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Ulnar Nerve Entrapment InCubital Tunnel: Transposition Versus Decompression Alone

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Abstract

Background: Ulnar nerve entrapment at the elbow is the second most common compression neuropathy after carpal tunnel syndrome (CTS). Surgery is usually necessary to treat chronic neuropathy associated with muscle weakness or neuropathy that does not respond to conservative measures. The aim of the present study was to evaluate patient-reported and surgeon-evaluated outcome of ulnar nerve entrapment in cubital tunnel decompression versus transposition.Patients and Methods: The study was conducted at Neurosurgery Department, Zagazig University Hospitals on 18 ulnar nerve entrapment patients 9 cases undergone simply decompression operation and 9 cases undergone transposition operation.All cases were subjected to medical records of all cases, clinical diagnosis and Electrodiagnostic tests. Postoperative outcome was assessed and graded, based on patient-reported and surgeon-evaluated outcome, into four groups: cured, improved, unchanged or exacerbated Results:88.9% of the decompression group shows full motor power (FMP) postoperatively while this was shown in 44.4% of transposition group with no significant difference(P<0.05) between the two groups.All patients of both groups show postoperative improved sensory manifestations. There was highly significant difference (p<0.05) between the two studied groups regarding postoperative nerve conduction velocity NCV as it was higher in decompression group than transposition group (57.28±2.5 vs. 54.18±3.35)m/s. while there was no significant difference between them regarding nerve thickness by ultrasound.Conclusion:Perioperative assessment of ulnar nerve subluxation at primary surgery for UNE should be routine and, if found, an ulnar nerve transposition should be performed in the same surgical session, to minimize the need for revision surgery.

Keywords: Decompression; Nerve velocity; Carpal Tunnel Syndrome ;Ulnar Nerve Entrapment

Introduction:

Cubital tunnel syndrome is the most common form of ulnar nerve entrapment (UNE) and the second most common entrapment neuropathy of the upper extremity **(1)**.

Symptoms of cubital tunnel may start insidiously or acutely, the latter being more common with trauma. The clinical symptoms are related to the mixed sensory and motor neural fibers of this nerve. Symptoms progress from mild intermittent numbness induced with elbow flexion to constant anesthesia. Pain and tenderness over the medial epicondyle and cubital tunnel may be present with flexion and extension of the elbow. Weakness of ulnar nerve innervated intrinsic hand muscles can also be seen at this time. Weakness starts with clumsiness and loss of dexterity of the hand, with progression to weakness of grip and pinch (Froment's sign) **(2)**.

The elbow flexion test is performed with both elbows maximally flexed and wrists in full extension for three minutes, while the Pressure provocative test is done by applying pressure for 60 seconds over the ulnar nerve just proximal to the cubital tunnel with the elbow flexed at 20º and forearm is supinated. These tests are positive if symptoms of pain, numbness, and paresthesias occur in the ulnar nerve distribution **(3)**.

If the patient's symptoms become persistent and accompanied with muscle atrophy and sensory changes, surgical treatment should become a consideration. Many surgical procedures are advocated for the treatment of cubital tunnel syndrome, including simple decompression, anterior transposition (subcutaneous, submuscular, intramuscular), and medial epicondylectomy**(4)**.

Surgical treatment of patients with cubital tunnel syndrome is governed by the following principles: release all possible sites of compression; preserve the vascularity of the ulnar nerve at the elbow; allow early mobilization of the elbow; and if the nerve subluxates during surgery, then perform a medial epicondylectomy **(5)**.

Anterior transposition surgical procedures can be grouped into 3 classes, depending on the location of the transposed ulnar nerve: subcutaneous anterior transposition, submuscular anterior transposition, and intramuscular anterior transposition **(6)**.

Despite a generally good reported outcome for surgical treatment of ulnar nerve entrapment, relapse occurs in 3-19% of cases in the form of persistent or recurrent symptoms. Persistent symptoms may be related to an incomplete release of structures affecting the ulnar nerve or to intraneural pathology, while recurrence after primary surgery may be due to

perineural scarring and adhesions. Predictors of recurrence are female gender, age < 50 years, concomitant CTS, clinically mild ulnar nerve entrapment (i.e., McGowan stage I) and previous elbow fracture or dislocation **(7)**.

Recurrent ulnar nerve entrapment is usually treated with ulnar nerve transposition, achieving satisfactory results in 73-82% of patients; the main improvement being a reduction of pain, whereas return of sensibility and motor function are more unpredictable **(8)**.

