



Endoscopic Ulnar Nerve Release and Transposition: Single Portal Technique

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60.1 Background

Ulnar neuropathy at the elbow, known as cubital tunnel syndrome, is a common compressive neuropathy in the upper limb. When non-operative management has failed to sufficiently improve the condition, surgery can be undertaken to decompress the nerve, with or without anterior transposition, and this can be performed via an open or endoscopic approach. The risk of postoperative instability is minimal when the ulnar nerve is decompressed in situ rather than neurolysed. The ulnar nerve should be assessed intraoperatively with passive elbow motion after decompression; if found unstable, the nerve should be anteriorly transposed or stabilised during the procedure. The medial head of triceps should additionally be evaluated intraoperatively

with elbow motion to ensure that it does not snap over the medial epicondyle; if snapping is present then the medial head should be debrided or transferred. For patients with an unstable ulnar nerve pre-operatively, transposition should be the planned procedure.

60.2 Surgical Anatomy

The ulnar branches of the medial cutaneous nerve of the forearm (MCFN) course in a distal direction obliquely and posteriorly and should be looked out for and protected during ulnar nerve surgery at the medial side of the elbow to reduce the risk of sensory loss post-surgery. The medial intermuscular septum is attached to the humerus distal to the teres major and passes along the supracondylar ridge to the medial epicondyle. At the mid-arm level, the ulnar nerve passes posterior through the intermuscular septum and descends anterior to the medial head of the triceps muscle. In the majority of patients, the arcade of Struthers (a thin band of fascia between the medial triceps and intermuscular septum approximately 8 cm proximal to the medial epicondyle) is present and the ulnar nerve passes underneath the arcade. At the elbow, the ulnar nerve passes posterior to the medial epicondyle and medial to the olecranon in the cubital tunnel. Here, the nerve courses along on the retrocondylar groove of the humerus and cov-

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ered by Osborne's ligament, which is a fusion of the deep fascia between the heads of flexor carpi ulnaris (FCU) and the antebrachial fascia. After passing through the cubital tunnel, the ulnar nerve travels between the ulnar and humeral heads of FCU down the forearm. Anconeus epitrochlearis is a muscle present in a small percentage of the population originating at the posterior medial epicondyle and inserting on the olecranon and forms an arch over the cubital tunnel. The ulnar nerve can be compressed at one or more of several sites along the above route including the intermuscular septum, arcade of Struthers, anconeus epitrochlearis, cubital tunnel, and fascial bands within FCU.



Fig. 60.1 Ganglion compressing ulnar nerve on T2 MRI axial image

60.3 Indications and Contraindications

Operative intervention for ulnar neuropathy at the elbow is justified for patients with sufficient symptoms in whom further non-operative management is unlikely to provide sufficient benefit.

- Patients with ulnar neuropathy report sensory disturbance in the ulnar sensory area, and in more advanced neuropathy, clumsiness and weakness of the hand. A positive Tinel's sign is present. Prolonged flexion of the elbow for approximately 60 seconds often reproduces the neurological symptoms. The scratch collapse test can be helpful in the examination for ulnar neuropathy patients [1].
- A smaller group of patients suffer from instability of the ulnar nerve due to the nerve subluxing over the medial epicondyle with elbow flexion and reducing posteriorly with elbow extension. These patients experience sudden shooting ulnar nerve symptoms and pain at the elbow with the snapping of the ulnar nerve. Ulnar nerve instability can however be asymptomatic.

There are some patient groups listed below who are unlikely to improve sufficiently with non-operative treatment and in whom proceeding directly to operative intervention is more likely to be warranted:

- Patients with extrinsic compressive lesions (ganglions, osteophytes, anconeus epitrochlearis) (Fig. 60.1).
- Patients with severe neuropathy and wasting of the hand intrinsic muscles.
- Patients with very severe symptoms.
- Elderly patients with significant neuropathy or symptoms, especially in the over 80-year-age group, as the ulnar nerve can be damaged more rapidly by compression in this patient group.

