03-025

ANODIZED Mg-BASED ALLOY FOR USE AS BIODEGRADABLE BONE IMPLANT

Merlo, J.L.(1); Salemme Alonso, L.(2); Otaz, M.A.(3); Carrizo, S.(1); Tano De La Hoz, M.F.(1); Katunar, M.R.(1); Cisilino, A.(1); Ballarre, J.(1); Ceré, S.(1);
(1) INTEMA; (2) SI; (3) OV;

Magnesium (Mg)-based alloys are promising candidates for the development of new biodegradable materials for fracture repair implants. However, the high degradation rate of Mg in aqueous media releases hydrogen gas, which causes pain and local swelling. Superficial treatments, such as anodizing technique, emerge as a potential solution to this limitation. The aim of this study is to characterize the surface chemistry and topology of the anodized material, as well as to evaluate its in vitro cytocompatibility and in vivo osteoconductivity. Anodizing of Mg alloy (AZ91) pieces was performed at low voltage in potassium hydroxide solution. Raman spectroscopy and roughness before and after immersion in simulated body fluid (SBF) were measured to determine surface composition and topography. In vitro cytocompatibility was determined measuring bovine fibroblasts adhesion and proliferation after 24 h of culture on the material´s surface (compared with non-anodized AZ91 samples). Osteoconductivity and hydrogen release was evaluated in adult male rats: two pins of the same material (anodized AZ91 or control –polylactic acid, PLA; a biodegradable material clinically- used) were transversely placed one in each femur. After 7 days of implantation, the animals were sacrificed and mineralization rate was determined detecting different fluorochromes, previously administered to the rats. The release hydrogen and histomorphometric measurements of new bone were assessed through Toluidine Blue staining. Additionally, chemical composition and maturity of the new bone was studied analyzing the intensity of the peaks corresponding to phosphates, beta-carbonates and amides I and III by Raman spectroscopy. From the SBF soaking experiments, the presence of phosphates deposits appeared at 1 day of immersion for the anodized samples. Roughness essays demonstrate that the anodizing process generates an even and homogeneous surface, with a slight increment in Rz value from the polished surface. In the in vitro cytocompatibility tests, an increase in bovine fibroblasts adhesion and proliferation was detected over the anodized surfaces samples, compared with controls. In vivo results showed no apparent hydrogen liberation at the interface material-tissues, as well as bone formation around the implant. Mineralization rate could not be determined due to fluorochromes overlapping; however, the direction of the mineralization deposition appeared to be towards the implant. Lastly, ratios of mineral: matrix composition (v2 PO4/amide III) and the degree of carbonate substitution (CO3/v2 PO4) calculated from Raman spectra revealed mature bone around the anodized Mg implant after 7 days of implantation. Based on these results, anodizing process at low voltage is a promising superficial treatment for the development of Mg- based biomedical applications.