

Cell morphology, - volume, expression of vinculin and migration are altered as response of human bone marrow cells to topographical characteristics of the culture substrate

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INTRODUCTION: Human bone marrow cells (HBMCs) are a heterogeneous cell population that consists of haematopoietic cells and mesenchymal stem cells. These mesenchymal stem cells (MSCs) are able of self-renewal and can differentiate into various cell types like osteoblasts, chondrocytes and adipocytes. This study investigates the effect of surface topographies on cell architecture and migration of HBMCs using simplified surface models in an *in vitro* culture system.

METHODS: Well-defined inverse Ti topographies were fabricated by electrochemical micromachining through patterned photoresists. Those served as masters for injection molding with polybutyleneterephthalate in which five different surface topographies were imprinted (Fig. 1).

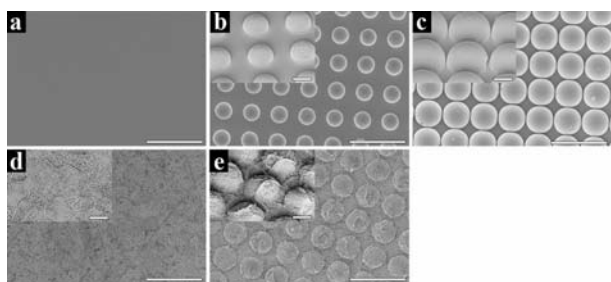


Fig. 1: SEM images of the different surface topographies. (a) smooth, (b) hemispheres of 30 μm and 20 μm spacing (30/20), (c) hemispheres of 50 μm and no spacing (50/00), (d) imprint of etched Ti surface (p/e^-) and (e) combination of 30/20 with p/e^- (30/20 e^-). Big bar: 100 μm , small bar: 20 μm .

The structured polymer substrates were subsequently Ti-coated by physical vapour deposition.

Adult HBMCs were isolated from patients obtaining a total hip prosthesis. After the first passage, the cells were plated out on the different structured culture substrates and grown in α -MEM plus 10% FCS and 1% PSN.

RESULTS: The surface topography influences the morphology and migration of cells. Cells on the

imprint of etched surfaces (p/e^- , 30/20 e^-) were spindle-shaped, showed a condensed morphology with reduced focal contacts (Fig. 2, d, e) and increased migratory activity (Fig. 3). In contrast, actin filaments of cells on the 50/00 structure span from one hemisphere to the neighbouring hemisphere with dense focal contacts on the top of the hemispheres (Fig. 2, c) that caused strong anchorage to the substrate, which was associated with a decreased migratory activity (Fig. 3). Cells on the 30/20 structure were predominately located around the hemispheres (Fig. 2, b) with well-established focal contacts. Interestingly, these cells also displayed high migration abilities (Fig. 3).

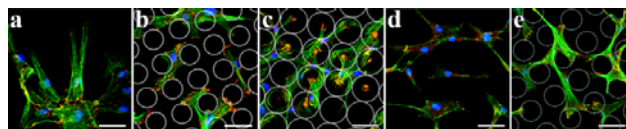


Fig. 2: Adult HBMCs cultured on the smooth (a), 30/20 (b) 50/00 (c), p/e^- (d) and 30/20 e^- (e) surface. Cells were stained for F-actin (green), vinculin (red) and nuclei (blue). Bar: 50 μm .

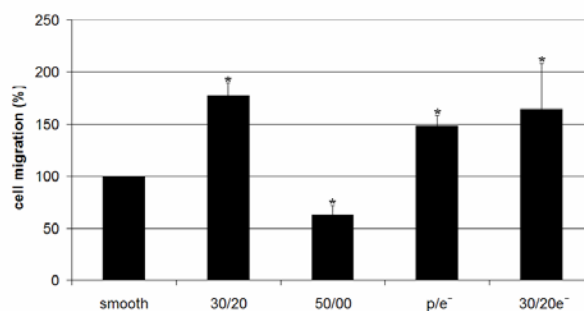


Fig. 3: Cell migration of HBMCs the smooth (a), 30/20 (b) 50/00 (c), p/e^- (d) and 30/20 e^- (e) surface. (*) determines the significance when compared to the reference smooth surface.

DISCUSSION & CONCLUSIONS: Ordered structures in the micrometer range as well as random structures in the submicro- and micrometer range had distinct effects on the morphology, volume and migration. Further work will focus whether by controlling of the cell shape the commitment of HBMCs could be influenced.