Minimally Invasive Release of the Cubital Tunnel

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Entrapment of the ulnar nerve that leads to cubital tunnel syndrome is a common and often disabling disease. Current surgical treatment options involve simple decompression, medial epicondylectomy, or a variety of anterior transposition procedures. Such techniques often involve extensive exposure of the ulnar nerve with prolonged periods of immobilization. Because of this, patients may often experience significant postoperative pain, scarring, and joint stiffness. In this paper, we describe a minimally invasive technique for treating cubital tunnel syndrome using endoscopic assistance. This procedure enables complete ulnar nerve decompression through one small incision. Direct visualization of all potential anatomic compression sites for a distance of 20 cm around the medial epicondyle is possible. This endoscopic approach to cubital tunnel release is appealing, especially to those patients with mild to moderate symptoms who may otherwise be reluctant to undergo a more involved conventional surgery. It decreases postoperative pain, reduces scarring, and promotes an earlier return to activity than traditional open techniques allow, due to a decreased immobilization period.

Cubital tunnel syndrome is the second most common compressive neuropathy in the upper extremity. The elbow is the most common site of ulnar nerve compression. Numerous etiologies of cubital tunnel syndrome have been described. These include constricting fascial bands, bony spurs, subluxation of the ulnar nerve over the medial epicondyle, ganglia, cubitus valgus, and direct compression. However, the most common presentation of this syndrome is anatomic compression without specific pathology. Several points of potential compression exist along the course of the ulnar nerve at the elbow. These include the fascial arcade of Struthers, the medial intermuscular septum, the cubital tunnel, Osborne's ligament, the two heads of the flexor carpi ulnaris (FCU), and the flexor pronator aponeurosis. Successful treatment of ulnar nerve entrapment in these cases is dependent on surgical release of all possible compression sites.

Available surgical options for ulnar nerve decompression at the elbow include simple decompression, medial epicondylectomy,[1] anterior transposition[2,3] (subcutaneous, intramuscular, and submuscular), and neurolysis. Each procedure has its advantages and disadvantages in certain select patient populations. However, achieving complete release of all potential compression sites using the standard techniques often requires an extensive incision and dissection, which can lead to painful postoperative scarring and contracture formation.

We have developed a new operative technique using endoscopic assistance for cubital tunnel decompression. The purpose of this technique is to minimize surgical exposure of the ulnar nerve, improve decompression of entrapment sites, and enable an earlier return to work as compared with traditional open techniques. Several authors have used an endoscopic technique successfully in carpal tunnel release surgery, enabling earlier functional recovery and decreased scar tenderness.[4-6] We will describe our surgical technique and instrumentation in this paper. The endoscopic technique presented here represents an alternative surgical option for the treatment of cubital tunnel syndrome and is not intended to replace the conventional open techniques.

Patient Selection and Indications

Before attempting this technique clinically, the senior author (TMT) strongly believes that multiple trials should be performed in cadaveric models by hand surgeons experienced in endoscopy. Once the surgical instrumentation and relevant anatomy are thoroughly understood, the endoscopic cubital tunnel release becomes a straightforward procedure.

Patients who have mild to moderate lesions (McGowan classification system Grades I & II)[7,8] with ulnar nerve paresthesia and some intrinsic muscle weakness are good candidates for this procedure. Even some patients with severe lesions (McGowan grade III) who present with intrinsic atrophy and weakness have demonstrated good postoperative results with recurrence rates comparable to those of open techniques.[9] Contraindications to the endoscopic technique include severe cubital valgus or elbow deformity, osteoarthritis of the elbow, or recurrent compression after previous surgery. Generally, the procedure of choice in cases of recurrent cubital tunnel compression is a submuscular transposition. A safe, endoscopic decompression cannot be performed if any significant associated pathology is present at the elbow and, therefore, such pathology would be a contraindication to the use of this technique.