Anterior transposition of the decompressed ulnar nerve may be performed in:

- Nerve instability prior to surgery.
- Following an in situ decompression if there is more than mild nerve instability (2 mm of anterior motion with elbow flexion) [2].
- The most common alternative to transposition for instability is to stabilise the nerve in situ with a flap of flexor-pronator or triceps fascia. Nerve stabilisation in situ is suitable for patients with mild to moderate increase in nerve motion with flexion, and without frank subluxation over the medial epicondyle [2, 3].

Endoscopic surgery may be contraindicated, and an open approach favoured when local nerve lesions or systemic conditions exist, and which

may lead to an increased risk for complications. Individual surgeon experience would determine the most suitable surgical approach.

- In some revision cubital tunnel surgeries, extensive adhesions may circumferentially engulf the ulnar nerve. Lysis of nerve adhesions and epineurolysis may best be performed via an open approach, using loupe magnification and microsurgical techniques.
- Neuromas of the ulnar nerve may result from previous injury and neurolysis, or excision and nerve grafting, may best be undertaken by an open microsurgical approach. Primary nerve pathology is uncommon. Schwannomas in the vicinity of the cubital tunnel present with focal nerve swelling and severe symptoms and responds well to microsurgical dissection and excision which may be undertaken open. Neurofibromatosis affecting the ulnar nerve presents with segmental nerve enlargement and may be best evaluated by an open wide decompression.
- Elbow joint osteophytes, synovial cysts, and rheumatoid pannus, as well as impinging metalware from previous fracture fixation are lesions which must be treated as well during endoscopic surgery to prevent persistence of symptoms.
- Systemic conditions such as haemophilia may cause a compression neuropathy of the ulnar nerve. Perineural haematoma, intra-muscular haemorrhage, or nerve compression from elbow joint haemarthrosis can be evaluated and drained via open surgery while maintaining nerve visibility and protection.
- Patients on perioperative anticoagulation are at risk for postoperative haematoma. A meta-analysis of endoscopic versus open cubital tunnel surgery reported the endoscopic approach having an increased risk for postoperative haematoma which may require reoperation [4].
- Hereditary Neuropathy with Pressure Palsy (HNPP) is an inherited condition affecting development of myelin and leads to nerve hypersensitivity to the slightest pressure or stretch during surgery, in which an open approach may be considered.

60.4 Surgical Technique

The procedure is carried out with a general or regional anaesthetic and exsanguination of the upper limb prior to inflating an upper arm tourniquet. The patient is supine with the upper limb placed on an arm table at about 80° of shoulder abduction. Placing a padded object under the tip of the elbow elevating it by approximately 5 cm is helpful. The endoscopic stack is located near to the patient's head area with the surgeon sitting at the axilla, and the surgical assistant between the arm and the head. The endoscopy is undertaken dry with no fluid or carbon dioxide used. The in situ decompression technique described here is as described by Hoffman and Siemionow [5]. The ulnar nerve transposition described later is an addition to this technique by the first author comprising an endoscopically assisted mini-open procedure.

The instruments used in the procedure include a surgical blade, scissors for dissection and decompression of the nerve, endoscope, long bipolar diathermy bayonet forceps, and forceps and needle holder. It is useful to have a selection of scissors including shorter scissors such as curved tenotomy scissors for the initial dissection and longer blunt-tipped curved scissors for endoscopic work, and finally some blunt tipped curved 17–23 cm scissors for endoscopic dissection furthest from the incision. The authors use a 4 mm 18 cm length Hopkins II Forward-Oblique 30 degrees telescope with large fenestrated distal spatula optical dissector (Karl Storz, Tuttlingen, Germany). A speculum is useful at times during this procedure (Fig. 60.2).

