ESEM Investigation on Osseo Integration of Ti Alloy Implants

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INTRODUCTION: Vanadium free Ti alloy has been developed for biomedical use in orthopedics and dental applications. Interaction of the implant with its biological environment, implant material/osseous interface formation, and long-term success integration in the human body is dependent on surface properties of the implant device. After *in vitro* tests that allow us to determine the optimum roughness of implant surface and the necessity or not of surface thin-film depositions, we are now in the stage of investigations on implants used for *in vivo* tests.

METHODS: *In vivo* tests were made with implants of Vanadium free alloy (Ti-Al-Nb). Uncoated samples (50µm roughness) were inserted in rabbit femur for 2 months. Extracted samples were analyzed by environmental scanning electron microscopy (ESEM) and energy-dispersive x-ray (EDX) microanalysis.

RESULTS: The bone–implant interface study revealed a convenient osseous integration. A mineralized extracellular matrix was formed on the implant material, with some fibrous parts in the case of sharp edges.

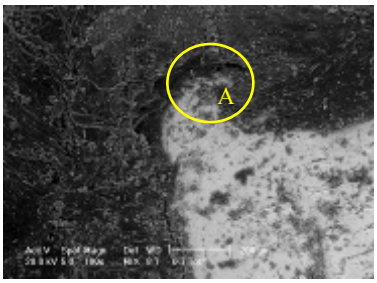


Fig. 1: ESEM observation of tissue/implant interface.

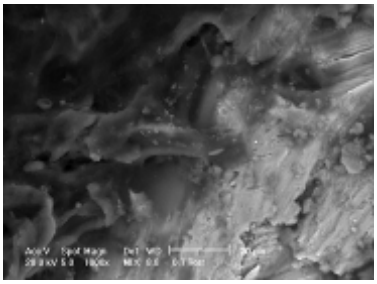
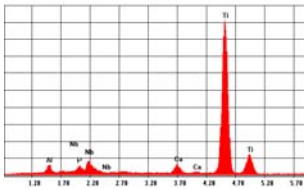


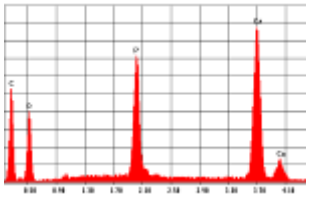
Fig. 2: ESEM observation of tissue/implant interface – detail (A).

Table 1. EDX analysis of elements in implant



Element	Wt %	At %
AlK	2.72	4.83
P K	1.89	2.92
NbL	7.78	4.01
CaK	3.09	3.70
TiK	84.51	84.53

Table 2. EDX analysis of elements in bone



Element	Wt %	At %
C K	47.13	61.17
O K	29.66	28.91
P K	7.83	3.94
CaK	15.38	5.98

EDX analysis of the implant revealed the alloy composition: 5%Al, 4%Nb and Ti (balance). The presence of Ca and P can be explained as adherences from cutting. EDX analysis of the bone exposed the absence of any other elements than Ca, C, O and P, proving the biocompatibility of the implant material.

DISCUSSION & CONCLUSIONS: Observation of the interface between the cell layer and substrate revealed the presence of calcium and phosphorous-rich globular deposits associated with collagen fibers on all materials *in vitro* and *in vivo*. No contamination from implant material can be observed.

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ACKNOWLEDGEMENTS: The authors express their gratitude to Romanian National Authority for Scientific Research (ANCS) and Managerial Agency for Scientific Research, Innovation and Technological Transfer (AMCSIT-Politehnica), for the funds provided for this research (Research Project CEEX no. 46/2005, RETEβDENT).