

# Cubital tunnel syndrome – Review of current literature on causes, diagnosis and treatment

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**Abstract** Cubital tunnel syndrome is common, but not fully understood. Fortunately, most cases of ulnar nerve compression improve with nonsurgical treatment and large majority get better with surgical decompression. The fact that most people get better with and without surgical treatment is likely the reason that multiple studies have failed to show improved results with different types of decompressions for mild cubital tunnel syndrome. Transposition surgeries have been shown to yield better results with more severe cases and patients who failed previous simple releases, likely secondary to release of other compression sites that were missed by the initial surgery. Knowing more about pathology of the cubital tunnel syndrome such as compression versus traction injury and having better modalities for evaluation of the nerve should help us to better tailor treatment for the patients in the future.

**Keywords** Cubital tunnel · ulnar nerve · decompression, treatment · transposition technique · review

## Introduction

Although the incidence of cubital tunnel has not been well reported, it is estimated to be around 1% in United States. Ulnar nerve compression is the second most common nerve entrapment of the upper extremity after carpal tunnel syndrome. [1] Ulnar nerve can be entrapped at multiple sites of the upper extremity, from the cervical nerve roots C8/T1 and brachial plexus to more distal sites at the elbow, forearm and wrist. Elbow entrapment is seen most commonly and has been referred to as the tardy ulnar nerve palsy in the past. ‘Cubital tunnel syndrome’ is the term introduced by Feindel and Stratford in 1958 because of its similarity to carpal tunnel syndrome [2, 3].

## Pathology of nerve compression

### *Anatomical factors*

Multiple sites of compression of the ulnar nerve have been identified around the elbow. The most proximal site of compression around the elbow involves the arcade of Struthers. The arcade of Struthers is a hiatus in the medial intermuscular septum approximately 8cm proximal to the medial epicondyle. This thickening of deep fascia of distal arm that extends between medial head of the triceps and the intermuscular septum is present in 70% of people [4]. Another reported site of compression is the medial intermuscular septum itself. Osborne was the first to describe another more distal site of compression. This transverse band crosses the ulnar nerve just distal to the medial epicondyle and is termed Osborne’s ligament. It is the most commonly identified site of compression of the ulnar nerve at the elbow. Additionally, a thick facial band between the two heads of flexor carpi ulnaris has also been implicated in some cases. Appreciation of the multiple sites of compression is crucial, so that each site can be evaluated during surgery for successful release.

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### *Space occupying lesions*

Multiple pathological conditions that occupy the cubital tunnel can cause cubital tunnel syndrome. Those lesions include tumors, ganglions, bony spurs, medial epicondyle nonunions from previous fractures, hypertrophic callus, synovitis in rheumatoid arthritis or gout, as well as hematoma formation in hemophiliacs or patients on blood thinners. In most cases of cubital tunnel syndrome no space occupying lesion can be identified.

### *Intrinsic stretch*

Given that symptoms of cubital tunnel syndrome are exacerbated with elbow flexion, there has been much debate about relative importance of external compression versus intrinsic traction. Previous studies that used pressure measurements in the cubital tunnel showed both types of mechanisms at work, but they were not able to show the amount of contribution from each mechanism specifically [8, 9]. More recently, Gelberman et al looked at both the interstitial and extraneural pressures on the ulnar nerve at the cubital tunnel using pressure measuring catheters as well as MRI to evaluate compression and cubital tunnel volume change with elbow flexion. They noticed much larger increase in intraneural pressure compared to extraneural pressure with no evidence of direct compression. This data points to traction of the ulnar nerve with elbow flexion to be more likely the major contributor to increased intraneural pressure and symptomology [7]. This information would incline the surgeon to transpose the nerve, instead of releasing the compression alone.

