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COMPRESSIVE NEUROPATHIES IN THE UPPER EXTREMITY (E SHIN, SECTION EDITOR)

Cubital Tunnel Syndrome: Current Concepts

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Abstract

Purpose of Review Compressive neuropathy of the ulnar nerve across the elbow is a common diagnosis encountered frequently within a hand and upper extremity clinical practice. Appropriate and timely evaluation, diagnosis, objective testing, and evidence-based decisions regarding treatment options are paramount in the optimal care of the patient with this pathology. An understanding of current literature is critical in determining and understanding best practices.

Recent Findings A thorough review of the recent literature regarding physical examination, diagnostic testing, and nonoperative versus operative results was performed. Regarding physical examination, the glenohumeral internal rotation test and scratch collapse test are more effective and sensitive than traditional maneuvers such as Tinel's testing and the elbow flexion test. Electrodiagnostic testing, magnetic resonance imaging, and ultrasound evaluation have all been shown to be effective in diagnosing cubital tunnel syndrome. However, no single test has proven itself to be superior. Nonoperative treatment can be successful for mild cases of cubital tunnel syndrome. Surgical release techniques comparing open with endoscopic release are equivocal, and in situ release versus transposition techniques show that transposition should not be performed routinely.

Summary The diagnosis and treatment of cubital tunnel syndrome do not have a well-defined algorithm based on current literature. The treating physician must therefore utilize the available information to determine a diagnostic and treatment plan individualized to the patient. More rigorous scientific studies are needed to determine the most effective surgical approaches for cubital tunnel syndrome.

Keywords Cubital tunnel syndrome · Ulnar neuropathy · Ulnar nerve compression · Ulnar nerve transposition · Cubital tunnel release · In situ decompression

Introduction

Treatment of compressive neuropathy of the ulnar nerve isolated to the elbow, commonly referred to as cubital tunnel syndrome, involves a complex decision-making process and consideration of multifactorial elements of patient symptomatic presentation, diagnostic results, and patient-specific findings on physical examination. Unfortunately, current literature review does not fully support a single, reliable algorithm that can be utilized across a broad patient population. Broad-based literature evaluations have not elucidated definitive treatment guidelines [1]. Therefore, it is imperative that the surgeon be well versed in up-to-date, evidence-based studies to help guide the diagnostic and treatment plan.

A thorough assessment of patient history, performance of clinical examination techniques, and electrodiagnostic testing are critical in determining the most beneficial treatment decision. Nonoperative treatment methods must be considered carefully and based on individual patient characteristics. Application of the chosen surgical technique should be contingent on expected outcomes guided by current literature. The goal of this paper is to present an objective summary of the current literature and determine the best practices for ulnar neuropathy based on this information.

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Patient Presentation

The typical patient presentation for cubital tunnel syndrome in the early phase of the pathologic process involves numbness, tingling, and paresthesias of the ring/small fingers and the dorsoulnar hand. These symptoms are commonly accentuated at night time and can be brought on by certain positional activities such as using a cell phone or maintaining a prolonged flexed elbow posture during work or recreational activities. Patients that delay the initial presentation to a physician and develop progressive and chronic disease may present with hand weakness and occasionally complain of difficulty performing fine motor skills, such as clipping fingernails [2].

Physical Examination

Physical examination of the patient presenting with symptoms concerning for cubital tunnel syndrome is initiated with observation of the intrinsic musculature of the hand and posture of the ulnar two digits. In chronic and severe cases, atrophy of the first dorsal interosseous muscle belly and clawing may be readily observed. Motor function of the intrinsic muscles of the hand should also be tested and graded. Sensation should be tested with light touch, in addition to an examination of two-point discrimination and Semmes-Weinstein monofilament thresholds.

The ulnar nerve should be evaluated with palpation of the nerve itself just posterior to the medial epicondyle. Tinel's testing in this location may be positive, creating a radiating sensation along the ulnar border of the forearm into the hand. The nerve should be tested for subluxation or hypermobility on elbow motion. In cases of severe and chronic compressive neuropathy of the ulnar nerve, hypothenar atrophy may be present, in addition to positive Froment and/or Wartenburg signs. Provocative physical examination tests should be considered as well. The glenohumeral internal rotation test has been shown to take less than 5 seconds to demonstrate positive findings and is 87% sensitive and 98% specific [3]. The scratch collapse test has also been described as a useful examination maneuver and is more sensitive than the Tinel's test [4].

