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Surgical Options in Treatment of Compressive Ulnar Neuropathy

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Abstract

Background: Ulnar nerve compression is a prevalent signof neuropathy that involves the trapping of ulnar nerve of the upper extremities. The most effective surgical treatment for ulnar nerve compression is still a subject of debate.

Aim of Study: This study aimed to evaluate the surgical outcomes of in situ ulnar nerve decompression versus transposition as a treatment for compressive ulnar neuropathy.

Patients and Methods: This randomized clinical trial was conducted on patients with compressive ulnar neuropathy, aged 18-60 years of both sexes. Patients were divided into two equal groups: Group A: Open in situ decompression; Group B: Subcutaneous transposition.

Results: Visual analogue scale (VAS) and disabilities of the arm, shoulder, and hand (DASH) scoreswere significantly lower at 1y in group B than in group A (p=0.020 and 0.016 respectively). Motor conduction velocity (MCV) 1 and 2 scores were significantly higher at 1y in group B than in group A (p<0.05). Revision rate was significantly higher in group A by 4.5 times than group B (95% CI: 1.08-18.77) (p=0.037). Postoperative complications were insignificantly different among both groups.

Conclusions: Subcutaneous transposition is more efficientthan in situ decompression in treating nerve compression syndrome as evidenced by notable reductions in pain, DASH scores, lower revision surgery rates, and increased motor conduction velocities.

Key Words: *In situ – Ulnar nerve – Decompression – Transposition – Ulnar nerve compression.*

Introduction

ULNAR nerve compression is second most frequent peripheral neuropathy affecting the upper extremities, following carpal tunnel syndrome; it affects an estimated 21 out of 100,000 individuals **[1]**. It is recognized that this syndrome can be caused by trauma to the elbow joint, stretching, bending, or repetitive pressure **[2]**. Failure to manage chronic ulnar nerve compression can result in the weakening of the first dorsal interosseus muscle, which in turn impairs one's ability to perform fine motor tasks, ultimately leading to a decline in quality of life **[3]**.

The initial recommendation for patients with moderate symptoms of compressive ulnar neuropathyis conventional therapy. If conventional therapyis unsuccessful, operative treatment is recommended **[4]**. Surgical alternatives encompass a variety of approaches, including decompression alone or in combination with medial epicondylectomy, as well as transposition of the ulnar nerve via subcutaneous, intramuscular, or both **[5]**.

Many surgeons frequently perform anterior subcutaneous transposition of the ulnar nerve among these techniques **[6]**. This method reduces the dynamic pressure that occurs during elbow flexion by transposing the ulnar nerve anterior to the medial epicondyle **[7]**. A significant amount of dissection is required to transpose the ulnar nerve, which may damage the nerve's vascularity. Given this circumstance, straight forward in situ ulnar nerve decompression has progressively gained favor because it appears to produce comparable postoperative outcomes to ulnar nerve transposition **[4]**.

In situ decompression can prevent excessive scarring and devascularization of the nerve, but it can also cause an inadequate release of compressive structures, lessen nerve stress, and increase the risk of nerve instability and chronic problems in the future **[8]**.

As a result, revision rates following in situ decompression have been reported to range from 0.9% to 19% **[9,10]**. Finally, some authors have contended that in situ decompression might not be necessary for the subluxating nerve **[11,12]**.

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The study's overarching goal was to assess the effectiveness of in situ ulnar nerve decompression and transposition on surgical outcomes for compressive ulnar neuropathy.

Patients and Methods

This randomized controlled open-label trial was performed on 50 patients, both sexes, aged 18-60 years, with compressive ulnar neuropathy at Kafr El-Sheikh University Hospitals, From June 2023 – January 2024 as well as other private and governmental hospitals. The research was performed from to following the approval of the Ethical Committee Kafr El-Sheikh University Hospitals (approval code: KFSIRB200-120). Before proceeding, the patient had to provide their signed informed consent.

Exclusion criteria were previous elbow fractures or surgery, polyneuropathies, rheumatoid arthritis, cervical radiculopathy, or inflammatory disease, cervical spondylopathy, and thoracic outlet syndrome.