The aim of the present study was to evaluate patient-reported and surgeon-evaluated outcome of ulnar nerve entrapment in cubital tunnel decompression versus transposition.

Patients and Methods:

This non-randomized case-control study was conducted at Neurosurgery Department, Zagazig University Hospitals on 18 surgically treated ulnar nerve entrapment patients; 9 cases were treated by simple decompression and 9 cases were treated by transposition. This study was done for a year. Patients with concomitant cervical radiculopathy and traumatic ulnar nerve injury were excluded.

The work has been carried out in accordance World Medical Association (Declaration of Helsinki) for studies involving humans before prospective collection of patient's data and after informed consent was obtained from patients.

All cases were subjected to medical records of all cases, clinical diagnosis and Electrodiagnostic tests including nerve conduction studies and needle EMG. Simple decompression is the method of choice in ordinary cases, but if a clear luxation or hypermobility of the ulnar nerve is seen pre- or peri-operatively, a submuscular (or sometimes subcutaneous) nerve transposition is performed.

Surgical technique:

Simple decompression was performed through a 6-10 cm long curved incision, slightly going ventral to the medial epicondyle avoiding exposure and scar directly over the nerve at sulcus level, along the course of the ulnar nerve. The ligament of Osbourne and the superficial and deep fascias of the flexor carpi ulnaris muscle were incised. The Struther´s arcade or any aponeurosis were not released if the clinical findings did not indicate anything else. The ulnar nerve itself was then retained on its bed and not circumferentially dissected from the surrounding connective tissue.

Figure (1) arm externally rotated and elbow flexed and forearm in the supine position.

Figure(2)Decompression of ulnar nerve in cubital tunnel.

Subcutaneous or submuscular anterior transposition of the ulnar nerve was performed in some patients with severely tensed ulnar nerve due to cubitus valgus over 30° or those engaging in work using the inside of the elbow or those receiving reoperation. In addition, the decision to use a microscope was made at random. The final choice of Subcutaneous or

submuscular anterior transposition of the ulnar nerve depends on the surgeon and is based on patient and clinically-related factors, e.g. patient comorbidity, and amount of available fat tissue.

Postoperative outcome was assessed and graded, based on patient-reported and surgeon-evaluated outcome, into four groups: cured, improved, unchanged or exacerbated (i.e. previously defined as worsened). Following this distribution, cases were re-assigned into two groups for clinical reasons: cured/improved and unchanged/exacerbated.

Statistical analysis

The data was analyzed by using Statistical Package for Social Sciences (SPSS) software program. The values were noted as mean and standard deviation. Chi-square test and Analysis of Variance (ANOVA) were used for statistical analysis when appropriate. In all tests, P value below 0.05 was considered statistically significant.

Results:

The present study showed that there were no significant differences (P>0.05) between the two studied groups regarding age, sex and occupation. Moreover no one in both groups had history of comorbidities. **(Table 1)**

Table (1): Some demographic data of the studied two patients groups (n=18):

Demographic data	Decompression group n=9		Transposition group n=9		Test	p-value
Age: Mean ±SD median Min-Max	42.7±15.1 45 20-65		40.2±15.08 44 18-63		Mann-Whitney test (MW)	0.8
	N	%	N	%		
Sex: Male female	8 1	88.9 11.1	7 2	77.8 22.2	0.4a	0.5
Occupation : Manual worker Carpenter Farmer Secretary	2 3 2 0	22.2 33.3 22.2 0.0	3 2 2 1	33.3 22.2 22.2 11.1	4.4b	0.6

Housewife	1	11.1	0	0.0		
Employee	1	11.1	0	0.0		
Security man	0	0.0	1	11.0		

MW: Mann-Whitney test a: Fisher's exact test b: X2: Chi square test

Table (2) shows that there were no statistical significant differences (p>0.05) between the two studied groups regarding the studied preoperative data.

