Behavior of primary human osteoblasts on trimmed and sandblasted Ti6Al4V surfaces functionalized with integrin $\alpha v \beta 3$-selective cyclic RGD peptides.

Abstract:
It is well known that functionalization of surfaces with cell adhesive peptides mimicking the integrin binding motif of extracellular matrix proteins is a feasible approach to improve osseointegration of implant materials. Also, modification of the surface properties of the material (e.g., roughness) strongly influences cell behavior. However, these two approaches are rarely studied together. This study addressed the hypothesis that the combination of peptide functionalization and surface roughness will have an enhancing effect on the adhesion process of osteoblasts. To test this hypothesis, a series of $\alpha v \beta 3$-selective cyclic RGD peptides were prepared and immobilized on trimmed ($S(a) = 0.74 \mu m$, smooth) and sandblasted ($S(a) = 3.24 \mu m$, rough) Ti6Al4V disks. Effects of these surface modifications were evaluated with respect to integrin $\alpha v \beta 3$-mediated adhesive capacity, cell morphology, and spreading of primary human osteoblasts. After 3 h of incubation, osteoblasts adhered more strongly on sandblasted than on trimmed noncoated Ti6Al4V surfaces. Their attachment efficiency was further enhanced in the presence of RGD peptides. However, peptide functionalization had a relatively stronger impact on osteoblast attachment on trimmed surfaces compared with sandblasted surfaces. Cell morphology after 3 h of culture
was exclusively altered by surface topography. RGD coating was critical for osteoblast spreading on both trimmed and sandblasted materials after 1 h of incubation but it showed almost negligible effects after 3 h. The results of this study provide evidence that the alliance of RGD coating and surface topography on Ti6Al4V positively influences osteoblast adhesion and spreading, especially at very early adhesion times.

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