DOI: 10.7860/JCDR/2026/87867.23472

Case Report

Physiotherapy Section

Rehabilitation of a Rare Combined Radial, Median, and Ulnar Nerve Injuries following Handcuff Compression: A Case Report

ABHISHEK MANDAL[1], MANISHA MONDAL[2], AKANKSHA SAXENA[3], MANDEEP KUMAR JANGRA[4], RUCHIKA[5]

BY-NC-ND

ABSTRACT

Prolonged compression and abnormal stretch is the cause of many types of Peripheral Nerve Injuries (PNI), but injury due to overtightened handcuffs is a rare occurrence. These neuropathies have a poor prognosis if not treated promptly. A 24-year-old man with combined radial, median, and ulnar nerve injury following handcuff restraint received a 40-day physiotherapy protocol intervention (30-40 min/session). Interventions included proprioceptive neuromuscular facilitation, functional electrical stimulation, and functional activities administered each day for 10 days and then five days/week for the remaining 30 days. Measurements were taken at baseline (T0), then at every 10 sessions (T1, T2, T3, T4). Progress was evaluated on a10-session interval using the Quick Disabilities of the Arm, Shoulder and Hand (DASH), Patient Rated Wrist Evaluation (PRWE), pinch and hand grip strength using hand dynamometer. Grip and pinch strength improved from 0-10 kg and 0-5 kg, respectively whereas disability score on QuickDASH changed from 59.09% to 13.63% and PRWE improved from 48.5 to 4.5 point. An individually tailored advanced physiotherapy regime was effective in improving gross motor, fine motor skills and functional recovery of an individual with a rare handcuff injury. Significant improvements were also observed in elbow, wrist, and metacarpophalangeal joint range of motion. Thus, a structured, phase-wise physiotherapy approach can be the first line of effective treatment in functional recovery of individuals with a rare handcuff injury.

Keywords: Electric stimulation, Motor skills, Muscle stretching exercises, Peripheral nerve injuries, Young adult

CASE REPORT

A 24-year-old right-hand dominant male (BMI: 20.8 kg/m^2) reported to the neurological physiotherapy department (Oct 2024) with a 1-month history of difficulties opening his fist, gripping things, performing overhead activities, and writing. He described being tied to a chair backrest for 4-5 hours at a police station one month back, after which he had severe numbness and paralysis in the right upper limb. Left-sided numbness vanished within a few hours. Gradually increasing symptoms were intermittent, with increased wrist, finger, and elbow weakness. Initially, he went to the local doctor with his complaint, and was prescribed vitamin B12 (methylcobalamin supplementation) and advised for physiotherapy treatment, however, due to persistent motor deficits, he was referred for physiotherapy.

On examination, the patient displayed claw hand and intrinsic minus deformity due to thenar and hypothenar atrophy. Right triceps weakening was noticeable, with failure to maintain antigravity elbow extension, whereas forearm flexors remained intact. Muscle strength tests revealed grade 0 elbow extensors, grade 1 wrist and finger extensors, and grade 5 strength in brachioradialis, wrist and finger flexors, and shoulder muscles [1]. The right hand thenar and hypothenar muscles showed atrophy, resulting in an 'intrinsic minus hand. There was partial loss of sensory function (only light touch) of the back of the right arm, dorsal side of the forearm, thenar and hypothenar muscle area and tiger mouth area. Furthermore, there was no motor function present in the right thumb. Froment's sign was positive, and the patient was unable to produce the "O" sign, whereas Hoffmann's, Upper limb tension tests, Tinel's, and Wartenberg's tests were negative [2,3]. There was no discomfort, swelling, tenderness, or skin discolouration. Nerve conduction investigations demonstrated reduced amplitude of the right radial nerve [Table/Fig-1]. Based on these observations, a diagnosis of high radial nerve damage with accompanying low median and ulnar nerve involvement was determined. Informed consent was acquired before starting physiotherapy management.

