing bone formation in front of the window and in the gap

**DISCUSSIONS & CONCLUSIONS:** In the literature the results of coupling Co-Cr alloys and stainless steel is inconsistent. Younkin states that MP35N is extremely noble and caused galvanic corrosion of 316L and carbon steel in seawater tests. However, Reclaru et al. evaluated the galvanic current of a Co-Cr/REX 734 steel couple, and concluded that there was no appreciable risk for a crevice corrosion caused or amplified by the galvanic coupling. In this work, no major signs of corrosion were visible using SEM. However, some localised artefacts were observed that could have indicated corrosion. The incidence of artefacts was sporadic and did not vary considerably between test groups.

Particles observed on histological evaluation could potentially be of concern; however, the fact that no significant difference was detected between groups, indicates that the use of Co-Cr alloys as guide wires would not increase the presence of particle formation *in vivo*. Furthermore the absence of an associated cellular reaction around the particles might support the possibility that these particles were created as an artefact of either the model used, or the analysis methods.

Despite the comprehensive evaluation of tissue from the animals in this study, we could not detect an adverse *in vivo* effect of using dissimilar materials compared with stainless steel alone in a model of a broken guide wire in a cannulated screw.

**REFERENCES:** Reclaru L, et al. *Biomaterials* 2002; 23: 3479-85.

Younkin CN. *J Biomed Mater Res Symposium*. 1974;5:219-26.