Anadolu Psikiyatri Dergisi || ISSN: 1302-6631 || Volume 26; Number 5
https://doi.org/10.5281/zenodo.17075852

Cubital Tunnel Syndrome – Literature Review and Analysis of Contemporary Treatment Methods

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Abstract— Cubital tunnel syndrome (CuTS) is the second most common compressive neuropathy of a peripheral nerve. The aim of this study is to review the current literature on the pathophysiology, diagnosis, and treatment methods of cubital tunnel syndrome, with particular emphasis on surgical outcomes and conservative therapy. The results of the latest meta-analyses and randomized controlled trials are also discussed.

Keywords— cubital tunnel syndrome, ulnar nerve entrapment, ulnar nerve decompression, neuropathy

INTRODUCTION

Cubital tunnel syndrome (CuTS) is a compressive neuropathy resulting from chronic irritation of the ulnar nerve within the groove on the posteromedial aspect of the elbow joint. It can lead to significant impairment of hand function, particularly in terms of sensation and fine finger movements [3, 7]. Epidemiologically, it is the second most common cause of compressive neuropathy after carpal tunnel syndrome [1, 2, 32]. This condition often affects physically active individuals and athletes, in whom excessive elbow flexion or repetitive microtrauma leads to ulnar nerve overload [14].

MATERIALS AND METHODS

Data collection and analysis

We conducted a narrative review of studies published between 1969 and 2025, focusing on the diagnosis, treatment, and surgical management of cubital tunnel syndrome (ulnar neuropathy at the elbow). The primary databases searched were PubMed and Google Scholar. Search terms included combinations such as "cubital tunnel syndrome", "ulnar nerve compression AND elbow", "surgical treatment AND ulnar neuropathy", "conservative management AND cubital tunnel", and "ultrasound diagnosis AND ulnar neuropathy". We supplemented the review with relevant anatomical and neurophysiological studies. Two independent reviewers screened titles and abstracts (last search in August 2025), with disagreements resolved by consensus.

Inclusion and exclusion criteria

Eligible studies included full-text articles available in English or Polish, published between 1969 and 2025. Study designs encompassed randomized controlled trials, prospective and retrospective cohort studies, meta-analyses, systematic reviews, and population-based registry analyses. Case series and clinical reviews with ≥30 patients were also considered. Studies needed to involve adult patients diagnosed with cubital tunnel syndrome or ulnar neuropathy at the elbow. Outcomes of interest included clinical efficacy of treatment modalities, electrophysiological and imaging diagnostic accuracy, surgical complications, and patient-reported functional outcomes.

Excluded were case reports, conference abstracts, editorials, commentaries, animal or preclinical studies, purely biomechanical or economic analyses without clinical data, and studies focused on pediatric populations or neuropathies unrelated to the ulnar nerve at the elbow.

AI assistance

In preparing this work, we used ChatGPT for the purpose of translation and editing only. We then reviewed and edited the manuscript for its intellectual content and academic rigour.

RESULTS

Course of the Nerve and Innervation Territory

The ulnar nerve (nervus ulnaris) is one of the main branches of the brachial plexus, arising from the C8 and T1 nerve roots. After leaving the axilla, it runs along the medial side of the arm, accompanying the brachial artery, and heads toward the elbow joint. At the mid-arm level, the ulnar nerve passes through the medial intermuscular septum into the posterior compartment, located between the biceps brachii and the brachialis muscles. It then approaches the medial epicondyle of the humerus, where it courses superficially within the cubital tunnel (sulcus nervi ulnaris), bounded laterally by the humerus and medially by the arcade of Struthers, formed by the aponeurotic band of the flexor carpi ulnaris muscle. The ulnar nerve then enters the forearm by piercing the flexor carpi ulnaris muscle on its medial aspect. In its further course, it runs along the medial border of the flexor digitorum profundus muscle and proceeds toward the wrist. At the wrist, the nerve passes through Guyon's canal, where it divides into a superficial and a deep branch [25].

TABLE 1. THE MOTOR INNERVATION AREA OF THE ULNAR NERVE. [25]

Ulnar nerve branch	Motor innervation area
Deep branch	Opponens digiti minimi muscle, Abductor digiti minimi muscle, Flexor digiti minimi brevis muscle, Interosseous muscles, Lumbrical muscles III and IV, Adductor pollicis muscle, Deep head of flexor pollicis brevis muscle.
Superficial branch	Palmaris brevis muscle

TABLE 2. THE SENSORY INNERVATION AREA OF THE SUPERFICIAL BRANCH OF THE ULNAR NERVE [25].