Diagnostic Testing

As ulnar nerve compression becomes more severe or chronic in cubital tunnel syndrome, diagnostic tests will show a progression from dynamic ischemia to demyelination and finally axonal loss. Interpretation of diagnostic tests such as electromyography (EMG), ultrasound, and magnetic resonance imaging (MRI) will aid in diagnosing the functionality of nerve fibers and the progression of ulnar neuropathy at the cubital tunnel. These tests should be used to further confirm the suspected diagnosis as determined from history and physical examination.

Electrodiagnostic Examination

Electromyography (EMG) is a technique used to evaluate electrical output of skeletal muscles. EMG testing may show negative results when the patient is in the dynamic ischemia stage of disease since compression of the ulnar nerve and the resultant decrease of ulnar nerve perfusion has not yet slowed conduction velocity in the fastest-conducting nerve fibers [5•]. However, as cubital tunnel syndrome progresses to demyelination, EMG testing will display abnormal spontaneous activity and reduced recruitment of motor units [6].

More severe cases of cubital tunnel syndrome or prolonged ulnar compression will result in axonal loss [5•]. Electromyography results at this stage will show abnormal activity during the insertional phase (indicating muscle denervation), while motor axon loss gives rise to fibrillations during resting phase [5•]. The presence of motor unit action potentials during the recruitment phase indicates attempted re-innervation by either collateral sprouting or axonal re-innervation.

Additional diagnostic findings on nerve conduction are helpful in confirming the site, and determining the severity, of ulnar nerve compression. According to the summary statement issued by the American Association of Neuromuscular and Electrodiagnostic Medicine, the greatest strength of evidence for diagnosis of cubital tunnel syndrome is conduction velocity less than 50 m/s across the elbow or when conduction velocity from the *above-elbow* to *below-elbow* segment is slowed greater than 10 m/s compared with the *below-elbow* to *wrist* segment [7].

Ultrasound

Ultrasound employs sound waves for imaging that allow for the evaluation of nerve size. High definition ultrasound has become increasingly effective and more specific in diagnosing cubital tunnel syndrome in recent years. In a study of patients experiencing cubital tunnel syndrome but displaying normal electrodiagnostic results, ultrasound demonstrated an enlarged cross-sectional area (CSA) of the ulnar nerve near the elbow [8].

Advantages of ultrasound include increased comfort for patients, minimal time requirements, and determination of the enlargement site and compression location of the nerve as is often seen in cubital tunnel syndrome [9]. However, unlike electrodiagnostic testing, ultrasound studies cannot provide functional information to evaluate nerve conduction. In a study that compared the CSA of the ulnar nerve between patients with cubital tunnel syndrome and controls, ultrasound results showed that the average CSA of the ulnar nerve was larger in the symptomatic group versus the asymptomatic group (0.19 cm^2 in the cubital tunnel group vs 0.065 cm^2 in the control group), indicating a significant statistical difference in ulnar nerve size [10].

A similar study by Volpe et al. demonstrated that the maximum CSA, defined by enlargement of the ulnar nerve near the elbow, was 14.6 mm^2 in patients with confirmed ulnar neuropathy at the elbow versus 7.1 mm^2 in control patients [11]. Patients experiencing axonal loss demonstrated a mean CSA of 18.3 mm^2, whereas patients with less severe symptoms such as demyelination demonstrated a CSA of 11.1 mm^2 [11].

Magnetic Resonance Imaging

One additional imaging technique that has been undergoing study for evaluation of cubital tunnel syndrome is MRI. For this particular diagnosis, MRI is helpful in evaluating soft tissue details and characterizing the extent and location of the lesion [11]. One study compared MRI with EMG testing and found that MRI was 25% more sensitive in diagnosing cubital tunnel syndrome than EMGs [12]. The most frequent MRI findings included a combination of high signal intensity and nerve enlargement (63%), followed by nerve compression (27%), isolated high signal intensity (23%), and isolated nerve enlargement (2%) [12]. However, this study found that MRI results did not differ based on the severity of the disease and therefore may be considered useful in confirming the diagnosis, but not in determining prognosis for recovery.

In a study evaluating the role of magnetic resonance neurography, MRI demonstrated an increased nerve T2 signal as measured by a T2-weighted contrast-to-noise ratio in subjects with cubital tunnel syndrome compared with controls, with a sensitivity and specificity of 83% and 85%, respectively [13]. They were able to distinguish mild cases from severe cases by way of nerve caliber measurements [13].

