The Influence of Metalized Graphene Oxide/Reduced Graphene Oxide and Sulfonated Polystyrene on Dental Pulp Stem Cell Differentiation and Protein Adsorption

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Human dental pulp stem cells (DPSCs) can differentiate into multiple specialized cell types, showing potential for regenerative medicine. Advances in tissue engineering depend on designing artificial surfaces with suitable properties for the adsorption and organization of extracellular matrix proteins, and the objective of this project was to develop such a surface. Sulfonated polystyrene (SPS), used as a scaffold for tissue development, stimulates protein adsorption due to sulfonate's negative charge. Graphene and graphene oxide sheets can potentially enhance stem cell growth because they are biocompatible soft membranes with "high in-plane" stiffness and could become transferable and implantable platforms. This project created graphene oxide (GO) and reduced graphene oxide (RGO) functionalized with gold (Au) or silver (Ag) nanoparticles incorporated into SPS surfaces to study the combined impact on DPSC differentiation and protein adsorption, with the hypothesis that this combination would supply more charges to better adsorb proteins to the surface and possibly stimulate differentiation. Proteins of cells plated on all RGO-SPS surfaces were more highly adsorbed and densely packed as compared to GO-SPS or plain SPS surfaces; proteins on AuRGO-SPS were the densest. Additionally, cell moduli data indicated that cells plated on the metalized RGO were nearly an order of magnitude harder (hinting early stage odontoblastic differentiation) than those plated on metalized GO, increasing moduli even more than Dexamethasone, a glucocortoid known to enhance this process in DPSCs. This suggests that the metal-RGO solutions may be instrumental in osteogenic induction and hold promise for implementing metalized graphene-incorporated SPS scaffolds in tissue engineering.

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