Table (2): Comparison between the two studied groups regarding pre-operative data (n=18):

Preoperative data	Decompression group (n=9)		Transposition group (n=9)		X2	p-value
	N	**%**	**N**	**%**		
Previous trauma to elbow:						
Yes	**0**	**0.0**	**1**	**11.1**	**1.05**	**0.3**
No	**9**	**100.0**	**8**	**88.9**		
Motor power:						
G3	**1**	**11.1**	**3**	**33.3**	**2.1**	**0.3**
G4	**1**	**11.1**	**2**	**22.2**		
Full motor power(FMP)	**7**	**77.8**	**4**	**44.4**		
Sensory symptoms (tingling and numbness):						
Positive	**9**	**100.0**	**9**	**100.0**	**-**	**-**
Deformity :						
No	**7**	**77.8**	**4**	**44.4**	**3.01**	**0.2**
Claw hand	**2**	**22.2**	**3**	**33.3**		
Cubitus valgus	**0**	**0.0**	**2**	**22.2**		
Froment test:						
Positive	**2**	**22.2**	**4**	**44.4**	**1**	**0.3**
Negative	**7**	**77.8**	**5**	**55.6**		
Tinel's test:						
Positive	9	100.0	9	100.0	-	--

X2: Chi square test

The preoperative mean±SD of NCV was 37.48±7.1 (m/s) and 36.7±4.35 (m/s) in decompression group and transposition group respectively with no significant difference between them (p<0.05). Also the preoperative mean±SD of nerve thickness by ultrasound in both groups is almost equal (21.3±7.1 and 21.8±5.1 respectively)mm.

According to Intra-operative data, the mean amount of blood loss without using tourniquet in decompression group was significantly (p<0.05) lower than that of transposition group (26.67±7.07 cc and 48.89±13.6 cc respectively). Also the mean time of operation in decompression group(46.6±3.5 min) was significantly (p<0.05) lower than that of transposition group (67.78±16.2 min).

Table (3): Comparison between the two studied groups regarding some intra-operative data (n=18):

Intra-operative data	Decompression group (n=9)	Transposition group (n=9)	t-test	p-value
Amount of blood loss(cc): mean±SD Min-Max	 26.67±7.07 20-40	 48.89±13.6 30-70	4.3	0.001*
Time of operation (min): mean±SD Min-Max	 46.6±3.5 40-50	 67.78±16.2 40-80	3.8	0.002*

^chi square test *statistical significant (p>0.05)

This table shows that 88.9% of the decompression group shows full motor power (FMP) postoperatively while this was shown in 44.4% of transposition group with no significant difference(P<0.05) between the two groups. All patients of both groups show postoperative improved sensory manifestations, while the deformity was improved postoperatively in equal percent (22.2%) of both groups. All post-operative data was reported in details in **(Table 4)**

Regarding postoperative complications (infection, hematoma, injury to vessels and joint stiffness) no one in both groups reported any complications. **(Table 4)**

Table (4): Comparison between the two studied groups regarding prost-operative data (n=18):

Post -operative data	Decompression group (n=9)		Transposition group (n=9)		X2	p-value
	N	**%**	**N**	**%**		
Motor power: G3 G4 FMP	 0 1 8	 0.0 11.1 88.9	 1 4 4	 11.1 44.4 44.4	4.1	0.1
Sensory symptoms (tingling and numbness): Not improved improved	 0 9	 0.0 100.0	 0 9	 0.0 100.0	--	---
Deformity : No as preoperative The same improved	 7 0 2	 77.8 0.0 22.2	 4 3 2	 44.4 33.3 22.2	3.9	0.1
Complications: Yes No	 0 9	 0.0 100.0	 0 9	 0.0 100.0	--	--
Froment sign : Positive Negative	 1 8	 11.1 88.9	 2 7	 22.2 77.8	0.4	0.5

Tinel's Test: Positive Negative	 0 9	 0.0 100.0	 0 9	 0.0 100.0	 -	 ---

X2: chi square test

there was highly significant ($p<0.001$) increase in nerve conduction velocity (NCV) postoperative than preoperative in both groups, also there was the highly significant decrease nerve thickness by (U/S) postoperative than preoperative in decompression group and this decrease in thickness was significant ($p<0.05$) in transposition group. **(Table 5)**

Table (5): Comparison NCV and nerve thickness before and after operation in both groups (n=18):

NCV and thickness(U/S)		Before	After	p-value^
Decompression group n=9	**NCV(m/s):** Mean ±SD Min-Max	 37.48±7.1 30-49	 57.28±2.5 53-60	**<0.001****
	Thickness(U/S) (mm): Mean ±SD Min-Max	 21.3±7.1 10-36	 11.1±3.2 7-18	**<0.001****
Transposition group n=9	**NCV(m/s):** Mean ±SD Min-Max	 36.74±4.35 32-46	 54.18±3.35 50-58	**<0.001****
	Thickness(U/S) (mm): Mean ±SD Min-Max	 21.8±5.1 10-28	 13.67±3.84 9-19	**0.001***

^: paired-t test ****high significant difference (p<0.001).**

Discussion

The study was conducted at Neurosurgery Department, Zagazig University Hospitals on 18 ulnar nerve entrapment patients; they were divided into two groups: first group included 9 cases undergone simply decompression operation and the second group included 9 cases undergone transposition operation.