Randomization and blindness:

The allocation of patients was conducted at random using computer-generated randomization numbers, and the codes for each patient were placed in a sealed, opaque envelope. The patients were concurrently assigned to two equal categories in a parallel manner, utilizing a 1:1 allocation ratio: Group A: Patients were treated with in situ decompression; Group B: Patients were treated with subcutaneous transposition. The study was open-label due to the varied techniques employed.

The patients underwent a complete medical history, clinical examination, laboratory investigation, a neurological evaluation to rule out multiple sclerosis or polyneuropathy, and electrodiagnostic studies [electromyography (EMG) that showed a motor conduction velocity (MCV) throughout the elbow of 50m/s], and recurrent elbow pain following conservative treatment.

A visual analog scale (VAS) was utilized for pain evaluation **[13]**. The patient was asked to identify the point on the line that most accurately represents their pain. The score ranges from 0 (no symptom) to 10 (the most severe manifestation).

The Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire **[14]** was employed for functional assessment in order to measure symptoms and impairments affecting the upper extremities. Thirty items measuring impairment and symptoms are the backbone of the DASH, with scores ranging from zero (no disability) to one hundred (good health).

Surgical technique:

Without the use of a tourniquet, the surgeries were carried out under general or local anesthetic, as preferred by the surgeon. A broad-spectrum antibiotic was commenced for all cases at the time of skin incision.

The Philips iU22 (Philips Medical Instruments, Bothell, WA) was employed to execute ultrasonography, which utilized a linear array transducer with a frequency range of 5–17 MHz. The patients were positioned on their backs with their arms at their sides and their elbows bent at 90 degrees. Through the halfway of the forearm and into the midpoint of the forearm, the ulnar nerve was checked. The nerve's cross-sectional area was determined by measuring it at its most enlarged location, which may be in the ulnar groove, below the elbow, or above the condyle.

Open in situ decompression technique:

The medial epicondyle served as the focal point for the 3-centimeter skin incision of the procedure. The first ulnar nerve motor branch was reached in the distal release due to the proximally expanded median intermuscular septum. It was also approved to mobilize the elbow immediately.

Subcutaneous transposition technique:

At the epicondylar groove was positioned a skin incision of 8-10cm that was curved. The medial epicondyle was crossed over and the ulnar nerve trunk was translated forward after being released along the tunnel. To stabilize the tissue, a fascial flap was employed, which included a lateral pedicle taken from the epicondyle muscles' superficial fascia. The ulnar nerve was stabilized by suturing the medial edge to the subcutaneous tissue. It was permitted to mobilize immediately.

The post-anesthesia care unit was accessed by each patient, and then they were transferred to the internal ward. If no problems arose, the majority of patients were sent home on the very first day after surgery. It was noted how often problems occurred after the operation.

All patients were scored postoperatively according to the Wilson & Krout criteria **[15]**. Excellent condition was defined as having minimal sensory and motor issues and no tenderness at the site of the incision; fair condition was defined as having a mild deficit but sporadic pain or soreness at the site of the incision or osteotomy; If there was a reduction in the deficit but it did not go away, it would be considered fair; if not, it would be considered poor.

The primary outcome was the revision rate (re-operation rate). The secondary outcomes were operative time, VAS, DASH, postoperative complications, and MCV.

Sample size calculation:

The IBM SPSS Sample Power 3.0.1 (IBM Corp., Armonk, NY, USA) was employed to determine the necessary sample size. The primary outcome is the

long-term reoperation rate. According to prior research by Hutchinson et al., there was a 13% difference in the reoperation rate between underwent in-situ decompression and subcutaneous transposition (25% vs. 12%) **[16].** Therefore, to attain a power of 80% and detect the expected difference in the long-term reoperation rate of 20% at a significance level of 0.05, it was calculated that a minimum sample size of 25 patients in each group is required.

Statistical analysis:

SPSS v27 (IBM©, Armonk, NY, USA) was employed to execute the statistical analysis. In order to ensure that the data was distributed normally, histograms and the Shapiro-Wilks test were employed. In order to examine the quantitative parametric data, which is displayed as mean and standard deviation (SD), the unpaired student *t*-test was employed. The Mann-Whitneytest was applied to analyze quantitative non-parametric data, which were expressed as the median and interquartile range (IQR). The Chi-square test or Fisher's exact test was utilized to analyze qualitativevariables, which were presented as frequency and percentage (%) when appropriate. For statistical purposes, significant was defined as a two-tailed *p*-value that was less than 0.05.

