

Case Series

Optimizing outcomes in ulnar nerve injuries: nerve grafting after primary neurorrhaphy

**Victor Hugo Garzón Ortega^{1*}, Verania Fernanda Hernández Barrón¹,
Fernando Fernández Varela Gómez², Lucio Alejandro Santos Moyron¹,
Alexander Cárdenas Mejía³**

¹Department of Plastic and Reconstructive Surgery, Hospital General “Dr. Manuel Gea González”, Mexico City, Mexico

²Department of Plastic and Reconstructive Surgery, Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán, Mexico City, Mexico

³Peripheral Nerve Clinic of Plastic and Reconstructive Surgery, Hospital General “Dr. Manuel Gea González”, Mexico City, Mexico

Received: 12 February 2025

Revised: 13 March 2025

Accepted: 08 April 2025

*Correspondence:

Dr. Victor Hugo Garzón Ortega,

E-mail: victorhugogarzon009@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

This case series rigorously assesses the efficacy of primary neurorrhaphy followed by secondary nerve grafting in five patients with ulnar nerve injuries, utilizing the quick disabilities of the arm, shoulder, and hand (QuickDASH) score as a standardized measure of functional outcomes. Treated between 2019 and 2023, these patients underwent initial neurorrhaphy followed by nerve transfer. Functional assessments were conducted preoperatively, post-neurorrhaphy, and post-nerve transfer using the QuickDASH questionnaire. The mean preoperative QuickDASH score was 43.00 (standard deviation [SD]=7.34), improving to 36.20 (SD=6.54) after neurorrhaphy (mean difference=-6.8, $p<0.01$), and further to 24.20 (SD=2.59) after nerve transfer (mean difference=-12, $p<0.01$). Paired t-tests substantiated statistically significant enhancements in functional activity at each intervention stage ($p<0.01$). These results indicate that integrating primary neurorrhaphy with secondary nerve transfer effectively restores nerve function in acute ulnar nerve lacerations. This study underscores the potential of these combined surgical strategies to optimize outcomes in complex peripheral nerve injuries, though larger-scale investigations are warranted to confirm these findings.

Keywords: Ulnar nerve injury, Nerve grafting, Neurorrhaphy, Peripheral nerve repair, QuickDASH

INTRODUCTION

Ulnar nerve injuries pose significant clinical challenges, resulting in pronounced motor and sensory deficits within the nerve's innervation territory. The therapeutic approach varies according to injury severity and etiology, with surgical intervention being imperative for clean, sharp lacerations. Despite this, the optimal surgical strategy remains under scrutiny.¹ Although primary neurorrhaphy followed by nerve grafting is infrequently employed, its effectiveness merits thorough exploration.

Among peripheral nerve injuries, ulnar nerve lesions predominate.² These injuries typically present with sensory impairments along the ulnar nerve distribution, the extent of which correlates with the injury's anatomical level. Motor deficits-including compromised finger adduction and abduction, diminished power grip, and impaired fine motor skills-often prove functionally debilitating.³ Ulnar nerve injuries are classified as high or low, determined by their location relative to the origin of the flexor carpi ulnaris (FCU) or the flexor digitorum profundus (FDP) to the fourth and fifth fingers. High

lesions impose additional constraints, such as reduced ulnar wrist deviation.⁴

Sunderland classification

The Sunderland classification provides a systematic framework for evaluating ulnar nerve injuries, categorizing them from grade I (neuropraxia) to grade V (complete transection).⁵ Its clinical relevance in directing treatment and forecasting outcomes has been substantiated across multiple studies.⁶

