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Short communication

Side to side coaptation – new technic in peripheral nerve surgery – preliminary report

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Abstract

This study presents and evaluates side-to-side nerve repair techniques for their ability to induce collateral nerve sprouting. The coaptation of the ventral branches of spinal nerves C5 and C6 to C7 through an incision epineurium was used to repair the nerve. The number of myelinated fiber axons and G-ratio was evaluated. Preliminary results indicate the possibility of using side to side coaptation in brachial plexus nerve surgery.

Key words: coaptation, roots avulsion, spinal nerve

Introduction

Avulsion of the roots of the brachial plexus are among the most severe peripheral nerve system lesions and until very recent years were treated as inoperable. In these cases end to end neurorrhaphy is impossible, because of the lack of the proximal stump. Therefore root avulsion injuries of the brachial plexus are usually treated by autologous nerve graft with end-to-end neurorrhaphy of a healthy donor nerve to the avulsed distal nerve stump. (Sananpachi et al.

2002). However, this approach has the drawback that it sacrifices a donor nerve and its target to provide reinnervation for the recipient nerve and target muscles (Schmidhammer et al. 2005). Recent reports prove that an alternative method may be use end-to-side coaptation (Viterbo et al. 1992). In this case the axons are derived from an uninjured brachial plexus component by collateral sprouting. This method is already used in the long branches of the brachial plexus. However, in the case of high brachial plexus injuries, at the level of the roots, the above

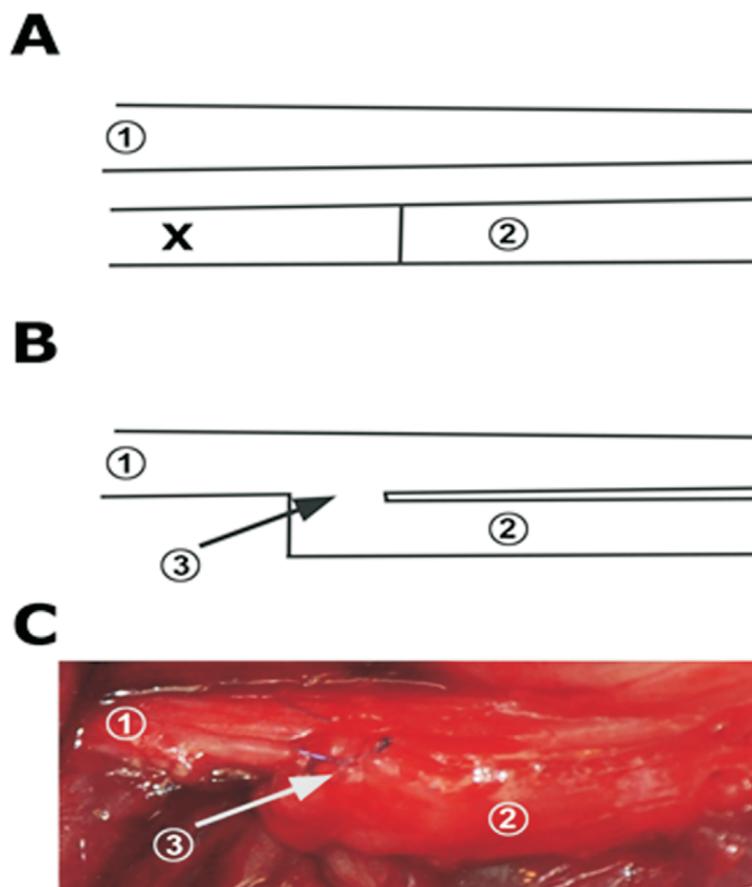


Fig. 1. Intraoperative picture and schematic illustration of surgical neurorrhaphy. A, B Schematic illustration. C Surgical photograph 1-uninjured nerve-donor nerve, 2-injured nerve-distal stump coapted nerve. 3. Side to side coaptation via epineural window. X-large defect injured nerve.

method, for anatomical reasons (short, wide trunk), is difficult to use. The purpose of this paper is to present and evaluate a new technique of side to side neurorrhaphy.

Materials and Methods

The experiments were approved by the Local Ethics Committee for animals at the University of Life Sciences in Wrocław. In 6 New Zealand White rabbits side to side repairs on brachial plexus left limbs were made. All surgical procedures were performed with a lateral approach. The ventral branches of the spinal nerves C5 and C6 were avulsed from the spinal canal. Side-to-side repair was made via a 3-mm window on right side ventral branches of spinal nerves C5 and C6, and the distal stump was sutured using 2 10-0 ethilon stitches via a 3-mm window on the left side ventral branches of spinal nerve C7 (Fig. 1a, 1b, 1c). The control group consisted of 6 right healthy limbs. The analysis was made on the basis of histological analysis of the number of myelinated fibers and a g-ratio (the

ratio of the axon diameter to the diameter of the entire fiber) (Fig. 2).

Results and Discussion

Comparison of collected material from C5 and C6 1 cm after coaptation to material from C5 and C6 on the same level in the control group shows that the number of myelinated axons was markedly reduced in side to side groups compared to the control group-44%. The number of axons myelin fiber density [fiber/mm²] was accordingly 143.22 \pm 4.4 in the experimental and 342.19 \pm 2.643 in control group. The G-ratio was respectively 0.64 \pm 0.08 in the experimental group compared to 0.66 \pm 0.07 in the control group, and the myelin sheath [μ m] 1.54 \pm 0.66 in the experimental group compared to 2.19 \pm 0.48 in the control group. The results of the number of myelinated axons in the side to side coaptation group compared to the number of myelinated axons after end to side neurorrhaphy, is slightly lower than that known from the literature, where it is about 50%-60% of the

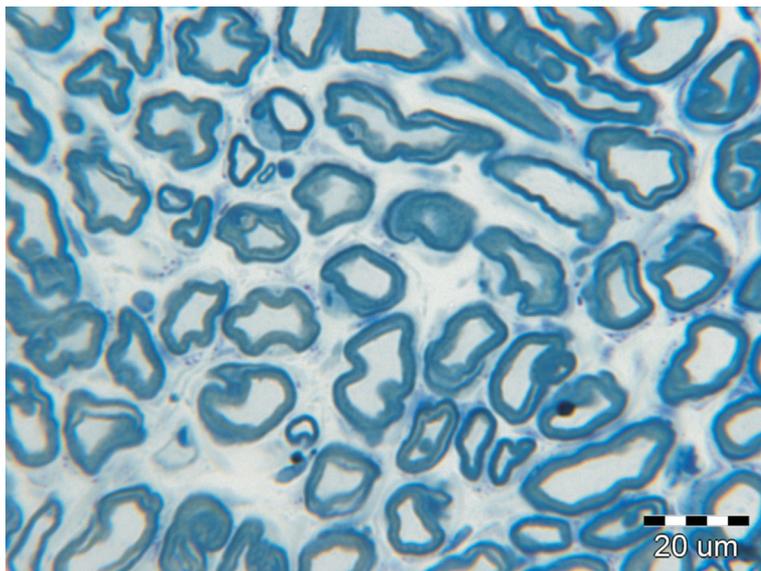


Fig. 2. Microscopic image of sampled nerve 1 cm from the coaptation. Toluidine blue staining.

original axons (Zhang 1999). On the other hand, the second essential parameter for collateral sprouting is correct value of G-ratio. As reported (Chomiak and Hu 2009), the G-ratio in peripheral nerve is more than 0.6. In our experimental group the result of G-ratio more than 0.6 indicates normal function of conduction in myelinated fibers. These results indicate a possibility of nerve conduction after side to side coaptation surgery. However, additional research is required, particularly retrograde labeling.

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