Introduction and Purpose

UV-light and non-thermal plasma (NTP) are able to increase wettability and improve the chemical surface composition of titanium by decreasing carbon remnants. Both methods were able to increase the bioactive capacity of titanium surfaces in vitro with slight advantages for NTP in carbon removal and cell proliferation compared to UV-light. The aim of this study was to determine and compare the effects of UV light and non-thermal plasma (NTP) treatment on osseointegration of titanium implants in vivo.

Methods

- Approval by the Hamburg Authority of Health and Consumer Protection (V1305/591-00.33)
- 54 titanium implants (Camlog Conelog®) were randomly inserted into the forehead of 6 juvenile pigs
- 18 implants served as non-treated control group, 36 implants were divided as experimental groups and either treated by UV light (0.05 mW/cm² at λ = 360 nm and 2 mW/cm² at λ = 250 nm) or by NTP of argon (24W, -0.5 mbar) for 12 minutes each
- 2 animals were sacrificed after 2, 4 and 8 weeks, respectively
- Resonance frequency analysis (Ostell ISQ) was conducted after implant placement and at sacrifice
- µCT-scans and histomorphometric analysis (bone-to-implant contact [BIC] and bone area fraction occupancy [BAFO]) were used to assess osseointegration

Results

- All implants showed excellent osseointegration (Fig. 2)
- After initial loss of ISQ values, all implants showed a constant increase of ISQ values without significant differences between control and experimental groups (Fig. 3)
- BIC values of all implants increased steadily during 8 weeks of healing (Fig. 4)
- Surface treated implants showed higher BIC values compared to non-treated implants at each time point but differences were only significant after 4 and 8 weeks (P < 0.05)
- NTP treated implants showed higher but not statistically significant BAFO values at any time point (Fig. 5)

Conclusions

In this study, UV-light and NTP were able to increase the bioactive capacity of titanium implants in vivo. Although surface treated implants showed higher BIC and BAFO values at nearly any time, only the differences between NTP as well as UV-light and the non-treated implants at 4 and 8 weeks were statistically significant. No statistically significant differences were determined between UV-light and NTP. Further studies are needed to confirm the transferability of the identified effects on zirconia surfaces in vitro and in vivo.

Disclosure

This research project was granted by the Oral Reconstruction Foundation (CF11501). The UV and NTP devices were provided free of charge by the manufacturers. Titanium disks were provided by Camlog Biotechnologies AG. The authors declare no conflict of interest.

Contact:  Dr. Anders Henningsen
Department of Oral and Maxillofacial Surgery
University Hospital Hamburg-Eppendorf
Email: a.henningsen@uke.de
Phone: +49 (0)40 – 741053259