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# Evaluation of Early Results of Neurotization in High Ulnar Nerve Injury

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ORIGINAL ARTICLE

# Evaluation of Early Results of Neurotization in High Ulnar Nerve Injury

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Abstract

*Background:* ***Significant grip, pinch weakness, and ulnar digit clawing are the consequences of ulnar nerve injury. Sensory and motor deficiencies also affect the hand. There are two categories of ulnar nerve injuries: low and high.***

*Aim and objectives:* ***To evaluate motor and functional outcomes and clawing correction after AIN transfer to DMUN.***

***Patients and methods: From March 2020 to August 2023, researchers at the orthopedic departments of Al-Azhar University Hospitals and Assiut University Hospitals analyzed the results of two types of transfers for patients with high ulnar nerve injuries: end-to-end transfers (AIN) and structured end-to-side transfers (SETS). The participants included eighteen men and two females.***

*Results:* ***The results of the interossei procedure were negative in 16 patients (80.0%), fair in 3 patients (15%), and outstanding in 1 patient (5%). When comparing the patients' interossei scores before and after surgery, no statistically significant difference was found (P= 0.793). Sixteen patients (80%) demonstrated a reasonable improvement in grip strength, three patients (15.0%) a significant improvement, and one patient (5%). Concerning Grip, there was no statistically significant change between the pre- and post-operative patient groups (P= 0.017).***

*Conclusion:* ***The transfer of the anterior interosseous nerve (AIN) to the deep motor branch of the ulnar nerve (DMUN) was not successful in fully restoring nerve function to the intrinsic muscles that are normally supplied by the ulnar nerve.***

*Keywords:* Neurotization; high ulnar nerve injury; outcomes

## 1. Introduction

The ulnar nerve Injury causes severe grip and pinch weakness, causing the ulnar digits to claw, as well as sensory and motor deficiencies in the hand. There are two categories of ulnar nerve injuries: low injuries and high injuries.[1]

Damage to the nerve above the point where the FCU muscle's motor branch originates is known as a high ulnar injury. Loss of feeling in the little finger and the ulnar side of the ring finger, as well as a weakening of the grip and pinch strength in the hand, can result from high-level nerve damage.[2]

If you handle very close injuries in the arm early on with repair or grafting, there is a high chance that the muscles will lose their shape forever before the new axons can reach the motor end plates.[3]

Transfer of anterior interosseus nerve (AIN) to a deep branch of the ulnar nerve to restore motor function either from the original end to the end or, more recently, supercharged end-to-side nerve transfer (SETS) has been proposed.[4]

This study evaluated motor and functional outcomes and clawing correction after AIN transfer to DMUN.

## 2. Patients and methods

This study was conducted on twenty patients, 18 males, and two females, with high ulnar nerve injury, enrolled to analyze the outcomes of AIN Transfer to DUMN, either end-to-end or SETS transfer at the orthopedic department, faculty of medicine, Azhar University Hospitals and the microsurgery unit, orthopedic department, Assiut University Hospitals from 3/2020 to 8/2023.

2.1.Inclusion criteria: Injuries happen at or above the elbow area and close to where the FCU branch starts. Type of damage: a post-traumatic injury. Sex: both men and women. More than ten years old.

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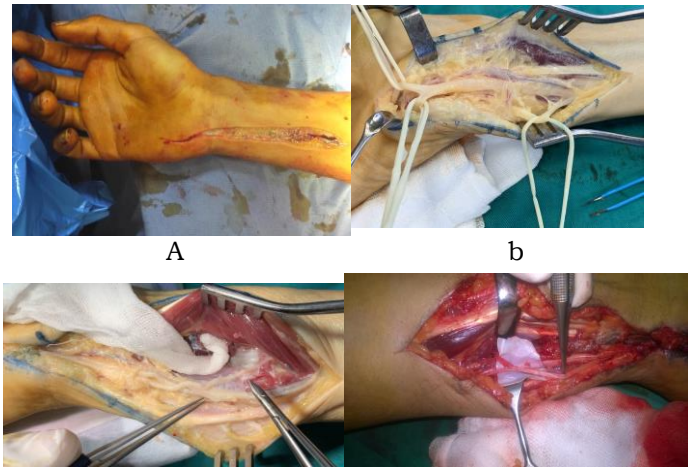
2.2.Exclusion criteria: Individuals who have suffered damage to their nerves farther down the FCU branch, near the area that receives motor and sensory innervation, It is recommended that patients with neuropraxia undergo observational treatment without surgical intervention, as a full recovery is anticipated. The patient may not show up until twelve months after the injury or Patients whose injuries have progressed to the point where there is no way to reverse the fibrosis and atrophy that has occurred in their muscles. When patients with cognitive illnesses like dementia decline to take part in a study, tendon transfers may be the best option.