Nonoperative Treatment

Patients diagnosed with mild cubital tunnel syndrome may be able to avoid surgical intervention. Mild cases of cubital tunnel syndrome are defined by a motor nerve conduction velocity > 40 m/s across the elbow [5•]. According to a study from the Washington University School of Medicine, 58.7% of their 53,401 cubital tunnel patients were successfully treated with nonoperative approaches [14•]. Similarly, Padua et al. found that approximately half of their cubital tunnel patients improved with conservative care [15]. Symptomatic relief was correlated to an increase in nerve conduction velocities across the elbow.

Various nonoperative treatment options exist for patients. Positional manipulations include soft protective padding over the medial aspect of the elbow [5•]. Eliminating elbow flexion at night, such as through the use of a soft towel wrapped around the elbow or a cubital tunnel splint, for a 3–6 month duration can improve mild cubital tunnel symptoms [16]. Over-the-counter pain relievers that reduce inflammation can prevent symptoms from worsening. Bracing or splinting, for at least a week, with a neutral wrist splint decreases stretch on the ulnar nerve in Guyon's canal, limiting further compression. Hand therapy can be beneficial to stretch and strengthen the hand, arm, and elbow. Cubital tunnel symptoms are reduced by eliminating or modifying strenuous physical activity that requires prolonged elbow flexion. However, when nonoperative treatment is unsuccessful, patients exhibiting decreased amplitudes of nerve conduction are recommended surgical treatment [5•].

Surgical Treatment Options

The decision-making process for surgical management is complex and based on multiple factors. These factors include severity of disease, physical examination findings, patient history, and degree of success or failure with nonoperative, conservative care. A broadly accepted gold standard for surgical management does not exist. In general, the goal of surgery centers around the concept of relieving compressive pressure on the nerve. The anatomy of compressive sites of the ulnar nerve across the elbow has been well described [2]. In general terms, the surgical technique decision tree includes two main branches: release of the ulnar nerve with preservation of normal anatomic nerve position or release of the nerve with mobilization and creation of alternate anatomy.

Open or Endoscopic Cubital Tunnel Release In Situ

Open release of the ulnar nerve in situ involves release of all compressive sites along the nerve while maintaining the normal course of the nerve posterior to the medial epicondyle. The endoscopic technique, similarly, releases the same structures albeit through a smaller incision. Current available research has failed to definitively determine a superior technique between these two methods. There are conflicting reports in the literature. For instance, a systematic review identified 82.7% *good* or *excellent* success rates with open techniques compared with 92.0% for endoscopic techniques. Patients treated with the endoscopic technique experienced fewer complications [17••].

More recently, in a comparative meta-analysis between these techniques, it was determined that there are no significant differences in primary outcomes. However, this same study did identify a significant difference favoring endoscopic surgery for decreased scar tenderness and elbow pain [18••]. Pooled results, however, showed no difference in complication rates [18••].

In another meta-analysis, which compared simple decompression with subcutaneous and submuscular transposition techniques, the study authors found no statistically significant differences between simple decompression and transposition, suggesting that the ulnar nerve does not require routine transposition [19].

Subcutaneous Transposition

Altering the course of the ulnar nerve from posterior to anterior to the elbow's axis of rotation may help by decreasing tension on the nerve. Multiple techniques for transposition exist. Subcutaneous transposition creates a subcutaneous pathway for the ulnar nerve anterior to the medial epicondyle.

The evidence-based benefit of performing a transposition for cubital tunnel syndrome remains controversial. A recent meta-analysis comparing in situ decompression with anterior transposition did not identify any significant differences in outcomes or rate of revision surgery, although significantly more complications were reported with transposition surgery compared with in situ decompression [20••].

In a long-term retrospective study, revision surgery rates for patients undergoing subcutaneous transposition was 12% versus 25% for in situ decompression, with 78% of those revisions being performed within 3 years of the index procedure [21••]. In contrast, however, a retrospective review of 216 patients undergoing in situ decompression demonstrated only a 3.2% recurrence rate [22••]. Subcutaneous transposition of the nerve should be considered in cases of ulnar nerve instability, wherein the ulnar nerve subluxes or dislocates out of its groove during passive elbow motion once the nerve is completely released.

Submuscular Transposition

Submuscular transposition of the ulnar nerve involves elevation of the flexor/pronator origin from the medial epicondyle and transposition of the nerve deep to the muscle mass. This provides coverage of the nerve and is typically considered in thinner patients or in revision cases.

