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SURGERY ARTICLES

Endoscopic detection of compressing fascial bands around the ulnar nerve within the FCU

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Abstract
Background The aim of this study is to endoscopically evaluate the ulnar nerve proximal and distal to the cubital tunnel after in situ decompression to identify and eventually release fascial bands capable of compressing the ulnar nerve.
Methods We performed a retrospective review of 16 ulnar nerve compression cases in 12 patients. Eight men and four women with a mean age of 52 years (range, 23–77 years) were clinically diagnosed and confirmed with neurophysiologic studies. A 4–6-cm curvilinear incision was made at the medial elbow, and the ulnar nerve was identified and decompressed at the cubital tunnel. Then, a 2.7-mm endoscope was passed 8 to 10 cm proximal and distal to the medial epicondyle allowing for visualization of the ulnar nerve and its surrounding soft tissues.
Results The endoscopic evaluation of the 16 ulnar nerves demonstrated no compressive bands outside of the cubital tunnel. All patients had satisfactory outcomes.
Conclusions The good results reported after in situ ulnar nerve decompression have questioned the need for endoscopically assisted decompression of the ulnar nerve proximal and distal to the cubital tunnel. Some authors suggest the existence of fascial bands within the flexor carpi ulnaris (FCU) capable of compressing the ulnar nerve. This study would suggest that fibrous bands deep in the FCU capable of compressing the ulnar nerve do not exist. Our satisfactory outcomes would support the perception that extensive decompression of the ulnar nerve beyond the cubital tunnel is not routinely needed.

Keywords Ulnar nerve · Cubital tunnel · Endoscopic

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Introduction

Cubital tunnel syndrome or ulnar neuropathy at the elbow is the second most prominent neuropathy of the upper extremity. Osborne's bands represent the predominant compression site in the cubital tunnel, which is bordered laterally by the elbow, anteriorly by the medial epicondyle, and medially by the origin of the flexor carpi ulnaris (FCU) [5, 10]. Potential sites of compression proximal to the cubital tunnel include the Arcade of Struthers and the medial intermuscular septum. Distal sites of potential compression include the area between the FCU and the medial forearm musculature.

While nerve conduction studies assist in diagnosing compression of the ulnar nerve, the treatment can depend on the site of compression. The surgical options for treatment of cubital tunnel syndrome include decompression (in situ) of the ulnar nerve, medial epicondylectomy, and anterior transposition of the nerve (submuscular, intramuscular, or subcutaneous). In addition to these approaches, endoscopic cubital tunnel release has recently been added to the surgeon's armamentarium.

The good results reported after in situ ulnar nerve decompression led the senior author to question the need for endoscopically assisted decompression of the ulnar nerve proximal and distal to the cubital tunnel [3, 4, 8, 11]. Siemionow et al. performed cadaveric dissection and reported the existence of fascial "bands," or segmental fascial thickenings, within the FCU of the proximal forearm capable of compressing the ulnar nerve [14]. The recommendations from their study included an extended dissection distally, potentially with the use of an illuminated speculum or endoscope. Hoffmann and Siemionow describe visualization of these bands endoscopically and recommend endoscopic release of these distal "bands [9]." However, extended dissection can potentially cause postoperative scarring and damage to the nerve itself. In an effort to identify and eventually release any such bands in patients undergoing in situ decompression, the ulnar nerve of patients undergoing in situ decompression was examined endoscopically. The purpose of this study is to detect if fascial bands within the FCU capable of compressing the ulnar nerve exist and can be found endoscopically.

Materials and Methods

Twelve (16 procedures) patients presenting with signs and symptoms of cubital tunnel syndrome underwent ulnar nerve endoscopic examination immediately after in situ ulnar nerve decompression from 2008 to 2010. A retrospective review of these 12 patients was performed. Excluded were patients who presented with significant subluxation of the ulnar nerve that required transposition and patients with previous surgery to ulnar nerve at the cubital tunnel. We did not exclude patients based on primary or secondary surgery status and rheumatic or metabolic diseases. There were eight men and four women with a median age of 52 years (range, 23–77). Four patients had bilateral cubital tunnel syndrome and underwent decompression procedures on different dates for each limb.

Diagnosis was based on history, clinical examination (i.e., pain over medial epicondyle, positive Tinel's sign, sensory loss, weakness or atrophy of the muscles innervated by the ulnar nerve, and positive elbow flexion test) and confirmed by neurophysiologic studies including inching technique (nerve conduction velocity and electromyography). Informed consent was obtained from each patient. Each patient's ulnar neuropathy was preoperatively graded on the McGowan scale of severity as well as the Gabel/Amadio scale to assess improvement postoperatively [7, 12] (Tables 1 and 2). Eleven patients displayed grade I severity, four had grade II severity, and one patient had grade III McGowan severity.