The side of the hand	Sensory innervation area
Palmar surface	Finger V (little finger), medial part of finger IV (ring finger).
Dorsal surface	Predominantly small finger V (little finger), finger IV (ring finger), medial part of finger III (middle finger) (proximal phalanx and part of the middle phalanx).

Etiology and Pathophysiology

CuTS may be caused by chronic compression of the nerve, its displacement, or structural changes within the cubital tunnel. The pathophysiology includes axonal ischemia, conduction abnormalities, and demyelination [3, 4, 17]. Compression increases intraneural pressure, leading to microcirculatory disturbances and nerve dysfunction [13].

The most common compression sites include: Arcade of Struthers, Osborne's ligament (ligamentum epitrochleo-anconeum), Medial intermuscular septum of the arm, Medial head of the triceps brachii muscle, Medial epicondyle of the humerus and cubital tunnel, Osteophytes and bony deformities after fractures, Synovial cysts, ganglia, and benign tumors (e.g., lipomas), Post-traumatic scar tissue, Displacement (subluxation or dislocation) of the ulnar nerve during elbow flexion [12, 18].

Risk Factors

Identified risk factors for cubital tunnel syndrome include repetitive elbow flexion and microtrauma [14, 23], physically demanding work involving the elbow [14], anatomical variations of the ulnar nerve groove [12], obesity and metabolic conditions such as diabetes [24], as well as previous elbow injuries or bony deformities [18].

Diagnosis

Diagnosis is based on clinical symptoms such as sensory loss in the fourth and fifth digits and a positive Tinel's sign. Physical examination often reveals weakness of the interosseous muscles and adductor pollicis [3, 19]. Neurophysiological studies—electromyography (EMG) and nerve conduction velocity (NCV)—confirm the diagnosis [5, 6, 19]. Imaging (ultrasound, MRI) can help detect compression sites and anatomical variants [5, 17].

Electromyography (EMG) combined with nerve conduction velocity (NCV) studies are considered the gold standard in diagnosing ulnar nerve entrapment. Typical findings in CuTS include: Conduction velocity <50 m/s across the elbow (10 cm above and 10 cm below the medial epicondyle) [26, 27], Decreased CMAP amplitude, Presence of denervation potentials (fibrillations, positive sharp waves) in ulnar-innervated hand muscles, Conduction velocity difference >10 m/s between the elbow segment and another ulnar segment or between the affected and healthy side [27].

High-resolution ultrasound (US) allows real-time morphological evaluation of the ulnar nerve. It is non-invasive, dynamic, and widely available. Common findings include: cross-sectional area (CSA) around 10 mm^2 at the cubital tunnel (with cut-off values ranging from 9 mm^2 to 11 mm^2 in different studies) [28], loss of fascicular pattern and hypoechogenicity, visualization of compressive structures (e.g., osteophytes, cysts), subluxation or snapping of the nerve during elbow motion US is particularly useful for differentiating mechanical causes of compression and for preoperative planning [28, 29].

Magnetic resonance imaging (MRI) is not a first-line test but is valuable in unclear cases or before planned surgery. It can assess: Nerve signal changes (edema, fiber degeneration), Secondary muscle changes (atrophy, denervation-related T2 hyperintensity), Pathologies of adjacent structures (e.g., ganglion cysts, nerve tumors, fibrosis) MRI is especially useful in post-traumatic, recurrent cases or for differentiating from other brachial plexus neuropathies [30].

Clinical application and comparison of methods: EMG remains the primary tool for confirming neuropathy and assessing severity [19, 26, 27], while US enables morphological and dynamic evaluation of the nerve and identification of mechanical causes of compression [5, 17, 29]. MRI is a complementary modality, particularly for detecting deep structural lesions or in patients with nonspecific symptoms [30].

Conservative Treatment

Avoidance of prolonged elbow flexion, ergonomic modifications, and the use of nighttime splints are well supported by randomized controlled trials and systematic reviews [14, 15, 22]. Supplementation with B vitamins (B1, B6, B12) has been proposed in neuropathic pain syndromes in general [20], but evidence for its specific efficacy in cubital tunnel syndrome remains limited.

Activity Modification and Ergonomics

The cornerstone of conservative treatment is patient education and elimination of factors exacerbating symptoms, such as: Prolonged elbow flexion (>90°) e.g., holding a phone, sleeping, direct pressure on the cubital tunnel (e.g., leaning on elbows, resting on desk edges).

Repetitive elbow flexion and extension movements Avoidance of these positions and changes in workplace ergonomics are recommended. Some studies report significant symptom improvement solely after behavioral modifications [3].

