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Efficacy of 780-nm Laser Phototherapy on Peripheral Nerve Regeneration after Neurotube Reconstruction Procedure (Double-Blind Randomized Study)

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ABSTRACT

Objective: **This pilot double-blind randomized study evaluated the efficacy of 780-nm laser phototherapy on the acceleration of axonal growth and regeneration after peripheral nerve reconstruction by polyglycolic acid (PGA) neurotube.** ***Background Data:*** **The use of a guiding tube for the reconstruction of segmental loss of injured peripheral nerve has some advantages over the regular nerve grafting procedure. Experimental studies have shown that laser phototherapy is effective in influencing nerve regeneration.** ***Methods:*** **The right sciatic nerve was transected, and a 0.5-cm nerve segment was removed in 20 rats. A neurotube was placed between the proximal and the distal parts of the nerve for reconnection of nerve defect. Ten of 20 rats received post-operative, transcutaneous, 200-mW, 780-nm laser irradiation for 14 consecutive days to the corresponding segments of the spinal cord (15 min) and to the reconstructed nerve (15 min).** ***Results:*** **At 3 months after surgery, positive somato-sensory evoked responses were found in 70% of the irradiated rats ($p = 0.015$), compared to 30% of the non-irradiated rats. The Sciatic Functional Index in the irradiated group was higher than in the non-irradiated group ($p < 0.05$). Morphologically, the nerves were completely reconnected in both groups, but the laser-treated group showed an increased total number of myelinated axons.** ***Conclusion:*** **The results of this study suggest that postoperative 780-nm laser phototherapy enhances the regenerative process of the peripheral nerve after reconnection of the nerve defect using a PGA neurotube.**

INTRODUCTION

In cases where a peripheral nerve is injured and complete segmental loss exists, the treatment of choice is nerve reconstruction using an autogenous nerve graft. The use of a regenerating guiding tube for the reconstruction of massive segmental loss of a peripheral nerve has some advantages over the regular nerve grafting procedure. It is simple and time saving, and does not require a donor of an autologous nerve. The use of both biodegradable and non-biodegradable artificial nerve tubes has been extensively investigated *in vivo.* Using nerve tubes composed of silicone, the nerve recovery was jeopardized due to a late foreign body response and chronic nerve compression.[1] Collagen,[2] polyglycolic acid (PGA),[3] and copolymers of lactide and ε-caprolactone[4] are among the *in vivo* degradable materials used as alternatives to autologous nerve grafts. The correction of large nerve defects with functional recovery using a degradable graft still remains a challenge. However, for the treatment of complete peripheral nerve injury where the nerve defect is significant, an innovative biodegradable composite co-polymer guiding neurotube, based on tissue engineering technology, was recently described.[5]

After nerve reconstruction, sprouting of regenerated fibers from the proximal stump begins and is followed by the elongation of the fibers along the sheaths of the distal nerve towards the target organ. The number of regenerated fibers and their reconnection with the target organ determines the quality of functional recovery.[6] Functional return and regeneration, in general,

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