60.5 In Situ Decompression

60.5.1 Preliminary Dissection

- A small (20 mm) gently curved longitudinal incision is made at the ulnar retrocondylar groove over the ulnar nerve closer to the medial epicondyle than the tip of the olecranon. If transposition is the intended procedure from the outset, the incision is 4 cm in length



Fig. 60.2 Endoscopic equipment for cubital tunnel surgery

centred over the cubital tunnel. During the procedure, if a longer incision is felt to be required or will be safer, then the incision can be easily lengthened.

- The subcutaneous tissues are bluntly dissected with tenotomy scissors to preserve any branches of the medial cutaneous nerve of the forearm. At times, no branches of the cutaneous nerves will be present in the incision area due to its short length, but commonly at least one branch will be present and should be protected. During dissection at the elbow, a small portion of patients will have an anconeus epitrochlearis muscle which will require incising. This is carried out by directly incising the muscle fibres in line with the ulnar nerve with the small open incision.
- At this stage, palpation with a fingertip is useful in identifying the position of the ulnar nerve which is then exposed by placing a small incision in the retinaculum (Osborne's ligament) overlying it (Fig. 60.3).
- A soft tissue space is produced in the line of the ulnar nerve just superficial to the deep fascia for approximately 10 cm distally and 8 cm proximally using a blunt tunnelling forceps or bluntly with scissors. This soft tissue space

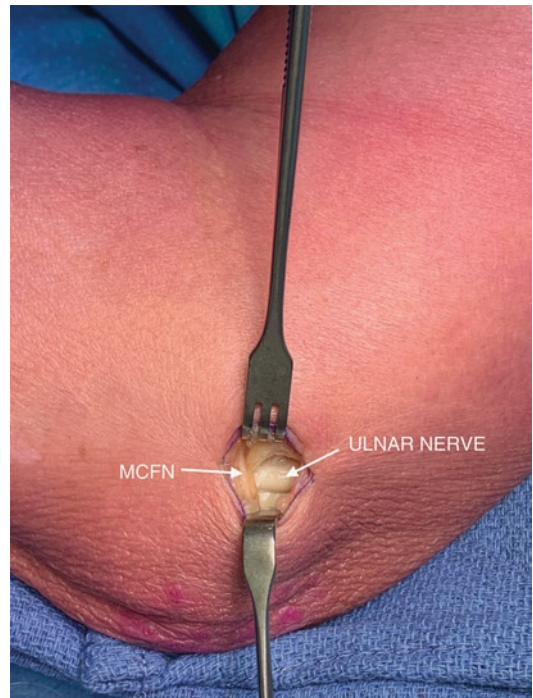


Fig. 60.3 Ulnar nerve and MCFN visible in the incision

requires to be sufficiently large to accommodate the endoscopic instruments.

- For most patients, at this stage the hooded endoscope will keep the soft tissue space suf-

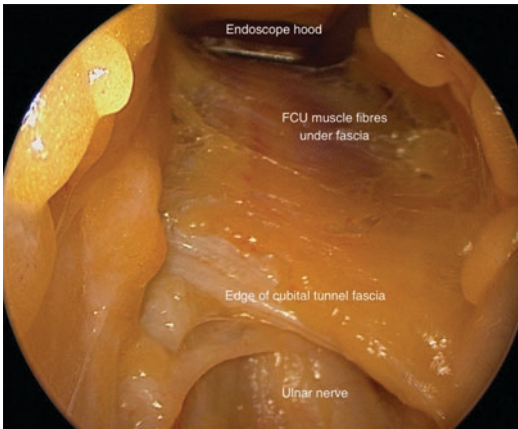


Fig. 60.4 Initial distal endoscopic view

ficiently open. However, for patients who have a thick layer of adipose tissue which is crowding the visualisation of the endoscopic operative space, a speculum can be placed in the incision, in addition to the endoscope. When dissection is carried out proximally to the elbow, a speculum is commonly beneficial. Given the endoscope has a light source, using an additional light source on speculum is unnecessary. Prior to placing the endoscope into the incision, an endoscopic lens antifog agent may be used to wipe the optical tip of the endoscope to safely prevent fog formation and improve visualisation.