2.4.Methods

Surgical technique

Patient Positioning and Anesthesia: Both general and regional anesthesia were used during the operation. The patient was positioned on their back. The arm was positioned on a sideboard in an extended, abducted position, and a Tourniquet was fastened. The ulnar nerve injury site was explored after a tourniquet was applied at the elbow. An incision was made over the nerve. Neuroma excision if applicable. The ulnar nerve can be transposed anteriorly if necessary. Under the guidance of a microscope, an epineural repair utilizing 8-0 nylon sutures was executed to restore the ulnar nerve without causing any strain. An incision was created at the wrist and distal forearm, which extended proximally over the wrist, overlying the hypothenar eminence and opening the Guyon canal. The Guyon canal was used to decompress the ulnar nerve. The next step was to divide the ulnar nerve into its motor and sensory fascicles as far as 8 to 10 cm from the wrist crease using intraneural dissection. The next step in locating the pronator quadratus PQ muscle was to radially retract the long flexor tendons.

To transfer to the ulnar nerve, the AIN was split proximally to its first branch and mobilized. The deep motor branch of the ulnar nerve was dissected and separated in the forearm enabling tension-free transfer to AIN in end-to-end transfer. Open the perineurium of the motor fascicular group of the ulnar nerve and transpose AIN toward the perineural window in the motor fascicles to achieve end-to-side coaptation (6–8 cm proximal to wrist crease). Move the hand and forearm fully to verify nerve repair tension. Tension-free repair is needed for SETS or end-to-end transfer. Under microscope magnification, 9/0 or 10/0 nylon nonabsorbable sutures repaired all damage. The patient was followed at three, nine, twelve, and eighteen months.



A b c d

Figure 1. a. incision, b. identification and intranural dissection of ulnar nerve, c. end to end transfer, d. supercharge end to side transfer.

## 3. Results

According to demographic data, the mean age and standard was 37.25 ± 15.82 ranging from12 – 69 years, 80% of studied patients was males while 20% was females. The majority of studied patients was manual worker. Table 1

*Table 1. Demographic data and characteristics of the studied patients.*

| | | STUDIED PATIENTS N=20 |
|---|---|---|
| AGE | Mean ± SD<br>Range | 37.25 ± 15.82<br>12 - 69 |
| GENDER | Male | 16(80%) |
| | Female | 4(20%) |
| OCCUPATION | Housewife | 4(20%) |
| | Farmer | 5(25%) |
| | Manual worker | 9(45%) |
| | Student | 2(10%) |

According to Operative data, 45% their injury caused by Sharp knife, 40% by RTA, 15% by fall. most of injuries were at elbow level 11 cases (55%) followed by above elbow level 5 cases (25%) and proximal forearm 4 (20%). the mean time and SD between injury and surgery was 5.11 ± 2.55 months ranging from 0 – 10 months. (Table 2)

*Table 2. Operative data of studied patients.*

| | | STUDIED PATIENTS N=20 |
|---|---|---|
| MECHANISM OF INJURY | RTA (Post-operative) | 8(40%) |
| | Fall (Post-operative) | 3(15%) |
| | Sharp knife | 9(45%) |

| | | |
|---|---|---|
| SIDE AFFECTED | Right | 10(50%) |
| | left | 10(50%) |
| SIDE DOMINANT HAND | Dominant | 12(60%) |
| | Non Dominant | 8(40%) |
| LEVEL OF INJURY | elbow | 11(55%) |
| | Above elbow | 5(25%) |
| | Proximal forearm | 4(20%) |
| TYPE OF SURGERY | End to end | 10(50%) |
| | Sets | 10(50%) |
| TIME OF SURGERY (MONTH) | Mean ± SD<br>Range | 6.11 ± 2.55<br>0 - 10 |

