Endoscopic Anterior Subcutaneous Transposition of the Ulnar Nerve

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Abstract: Cubital tunnel syndrome refers to ulnar nerve compressive neuropathy and most commonly occurs at the level of the elbow. Surgical options include in situ decompression, decompression with anterior transposition of the ulnar nerve, and medial epicondylectomy with or without decompression. With the advancement of endoscopic surgery, techniques of endoscopic in situ decompression of the ulnar nerve, endoscopy-assisted anterior transposition, and endoscopic anterior transposition of the ulnar nerve have been reported with the advantage of minimally invasive surgery. We describe a 2-portal technique of endoscopy-assisted anterior subcutaneous transposition of the ulnar nerve.

Ulnar nerve compressive neuropathy most commonly occurs at the level of the elbow and is termed cubital tunnel syndrome. It is the second most common neuropathy of the upper extremity. The most common compressive site is at the cubital tunnel by the arcuate ligament (Osborne’s band or cubital tunnel retinaculum), which is the fascial band attaching to the olecranon and the medial epicondyle and forming the superficial border of the cubital tunnel. Other potential sites of entrapment include the arcade of Struthers (a fascial band between the medial head of the triceps and the medial intermuscular septum) and the deep flexor pronator aponeurosis between 2 heads of the flexor carpi ulnaris muscle. The surgical options can be categorized into in situ decompression of the ulnar nerve at the level of the cubital tunnel, decompression with anterior transposition of the ulnar nerve (subcutaneous, intramuscular, or submuscular transposition), and medial epicondylectomy with or without decompression.

Endoscopic in situ decompression of the ulnar nerve, endoscopically assisted ulnar nerve transposition, and endoscopic anterior transposition of the ulnar nerve have been reported with the advantage of minimally invasive surgery. We describe a 2-portal technique of endoscopic anterior subcutaneous transposition of the ulnar nerve. It is indicated for symptomatic cubital tunnel syndrome or symptomatic ulnar nerve instability. It is contraindicated under the following conditions: when open procedure for concomitant elbow pathologies is needed, in case of cubital tunnel syndrome due to space occupying lesion, with a very muscular patient, with a patient with very thin subcutaneous layer, or in a case of lack of expertise (Table 1).

Technique

Preoperative Planning and Patient Positioning

Preoperative electrophysiological study can confirm the diagnosis of cubital tunnel syndrome. The patient is in the supine position with the upper limb on the side table. An arm tourniquet is applied to provide a bloodless operative field. A 4.0-mm 30° arthroscope (Dyonics, Smith and Nephew, Andover, MA) is used for this procedure. Fluid inflow is by gravity, and no arthropump is used.

Portal Placement

The procedure is performed via the volar and dorsal portals. The volar portal is about 1 to 2 cm lateral and...
anterior to the medial humeral epicondyle. The dorsal portal is at the level of the upper border of the medial humeral epicondyle and over the ulnar nerve (Fig 1).

**Developing a Subcutaneous Pouch**

One-centimeter longitudinal skin incisions are made at the portals. The subcutaneous tissue is bluntly dissected to the deep fascia. A subcutaneous pouch is developed by a sweeping motion with a trochar cannula (Fig 2). This prepares for subsequent subcutaneous transposition of the ulnar nerve.

**Endoscopic Release of the Deep Fascia Covering the Ulnar Nerve**

The volar portal is the viewing portal, and the dorsal portal is the working portal. The ulnar nerve is carefully identified and dissected out at the dorsal portal.

The deep fascia covering the ulnar nerve is traced and released proximally. The arthroscope needs to turn 90° and advance proximally along the ulnar nerve. This is facilitated by first retracting the deep fascia with a peanut swab. The advancement of the arthroscope can be guided by the stem of the holder of the peanut swab. With the arthroscope in place, the peanut swab is withdrawn. A retrograde knife (Smith and Nephew) is introduced via the dorsal portal. It is advanced proximally under arthroscopic guide. The deep fascia is cut open posterior to the ulnar nerve by the retrograde knife (Fig 3). The release should be under arthroscopic guidance in order to avoid injury to the ulnar nerve and accompanying vessels. The release should be completed down to the dorsal portal. The more proximal part of the deep fascia can be released by a long SuperCut scissors (Stille, Lombard, IL) and an endoscopic scissors (Lagis, Tawan Mcweis, Thailand).

