Role of Physiotherapy in Radial Nerve Palsy Following The Humeral Shaft Fracture: A Case Report

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***Abstract*—Background: Radial nerve paralysis frequently occurs as a complication of humeral shaft fractures due to the nerve's close anatomical relationship with the humerus, often leading to wrist drop, compromised hand function, and substantial impairment. Physical therapy is commonly utilized to regain function, yet its precise contribution and effectiveness in these cases require further investigation.**
Objective: This case study seeks to assess the impact of a systematic physical therapy program on enhancing motor capabilities and quality of life in a patient with radial nerve palsy following a humeral shaft fracture.
Method: A 55-year-old male with a mid-shaft humeral fracture and subsequent radial nerve palsy underwent surgical stabilization followed by a 12-week physical therapy regimen. The program consisted of constraint induced movement therapy, passive mobility exercises, gradual muscle strengthening, nerve mobilization techniques, and task-oriented training. Progress was evaluated using the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, hand grip power, and wrist extension range of motion at baseline, 6 weeks, and 12 weeks.
Result: By 12 weeks, the patient demonstrated notable progress, with wrist extension improving from 0° to 45°, grip power increasing by 70%, and the DASH score dropping from 75 to 15, reflecting improved functional restoration. Electromyography confirmed partial nerve recovery by the program's conclusion.
Conclusion: Physical therapy was instrumental in promoting functional restoration and alleviating disability in this instance of radial nerve palsy after a humeral shaft fracture. Timely intervention, customized exercises, and regular evaluation were critical to achieving optimal results. These observations highlight the value of physical therapy as a vital element of comprehensive care in such injuries

***Index Terms*—Radial nerve palsy, humeral shaft fracture, physical therapy, functional restoration, wrist drop rehabilitation**

I. INTRODUCTION

The radial nerve stems from the posterior cord of the brachial plexus and supplies the upper limb. It also supplies the triceps brachii muscle of the arm, the muscles in the posterior compartment of the forearm (also known as the extensors), the wrist joint capsule, and aspects of the dorsal skin of the forearm and hand.
The radial nerve proper controls
Triceps
Anconeus
Extensor carpi radialis longus (ECRL)
Extensor carpi radialis brevis (ECRB)
Brachioradialis
The radial nerve divides into a deep (mostly motor) branch, which becomes the posterior interosseous nerve (PIN), and a superficial branch.
Extensor digitorum
Supinator muscle
Extensor digiti minimi (EDM)
Extensor carpi ulnaris (ECU)
Abductor pollicis longus (APL)
Extensor pollicis longus (EPL)
Extensor pollicis brevis (EPB)
Extensor indicis proprius (EIP)
Sensory supply includes [3]
Posterior cutaneous nerve (arm and forearm)
Superficial branch of the radial nerve (SBRN)
Dorsal digital branch
The following tests can quickly assess the radial nerve and its motor and sensory functions [4].

Motor function: Thumb extension against resistance.
Sensory function: Two-point discrimination on the dorsum of the thumb.
Nevertheless, a thorough physical exam is always required. Radial nerve injuries have distinct signs and symptoms depending on where and how the nerve has been damaged.

II. MATERIAL AND METHODS

Type Of Study: Case Study.
Study Design: An Experimental Clinical Case Report Highlighting the Role of Physiotherapeutic Rehabilitation in a Patient Presenting with Radial Nerve Palsy Secondary to a Humeral Shaft Fracture.
Type Of Sample: Convenience Sampling (Individual Patient Selected Based on Specific Clinical Presentation).
Sample: One Male Patient, Aged 55 Years, Diagnosed with Radial Nerve Palsy Secondary to A Conservatively Managed Mid-Shaft Humeral Fracture.
Duration Of Study: 12 Weeks (3 Months) Of Physiotherapy Intervention and Follow-Up.
Materials To Be Used:
Functional Humerus Brace
Dynamic Wrist-Hand Extension Splint
Electrical Stimulation Unit (TENS/EMS)
Goniometer (For ROM Assessment)
MRC Scale (For Muscle Strength Grading)
Resistance Bands, Therapy Putty,
Documentation Sheet for Subjective and Clinical Progress
Pen, Peg Board, Seizure,
Glass, Comb, Finger Climber
Dependent Variable