Results

Out of 66 patients evaluated for eligibility, 5 declined to participate, and 11 did not fulfill the criteria. The others were split into two groups of 25 each using a random allocation method. Statistical analysis was carried out on all allocated patients. Fig. (1).

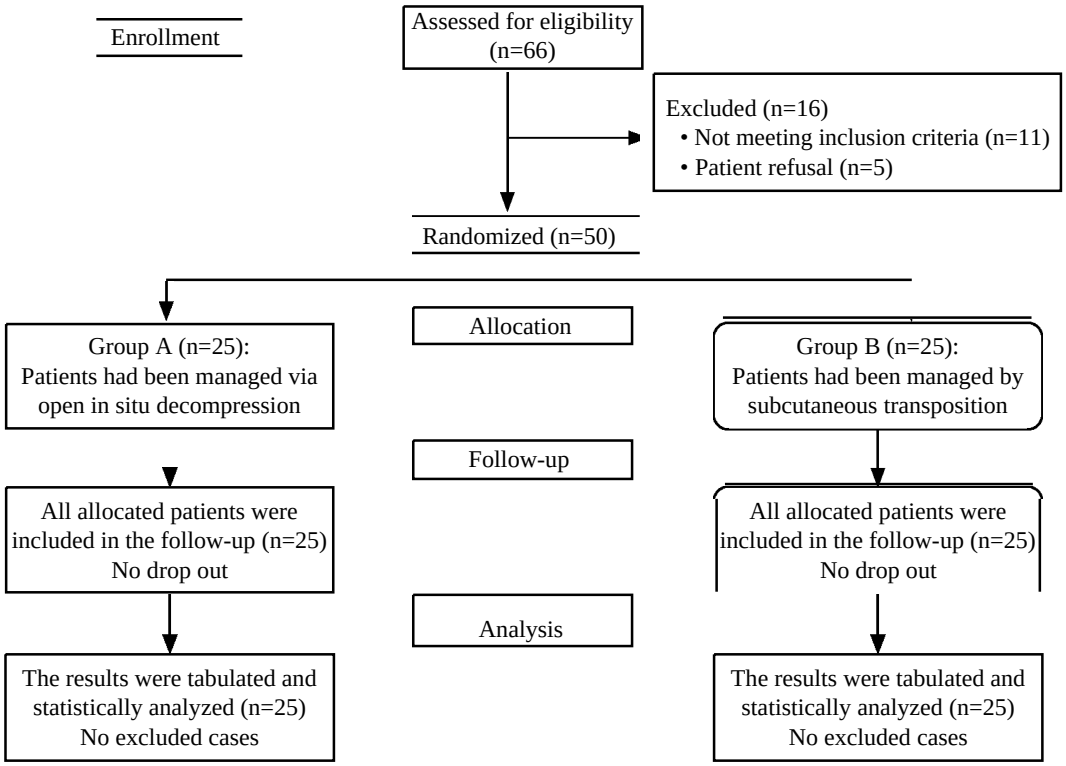

Fig. (1): CONSORT flowchart of the enrolled patients.

Regarding the two groups' demographics, there was no statistically significant difference. Operating time was significantly different between groups A and B. (*p*=0.005). Table (1).

There was no statistically significant difference in VAS at preoperative, 1m, 3m, and 6m between the two groups. However, Group B had a significant decrease in VAS than in group A at one year (*p*-value=0.020). Table (2).

DASH scores at preoperative, 1, 3, and 6m were not statistically significantly different between the two groups. However, group B had a significant decrease in DASH score than group A at one year (*p*-value=0.016). Table (3).

The two groups did not differ significantly at preoperative, 1m, 3m, and 6m in MCV 1 and 2 scores, however group B had significantly higher scores at 1 year than group A (*p*-value <0.05). Table (4).

The revision rate was significantly higher in group A by 4.5 times than group B (95% CI: 1.08-18.77) (*p*-value=0.037). Postoperative complications (hematoma, infection, antebrachial cutaneous nerve injury, and Ulnar nerve instability) were insignificantly different amongthe two groups. Table (5).

Table (1): Demographic data and operative time of the studied groups.

