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Morphofunctional evaluation of end-to-side neurorrhaphy through video system magnification

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ABSTRACT

Background: The surgical microscope is an essential tool for microsurgery. Nonetheless, several promising alternatives are being developed, including endoscopes and laparoscopes with video systems. However, these alternatives have only been used for arterial anastomoses so far. The aim of this study was to evaluate the use of a low-cost video-assisted magnification system in end-to-side neurorrhaphy in rats.

Materials and methods: Forty rats were randomly divided into four matched groups: (1) normality (sciatic nerve was exposed but was kept intact); (2) denervation (fibular nerve was sectioned, and the proximal and distal stumps were sutured—transection without repair); (3) microscope; and (4) video system (fibular nerve was sectioned; the proximal stump was buried inside the adjacent musculature, and the distal stump was sutured to the tibial nerve). Microsurgical procedures were performed with guidance from a microscope or video system. We analyzed weight, nerve caliber, number of stitches, times required to perform the neurorrhaphy, muscle mass, peroneal functional indices, latency and amplitude, and numbers of axons.

Results: There were no significant differences in weight, nerve caliber, number of stitches, muscle mass, peroneal functional indices, or latency between microscope and video system groups. Neurorrhaphy took longer using the video system ($P < 0.05$). The amplitude was higher in the microscope group than in the video group.

Conclusions: It is possible to perform an end-to-side neurorrhaphy in rats through video system magnification. The success rate is satisfactory and comparable with that of procedures performed under surgical microscopes.

Introduction

Peripheral nerves are frequently affected by traumatic injuries. Total or partial section, stretch, compression, avulsion, and crushing can reduce or interrupt nerve transmission, causing reduction or loss of sensitivity and motility in the innerved area.[1] If peripheral nerve injuries are not adequately treated, they cause significant deficits, which reduce the patient's quality of life and functional capacity to work.[1,2]

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End-to-side neurorrhaphy is defined as the coaptation of a sectioned neural stump to an adjacent donor nerve.[3,4] This technique is simple and causes minimal morbidity to the donor nerve. Despite its limitations, end-to-side neurorrhaphy is the standard treatment for complex situations when end-to-end repair is not possible, as in extensive neural tissue loss or unavailability of the proximal stump.[3-6]

Several promising video systems with good with image quality and magnification have been suggested as alternatives to the surgical microscope.[7,8] Recent advances in digital technology have made high-resolution camcorders more accessible at low cost and with accurate image transmission.[7-10] These new technologies have been applied in the experimental field with encouraging results.

Video microsurgery presents several advantages[7-10]: (1) better ergonomics; (2) access to the patient without interposition of microscope equipment; (3) easy to assemble; (4) portable; (5) lower cost; (6) easy image recording; (7) greater involvement and commitment of the surgical team; and (8) high-definition imaging of tiny structures. The main limitations of the video-assisted system are the lack of a stereoscopic view, similar to laparoscopic surgery, and the level of training required to master the technique.[11]

Video systems have only been used to perform arterial anastomoses so far.[7-10] One of the most important applications of microsurgery is the neurorrhaphy of peripheral nerves. The aim of this study was to evaluate the use of a novel low-cost method of video-assisted magnification in peripheral end-to-side neurorrhaphy in rats.

Materials and methods

Ethics and experimental protocol

This study was approved by the Ethics Committee for the Use of Animals of the State University of Pará. All institutional and national guidelines for the care and use of laboratory animals were followed. Forty female Wistar rats (*Rattus norvegicus*) obtained from the Animal Colony of the Experimental Surgery Laboratory were used. Rats weighed 180-300 g and were kept in a controlled environment with food and water *ad libitum*.