- DASH
- VAS
- ROM
- MMT

Independent Variable

- Splinting
- ROM
- Edema Management
- CIMT
- Stretching

Pre Rehabilitation Assessment
Name: Surendar Kumar Singh
Age: 55yrs
Sex: Male
DOA: 10 April 2025
Occupation: Driver
Handedness: Right
Address: Dehri on Sone
Weight: 52 kg
Ref By: Orthopaedic surgeon
Chief Complaints:

- Inability to perform active wrist extension.
- Inability to achieve voluntary finger extension.
- Diminished or absent sensory function in the involved area.
- Limitations in executing routine daily activities such as hair grooming and overhead movements.

History of present illness: Patient is well before 05/10/2024 after that patient is Fell from a ladder while painting him apartment, landing on him right arm go to the Avinash hospital Has x ray finding of Closed mid-shaft humeral fracture that managed at 05/03/2025 with Underwent open reduction and internal fixation (ORIF) with a dynamic compression, now patient is coming at physiotherapy OPD at 10/04/2025 with wrist drop.
History of past illness: No
Occupational history: Driver
Socio Economic History: BPL

Table no-01 Pain History

Side: right	Site: wrist	Onset: gradual
Duration:1Month	Type: acute	Aggravating factors: wrist movement Exercise
Relieving factors: Rest	Severity of Pain: Mild	VAS/NPRS: 6

On Observation:
Built: Normal–Mesomorphic
Posture: Standing
Muscle wasting: Local
Pressure sores: Absent
Oedema: Absent
Tropical changes: Scar
Involuntary Movements: No
Mode of ventilation: Natural
appliances: No
On Palpation
Warmth: Normal
Tenderness: Side: right Site: wrist joint
Tone: Hard

Table no -02 Muscles Power Grading

MUSCELE POWER	Muscles	Rt	Lt
Shoulder	Flexion	4	4\5
	Extension	4	4\5
	Abduction	4	4\5
	Adduction	4	4\5
	Int-Rotation	4	4\5
	Ext–Rotation	4	4\5
Elbow	Flexion	4	4\5
	Extension	4	4\5
Forearm	Pronation	0	4\5
	Supination	0	4\5

Table no- 03 Range of motion

Joints	Muscles	Rtactive	Rt passive	Ltactive	Ltpassive
Shoulder	Flexion	00to 1800	00to 1800	00to 1800	00to 1800
	Extension	00to 450	00to 400	00to 450	00to 400
	Abduction	00to 1800	00to 1800	00to 1800	00to 1800
	Adduction	00to 400	00to 400	00to 400	00to 400
	Int-Rotation	00to 700	00to 700	00to 700	00to 700
	Ext–Rotation	00to 900	00to 900	00to 900	00to 950
Elbow	Flexion	00to 1450	00to 1450	00to 145º	00to 1450
	Extension	900to 00	900to 00	900to 00	900to 00
Forearm	Supination	00to 400	00to 900	00to 900	00to 850
	Pronation	00to 450	00to 850	00to 850	00to 900
Wrist	Flexion	00to 700	00to 700	00to700	00to 700
	Extension	00to 00	00to 500	00to 700	00to 700
Wrist	Radial Deviation	00to 100	00to 200	00to 200	00to 200
	Ulnar Deviation	00to 150	00to 200	00to 300	00to 300

Table no- 04 Reflexes

	REFLEX	LEFT	RIGHT
Deep	Biceps	Normal	Normal
	Brachioradialis	Normal	Normal
	Triceps	Normal	Normal

Table no- 05 Muscle girth

Area	Rt(cm)	Lt(cm)
Arm	25cm	26cm
Forearm	22cm	23cm

Physiotherapy Intervention Plan

Phase (Initial Post Operative) (Weeks 1-6)

Status At Start: 6 Weeks Post-Injury as of April 10, 2025, still in a Sling Per Orthopaedic Guidance.

