DEUTSCHER ZAHNÄRZTETAG

MEIN KONGRESS

Formation and detection of titanium nano-particles as a consequence of wear. An ex vivo study in human donor bone

Friedrich Müller, Janine Müller, Marcus Horn, Maximilian Schmidt-Breitung and Viktor Foltin

Corresponding author: Dr. Friedrich Müller M.Sc. M.Sc. Tannenring 76, 65207 Wiesbaden, Germany, praxis@muellerzahnaerzte.de

St. Elisabeth University, Bratislava, Slovakia

Summary & Conclusion

This unpretentious investigation actually shows that wear of titanium can occur in human bone simply due to implant insertion. Though wear is extremely limited in human donor bone and of little clinical relevance, further long-term investigations regarding aspects of bio-tribocorrosion in dental implants are needed. The risk of prolonged inflammation during osseointegration is considered to be extremely low, and therefore titanium implants are a safe and predictable therapeutic option.

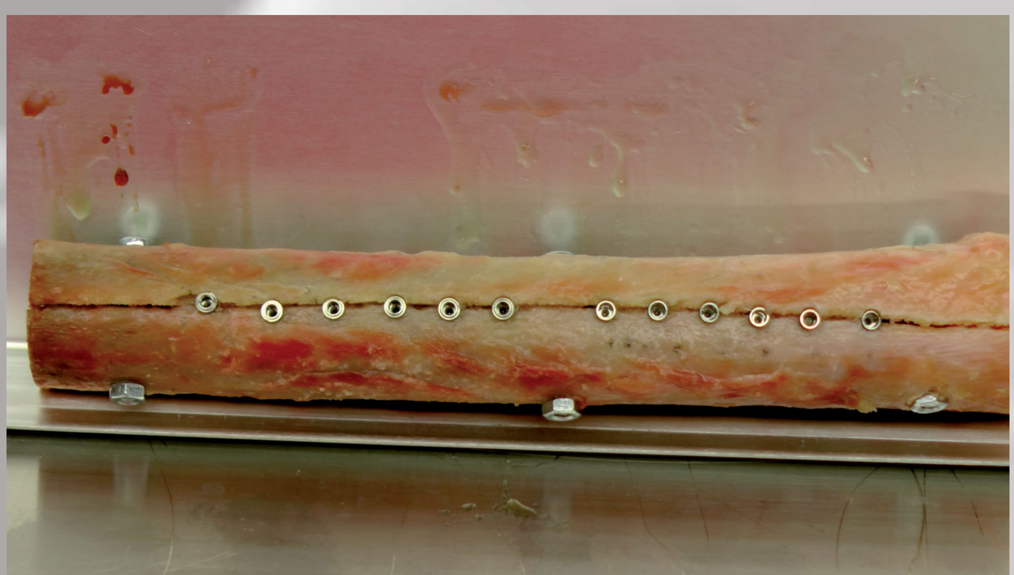
This investigation was financially supported by DGZMK, the Oral Reconstruction Foundation, and Thommen.

Introduction

In orthopaedics, wear of titanium endo-prosthesis components is an increasing problem, especially in hip prostheses. Inflammation and tissue degeneration make surgical revisions risky and unfavourable. As approximately one million dental implants are inserted every year in Germany alone, side-effects like multi-etiological peri-implantitis or titanium incompatibility have become more frequent. This study was motivated by the need to prevent disturbance of osseointegrative healing of implants after insertion due to phagocytosis of nano-particles, which may cause activation of prolonged tissue inflammation with a subsequent higher risk of implant loss or activation of multi-etiological peri-implantitis.

Methods

Human donor bone of D1 quality (Os femoris) was cut to appropriate size and 6 Conelog implants (Camlog) of 3.8mm diameter (3 implants of osseointegrative surface and 3 of smooth surface, Figure 3) together with 6 Thommen implants of 4mm diameter (3 implants of osseointegrative surface and 3 of smooth surface, Figure 2) were inserted with a maximum torque of 20Ncm. Afterwards the bone cavity was opened and investigated for titanium wear. Scanning electron microscopy and energy dispersive X-ray spectroscopy were used to perform detection of nano-particles. Statistical analysis was performed using ANOVA.