**Table 1. Indications and Contraindications of Endoscopic Anterior Subcutaneous Transposition of the Ulnar Nerve**

| Indications                              | Contraindications                                      |
|------------------------------------------|--------------------------------------------------------|
| Symptomatic cubital tunnel syndrome      | If open procedure for concomitant elbow pathologies is needed |
| Symptomatic ulnar nerve instability      | Cubital tunnel syndrome due to space occupying lesion   |
|                                          | Very muscular patient                                  |
|                                          | Patient with very thin subcutaneous layer               |
|                                          | Lack of expertise                                       |

*Fig 1. Endoscopic anterior subcutaneous transposition of the right ulnar nerve. The patient is in the supine position with the upper limb on the side table. The volar portal (VP) is about 1 to 2 cm medial and anterior to the medial humeral epicondyle (ME). The dorsal portal (DP) is at the level of the upper border of the medial humeral epicondyle and over the ulnar nerve. (MIS, medial intermuscular septum.)*

*Fig 2. Endoscopic anterior subcutaneous transposition of the right ulnar nerve. The patient is in the supine position with the upper limb on the side table. A subcutaneous pouch is developed by sweeping motion with a trochar cannula (TC) via the dorsal portal (DP). (ME, medial humeral epicondyle; MIS, medial intermuscular septum.)*

**Endoscopic Release of the Arcade of Struthers**

The volar portal is the viewing portal, and the dorsal portal is the working portal. When the release of the proximal fascia goes proximally, the arcade of Struthers can be identified. It can also be released by the long SuperCut scissors and endoscopic scissors (Fig 4). The arcade can be dissected out from the ulnar nerve with a peanut swab before the release. The release should be at the posterior aspect of the ulnar nerve. This can avoid accidental damage to the ulnar nerve, which turns from anterior compartment to posterior compartment at the arcade of Struthers.
Endoscopic Release of the Cubital Tunnel Retinaculum and the Flexor Pronator Retinaculum

The volar portal is the viewing portal, and the dorsal portal is the working portal. The cubital tunnel retinaculum (arcuate ligament) is released by a SuperCut scissors. The arthroscope is turned 90° and advanced distally. The flexor pronator retinaculum between the 2 heads of flexor carpi ulnaris is released by the SuperCut scissors (Fig 5). It is important to ensure all the fascial bands over the ulnar nerve are released.

Endoscopic Release of the Medial Intermuscular Septum

The dorsal portal is the viewing portal, and the volar portal is the working portal. The medial intermuscular septum is identified as a tough structure anterior to the ulnar nerve. A retrograde knife is advanced proximally via the volar portal. The septum should be released at the base of the septum and close to the humeral bone (Fig 6). The septum is released from proximal distally and should be continuous along the ridge of the medial humeral epicondyle. This can relieve the tension of the septum. The release should be under arthroscopic visualization in order to avoid damage to the ulnar nerve. The surgeon should be careful to cut only the septum without cutting into the anterior compartment musculature in order to avoid injury to the brachial artery and median nerve.

Endoscopic Mobilization of the Ulnar Nerve

The volar portal is the viewing portal, and the dorsal portal is the working portal. The fascial tissue embedding the ulnar nerve is bluntly dissected with an arthroscopic probe (Dyonics, Smith and Nephew) (Fig 7). The arthroscope is switched to the dorsal portal. The ulnar nerve can be mobilized and retrieved anteriorly via the released deep fascia by the arthroscopic probe via the volar portal. This confirms adequate mobilization of the ulnar nerve.

Anterior Subcutaneous Transposition of the Ulnar Nerve

The ulnar nerve is placed posterior to the medial epicondyle. The dorsal portal is retracted anteriorly and distally to expose the medial epicondyle and the
common flexor origin. The flexor origin is anchored by a curved needle loaded with no. 1 vicryl suture (Ethicon, Somerville, NJ). The suture limbs are retrieved to the dorsal portal and pass under the ulnar nerve. The nerve is transposed anteriorly in the subcutaneous pouch and held in place by a retractor via the volar portal. The suture limbs are passed through the subcutaneous tissue between the volar and dorsal portals by means of a straight-eyed needle. The retractor blade protects the ulnar nerve from injury by the needle. The transposed ulnar nerve is kept in place by suturing the subcutaneous tissue to the common flexor origin (Fig 8, Table 2, Video 1). Postoperatively, free mobilization of the elbow is allowed.