Interventions:

- Splinting: Fitted With a Custom Dynamic Cock-Up Splint to Position the Wrist At 20° Extension and Maintain Finger Extension, Worn Continuously Except During Therapy.
- Passive Rom: Gentle Passive Exercises for the Right Wrist, Metacarpophalangeal (Mcp), And Proximal Interphalangeal (Pip) Joints, 10 Repetitions Twice Daily, Avoiding Stress on the Fracture Site.
- Oedema Management: Hand Elevation and Light Compression Wrap Applied to Reduce Postoperative Swelling.
- Shoulder Maintenance: Active Rom Exercises for the Right Shoulder (Pendulum Exercises) To Prevent Frozen Shoulder, 5 Minutes Twice Daily.
- Education: Is Instructed on Sling Use, Splint Care, And Avoiding Compensatory Overuse of the Left Arm.
- Cimt (Constraint Induced Movement Therapy)
- Reach And Graps Exercise For 1 Hour
- Pick And Place Object For 1 Hour
- Functional Task Like Feeding For 30 Min
- Phase (Intermediate) (Weeks 6-12)

Status At Start: Orthopaedic Follow-Up At 6 Weeks Confirms Early Callus Formation; Sling Discontinued, But Weight-Bearing Is Restricted.

Interventions:

- Active-Assisted Rom: He Begins Active-Assisted Wrist and Finger Extension Exercises Using Her Left Hand, Progressing to Gravity-Assisted Extension (E.G., Arm Supported on A Table, Lifting Wrist), 3 Sets Of 10 Reps Daily.
- Electrical Stimulation: Nmes Applied to the Extensor Carpi Radialis Longus and Extensor Digitorum, 20 Minutes Per Session, 3 Times Weekly, To Stimulate Muscle Activity and Support Nerve Regeneration.
- Light Strengthening: isometric exercises for elbow flexors and shoulder muscles with no resistance, progressing to 1-2 lb weights by week 10.
- Sensory Monitoring: Therapist Notes Slight Tingling in the Dorsal Hand, Suggesting Early Nerve Recovery.
- CIMT (Constraint Induced Movement Therapy)
- Increase The Level of Difficulty
- Reach An Graps Exercise For 1 Hour
- Pick And Place Object For 1 Hour
- Functional Task Like Feeding For 30 Min
- Repeat This Task In 2 Sessions Every Day

Phase (Advance Strengthening) (Weeks 12-24)
Status At Start: At 12 Weeks, He Shows Wrist Extension At 2/5 (Mmt) And Finger Extension At 1/5, With Improved Sensation.

Interventions:

- Active Strengthening: Progressive Resistance Exercises with TheraBand's (Yellow to Red Resistance) For Wrist and Finger Extensors, 3 Sets Of 15 Reps, 3 Times Weekly.
- Functional Training: Task-Specific Activities Introduced, Such As Using a Mouse, Holding A Pencil, And Buttoning Clothes, 15-20 Minutes Daily.
- Stretching: Gentle Flexor Stretching to Counter Prolonged Splinting, Held For 20-30 Seconds, 5 Reps Daily.
- Sensory Re-Education: Texture Discrimination Tasks (E.G., Identifying Coins or Fabrics) To Enhance Sensory Recovery.
- Reach An Graps Exercise For 45 Min
- Pick And Place Object For 45 Min
- Functional Task Like Feeding For 15 Min

