

RESEARCH

**Repair of nerve injury by implanting prostheses
obtained from isogenic acellular nerve segments** ☆



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Received 11 October 2016; accepted 9 June 2017

KEYWORDS

Nerve regeneration;
Nerve prosthesis;
Isogenic nervous
graft;
Chemical acellular
method;
Peripheral nerve
repair;
Isograft;
Allograft

Abstract

Introduction: When a nerve section with a significant gap occurs, it is necessary to use a prosthesis to suture it. To date an autologous nerve segment graft appears to be the best treatment; but it has several important disadvantages. Our goal is to study the effectiveness of an isogenic acellular nerve prosthesis comparing a simple suture with tubulisation.

Material and method: Four groups of Wistar rats were used. The animals in Group 0 served as donors of nerve segments to graft. Group 1 received the implant with an end-to-end suture. In Group 2, the implant was sutured inside an ϵ -caprolactone tube. Group 3 received it in a polylactic-co-glycolic acid tube. We evaluated the motor function (sciatic index and step test in motion), and the regeneration length by histological study of regeneration, after a maximum of 3 weeks.

Results: Regeneration was uneven in the three groups. In all groups, there were implants with regenerated nerve fibres at the maximum studied length (15 mm) and others where regeneration was scarce. The mean regeneration length was greater in the direct end-to-end suture group (G1), although the regeneration speed was similar in the three groups. Group 1 showed the highest percentage of regeneration, but the variability of results prevents this difference reaching statistical significance. We found no significant differences between the two groups with polymer tubes.

☆ Please cite this article as: García-Medrano B, Mesuro Domínguez N, Simón Pérez Cl, Garrosa García M, Gayoso del Villar S, Mayo Íscar A, et al. Reparación de lesiones en nervios mediante el implante de prótesis obtenidas de segmentos acelulares de nervio isogénico. Rev Esp Cir Ortop Traumatol. 2017;61:359–366.

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PALABRAS CLAVE

Regeneración nerviosa;
Prótesis de nervio;
Injerto nervioso isogénico;
Descelularización química;
Reparación nervio periférico;
Isoinjerto;
Alloinjerto

Conclusion: For the implantation of isogenic acellular nerve prosthesis, under our experimental conditions, the direct end-to-end suture was more effective than when it is protected with biopolymer tubes.

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Reparación de lesiones en nervios mediante el implante de prótesis obtenidas de segmentos acelulares de nervio isogénico

Resumen

Introducción: Cuando se produce una sección nerviosa con separación significativa de los cabos es necesario utilizar una prótesis, a modo de puente, para suturarlos. La mejor prótesis es un segmento de nervio autógeno, pero presenta importantes inconvenientes. Nuestro objetivo es comparar la eficacia de la sutura simple con la tubulización para el implante de una prótesis de nervio isogénico descelularizado.

Material y método: Se utilizan 4 grupos de ratas Wistar. Grupo 0: animales donantes de nervio ciático. Grupo 1: recibió el implante con sutura término-terminal. Grupo 2: recibió el implante dentro de un tubo de ϵ -caprolactona. Grupo 3: lo recibió en un tubo de poliláctico-co-glicólico. Se evaluó la función motora (índice ciático) y la extensión de la regeneración (estudio histológico) a las 3 semanas del implante.

Resultados: La regeneración ha sido irregular en los 3 grupos experimentales. En todos hay implantes en los que las fibras nerviosas regeneran la longitud máxima estudiada (15 mm) y otros en los que la regeneración es muy escasa. La longitud media de regeneración es mayor en el grupo de sutura directa (G1), aunque la velocidad es similar en los 3. El grupo 1 muestra el mayor porcentaje de regeneración, aunque la variabilidad de los resultados impide que esta diferencia alcance significación estadística. No hemos hallado diferencias significativas entre los dos grupos con tubos de diferentes polímeros.

Conclusión: Para implantar prótesis de nervios isogénicos descelularizados es más eficaz, en nuestras condiciones experimentales, la sutura término-terminal que los tubos de polímeros biocompatibles.

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Introduction

Peripheral nerve injuries are a major cause of morbidity and disability and generate high financial costs worldwide. The incidence of these injuries in Sweden is 13.9 per 100,000 inhabitants per year.¹ In the United States, 20 million American suffer peripheral nerve injury, and at an annual cost of 150,000 million dollars.² Therefore, studies covering this subject will be of great interest in terms of healthcare and will have important socio-economic impact.

When a peripheral nerve is sectioned with no excessive gap between the proximal and distal nerve ends, nerve regeneration can be achieved using a simple end-to-end suture. Recovery of a nerve's functional capacity of between 30% and 90% is considered acceptable.² Most often the proximal and distal nerve ends have been separated, either due to traumatic loss of nerve tissue or due to retraction of the ends of the sectioned nerve.³ In the event that they cannot be brought near enough to suture without excessive tension, which would hinder regeneration, a "biological bridge" needs to be placed to join the proximal and distal ends of the nerve and promote repair.

To date, autologous nerve segment graft appears to be the best method to repair these injuries.³ Generally a sensory nerve from the same patient is sacrificed to regenerate a motor nerve. Recent studies⁴ indicate that mixed sensory and motor compositions are equally effective for the repair of a mixed nerve. Autologous transplants have several disadvantages, such as increased operation time and difficulty, shortage of available nerve, unequal sizes of the implanted nerve and the receptor nerve, pain, loss of sensitivity or the formation of sores or neuromas.⁵

A great many synthetic as well as biological substances have been used as alternatives to autologous nerves to circumvent these disadvantages. Silicone was one of the first of these materials to be used. Although silicone tubes are not currently considered the most appropriate for repairing injured nerves, they are still a benchmark in experimental studies.⁶ Synthetic polymers, such as poly lactic acid, poly lactic-co-glycolic acid (PLGA), ϵ -caprolactone (ϵ -CPL) or mixtures of these have been widely used to manufacture tubular structures that promote nerve regeneration.⁷ These polymers have suitable mechanical qualities to be implanted and are biocompatible, thus nerve regeneration is enabled through them. New biomaterials have also been described,

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