The Effects of Intraoperative Electrical Stimulation on Nerve Regeneration Across Nerve Isografts

Grace C. Keane, Deng Pan, Daniel A. Hunter, Lauren Schellhardt, Alison K. Snyder-Warwick, Susan E. Mackinnon, Matthew D. Wood

Introduction

• Despite their regenerative ability, peripheral nerve injuries in humans typically result in minimal functional recovery and debilitating morbidity.

• Brief electrical stimulation (Estim) has demonstrated positive outcomes on nerve regeneration after injury.

• Using a rat tibial nerve isograft model, we explored the effects of Estim on axon regeneration and functional recovery across nerve isografts.

• We also aimed to parse where Estim functions to improve peripheral nerve regeneration: the neuronal cell-body, the non-neuronal cells of the isograft, or some combination of both.

Methods

• One (1) cm isografts were inserted between cut tibial nerve ends and stimulated proximally for 1 hr at 0.5 mA.

• Axon regeneration and cell populations were quantified using immunofluorescence; Recovery via walking track and grid walk analysis.

• To determine which cells are affected by Estim to improve regeneration, the donor isograft or the recipient nerve were independently stimulated prior to grafting.

Results

Estim Increases Early Axon Regeneration

Estim Improves Long-Term Functional Recovery

Estim Affects Macrophage Accumulation

Estim of Isografts Alone Promotes Axon Growth

Conclusions

Estim promotes regeneration likely via effects to the neuron and its axons, but also via non-neuronal cells within an isograft. These effects improve axon regeneration and functional recovery across short (1 cm) isografts.