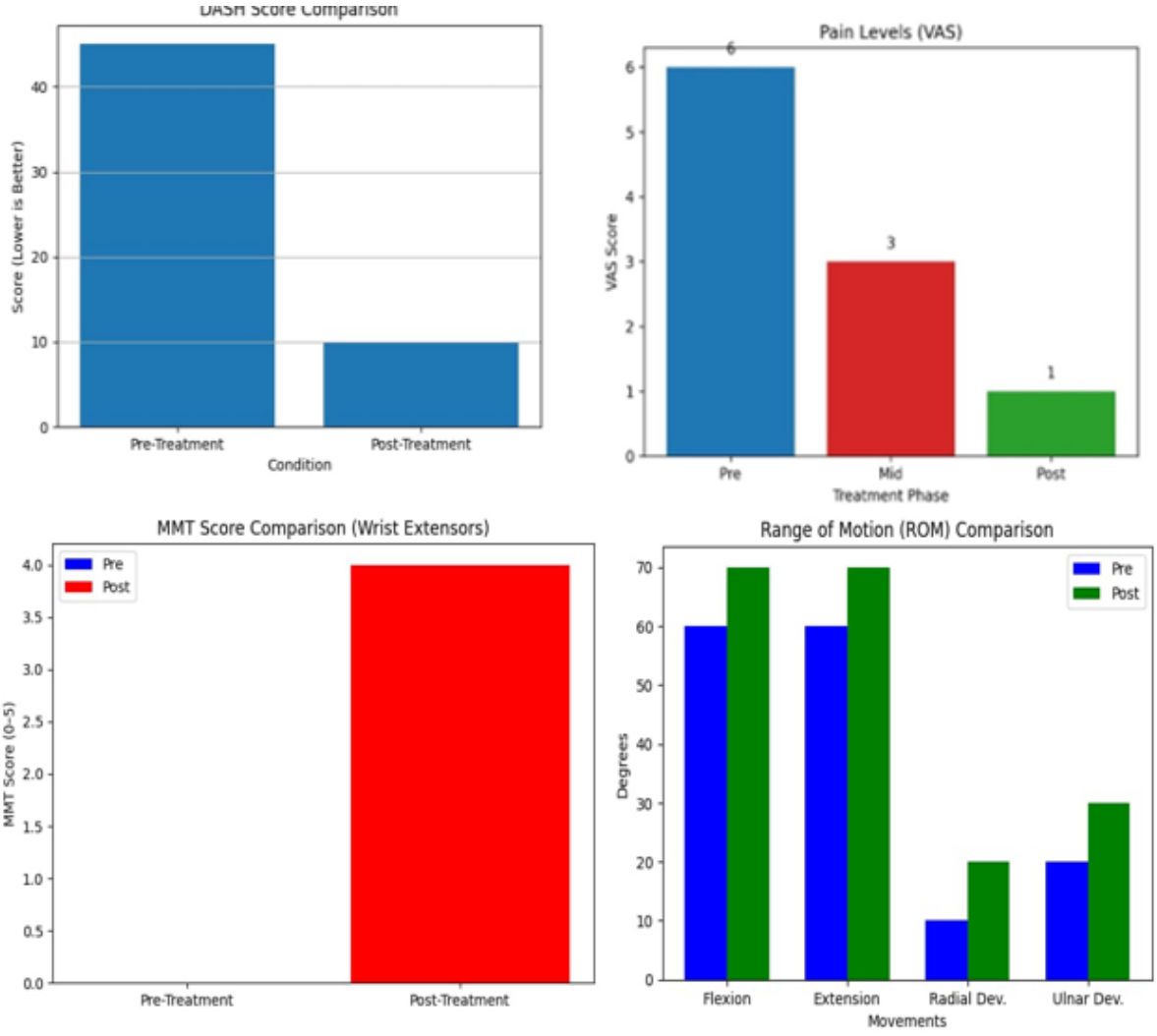
Table no- 06 Muscles Power Grading

MUSCELE POWER	Muscles	Rt	Lt
Shoulder	Flexion	4	4\5
	Extension	4	4\5
	Abduction	4	4\5
	Adduction	4	4\5
	Int-Rotation	4	4\5
	Ext–Rotation	4	4\5
Elbow	Flexion	4	4\5
	Extension	4	4\5
Forearm	Pronation	4	4\5
	Supination	4	4\5

Table no- 07 Range of motion

Joints	Muscles	Rtactive	Rt passive	Ltactive	Ltpassive
Shoulder	Flexion	00to 1800	00to 1800	00to 1800	00to 1800
	Extension	00to 450	00to 400	00to 450	00to 400
	Abduction	00to 1800	00to 1800	00to 1800	00to 1800
	Adduction	00to 400	00to 400	00to 400	00to 400
	Int-Rotation	00to 700	00to 700	00to 700	00to 700
	Ext–Rotation	00to 900	00to 900	00to 900	00to 950
Elbow	Flexion	00to 1450	00to 1450	00to 1450	00to 1450
	Extension	00to 1450	00to 1450	00to 1450	00to 1450

