SCIENTIFIC ARTICLE

Ulnar Nerve Repair With Simultaneous Metacarpophalangeal Joint Capsulorrhaphy and Pulley Advancement

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Purpose To evaluate the validity of performing a static anti-claw procedure (metacarpophalangeal joint volar capsulorrhaphy and A1 and A2 pulley release) at the time of ulnar nerve repair for acute or chronic lacerations to prevent development of claw hand deformity and disability or to correct them.

Methods We present a case series of 14 patients for whom metacarpophalangeal joint capsulorrhaphy and pulley advancement were done at the time of ulnar nerve management. Direct nerve repair was performed in 10 patients, nerve grafting in 2, neurolysis in 1, and combined direct repair and anterior interosseous nerve transfer in 1. Outcome measurements included assessment of claw hand correction and sequence of phalangeal flexion according to modified evaluation criteria of Brand and motor recovery of ulnar nerve function using the British Medical Research Council (MRC) scale.

Results Average follow-up was 39 months. At 3 months, 12 patients had good and 2 had fair claw hand correction. At 6 months, 2 patients had excellent, 10 patients had good, and 2 patients had fair correction. At final follow-up, 13 patients had good to excellent correction and 1 had fair correction. Motor recovery of the intrinsic muscles was rated from 2 to 5 according to the MRC scale.

Conclusions This technique is simple and effective. It acts as an internal orthosis during recovery of sufficient strength of the intrinsic muscles. In cases of incomplete recovery of the intrinsic muscles (up to MRC grade 2), it may eliminate the need for secondary surgery to correct a claw hand deformity. *(J Hand Surg Am. 2015;■(■):■−■. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic IV.

Key words Claw hand, MCP capsulorrhaphy, pulley advancement, ulnar nerve.

Compared with radial and median nerve injuries, ulnar nerve injuries are often considered the least favorable injury to the upper extremity.[1−3]

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Ulnar nerve paralysis is usually associated with a claw-like appearance of the fourth and fifth digits when these fingers are extended. This is termed claw hand deformity, or metacarpophalangeal (MCP) hyperextension with interphalangeal (IP) flexion. In addition, motor imbalance resulting from absent intrinsic muscles can lead to a claw hand disability, which describes the inability to flex the finger joints sequentially from proximal to distal during functional activities. This mechanism of finger flexion is reversed in clawed finger, and finger flexion proceeds from distal to proximal joints.[4,5] This results in larger objects being pushed out of the palm by the fingertips.[6]

Ulnar claw finger deformity can be corrected through use of an orthosis or by static tissue tightening procedures or dynamic tendon transfers.[7]

Static procedures prevent MCP joint hyperextension to allow the long extensors to extend the IP joints. They include either bony or soft tissue tightening procedures. Metacarpophalangeal volar plate capsulorrhaphy is one method used to correct claw deformity in late cases of ulnar nerve injury.[4]

Correction of claw disability can be done by either tendon transfer or incision of the proximal components of the flexor sheath, termed pulley advancement. Advancement of the pulley increases flexor force at the MCP joint, thus improving finger flexion rhythm.[8]

Inspired by the concept of an internal orthosis, we added MCP joint capsulorrhaphy and pulley advancement at the time of ulnar nerve repair. The purpose of this study was to evaluate the short-term validity of this technique in preventing the development of claw hand deformity and disability in cases of acute lacerations of the ulnar nerve or correction of the deformity and disability in cases with late presentation.

PATIENTS AND METHODS

We studied 14 patients with ulnar nerve laceration for whom simultaneous MCP capsulorrhaphy and pulley advancement were done at the time of neurorrhaphy. The operations were performed in our institute between July 2008 and October 2010. Inclusion criteria were acute ulnar nerve laceration ($<$ 2 mo duration) with or without other tendon or median nerve lacerations, and chronic ulnar nerve laceration ($\geq$ 2 mo duration) necessitating surgical intervention. Proximal lesions were excluded (eg, traumatic brachial plexus injury). There were no exclusion criteria regarding age or sex. Average age of patients was 26 years (range, 4–53 y). There were 13 males and 1 female. The dominant hand was injured in 8 patients and the nondominant hand was in 6. Ten ulnar nerve injuries were at the wrist and distal forearm, 2 in the mid-forearm, and 2 in the proximal forearm. The ulnar nerve injury was isolated in 12 patients and the ulnar and median nerve were both injured in 2. In 10 cases there were other soft tissue injuries (flexor tendons of the wrist and fingers, ulnar artery, and or median nerve). The interval between the injury and surgery averaged 47 days (range, 0–180 d). Seven patients were operated on the day of injury. Four patients had prior surgeries. Flexor tendons had been repaired in 2 patients who were referred for secondary repair of the ulnar nerve. In the other 2 patients the ulnar nerve was repaired primarily elsewhere with unsatisfactory regeneration. The mode of trauma was a sharp object in 12 cases, a road traffic accident in 1, and a revolving machine in 1. All patients provided informed consent and our institutional review board approved the study protocol.

Surgical technique

Ulnar nerve neurorrhaphy was done at the beginning of the procedure (in addition to repair of other soft tissue injuries, if any). Neurorrhaphy was performed by direct epineural repair, sural grafting, and nerve transfer or combined procedures. We performed the neurorrhaphy using microscopy and 8-0 or 9-0 nylon or polypropylene sutures. Next, we used a transverse incision at the distal palmar crease at the base of the little and ring fingers. In later cases, we added an oblique limb from the medial end of the incision to the web space between the 2 fingers for a better view and to facilitate the capsulorrhaphy). Then, we released the pulley by incising the A1 pulley in the midline and continued the split to the A2 pulley using scissors just distal to the proximal digital flexion crease. We considered splitting to be appropriate if traction on the flexor tendons effectively flexed the MCP joint.

The flexor tendons were retracted and a capsulorrhaphy was performed by excising an elliptical part of the anterior capsule. This was followed by plication of the capsule using 2-0 polypropylene sutures so that the MCP joint of the little finger rested in 40° flexion and that of the ring finger in 30° flexion. In cases of chronic ulnar nerve injuries, we performed capsulorrhaphy so that the MCP joint rested in 30° to 40° flexion more than the assisted angle of correction[8] (the minimum angle of flexion of the MCP joint at which the patient could fully extend the proximal and distal interphalangeal joints with the wrist in neutral), which was determined preoperatively to account for expected postoperative stretch. Figure 1 shows the intraoperative steps.

Postoperative management

Patients were placed in an orthosis for 4 weeks with the MCP joint in 90° flexion and the IP joints extended if there was no accompanying tendon repair. If there was accompanying tendon repair, the orthosis incorporated slight flexion of the wrist and IP joints and was worn for 6 weeks. Passive movement of the long flexors at the IP joints was encouraged to decrease adhesions at the capsulorrhaphy site without jeopardizing the nerve and any tendon repairs. All patients were referred to physiotherapists by the third week.

Direct nerve repair was performed in 10 patients, sural nerve grafting in 2, neurolysis in 1, and combined direct repair and anterior interosseous nerve transfer