Surface polishing eases intramedullary nail removal – A novel *in vivo* study

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INTRODUCTION: Intramedullary (IM) nails are fabricated for orthopaedic clinics from either titanium-6%aluminium-7%niobium (TAN) or electropolished stainless steel (SS). Yet, removal of TAN IM nails often produces more extraction related complications compared Ss IM nails of the same design. Despite the knowledge that surface microtopography can be a major determinant of osseointegration, this avenue, in terms of IM nailing technology, has not previously been explored as a potential resolution to issues involving device removal. In fact, many studies suggest alternative methods for removal only once conventional methods have failed. In this study, we present a novel, and simple method for reducing the problems associated with IM nail removal, and resulting intra-operative complications, due to excessive bony on-growth.

METHODS: Study approval was granted by the Cantonal animal ethics committee (GR 5/2006). Commercially available Synthes® 9.5mm Universal Humeral Nails (UHN) made of shot-peened electropolished stainless steel (SS) titanium-6%aluminium-7%niobium (TAN) with either a standard micro-rough surface (S-TAN) or experimental smooth paste-polished surface (PP-TAN) were studied. Fourteen adult female Swiss Alpine sheep were divided into two groups of 7. Using a bilateral, non-fracture model, seven sheep were implanted with S-TAN nail in one tibia and a SS nail in the contralateral tibia. The remaining 7 sheep were implanted with an S-TAN nail in one tibia and a PP-TAN nail in the opposite tibia. After 12 months implantation, mechanical pull out tests were performed on 6 of the 7 nails from each group ($p<0.05$). The remaining nail stayed *in situ* for histomorphometric analyses.

RESULTS: Pullout tests demonstrated that the SS nails had a significantly lower pullout force than S-TAN nails implanted in the same sheep ($p=0.028$; Fig1A). Removal of PP-TAN nails demonstrated a markedly lower ($p=0.043$) pullout force in comparison with the S-TAN nails implanted (Fig1B). Observations after removal showed bone growth directly within the nail PP-TAN interlocking holes however any tissue within the screw holes was easily displaced with a K wire (Fig. 2A). Contrastingly, within holes of S-TAN nails, bone in-growth was evident (Fig. 2B). Furthermore, this hard tissue could not be displaced.

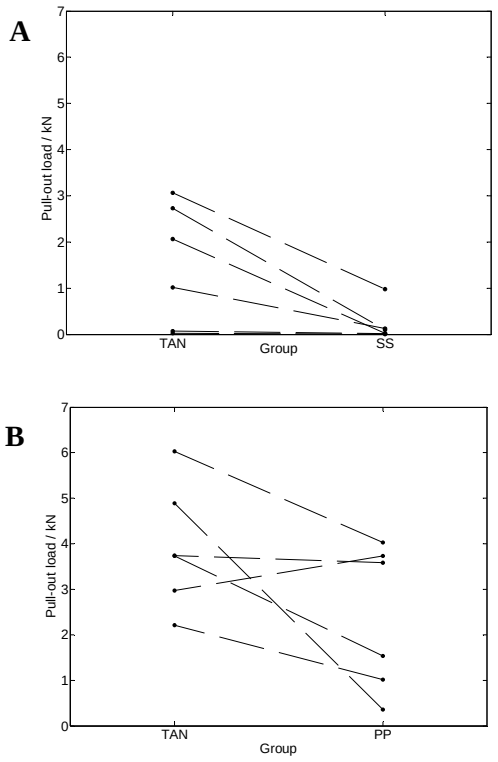

Fig.1. A significant reduction in extraction force was observed for SS ($p=0.028$) compared to S-TAN IM nails (Fig1A) and PP-TAN ($p=0.043$) compared to S-TAN IM nails (Fig1B).

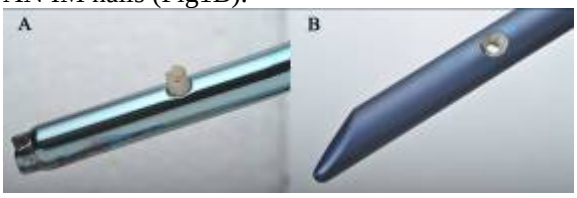

Fig.2. Tissue within interlocking holes of PP-TAN nails was easily displaced with a K wire (Fig2A) but S-TAN nails promoted in-growth of bone and this could not be removed (Fig2B).

CONCLUSIONS: Since TAN is preferred over EPSS for IM nailing due to its better biocompatibility and mechanical properties, we believe these findings will be used to recommend changes to current surface technologies of intramedullary nails, to reduce complications seen with nail removal, especially in rapidly growing bone in paediatrics.

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