Operative Decisions for Endoscopic Treatment of Cubital Tunnel Syndrome

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Abstract: The authors review the relevant anatomy and provide technical tips for endoscopic decompression of the cubital tunnel. Cubital tunnel syndrome is the second most common nerve compression syndrome in the upper extremity. Until recently, surgeons focused on open decompression combined with submuscular or subcutaneous transposition of the nerve. Decompression was usually limited to the region of the medial epicondyle, and related morbidity was relatively high. Endoscopic decompression is a promising technique because the dissection range can be extended and the scar length can be reduced. The authors review the relevant anatomy for the endoscopic approach and give some recommendations concerning the details of the surgical technique.

Cubital tunnel syndrome is the second most common nerve compression syndrome in the upper extremity after carpal tunnel syndrome. Until recently, surgeons focused on open decompression combined with submuscular or subcutaneous transposition of the nerve. Decompression was usually limited to the medial epicondyle region, with a decompression range of 10 to 12 cm. Accordingly, the resulting scars and related morbidity were large. Conversely, endoscopic decompression according to Hoffmann and Siemionow is a relatively new method for treating cubital tunnel syndrome by which a decompression range of 20 to 30 cm can be managed with a 1.8- to 2-cm skin incision. Anatomic studies and observations of this method show that transverse, ligament-like thickenings of the submuscular membrane are possible causes of nerve compression in this area.

Anatomy

In the area of the elbow, 5 common points of compression can be identified: the arcade of Struthers, the medial intermuscular septum, the medial epicondyle, Osborne’s ligament, and the fascia of the deep flexor pronator muscles. The ulnar nerve follows the axillary artery at the upper arm medially into the sulcus bicipitalis medialis and perforates the medial intermuscular septum to reach the dorsal side of the upper arm. An aponeurotic rim of the triceps muscle is sometimes present at the upper arm and the arcade of Struther, which is a fibrotic ligament between the triceps muscle and the intermuscular septum. Although detected in only 13.5% of ca-

Davercic specimens in 1 study, this structure can be a site of compression, particularly after previous anterior transposition of the nerve. The nerve continues distally between the medial intermuscular septum (which extends from the coracobrachialis muscle proximally to the medial epicondyle) and the triceps muscle. Vascular anomalies or thickening of the nerve itself may cause compression in this region. The nerve reaches the cubital tunnel, which is located between the medial epicondyle and the olecranon (Figure 1). The cubital tunnel is covered by a ligament-like thickening of the fascia, known as Osborne’s ligament (also called the ulnar collateral ligament, cubital retinaculum, or arcuate ligament), which is a thickened transverse band between the medial epicondyle and the olecranon.

The more distal ligament extending between the 2 heads of the flexor carpi ulnaris (FCU) muscle is called Osborne’s fascia. According to anatomic studies, subtle variations of this ligament may cause higher tension on the nerve at elbow flexion and predispose some individuals to compression symptoms. The ulnar nerve courses under this ligament toward the palmar side of the forearm. After leaving the distal entrance of Osborne’s ligament, the nerve is covered by the fascia of the deep flexor pronator muscles, which is the most distal common site of compression at the elbow. It continues its course along the lateral side of its reference muscle (the FCU muscle). Less often, atypical muscle tissue, known as the epitrochleoanconeus muscle, is found in the cubital tunnel.

In the area of the medial epicondyle, the nerve branches to the dorsal parts of the elbow (ramus articularis cubiti). It further branches to the FCU muscle and to the ulnar part of the flexor digitorum profundus muscles. A dorsal branch leaves the nerve but not usually before the distal one-third of the forearm. The bottom of the cubital tunnel consists of the channel between the medial epicondyle and the olecranon. Osseous deformations, such as arthritic osteophytes or valgus deformity, may cause compression. The entrance of the cubital tunnel roof is built by the fibrous humeroulnar arcade, which becomes the fascia of the FCU muscle between its 2 heads.

Anatomic studies of cubital tunnel syndrome show fibrous strands of the deep fascia in various diameters in a relatively constant distance to the retrocondylar groove. Two types of fascia that have either 3 or 4 fibrous strands, type 1 or 2 fascia, respectively, in a constant distance from the retrocondylar groove can be distinguished (Figure 2). If the nerve is transposed and these strands are not cut, kinking of the nerve is possible and can cause continuous symptoms or recurrence.

Patients susceptible to ulnar nerve compression at the elbow are those with frequent flexion of the elbow, such as what occurs when holding telephones or working with vibrating machines. Diabetes mellitus is also a risk factor because it compromises microcirculation and the innate metabolism of the nerve. Playing sports with overhead-throwing actions, where strong flexion and acceleration occur, is also a predisposing factor.

**Symptoms**

Paresis commonly has a sudden onset (ie, overnight). Patients report intermittent numbness in the ring and small fingers or in the hypothenar. Tearing pain in the forearm and elbow are also reported. In
more advanced stages, patients have a loss of strength in the affected hand and some loss of skillfulness in the most important types of grip. Due to paresis of the intrinsic muscles, patients may be unable to adduct the small finger. In late stages, the interosseous muscles and the adductor pollicis muscle become atrophic (Figure 3).

Dellon’s classification can be used to grade cubital tunnel syndrome into 3 stages: stage 1 (mild), intermittent paresthesia, subjective weakness; stage 2 (moderate), intermittent paresthesia, measurable weakness; stage 3 (severe), permanent paresthesia, palsy.¹¹

ENDOSCOPIC DECOMPRESSION

In addition to the instruments required for open decompression, a lighted speculum, a dissector with 4-mm optics (Figure 4), and a camera with a monitor are needed.