Anatomy

Entrapment of the ulnar nerve can occur anywhere along its path. The most common sites of compression are the arcade of Struthers, the medial intermuscular septum, the cubital tunnel, and the deep flexor-pronator aponeurosis.[10] The arcade of Struthers is the most proximal site of ulnar nerve

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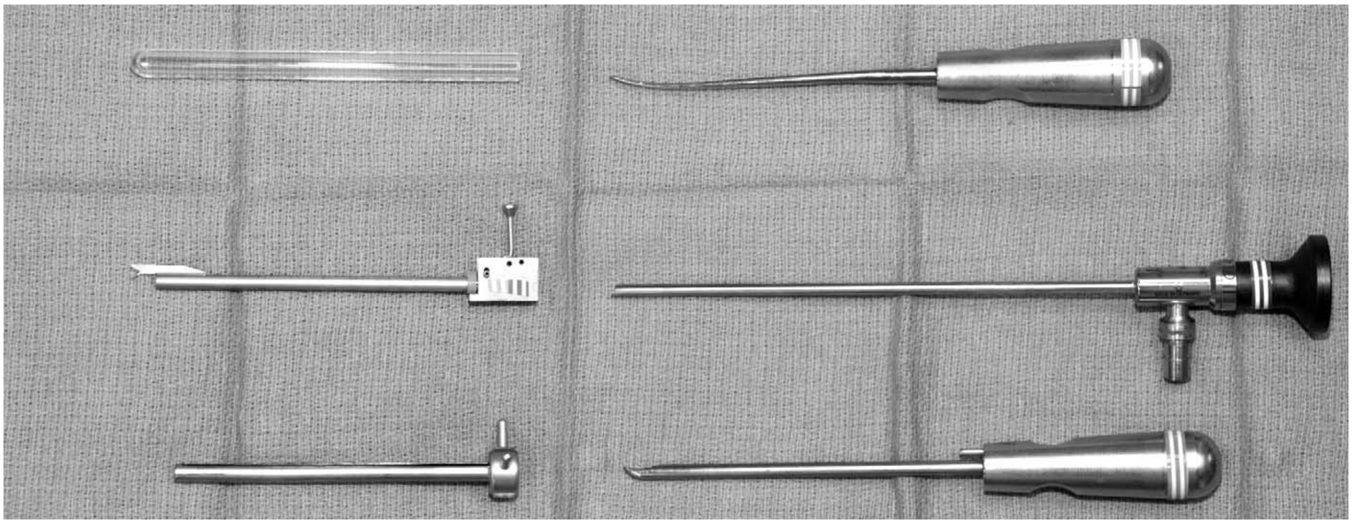

Fig 1. The surgical instruments used in the endoscopic technique include (in clockwise order) an elevator, a 30° endoscope, an obturator, a cannula, a pushing knife with locking device and a glass tube.

entrapment at the elbow.[11] It is found in most patients 8 to 10 cm proximal to the medial epicondyle. This structure is formed by the attachments of the fascia and superficial muscle fibers of the medial head of the triceps, a fascial extension of the coracobrachialis tendon, and the medial intermuscular septum. The arcade of Struthers extends from the medial intermuscular septum to the medial head of the triceps. The medial intermuscular septum, which extends from the coracobrachialis muscle proximally to the medial epicondyle distally, can be a site of compression.

Next, the ulnar nerve passes into the forearm through the cubital tunnel.[12] The ligament of Osborne or the medial epicondyle retinaculum forms the roof of the cubital tunnel. The tunnel passes from the medial epicondyle to the tip of the olecranon and connects the ulnar and humeral heads of origin of the FCU. The elbow capsule and the posterior and transverse portions of the medial collateral ligament form the floor of the cubital tunnel. The medial epicondyle and olecranon form the walls of the tunnel.

After passing through the cubital tunnel, the ulnar nerve courses through the deep flexor pronator aponeurosis approximately 5 cm distal to the medial epicondyle. The ulnar nerve then travels beneath the muscle belly of the FCU. Distally, the ulnar nerve descends on the medial side of the forearm between the flexor digitorum profundus (FDP) and the FCU.

In addition to the course of the ulnar nerve, special attention must be directed toward other important neurovascular structures in the vicinity of the elbow. The posterior branches of the medial antebrachial cutaneous nerves cross the ulnar nerve within 5 cm proximal or distal to the medial epicondyle. Often these branches are cut inadvertently when

Fig 2. A 5-cm zig-zag incision is made at the cubital tunnel between the medial epicondyle (superiorly) and the olecranon (inferiorly).