Current literature and comparative studies between techniques to determine the utility of submuscular transposition are relatively limited in number and quality. A meta-analysis comparing subcutaneous versus submuscular techniques failed to identify any appreciable differences, although the authors concluded that the many studies lacked methodological quality [23]. The decision, therefore, to perform a submuscular transposition seems more based on surgeon preference than current literature, and more research needs to be completed before evidenced-based recommendations on this surgical technique can be made.

In Situ Release with Medial Epicondylectomy

The addition of a medial epicondylectomy in surgical treatment of cubital tunnel syndrome involves removal of the medial epicondyle prominence subperiosteally to relieve pressure on the nerve. Research on this technique is limited. In a study evaluating clinical features that affect patient outcomes, the authors found that 77% of patients were ultimately satisfied with the procedure and would do it again [24]. A systematic review comparing medial epicondylectomy and transposition procedures identified *good* or *excellent* outcomes in 83% of epicondylectomy patients but also determined there were no significant differences between techniques [25•]. The authors concluded that the existing literature evaluating medial epicondylectomy is of limited methodological quality and does not allow firm conclusions to be determined based on current studies [25•].

Conclusion

Cubital tunnel syndrome is a commonly seen form of compressive neuropathy in the general population. Diligent assessment of patient history and physical examination factors, in addition to evaluation of diagnostic testing, is critical in determining appropriate treatments. No single test is completely definitive for confirming the diagnosis. In some cases, nonoperative treatment of cubital syndrome can be successful. In refractory cases, surgical intervention may be necessary.

Unfortunately, the available literature does not provide a reliable algorithm for best practices in treating this common condition. Most studies are of inconsistent methodological quality, so conclusions drawn from their comparison must be considered carefully. When choosing a surgical approach, it seems that the current literature supports in situ nerve decompression alone in lieu of transposition techniques, albeit with a slightly increased risk of disease recurrence.

Compliance with Ethical Standards

Conflict of Interest Michael N. Nakashian declares that he has no conflict of interest. Danielle Ireland declares that she has no conflict of interest. Patrick Kane declares that he has no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

References

Papers of particular interest, published recently, have been highlighted as:
- • Of importance
- •• Of major importance

1. Caliandro P, La Torre G, Padua R, Giannini F, Padua L. Treatment for ulnar neuropathy at the elbow. Cochrane Database Syst Rev. 2012:CD006839.
2. Staples JR, Calfee R. Cubital tunnel syndrome: current concepts. J Am Acad Orthop Surg. 2017;25:e215–e24.