### **Clinical features**

Patients with cubital tunnel syndrome present with paresthesias over the small and ring fingers. Paresthesias present early in the disease and progress to motor dysfunction as the compression of the nerve becomes more severe and chronic. Intrinsic muscle weakness, as well as, weakness of flexor digitorum profundus of small and ring fingers can be seen in more advanced disease, which presents as clawing. Sparing of flexor digitorum profundus (FDP) is seen with more distal compression, such as seen at Guyon's canal and can help with differential diagnosis. This FDP sparing is called ulnar paradox, which means that the more distal the lesion is on the ulnar nerve the less clawing is noted due to decreased involvement of flexor digitorum profundus with more distal lesions. Patient also can complain of their small finger getting caught when trying to place their hand in a pocket of their pants. This is due to overpower of small finger extensor without opposition of interosseous muscles

causing small finger abduction and is called Wartenberg sign.

On physical exam there is a positive tinel sign over the cubital tunnel. Froment sign is noted due to weakness of adductor pollicis muscle. Froment sign is positive when a patient is given a piece of paper and holds it together between the thumb and index finger with flexion of the thumb IP joint. Positive flexion sign at the elbow with supination and wrist extension reproducing the symptoms up to 60 seconds and ulnar nerve subluxation with elbow flexion can also be seen. Still, flexion and tinel signs have been noted to be falsely positive in up to 24% of cases [5]. False positive results could also be due to the fact that, even under normal elbow flexion conduction velocity and intraneural pressure can decrease as described previously in cadaveric studies [7, 10]. Tenderness over the hook of hamate or pisiform should be evaluated to rule out compression at the guyon's canal. Abnormal finger flexion and loss of dorsal sensory branch of the ulnar nerve as seen in cubital tunnel compression can help in differentiating it from Guyon's canal pathology. Spurling test should be used to check for cervical causes of symptoms. Hand diagram for patient is often used to help portray the involvement of the sensory ulnar nerve distribution to the examiner [4].

Many diagnostic studies are helpful in confirming the suspected diagnosis and can also rule out specific causes of cubital tunnel compression. Plain X-rays should be obtained to look for degenerative changes of the cervical spine and elbow, as well as bony compression from spurs or previous fractures. Neurophysiological studies are helpful in establishing diagnosis and should be done if surgery is planned, in order to document preoperative baseline. Ulnar nerve velocity of <50 m/s at the elbow is considered positive for cubital tunnel syndrome [3].

### **Treatment and outcomes**

Conservative, nonsurgical treatments should be tried initially as they are effective in relieve of the symptoms in up to 50% of the cases. Nonsurgical treatment should be tried for at least 3 months before surgical intervention, especially in mild cases [2]. NSAIDs, activity modification that eliminates prolonged elbow flexion as well as nighttime splinting at 45 degrees of flexion and the use of elbow pad, have been described with good results. Vitamin B6 use is controversial and there is no concrete data to support its use. Most of the evidence for vitamin B6 stems from treatment of carpal tunnel syndrome [28].

There are three commonly used surgical treatments and there are proponents for use of each treatment. First type of surgical treatment is simple decompression, by either open or endoscopic release of the Osborne's band. This is reserved for mild cases, with recent onset of symptoms and mild sensory changes on the nerve studies. Advan-

tages include simple operation, less devascularization of the nerve and less scarring. Disadvantages include limited decompression and possibly missing compression at other sites. Endoscopic decompression has also been described in the literature. In a recent study by Bultmann, 47 patients with various levels of severity of cubital tunnel syndrome underwent endoscopic release with 98% reporting good to excellent results after the surgery. Majority of those patients did not have strength loss preoperatively suggesting milder cubital tunnel syndrome, but their sensation has improved to normal levels in 94% of cases [29]. Other studies have described good results in about 78% of the patients [30]. Endoscopic decompression can have similar indications as simple decompression. The second type of surgical treatment which involves medial epicondylectomy has also been used to relieve cubital tunnel syndrome, especially with visible compression from osteophytes and previous fractures of distal humerus. Advantages include specific and more extensive decompression, but there is higher risk of causing nerve subluxation, which can lead to continued symptoms. Goldberg et al. retrospectively analyzed 48 medial epicondylectomy procedures in 46 patients and noted improvement of symptoms in 98% of the patients, although strength improved only in about half of the patients. Worse results were seen with more severe preoperative function. [34] Third surgical technique is anterior transposition of the ulnar nerve with placement of the nerve subcutaneous, submuscular or intramuscular. Advantages include thorough release of ulnar nerve and evaluation of multiple sites of compression. Theoretical disadvantages include decrease blood supply to the nerve from soft tissue dissection, as well as higher likelihood of nerve injury from manipulation and complexity of the procedure [16].

