ADSCs in a fibrin matrix enhance nerve regeneration after epineural suturing in a rat model.

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Abstract:

Background: Due to their unique properties, adipose derived stem cells (ADSCs) obtain promising potential to enhance nerve regeneration. The aim of this study was to investigate if fibrin-glue embedded ADSCs were a beneficial adjunct to primary coaptation in a rat sciatic nerve model. Materials and methods: Fifty male Lewis rats underwent sciatic nerve transection and subsequent epineural suture repair. The treatment group received ADSCs re-suspended in fibrin glue, while the control group received fibrin glue only. After 7, 21, 35, and 63 days, analysis involved axon count, myelin sheath thickness as well as N- and G-ratios. Additionally, muscle weight quotient (operated vs. non-operated site of the same animal) was calculated and compared between treatment and control groups. For co-detection of vital ADSCs, vessel walls, and Schwann cells, immunolabeling was performed with CM-DiI, SMA, and S-100 antibodies, respectively. Results: ADSCs led to a significant increase of myelinization at day 21 (0.508 +/- 0.085 mum vs. 0.381 +/- 0.044 mum, P = 0.025) and day 35 (0.872 +/- 0.09 micro m vs. 0.495 +/- 0.078 micro m; P = 0.01) after surgery. Axon count was significantly increased at day 21 (420 +/- 119 vs. 129 +/- 63; P = 0.003) and day 63 (284 +/- 137 vs. 111 +/- 26; P = 0.046) after surgery. N- and G-ratios were significantly different compared with control indicating enhanced nerve regeneration due to ADSC treatment at each time point ($P < 0.05$). Muscle weight quotient was significantly higher in the treatment group compared with the control at day 21 (44.01% +/- 6.16% vs. 35.03% +/- 2.61%; P = 0.014) and day 63 (65.49% +/- 2.81% vs. 58.79% +/- 4.06%; P = 0.009) after surgery. Co-detection of immunolabeled cells

showed vital ADSCs at the neuronal repair site and in close proximity to intraneuronal vessels indicating active participation of ADSCs in the process of nerve regeneration and associated angiogenesis. Conclusion: ADSCs embedded in a fibrin matrix can significantly enhance regeneration of peripheral nerve injuries after primary coaptation. © 2015 Wiley Periodicals, Inc. Microsurgery 36:491-500, 2016.