Regenerating neuroimplants in spinal cord injury

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Spinal cord injury (SCI), a traumatic disease characterized by a massive degeneration of neural tissue, is recently targeted for combinatory neuroregenerative therapeutic interventions. Our approach focuses on the development of pharmacologically pulsed neuroimplants, using 3D collagen scaffolds hosting Neural Stem Cells (NSCs). We tested 3D matrices either made of pure bovine collagen I (3D-C) or in combination with 8% chondroitin sulphate proteoglycan (3D-CG). We investigated the effects of these scaffolds on NSCs proliferation, differentiation and functionality in culture. Embryonic cortical NSCs were chosen, as they represent a cell population mainly composed of stem and progenitors cells with high proliferative capacity and trileneage differentiation potential. Our findings show that the composition of 3D scaffolds plays a significant functional role: scaffolds with a combined composition (92% collagen/8% chondroitin-6-sulphate) supported NSCs survival and proliferation throughout a time frame of 10 days in vitro whereas pure collagen scaffolds favored the differentiation of the same cells in functional neurons and increase electrophysiological activity. Due to the high efficacy of the 3D-C scaffold to support the functionality of the differentiated NSCs we used this type of culture system for its transplantation in the spinal cord of mice after experimental SCI, assessing its possible regenerative efficacy. The dorsal column crash mouse model for experimental SCI was used, where both sensory ascending and motor descending pathways are affected, assessing their ladder-walking performance. Our finding show that the treated with the 3D scaffold-NSC group performed better with reduced foot fault score during these 4 weeks of assessment, compared to the untreated, crash group. Interestingly, transplantation of 3D collagen scaffold seeded with NSCs facilitated the development of neural tissue, induced the regeneration capacity at the lesion site and reduce the extended astrogliosis in the lesion area 6-weeks after the experimental spinal cord injury in mice.