Assessment of Peripheral Nerve Regeneration Using Diffusion Tensor Imaging (DTI) in Reverse and Forward Autografts

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Hypothesis: Diffusion tensor imaging (DTI) is magnetic resonance technology that is widely used in the study of the central nervous system and is emerging as a tool to non-invasively image peripheral nerves and assess the extent of nerve fiber regeneration[1]. Given no definite consensus on the accepted autograft orientation during peripheral nerve injury repair, we compare outcomes between reverse and normally oriented (forward) autografts utilizing DTI[2].

Methods: Thirty-six female Sprague Dawley rats were divided into 3 groups: 1) Control- left sciatic nerve isolation without injury, 2) Reverse Autograft- 10mm cut left sciatic nerve segment reoriented 180° and used to coapt the proximal and distal ends, or 3) Forward Autograft- 10mm cut nerve segment kept in its normal orientation for coaptation. Animals underwent Sciatic Function Index (SFI) and Foot Fault (FF) behavior studies at 72 hours, and then weekly. At 6 weeks, axons proximal, within, and distal to the autograft were evaluated using DTI and choline acetyltransferase motor staining for immunohistochemistry (IHC). Bilateral gastrocnemius/soleus muscle weights were compared to obtain a net wet weight to assess the degree of muscle atrophy. Statistical significance was determined using Mann-Whitney U test.

Results: DTI findings including fractional anisotropy (FA), radial diffusivity, and axial diffusivity were similar between reverse and forward autografts at all nerve segments. There was no statistically significant difference in median motor axon counts proximal/within/distal between reverse and forward autografts (1519/561/362 vs 1516/490/338, p=ns). Likewise, there was no difference in behavioral studies (SFI, FF) at any tested time point, or net muscle weight (1.37g vs 1.33g) at 6 weeks.

Conclusion: DTI proves to be a reliable tool to assess peripheral nerve regeneration. It supports that reversing nerve autograft polarity does not influence outcomes. Autograft repairs should therefore be oriented in the direction that allows the best fascicular alignment.

References:

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