3. Ochi K, Horiuchi Y, Tanabe A, Waseda M, Kaneko Y, Koyanagi T. Shoulder internal rotation elbow flexion test for diagnosing cubital tunnel syndrome. J Shoulder Elb Surg. 2012;21:777–81.
4. Cheng CJ, Mackinnon-Patterson B, Beck JL, Mackinnon SE. Scratch collapse test for evaluation of carpal and cubital tunnel syndrome. J Hand Surg Am. 2008;33:1518–24.
5.• Dy CJ, Mackinnon SE. Ulnar neuropathy: evaluation and management. Curr Rev Musculoskelet Med. 2016;9:178–84 **This paper reviews the evaluation of patients with cubital tunnel syndrome and discusses physician examination and diagnostic techniques. It also reviews surgical treatment decision processes.**
6. Chung T, Prasad K, Lloyd TE. Peripheral neuropathy: clinical and electrophysiological considerations. Neuroimaging Clin N Am. 2014;24:49–65.
7. American Association of Electrodiagnostic M, Campbell WW. Guidelines in electrodiagnostic medicine. Practice parameter for electrodiagnostic studies in ulnar neuropathy at the elbow. Muscle Nerve Suppl. 1999;8:S171–205.
8. Yoon JS, Walker FO, Cartwright MS. Ulnar neuropathy with normal electrodiagnosis and abnormal nerve ultrasound. Arch Phys Med Rehabil. 2010;91:318–20.
9. Landau ME, Campbell WW. Clinical features and electrodiagnosis of ulnar neuropathies. Phys Med Rehabil Clin N Am. 2013;24:49–66.
10. Wiesler ER, Chloros GD, Cartwright MS, Shin HW, Walker FO. Ultrasound in the diagnosis of ulnar neuropathy at the cubital tunnel. J Hand Surg Am. 2006;31:1088–93.
11. Volpe A, Rossato G, Bottanelli M, Marchetta A, Caramaschi P, Bambara LM, et al. Ultrasound evaluation of ulnar neuropathy at the elbow: correlation with electrophysiological studies. Rheumatology (Oxford). 2009;48:1098–101.
12. Vucic S, Cordato DJ, Yiannikas C, Schwartz RS, Shnier RC. Utility of magnetic resonance imaging in diagnosing ulnar neuropathy at the elbow. Clin Neurophysiol. 2006;117:590–5.
13. Baumer P, Dombert T, Staub F, et al. Ulnar neuropathy at the elbow: MR neurography–nerve T2 signal increase and caliber. Radiology. 2011;260:199–206.
14.• Osei DA, Groves AP, Bommarito K, Ray WZ. Cubital tunnel syndrome: incidence and demographics in a national administrative database. Neurosurgery. 2017;80:417–20 **This large, database-driven study examined patients over a 6-year period, identifying the incidence of cubital tunnel syndrome across the US population and any demographic associations.**
15. Padua L, Aprile I, Caliandro P, Foschini M, Mazza S, Tonali P. Natural history of ulnar entrapment at elbow. Clin Neurophysiol. 2002;113:1980–4.
16. Shah CM, Calfee RP, Gelberman RH, Goldfarb CA. Outcomes of rigid night splinting and activity modification in the treatment of cubital tunnel syndrome. J Hand Surg Am. 2013;38:1125–30 e1.
17.•• Toirac A, Giugale JM, Fowler JR. Open versus endoscopic cubital tunnel in situ decompression: a systematic review of outcomes and complications. Hand (N Y). 2017;12:229–35 **This study is a systematic review evaluating outcomes and complications of open versus endoscopic cubital tunnel release, suggesting the superiority of endoscopic techniques when complication rates and patient satisfaction were taken into account.**
18.•• Byvaltsev VA, Stepanov IA, Kerimbayev TT. A systematic review and meta-analysis comparing open versus endoscopic in situ decompression for the treatment of cubital tunnel syndrome. Acta Neurol Belg 2019. **This review systematically compared open versus endoscopic cubital tunnel surgeries and found that patients who underwent an endoscopic approach demonstrated greater improvement in scar tenderness but equivalent clinical postoperative recovery and no difference in adverse events.**
19. Nabhan A, Ahlhelm F, Kelm J, Reith W, Schwerdtfeger K, Steudel WI. Simple decompression or subcutaneous anterior transposition of the ulnar nerve for cubital tunnel syndrome. J Hand Surg Br. 2005;30:521–4.
20.•• Said J, Van Nest D, Foltz C, Ilyas AM. Ulnar nerve in situ decompression versus transposition for idiopathic cubital tunnel syndrome: an updated meta-analysis. J Hand Microsurg. 2019;11:18–27 **By performing a meta-analysis of in situ decompression versus ulnar nerve transposition, the authors found no statistically significant differences in outcomes or revision rates. There were significantly more complications with ulnar nerve transposition.**
21.•• Hutchinson DT, Sullivan R, Sinclair MK. Long-term reoperation rate for cubital tunnel syndrome: subcutaneous transposition versus in situ decompression. Hand (N Y) 2019:1558944719873153. **The authors found a statistically higher reoperation rate for in situ decompression compared to subcutaneous transposition with a minimum five-year follow-up period.**
22.•• Gaspar MP, Kane PM, Putthiwara D, Jacoby SM, Osterman AL. Predicting revision following in situ ulnar nerve decompression for patients with idiopathic cubital tunnel syndrome. J Hand Surg Am. 2016;41:427–35 **From a retrospective review of 216 cases, this study found that the risk of revision surgery following in situ release was 3.2%. The only significant risk factor was age younger than 50.**
23. Liu CH, Chen CX, Xu J, Wang HL, Ke XB, Zhuang ZY, et al. Anterior subcutaneous versus submuscular transposition of the ulnar nerve for cubital tunnel syndrome: a systematic review and meta-analysis. PLoS One. 2015;10:e0130843.
24. Roh YH, Kim S, Gong HS, Baek GH. Clinical features affecting the patient-based outcome after minimal medial epicondylectomy for cubital tunnel syndrome. J Plast Reconstr Aesthet Surg. 2018;71:1446–52.
25.• O'Grady EE, Vanat Q, Power DM, Tan S. A systematic review of medial epicondylectomy as a surgical treatment for cubital tunnel syndrome. J Hand Surg Eur. 2017;42:941–5 **This study evaluated 21 case series reporting on 886 medial epicondylectomies. The results were equivocal in supporting the use of medial epicondylectomy as a standard surgical approach. The study authors concluded that the existing literature is of limited methodological quality and does not allow for firm conclusions to be drawn regarding the efficacy of medial epicondylectomy compared with other techniques.**