They were randomly assigned into four groups of 10 animals each as follows: (1) normality group (NG): The sciatic nerve and its branches were exposed, but they were kept intact; (2) denervation group (DG): The fibular nerve was sectioned, and its proximal and distal stumps were sutured—transection without repair; (3) microscope group (MG): The fibular nerve was sectioned, its proximal stump was buried inside the adjacent musculature, and the distal stump extremity was sutured to the tibial nerve. Microsurgical procedures were performed under a microscope; and (4) video system group (VG): The fibular nerve was sectioned, its proximal stump was buried inside the adjacent musculature, and the distal stump extremity was sutured to the tibial nerve. Microsurgical procedures were performed with guidance from a video system.

Surgical procedures

The surgical procedures were performed by the same surgeon (R.S.M.B.) with >20 y of experience in microsurgery. Rats were anesthetized with ketamine (70 mg/kg) and xylazine (10 mg/kg) intraperitoneally and then shaved and placed in a horizontal supine position. Antisepsis was performed on the right posterolateral face of the thigh. Surgery was performed as previously described.[3,4,12,13] Under direct visualization, a longitudinal incision was made in the posterolateral region of the right member, from the major trochanter toward the lateral condyle of the femur. A blunt dissection was made between the gluteus maximus muscles and quadriceps to expose the full-length sciatic nerve complete with branches, including the common fibular, tibial, and sural nerves (Fig. 1). In the NG, the sciatic nerve and its branches were exposed and dissected but were kept intact.

In the DG, the sciatic nerve and its tibial and fibular branches were exposed. The fibular nerve was carefully dissected and sectioned 7 mm distal to its emergence from the sciatic nerve. The proximal and distal stumps of the fibular nerve were sutured to different distant muscular groups using 5-0 nylon to prevent nerve regeneration. The tibial nerve remained intact. In the MG and VG, the fibular nerve was carefully dissected and sectioned 7 mm distal to its emergence from the sciatic nerve. The proximal stump of the tibial nerve was buried inside the adjacent musculature using 5-0 nylon, and the distal stump was sutured to the tibial nerve by end-to-side suture, without epineurotomy, 7 mm after the bifurcation of the sciatic nerve with a simple stitch using 10-0 nylon. These two groups differed only in the magnification technique used.

In all groups, the aponeurotic muscle plane was sutured with a simple stitch using 5-0 nylon, and skin synthesis was achieved by a continuous suture using 6-0 nylon. A lactated ringer (5 mL/kg intravenous) was administered to compensate for blood loss. Neither antibiotics nor systemic anticoagulants were used. The surgical time was recorded for MG and VG.

In the MG, microsurgical procedures were performed under a DFVasconcelos microscope with an image magnification of ×40 (12× of lens system times 2.5 of objectives). In the denervation and VG, procedures were performed under the guidance of a video system.[7,8] The video system was composed of a Canon EOS Rebel T3i digital camera with video capability and a Canon EF 50 mm Compact Macro Lens f/2.5.

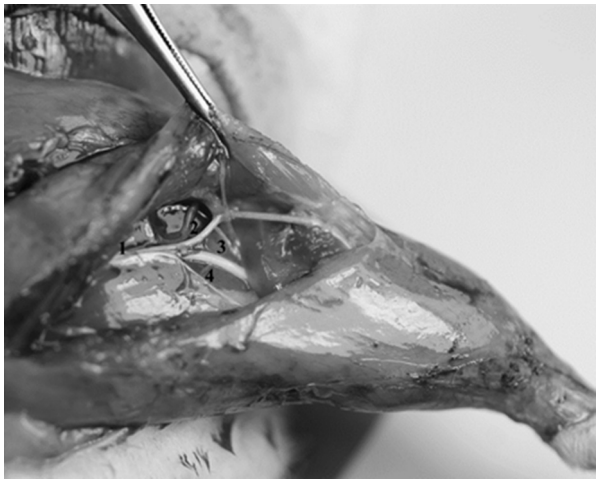

Fig. 1 – Sciatic nerve (1) and ramification of the common fibular (2), tibial (3), and sural (4) nerves.