Surgical treatment of ulnar nerve injuries

Conventional nerve repair, reliant on tension-free neurorrhaphy, often fails to accelerate reinnervation—a critical determinant of functional recovery. Nerve transfer has emerged as a viable alternative, leveraging expendable adjacent nerves to transform proximal injuries into distal ones, thus hastening reinnervation and enhancing outcomes.⁷ For extensive defects (≥ 4.0 cm), where direct end-to-end suturing or autologous grafts are impractical, nerve grafts offer a practical solution.⁸ Conditions such as neurotmesis and axonotmesis frequently result in persistent deficits due to delayed reinnervation, positioning nerve transfers as a promising option for earlier functional restoration.^{9,10}

DASH score

Patient reported outcome measure, evaluates physical function and symptoms in individuals with upper limb musculoskeletal disorders. Comprising 30 items, it offers comprehensive assessment of patient status.¹¹

QuickDASH

The QuickDASH, an abridged version of the DASH questionnaire, minimizes respondent burden while preserving robust psychometric properties. Its 11 items assess upper extremity function, encompassing daily activities (e. g., lifting, carrying), pain intensity, and functional limitations.¹²

CASE SERIES

This study encompasses five patients with acute, complete ulnar nerve lacerations, managed between 2019 and 2023 at Hospital General “Dr. Manuel Gea González”. Each underwent primary neurorrhaphy followed by secondary nerve transfer. Functional outcomes were quantified using the QuickDASH questionnaire, which employs a Likert scale ranging from 1 (no difficulty) to 5 (unable to perform), with higher scores reflecting greater disability. Scores were converted to percentages via a standardized formula and evaluated preoperatively, post-neurorrhaphy, and post-nerve transfer. Statistical analysis with paired t tests, conducted using SPSS software (version 19 for Mac), assessed intervention efficacy.

Case 1: High ulnar nerve injury secondary to lacerating trauma

A 54-year-old male sustained a laceration from a grinding tool affecting the dorsal and volar proximal third of the left forearm. Initial management at an external facility involved primary wound closure. Eight days post-injury, evaluation by the plastic and reconstructive surgery service revealed persistent forearm pain during finger movements, sensory loss in the fourth and fifth fingers, and generalized hand weakness. Examination disclosed positive Froment and Wartenberg signs and hypoesthesia (6/10) in the ulnar nerve distribution. The preoperative QuickDASH score of 32 indicated substantial impairment. Imaging excluded fractures, confirming a low ulnar nerve injury diagnosis.

Initial treatment comprised surgical debridement, edge remodeling, and tertiary intention closure, followed by referral to the Peripheral Nerve Clinic. Electromyography (EMG) two months later demonstrated severe ulnar mononeuropathy with axonotmesis from the FCU’s first branch and partial reinnervation. Surgical exploration, nerve coaptation, and sural nerve grafting performed. Three months postoperatively, QuickDASH score improved to 22, reflecting notable functional recovery.

Case 2: High ulnar nerve injury secondary to motor vehicle accident

A 28-year-old female sustained a right ulnar nerve injury from a proximal forearm laceration in a motor vehicle accident. Initial care included wound irrigation, debridement, and primary neurorrhaphy. Four days later, open reduction and internal fixation (ORIF) with an anatomical locking compression plate (LCP) and a pedicled latissimus dorsi flap addressed soft tissue defects. Five months post-injury, the peripheral nerve clinic performed ulnar nerve reconstruction with sural nerve grafting. The preoperative QuickDASH score of 40 indicated significant disability, improving to 21 post-surgery and rehabilitation.

Case 3: Low ulnar nerve injury with median nerve and flexor system involvement

An 18-year-old male experienced trauma to the left hand and wrist, severing the flexor tendons to the second and fourth digits and injuring the ulnar and median nerves. Initial management involved exploration, debridement, and primary neurorrhaphy. Subsequent presentation revealed limited motor and sensory function and an abnormal hand posture with extended metacarpophalangeal and interphalangeal joints. Five months later, secondary surgery included sural nerve grafting to the ulnar and median nerves, pronator quadratus transfer to the median nerve’s recurrent motor branch, and rod placement in the FDP tendons of the second and fourth fingers and flexor pollicis longus (FPL). Later, rods were removed, and tendon grafts with

tenorrhaphies were performed. Postoperative follow-up demonstrated enhanced finger flexion and preserved sensation, with the QuickDASH score improving from 50 post-neurorrhaphy to 27 post-grafting.