A recent meta-analysis by Macadam et al based on 10 studies showed no statistically significant difference between simple decompression and nerve transposition but only a trend toward improved results with transposition of the ulnar nerve [24]. Dr. Kevin Chung did another metaanalysis of previous studies. [11] Those studies included extensive review by Bartels et al. who analyzed studies between 1970 and 1997 and noted that if patients were not evaluated base on severity of symptoms, simple decompression had better results. On the other hand, when controlled for severity results were very similar [12]. Another study by Mowlavi et al. which analyzed 30 published studies from 1945 to 1995 showed good surgical outcomes for mild to moderate disease and poor outcomes for severe disease with any types of surgical procedures [13]. Limitations of previous studies included low power and poor data quality. Dr. Chung came to conclusion that given no clear evidence of better results with extensile procedures, simple decompression should be favored as the initial surgical procedure [10]. A study by Adelaar et al., showed similar results for simple versus

subcutaneous and submuscular release with all severity of cubital tunnel syndromes grouped together, but slightly better results with moderate degree of compression when using submuscular transposition [26]. Submuscular transposition has also been commonly used for recurrent cubital tunnel syndrome, but recent studies have showed good results with subcutaneous transposition as well [27]. A recent study by Keiner et al., looked at 33 patient treated with either submuscular transposition or simple decompression over longer follow up of at least 3 years. 10 of 16 patient in transposition group and 11 of 17 patients in decompression group were completely free of symptoms. Although study sample was small, no difference was found between the two groups long term and authors recommended simple decompression as a less invasive procedure [33].

Again, review of multiple studies fails to show one superior procedure with improved outcomes when comparing between different types of decompressions [10–24]. This is especially true for mild to moderate forms of cubital tunnel syndrome. In those cases simple decompression is often chosen due to minimally invasive nature of this approach. In other patient with severe stage of the disease, cubitus valgus and nerve subluxation, anterior transposition procedures should be strongly considered [15, 33]. Further randomized prospective, multicenter studies are needed to improve power of the results. Fur-



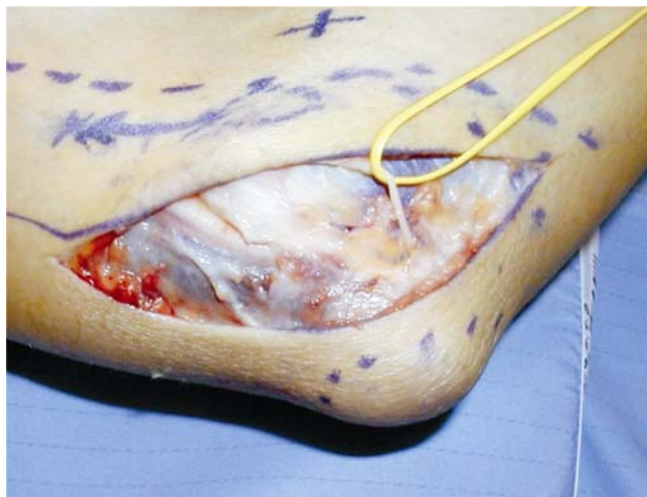
**Fig. 1** Surface anatomy for anterior transposition of the left ulnar nerve at the elbow. The medial epicondyle is outlined. The solid line running posterior to the medial epicondyle marks the incision. The 'X' 2.5 cm proximal to the medial epicondyle marks location of where the inferior ulnar collateral vessels (IUCV) enter the ulnar nerve. The second 'X' is 2.5 cm anterior and inferior to the medial epicondyle and is the location where the fascial flap is sutured to retain the ulnar nerve in its subcutaneous location after transposition. The dotted lines mark the course of the posterior branches of the medial antebrachial cutaneous nerve (MACN).

ther future studies should include a more specific pre operative evaluation of severity of the disease and post surgical evaluation of outcomes.

