

## Can we Influence the Risk of Infection by Implant Design Changes?

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**Introduction:** The development of an infection after implantation of a fracture fixation device is known to be influenced by design aspects of the implant such as the surface area available for colonisation, whether or not it creates dead space, bone contact area, compression, periosteal necrosis and the stability provided by the implant<sup>1,2</sup>. *In vivo* studies using implants of identical dimensions, only differing in material have shown that the implant material is also a factor that can affect infection rate for intramedullary nails and dynamic compression plates<sup>3,4</sup>. Of the commonly used orthopaedic implant materials stainless steel and titanium; stainless steel is associated with an increased infection rate in comparison with titanium for intramedullary nails and dynamic compression plates<sup>3,4</sup>. Aside from bulk material differences, these implants also differ in surface topography, from the smooth electropolished surface of stainless steel implants to the non-polished microrough surface of titanium implants.

Polishing the surface of titanium and titanium alloy internal fixation plates can minimise unwanted soft-tissue adhesion in areas where tissues must glide and ease removal of screws and intramedullary nails in comparison with standard equivalents<sup>5,6</sup>, with significant clinical benefit in certain situations. The effect surface polishing has on *in vitro* bacterial adhesion and *in vivo* infection rate has been uncertain to date. Therefore we have evaluated locking compression plates (LCP's) which are designed to minimise damage to the periosteum, with standard microrough surfaces and polished ones to ascertain the effect of polishing titanium upon sensitivity to infection.

**Methods:** The materials under investigation included standard commercially pure titanium (cpTi) and titanium aluminium niobium alloy (TAN) both in their microrough form, as used clinically. Electropolished stainless steel (EPSS), cpTi and TAN were also investigated as polished equivalents. The surfaces of these metals were characterised with respect to topography, chemistry and hydrophobicity. Bacterial adhesion to the same five materials was performed *in vitro* and subsequently an *in vivo* investigation of the infection rate of the same five material types were

compared using standard AO LCP's in New Zealand White rabbits.

**Results:** The surface characterisation showed that polishing cpTi and TAN reduced surface roughness without a significant change in chemistry or hydrophobicity. The *in vitro* analysis of bacterial adhesion found that polishing TAN surfaces significantly decreased the amount of *S. aureus* adhesion compared to the microrough standard TAN. The standard TAN had a higher affinity to the bacteria compared to cpTi (polished or rough) or EPSS. With the *in vivo* study using LCP's composed of these same materials, we found that polishing the surface of fracture fixation implants does not influence *in vivo* infection rate for cpTi or TAN in comparison with EPSS.

**Discussion and conclusions:** The *in vitro* results indicated that standard TAN is more susceptible *in vitro* to bacterial adhesion than polished TAN; however, we did not observe an increase for the *in vivo* infection rate for standard TAN in comparison with polished TAN. The *in vivo* results show that polishing either cpTi or TAN does not increase infection rate with the stable internal fixation system (LCP). The material related difference previously shown for intramedullary nails and dynamic compression plates for EPSS and cpTi<sup>3,4</sup> is not retained in the locked system. The locked system is designed to minimise damage to the periosteal vasculature and surface of the bone. Therefore polishing which has previously been shown to ease implant removal, by prevention of bony integration and to prevent gliding tissue damage, could be clinically implemented with LCP's and screws, since we show that it does not reduce infection resistance.

### References:

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