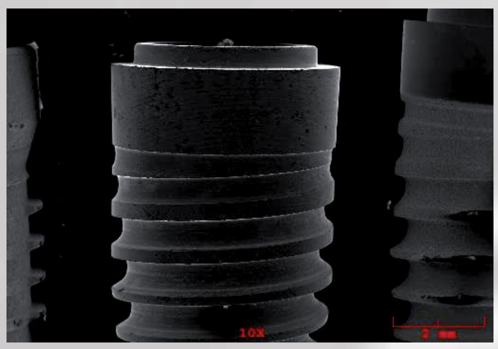


Figure 1 left: Os femoris with inserted implants

Figure 2 above: Thommen implant, osseointegrative surface

Figure 3 right: Conelog (Camlog) implant, smooth surface

Results

The occurrence of titanium was very limited. Therefore the size of particles could not be measured. Overall, 150 sites in 12 implants were analysed (average of 12.5 sites per implant). In total, the measurements of 37 sites produced positive detection of small traces of titanium (0.016 – 0.364 wt.%). No differences were found regarding the surface morphology or type of manufacturer, but remarkably there were differences in the sub-groups (Figure 4). There was a statistically significant difference between smooth and osseointegrative surface in Camlog implants ($p=0.0161$) as well as a marginal significance between smooth surface implants of Thommen and Camlog ($p=0.0826$). No difference was found in smooth and osseointegrative Thommen implants ($p=0.696$).

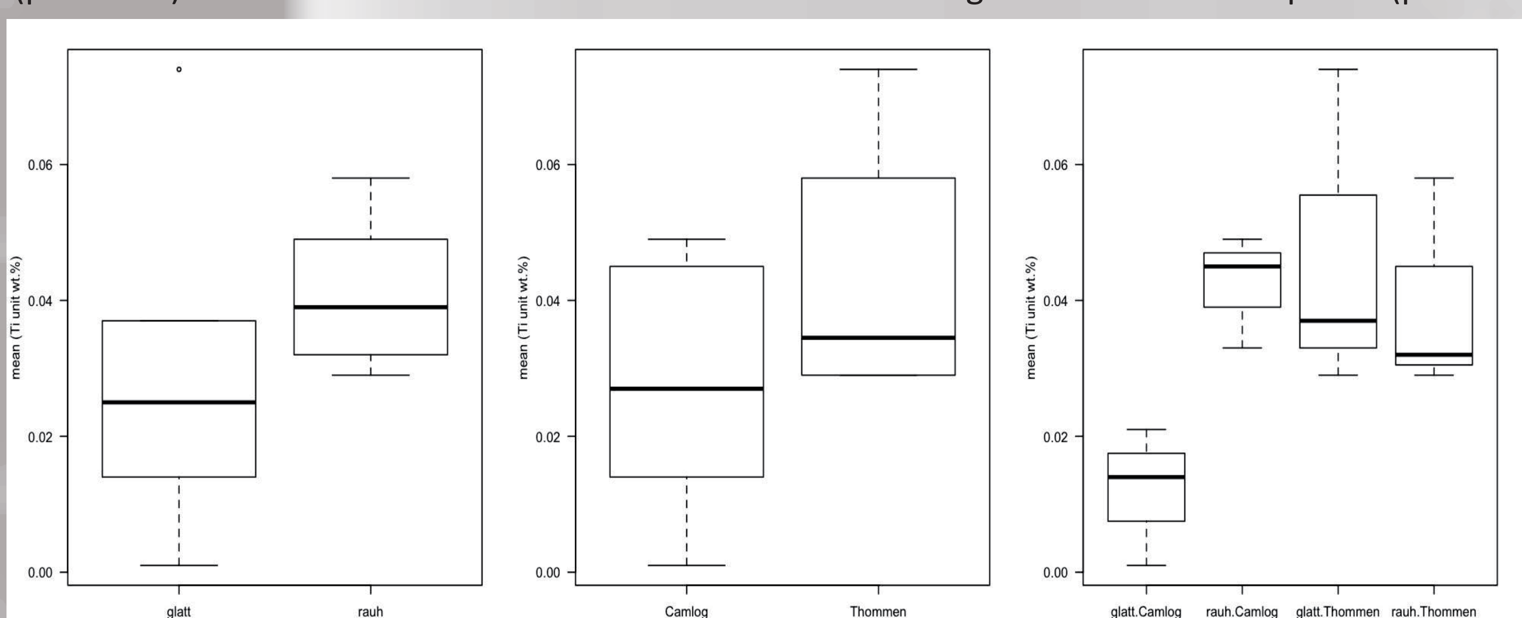


Figure 4: Boxplots of group and sub-group comparisons

References

Müller F, Müller J, Schmidt-Breitung M: Entstehung und Nachweis von Nanopartikeln durch Abrieb von Titanimplantaten. DZZ, Deutsche Zahnärztliche Zeitschrift 2019; 74(1): 36-43

Müller F, Müller J: Drehmomentabhängige Insertionstiefe in D1-Kunstknochen. In-vitro-Untersuchung an CONELOG Implantaten. Implantologie 2016; 24: 327–333