	Group A (n=25)	Group B (n=25)	*p*-value
Age (years)	40.6±9.31	38.36±11.58	0.455
Sex:			
Male	14 (56%)	16 (64%)	0.564
Female	11 (44%)	9 (36%)	
Weight (kg)	81.92±11.58	83.56±16.26	0.683
Height (m)	1.64±0.07	1.68±0.07	0.084
BMI (kg/m^2)	30.54±5.83	29.88±6.68	0.710
Affected side:			
Right	18 (72%)	15 (60%)	0.370
Left	7 (28%)	10 (40%)	
Operative time (min)	54.8±8.95	62.2±9.02	0.005*

Data are presented as mean ± SD or frequency (%).
*: Significant as *p*-value ≤0.05. BMI: Body mass index.

Table (2): VAS of the studied groups.

	Group A (n=25)	Group B (n=25)	*p*-value
Preoperative	6 (5 - 7)	6 (5 - 7)	0.605
1m	3 (2 - 4)	4 (2 - 4)	0.304
3m	2 (2 - 4)	2 (1 - 4)	0.327
6m	2 (1 - 3)	2 (1 - 3)	0.428
1y	2 (1 - 2)	1 (1 - 2)	0.020*

Data are presented as median (IQR).
*: Significant as *p*-value ≤0.05. VAS: Visual analog scale.

Table (3): DASH of the studied groups.

	Group A (n=25)	Group B (n=25)	*p*-value
Preoperative	15.92±4.13	16.92±2.84	0.324
1m	13.68±4.03	14.44±2.95	0.450
3m	12.6±4.53	11.8±2.99	0.464
6m	12.44±5.12	10.64±2.89	0.132
1y	12.88±5.13	9.92±2.96	0.016*

Data are presented as mean ± SD. *: Significant as *p*-value ≤0.05.

Table (4): MCV of the studied groups.

	Group A (n=25)	Group B (n=25)	*p*-value
		MCV1	
Preoperative	41.08±3.37	41.32±3.89	0.817
1m	44.16±3.36	44.48±3.97	0.760
3m	45.16±4.31	46.36±4.12	0.319
6m	47.04±4.97	48.4±4.26	0.304
1y	49.04±5.73	52.76±4.53	0.014*
		MCV2	
Preoperative	41.24±2.93	41.44±3.9	0.838
1m	44.52±2.93	44.44±3.96	0.936
3m	45.64±3.07	46.32±3.97	0.501
6m	47.56±3.55	48.6±4.55	0.372
1y	49.88±3.89	53.12±4.62	0.010*

Data are presented as mean ± SD. *: Significant as *p*-value ≤0.05.

Table (5): Revision rate and postoperative complications of the studied groups.

	Group A (n=25)	Group B (n=25)	*p*-value
Revision rate (Reoperation)	9 (36%)	2 (8%)	0.037*
Postoperative complications:			
Hematoma	1 (4%)	4 (16%)	0.348
Infection	1 (4%)	3 (12%)	0.609
Antebrachial cutaneous nerve injury	0 (0%)	1 (4%)	1
Ulnar nerve instability	1 (4%)	0 (0%)	1

Data are presented as frequency (%). * Significant as *p*-value ≤0.05.

Discussion

Ulnar nerve compression represents one of the most widespread peripheral nerve entrapment syndromes after carpal tunnel syndrome **[17]**. After non-invasive methods of decompression of the ulnar nerve have failed, surgical decompression may be considered. In situ decompression or transposition of the ulnar nerve remains the more optimal surgical approach for ulnar nerve compression, depending on clinical assessment and patient-specific factors **[18].**

Our findings indicated that there was no statistically significant difference in VAS and DASH scores at preoperative, 1m, 3m, and 6m among the two groups and were significantly lower at 1y in subcutaneous transposition group than in situ decompression group. The two groups did not differ significantly at preoperative, 1m, 3m, and 6m in MCV 1 and 2 scores and were significantly higher at 1y insubcutaneous transposition group than in in situ decompression group. The subcutaneous transposition group had a significantly reduced revision rate than in situ decompression group. Postoperative complications were insignificantly different between both groups.

