HUMAN MESENCHYMAL OSTEOBLAST STEM CELLS BEHAVIOUR ON MACRO AND NANO STRUCTURED SURFACES

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Abstract

In prosthetic medicine, optimizing the surface properties of implants can facilitate the adhesion of bone-forming cells and thereby may promote osseointegration. The precise role of surface chemistry and topography on the early events in implants' osseointegration remain poorly understood. In addition, comparative clinical studies with different implant surfaces are rarely performed.

In the present study we investigate the biocompatibility and the attachment strength of human bone marrow cells on four different types of surfaces, namely: Titanium, Titania Nanotubes, Carbon Nanotubes and Polymer; the purpose of this comparative research is to make a step forward understanding what type of implant material and surface topography is the most appropriate for osteoblasts' development and proliferation.

Methods:
Pure titanium plates were used as control material. Additionally, three different types of materials were manufactured: i) titania nanotubes growth through electrochemical anodizing of titanium plates ii) CNTs solution injected on titanium plates iii) Biocompatible acrylic sprayed on pure titanium plates. Human bone marrow stromal cells of third passage were seeded at a density of 10000 cells/ cm^2 on the sample disks and cultured at 37°C. Proliferation was estimated by Total Protein and DAPI staining after 1, 3 and 7 days and differentiation through alkaline phosphatase activity (ALP). A rotating disk device was used to measure the detachment strength of the cell layer. The shear stress at the surface of the rotating disk is given by: $\tau=0,8r\rho(v\omega^3)^{1/2}$, where r is the distance from the center, ρ is the buffer density, v is the kinematic viscosity of the buffer and ω is the angular velocity.

Results and Conclusions
It was found that proliferation was the highest on Titania Nanotubes substrate, but not significantly different from that one on CNTs surfaces. The highest expression of ALP activity was on Titania Nanotubes and the lowest on Polymer substrate. The shear stress, applied for 10min to detach the cells, was significantly higher for CNTs and Titania Nanotubes, in comparison to Pure Titanium and Polymeric substrate.

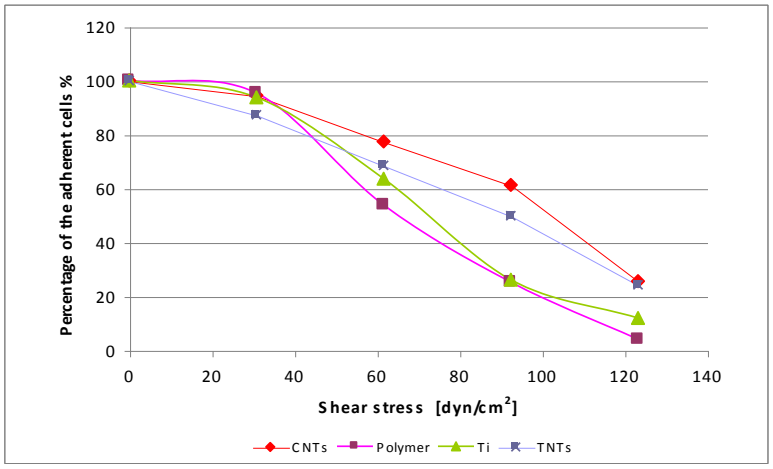

Fig.1 Percentage of adhered cells on the sample surfaces at different stress levels