ORAL RECONSTRUCTION GLOBAL SYMPOSIUM 2018
26. – 28. APRIL 2018 I ROTTERDAM, NETHERLANDS

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Influence of UV-light and non-thermal plasma on osseointegration of titanium implants *in vivo*

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

- Approvel 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** (Osstell 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

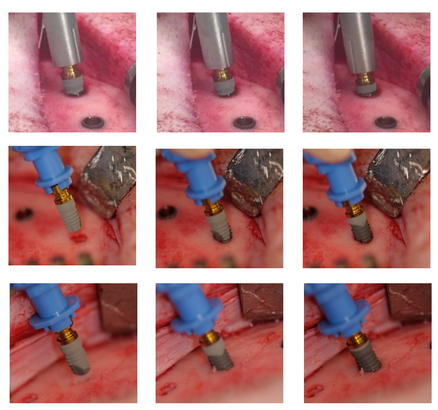

Fig. 1: Implants at placement. 1st line non-treated; 2nd line UV-light; 3rd line NTP

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)

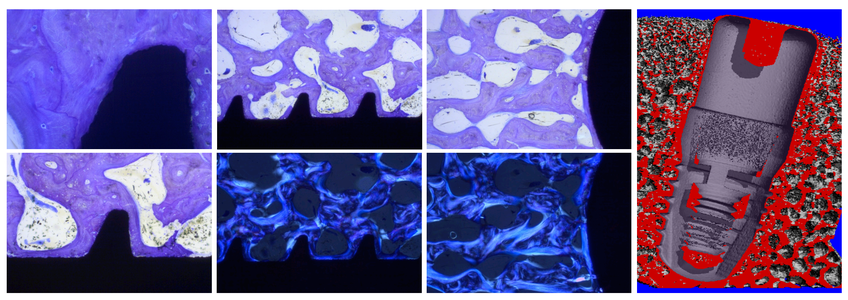

Fig. 2: histological preparation of an osseointegrated implant; a, b, c, e toluidine blue; d, f polarisation light; a 160x magnification, b 50x magnification, c, d, e, f 25x magnification; g µCT

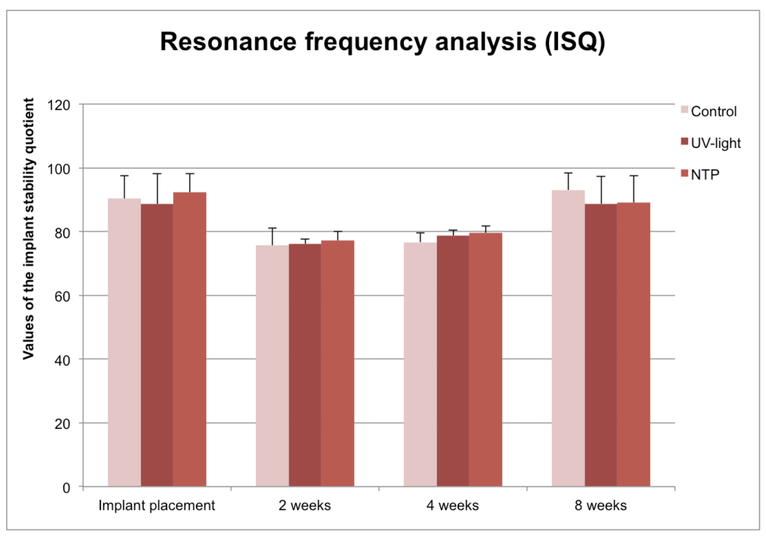

Fig. 3: ISQ values at implant placement and at time of sacrifice after 2, 4 and 8 weeks of healing.

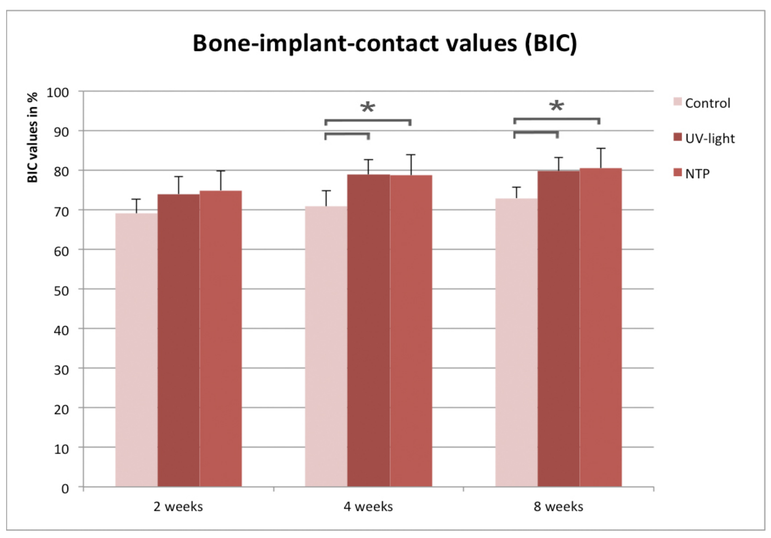

Fig. 4: BIC values at time of sacrifice after 2, 4 and 8 weeks of healing. * statistically significant differences

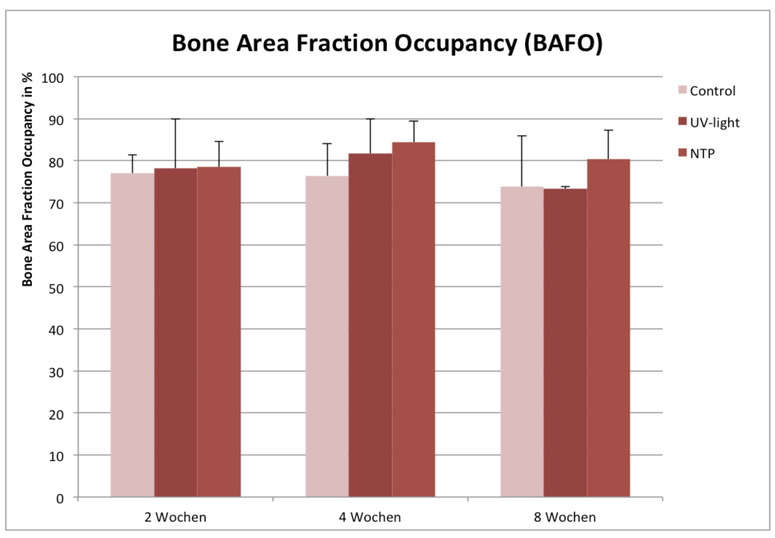

Fig. 5: BAFO values at time of sacrifice after 2, 4 and 8 weeks of healing.

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.

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