Chondroitin sulfate immobilization at the surface of electrospun nanofiber meshes for cartilage regeneration

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Aiming at improving the biocompatibility of biomaterial scaffolds, surface modification presents a way to preserve their mechanical properties and to improve the surface bioactivity. In this work, chondroitin sulfate (CS) was immobilized at the surface of electrospun poly(caprolactone) nanofiber meshes (PCL NFMs). The immobilization was performed with 1-ethyl-3-(3-dimethyl-aminopropyl) carbodiimide (EDC)/N-hydroxysuccinimide (NHS). Contact Angle, SEM, Optical Profilometry, FTIR, X-ray photoelectron spectroscopy techniques confirmed the CS-immobilization in PCL NFMs. Furthermore, CS-immobilized PCL NFMs showed lower roughness and higher hydrophilicity than the samples without CS. Human articular chondrocytes (HACs) were cultured on electrospun PCL NFMs with or without CS immobilization. It was observed that HACs proliferated through the entire time course of the experiment in both types of scaffolds. SEM observations revealed that HACs maintained their typical morphology and produced extracellular matrix. Glycosaminoglycans quantification showed increased values over time. Quantitative-PCR of cartilage-related genes revealed over-expression of Aggrecan, Collagen type II, COMP and Sox9 on both types of NFMs tested, with higher values for PCL. In conclusion, CS immobilization in PCL NFM was achieved successfully and provides a valid platform enabling further surface functionalization methods in scaffolds to be developed for cartilage tissue engineering.