Original Article

Review of Anterior Submuscular Transposition of Ulnar Nerve for Cubital Tunnel Syndrome

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ABSTRACT

Objective: In this study, we report the results of patients who underwent ulnar nerve submuscular anterior transposition surgery due to cubital tunnel syndrome. **Methods:** Data of 46 patients who underwent anterior submuscular transposition surgery due to cubital tunnel syndrome between January 2010 and December 2014 were retrospectively reviewed. Twenty-seven patients with preoperative and postoperative complete medical records available and who had completed at least 24 months follow-up were included in the study. **Results:** According to preoperative McGovan staging system, 1 patient was classified as stage 1, 8 were stage 2A, 3 were stage 2B, and 15 were stage 3. The mean follow-up time was 61.4 (35–88) months. The mean DASH score of the patients was calculated as 19 (0–81.81). Mayo elbow performance score was excellent in 13 patients, good in 7, fair in 6, and poor in 1. **Conclusion:** Anterior submuscular transposition of ulnar nerve had resolved symptoms 89% of our patients. The technique is a successful method with a low recurrence and complication rate.

KEYWORDS: *Cubital tunnel, entrapment, nerve compression, nerve transposition, ulnar nerve*

INTRODUCTION

Cubital tunnel syndrome, a symptomatic ulnar nerve dysfunction that occurs as a result of a combination of compressive, stretching, and frictional forces in the elbow area, is the second most common peripheral entrapment neuropathy.[1,2] Besides static primary disorders (cubitus valgus, osteoarthritis, etc.), secondary effects such as physiological tension or instability during elbow flexion can also lead to the appearance of chronic compression symptoms.[3-5] Surgical treatment options such as subcutaneous or submuscular transfer, in-situ decompression whether open or endoscopic or medial epicondylectomy, may be applied in patients with conservative treatment resistance.[6] However, up-to-date randomized trials evaluating symptom relief and surgical success have not been able to identify a surgical method that should be preferred.[7-9] While there is insufficient evidence of the superiority of each technique.[7-9] In selecting the surgical technique, experience of the surgeon is also important.[10]

In this study, we aim to retrospectively evaluate the results of patients who underwent ulnar nerve submuscular anterior transposition surgery due to cubital tunnel syndrome.

MATERIALS AND METHODS

Data of patients who underwent anterior submuscular transposition surgery due to cubital tunnel syndrome, between January 2010 and December 2014, in the Orthopedics and Traumatology Department of tertiary university hospital were retrospectively reviewed. The study was conducted in accordance with the Helsinki Declaration.[11]

Forty-six patients were detected. Patients with preoperative and postoperative complete medical records

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available and who had completed at least 24 months follow-up were included in the study.

During the diagnosis, history and physical examination findings were taken into consideration. Electromyography (EMG) was used as a supporting test and was not performed in all patients. Sensory disturbance in hand ulnar dermatome, pain in fourth and fifth fingers, presence of intrinsic atrophy, positivity of paper compression test (Froment's sign), Tinel finding in cubital tunnel, and presence of Wartenberg sign were considered during diagnosis.

Patients were divided into four groups according to the McGowan classification modified by Goldberg before the surgery [Table 1].[12] All of the patients were operated on by the same surgeon who had Level V experienced in peripheral nerve surgery.[13]

Surgical technique

Under general or regional block anesthesia, a nonsterile pneumatic tourniquet is placed proximal arm, care taken to not interfere with the ulnar nerve dissection. Accompanied by pneumatic tourniquet and 4× magnification, a 14-cm length incision is made by centering the posterior condylar groove of humerus. After blunt dissection of subcutaneous tissue by taking care not to harm medial antebrachial cutaneous nerve, anterior skin flap is lifted from subcutaneous fascia and common flexor muscle mass [Figure 1a].

Following the exploration of the ulnar nerve proximal to the medial epicondyle, the ulnar nerve is dissected approximately 7 cm distally and proximally from the level of the medial epicondyle, care taken to not harm the nerve blood supplies [Figure 1b]. Starting from the distal end of the cubital tunnel, just distal to the condylar groove, Osborne's ligament, the thickened fascia between the two heads of the flexor carpi ulnaris (FCU), are divided longitudinally over the course of the ulnar nerve along with the investing fascia overlying the FCU. In some cases, motor branch for FCU may be so proximally branched in the cubital tunnel and may prevent transposition [Figure 1c]. At proximal side, ligament of Struthers is loosened, and medial intermuscular septum is excised.