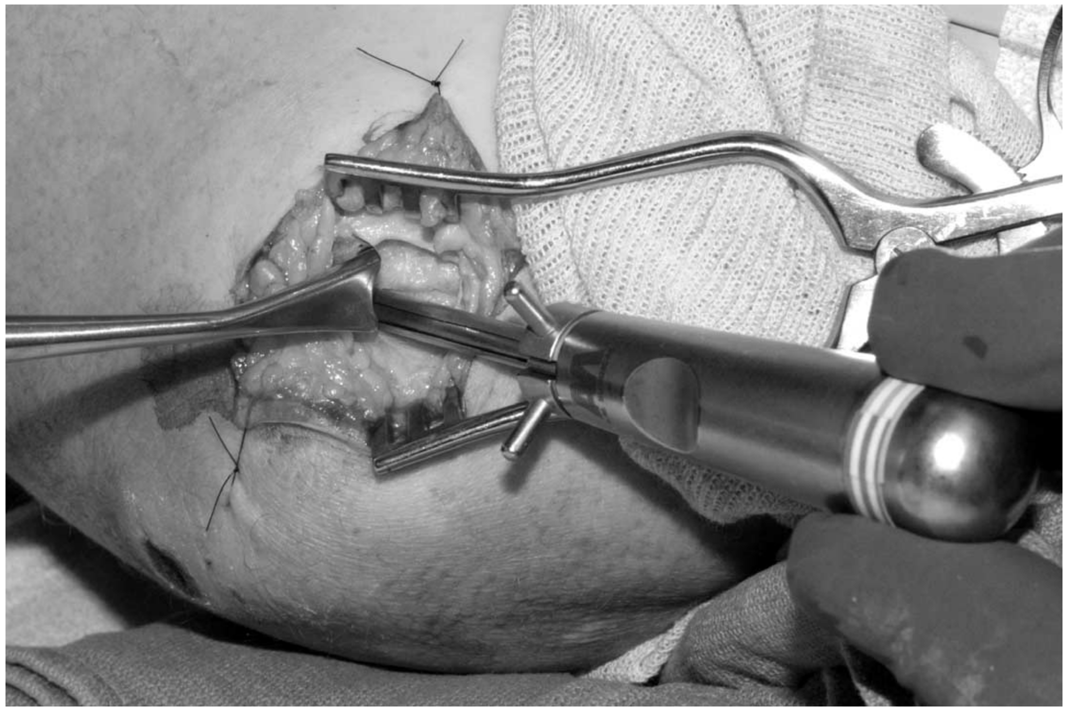

Fig 3. The elevator is shown being inserted adjacent to the ulnar nerve distally into the forearm.

making the skin incision for a cubital tunnel release, resulting in dysesthesia and painful scar formation.[13] The blood supply to the ulnar nerve also is at risk during exposure and decompression. The inferior ulnar collateral arteries provide the extrinsic blood supply. Potential neurovascular complications can be minimized or avoided by a less invasive approach.

Surgical Technique

Several of the instruments required for this procedure have been custom-made and are demonstrated in Fig 1.

Endoscopic cubital tunnel release is performed under axillary block anesthesia with the patient in the supine position. The extremity is exsanguinated, and a tourniquet is inflated to 250 to 300 mm Hg. Then the shoulder is abducted 90° and the elbow flexed 90°, supported by towels and by the assistant. A 5 cm zigzag incision is made along the course of the ulnar nerve at the cubital tunnel between the medial epicondyle and the olecranon (Fig 2). Next, the subcutaneous tissue is separated carefully with tenotomy scissors to protect the medial antebrachial cutaneous nerves. Then, Osborne's ligament is opened longitudinally and the ulnar nerve is exposed. Further distally, the FCU fascia is exposed

