New approaches for the treatment of SCI use advances in the fields of nanotechnology, biomaterial science and cell therapy.
The results presented in this thesis showed that superparamagnetic iron oxide nanoparticles coated with a stable dopamine-hyaluronane associate can be used for the safe and effective labeling of MSC. Cell labeling efficiency, viability and the relaxivity of the tested particles were significantly better than those obtained with the commercial particles Endorem®. The DPA-HA coated nanoparticles can be used for the noninvasive monitoring of cell therapy using MRI.
Furthermore, we showed that SPION can be used for the targeted delivery of MSC to the site of a spinal cord lesion. The labeled cells can be concentrated in the lesion area by means of a magnetic implant. The process of cell targeting depends on the physical characteristics of the magnetic implant as well as on the biological features of the cells and nanoparticles, as we described with a proposed mathematical model.
It is possible to modify the properties of the magnetic system, e.g. by changing the shape or size of the magnet, thus tuning the magnetic force distribution and the gradient of the magnetic field necessary for effective cell targeting.
A promising therapeutic strategy for the treatment of spinal cord injury is the use of hydrogels, which can be used to bridge a spinal cord lesion either alone or in combination with stem cells. We showed that the bioadhesive properties of a superporous hydrogel based on PHEMA can be significantly improved by the covalent immobilization of Ac-CGGASIKVAVS-OH peptide on the surface of the hydrogel. The modified hydrogel also supports the differentiation and growth of neural precursors. The Ac-CGGASIKVAVS-OH-modified PHEMA hydrogel is thus an attractive candidate for further application in neural tissue engineering.