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Quantitative characterization of regenerating axons after end-to-side and end-to-end coaptation in a rat brachial plexus model: a retrograde tracer study.

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Abstract

The efficacy of end-to-side repair as a method of nerve reconstruction has been questioned, and most studies that characterize the mode of re-innervation are marred by inappropriate experimental design and lack quantitative analysis. This makes characterization of re-innervating neurons confusing and consequently controversy remains as to the extent and source of reinnervating axons. In an experimental brachial plexus rat model, we transected the musculocutaneous nerve, labeled its neuron pool with Fast-Blue and joined the distal stump to the side of the intact ulnar nerve, or to the proximal stump of the divided ulnar nerve, to characterize neurons that reinnervate the recipient nerve. Tetramethyl-rhodamine dextran (TMRD) or fluoro-gold was used to map the reinnervating motor and sensory neurons at 12 weeks post-transection. No neurons originally labeled from musculocutaneous nerve were subsequently labeled with TMRD or fluoro-gold, showing that this original neuron pool does not contribute to re-innervation of the distal musculocutaneous nerve, but that reinnervation occurs solely by ulnar nerve motor and sensory axons. In the end-to-side group, 16.4% of the motor and 7% of the sensory donor ulnar nerve neurons re-innervated the musculocutaneous nerve exclusively, and a further 10% motor and 11.6% sensory innervated the musculocutaneous nerve by collateral sprouting of their axons. This compared to re-innervation by 62.6% of motor and 70.4% of ulnar nerve sensory neurons in the positive control that underwent end-to-end repair. Our results confirm the concept of collateral sprouting and support the use of end-to-side repair.

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