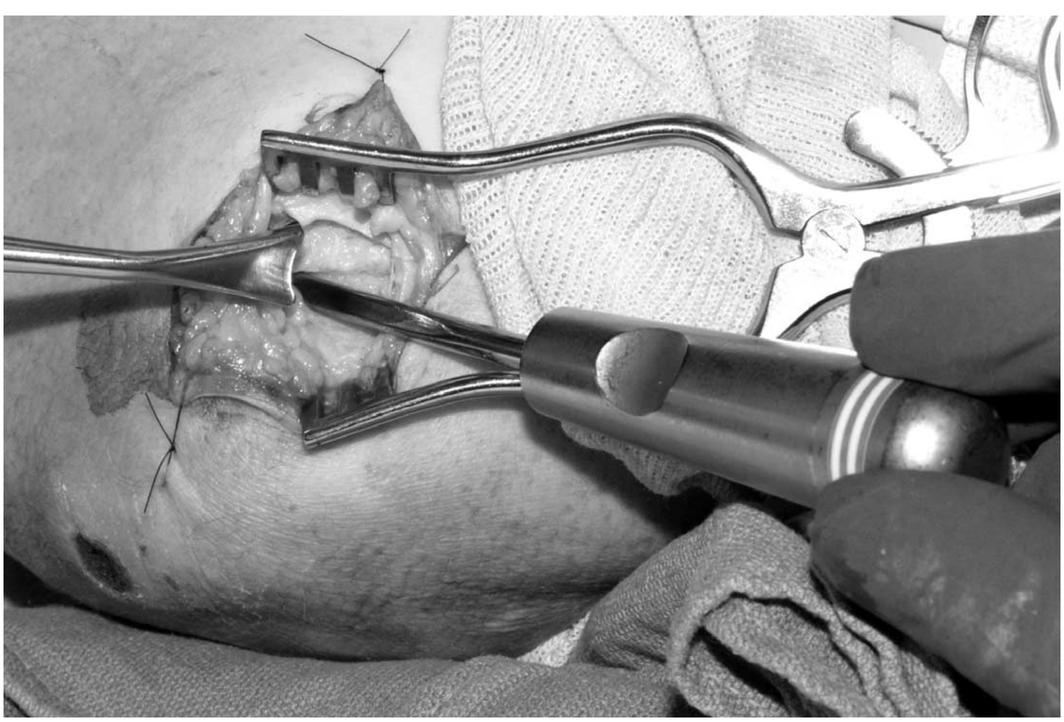

Fig 4. The cannula and obturator are inserted to allow for easier passage of the endoscope.

