A novel air-based non-thermal plasma (NTP) approach for the enhancement of Ti-6Al-4V dental implants

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Statement of Purpose: The objective of this investigation was to histometrically evaluate the effect of air-based non-thermal plasma treatment on two different implant surfaces applied directly prior to implant placement, in a canine model. An untreated implant group was used as a control.

Methods: This study utilized plateau root form endosseous Ti-6Al-4V implants (Bicon LLC, Boston, MA, USA). The *in vivo* evaluation comprised of 7 adult male beagles of approximately 1.5 years old[1]. The investigated implant surface treatment groups consisted of titanium (Ti) and calcium-phosphate (CaP) implants, additionally the same implant groups were also subjected to non-thermal plasma (NTP) treatment[2] with compressed air for 20 seconds/quadrant with KinPen™ (INP-Greifswald, Germany) (Ti-P and CaP-P). The implantation site was the radius epiphysis, the right limb of each animal provided implants that remained for 3 weeks *in vivo*, while the left limb provided implants that remained 6 weeks *in vivo*. Implants were alternated from proximal to distal along the center of the bone to eliminate any bias among site location.
The bone-to-implant contact (BIC) was determined at 50X-200X magnifications while the bone area fraction occupancy (BAFO) 100X (Leica DM2500M, Leica Microsystems GmbH, Wetzlar, Germany) by means of computer software (Leica Application Suite, Leica Microsystems GmbH, Wetzlar, Germany). The regions of BIC contact along the implant perimeter were subtracted from the total implant perimeter, and calculations were performed to determine the BIC percentage. The BAFO percentage areas occupied by bone were calculated from the total area within the healing chambers [1].
Statistical analysis was performed by Kruskall-Wallis at 95% level of significance and Dunn's post-hoc test.

Results: Upon euthanization and completion of the study it was concluded that there were no complications or clinical concerns therefore no implants were excluded from this study.
Histomorphometric analysis (Figure 1a and 1b) showed no differences between implant surface and surface treatment for BIC and BAFO ($p>0.06$). While at 6 weeks *in vivo* there were significant differences between implant surface and surface treatment for BIC ($p=0.02$) while no significant differences were measured for BAFO ($p=0.69$).

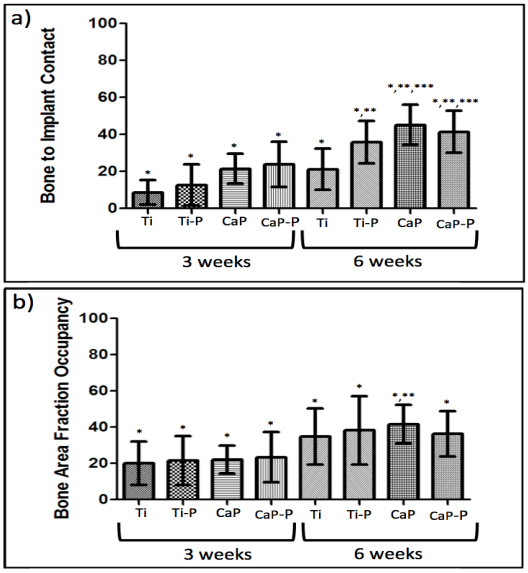

Figure 1: (a) Bone to implant contact (BIC) and (b) bone area fraction occupancy (BAFO) percentages for the Ti, Ti-P, CaP and CaP-P groups at different times *in vivo*. The results shown as mean ± 95% confidence interval with the asterisks (*) indicating statistically homogenous groups.

Conclusion: The CaP coated implants showed marginally higher BIC values in comparison versus the Ti implants for both times *in vivo*. While BAFO values exhibited no differences among surfaces within the times *in vivo*.

References:

[1] Marin C, Granato R, Suzuki M, Gil JN, Janal MN, Coelho PG. Histomorphologic and histomorphometric evaluation of various endosseous implant healing chamber configurations at early implantation times: a study in dogs. Clin Oral Implants Res 2010; 21(6): 577-83

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[1] Approval received from the Ethics Committee for Animal Research at the E´cole Nationale Veterinaire d'Alfort (Maisons-Alfort, Val-de-Marne, France
[2] Implant surfaces were NTP treated directly prior to placing implant.