

Summary

Progress in experimental treatments of spinal cord injury (SCI) utilizing growth factors, stem cells and biomaterials has revealed the pathological mechanisms of the secondary processes and demonstrated the potential of combined therapy for future clinical treatment. The mobilization of bone marrow by the combined application of Flt3 ligand and G-CSF diminishes astrogliosis and increases axonal sprouting and thus leads to more pronounced spinal tissue sparing and neurological improvement when compared with single treatments. All types of stem cells used in this study significantly decreased the locomotor deficit after SCI. The most noticeable impact was observed in the NP-iPS treated group, especially due to their long term survival, interaction with host tissue, their impact on glial scarring and modulation of the immune response. MSCs, despite their short lifetime, decrease the immune response after SCI and modulate glial scar formation. The lowest effectivity on locomotor recovery after SCI was demonstrated by fetal spinal progenitors, which were not capable of sufficient integration into the host tissue, even though they showed long-term survival and differentiation.

The methods used to prepare methacrylate based hydrogels have a significant impact on the adhesion, growth and survival of MSC both, *in vitro* and *in vivo*. The survival of MSCs *in vitro* was noticeably higher in hydrogels prepared by polymerization using the solid porogen washout technique, modified with either a positive charge (MOETACI) or an RGD sequence on their surface, which is recognised by integrins. In *in vivo* models of lateral hemisection, MSC survival improved in the HEMA hydrogel grafted animals, which proves that HEMA-MOETACI gel is a better cell carrier. On the other hand, the highest number of axons and greatest capillary permissive environment *in vivo* was observed in the HPMA-SP-RGD hydrogel. Consequently, HPMA-SP-RGD together with MSCs could potentially lead to a synergistic effect in SCI therapy. A combination of SPC-01 cells and the HEMA hydrogel covalently modified with serotonin molecules led to transient changes in injured spinal cords, but have not shown any long term impact, which would have a permanent effect on spinal tissue regeneration. Covalently bound serotonin has accelerated the differentiation of NPs within the HEMA hydrogel.