Regarding motor function assessment in our study, interossei showed bad results in 16 (80.0%) patients, fair in 3 (15%) and excellent in 1 (5%) patient. There was no statistical significance difference between studied patients before and after surgery regarding to interossei P= 0.793. Table 3

*Table 3. interossei before and after surgery between the studied patients*

| | | BEFORE | AFTER | TEST VALUE | P VALUE |
|---|---|---|---|---|---|
| INTEROSSEI | Bad | 17(85%) | 16(80%) | $X^2$ =1.03 | 0.793 |
| | Fair | 3(15%) | 3(15%) | | |
| | Good | 0(0%) | 0(0%) | | |
| | Excellent | 0(0%) | 1(5%) | | |

P-value > 0.05: Non-significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant *: Chi-square test

Grip strength showed fair improvement in 16 (80%) patients, good improvement in 3 (15.0%) and excellent in 1 (5%) patient. There was no statistical significance difference between studied patients before and after surgery regarding to Grip P= 0.017. Table 4

*Table 4. grip strength assessment before and after surgery among the studied patients*

| | | BEFORE | AFTER | TEST VALUE | P VALUE |
|---|---|---|---|---|---|
| GRIP | Poor | 6(30%) | 0(0%) | $X^2$ =10.133 | 0.017 |
| | Fair | 14(70%) | 16(80%) | | |
| | Good | 0(0%) | 3(15%) | | |
| | Excellent | 0(0%) | 1(5%) | | |

P-value > 0.05: Non-significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant *: Chi-square test

Pinch strength showed poor improvement in 16 (80%) patients, fair in 2 (10%) patients good in 1 (5%) patient and excellent in 1 (5%) patient. There was no statistical significance difference between studied patients before and after surgery regarding to Pinch P=0.217. Table 5

*Table 5. pinch strength before and after surgery among the studied patients.*

| | | BEFORE | AFTER | TEST VALUE | P VALUE |
|---|---|---|---|---|---|
| PINCH | Poor | 20(100%) | 16(80%) | $X^2$ =4.444 | 0.217 |
| | Fair | 0(0%) | 2(10%) | | |
| | Good | 0(0%) | 1(5%) | | |
| | Excellent | 0(0%) | 1(5%) | | |

P-value > 0.05: Non-significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant *: Chi-square test

Clawing showed poor improvement in 11 (55%) patients, fair in 5 (25%) patients good in 2 (10%) patients and excellent in 2 (10%) patients. There was no statistical significance difference between studied patients before and after surgery regarding to Clawing P= 0.523. Table 6

*Table 6. clawing correction before and after surgery among the studied patients.*

| | | BEFORE | AFTER | TEST VALUE | P VALUE |
|---|---|---|---|---|---|
| CLAWING | Poor | 12(60%) | 11(55%) | $X^2$ =2.243 | 0.523 |
| | Fair | 5(25%) | 5(25%) | | |
| | Good | 3(15%) | 2(10%) | | |
| | Excellent | 0(0%) | 2(10%) | | |

P-value > 0.05: Non-significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant *: Chi-square test

3.1.CASE PRESENTATION

Case 1: Male patient 27 years old with ulnar nerve injury at elbow with sharp knife, underwent direct repair of ulnar nerve at elbow and distal SETS transfer of AIN to DUMN at distal forearm. Follow up after one year showed no improvement in intrinsic muscles function with persistence of clawing.

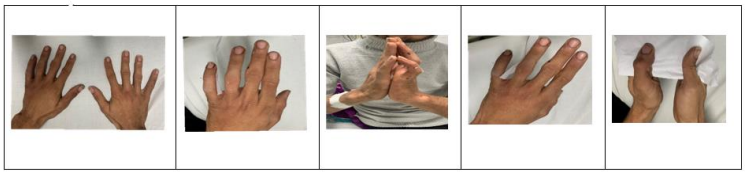


Figure 2. preoperative assessment of high ulnar nerve injury showed clawing of ring and little finger, positive froment sign and weak intrinsics.

Figure 3. Follow up after one year showed wasting of intrinsics, persistence of clawing and froment sign.

## 4. Discussion

According to demographic data, our results showed that the mean age of the studied patients was 37.25 ± 15.82 years, ranging from 12 – 69 years; 80% of studied patients were males, while 20% were females. The majority of studied patients were manual workers.

