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The influence of surface roughness of titanium on β1- and β3-integrin adhesion and the organization of fibronectin in human osteoblastic cells

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Abstract

Mechanisms of cell adhesion and extracellular matrix formation are primary processes in the interaction with the material surface of an implant which are controlled by integrin receptors. The aim of our study was to find out whether β1- and β3-integrins of osteoblastic cells sense the surface topography of titanium, and if structural alterations of integrin adhesions were involved in the organization of fibronectin. Pure titanium surfaces were modified by polishing (P), machining (NT), blasting with glass spheres (GB), and blasting with corundum particles (CB) resulting in increasing roughness. Confocal microscopic investigations revealed fibrillar adhesions of β1- and α5-integrins on P, NT, and GB, but on CB with its sharp edges these integrin subunits did not form fibrillar adhesions. β3 generally appeared in focal adhesions. We observed aligned fibrillar structures of fibronectin on NT not only on the basal site but interestingly, also on the apical cell surface. In contrast, on CB, fibronectin appeared apically clustered. We suggest that this alignment of fibronectin fibrils depends on the directed actin cytoskeleton and in particular, on the capability of the β1-integrins to form fibrillar adhesions, which is affected by the surface roughness of titanium.

Keywords: Osteoblast; Integrin; Actin; Fibronectin; Titanium; Surface roughness