Characterization of a new bone reconstructed at the interfaces with implants

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Nanotechnology in material science and engineering has been developed with great success in the last decade. In orthopaedic surgery Titanium (Ti-Al-4V) implants are currently coated with nano-hydroxyaptite (n-HAp), $Ca_{10}(PO_4)_6(OH)_2$, in order to obtain a stable and functional direct connection between the bone and the implant. Bone is a composite material associating a mineral phase in the form of HAp-crystals and an organic matrix constituted by collagen. The c-axes of HAp and the collagen fibres are preferentially oriented in the direction of the stresses that the bones need to withstand. At the implant-bone interface the new bone reconstituted after implantation must have the same orientation as the natural bone in order to accept the implant. Therefore we studied the mechanical properties of the new bone crystals reconstituted at the interface applying non destructive x-ray diffraction. The required high spatial resolution was achieved utilizing high-energy synchrotron radiation on ID15 at ESRF.

In this study a sheep received two different types of implants coated with n-HAp and with HAp. After 60 days the implants have been extracted together with the bones. The specimen have been prepared in the Pius Branzeu Centre of Laparoscopic Surgery and Microsurgery (Romania).

The results of the new bone crystals at the interface obtained by the synchrotron radiation study are particularly interesting and reveal a great advantage of the n-HAp coated implant interface.

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