Case 4: Low ulnar nerve injury secondary to work-related machinery accident

A 45-year-old male sustained a deep right wrist laceration from industrial machinery, transecting ulnar nerve and partially damaging FCU and FDP to 4th and 5th fingers. Emergency care included wound irrigation, debridement, and primary neurorrhaphy. Three weeks post-injury, persistent paresthesia, hand weakness, and fine motor difficulties yielded QuickDASH score of 44. EMG at 4 months revealed poor regeneration and axonotmesis. Five months post-injury, sural nerve grafting and FDP tendon grafts were performed. Three months later, improved finger flexion, grip strength, and partial sensory recovery reduced QuickDASH score to 25.

Case 5: Low ulnar nerve injury secondary to glass laceration

A 32-year-old female sustained a left wrist laceration from glass, transecting the ulnar nerve, partially

damaging the median nerve, and disrupting flexor tendons to the fourth and fifth digits. Immediate surgery included debridement, primary neurorrhaphy, and tendon repairs. Three months later, persistent numbness, finger clawing, and grasping difficulties resulted in a QuickDASH score of 49. EMG at 5 months indicated severe axonal loss. Secondary surgery involved sural nerve grafting to both nerves and staged tendon reconstruction. Three months postoperatively, enhanced grip strength, reduced clawing, and sensory improvement lowered the QuickDASH score to 26.

The mean preoperative QuickDASH score 43.00 (SD=7.34). Post-neurorrhaphy, it decreased to 36.20 (SD=6.54), with a mean difference of -6.8 points (SD=1.79 and $p<0.01$). Paired t test analysis confirmed significant functional improvement ($t=8.500$ and $p=0.001$) (Table 1). Following the nerve transfer, mean score further improved to 24.20 (SD=2.59), with the mean difference of -12 points (SD=4.30 and $p<0.01$). Paired t tests were validated the significant differences between pre-operative and post-nerve transfer scores ($t=7.916$ and $p=0.001$) and between post-neurorrhaphy and post-nerve transfer scores were ($t=6.239$ and $p=0.003$), affirming efficacy of the both interventions (Table 2 and Figure 1).

Table 1: Descriptive statistics of Quick-DASH.

Variables	Pre-surgical functional activity	Post-neurorrhaphy functional activity	Post-nerve transfer functional activity
Mean	43.000	36.200	24.200
SD	7.348	6.535	2.588
Minimum	32.000	27.000	21.000
Maximum	50.000	43.000	27.000

