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ENHANCED CELL INTEGRATION TO TITANIUM-GRAFIT COMPOSITE

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Introduction

Titanium based materials are widely used owing to desirable properties that include light weight, high strength and durability. Titanium based materials are also biocompatibile, making them ideal for medical replacement structures such as orthopedic and dental implants.

Nevertheless, because of poor wear resistance, titanium materials are still facing clinical challenges such as implant loosening over time. The addition of graphite to lower the friction coefficient and increase wear resistance could produce a composite material that overcomes these disadvantages. Furthermore, the addition of graphite could improve the cell/material surface interaction and influence the cell capacity to proliferate and differentiate.

In our study the ability to promote cell proliferation and adhesion of titanium and titanium-grafit composite was compared by assessing the attachment of human normal osteoblasts in vitro.

Materials and methods

Materials

Specimens were fabricated by means of powder metallurgy method. Commercially available pure titanium in volume 80% and graphite in volume 20% were used as the component powders. The particle size of the pure titanium powder was below 150 μm, graphite powder had a mean particle size of 100 μm. Both components were mixed, cold compacted under pressure of 500 MPa and sintered for three hours in vacuum at the temperature of 1230^0C.

Cell culture

The autoclaved titanium or titanium-graphite composite round compacts were placed in 48-well plates, one in each well. 1 ml of cell suspension containing $1{,}5\times10^4$ NHOst cells (Lonza, USA) was added on the surface of each specimen. Cells seeded on tissue culture plates (TCPS) at the same density, were used as positive controls. The biocompatibility of the sintered titanium-graphite composite was determined by the cytotoxicity studies (ToxiLight assay, Lonza, USA), adherence (crystal violet absorbance test) and proliferation rate (ViaLight assay, Lonza, USA) of cells seeded on materials. The morphology of the adherent cells was studied by fluorescence microscopy.

Results

Obtained results indicate that the presence of graphite have an impact on cellular adhesion, but not significantly on cellular proliferation. The cells seeded on the surfaces of the titanium-graphite composites have slightly lower proliferation, as compared to those cells seeded on the pure titanium and TCPS surfaces. However, it was observed that the human osteoblasts adhered well onto the surface of titanium-graphite compacts and exhibit proper phenotype (FIG.1).

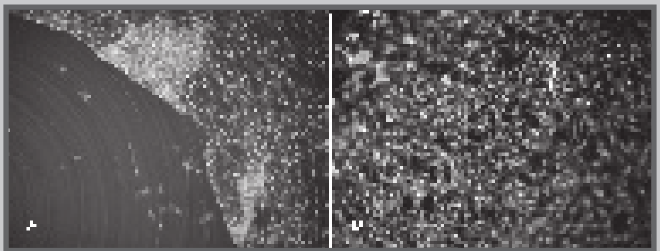

FIG.1 The cell adherence to titanium (A) and titanium-graphite composite (B). Cells well proliferated on the surface of titanium can be very easily detached from it. Micrographs obtained through fluorescence microscopy. Objective magnification 10x.