Nighttime Immobilization

The use of elbow splints or night orthoses maintaining the elbow in extension (or slight flexion of 30–45°) is widely recommended. This method has demonstrated clinical improvement in randomized controlled trials after approximately 3–6 months of treatment, although the exact success rates vary between studies [33, 34, 35].

Physiotherapy and Neural Mobilization

Modern approaches include manual therapy and neural mobilization techniques (nerve gliding techniques), which aim to: Improve the mobility of the nerve relative to surrounding tissues, reduce nerve adherence or scar formation, decrease tension and swelling around the nerve These techniques are considered safe and have shown beneficial effects in pilot studies and systematic reviews, although their effectiveness requires further high-quality research [36, 37].

Steroid Injections

Although glucocorticosteroid injections are routinely used in other tunnel syndromes (e.g., carpal tunnel syndrome), their use in cubital tunnel syndrome is controversial. Some authors suggest cautious application in inflammatory cases; however, the risk of nerve injury when injecting into the cubital tunnel limits their widespread use [38].

Indications for Ending Conservative Treatment

Lack of improvement after 3–6 months of conservative treatment, progressive atrophy of intrinsic hand muscles, increasing neuropathic pain, or signs of axonal damage in EMG are indications to consider surgical treatment [31,34].

Surgical Treatment

Surgical management of cubital tunnel syndrome includes two main approaches: simple ulnar nerve decompression and anterior transposition. In simple decompression, the tissues compressing the nerve—such as Osborne’s ligament or the arcuate ligament of the flexor carpi ulnaris—are divided without altering the nerve’s position. This technique is less invasive, allows for faster recovery, and carries a lower risk of complications [1, 4, 6, 32], but may be less effective in patients with ulnar nerve instability [12].

Anterior transposition relocates the ulnar nerve anteriorly to the elbow’s axis, thereby reducing both compression and traction forces. Variants include subcutaneous transposition (nerve placed under the skin, above the muscles) [2, 8], submuscular transposition (nerve placed beneath the forearm muscles) [6, 9], and intermuscular transposition (nerve placed between the forearm muscles) [8]. This method is effective for cases involving nerve instability [2, 12], but it is more invasive and associated with a higher risk of complications [10, 16].

Meta-analyses indicate that both approaches achieve comparable outcomes, with the optimal choice guided by individual patient factors [1, 4, 6].

Complications

The most common postoperative complications include recurrence of symptoms (10–15%) [10, 16], scar pain (5–10%) [10], rare neurovascular injuries (up to 3%) [11, 16], and occasional sensory disturbances or muscle weakness [11].

Prognosis

Prognosis depends largely on the severity of neuropathy and preoperative neurophysiological findings. Patients with mild to moderate EMG abnormalities tend to have better surgical outcomes than those with severe neuropathy and marked axonal loss [3, 5, 21]. Early diagnosis and timely intervention significantly improve the likelihood of full recovery [10, 21].

DISCUSSION

Cubital tunnel syndrome (CuTS) remains a diagnostic and therapeutic challenge. Despite advances in imaging and neurophysiology, there is no universally accepted management algorithm. EMG and NCV are the gold standards for confirming diagnosis and grading severity, while high-resolution ultrasound adds valuable dynamic and morphological assessment for surgical planning. MRI is reserved for complex or post-traumatic cases. Early diagnosis, especially in moderate EMG abnormalities, is associated with better surgical outcomes.

Conservative treatment—particularly activity modification, avoidance of prolonged elbow flexion, and nighttime splinting—is effective in mild CuTS. Physiotherapy methods, including nerve gliding, show promise but require stronger evidence. Steroid injections are controversial due to the risk of nerve injury and are rarely indicated.

Surgical options, primarily simple decompression and anterior transposition, yield comparable results in most studies, with technique selection guided by nerve stability and patient-specific factors. Recurrence rates of 10–15% and postoperative discomfort remain important considerations.

Current evidence is limited by heterogeneous populations, non-standardized outcomes, and a shortage of long-term randomized controlled trials. Future research should focus on large-scale comparative studies, integrating imaging, EMG, and patient-reported outcomes to inform standardized treatment guidelines.

CONCLUSIONS

Cubital tunnel syndrome (CuTS) is a significant clinical problem, and despite various treatment methods, the choice of the optimal surgical technique remains an individual decision. Both conservative and surgical treatments should be tailored to the severity of the neuropathy and the patient’s specific characteristics. Further research, especially long-term and randomized studies, is needed to determine the best therapeutic approach.

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