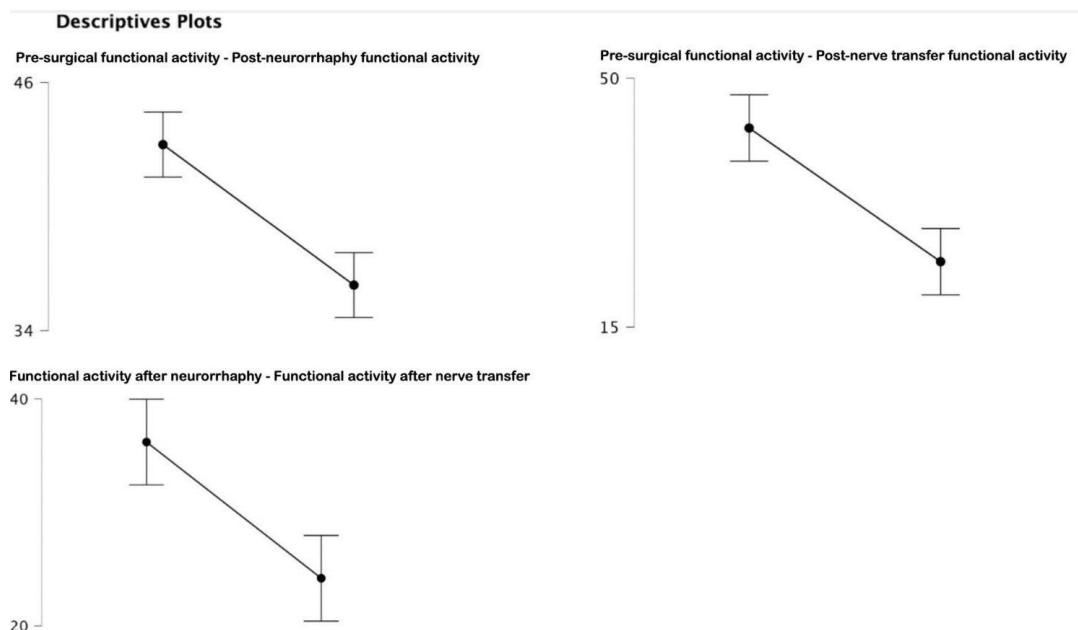


Figure 1: Comparison of functional activity scores across surgical stages.

Descriptive plots illustrating the changes in functional activity scores between pre-surgical, post-neurorrhaphy, and post-nerve transfer stages. Each plot shows the mean scores with 95% confidence intervals, highlighting the differences observed between the stages.

Table 2: Paired samples T test of pre-surgical and post surgical interventions.

Measure 1	Measure 2	T	Df	P
Pre-surgical functional activity	Post-neurorrhaphy functional activity	8.500	4	0.001
Pre-surgical functional activity	Post-nerve transfer functional activity	7.916	4	0.001
Post-neurorrhaphy functional activity	Post-nerve transfer functional activity	6.239	4	0.003

DISCUSSION

Meticulous surgical exploration is paramount, requiring layer-by-layer dissection and systematic referencing throughout the procedure. The use of wide awake local anesthesia no tourniquet (WALANT) enhances intraoperative assessment by enabling real-time evaluation of muscular and tendinous function, while also facilitating the identification of anatomical structures. For patients previously managed by other services, comprehensive preoperative evaluations, including EMG, are essential to determine the injury's origin and severity and to identify candidates for local nerve transfers.

The etiology of ulnar nerve injuries significantly influences the surgical approach. For clean, sharp lacerations with nerve gaps ≤ 1 cm, primary neurorrhaphy is the preferred initial treatment. In cases with larger gaps or delayed presentations, nerve grafts are indicated to effectively bridge the defect. In this study, primary neurorrhaphy alone yielded significant functional improvements, with the mean QuickDASH score decreasing from 43.00 to 36.20 (mean difference=-6.8, $p<0.01$). These findings align with Vordemvenne et al who reported that patients regained approximately 70% of hand function following primary microsurgical repair, particularly in younger individuals.¹³ Similarly, Basar et al observed superior DASH scores in clean transection injuries compared to those with extensive soft-tissue damage, consistent with our Cohort.¹⁴

Nerve transfer strategies are particularly advantageous in proximal injuries or delayed cases where grafting alone is insufficient. Motor-to-motor transfers within the same functional domain are preferred, as they accelerate target muscle reinnervation. In this series, combining primary neurorrhaphy with secondary nerve transfers further reduced the mean QuickDASH score to 24.20 (mean difference=-12, $p<0.01$), underscoring the efficacy of this approach. Gontre et al similarly reported that primary repair alone resulted in higher QuickDASH scores (46 ± 4 at 12 months) compared to combined repair with anterior interosseous nerve transfer (24 ± 3), mirroring our results.⁹ Sallam et al also found nerve transfers superior to grafting in high ulnar nerve injuries, with 83.33% of patients achieving M3 or greater motor recovery, suggesting that transfers enhance outcomes in complex cases.¹⁵

Direct comparisons between neurorrhaphy and grafting are challenging due to their distinct indications: neurorrhaphy is typically employed for immediate repairs

(within 72 hours), while grafting is reserved for early repairs (after three weeks). Conversely, Koshy et al suggest that nerve transfers outperform grafts in delayed proximal injuries by reducing reinnervation time.¹⁶ Our combined approach leverages both techniques, optimizing neurotization and shortening recovery timelines compared to traditional methods.