Discussion
Debate continues about the in situ release versus anterior transposition of the ulnar nerve for management of cubital tunnel syndrome. Proponents of in situ release believe that release of the arcuate ligament and the flexor pronator retinaculum is all that is required to adequately release the cubital tunnel. The advantages of this approach include procedural simplicity, decreased operative time and morbidity with faster recovery, and preservation of neural blood supply. Although anterior transposition may have a higher complication rate than in situ decompression, it can relieve both the compression and traction injury to the ulnar nerve. It can also be used to manage symptomatic subluxation of the ulnar nerve.
Open anterior transposition requires a long incision and extensor dissection. Endoscopy-assisted ulnar nerve transposition used endoscopic release of the deep fascia, arcade of Struther, and the intermuscular septum and open release and mobilization of the ulnar nerve distal to the cubital tunnel. This allows adequate decompression of the ulnar nerve at the elbow level. However, the proximal release requires a long retractor, inducing significant compression to the subcutaneous tissue. The dry arthroscopy sometimes provides a suboptimal view, especially at the region of the arcade of Struther. In this reported technique, the arthroscopic procedure is performed under usual fluid inflow. This provides a better arthroscopic view, especially during proximal release. Moreover, the incisions are smaller.

This technique has the advantage of creating a smaller wound, requiring little soft-tissue dissection, having better arthroscopic visualization, causing less vascular insult to the nerve, and resulting in faster recovery for the patient. It has the potential risk of injury to the medial antebrachial cutaneous nerve, ulnar nerve, the branch that innervates the flexor carpi ulnaris, the brachial artery, and the median nerve and inadequate release or inadequate mobilization of the ulnar nerve (Table 3).

**Fig 7.** Endoscopic anterior subcutaneous transposition of the right ulnar nerve. The patient is in the supine position with the upper limb on the side table. The volar portal is the viewing portal, and the dorsal portal is the working portal. The fascial tissue embedding the ulnar nerve (UN) is bluntly dissected with an arthroscopic probe (AP).

**Fig 8.** Endoscopic anterior subcutaneous transposition of the right ulnar nerve. The patient is in the supine position with the upper limb on the side table. (A) The ulnar nerve is placed posterior to the medial epicondyle. The dorsal portal is retracted anteriorly and distally to expose the medial epicondyle and the common flexor origin. The flexor origin is anchored by a curved needle loaded with no. 1 vicryl suture. (B) The suture limbs are retrieved to the dorsal portal and pass under the ulnar nerve. (C) The nerve is transposed anteriorly in the subcutaneous pouch and held in place by a retractor via the volar portal. The suture limbs are passed through the subcutaneous tissue between the volar and dorsal portals by means of a straight-eyed needle. The retractor blade protects the ulnar nerve from injury by the needle. (D) The transposed ulnar nerve is kept in place by suturing of the subcutaneous tissue to the common flexor origin. (CFO, common flexor origin; DP, dorsal portal; MIS, medial intermuscular septum; S, suture; SEN, straight-eyed needle; UN, ulnar nerve; VP, volar portal.)
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Table 2. Pearls and Pitfalls of Endoscopic Anterior Subcutaneous Transposition of Ulnar Nerve

| Pearls | Pitfalls |
|--------|---------|
| Release by means of retrograde knife should be under arthroscopic visualization to prevent injury to the ulnar nerve. | Anterior subcutaneous transposition is not suitable for very muscular patient with thin subcutaneous layer. |
| The release of the arcade of Struthers should be performed at the posterior side of the ulnar nerve. | Caution should be taken during release of the medial intermuscular septum in order to avoid damage to the brachial artery and the median nerve, which are anterior to the septum. |
| Release of the deep fascia should be completed down to the dorsal portal. | Caution should be taken during mobilization of the distal part of the ulnar nerve to avoid damage to the branch of the flexor carpi ulnaris. |
| Release of the intermuscular septum should be continuous along the medial epicondylar ridge. | |
| All the fascial bands deep to the flexorpronator retinaculum should be released. | |

Table 3. Advantages and Risks of Endoscopic Anterior Subcutaneous Transposition of the Ulnar Nerve

| Advantages | Risks |
|------------|-------|
| Smaller wound | Medial antebrachial cutaneous nerve can be damaged at the skin incisions. |
| Requires little soft-tissue dissection | Injury to the branch that innervates the flexor carpi ulnaris |
| Better arthroscopic visualization | Injury to the ulnar nerve |
| Causes less vascular insult to the nerve | Injury to the brachial artery and median nerve |
| Faster recovery for the patient | Inadequate release of the ulnar nerve |
| | Inadequate mobilization of the ulnar nerve |