Surgical Technique

Generally, the operation is performed with the patient under general anesthesia and with the use of an upper-arm tourniquet. The arm is positioned on an arm table with the shoulder in 90° of abduction. The elbow is flexed, and the wrist is supinated. After palpation of the nerve behind the epicondyle, a 2-cm incision is made along the retrocondylar groove (Figure 5). The roof of the cubital tunnel is exposed and opened. The nerve is easy to spot due to its bright color and its longitudinal committing veins. After identifying the nerve, the roof is cut over a short distance in proximal and distal directions. The tunnel is bluntly dissected on the fascia using forceps.

Using this method, the separation of the fascia from subcutaneous tissue is usually straightforward (Figure 6). The lighted speculum is inserted into the dissected tunnel to cut Osborne’s ligament. The FCU fascia can also be dissected under vision by the speculum. In a proximal direction, the fascia of the upper arm is dissected as far as possible by using the speculum. The endoscope with the dissector can then be inserted to continue decompression. Dissection at the upper arm is usually easier because the nerve is only covered by the fascia. Often, it is even possible to dissect right under the tourniquet. A firm Struther arcade is sometimes found at the upper arm, which must be dissected to complete decompression. Distal dissection is more challenging because several layers of tissue must be removed to decompress the nerve. Then, dissection of the forearm fascia is continued. Crossing blood vessels can be undermined and preserved (Figure 8).

After that, the 2 bellies of the FCU muscle, which are connected by a muscle bridge, are divided. At the proximal end of the muscle bridge, the sharp-edged tendon arcade of the FCU muscle is located 3 cm distal to the retrocondylar groove (Figure 9). After separation, decompression of the FCU muscle from the nerve is continued. The deep fascia with its submuscular membranes is dissected at a length of 10 to 15 cm starting from the groove (Figures 10, 11). As in the superficial layers, nerve branches and crossing vessels can be identified and preserved. In adipose patients, dissection is sometimes more difficult to perform due to protruding fat. Electrocautery is rarely necessary except at the incision rims, and a drain is seldom required. Intracutaneous
hematomas sometimes occur, but they usually heal spontaneously.

Postoperative Treatment
Elastic gauze is used in addition to the dressing (Figure 12) to restrict elbow movement for 10 days postoperatively. The drape is applied with the elbow in 45° of flexion and allows light movement but prevents complete flexion and extension. If patient compliance is limited, an upper-arm cast can also be used. Beginning on postoperative day 11, an elbow bandage is used for another 4 weeks.

DISCUSSION
Cubital tunnel syndrome is a compression syndrome of the ulnar nerve in the upper arm and forearm. Recently, a trend toward less-invasive procedures for ulnar nerve decompression, instead of open transposition (submuscular or subcutaneous) toward endoscopic decompression has been observed. Massive scarring and neuroma formation are common, particularly after open decompression and nerve transposition. Transposition is justified for selected indications, particularly in posttraumatic cases. Endoscopically, longer decompression distances are possible with minimal trauma compared with the traditional approach. Decompression can be performed atraumatically, and collateral nerves and vessels can be preserved. Devascularization of the nerve and damage of the collateral nerves does not occur with this method, as is possible with transposition. In the literature, decompression without transposition is recommended for primary surgery, both open and endoscopic, even in severe cases. This is also recommended for cases with luxation tendency of the nerve and slight deformation of the elbow.

However, severe deformations of the elbow, such as strong valgus deformity, arthritis with osteophytes impinging into the cubital tunnel, or massive and long-standing elbow contractures requiring release, are contraindications to the endoscopic procedure. A previous open procedure is sometimes regarded as a contraindication. However, the authors successfully performed endoscopic decompression after a failed open surgery but did not do it in cases of previous transposition of the nerve or when supposed massive scarring was observed. A situation where subluxation of the ulnar nerve over the medial epicondyle is supposed to be the main reason of symptoms is regarded as a relative contraindication for endoscopic release. In these cases, decompression without transposition may even aggravate symptoms by increasing the instability of the nerve.

The authors regard epineural dissection to be rarely indicated and interfascicular dissection to be never indicated. Assmus reported a series of 523 open decompressions without transposition. He found a recovery time in cases of light and medium severity of 2 to 4 months and a recovery time of up to 12 months in patients of high severity on average. Hoffmann and Siemionow reported good and very good results in 94% of cases, with 95% of the patients describing symptoms of improvement within 24 hours or a few days, and no recurrence occurred. Very good results were also observed in Dellon stage II (97%) and III (89%). According to the authors, this contradicts the prevailing opinion that the surgical approach in cubital tunnel syndrome should be adapted to its stage. Superficial hematomas and loss of sensation in the ulnar forearm were reported as complications, were temporary, and occurred in 8% of the patients initially. After blunt dissection of the tunnel was performed more cautiously, this complication was not
observed any more according to the author.2

Operative time is considerably shorter for the endoscopic than the open approach when performed by an experienced surgeon. Learning time in this method is short for a skilled surgeon. However, profound experience in nerve surgery and mastering the open technique are requirements for using the endoscopic method. Higher requirements in technical equipment and higher costs are drawbacks of this method. However, patient satisfaction is considerably higher due to a more aesthetically pleasing scar and reduced pain. Other compression syndromes, such as the anterior interosseous syndrome, the supinator syndrome, or Wartenberg’s syndrome, could also be treated endoscopically with minimal invasiveness.

CONCLUSION
For the endoscopic treatment of cubital tunnel syndrome, knowledge of relevant anatomy and experience with the open technique are required. The endoscopic approach may become the standard treatment for cubital tunnel syndrome.

REFERENCES