Chitosan tubes enriched by skeletal muscle for peripheral nerve regeneration

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BACKGROUND: Recent studies demonstrated that chitosan tubes for peripheral nerve repair show results similar to those obtained using autologous nerve grafts after immediate repair of rat sciatic nerve gaps. These promising pre-clinical results led to approval of the chitosan tubes for clinical use as Reaxon® Nerve Guide (Medovent GmbH, Mainz, Germany). The aim of this study was to improve the performance of hollow chitosan tube by the enrichment with longitudinal skeletal muscle fibres. As previously demonstrated, muscle fibres used to fill a vein ("muscle in vein" conduit) improve peripheral nerve regeneration when used to bridge a nerve defect up to 2cm.
METHODS: The rat median nerve was immediately repaired by means of two different conduits: 10mm hollow chitosan tube and 10mm chitosan tube filled with skeletal muscle fibres (a longitudinal piece of *pectoralis major* muscle introduced inside the tube, "muscle in tube"). 10mm autologous nerve graft was used as a positive control. Samples were harvested at both early (7, 14, 28 days after nerve repair) and late (3 months) time points, and functional, morphological, stereological and biomolecular analyses were carried out.
RESULTS: The biomolecular analysis carried out on early time points shows that the muscle inside the tube produces and releases Neuregulin1, a key factor for Schwann cell survival and activity, usually released following nerve injury. Functional, stereological and morphometric analyses were performed on the distal part of regenerated nerve, 3 months after nerve repair, to evaluate the regeneration outcome. Data analysis shows no significant differences between hollow chitosan tube and muscle in tube groups.
CONCLUSIONS: For short gap (<1cm), both hollow chitosan tube and muscle in tube are promising techniques to repair nerve defects. The muscle in tube releasing Neuregulin1 might be a good strategy to promote regeneration when the gap is longer than 1cm and/or repair is delayed in time.