Regenerative cell injection in denervated muscle reduces atrophy and enhances recovery following nerve repair

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INTRODUCTION: Functional muscle recovery after a peripheral nerve injury is far from optimal due to atrophy of the muscle arising from prolonged denervation. We hypothesised that injecting regenerative cells in denervated muscle would reduce atrophy.

METHODS: A rat sciatic nerve lesion was performed and Schwann cells (SC) or adipose derived stem cells, untreated and induced to a “Schwann cell-like” phenotype (dASC) [1], were injected into the gastrocnemius muscles. Nerves were either repaired immediately or capped to prevent muscle reinnervation. One month later, functionality was measured using a walking track test [2] and muscle atrophy was assessed by examining muscle weight and histology.

RESULTS: In both experimental models (repair and capping of the nerve), cell injection groups displayed significantly higher muscle weight than the sham groups. Animals subjected to nerve injury followed by repair and injection of growth medium in the muscle showed greater than 60% weight reduction compared with the contra-lateral side. Injections of untreated ASC did not enhance muscle weights. However, significantly less muscle atrophy was observed in the dASC (p<0.01 for nerve repair, p<0.001 for capping of nerve) and in the SC groups (p<0.001 for nerve repair, p<0.001 for capping of nerve). Nerve repair also resulted in increased muscle weights compared with the no-repair groups. Histological (Fig. 1) and functional analysis confirmed these results. The repair sham group showed both fast and slow muscle fibers with less than 20% area size compared with the contra-lateral side. In animals treated with injections of dASC or Schwann cells there was a significant increase in muscle fiber size. The rats in the dASC and Schwann cell injection groups also showed significantly better functional results in the walking track test when compared with the sham group. The times required for the rats to cross the ladder were reduced and there was an increased accuracy of foot placement.

DISCUSSION & CONCLUSIONS: Our results indicate that injecting stem cells or Schwann cells reduces muscle atrophy occurring as a result of denervation. Adipose derived stem cells appear to be a promising, clinically relevant cell population, for treatment of traumatic nerve injuries.


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