Direct Repair of Nerves Under Tension Has Better Functional and Histologic Outcomes Than Use of an Isograft

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INTRODUCTION

- The optimal method to reconstruct a segmental defect in the treatment of traumatic nerve injuries is unknown.
- Repair of nerves under tension is thought to lead to worse functional outcomes secondary to increased scarring[1], potential for rupture and poor regeneration capability[2].
- Options for treatment include include mobilization and primary repair under tension, splinting of the nerve with a conduit[3], or repair with an interpositional isograft
- Little is known about the outcomes from conduit assisted repair compared to the above alternatives.

OBJECTIVES

- Investigate the use of a novel conduit splinting technique to mitigate tension at the coaptation site of a rat sciatic nerve transection model to determine the optimal reconstruction method for segmental nerve defects.

METHODS

- Forty Lewis rats were divided into 4 groups of 10, with a different repair technique performed in each group.
- A unilateral sciatic nerve segmental defect was created in each rat by excising 5 mm of sciatic nerve in a standardized fashion.
- The segmental defect was then repaired or reconstructed using one of four techniques: primary repair under tension, repair with use of a conduit splint, reverse isograft with conduit splinting, and reverse isograft without splinting (Figures 1 & 2).
- After 6 weeks, functional outcomes were assessed by measuring Sciatic Functional Index (SFI) using walking track analysis (Fig. 3).
- Histologic outcomes were also assessed using a semi-automated detection algorithm to measure number of axons, axonal size, density, amount of debris and remyelination.
- Normality of the data was assessed with Shapiro-Wilks test. Kruskal-Wallis test with adjustment for normal comparisons was utilized to compare histologic parameters among groups.

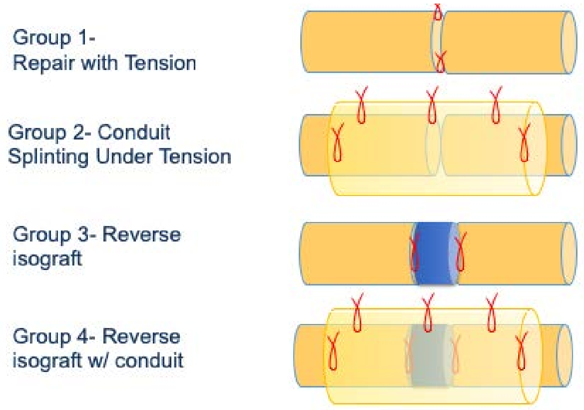


Figure 1: Experimental Groups

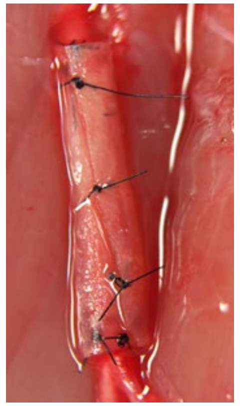


Figure 2: Conduit splinting technique designed to reduce repair site tension.

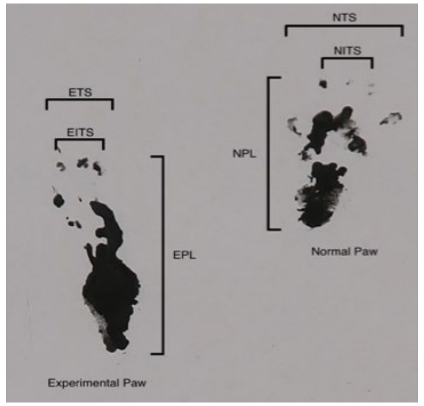


Figure 3: Measurements for SFI.

RESULTS

- Nerve splinting with a conduit reduced repair site rupture rates compared to a conduit alone.
- For repairs under high tension, conduit splinting resulted in similar axon density, size and number (Figure 4).
- The best functional outcomes, as measured by SFI, were found in primary repairs under tension (Figure 5).
- More debris was found with use of a conduit splint or isograft alone (Figure 6) compared to primary repair under tension and remyelination was better with primary repair under tension compared to isograft (with or without conduit).

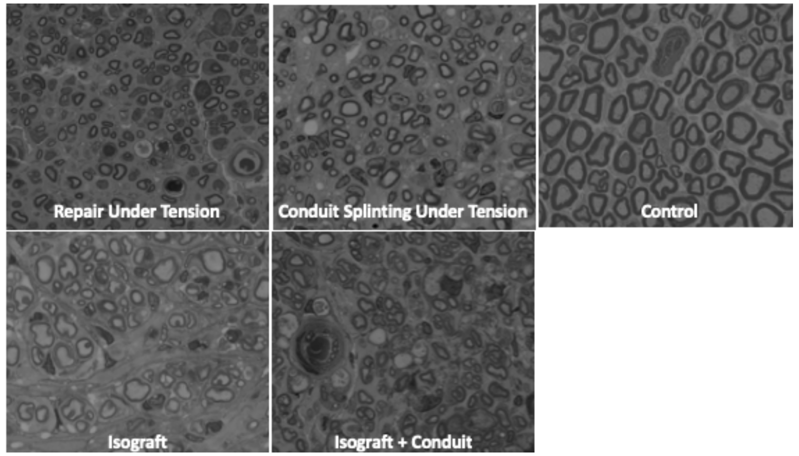
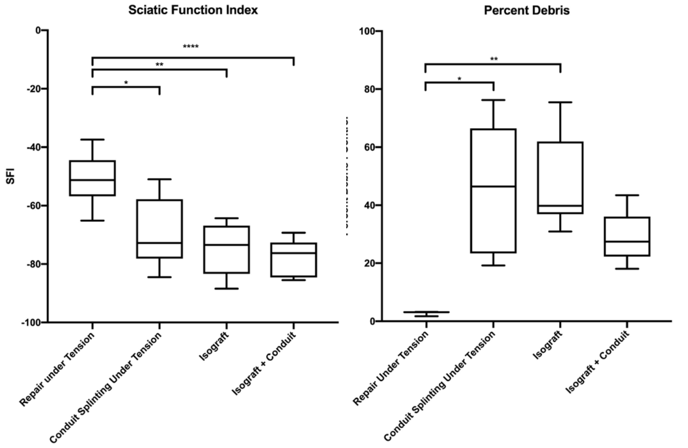


Figure 4: Nerve splinting reduced repair site rupture rates, but led to more debris compared to repairs under tension or with an isograft. Axon density, size and number were not significantly different.



Figures 5&6: Conduit splinting resulted in similar axon number, size and density, but worse functional outcomes and more debris compared to intact primary repairs.

CONCLUSION

- Mitigating tension at the coaptation site through a technique of nerve conduit splinting had a trend towards reduced rupture rates for nerve repairs associated with a segmental defect.
- Of interest, outcomes of primary nerve repair under tension that did not rupture demonstrated better functional results at 6 weeks compared to splinting or reverse isograft groups.
- While repair under tension has the potential to lead to catastrophic failure, those that remain intact may perform better than defects reconstructed with an isograft. .

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