#### *Author's preferred technique for anterior transposition*

The author prefers using subcutaneous transposition of the ulnar nerve paying attention to the inferior ulnar collateral artery as the main supply to the transposed nerve [31]. Technique involves making a 10 cm incision posterior to the medial epicondyle, with the epicondyle being in the center of the incision. Inferior ulnar collateral vessels are about 2.5 cm proximal to the medial epicondyle (Fig. 1). During the dissection to the ulnar nerve, care is taken to protect the medial antebrachial cutaneous nerve to the forearm (Fig. 2). Ulnar nerve is then dissected out insitu (Fig. 3). Attention is then directed at isolating and

protecting the ulnar collateral artery supplying the nerve. This is done by careful elevation and resection of the medial intermuscular septum around the vessel (Figs. 4–5). After protection of the vessel and the mesoneurium, the nerve is transposed anteriorly and freed at all proximal and distal compression sites mentioned before. A single fascial flap 1 × 2 cm in size is then created from the fascia of the common flexor mass to secure the nerve at a subcutaneous anterior location (Figs. 6–7). This flap is sutured loosely to allow for unobstructed gliding of lateralized nerve after transposition. Finally, the nerve is checked for smooth gliding and no other sites of compression at its new location with full range of motion of



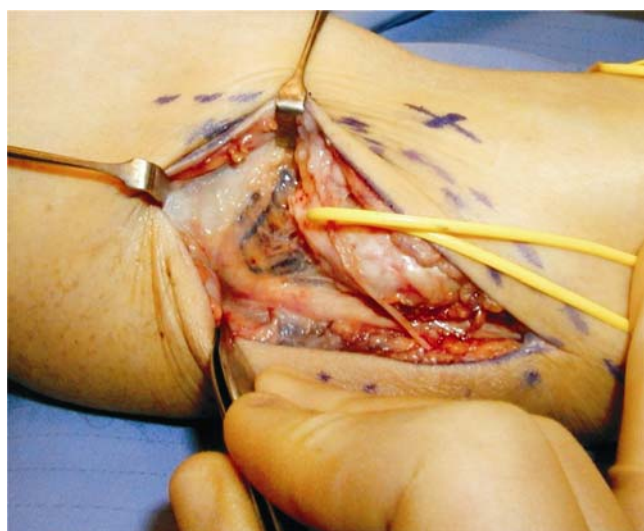
**Fig. 2** After incision, branches of the MACN are identified and tagged with a rubber loop.



**Fig. 3** A complete in situ release of the ulnar nerve has been performed extending distally into the flexor carpi ulnaris muscle.



**Fig. 4** The medial intermuscular septum is retracted with the forceps to identify the IUCA as it enters the ulnar nerve 2.5 cm proximal to the medial epicondyle.



**Fig. 5** The IUCA is visualized clearly and preserved after careful excision of the medial intermuscular septum.



the elbow. Patient is then splinted and started on early range of motion of the elbow to prevent elbow stiffness and scar formation.

