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Titanium Diffusion in Shinbone of Rats with Osseointegrated Implants

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Dental implants are composed of commercially pure Ti (which is actually an alloy of titanium, and minor or trace components such as aluminum and vanadium). When the implant is inserted, its surface undergoes a number of chemical and mechanical processes, releasing particles of titanium to the medium. The metabolism of free ions of titanium is uncertain; the up-taking processes in the body are not well known, nor their toxic dose. In addition, physical properties of newly formed bone, such as diffusivity and activation energy, are scarce and rarely studied.

In this study, we analyzed the diffusion of titanium in the titanium-implanted shinbones of six adult male Wistar rats by spatially resolved micro x-ray Fluorescence. The measurements were carried out at the micro-fluorescence station of the X-Ray Fluorescence (XRF) beamline of the Brazilian synchrotron facility LNLS (from Portuguese "*Laboratorio Nacional de Luz Sincrotron"*). For each sample, XRF spectra were taken by linear scanning in area near the new bone formed around the Ti implant.

The scanning line show a clear effect of titanium diffusion while calcium intensity presents a different behavior. Moreover, a clear correlation among the different structures of bones is observed in the Ti and Ca intensities.

Diffusion coefficients for titanium diffusion in the shinbones were successfully obtained by studying the intensity ratio Ti / Ca in spectra measured. A similar diffusion is observed in rats having the implant for a month than in rats having the implant for three months. As expected, the diffusion coefficient is larger for the group of rats that had the implant for a shorter time. The results obtained in these measurements may allow determining quantitatively the parameters of diffusion rates and other physical properties of new bone.