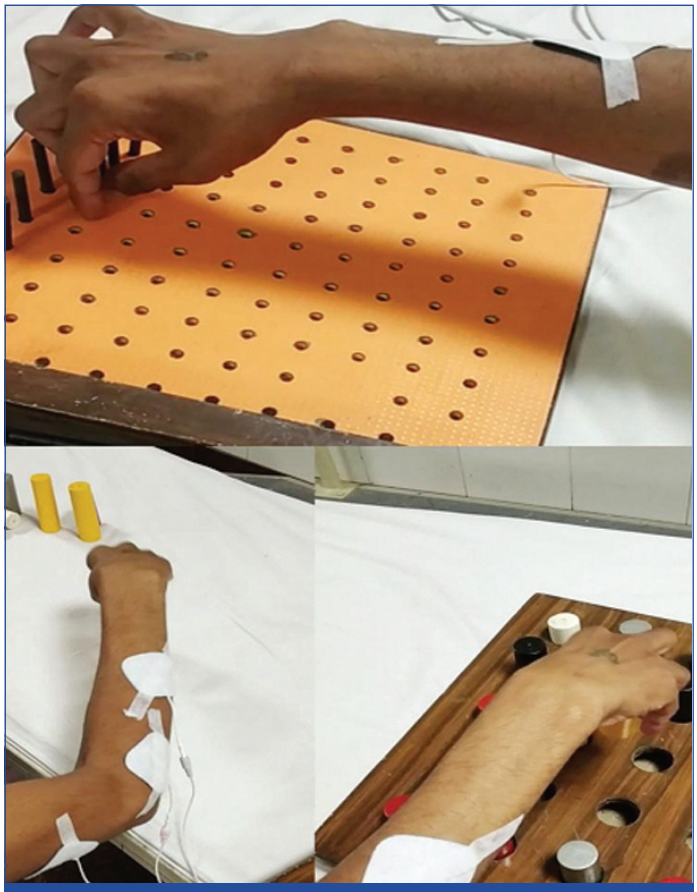
Nerve	Type	Distal latency (ms)	Amplitude	Conduction velocity (m/s)
Median	Motor	3.37	5.83 mV	56.23
Ulnar	Motor	3.00	6.87 mV	55.29
Radial	Motor	3.07	3.49 mV	66.37
Axillary	Motor	4.27	2.03 mV	44.50
Musculocutaneous	Motor	4.50	1.14 mV	48.89
Median	Sensory	3.28	12.30 µV	45.73
Ulnar	Sensory	2.80	9.68 µV	42.86
Radial	Sensory	2.48	7.92 µV	44.35

[Table/Fig-1]: Nerve conduction study findings (right upper limb).

Discussion of physiotherapy management: The patient received a total of 40 sessions, each consisting of 30-40 minutes in duration. First 10 days patient took treatment daily, then frequency of treatment sessions was reduced to five days/week for the next 30 sessions. Measurements were taken at baseline (T0), then at every 10 sessions (T1, T2, T3, T4). A rest interval of approximately 30-60 seconds was given between sets based on patient tolerance.

First phase (1st to 10th regular session): Neuromuscular Electrical Stimulation (NMES) was applied to the wrist, finger, and elbow extensors using biphasic pulsed current. Stimulation parameters included an intensity of 25-30 mA, sufficient to produce visible muscle contraction, with 30 contractions per muscle group. Active Assisted Elbow and Wrist Extension Range of Motion (AAROM) exercise and Passive Range Of Motion (PROM) finger extension exercise with facilitation was done with the intensity of 2 sets of 10 repetitions. Patient was advised for dynamic cockup splint to assist weakened wrist extensors.

Second phase (11th to 20th session, 5 days/ week): Active Elbow Extension (AROM) exercises in gravity-eliminated plane were initiated when patient improved. FES was applied for 15 minutes using two pairs surface electrodes which is disposable (Bi-phasic, 4:2 sec ramp up/down, 35Hz, 200µs pulse width, 20-30 mA intensity). This intensity was maintained to achieve functional contraction during task-oriented activities. The first pair extended the fingers, thumb, and wrist by placing the active electrode on the Extensor Digitorum Communis (EDC) and the indifferent electrode on the EPL and APL. The second set of electrodes extended the elbow with the active electrode over the posterior deltoid and the passive electrode on the triceps [Table/Fig-2] shows FES-stimulated peg board workouts for functional development.



[Table/Fig-2]: Physiotherapy intervention for fine and gross motor activity using FES and pegboard.

Third and fourth phase (21st to 40th session, 5 days/ week): Full AROM in Grade 2 was achieved on wrist. AAROM for elbow and wrist extension against gravity, two sets of 10 repetitions each was given. FES was continued and gradually intensity was decreased (15-20 mA) as voluntary muscle activation improved, to promote active control rather than passive electrically driven movement. Proprioceptive neuromuscular facilitation D1 and D2 diagonal pattern of movement were added with 10 repetitions each. Clay activities were given for 10 minutes and finally peg board exercise to facilitate the grasp and release of hand.

