

ELECTROCHEMICAL DEPOSITED CAP COATINGS ON TPS-SUBSTRATES

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INTRODUCTION: More and more younger patients are involved in orthopaedic and dental therapy. Hence, corresponding implant systems or medical devices are expected to function without complications for several decades. In this context, the long-term complications reported for bioactive calcium phosphate coatings obtained by plasma-spraying such as delamination from substrate with subsequent particle formation or dramatic peri-prosthetic bone loss observed after gingival recession and plaque contamination, may challenge their short-term achievements /1, 2/. The use of fully resorbable calcium phosphate (CaP) coatings should combine the initial integration advantages of CaP's and the eradication of the above mentioned mid- and long-term concerns. The aim of this study was to evaluate the in-vitro and in-vivo performance of a fully resorbable CaP coating (BONIT[®], DOT GmbH, Rostock, D) deposited on rough titanium plasma sprayed (TPS) surfaces. **METHODS:** 1) In vitro test: TiAl6V4 disks ($\varnothing=15$ mm) were coated with c.p. titanium by plasma-spraying (TPS). In a second step the CaP-layer (BONIT[®]) was deposited on the existing microstructure. A layer thickness between 15-20 microns was obtained by a special electrochemical deposition method. Degradation of the resorbable coating was detected after 2, 7, 14 and 28 days in an artificial bone fluid. Secondly cell culture experiments were performed. The control group consisted of three TPS coated disks, the test groups comprised six disks each coated with the BONIT[®] layer. Proliferation tests were performed with human fetal osteoblast cells hFOB 1.19. In addition the osteoblast phenotype was assessed, especially the intracellular production of collagen I was observed.

2) Pilot In vivo test : Implants ($\varnothing=4.9$ mm x 8 mm, Oraltronic, Bremen, D) were inserted in the maxilla of a female Land Race pig and were left submerged. TPS coated implant served as the control group, the test group was also coated with a 15-20 μ m thick BONIT[®] layer. Sample size for both groups was n = 8. After six weeks of implantation, implants were retrieved and investigated histologically. The observation comprised histomorphometric analysis and

determination of the dissolution extent of the BONIT[®] coating.

RESULTS: The in vitro degradation test showed that the BONIT[®] layer was nearly completely degraded. Partly, isolated apatite structures containing fluid components have been formed on the surface. The cell culture showed a nearly confluent cell layer, the proliferation rate was lower at the control TPS coated. SEM analysis conducted on the BONIT[®] coated samples revealed attached and completely spread osteoblasts. On the TPS coated disks, cells were less in number and the cell morphology was significantly inhibited. Hence the SEM findings confirmed the cell proliferation results. The cell metabolism was more activated through the availability of the soluble CaP components as shown by the findings of the intracellular osteocalcin and collagen I production. In vivo, after 6 weeks of implantation, the direct bone apposition rate at the TPS and the BONIT[®] coated implants was respectively 49,8% and 73%. The CaP coating was resorbed over more than 99% of the implant surface. The coating dissolution did not lead to unfavourable reactions as recently observed in adjacent tissue around resorbing plasma-sprayed or electrophoretically CaP coatings.

DISCUSSION & CONCLUSIONS: As a good correlation between the in vitro and in vivo tests was found, it can be concluded, that the investigated BONIT[®] coating might be able to replace the first generation of plasma-sprayed HA for an enhanced bone response over the requested long-term. In addition, the present results show that suitable in vitro tests can be a promising and time-saving tool to predict the biological response of bioactive surface modifications in the frame of preclinical screening experiments.

REFERENCES: ¹ Wheeler (1996) Eight-year clinical retrospective study of titanium plasma sprayed and hydroxyapatite coated cylinder implants; *Intern. J. of Oral Maxillofacial Implants*, 11, pp 340-350. ² Soballe, Overgaard (1996) The current status of hydroxyapatite coatings of prosthesis *J. Bone Joint Surg*, 78 B, pp 689-691.