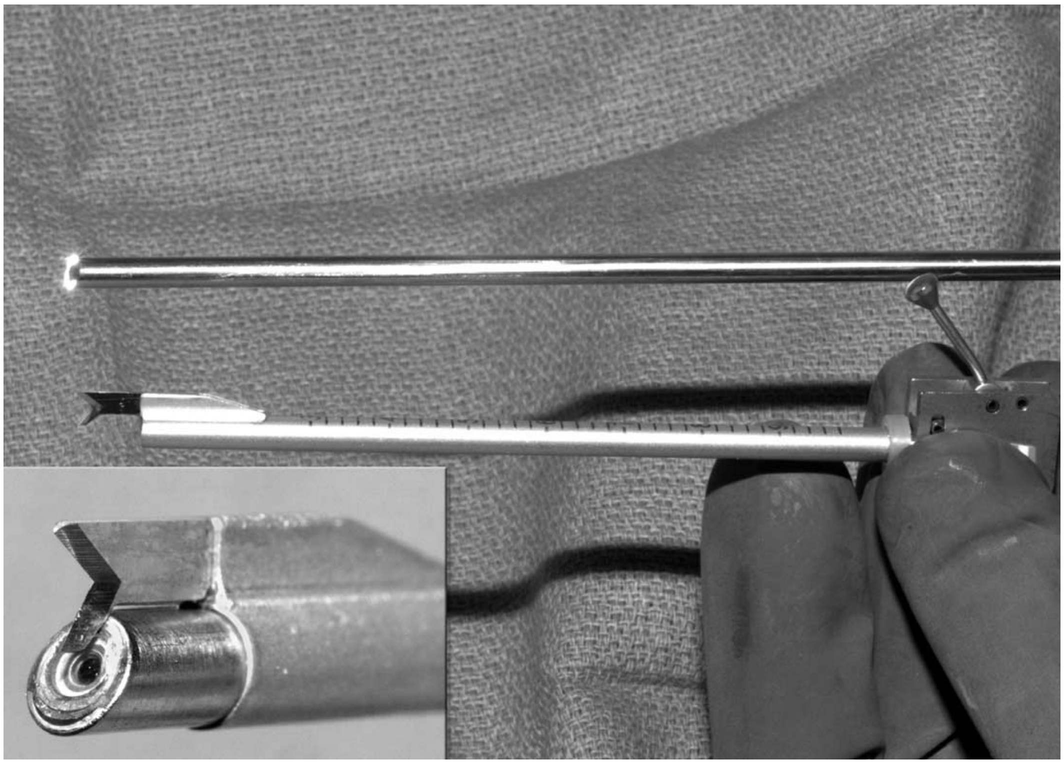

Fig 5. The pushing knife is secured into position on the endoscope with the viewing angle of the endoscope oriented toward the knife blade.

and partially divided. Next, the flexor pronator aponeurosis is identified between the sheath and the nerve. At this stage, a lighted retractor is used to lift the subcutaneous tissue away from the superficial forearm fascia overlying the FCU. Then, the elevator is inserted between the ulnar nerve and the sheath for a distance of approximately 10 cm (Fig 3). The cannula and obturator (A.M. Surgical, Smithtown, NY) are passed from proximal to distal for a distance of approximately 10 cm (Fig 4). The 4-mm 30° endoscope is inserted into the cannula to visualize the sheath surrounding the ulnar nerve. Then, the scope is removed. The pushing knife is secured into position on the endoscope using the locking device, and the viewing angle of the endoscope is oriented toward the knife blade (Fig 5). Next, the knife/endoscope is introduced into the cannula and, as the surgeon observes the monitor, the sheath around the ulnar nerve is divided. Then, the instruments are withdrawn, and the division is verified by inserting transparent glass tubes that were custom-made by Ace Glass Company (Louisville, KY) (Fig 6). Two photographs are taken via the endoscope inserted into the glass tubes, directly visualizing the cut edges of the sheath (proximally and distally).

Then, the instruments are withdrawn and reintroduced proximally through the incision. In a similar fashion, the

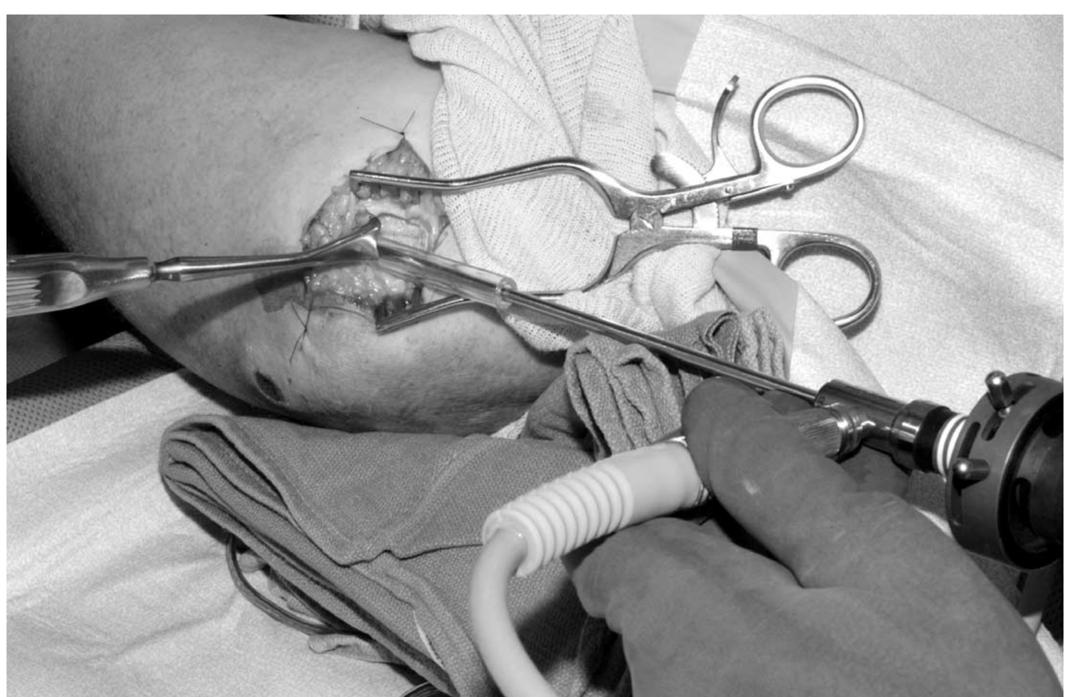

Fig 6. The endoscope is inserted into a transparent glass tube to visualize the cut edges of the sheath/fascia.