The QuickDASH, PRWE and grip and pinch strength were measured pre and post-treatment [4-6]. The improvements after 40 sessions on ROM, QuickDASH, grip and pinch strength and PRWE are given in [Table/Fig-3] which explains-Active range of motion throughout all joints progressed from baseline (T0) through to final evaluation (T4), with elbow extension increasing to 0°-135°, and wrist extension to 0°-85°. Grip strength increased from 0 to 10 kg and pinch strength from 0 to 5 kg. Functional disability markedly diminished as shown by a decrease in QuickDASH (59.09% to 13.63%) and PRWE (48.5 to 4.5) scores, indicating effective upper-limb recovery.

According to International Classification of Functioning, Disability and Health (ICF) categories, the Brief ICF core set for hand conditions for the patient in all Phases is provided in [Table/Fig-4], which explains progressive improvement of all domains from T0 to T4. Body functions and structures improved from severe impairment to normal or mild residual deficits, and activity and participation limitations were reduced to minimal or no restriction by final assessment. Throughout rehabilitation, environmental factors remained consistent facilitators [7]. The patient was advised to report for follow-up 15 days after completion of the 40-day treatment protocol. However, the patient did not return for the scheduled follow-up visit, therefore, no additional follow-up assessment could be performed.

Joint motion	T0 (Baseline)	T1	T2	T3	T4
Elbow extension	0°	0°-45°	0°-80°	0°-110°	0°-135°
Forearm supination	0°-30°	0°-50°	0°-70°	0°-85° -	0°-90°
Wrist extension	0°	0°-30°	0°-55°	0°-70°	0°-85°
Ulnar deviation	0°	0°-15°	0°-15°	0°-20°	0°- 35°
Radial deviation	0°	0°-10°	0°-15°	0°-20°	0°-25°
MCP Flexion	0° - 30°	0°-55°	0°-70°	0°-85°	0°-90°
MCP Extension	0°	0°-5°	0°-10°	0°-12°	0°-15°
Grip and Pinch strength, Quick DASH and PRWE					
Grip strength (Kg)	0	2.5	5	7.5	10
Pinch strength (Kg)	0	1	2.5	4	5
Quick DASH (%)	59.09	56.81	27.27	25	13.63
PRWE Functional subscale	48.5	41	29.5	15.5	4.5

[Table/Fig-3]: Active ROM values, grip and pinch strength, Quick DASH and PRWE scores for right hand.
MCP:Metacarpophalangeal;DASH: Disabilities of the arm, shoulder and hand;PRWE:Patient rated wrist evaluation

ICF terminology	T0	T1	T2	T3	T4
Body functions					
Touch function	b265.2	b265.1	b265.0	b265.0	b265.0
Mobility of joint function	b710.3	b710.2	b710.1	b710.0	b710.0
Stability of joint function	b715.3	b715.2	b715.1	b715.0	b715.0
Muscle power function	b730.4	b730.3	b730.2	b730.1	b730.1
Body structures					
Structure of upper arm	s7300.3	s7300.2	s7300.1	s7300.0	s7300.0
Structure of forearm	s7301.3	s7301.2	s7301.1	s7301.0	s7301.0
Structure of hand	s7302.3	s7302.2	s7302.1	s7302.0	s7302.0
Activities and participation					
Writing	d170.4	d170.3	d170.2	d170.1	d170.1
Lifting and carrying objects	d430.3	d430.3	d430.2	d430.1	d430.0
Fine hand use	d440.4	d440.3	d440.2	d440.1	d440.0
Hand and arm use	d445.3	d445.2	d445.1	d445.1	d445.0
Driving	d475.3	d475.2	d475.1	d475.0	d475.0
Caring for body parts	d520.3	d520.2	d520.1	d520.0	d520.0
Dressing	d540.2	d540.1	d540.0	d540.0	d540.0
Eating	d550.3	d550.2	d550.1	d550.0	d550.0
Drinking	d560.2	d560.1	d560.0	d560.0	d560.0
Doing house work	d640.4	d640.3	d640.2	d640.1	d640.0
Caring for household objects	d650.4	d650.3	d650.2	d650.1	d650.0
Recreation and leisure	d920.3	d920.3	d920.1	d920.1	d920.0

Environmental factors					
Products and technology (e1)	e115. +3	e115. +2	e115. +1	e115.0	e115.0
Support and relationship (e3)	e310. +3	e310. +2	e310. +2	e310. +2	e310. +2
Friends (e3)	e320. +3	e320. +2	e320. +1	e320.+1	e320. +1
Health professionals (e3)	e355. +4	e355. +3	e355. +2	e355. +1	e355. +1
Personal factors	(e.g. age, coping style not coded in ICF)	n/a	n/a	n/a	n/a

[Table/Fig-4]: Findings from the Brief ICF core set for patient hand conditions in every phase based on ICF categories.

