HYDROXYAPATITE PARTICLES MAINTAIN PERI-IMPLANT BONE MANTEL IN OSTEOPOROTIC BONE

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INTRODUCTION: In osteoporotic bone, during remodelling of the initial woven bone peri-implant mantel to lamellar bone, resorption exceeds bone formation resulting in loss of implant osseointegration and loosening. Endobon® (Biomet) is a non-resorbable osteoconductive hydroxyapatite (HA) clinically used as bone filler. The goal of this study was to investigate if such a simple non-resorbable material could maintain a more dense and functional peri-implant bone structure, by shifting remodelling events in osteoporotic bone.

METHODS: Sixty 12 week old female Wistar rats were ovariectomized and 4 weeks later, osteopenia was verified with *in vivo* bone mineral density (BMD) measurements (XtremeCT, Scanco AG). Titanium screws were implanted bilaterally into the proximal tibial metaphysis. In the right tibia, the drill-hole was filled with 6 mg of HA particles before screw insertion. The rats were euthanized 1 hour, 2, 4, 6, and 8 weeks post implantation. Histomorphometric analysis was performed using Toluidine blue and Giemsa/Eosin staining protocols to differentiate between lamellar and woven bone in a 500µm thick peri-implant region of mid-sagittal sections. The amount of bone material and the contact rate, i.e. the percent of screw perimeter covered by bone tissue and HA particles, were assessed quantitatively at all time-points.

RESULTS: Ovariectomy successfully induced a mean decrease in trabecular BMD of approximately 30% after 4 weeks. Results from the histological analysis demonstrated that lamellar bone area percentage significantly increased with time in a similar way on both sides ($p=0.001$). After the same abundant increase in woven bone area during the first 2 weeks, woven bone was subsequently resorbed differently ($p=0.001$), whereby woven bone area percentage remained significantly higher on the HA-side compared to the control-side for the remaining experimental period ($p<0.001$) (Fig. 1). Besides the higher amount of bone material in the peri-implant region, HA particles induced more new bone in direct contact with the implant surface during the remodeling phase.

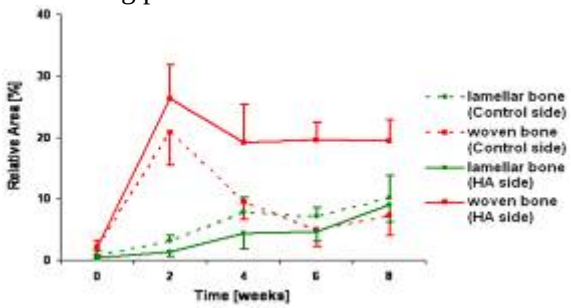

Fig. 1: Percent surface (mean ± SD) of lamellar (green) and woven (red) bone in the peri-implant region (—: HA side, ---: control side).

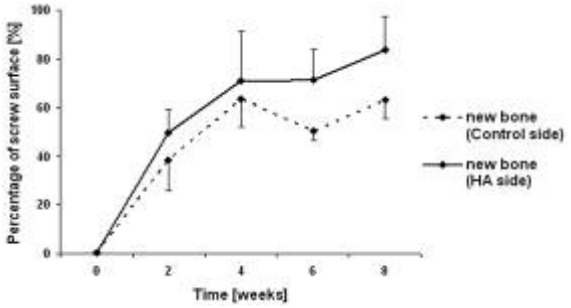

Fig 2: Contact rate (mean ± SD). Percentage of screw contour covered with newly formed bone (—: HA side, ---: control side).

DISCUSSION: The results of this study indicate that HA particles inhibit resorption of woven bone without affecting lamellar bone growth, thus resulting in maintenance of a denser peri-implant bone mantel in osteoporotic trabecular bone. Due to the presence of HA, remodelling processes were postponed and osseointegration was improved. This effect may play an important role in the prevention of implant loosening and cut-outs in clinical cases.

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