Table 1 McGowan scale of severity of cubital tunnel syndrome

Grade	Symptoms
I	Mild lesions with paresthesias in the ulnar nerve distribution and a feeling of clumsiness in the affected hand; no wasting or weakness of the intrinsic muscles
II	Intermediate lesions with weak interossei and muscle wasting
III	Severe lesions with paralysis of the interossei and a marked weakness of the hand

Surgical Technique

All patients underwent general anesthesia. Each patient was placed in the supine position with the arm placed on a hand surgery table. The arm was exsanguinated using a Martin bandage, and a sterile pneumatic tourniquet was inflated to 250 mmHg.

A 4–6-cm curvilinear incision was made just posterior to the medial epicondyle along the path of the ulnar nerve. Careful dissection was carried out using loupe magnification taking care to protect any branches of the medial antebrachial cutaneous nerve. The ulnar nerve was identified in the cubital tunnel by opening the cubital tunnel at its midsection just posterior to the medial epicondyle. The distal one half of the cubital tunnel was then released including Osborne's ligament and any compressive fibers in the proximal FCU. The proximal cubital tunnel was then released on average 3 to 5 cm from the medial epicondyle. Ulnar nerve subluxation was evaluated by flexing the elbow (none of the 16 nerves subluxated.)

A 2.7-mm endoscope (total external diameter including the sheath=4.0 mm) with 30° lens was atraumatically introduced just medial to the nerve. Great care was taken to avoid contusing the ulnar nerve. The endoscopy was carried out with the elbow flexed between 60° and 90°. The endoscope was passed 8 to 10 cm proximal and distal to the medial epicondyle. Careful slow advancement and then retraction of the scope allowed for visualization of the ulnar nerve and its surrounding soft tissues.

After completion of endoscopy, the tourniquet was released, and the subcutaneous and skin layers were reapproximated in a standard fashion. A bulky dressing was applied, and the patient was placed in a sling for comfort.

The patients returned to clinic 1 to 3 days after the surgery for dressing change and neurovascular examination. The patients could weight-bear as tolerated, but were instructed not to flex the elbow past 90° for the first 3 weeks. They were seen again at 3 weeks and 6 weeks postoperatively when range of motion restrictions were removed, and repeat neurovascular examinations were performed.

Table 2 Gabel/Amadio scale of cubital tunnel syndrome severity

Score (points)	Motor	Sensory	Pain
3	Normal	No numbness	No pain
2	Weaker than the opposite side	2-point discrimination normal; intermittent paresthesias	Intermittent pain
1	Obvious atrophy	2-point discrimination >6 mm; constant numbness	Constant pain; intermittent meds
0	Intrinsic paralysis with claw deformity	2-point discrimination >10 mm; anesthesia	Needs narcotics regularly

Score of 9, Excellent; score of 2 or more in each category with an increase in score in each category of 1 or more points, or an increase in total score of 4 or more points, Good; score of less than 2 points in any category, but with an increase in total score of 1–3 points, Fair; no change or decline in total score, Poor

Results

The endoscopic evaluation of the 16 ulnar nerves demonstrated no compressive bands proximal or distal to the cubital tunnel. All sites of compression were isolated to the area of the cubital tunnel and were easily identified and released through the 4–6-cm posteromedial incision. No fascial bands, compressive or not, were identified outside of the cubital tunnel. There were no complications. Average follow-up was 5 months (range, 1–12 months).

Ten of the 16 cases had intraoperative findings of multiple (>1) sites of compression under open visualization (Table 3). The most common sites of compression were Osborne's ligament and the entrance of the FCU muscle.

All patients had improvement outcomes in pain and sensory and motor outcomes per the Gabel/Amadio scale of severity. The preoperative average score was 5, and the postoperative average was 9, consistent with "excellent" outcomes. Thirteen of 16 patients had a perfect postoperative score of 9 (81%), 2 patients had a score of 8 (12.5%), and 1 patient had a score of 6 (6%). The one patient with a postoperative score of 6 had a preoperative score of 3 and had notable improvement in his function despite his advanced disease.