- The hooded endoscope is placed into the incision so the surgeon can visualise both the ulnar nerve beneath the small incision in the roof of the cubital tunnel, and the unincised distal edge of the retinaculum (Fig. 60.4).

60.5.2 Distal Endoscopic Decompression

- Firstly, dissection distal to the elbow is carried out and a pair of scissors is used to incise the remaining cubital tunnel retinaculum and fascia overlying FCU for several centimetres, until there will be sufficient space to work within FCU (Fig. 60.5). The authors do not decompress the forearm fascia more distally than is necessary, which is a variation to the original technique.



Fig. 60.5 Endoscope in situ distally and patient position

- Once the muscle fibres of FCU become clear deep to the fascia, the blunt end of the hooded optical dissector of the endoscope is used to bluntly separate the muscle fibres over the ulnar nerve through its initial course through FCU. At this point, the fibrous raphe between the two heads of the FCU is released, and then progressing distally any fascial bands that appear to compress the nerve are incised (Fig. 60.6). During the dissection, any motor branches of the ulnar nerve are seen and protected.
- The most common cause of compression of the ulnar nerve in cubital tunnel syndrome is typically at the cubital tunnel under Osborne's ligament. It has been suggested that it is not necessary to decompress the ulnar nerve beyond the cubital tunnel into FCU [12]. However, in a number of cases, fascial bands within FCU appear to deform the nerve and thus may have the potential to cause neuropathy. Therefore, the authors recommend decompression of the ulnar nerve for between

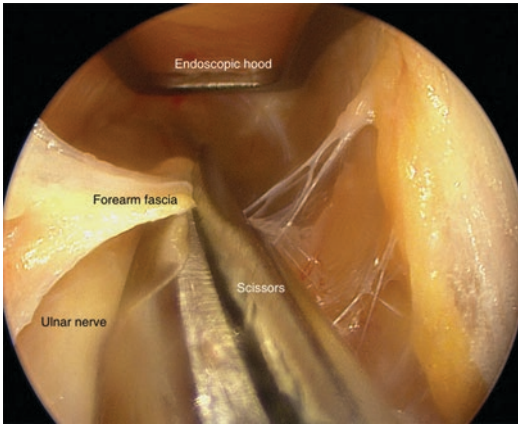


Fig. 60.6 Decompression within forearm

10 and 15 cm (the maximum working length of the endoscope) distally from the elbow.

60.5.3 Proximal Endoscopic Decompression

- Under loupe magnification, the remainder of the decompression of the ulnar nerve in the portion of the cubital tunnel that is visible through the incision is decompressed. The hooded endoscope, and if required a speculum, is then inserted into the incision directed proximally, with the ulnar nerve and the remaining edge of cubital tunnel roof to be incised in view.
- The cubital tunnel fascia and arcade of Struthers are decompressed up to the intra-muscular septum (Fig. 60.7).
- The nerve is inspected up to the intra-muscular septum; it is rarely compressed here and therefore the septum can usually be left undisturbed. If necessary, the septum can be decompressed.

60.5.4 Final Assessment

At the completion of the decompression, the surgeon should be confident that the nerve has been decompression from distally into FCU, through the cubital tunnel and proximally up to the intra-muscular septum. The nerve and the medial head



Fig. 60.7 Proximal decompression using scissors

of triceps are then inspected with elbow flexion and extension; if unstable then either transposition or in situ flap stabilisation should be carried out. If the medial head of triceps subluxes over the medial epicondyle with flexion, the tendon may be partially excised until the snapping no longer occurs.