### Complications and failure

Posterior branch of the medial antebrachial cutaneous nerve is a common complication especially during endoscopic procedures. This injury can present as painful scar or hyperesthesia in the medial forearm. Persistent symptoms of cubital tunnel syndrome are often present due to incomplete release of the ulnar nerve or postoperative scarring [6]. Early motion of the elbow can help prevent adhesions, which are more likely to occur with sub-

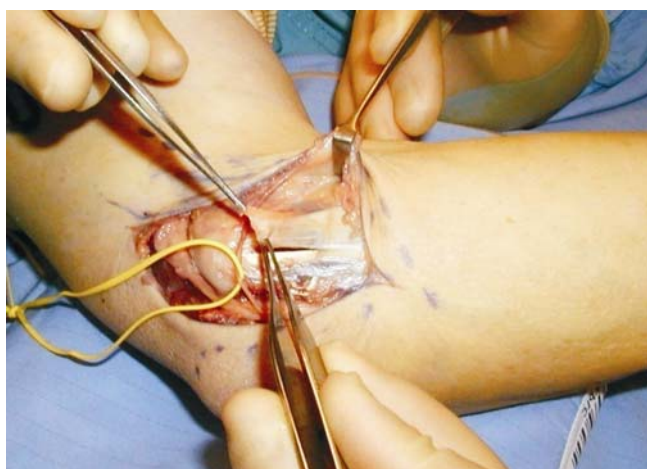
muscular transpositions because of muscle detachment. Subluxation of ulnar nerve can occur with simple decompression or medial epicondylectomy, leading to persistent symptoms. Thus, after simple decompression or medial epicondylectomy, the surgeon should check for ulnar nerve subluxation and convert the procedure to transposition to secure the ulnar nerve if subluxation is noted. Medial collateral ligament can also be injured with more extensive submuscular decompression or medial epicondylectomy.

### Summary

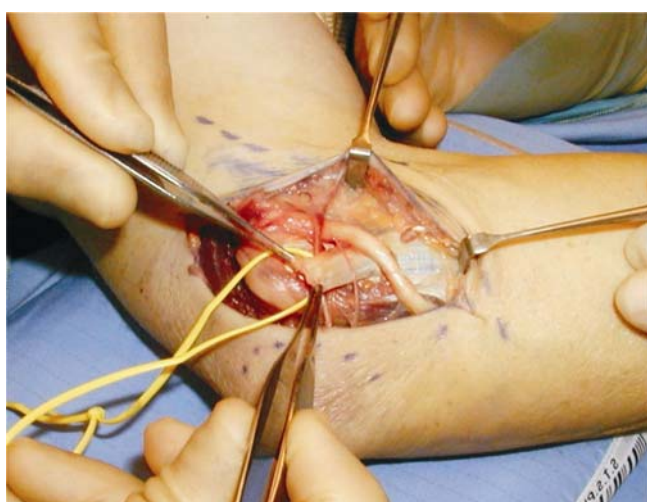
Cubital tunnel syndrome is common but not fully understood. Multiple sites of compression of the ulnar nerve at the elbow make it difficult to treat cases that are resistant to the mainstay therapy. It is thus crucial to correlate both the history and physical exam to provide the best type of procedure for each patient limiting the risk of complications. Fortunately, most cases of ulnar nerve compression improve with nonsurgical treatment and large majority get better with surgical decompression. The fact that most people get better with and without surgical treatment is likely the reason that multiple studies have failed to show improved results with different types of decompressions for mild cubital tunnel syndrome. Transposition surgeries have been shown to yield better results with more severe cases and patients who failed previous simple releases, likely secondary to release of other compression sites that were missed by the initial surgery. For mild to moderate cases of cubital tunnel simple decompression might be the procedure of choice due to its lower complexity and lack of evidence of worse results compared to other decompressive procedures. Knowing more about pathology of the cubital tunnel syndrome such as compression versus traction injury and having better modalities for evaluation of the nerve should help us to better tailor treatment for the patients in the future.

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**Fig. 6** A distally based fascial flap is raised off the common flexor origin and will be used to retain the transposed ulnar nerve in an anterior subcutaneous pocket.



**Fig. 7** The ulnar nerve has been transposed anteriorly after mobilizing the branch to the flexor carpi ulnaris to prevent tethering of the nerve. The mesoneurium with enclosed vessels has been preserved.

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