Forearm	Supination	00to 900	00to 900	00to 900	00to 900
	Pronation	00to 900	00to 900	00to 900	00to 900
Wrist	Flexion	00to 700	00to 700	00to700	00to 700
	Extension	00to 700	00to 700	00to 700	00to 700
	RadialDeviation	00to 200	00to 200	00to 200	00to 200
	UlnarDeviation	00to 200	00to 200	00to 200	00to 200



III. STATISTICAL ANALYSIS

Table no-08 DASH Score Comparison

Pre-treatment	DASH	Score: 45
Mid-treatment	DASH	Score: 25
Post-treatment	DASH	Score: 10

Interpretation

A marked reduction in the DASH score indicates significant improvement in functional ability of the upper limb. The patient showed progressive recovery in performing activities of daily living after completion of the physiotherapy rehabilitation program.

Table no -09 Manual Muscle Test (MMT)

Muscle Group	Pre-Treatment	Mid-Treatment	Post-treatment
Wrist Extensors	0	2	4

Interpretation:
Muscle strength improved from grade 0 to grade 4, indicating restoration of active muscle contraction against gravity and partial resistance after rehabilitation.

Table no-10 Range of Motion (Wrist Joint)

Movement	Pre-Treatment (°)	post-treatment (°)
Flexion	0	70
Extension	0	70
Radial Deviation	0	20
Ulnar Deviation	0	30

Interpretation:
Full range of motion was restored in all wrist movements following the rehabilitation program, indicating successful recovery of joint mobility.

Table no-11 Pain Level (VAS Score)

Pre-treatment	VAS Score: 6
Mid-treatment	VAS Score: 3
Post-treatment	VAS Score: 1

Interpretation: There was a gradual reduction in pain intensity during the rehabilitation period, showing effective pain management and improved functional use of the affected limb.

IV. RESULTS

After A 12-Week Physiotherapy Rehabilitation Program, The Patient Showed Improved Muscle Strength. Wrist Extensors Improved from Grade 0 To Grade 4 On MMT. Full Passive and Active Rom of the Shoulder and Elbow Restored. Wrist And Finger Extension Regained with Functional Movement Patterns. Grip Strength Improved From 0 Kg To 12 Kg Using a Dynamometer. Dash Score Reduced From 75 To 15 (Indicating Minimal Disability). Patient Was Able to Return to Daily Activities (ADLs) Independently Without a Splint Minimal Disability, Returned to Near-Normal Function in Daily Tasks. the patient reported noticeable improvements in activities such as carrying groceries, typing, and reaching overhead.

The patient was able to return to most of his usual activities, including light sports, without significant discomfort or limitation.

V. DISCUSSION

This Clinical Case Involving Surendar Kumar Singh Illustrates the Extensive and Multidimensional Contribution of Physiotherapy in The Rehabilitation of Radial Nerve Palsy Secondary to A Humeral Shaft Fracture.
During The Initial Stage of Care, Immobilization Was Supported with Appropriate Splinting, While Passive Range-Of-Motion Techniques Were Introduced to Minimize the Risk of Contracture Formation and to Preserve Joint Mobility and Structural Integrity.
With Regard to Neural Restoration, A Combination of Neuromuscular Electrical Stimulation (NMES) And Carefully Graded Exercise Therapy Was Incorporated. These Interventions Were Designed in Accordance with the Known Slow Regenerative Capacity of the Radial Nerve (Approximately 1 Mm Per Day), With Anticipated Functional Recovery Typically Observed Within A 4–6 Month Timeframe in Cases Involving Mid-Shaft Humeral Lesions.
In Terms of Functional Reintegration, The Rehabilitation Program Was Individually Tailored to Address the Patient's Occupational Demands, Thereby Facilitating a Gradual and Efficient Return to His Professional Activities, Particularly Those Related to Graphic Design."

VI. CONCLUSION

1. Early, structured physiotherapy plays a crucial role in the motor and functional recovery of radial nerve injuries following humeral shaft fractures.
2. Use of modalities like electrical stimulation, splinting, ROM exercises, and strength training promotes neural re-education and prevents muscle atrophy.
3. Patient-specific rehab protocols, combined with regular monitoring and patient compliance, significantly enhance recovery without surgical nerve repair[18].

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