The aim of this study is to evaluate outcome of ulnar nerve decompression in cubital tunnel versus transposition.

The current study shows that there were no significant differences ($P>0.05$) between the two studied groups regarding age and sex (15 males and 3 females). Males constituted the majority of revision transposition cases. **Asamoto et al. 2005(9)**assessed the outcomes of 81 operations for the treatment of ulnar nerve entrapment at the elbow performed on 55 males (bilateral operations in one) and 25 females. **Anker et al. 2018(10)**studied the outcome of

subcutaneous (SCT) and submuscular (SMT) ulnar nerve transpositions due to UNE. They found that among the primary transposition cases, about half were female.

The current study shows that there was no significant difference (P>0.05) between the two studied groups regarding occupation. The current results are not in match with **Bartels and Verbeek2007(11)**have indicated that heavy manual occupation with stationary and repetitive workload may predispose to UNE.

The current results also not in match with **Anker et al. 2018(10)**employed a majority in both transposition groups were employed in the manual, heavy, or blue-collar type of work with a repetitive workload.

In The current study, no one in both groups had history of comorbidities. **Anker et al. 2018(10)**evaluated the outcome and potential predictors for the outcome after simple decompression in UNE. One hundred seventy-two (71%) of the cases had comorbidity with other systemic conditions or concomitant CTS. **Anker et al. 2018(10)**found that five (33%) in the SCT group and 7 (25%) in the SMT group had concomitant CTS.

The current study shows that a majority of the cases had manual and heavy type of work with no significant difference (P>0.05) between the two studied groups regarding occupation.The current results agree with **Anker et al. 2018(10)** found thata majority of the cases had manual, heavy, blue-collar type of work**.**

The current study shows that there were no statistical significant differences (p>0.05) between the two studied groups regarding the studied preoperative data. All patients in decompression group and most of patients in transposition group had no previous trauma to elbow, all patients in both group had sensory symptoms like tingling and numbness. On the other hand, most of patients in decompression group (77.8%) and near half of patients (44.4%) in transposition group had no deformity and had full motor power.

The current results agree with **Anker et al. 2018(10)** found that one hundred seventy-eight (74%) had developed UNE without preceding trauma to the ulnar nerve.Most cases had numbness and paresthesia as their main symptom**.**

Anker et al. 2018(10)stated that twenty-one (49%) of the cases had developed UNE without preceding trauma to the ulnar nerve. In almost all cases, numbness and paraesthesia were the main symptoms. Preoperative subluxation of the ulnar nerve was found in majority of cases19 (60%) in the primary SCT group and 22 (79%) in the primary SMT group].

The current study shows that the preoperative mean±SD of NCV was 37.48±7.1 (m/s) and 36.7±4.35 (m/s) in decompression group and transposition group respectively with no

significant difference between them ($p<0.05$). Also, the preoperative mean±SD of nerve thickness by ultrasound in both groups is almost equal (21.3±7.1 and 21.8±5.1 respectively)mm.

Anker et al. 2018(10)carried out electrophysiology. Seven (47%) of the cases in the primary sub cutaneous transposition (SCT) group and 18 (64%) of the primary SMT group underwent preoperative electrophysiological examination. In 3 (43%) of the SCT cases, reduced conduction velocity was found along the ulnar nerve at the elbow, 1 (14%) had a nerve conduction block, and 1 (14%) exhibited axonal degeneration. Among the SMT cases, 6 (33%) had reduced conduction velocity, 1 (6%) had a nerve conduction block, and as many as 10 (56%) displayed axonal degeneration. No electrophysiological signs of ulnar nerve affection were found in the remainder of the primary cases.

The current study shows that the general anesthesia was used for all patients in transposition group and most of patients in decompression group while local anesthesia used for 11.1% of decompression group. **Anker et al. 2018(10)**used axillary plexus anesthesia was used most frequently [187 (78%)] and general anesthesia was used in the other cases [54 (22%)].

The current study shows that 88.9% of the decompression group shows full motor power (FMP) postoperatively, while this was shown in 44.4% of transposition group with no significant difference($P<0.05$) between the two groups. All patients of both groups show postoperative improved sensory manifestations, while the deformity was improved postoperatively in equal percent (22.2%) of both groups.