60.6 Anterior Transposition

- The incision is lengthened to approximately 4 cm. Any further cutaneous nerve branches identified by the blunt dissection with tenotomy scissors are protected.
- Under direct vision, the flexor-pronator fascia is then cleared of attached subcutaneous tissues protecting the cutaneous nerves during the dissection. Sufficient fascia is exposed to allow the creation of a flap of fascia with the apex at the medial epicondyle of sufficient length and breadth.
- The fascia flap should be 3–4 cm long by 2–3 cm wide. The flap is raised sharply with a knife from the underlying muscle.
- The tissue bed in which the anteriorly transposed ulnar nerve sits is then assessed to ensure there will be no tissue which will compress the nerve. Several tendinous regions within the muscle bed may require incision or excision; distally, the posterior tendinous edge of the flexor-pronator mass and proximally the distal edge of the median intra-muscular septum must be assessed and excised.
- Using the open incision, and more proximally and distally with the aid of the endoscope, a neurolysis of the ulnar nerve is undertaken prior to transposition.

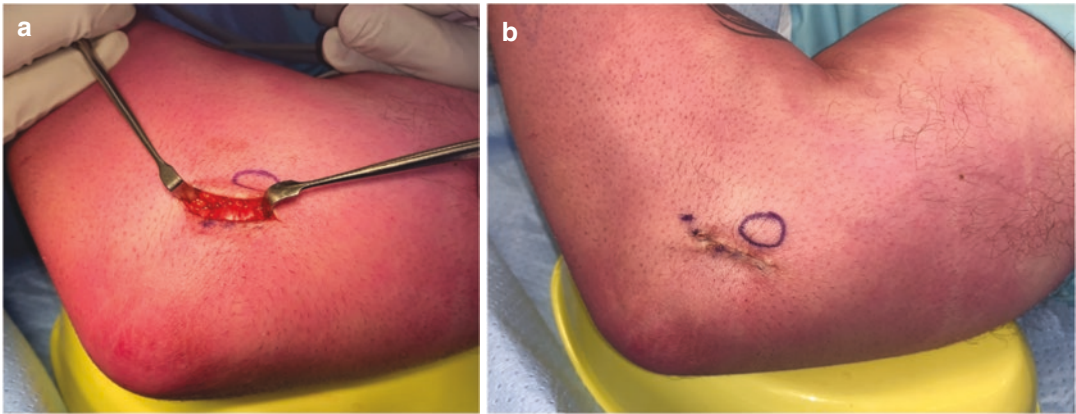


Fig. 60.8 (a, b) Anterior transposition and incision post-closure

- The nerve is then transposed anteriorly to the medial epicondyle with its accompanying longitudinal vascular supply, preserving the motor branches to the FCU and the flexor digitorum profundus. Occasionally, one of the branches to FCU requires sacrificing to allow the nerve to have a smooth course in its transposition.
- The ulnar nerve is then supported in position by the fascial flap which is brought superficial to the ulnar nerve and sutured to the deep dermis with 2/0 vicryl approximately 25 mm anteriorly to the incision.
- The elbow is passively moved through a full range of flexion and extension and the nerve is carefully assessed for stability and for any evidence of compression or tight bends throughout the range of motion. If there are any concerns, the sutures holding the flap can be removed and the flap reset with or without any further soft tissue releases as required. The medial triceps is assessed with elbow motion and partially incised if required.
- Once the surgeon is satisfied with the transposition, the wound is infiltrated with local anaesthetic and closed with 2/0 vicryl to the subcutaneous tissues and then 4/0 monocryl intra-dermal. Steristrips are applied, then a small adhesive dressing and orthopaedic padding bandage followed by a crepe bandage (Figs. 60.8 and 60.9).

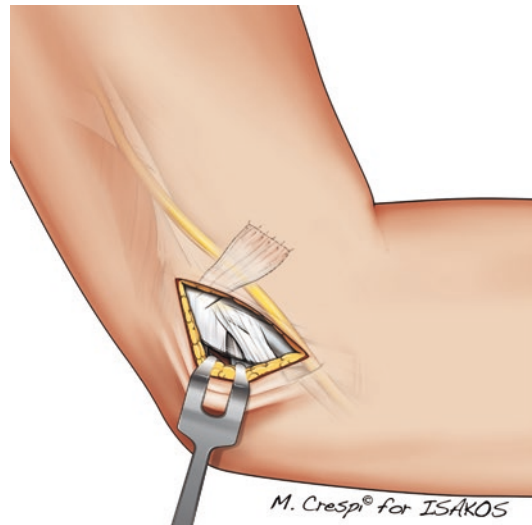


Fig. 60.9 Illustration of endoscopically assisted ulnar nerve anterior transposition (M. Crespi © for ISAKOS)