DISCUSSION

This case report describes the assessment and successful treatment of an adult male patient with radial, ulnar, and median nerve damage who received just physiotherapy. Sensory and motor function restored virtually completely. Functional electrical stimulation, especially when paired with activities to provide stimulation feedback, has been shown to improve paralysed muscles [8,9]. Re-innervating denervated muscle is essential for muscle function after a PNI. Unlike traditional strength training, proprioceptive neuromuscular facilitation prioritises movement sequences over particular muscles or groups of muscles. Multiplanar, synergistic movement patterns combined with verbal and tactile cues may produce better neuro-stimulation effects than standard strength training for neuroplastic changes, motor learning, and overflow that could enhance upper extremity function [10]. Proprioceptive neuromuscular facilitation and functional electrical stimulation was given to stretch and strengthen the extensor muscles in this patient.

These outcomes were obtained in the current case study. Like other previous studies these changes were quantified using the QuickDASH questionnaire and functional subscale of the PRWE which revealed a marked improvement following the intervention [11,12]. In peripheral compressive neuropathies without structural discontinuity, spontaneous recovery is common. Shao YC et al., noted that most conservatively treated radial nerve palsies demonstrate significant functional recovery within weeks to months when the nerve is maintained in continuity. Similar observations have been reported in compressive neuropathies where neurapraxic and axonotmesis injuries recover without surgical intervention [13].

The structure and pathologic variables of the radial nerve can cause the body's weight to compress on the upper limb if a person falls asleep in an unsuitable position while inebriated, reducing blood flow and producing sensorimotor dysfunction [14]. The upper radial nerve was crushed due to prolonged upper limb compression with the chair backrest. The patient returned to work and recovered functionally as demonstrated by DASH and PRWE questionnaires after 40 physiotherapy sessions. Patient was satisfied with treatment and claimed improvements in lifting, writing, and handling objects. His self-image and confidence improved, and he returned to work. Handcuff-related median and ulnar nerve lesions were infrequent, according to previous studies. Due to the large number of people who are restrained with handcuffs that tighten until they are locked in place, many people are at risk of wrist compression injuries, which can result in disabilities [15,16].

Handcuff-related neuropathy has been described in earlier reports. Stone DA and Laureno R reported "handcuff neuropathy," which mainly caused involvement of the superficial radial nerve due to tight restraint [17]. This case described isolated median or ulnar nerve involvement after wrist compression. However, simultaneous involvement of radial, median, and ulnar nerves is uncommon. Despite previous reports of injury concentrating on a single nerve site of damage, the case here shows a more complicated pattern most likely due to prolonged posterior restraint and sustained pressure against a rigid surface. The favourable recovery following structured physiotherapy further supports conservative rehabilitation in compressive neuropathies. Law enforcement personnel can prevent these injuries by being aware of the risk of nerve harm from excessively tight handcuffs, and should respond quickly to prisoner complaints of wrist compression caused by the handcuffs. There exist effective handcuffs with a design that minimises the risk of accidental overtightening; however, their usage is limited. The application of such restraints may assist in reducing the incidence of preventable nerve damage.

CONCLUSION(S)

The use of functional electrical stimulation in conjunction with traditional physical therapy had a critical role in the patient's recovery and return to work activities. Marked improvements were observed in motor strength, sensory function, and overall upper limb functionality following the structured physiotherapy intervention. The patient reported satisfaction with the treatment outcome, successfully returned to work, at the end of the rehabilitation period.

Authors' contribution: AM: Planned, conducted the assessment and evaluations, analysed the data and wrote the first draft. MM: Did the ideation, conceptualisation and interpretation of data, AS: Participated in the planning and supervision of the study, MKJ, R: Revised the manuscript.

