

INVESTIGATION OF A NOVEL METHOD FOR IN-VIVO MONITORING OF IMPLANT OSSEOINTEGRATION IN AN ANIMAL MODEL

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Introduction

Implant osseointegration and different surface modifications of different implant coatings can solely be analysed in animal experiments post mortem. In dental implantology, vibration analysis is used to detect the shift in resonance frequency and damping of the implant due to advanced bone ingrowth [Koh, 2009]. However, this method requires a close contact to the implant and excitation using an electrodynamic shaker. In our present work, a novel method with internal excitation of coated implants is investigated using the animal model New Zealand White Rabbit (NZWR).

Methods

The developed implant with octagonal cross section exhibits a cylindrical canal, in which a magnetic sphere can oscillate (Figure 1).

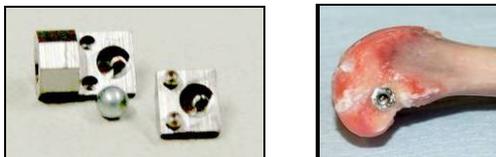


Figure 1: Left: Implant with octagonal cross section and magnetic sphere. Right: Inserted implant in the femoral condyle of a NZWR.

The sphere is excited using a coil and impinges inside the implant. These implants were inserted in each lateral femoral condyle of 6 NZWR. Thereby, implants with osseointegrative (BONITex®) surface layer as positive control were inserted in press-fit, while anti-adhesive coated implants (DOTIZE®) as negative control were inserted in exact-fit. Every week postoperatively, a sound analysis was performed and the transmitted oscillations were detected externally using a piezoelectric sensor placed at the skin over the condyle. After a test time of 4 weeks, the NZWR were sacrificed and the pull-out strengths of the implants were measured using a universal testing machine.

For evaluation, the centre of area of the normalized magnitude-frequency spectrum was calculated and the resulting central frequency was used to describe the shift of frequency.

Results

The mean values of the central frequency of the positive control were clearly smaller than of the negative control (Figure 2). The progression over 4 weeks shows a shift to higher frequencies due to a reduced stability in case of the negative control. The mean pull-out strength is significant higher for the positive control.

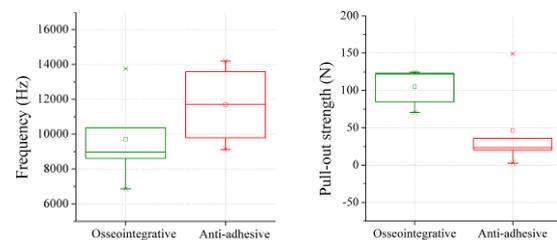


Figure 2: Left: Results of the central frequency. Right: Results of the pull-out strength.

Discussion

Standard tests of implant osseointegration using animal models can only be measured at the euthanasia point in time. In order to monitor osseointegration of e.g. implant coatings with a minimum of necessary animals, a method needs to be developed which allows measurements at different points in time at the same animal. The proposed method shows a reasonable correlation between the pull-out strength and the central frequency and thus high potential to monitor osseointegration of different coatings to almost an arbitrary number of time intervals.

References

Koh *et al*, J Adv Prosthodont,1:107-112, 2009.