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Manufacturing Synthetic Nerve Conduits for Extended Nerve Gaps: Present Assessments and Upcoming Research

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Introduction

Peripheral nerve injuries can result in significant functional deficits, requiring surgical intervention to repair the damaged nerves. In cases where there is a gap between nerve ends that cannot be closed directly, synthetic nerve conduits can be used to facilitate nerve regeneration. This article reviews the current state of manufacturing synthetic nerve conduits for extended nerve gaps, including the materials and fabrication techniques used, as well as the assessment of their efficacy in preclinical and clinical studies. Additionally, upcoming research directions and challenges in the field are discussed. The efficacy of synthetic nerve conduits in promoting nerve regeneration has been assessed in numerous preclinical and clinical studies. Preclinical studies in animal models have shown that synthetic nerve conduits can support nerve regeneration across extended nerve gaps, with outcomes comparable to or better than autografts. Clinical studies in humans have also shown promising results, with some studies reporting functional recovery and sensory improvement following nerve repair using synthetic conduits [1-3].

Description

Peripheral nerve injuries are a common clinical problem that can result from trauma, surgical procedures, or medical conditions. When a nerve is injured, the body's natural response is to initiate a process of regeneration, where new nerve fibers grow from the proximal nerve stump towards the distal stump. However, in cases where there is a gap between the nerve ends, such as in cases of extensive nerve damage, this process is impeded. Synthetic nerve conduits have emerged as a promising alternative to autografts for bridging these extended nerve gaps, providing a scaffold for nerve regeneration. Synthetic nerve conduits are typically made from biocompatible materials that can support nerve regeneration. Some of the most commonly used materials include Poly (Lactic-co-Glycolic Acid) (PLGA), Poly (Caprolactone) (PCL), and Poly (Ethylene Glycol) (PEG). These materials can be fabricated into conduits with different geometries and mechanical properties to suit the specific requirements of the nerve injury. Synthetic nerve conduits can be fabricated using a variety of techniques, including electrospinning, 3D printing, and solvent casting. Electrospinning is a commonly used technique for producing nanofibrous scaffolds with high surface area and porosity, which can enhance cell adhesion and proliferation [4,5]. 3D printing allows for the precise control of conduit geometry and internal structure, enabling the fabrication of conduits with complex shapes and architectures. Solvent casting is a simple and cost-effective technique for producing conduits with controlled porosity and mechanical properties [6].

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Conclusion

Despite the progress made in the field of synthetic nerve conduits, several challenges remain. One of the main challenges is achieving optimal nerve regeneration across extended nerve gaps, particularly in cases of large nerve defects. Future research directions include the development of bioactive materials and growth factor delivery systems to enhance nerve regeneration, as well as the use of stem cells and tissue engineering approaches to promote nerve repair. Synthetic nerve conduits have emerged as a promising alternative to autografts for bridging extended nerve gaps. Advances in materials science and fabrication techniques have enabled the development of conduits with tailored properties to support nerve regeneration. While challenges remain, ongoing research efforts hold promise for further improving the efficacy of synthetic nerve conduits and enhancing outcomes for patients with peripheral nerve injuries.

Acknowledgement

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Conflict of Interest

None.

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