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Biomaterials 2019: Cell/biomaterials interaction

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Abstract

The cell/material interaction is a complex, dynamic process in which the cell and the material synergistically influence the fate of the cell. Indeed, both materials intrinsic (i.e. topography, charge, potential, and contact angle) and extrinsic properties (i.e. surface functionalization, crystallinity, etc.) played a pivotal role in dictating the type and strength of the biological responses (Figure 1). Furthermore, the ability of biomaterials to release bioactive molecules (i.e. resveratrol, fluoride, etc.) expands the possibilities to control cell-cell interactions and/or intracellular signal transduction. Our recent research demonstrated a functional role of charged polymers in altering or supporting the osteogenic differentiation of mesenchymal stem cells (MSCs) through the modulation of the ephrinB2/EphB4 interaction. Indeed, cell-cell signaling pathways that lead to efficient differentiation of stem cells include the interaction of Ephrin ligands (ephrinB2) with Eph receptors (EphB4). For the first time we have shown that high charged polymers can affect the Eph/ephrin interaction between neighboring cells inhibiting the MSCs osteogenic differentiation via the perturbation of the bidirectional signaling. In contrast, low charged polymers modulate the differentiation of MSCs into an osteocyte lineage via cell-cell ephrinB2/EphB4 signaling. Moreover, we demonstrated that electrospun PCL and PLA nanofibers loaded with resveratrol (RSV) differently modulate DPSCs osteoblast differentiation and inhibit osteoclastogenesis depending on their RSV release kinetics. Our results indicate that the slow and continuous RSV release from PLA was able to modulate both osteoblast and osteoclast differentiation representing a promising material for the preservation of post-extraction integrity of alveolar socket. Taking together, our results highlight that rationally designed materials can give rise to biomaterials able to modulate functional aspects of biological signaling. Furthermore, understanding the mechanisms by which cells respond to external stimuli could be a successful strategy i.e. in cancer therapy, regenerative medicine, etc.

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