Recovery timelines provide further context for our findings. Donoso et al reported muscle activity detectable by EMG at seven months post-neurorrhaphy, with clinical movement evident by ten months, while grafting extends this to 12-14 months.¹⁷ In contrast, our patients demonstrated functional improvements as early as 3-5 months post-nerve transfer, likely due to accelerated reinnervation from the transfers, as supported by von Guionneau et al on supercharged end-to-side transfers.¹⁸ Terzis et al emphasize the importance of surgical intervention within five months for optimal outcomes, a criterion met by our secondary procedures.³

The QuickDASH questionnaire offers a standardized, sensitive measure of functional recovery. Its validity and reliability, as confirmed by Gummeson et al make it well-suited for assessing postoperative changes.¹⁹ Our observed scores are consistent with established benchmarks: Frostadottir et al noted elevated scores in patients with cold sensitivity, while Henn et al reported variability based on nerve stability, reinforcing the consistency of our improvements.^{20,21}

Future research

Investigating the long-term efficacy of combined neurorrhaphy and nerve transfer, optimal surgical timing, and advancements in graft materials (e. g., bioengineered matrices) could further enhance recovery. Exploring the feasibility of performing grafts and transfers in a single procedure and establishing standardized treatment protocols may advance clinical practice.

Limitations

The small sample size (five cases) restricts the generalizability of these findings, necessitating larger cohorts for validation. The retrospective design may introduce biases from incomplete records or treatment variability. Additionally, individual factors such as age and injury duration complicate standardization. Prospective, controlled studies with extended follow-up are required to substantiate these results.

CONCLUSION

This case series demonstrates that integrating primary neurorrhaphy with secondary nerve transfer significantly improves functional outcomes in acute ulnar nerve lacerations. The mean QuickDASH score decreased from 43.00 preoperatively to 36.20 post-neurorrhaphy and further to 24.20 post-nerve transfer ($p < 0.01$). These findings align with Gontre et al who reported superior outcomes with combined techniques compared to primary repair alone, emphasizing the role of nerve transfers in accelerating reinnervation. Despite the limited sample, this approach effectively restores function and enhances quality of life. Larger, prospective studies are essential to validate these results and standardize treatment protocols.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: Not required