Fig 7. The knife/endoscope is inserted through the cannula proximally into the arm.

AMM elevator is passed from distal to proximal as is the cannula and obturator. The endoscope is used again to visualize the ulnar nerve and the intermuscular septum. The knife/endoscope is reintroduced into the cannula (Fig 7) and the intermuscular septum and proximal sheath around the ulnar nerve are divided. Photographs are taken through the glass tubes using the endoscope to verify the cut edges of the sheath/fascia (Fig 8). At this stage, the ulnar nerve has been decompressed for a distance of approximately 10 cm proximal and 10 cm distal to the medial epicondyle (Fig 9). Next, the elbow is brought through a full range of passive motion movements to determine whether subluxation of the ulnar nerve has occurred. If ulnar nerve subluxation is observed, or was noted preoperatively, a medial epicondylectomy is performed through the same incision. Then, the tourniquet is released and hemostasis is achieved using bipolar electrocautery. The skin is closed with nylon sutures (Fig 10), and a soft dressing is applied to the elbow. Movement of the elbow is encouraged on the first postoperative day.

Conclusion

Conventional open techniques of ulnar nerve decompression, such as medial epicondylectomy and anterior transposition, are considered to be relatively safe and reliable. However, these surgical options often can result in significant postoperative

Fig 8. Verification of the cut edges of the sheath/fascia is again performed proximally through the glass tube.

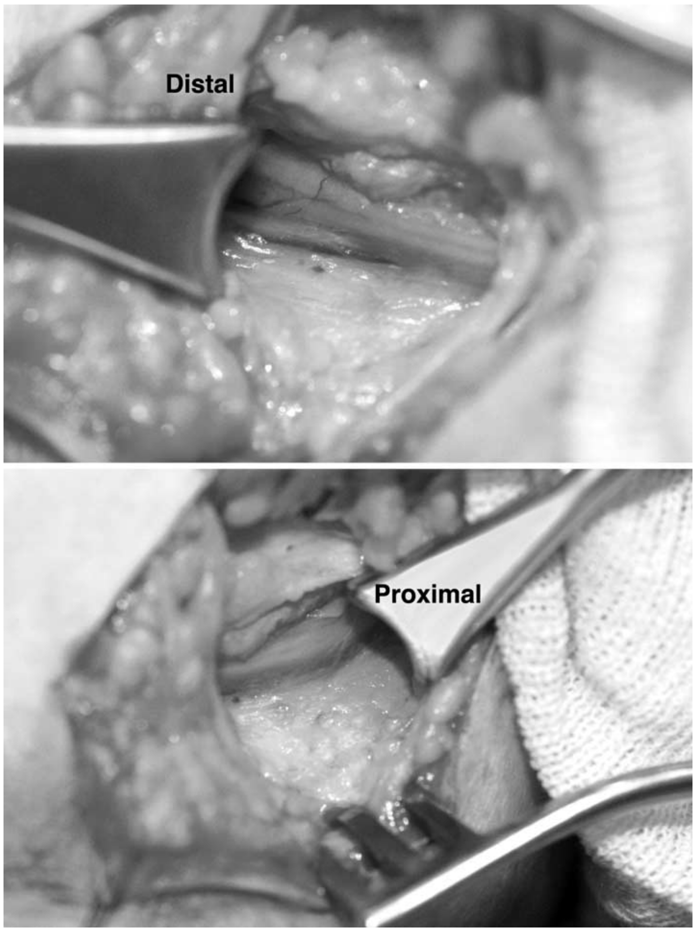

Fig 9. The ulnar nerve is shown decompressed distally and proximally to the medial epicondyle.

scarring and wound tenderness, delay in return to work, and elbow contractures secondary to prolonged immobilization. The morbidity of these techniques may prevent a patient with relatively minor symptoms from undergoing surgical treatment. Therefore, a minimally invasive technique for cubital tunnel syndrome seems most appropriate for this group of patients.

