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## Case study

## Ulnar nerve entrapment at the elbow. A surgical series and a systematic review of the literature

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## ABSTRACT

Chronic compression of the ulnar nerve at the elbow is the second most common entrapment neuropathy. Various surgical options have been described. Timing of surgery is also debated. In this study we report the long-term results of a consecutive surgical series of anterior subcutaneous transpositions and review the pertinent literature. Sixty consecutive patients underwent anterior subcutaneous transposition at our Institution to treat ulnar nerve compression at the elbow. McGowan scale was used in the neurological exam before surgery. Bishop rating system was used to assess outcome. Seventy-eight % of patients scored good-excellent. None of the patients worsened. No complications and no recurrences were reported. Young age and good pre-operative neurological status (McGowan grade 1) were predictive of favorable outcome both at univariate and at multivariate analysis. No differences in outcome were observed between patients with intermediate (McGowan grade 2) and severe (McGowan grade 3) neuropathy. Thirty-four studies assessing outcome of different surgical techniques were reviewed. Anterior subcutaneous transposition had the lowest recurrence rate with an excellent effectiveness and safety profile. The favorable predictive role for outcome of preoperative neurological status was confirmed. The good long-term clinical results of the present series and the results of literature analysis confirm the value of anterior subcutaneous transposition of the ulnar nerve at the elbow. This technique has a particular effectiveness in most severe compressions, where outcomes are comparable with intermediate neuropathy cases. Moreover, our results suggest an aggressive attitude towards ulnar nerve compression at the elbow, particularly in younger patients.

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## 1. Introduction

Ulnar nerve (UN) neuropathy at the elbow (UNE) is the second most common entrapment neuropathy after the median nerve at the wrist. UNE affects 1% of the population of the United States; in Italy an incidence of 24.7 cases per 100,000 persons/year has been reported [1]. Etiology is multifactorial: male sex, work experience and anatomical features as valgus elbow can all be considered predisposing elements [2,3]. The elbow is the first critical point for ulnar nerve chronic compression (Fig. 1). Various studies

exist on the complex anatomic-functional unit of elbow as well as on the pathophysiology of UNE [4–7]. The pathological mechanisms are both static and dynamic; the latter act during the elbow flexion when not only the compressive forces increase in the cubital canal, but also the nerve suffers from stretching and friction due to subluxation. All such static and dynamic mechanisms affect first blood supply and Schwann cells of the nerve; a true anatomical damage of axons develops lately.

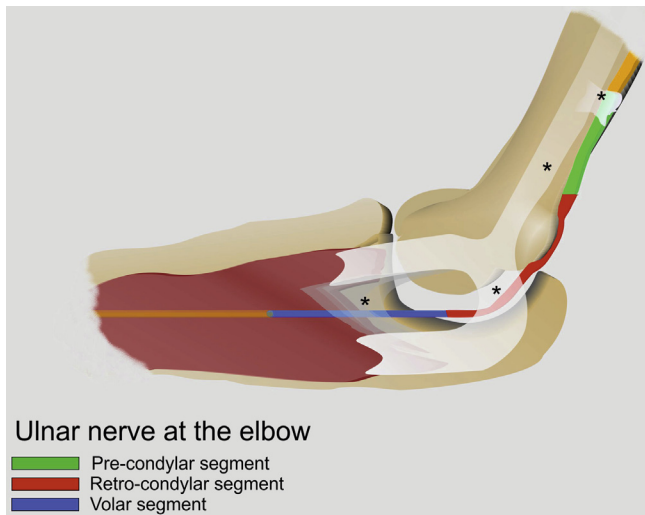
Symptoms of UNE include medial elbow pain and aching, paresthesia and numbness in the ulnar side of the forearm and hand, and weakness of the hand with loss of dexterity as well as gripping and lifting; in this case atrophy of the interossei muscles is evident (Fig. 2).