REFERENCES

- Post R, De Boer KS, Malessy MJA. Outcome following Nerve Repair of High Isolated Clean Sharp Injuries of the Ulnar Nerve. *PLoS One*. 2012;7(10):e47928.
- Kouyoumdjian J, Graça C, Ferreira VM. Peripheral nerve injuries: A retrospective survey of 1124 cases. *Neurol India*. 2017;65(3):551.
- Terzis JK, Kokkalis ZT. Outcomes of Secondary Reconstruction of Ulnar Nerve Lesions: Our Experience. *Plastic Reconstruct Surg*. 2008;122(4):1100.
- Kirsty U, Boyd IK, Fox SE. Nerve transfers. In P. Neligan and D. W. Buck (Eds.), *Core procedures in plastic surgery*. Elsevier. 2013;375-92.
- Sunderland S. A Classification Of Peripheral Nerve Injuries Producing Loss Of Function. *Brain*. 1951;74(4):491-516.
- Chhabra A, Ahlawat S, Belzberg A, Andreseik G. Peripheral nerve injury grading simplified on MR neurography: As referenced to Seddon and Sunderland classifications. *Indian J Radiol Imaging*. 2014;24(03):217-24.
- Ghoraba SM, Mahmoud WH, Elsergany MA, Ayad HM. Ulnar Nerve Injuries (Sunderland Grade V): A Simplified Classification System and Treatment Algorithm. *Plastic Reconstruct Surger*. 2019;7(11):e2474.
- Kornfeld T, Vogt PM, Radtke C. Nerve grafting for peripheral nerve injuries with extended defect sizes. *Wiener Medizinische Wochenschrift*. 2019;169(9-10):240-51.
- Gontre G, Polmear M, Carter JT, Castagno C, Herrera FA. Primary Repair versus Reverse End-to-Side Coaptation by Anterior Interosseous Nerve Transfer in Proximal Ulnar Nerve Injuries. *Plastic Reconstruct Surg*. 2023;152(2):384-93.
- Li Q, Zhang P, Yin X, Jiang B. Early nerve protection with anterior interosseous nerve in modified end-to-side neurorrhaphy repairs high ulnar nerve injury: A hypothesis of a novel surgical technique. *Artif Cells Nanomed Biotechnol*. 2015;43(2):103-5.
- Germann G, Wind G, Harth A. Der DASH-Fragebogen-Ein neues Instrument zur Beurteilung von Behandlungsergebnissen an der oberen Extremität. *Handchirurgie Mikrochirurgie Plastische Chirurgie*. 199;31(3):149-52.
- Pyörny J, Sletten IN, Jokihaara J. Concurrent validity study of QuickDASH with respect to DASH in patients with traumatic upper extremity amputation. *BMC Musculoskeletal Disord*. 2004;25(1):86.
- Vordemvenne T, Langer M, Ochma S, Raschke M, Schult M. Long-term results after primary microsurgical repair of ulnar and median nerve injuries. *Clin Neurol Neurosur*. 2007;109(3):263-71.
- Basar H, Basar B, Erol B, Tetik C. Comparison of ulnar nerve repair according to injury level and type. *Inte Orthop*. 2014;38(10):2123-8.
- Sallam AA, El-Deeb MS, Imam MA. Nerve Transfer Versus Nerve Graft for Reconstruction of High Ulnar Nerve Injuries. *J Hand Surg*. 2017;42(4):265-73.
- Koshy JC, Agrawal NA, Seruya M. Nerve Transfer versus Interpositional Nerve Graft Reconstruction for Posttraumatic, Isolated Axillary Nerve Injuries: A Systematic Review. *Plastic Reconstruct Surg*. 2017;140(5):953-60.
- Donoso RS, Ballantyne JP, Hansen S. Regeneration of sutured human peripheral nerves: An electrophysiological study. *J Neurol, Neurosurg Psychiatr*. 1979;42(2):97-106.
- Von Guionneau N, Sarhane KA, Brandacher G, Hettiaratchy S, Belzberg AJ, Tuffaha S. Mechanisms and outcomes of the supercharged end-to-side nerve transfer: A review of preclinical and clinical studies. *J Neurosur*. 2021;134(5):1590-8.
- Gummesson C, Ward MM, Atroshi I. The shortened disabilities of the arm, shoulder and hand questionnaire (Quick DASH): Validity and reliability based on responses within the full-length DASH. *BMC Musculoskeletal Disorders*. 2006;7(1):44.
- Frostadottir D, Ekman L, Zimmerman M, Dahlin LB. Cold sensitivity and its association to functional disability following a major nerve trunk injury in the upper extremity-A national registry-based study. *PLOS ONE*. 2022;17(7):e0270059.
- Henn CM, Patel A, Wall LB, Goldfarb CA. Outcomes Following Cubital Tunnel Surgery in Young Patients: The Importance of Nerve Mobility. *J Hand Surg*. 2016;41(4):e1-7.

Cite this article as: Ortega VHG, Barrón VFH, Gómez FFV, Moyron LAS, Mejía AC. Optimizing outcomes in ulnar nerve injuries: nerve grafting after primary neurorrhaphy. *Int Surg J* 2025;12:768-72.