After circumferential dissection while preserving the perineural vascular structures of the ulnar nerve, at 0.5-cm lateral of the medial epicondyle, a cleft is formed extending through the common flexor tendon to the bone. The facial bands and muscle mass with perpendicular tendinous tissue in the tunnel are excised. The freed nerve is gently transposed anteriorly, and fascia sutured in U shape by using absorbable suture [Figure 1d]. The elbow joint is fully flexed and extended, making sure that the nerve is free to slide in the tunnel and there is no nerve strain. The tourniquet is deflated. Meticulous hemostasis is achieved with bipolar cautery. A suction drain is placed in the incision line. An elastic bandage that completely wrapped the upper extremity is applied after surgery. The day after the surgery, the drain is removed; the patient is informed to move without restrictions except for avoiding tight grip and discharged from hospital. On the 15th day after the operation, sutures are removed. Patients were called for control at 1, 3, 6, and 9 months, and then every 6 months.

Statistical analysis

IBM SPSS Statistics version 25.0 for Windows was used for statistical analyses. The data were expressed as mean with standard deviation or frequency (percentage) for overall variables. Normality distribution was assessed using the Shapiro–Wilk test. Quantitative data were analyzed by independent samples *t*-test. Correlations were estimated using the Pearson correlation coefficients.

Results

Twenty-seven 46 patients were included in the study. Thirteen patients had previous history of elbow trauma and predisposing factor. The results were evaluated using Quick DASH scoring system and MAYO elbow performance score. Preoperative examination showed positive findings of Tinel sign in all cases, Froment's sign in 7 patients, and Wartenberg in 11 patients. Symptoms were less frequent and less severe

Table 1: Preoperative and postoperative final follow-up McGowan stage of patients

McGowan stage	Grade 0	Grade 1	Grade 2A	Grade 2B	Grade 3
Preoperatively	0	1	8	3	15
Postoperatively	16	1	5	3	3

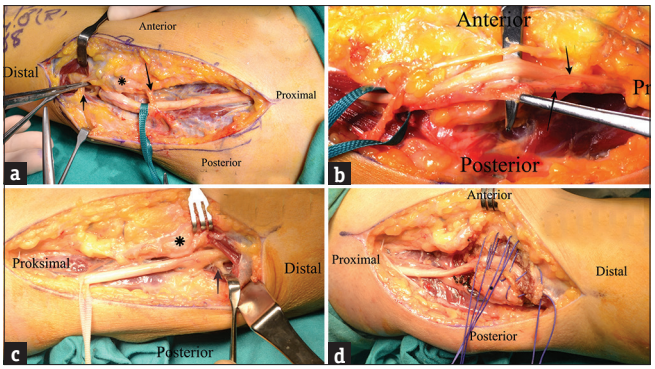

Figure 1: (a) Cutaneous branches of ulnar nerve showed by arrows, medial condyle showed with *. (b) Arrows show the ulnar nerve and concomitant vessels. (c) Motor branch of the ulnar nerve (black arrow) for FCU branched proximally, medial condyle showed with *. (d) Fascia sutured in U shape by using a number 2 absorbable multifilament suture

postoperatively. According to preoperative McGovan staging system, 1 patient was classified as stage 1, 8 patients were stage 2A, 3 patients were stage 2B, and 15 patients were stage 3. Eleven of the patients were female and 16 were male, and also 16 right and 11 left elbow surgically treated. Affected limb was dominant side in 23 and nondominant side in 4 patients. Mean age was 40.4 (17–61) and the mean follow-up was 58.4 (35–88) months. The mean DASH score of the patients was calculated as 19 (0–81.81). Mayo elbow performance score was excellent in 13 patients, good in 7 patients, fair in 6 patients, and poor in 1 patient. There was a strong and significant relationship between the DASH score and the MAYO score in the opposite direction (Pearson's correlation: −0.721; $P < 0.001$). Severe intrinsic atrophy (McGowan Stage 3) was associated with poorer results, both DASH and MAYO scores ($P = 0.024$). There was no statistical correlation between the follow-up duration with DASH and MAYO elbow performance score ($P > 0.05$).