Bartels et al. **[19]** showed no statistically significant difference in results between in situ decompression and subcutaneous anterior transposition in a randomized, prospective study. Nonetheless, they discovered that the transposition group experienced considerably more infections and complications. According to Biggs and Curtis **[20]**, a prospective randomized trial assessing in situ and transposition found that the latter group had greater infection rates.

Additionally, a retrospective study was conducted over a 20-year period by Kamat et al. **[21]** demonstrated that both in situ decompression and subcutaneous anterior transposition better results; however, patients undergoing anterior transposition were more prone to suffer from localized elbow pain following surgery. Bacle et al. **[22]** conducted found that in situ decompression and subcutaneous

or submuscular anterior transposition had similar rates of complications and clinical outcomes.

For the purpose of treating cuticular tunnel syndrome (CuTS), Mitsionis et al. [23] examined three surgical approaches. They concluded that transposition treatment resulted in worse outcomes than the other two methods and suggested in situ decompression as an easy, effective, and uncomplicated way to deal with CuTS. According to Said et al. [24], the in-situ group's operation time was significantly less than that of the transposition group.

Abouzeid et al. [1] noted that the transposition group had higher incidences of hematoma, infection, and antebrachial nerve injury than the in situ group. Within the in-situ group, the revision rate stood at 3.1%, whereas in the transposition group it was 2.2%. Additionally, research by Hutchinson et al. [16] demonstrated that in situ decompression had a 25% revision rate in the long run, while anterior subcutaneous transposition had a 12% rate.

The research encountered certain limitations, including a relatively small sample sizeas well as the absence of magnetic resonance imaging findings. Therefore, in order to establish more reliable conclusions regarding the efficacy of current treatments and reduce the necessity for revision surgery, future research should employ a larger sample size.

Conclusions:

Subcutaneous transposition is more efficientthan in situ decompression in treating nerve compression syndrome as evidenced by notable reductions in pain, DASH scores, lower revision surgery rates, and increased motor conduction velocities.

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Conflict of Interest: Nil.

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الخيارات الجراحية فى علاج الاعتلال العصبى الزندى الضاغط

الخلفية: ضغط العصب الزندى هو علامة سائدة للاعتلال العصبى الذى ينطوى على محاصرة العصب الزندى فى الأطراف العلوية. لا يزال العلاج الجراحى الأكثر فعالية لضغط العصب الزندى موضوعًا للنقاش. يهدف هذا البحث إلى تقييم النتائج الجراحية لتخفيف ضغط العصب الزندى فى الموقع مقابل تغيير مساره كعلاج للاعتلال العصبى الزندى الضاغط.

الطريقة: أجريت هذه التجربة السريرية العشوائية على مرضى يعانون من اعتلال العصب الزندى الضاغط، والذين تتراوح أعمارهم بين ١٨–٦٠ سنة، من كلا الجنسين. تم تقسيم المرضى إلى مجموعتين متساويتين: المجموعة أ: تخفيف الضغط فى الموقع؛ المجموعة ب: النقل تحت الجلد.

النتائج: كان مقياس شدة ودرجات الإعاقة فى الذراع والكتف واليد أقل بشكل ملحوظ عند سنة فى المجموعة (ب) مقارنة بالمجموعة (أ) (قيمة ب <٠,٠٥ و٠,٠١٦ على التوالى). كان مقياس سرعة التوصيل الحركى الأول والثانى أعلى بشكل ملحوظ عند سنة فى المجموعة (ب) مقارنة بالمجموعة (أ) (قيمة ب <٠,٠٥) وكان معدل الإعادة أعلى بشكل ملحوظ فى المجموعة (أ) بمقدار ٤,٥ مرات من المجموعة (ب) (فاصل الثقة ٩٥٪: ١,٠٨–١٨,٧٧) (قيمة ب=٠,٠٣٧). ولم يكن هناك فروق ذو دلالة إحصائية فى مضاعفات ما بعد الجراحة بين المجموعتين.

الاستنتاجات: االنقل تحت الجلد أكثر كفاءة من تخفيف الضغط فى الموقع فى علاج متلازمة ضغط العصب كما يتضح من انخفاض ملحوظ فى الألم، ودرجات الإعاقة فى الذراع والكتف واليد، وانخفاض معدلات إعادة الجراحة، وزيادة سرعات التوصيل الحركى.