Hydrogel Assisted Stem Cell Delivery for Peripheral Nerve Repair and Regeneration

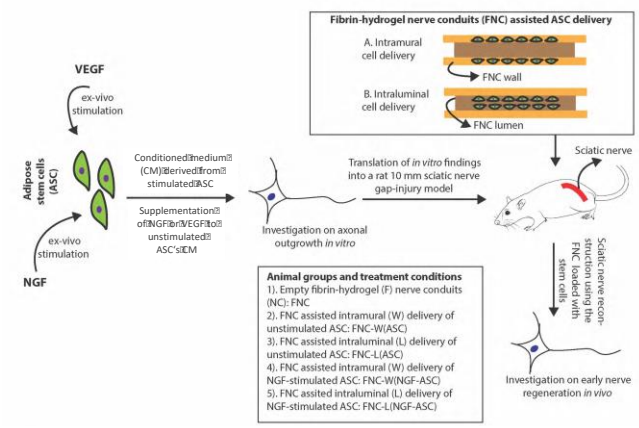

Figure 1: Ex-vivo stimulation of adipose stem cells using growth factors and fibrin-hydrogel nerve conduits assisted stem cell delivery strategies (Picture K. Prautsch).

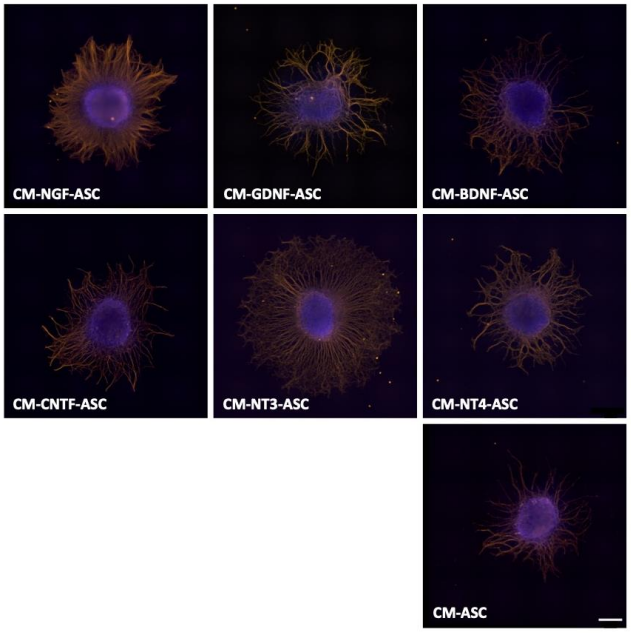

Figure 2: Neurotrophic potency of conditioned medium (CM) derived from NTF-stimulated ASC for supporting axonal regeneration. Microphotographs of dorsal root ganglion explants treated with CM derived from different NTF-stimulated ASC (Picture K. Prautsch).

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Injuries to the peripheral nerve system are a common clinical problem which affect mostly young individuals. Standard treatment methods are well established but are associated with several undeniable disadvantages that may have a long-lasting impact on the patients' quality of life.

The aim of my thesis was to investigate multidisciplinary translational approach for enhancing peripheral nerve regeneration as well as for the surgical nerve repair.
The first and second manuscript[1,2] of this thesis focused on the neurotrophic potency of adipose derived stem cells (ASC) in response to neurotrophic factors (NTF) stimuli, i.e. NGF, BDNF, NT3, NT4, GDNF, CNTF and VEGF *in vitro* and *in vivo*. The neuroregenerative events taking place in ASC and sensory neuronal cells upon stimulation, and the impact of two different stem cell delivery strategies, i.e. intramural versus intraluminal loading, in fibrin nerve conduits (FNC) on early nerve regeneration were investigated. In the third manuscript, a *prospective, randomized clinical trial* was conducted comparing the outcome of digital nerve injuries with or without nerve gap after experimental treatment with the fibrin nerve conduit (FNC) or the epineural suture with fibrin sealant versus the standard treatment with the autologous nerve graft or the epineural suture over a period of 12 months.
Ex-vivo stimulation of ASC by NTF and FNC assisted intramural delivery may offer new options for the development of effective stem cell-based therapies, while the FNC and the fibrin sealant might already present viable clinical treatment alternatives for the repair of short-gap nerve injuries.

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References:
(1) Prautsch KM, et al. Ex-Vivo Stimulation of Adipose Stem Cells by Growth Factors and Fibrin-Hydrogel Assisted Delivery Strategies for Treating Nerve Gap-Injuries. Bioengineering (Basel). 2020 May 5;7(2):42. doi: 10.3390/bioengineering7020042.
(2) Prautsch KM, et al. Modulation of Human Adipose Stem Cells' Neurotrophic Capacity Using a Variety of Growth Factors for Neural Tissue Engineering Applications: Axonal Growth, Transcriptional, and Phosphoproteomic Analyses In Vitro. Cells. 2020 Aug 21;9(9):1939. doi: 10.3390/cells9091939.