REFERENCES

[1] Naqvi U, Margetis K, Sherman AL. Muscle Strength Grading. 2025 Apr 27. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2026 Jan.
[2] Davis DD, Kane SM. Ulnar Nerve Entrapment. 2023 Aug 7. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2026 Jan.
[3] Campbell WW. DeJong's The Neurologic Examination. 7th ed. Philadelphia: Lippincott Williams & Wilkins; 2013.
[4] Qasheesh M, Ahmed WM, Uddin S, Fahim T. Validity, reliability & responsiveness of 'Shortened Disability Arm Shoulder Hand'(Quick DASH) questionnaire in measuring functional incapacity in individuals with upper extremity injuries. Int J Sci Res. 2021;10(8):266-69.
[5] Shafiee E, MacDermid J, Farzad M, Karbalaei M. A systematic review and meta-analysis of Patient-Rated Wrist (and Hand) Evaluation (PRWE/PRWHE) measurement properties, translation, and/or cross-cultural adaptation Disabil Rehabil. 2022;44(22):6551-65.
[6] Bari MA, Parrey JA, Khan AQ, Ajhar A, Singh S. Comparative analysis of hand dynamometer measurements across different arm positions: Implications for rehabilitation and functional assessment. Pedagogy of Physical Culture and Sports. 2024;28(5):360-69.
[7] Escorpizo R, Kostanjsek N, Kennedy C, Robinson Nicol MM, Stucki G, Üstün TB. Harmonizing WHO's International Classification of Diseases (ICD) and International Classification of Functioning, Disability and Health (ICF): Importance and methods to link disease and functioning. BMC Public Health. 2013;13(1):742.
[8] Pellot-Cestero JE, Herring EZ, Graczyk EL, Memberg WD, Kirsch RF, Ajiboye AB, et al. Implanted electrodes for functional electrical stimulation to restore upper and lower extremity function: History and future directions. Neurosurgery. 2023;93(5):965-70.
[9] Miyamoto T, Takeuchi M, Aoyama T, Hasegawa Y, Nakano T, Kurimoto S, et al. Peripheral nerve stimulation device enabling adjustment of stimulation voltage. International Symposium on Micro-NanoMechatronics and Human Science (MHS). 2018;2018:1-4.
[10] Fader L, Nyland J, Li H, Pyle B, Yoshida K. Radial nerve palsy following humeral shaft fracture : A theoretical PNF rehabilitation approach for tendon and nerve transfers. Physiother Theory Pract. 2022;38(13):2284-94.
[11] Zago NN, Souza LAPS, Kimura BG, Bertoncello D, Grecco MAS, Fernandes LFRM. Serious games therapy associated with conventional physical therapy intervention accelerated hand muscles strengthening and hand functioning after complex fracture of the wrist: A case report. J Hand Ther. 2020;33(4):580-86.
[12] Murphy RNA, Elsayed H, Singh S, Dumville J, Wong JKF, Reid AJ. A quantitative systematic review of clinical outcome measure use in peripheral nerve injury of the upper limb. Neurosurgery. 2021;89(1):22-30.
[13] Shao YC, Harwood P, Grotz MR, Limb D, Giannoudis PV. Radial nerve palsy associated with fractures of the shaft of the humerus: A systematic review. J Bone Joint Surg Br. 2005;87(12):1647-52. Doi: 10.1302/0301-620X.87B12.16132. PMID: 16326879.
[14] Latef TJ, Bilal M, Vetter M, Iwanaga J, Oskouian RJ, Tubbs RS. Injury of the radial nerve in the arm: A review. Cureus. 2018;10(2):e2199.
[15] Desmoulin G, Nolette M, Milner T. Preventative measures to reduce incidence of handcuff neuropathy. Journal of Forensic Biomechanics. 2023;14(6).

[16] Wali A, Hussain T. Devastating ischemic dimelic neuropathy after plastic zip tie handcuffs; message for security agencies. Ann Med Surg (Lond). 2022;78:103819.

[17] Stone DA, Laureno R. Handcuff neuropathies. Neurology. 1991;41(1):145-47.

PARTICULARS OF CONTRIBUTORS:
1. Postgraduate Student, Department of Physiotherapy, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana, India.
2. Consultant Physiotherapist, Department of Physiotherapy, Institute of Neurosciences, Kolkata, West Bengal, India.
3. Associate Professor, Department of Physiotherapy, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana, India.
4. Associate Professor, Department of Physiotherapy, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana, India.
5. Postgraduate Student, Department of Physiotherapy, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Akanksha Saxena,
Associate Professor, Department of Physiotherapy, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala-133207, Haryana, India.
E-mail: akankshasaxena623@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Feb 04, 2026
- Manual Googling: Mar 26, 2026
- iThenticate Software: Mar 28, 2026 (1%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Jan 31, 2026**
Date of Peer Review: **Feb 19, 2026**
Date of Acceptance: **Mar 31, 2026**
Date of Publishing: **Jun 01, 2026**