SCIENTIFIC ARTICLE

Comparison of the Effects of Subcutaneous Anterior Transposition and *In Situ* Decompression on the Histologic and Electrophysiologic Properties of the Ulnar Nerve: An Experimental Study in a Rabbit Model

Yoo Joon Sur, MD, Jung Soo Lee, MD, PhD, Seok Whan Song, MD, PhD

Purpose Although anterior transposition of the ulnar nerve is a commonly performed procedure for treatment of cubital tunnel syndrome, there are concerns that surgical mobilization puts blood supply to the nerve at risk. The purpose of this study was to compare the effects of subcutaneous anterior transposition (SAT) and *in situ* decompression (ISD) on the ulnar nerve's histologic and electrophysiologic properties in a rabbit model.

Methods We assigned 30 male, young adult New Zealand white rabbits to 1 of 3 groups (each group, n = 10). The extensive dissection–SAT group underwent complete neurolysis of the right ulnar nerve from brachial plexus to wrist and a subsequent SAT, the ISD group underwent ISD with 4-cm-long exposure of the ulnar nerve, and the SAT group underwent SAT with 4-cm-long circumferential neurolysis of the ulnar nerve. We killed the animals 7 days after the operation. We assessed electrophysiologic changes by finding the percentage of compound motor action potential of the surgical limb compared with the contralateral limb, and histologic changes by ischemic fiber degeneration.

Results The extensive dissection–SAT group showed a significantly lower percentage of compound motor action potential and higher grade of ischemic fiber degeneration than the ISD and SAT groups. On the other hand, the percentage of compound motor action potential and the grade of ischemic fiber degeneration were similar between the latter 2 groups without a statistically significant difference.

Conclusions This study demonstrated that surgical mobilization of the ulnar nerve during SAT has an effect similar to ISD on the nerve's histologic and electrophysiologic properties at the 7th postoperative day in a rabbit model.

Clinical relevance In a rabbit model, ISD and SAT appear to affect histologic and electrophysiologic findings of the ulnar nerve equally at postoperative day 7, which suggests that they would have the same relative safety in a clinical setting. *(J Hand Surg 2013;38A:660–665.*

Key words Anterior transposition of ulnar nerve, blood supply, cubital tunnel syndrome, histology, vascularity.

From the Departments of Orthopedic Surgery and Rehabilitation Medicine, College of Medicine, The Catholic University of Korea, Seoul, Korea.

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Corresponding author: Seok Whan Song, MD, PhD, Department of Orthopedic Surgery, Yeouido St. Mary's Hospital, College of Medicine, The Catholic University of Korea, 62 Yeouido-dong, Yeongdeungpo-gu, Seoul, 150-713, Korea; e-mail: sw.song@catholic.ac.kr.

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CUBITAL TUNNEL SYNDROME is the second most common compression neuropathy in the upper extremity after carpal tunnel syndrome. Although mild to moderate cubital tunnel syndrome can be treated nonsurgically, surgical treatment may be indicated when motor weakness develops or conservative measures are ineffective.[1,2] Surgical techniques include *in situ* decompression (ISD), subcutaneous anterior transposition (SAT), intramuscular anterior transposition, submuscular anterior transposition, and medial epicondylectomy, although controversy remains over which is the optimal treatment.[2] In addition, endoscopic techniques of ulnar nerve decompression have recently become more popular.[3,4]

Since the first description by Curtis in 1898,[5] anterior transposition of the ulnar nerve has been one of most commonly used surgical treatment options for cubital tunnel syndrome. This technique reduces not only compressive forces but also tensile forces generated within the nerve during elbow flexion by moving the nerve anterior to the ulnotrochlear axis of rotation.[6,7] However, there are concerns that surgical mobilization of the ulnar nerve for anterior transposition may compromise blood supply to the nerve and adversely affect its function.[2–4,8,9] The question of whether surgical mobilization of the ulnar nerve during anterior transposition has a negative influence on the blood supply to the nerve and its function is controversial.[7,10] The purpose of this study was to compare the effects of SAT and ISD on the ulnar nerve's histologic and electrophysiologic properties at the 7th postoperative day in a rabbit model. According to Kihara et al,[11,12] the 7th day after an ischemic insult is the optimal time to demonstrate established pathologic alteration, and the reduction of the nerve blood flow at this point strongly correlates with the degree of ischemic fiber degeneration (IFD) and reduction of compound motor action potential (CMAP). If surgical mobilization of the ulnar nerve during SAT impairs blood supply to the nerve considerably, it should induce measurable changes in the histologic and electrophysiologic properties of the nerve at the 7th postoperative day. We hypothesized that surgical mobilization of the ulnar nerve during SAT has no negative influence on its histologic and electrophysiologic properties compared with ISD.

MATERIALS AND METHODS

We used 30 male, young adult New Zealand white rabbits with average weight of 2.9 kg (range, 2.6–3.1 kg) in this study. In accordance with the National Institutes of Health and national law guidelines on the care and use of laboratory animals, our institutional animal care and use committee approved this experiment. Animals were housed in individual cages with 12-hour light–dark cycles and were provided with food and water available *ad libitum*. Animals were divided randomly into 3 groups (each group, n = 10).

We anesthetized the rabbits with intramuscular injections of a mixture of tiletamine and zolazepam (Zoletil 50; Virbac, Carros, France) at a dose of 15 mg/kg and xylazine (Rompun; Bayer, Leverkusen, Germany) at a dose of 5 mg/kg. The right forelimb was prepared and draped using sterile technique, and procedures were performed under 4.5× loupe magnification. With the animal in the supine position, we made a skin incision over the medial side of the elbow to expose the ulnar nerve. The local anatomy pertinent to the ulnar nerve in the rabbit appeared to be similar to that in the human in the way in which the ulnar nerve coursed posterior to the medial epicondyle and entered the ulnar groove, which was covered by thick fascia and part of overlying flexor muscles corresponding to the Osborne ligament and fascia of a human, and was distinctly different by the absence of the medial intermuscular septum or arcade of Struthers of a human.

In the extensive dissection and subcutaneous anterior transposition (ED-SAT) group, we exposed the ulnar nerve from the medial cord of brachial plexus to the wrist. We detached the ulnar nerve from surrounding soft tissues and completely stripped off the nerve's extrinsic vascular system including mesoneurium. Intraoperative bleeding was minimal and usually stopped spontaneously, but in case of continuous bleeding, hemostasis was achieved with bipolar electrocautery. Then, we transposed the ulnar nerve anteriorly in a subcutaneous plane and stabilized it using sutures placed between the subcutaneous fat tissue and superficial fascia. We performed skin closure with 3-0 nylon sutures. In the ISD group, we performed release of the cubital tunnel without circumferential neurolysis of the ulnar nerve. After identifying the medial epicondyle and cubital tunnel, we divided a proximal 2-cm and distal 2-cm length of thick fascia and part of overlying flexor muscles and exposed the ulnar nerve in the ulnar groove. The ulnar nerve was not detached from surrounding soft tissues of the ulnar groove. In the SAT group, we exposed a 4-cm length of the ulnar nerve in the same way as in the ISD group. The ulnar nerve was isolated from surrounding soft tissues including mesoneurium and transposed anteriorly in a subcutaneous plane. We transferred the rabbits to their cages and fed them a normal diet. The rabbits received intramuscular injections of gentamicin at a dose of 4 mg/kg and ketoprofen at a dose of 3 mg/kg once a day for 1 week.