Indications for surgery are debated. In patients with motor deficits, muscle wasting and/or progressive sensory symptoms, surgical treatment is straightforward. However, patients with milder presentations of ulnar neuropathy may improve with conservative measures; typically they have intermittent sensory symptoms and

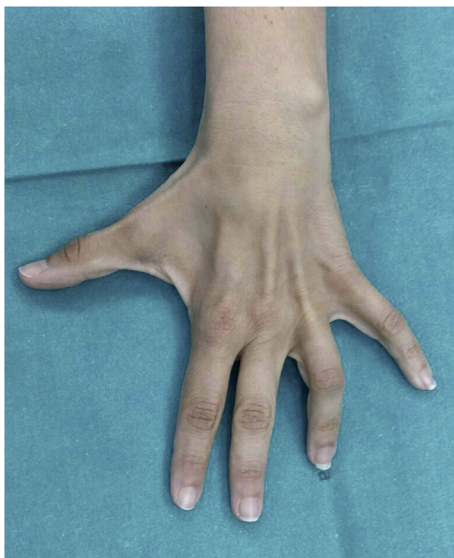
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**Fig. 1.** Schematic drawing of the right elbow region. The three crucial segments of the UN are represented with different colors. With \* are also easily recognized, from above to below respectively, the “arcade of Struthers”, the medial intermuscular septum, the myo-fascial retinaculum and the distal fascial-fibrous structures of the flexo-pronator muscles.



**Fig. 2.** Appearance of a McGowan grade 3. Left hand, dorsal view.

electrodiagnostic features of conduction slowing across the elbow. In these latter cases, surgical treatment is more controversial.

Similarly, the optimal surgical technique for the treatment of UNE remains controversial [8–10]. Simple opening of the cubital tunnel, medial epicondylectomy, anterior subcutaneous transposition (AST), anterior intra or submuscular transposition are the therapeutic surgical options. With the advent of minimally invasive procedures, endoscopic decompression of UNE has been also described [11].

The aims of this study were: 1) to analyze the long-term results of a homogeneous surgical series of UNE patients treated with AST between 2007 and 2012, in order to furnish predictive elements of outcome and to confirm the effectiveness and safety of our technique of choice; 2) to perform a systematic review of the literature in order to provide an up-to-date state-of-art of surgery for UNE and to analyze our results in such context.

## 2. Patients and methods

### 2.1. Ethical standards

All patients signed an informed consent form allowing for treatment, data collection and analysis, that was approved by the Institutional Ethics Committee of Catholic University School of Medicine, Roma, Italy.

The study was conducted in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

### 2.2. Patients cohort

Between January 2007 and December 2012, 60 consecutive patients were operated on at our Institution to treat UNE; their clinical and surgical charts were retrospectively reviewed. Out of 60 operated, 50 patients were reached at the follow-up. There were 19 female (38%) and 31 male (62%). Mean age was  $51.0 \pm 16.6$  years (mean  $\pm$  SD, range 18–79 years).

Before surgery, UNE was always confirmed by electrophysiological studies. Electromyography to detect diminished numbers of motor units action potentials, fibrillations and positive waves and polyphasic reinnervation potentials and to rule out secondary sites of entrapment. Nerve conduction study to assess conduction velocity (less than 50 m/s was considered pathological) across the elbow or loss of evoked sensory potentials. In order to be considered a candidate for surgery, both clinical disturbances (including purely subjective symptoms) and an electrophysiological evidence of UNE were needed. Preoperative clinical severity was graded using the McGowan scale: Grade 1, purely subjective symptoms and mild hypoesthesia; Grade 2, sensory loss and weakness of the intrinsic hand muscles and/or slight wasting; Grade 3, severe sensorimotor deficits (Fig. 2). Pre-operative assessment revealed 8 patients Grade 1 (16%), 27 patients Grade 2 (54%), and 15 patients Grade 3 (30%).

### 2.3. Surgery

In all patients AST was performed under local anesthesia (40 ml of 1% Mepivacain) as an outpatient procedure. Details on surgical technique have already been described (Fig. 3) [3].

### 2.4. Follow-up

Post-surgical clinical assessment and satisfaction were collected with 24–84 months follow-up (mean 54 months). Using the Bishop rating system (Fig. 4), patients were scored into three classes: class A) excellent (10–12 points); class B) good (7–9 points); and class C) poor (0–6 points).

### 2.5. Systematic literature review

Guidelines provided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [12] were followed (Supplementary Table S1). A search in the PubMed, Scopus and Web of Science databases was performed using, as key words, “ulnar nerve”, “cubital tunnel syndrome”, “simple decompression”, “anterior transposition”, “medial epicondylectomy”. The Cochrane database of systematic reviews was also searched. References from retrieved papers were checked for any additional studies. The full-text articles assessed for eligibility were 207. Studies involving pediatric patients (age <18 yrs), not describing an active surgical intervention, not reporting outcome evaluation, focusing exclusively on recurrent UNE and review studies were

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