NANOSCALE INSIGHTS ON OSTEOGENIC CELL INTERACTIONS WITH TITANIUM SURFACES

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It is now well established that the initial interaction of cells with biomaterial surfaces influences their subsequent behavior and ultimate outcome of implants. Cells can interact (1) chemically with adsorbed proteins, or (2) physically with surface features. Of these, the almost immediate adsorption of proteins onto substrates is widely believed to condition cellular response. To elucidate the contribution of these two parameters, we have grown mouse calvaria MC3T3-E1 osteogenic cells (a) on smooth titanium in the complete absence of serum for the first 3 hours of a 3-day culture period, and (b) on titanium with a nanoporous surface generated by oxidative patterning and known to improve osteogenesis. The initial absence of serum had no statistical effect on cell number, and qualitatively there was no difference in cell spreading and shape. Immunostaining for osteopontin and alkaline phosphatase indicated no difference in osteogenic cell activity. On the nanoporous surface, cells characteristically extended abundant filopodia, which emitted laterally a novel type of very fine extensions referred to as nanopodia. Immunostaining for vinculin further showed that focal adhesions were more abundant on this surface compared to smooth titanium. We have probed with the atomic force microscope (AFM) the intrinsic structural resistance of filopodia on smooth and nanoporous titanium. Initial results suggest that filopodia on the treated surface seem more resilient. Altogether, these results indicate that, contrary to the widely held belief, the initial adsorption of proteins under normal culture conditions has no influence on the response of MC3T3-E1 cells to titanium. They also suggest that the physicochemical relationship with the surface, which is more extensive on nanotopography, may represent a determinant factor. Supported by CIHR, FRQ_RSBO, NSERC and NIH.

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