The current results not in match with **Anker et al. 2018(10)**found that in 53/242 (22%) of the cases, no change in, or even worsened (i.e. more pronounced symptoms compared to preoperatively), symptoms were reported postoperatively by the patients.

We agree with **Steiner et al. 1996(12)** reported that simple decompression and anterior transposition produced equal outcomes.

Asamoto et al. 2005(9)performed simple ulnar nerve decompression or anterior transposition of the ulnar nerve (subcutaneous or intramusuclar) with or without the operating microscope. All patients without improvement of neurological findings had severe preoperative symptoms. Therefore, cases of poor outcome may be related to preoperative changes in the perineural vessels. **Anker et al. 2018(10)** found that 14/15 (93%) of thesis cutaneous transposition (SCT) cases and 22/28 (79%) of sub muscular transposition (SMT)cases reported being cured or improved.

Regarding postoperative complications (infection, hematoma, injury to vessels and joint stiffness) no one in both groups reported any complications. **Asamoto et al. 2005(9)**observed no complication in the perioperative findings and procedures in cases of poor outcome. Patients with poor outcome were in a hypersensitive state, so easily suffered damage caused by mobilizing nerves or perineural vessels due to severe perioperative neurological findings.

The current study shows significant difference ($p<0.05$) between the two studied groups regarding postoperative nerve conduction velocity (NCV) as it was higher in decompression group than transposition group (57.28±2.5 vs. 54.18±3.35)m/s, while there was no significant difference between them regarding nerve thickness by ultrasound.

The current study demonstrates that there was highly significant ($p<0.001$) increase in nerve conduction velocity (NCV) postoperatively than preoperatively in both groups, also there was the highly significant decrease nerve thickness by (U/S) postoperatively than preoperatively in decompression group and this decrease in thickness was significant ($p<0.05$) in transposition group.

Gokay and Bagatur2012(13) reviewed mid- and long-term results of patients with cubital tunnel syndrome who underwent subcutaneous anterior transposition of the ulnar nerve. They concluded that the relatively poor results of anterior subcutaneous transposition can be attributed to the fact that this procedure is particularly preferred in chronic patients with a long duration and advanced disease with probable intrinsic nerve damage. Subcutaneous transposition of the ulnar nerve for the surgical treatment of cubital tunnel syndrome is a reliable and easy method with a low complication rate and should be preferred for its mechanical advantage in solving the nerve traction problem.

The current study shows that patient with severe chronic sensory symptom and motor affection and weakness anterior subcutaneous transposition is found better to them than just decompression and also there was no complication post op no hematoma or infection or nerve damage or joint stiffness .

Anker et al. 2018(10)concluded that patients with a preoperatively electrophysiologically diagnosed nerve conduction block or axonal degeneration have higher risk of not being cured or improved after simple decompression in UNE. Older patients, those with a manual profession, and constant symptoms of UNE tend to be less improved after surgery.

The current study shows there was no significant deference in improvement post operative regarding to age or occupation as The current study was done on patient their age range from 18 to 65 years old and occupation vary between manual worker,carpenter,employee and house wife.all these cases show improvement post op regardless of age or occupation.

Anker et al. 2018(10)concluded that patients with comorbidity with other systemic diseases, musculoskeletal conditions or concomitant CTS have a higher risk of UNE relapse and need revision surgery. Surgeons should assess any tendency for peroperative subluxation at primary surgery for UNE, proceeding with concomitant transposition of the nerve to minimize the need for revision surgery.

We found that some patients with ulnar nerve subluxation were treated with simple decompression despite the fact that transposition is the standard procedure at our department when pre- or peri-operative subluxation exists. We can only speculate on the reasons for this, but it might be a definition issue or lack of preoperative agreement with the patient that a transposition will be performed if subluxation of the nerve is noted after simple decompression.

We think such a study may require a large number of cases or extensive cooperation with several institutes. We reconsider the use of simple decompression for ulnar nerve entrapement to potentially improve the outcome of patients with cubital tunnel syndrome.

Conclusion:

We concluded that results are nearly equal in both decompression and transposition surgeries, but patients with cubital tunnel syndrome have cured or improved of their ulnar nerve entrapment after surgical treatment with simple decompression with less operative time, less amount of blood loss, smaller wound, less exposure to nerve, less need to affect elbow joint except in large deformation than surgical treatment with transposition. In patients treated by simple decompression, there was no injury to flexor tendon and the operation can be done with local anesthesia.

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