There was no wound or infectious complication in follow-up. Secondary neurolysis was performed to two patients, who had history of elbow fracture, due to the recurrence of symptoms at 8 and 12 months after initial surgery, respectively. Both of the patients were symptom-free at final follow-up. All of the cases except three patients were satisfied (89%) with the result of surgery at final follow-up.

Discussion

In this study, we present the results of anterior submuscular transposition surgery applied to patients with cubital tunnel syndrome. Eighty-nine percent of our patients were satisfied with the treatment. This result was consistent with the results of submuscular transfer studies in the literature and was similar to the results of other techniques reported in the literature.[14,15]

A success rate of 86% was reported for the study involving 11.5 years of follow-up of 82 patients by Lancigu *et al*.[14] Similarly, Zimmermann reported 82 patients with anterior submuscular transposition with a success rate of 89%.[15] However, because traumatic events have been removed in both studies, there is no proposal for traumatic cases in these articles. Leffert reported successful results in 23 trauma-based of 38 patients with anterior submuscular transposition with Learmont technique.[16] In our series, we had 89% patient satisfaction in a mean 5-year follow-up.

The anterior transposition, frequently applied by surgeons, was planned by considering the traction-related symptoms in the ulnar nerve during elbow flexion. Dellon *et al*. showed that satisfactory results could be obtained independently of surgical technique in cases with low-grade symptoms, but that the success rate of simple decompression was low in patients with moderate-to-advanced symptoms.[17] Many studies have shown that both the tension in the ulnar nerve and the pressure around the nerve decrease with the transposition.[18,19] In in-situ decompression surgery, the pressure decreased but the tension continued.[18,19] With our technique, we have been able to minimize compressive and tension forces.

During the anterior transposition, dissection of the ulnar nerve about 15 cm may cause risk of nerve vascularity and damage to the medial antebrachial cutaneous nerve branches located in the incision site and risk for neuroma formation.[20] However, with the ulnar nerve, it is carried anteriorly in the nerve-associated vascular structures. It has also been shown that there is a rich collateral circulation around the nerve and a new bed for the nerve is formed by fibrosis mechanism after transposition of the nerve anteriorly.[20,21]

Different surgical techniques can be used in the treatment of cubital tunnel syndrome. Simple decompression of the ulnar nerve has become a popular method in recent years.[10] The surgical technique we used in the study was based on dynamic compressive forces affecting ulnar nerve. Hurwitz *et al*. showed that ulnar nerve instability may occur after simple decompression up to 50% and concluded not to dissect the nerve more proximal than 4 cm of medial epicondyle.[22] On the contrary, Butler and colleagues have similarly shown that decompression does not lead to instability in a cadaveric study.[23] In patients with cubital tunnel syndrome, the rate of subluxation is about 20%. Male sex and younger patient age were considered risk factors for possible subluxation after decompression.[24] However, the fact that predisposing factors were present in 13 patients in our series has made ulnar nerve transposition mandatory.

Complications may be considered to be higher in the anterior submuscular transfer surgery, which is a more complex surgical technique than simple decompression and anterior subcutaneous transfer. Complications of the technique include hematoma in the incision, medial antebrachial cutaneous neuroma in the cutaneous nerve branches, and elbow stiffness due to inactivity. None of these complications were encountered in our series. A study by Staples *et al*., in which 78 patients undergoing anterior transposition were evaluated, reported a postoperative hematoma rate of 15%.[8] Therefore, after the transposition procedure is completed, hemostasis should be carefully followed by terminating the tourniquet and compression should be applied with elastic bandage after the operation. In our series, we had

no postoperative hematoma. In our study, the recurrence rate was calculated as 7%, only two patients had recurrence. Both of these patients had fractures around the elbow previously. Recurrence rates in the literature ranged from 6% to 20%.[14-16]

Our study has several limitations. The major limitations are retrospective design and relatively small number of patients. Another limitation of our study includes that EMG is used only as a supportive test and not in all patients. We have not implemented EMG in our clinically diagnosed cases of cubital tunnel syndrome.

In this study, we present the results of ulnar nerve anterior submuscular transposition performed by a single experienced surgeon. It found good mid-term results with 89% of patients being satisfied and considering themselves healed. Although the results were subjective, they were similar to the results of similar studies reported in the literature. The recurrence rate was 7%; a second decompression procedure led to good results. In conclusion, we think that anterior submuscular transposition is a successful method with a low recurrence and complication rate.

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Conflicts of interest

There are no conflicts of interest.

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