60.7 Technical Tips

- For sufficient space to visualise the nerve and associated tissues, it is helpful to place some superior angulated force on the endoscope for elevating the tip of the spatula of the optical dissector.
- When dissecting in the subcutaneous and deeper layers, small nerve branches or vessels can be encountered and care must be taken to avoid injury to these structures. If required, for

surgical exposure, small vessels can be coagulated using bipolar diathermy.

60.8 Pitfalls

Snapping of the triceps is an uncommon condition where the medial head of triceps subluxes over the medial epicondyle during elbow flexion. It can be associated with and co-exist with ulnar nerve instability or alternatively can be mistaken for ulnar nerve instability [6]. Postoperative snapping of the triceps following surgery for ulnar neuropathy at the elbow is possible [7].

60.9 Postoperative Management and Rehabilitation

Patients are permitted to use their elbow and upper limb for light activities immediately postoperatively. Mobilising their elbow following surgery reduces the risk of scar tissue formation tethering the nerve and allows a more rapid resumption of everyday activities for patients. The bandages are removed at 2 days postoperatively and the adhesive dressings at 10 days. Patients should avoid heavy activities and avoid prolonged flexion of the elbow for 6 weeks to reduce the risk of secondary ulnar nerve instability. A portion of patients have bruising of their upper limb for some days, and this resolves by the two-week postoperative visit.

60.10 Complications

- *Ulnar nerve instability*: The ulnar nerve can be rendered unstable by decompression. To avoid instability, decompression is undertaken purely as an in situ decompression. At surgery, if the nerve appears unstable it should be transposed or stabilised. Furthermore, if prolonged elbow flexion and heavier upper limb activities are avoided for the first 4–6 weeks, post-surgery instability is rare. The nerve rarely can become unstable following anterior transposition due to the stretching of fascial

flap attachment. If postoperative instability occurs, revision anterior transposition either subcutaneously or submuscularly usually resolves the instability.

- *Snapping medial triceps*: This can develop postoperatively and should be looked for both before and during revision surgery. A snapping triceps can be confused for ulnar nerve instability.
- *Medial cutaneous nerves of the forearm*: These can be injured either temporarily or permanently following surgery for the ulnar nerve at the elbow. The key to this complication is prevention by carefully dissecting out and protecting the nerves. This complication is less frequent with endoscopic surgery owing to the small nature of the incision [4].
- *Extensive bruising*: Careful haemostasis is beneficial in reducing the risk of haematomas. Despite not using postoperative suction drains, postoperative bruising in most patients is self-resolving. If a haematoma causes neurological compression, urgent drainage of the haematoma is necessary.
- *Recurrent ulnar neuropathy*: In a small number of patients, the symptoms may recur after a few years post-surgery. If sufficiently severe, endoscopic or open surgery revision surgery can be considered.

60.11 Results

Over a 9-year period, in the first author's private clinic, 124 cases in 106 patients underwent endoscopic ulnar nerve surgery at the elbow. For decompressions the results were excellent (49%) and good (31%) in 80% of patients. For the remaining patients, 14% reported reasonable and 6% poor results. The majority of patients with poor results had additional cervical spine root compression to account for their lack of improvement. For transpositions, the results were excellent or good in 60% of patients. While the results for transposition appear worse, in this group many patients were found to have multiple pathologies in their upper limb or cervical spine. Revision procedures for six patients included

anterior subcutaneous and submuscular transposition for postoperative instability or insufficient improvement following initial surgery, and snapping medial head of triceps.

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