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Bacterial Cellulose as a feasible cell carrier for Retinal Pigment Epithelium Cell Transplantation

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Retinal Pigment Epithelium (RPE) cell transplantation is a potential therapy for retinal degenerative diseases that affect millions of people worldwide. However, for its use in cell therapy, RPE cells need to be transplanted as a functional cell monolayer, thus requiring a carrier substrate. An ideal substrate for this application should support acquisition and/or maintain the RPE phenotype; allow fluid transport and metabolites exchange; enable easy surgical manipulation; be well tolerated in the subretinal space; and biodegrade or integrate over time. Several biomaterials have been studied for this application, such as collagen, poly-L-lactic acid, gelatin, fibrinogen, deepithelialized amniotic membrane, among others. Although growth of healthy RPE has been achieved on both biodegradable and non biodegradable, synthetic and biologic substrates, only an exceptionally low number of these substrates show acceptable tissue response. Growth of RPE cell monolayers on bacterial cellulose (BC) surfaces presents itself as an interesting alternative for the replacement of both the RPE in degeneration and the compromised Bruch's membrane (BM) in retinal degenerative diseases. BC, produced by Gluconacetobacter xylinum, is a safe, non-degradable biomaterial and can be obtained with a thickness similar to BM, while maintaining its stability. The implantable substrate's functionality and durability depend on the bulk properties of the material and BC presents the ideal bulk properties for this application. In this regard, diffusion studies showed that BC presents the porosity and diffusion properties required for the transport of nutrients across the substrate (up to 300kDa diffusion). Additionally, biological response is governed by several surface properties: chemistry, topography, roughness, charge, energy and wettability. Although the wettability of unprocessed BC is not ideal, we have improved it through acetylation and coating of its surface with extracellular matrix (ECM, extracted from porcine urinary bladders). Indeed, the extent of surface wettability modification after BC surface acetylation was evaluated by water contact angle measurements, showing an increase from 20° to 75°, approximately. Moreover, we also demonstrated, by trypan blue dye exclusion and MTS assays, that RPE cell monolayers are viable and able to proliferate in BC substrates with ECM. These results were also confirmed by scanning electron microscopy, which showed that cells retained their normal morphology. Overall, results obtained so far demonstrated that both BC coating with ECM and BC acetylation improved the substrate performance, envisaging its potential application as a feasible RPE cell carrier.