This technique of cubital tunnel decompression with endoscopic assistance enables release of all structures, proximally and distally, for a length of approximately 20 cm through a 3-cm incision. The ulnar nerve is protected from the extensive dissection used in other open techniques, which helps preserve its vasculature and prevent possible motor nerve branch injuries. The endoscopic technique also minimizes the possibility of cutaneous nerve injury and results in diminished scar tenderness. In a series of 76 patients (85 elbows) reported by the senior author (TMT), results were found to be good to excellent in 87% of patients treated using this technique.[14] The procedure was noted to be safe with no serious complications. These results are comparable to the traditional open decompressive techniques reported in the literature, which overall result in 85 to 90% good-to-excellent results.[9]

Another endoscopic assisted ulnar nerve decompression technique has been reported by Nakao and coworkers[15] This technique involves three separate 5-mm incisions, which enables a fine tape to be inserted subcutaneously and “lifted” up, producing a space above the ulnar nerve for dissection. Although it is a small series, the preliminary results appear promising.

Controversy still exists as to the selection of the optimal technique for ulnar nerve decompression. We present a relatively straightforward, minimally invasive technique that can be included in the hand surgeon’s armamentarium against cubital tunnel syndrome. Its application seems most appropriate for patients with mild to moderate symptoms who remain unresponsive to conservative therapy. With future modifications of this technique, we feel this approach will decrease recovery and return to work time even more.

Fig 10. The final skin incision and closure is shown at the elbow.

References

1. Froimson AI, Anouchi YS, Seitz WH, et al: Ulnar nerve decompression with medial epicondylectomy of neuropathy at the elbow. Clin Orthop 265:200-206, 1991
2. Kleinman WB, Bishop AT: Anterior intramuscular transposition of the ulnar nerve. J Hand Surg Am 14:972-979, 1989
3. Levy DM, Apfelberg DB: Results of anterior transposition for ulnar neuropathy at the elbow. Am J Surg 123:304-308, 1972
4. Agee JM, McCarroll HR Jr, Tortosa RD, et al: Endoscopic release of the carpal tunnel: A randomized prospective multicenter study. J Hand Surg Am 17:987-995, 1992
5. Brown RA, Gelberman RH, Seiler III JG, et al: Carpal tunnel release: A prospective randomized assessment of open and endoscopic methods. J Bone Joint Surg Am 75:1265-1275, 1993
6. Tsuruta T, Tsai TM, Syed SA: Comparison of proximal and distal one portal entry techniques for endoscopic carpal tunnel release. J Hand Surg Br 19:618-621, 1994
7. McGowan AJ: The results of transposition of the ulnar nerve for traumatic ulnar neuritis. J Bone Joint Surg Br 32:293-330, 1950
8. Rayan G: Proximal ulnar nerve compression. Hand Clinic 8:325-336, 1992
9. Dellon AL: Review of treatment results for ulnar nerve entrapment at the elbow. J Hand Surg Am 14:688-700, 1989
10. Amadio PC, Beckenbaugh RD: Entrapment of the ulnar nerve by the deep flexor-pronator aponeurosis. J Hand Surg Am 11:83-87, 1986
11. Kane E, Kaplan EB, Spinner M: Observations of the course of the ulnar nerve in the arm. Ann Chir 27:487-496, 1973
12. Wadsworth TG: The external compression syndrome of the ulnar nerve at the cubital tunnel. Clin Orthop 124:189-204, 1977
13. Dellon AL, Mackinnon SE: Injury to the medial antebrachial cutaneous nerve during cubital tunnel surgery. J Hand Surg Br 10:33-36, 1985
14. Tsai TM, Chen IC, Majd ME, et al: Cubital tunnel release with endoscopic asssistance: Results of a new technique. J Hand Surg Am 24:21-29, 1999
15. Nakao Y, Takayama S, Toyama Y: Cubital tunnel release with lift-type endoscopic surgery. Hand Surg 6:199-203, 2001