In the same line, Monib SM et al. reported that the mean age of the study population was 31.2 ±7.66 years. As regards gender, 70.0% were males, while 30.0% were females, and the majority of the study population were manual workers (30.0%). Other occupations were butcher (10.0%), driver (10.0%), farmer (10.0%), housewife (10.0%), police officer (10.0%), student (10.0%) and teacher (10.0%).[5]

Basra KR et al. also reported that out of 13 patients, 10(77%) were males, while 3(23%) were females. The median age was 32 years, ranging from 18 to 42 years.[6]

According to operative data, our findings revealed that 45% of injuries were caused by Sharp knives, 40% by RTA (road traffic accidents), and 15% by falls. Most of the injuries were at the elbow level 11 cases (55%), followed by above elbow level 5 cases (25%) and proximal forearm 4 (20%). The mean time and SD between injury and surgery was 5.11 ± 2.55 months, ranging from 0 – 10 months.

Along with our results, Mohammed SS et al. reported that the highest distribution in the mode of trauma was road traffic (RTA) with 41.7%, elbow level of injury represented the majority with 58.3%, the time interval before surgery mean was 4.25±1.48 with minimum two months and maximum six months.[7]

Also, our results agreed with Novak CB & Mackinnon SE, who reported that the mean time from injury to surgery was 3 ±3 months with a range of 0 to 10 months.[8]

Regarding motor function assessment in our study, dorsal interossei showed bad results in 16 (80.0%) patients, fair in 3 (15%) and excellent in 1 (5%) patient. There was no statistically significant difference between studied patients before and after surgery regarding Dorsal interossei.

Our results disagree with Maohammed SS et al., who reported that postoperative dorsal interossei showed bad results in 16.7%, good in 41.66%, excellent results in 41.66%, and no patients showed excellent results.[7]

Also, our results disagree with Novak CB & Mackinnon SE, who reported that any patient reported no functional deficit in performing tasks in pronation. [8]

We found that grip strength showed fair improvement in 16 (80%) patients, good improvement in 3 (15.0%), and excellent in 1 (5%) patient. There was no statistically significant difference regarding Grip between studied patients before and after surgery.

This came from Baltzer H et al., who reported some improvement in the Grip strength of the affected side relative to the unaffected side in the nerve transfer group. However, this did not reach statistical significance.[9]

Also, our results contrast with those of Noaman HH et al., who reported that the grip strength in patients with good results was 80% of the normal side.[10]

In our study, PinchPinch to Zoom improved 16 (80%) patients, 2 (10%) patients, 1 (5%), and 1 (5%). Patients' Pinch to Zoom scores did not alter statistically before and after surgery.

Compared to the nerve transfer group, the damaged side's pinch strength improved, according to Baltzer H et al. Statistical significance was not reached.[9]

Our results differ with Monib SM et al., who found 60.0% perfect and 40.0% fair pinch improvement. In contrast, Novak CB & Mackinnon SE found that Lateral Pinch, measured by a standard pinch gauge, increased from 2.2 ± 2 to 13.8 ± 6 lb postoperatively. In contrast, Noaman HH et al. found that good-performing patients had pinch strengths of 80% of the normal side. Mohammed SS et al. found 66.7% perfect pinch improvement.[5,7,8,10]

We found that Clawing showed poor improvement in 11 (55%) patients, fair in 5 (25%) patients, good in 2 (10%) patients and excellent in 2 (10%) patients. There was no statistically significant difference between studied patients before and after surgery regarding Clawing.

This came by Koriem E et al., who reported that there was good improvement in clawing reported that in 1 patient, and excellent improvement in Clawing was reported in 9 patients in the nerve transfer group according to a brand score of .[11]

In addition, Mohammed SS et al. reported that only 33.3% had clawing improvement. Furthermore, Monib SM et al. reported that only 20.0% showed clawing improvement. , Bertelli JA &, Arami A who found that none of their 11 patients had improvement in clawing. [5,7,12]

### *4. Conclusion*

AIN (anterior interosseous nerve) transfer to DMUN (deep motor branch of the ulnar nerve) did not adequately reinnervate intrinsic muscles supplied by the ulnar nerve.

## Disclosure

The authors have no financial interest to declare in relation to the content of this article.

## Authorship

All authors have a substantial contribution to the article

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## Conflicts of interest

There are no conflicts of interest.

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