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Modulation of macrophage polarization induced "in vitro" by 3D micro scaffolds

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INTRODUCTION: The implantation "in vivo" of a polymeric micro scaffold triggers the immune system, by orienting macrophages towards the M1 (pro-inflammatory) or M2 (anti-inflammatory) phenotypes. These events evolve into a foreign body reaction (FBR) [1] responsible for the fibrotic encapsulation or integration of the implant, respectively. In this work, we optimized the design of a 3D micro scaffold in its ability to guide macrophage polarization, with the aim to maximize its potential for integration after implantation "in vivo".
METHODS: We performed fabrication of the 3D micro scaffolds by 2-photon polymerization of the SZ2080 biocompatible photosensitive resin, as described before [2]. We designed scaffold architectures consisting of microgrids with increasing pore dimensions, ranging from 10x10x15 µm3 to 50x50x20 µm3. We cultured human macrophages with different phenotypes (M0, M1, and M2) in the microstructures [3]. After 48 hours, we investigated the level of macrophage polarization by immunofluorescence staining and Western blot. We incubated macrophages with 1 µM of SiR-actin fluorogenic probes and we used time-lapse confocal imaging to assess how the macrophages cytoskeleton functionally adapts in presence of the microstructure.
RESULTS: Cell culture experiments allowed to appreciate how different 3D micro geometries modulate macrophages activity. Pro-inflammatory/anti-inflammatory protein expression evaluation demonstrated that pore geometry significantly influences macrophages polarization. Among the several micro scaffold geometries tested, we identified the microstructure better reducing the pro-inflammatory macrophages response.
DISCUSSION & CONCLUSIONS: Our results show that polarization towards M1 or M2 phenotypes is modulated by the different microstructure geometries tested, suggesting a need for integrating specific 3D geometrical features in the design of miniaturized implantable scaffolds, to potentially prevent their fibrotic encapsulation. Further investigation on how the macrophages cytoskeleton adapts and modifies in presence of the 3D microstructures will establish the role of the cytoskeleton in macrophage polarization. In future work, we will carry out additional assays to analyze specific molecules released in the cell culture supernatants to better corroborate our observations.
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REFERENCES: 1. A. Carnicer-Lombarte et al., Front Bioeng Biotechnol., 9:622524, 2021. doi: 10.3389/fbioe.2021.622524.
2. E. Jacchetti et al., Sci Rep. 11(1):3021, 2021. doi: 10.1038/s41598-021-81920-2.
3. P.L. Graney et al., Sci Adv., 6(18):eaay6391, 2020. doi: 10.1126/sciadv.aay6391.

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