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LIPSS stimulate stem mesenchymal cells differentiation to osteoblasts in titanium and tantalum

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Orthopaedic surgery has grown from the hand of new materials that made possible to perform procedures as total hip replacement with feasibility. These procedures are common in most orthopaedic departments, and more than 70 000 hip or knee replacements are performed in Spain every year. The survival of these implants is critical to prevent loosening and the need for revision arthroplasty. The ideal surface to interact with bone has not been created. We created laser induced periodic surface structures (LIPSS) in the surface of titanium and tantalum to study the behaviour of stem cells compared to polished surfaces. We created 12 discs of each material and polished them. Later we created LIPSS in 6 discs of each material. We cultured them in human stem cells in a concentration of 25000 cell per cm² for 20 days. We determined MTT, TNF- α , alkaline phosphatase, IL-6, osteopontin and osteocalcin every 5 days until the day 20. We confirmed outcomes behave as a normal distribution after applying the Kolmogorov Smirnov test. We compared materials and surfaces with the T-student test. We accepted a difference of 0.05 as significant. LIPSS created increase statistically cell metabolism (best values in MTT assay) and decrease inflammatory response to the material (IL-6 and TNF- α values). Collagen is produced in more quantity and cells differentiate to osteoblast easily. These differences are seen from the beginning until the endpoint (day 20). When LIPSS improved osteogenic properties of titanium and tantalum compared to smooth surfaces.

Parameter	Day 0	Day 5	Day 10	Day 15	Day 20	Day 0	Day 5	Day 10	Day 15	Day 20
MTT	0.4897	0.3420	0.5864	0.4090	0.6455	0.2413	0.7595	0.5466	0.6945	0.5466
IL-6	0.0106	0.0116	0.0200	0.0118	0.0340	0.0436	0.0280	0.0340	0.0340	0.0340
TNF-ALFA	0.0164	0.0211	0.0100	0.0118	0.0296	0.0196	0.0235	0.0196	0.0196	0.0196
PCN	0.0000	0.0000	0.0066	0.1030	0.2067	0.1288	0.1426	0.1030	0.1030	0.1030
OC	0.0648	0.0449	0.7827	0.5891	0.7183	0.5152	0.8525	0.6956	0.6956	0.6956
OC	0.3079	0.2032	0.2317	0.1865	0.5240	0.2362	0.8031	0.6269	0.6269	0.6269
OSP	0.4177	0.3114	0.3949	0.2130	0.5449	0.4049	0.2340	0.6311	0.6311	0.6311

Biography

Alberto Jorge is an orthopaedic Surgeon with special interest in biomaterials. He is focusing every effort in the study of the behaviour of surface modifications in the field of orthopaedic surgery. Previously he performed different modifications in PMMA to create composites with hydroxyapatite to prevent fibroblastic response (Pino et al 2015). Nowadays he is dedicated to laser modification of metals and cermets to increase anisotropic osteointegration of implants.

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