Table 3 Intraoperative sites of compression

Anatomical site	Number of intraoperative compressions
Osborne's ligament	11
FCU arch	10
Proximal FCU	6
Anconeus epitrochlearis	1
Aberrant FCU muscle extension to the medial epicondyle	1

Discussion

Tsai et al. in 1995 reported the use of endoscopy in the management of cubital tunnel syndrome [15]. Since then, multiple authors have reported their experience with various endoscopic cubital tunnel release techniques [2, 13, 16]. Degeorges and Masquelet studied the anatomy of the ulnar nerve within the FCU in 24 embalmed specimens and noted bands crossing the ulnar nerve in 46% of the specimens [6]. The clinical consequences of the bands were not known. Siemionow et al. described fascial bands distal to the proximal edge of the FCU [14]. These authors state "…The presence of these bands in the proximal forearm has clinical importance since they *may* play a role in entrapment of the ulnar nerve…" It is suggested that the described bands could be significant in patients undergoing an anterior transposition of the ulnar nerve as a failure to release them could lead to continued compression and kinking of the ulnar nerve during elbow flexion. The significance of these bands in the patient undergoing in situ decompression is, however, not clear. Indeed, one cannot escape the fact that the cadaver dissection itself disrupts the normal anatomic relations between the ulnar nerve and the surrounding issues ("observer effect"). Adequate visualization of the deep structures requires retraction of superficial structures. Such retraction distorts the anatomy surrounding the ulnar nerve such that structures, which typically would not impinge on the ulnar nerve, become constrictive.

The introduction of the 2.7-mm endoscope (4 mm diameter including the sheath) along the ulnar nerve should provide a more accurate assessment of the nerve as no traction is applied to the adjacent structures for visualization. The diameter of the scope and sheath produces minimal distortion of the perineural anatomy. Siemionow et al. have described a thin fascial sheath surrounding the ulnar nerve in the flexor carpi ulnaris. This sheath has not been visualized in any of our patients. This is not to question its existence but only to state that it was not readily visible through the endoscope and was not noted to compress the ulnar nerve. We observed rather a very loose non-compressive fibrofatty connective tissue surrounding the nerve.

Many authors have reported identifying and releasing fascial bands compressing the ulnar nerve during endoscopic cubital tunnel release [1, 9]. Given our observations, it would seem reasonable to wonder if the endoscopic techniques employed distort the perineural anatomy in such a way as to mislead the surgeon into believing non-compressive fascial structures are compressive. The creation of the optical space by definition must alter the anatomy surrounding the ulnar nerve. The technique popularized by Hoffman et al. includes the insertion of a small speculum into the FCU along the ulnar nerve followed by the introduction of a 4.0-mm endoscope equipped with a 5.8-mm-diameter sheath fitted with a terminal-dissecting tip [9]. The dissecting tip is used to keep tissues away from the tip of the endoscope thus creating an optical cavity.

There are inherent weaknesses in this study. We present a single surgeon's experience and approach in cubital tunnel decompression. Furthermore, our cohort consists of only 16 cases. A larger cohort with a randomized control would certainly increase the power and validity of the findings. It could also be imagined that our introduction of the endoscope into the areas proximal and distal to the cubital tunnel could potentially break the compressive fascial bands reported by others; however, this seems unlikely given that other authors have employed similar techniques and that if these bands truly were compressive they would be of greater resistance.

We endoscopically evaluated 16 ulnar nerves after in situ decompression to detect if fascial bands within the FCU capable of compressing the ulnar nerve existed. We did not find any such bands. Our study suggests that the fascial bands noted by several authors distal to the proximal FCU may not be of significance in those patients undergoing in situ decompression. Our study, however, does not answer the question whether dissection beyond the cubital tunnel is needed to adequately decompress the ulnar nerve. The study by Watts and Bain, however, gives some insights into this issue [17]. These authors compared two patient cohorts, one (19 patients) that underwent an endoscopic cubital tunnel release and the other (15 patients) that underwent an in situ decompression. These authors report the patient satisfaction and functional improvement in both cohorts were equivalent. There were, however, more complications (scar tenderness and elbow numbness) associated with the in situ decompression. This study would suggest that the release of the fibrous bands deep in the FCU was not needed to achieve satisfactory results in their 15 patients and would support our perception that extensive decompression of the ulnar nerve beyond the cubital tunnel is not routinely needed. A larger cohort of patients, however, is needed to provide statistical validity to this perception.

The good results reported after in situ ulnar nerve decompression have questioned the need for endoscopically assisted decompression of the ulnar nerve proximal and distal to the cubital tunnel [3, 4, 8]. Some authors suggest the existence of fascial bands within the FCU capable of compressing the ulnar nerve. This study would suggest that the release of the fibrous bands deep in the FCU was not needed to achieve satisfactory results in 16 cases and would support our perception that extensive decompression of the ulnar nerve beyond the cubital tunnel is not routinely needed.

Conflict of Interest There are no disclosures of financial support or possible conflict of interest on behalf of any of the three authors listed above. DJN serves as the President of the American Society for Surgery of the Hand (ASSH) and has ownership in Upex.

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