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# Rehabilitation Outcomes Following Multiple Metacarpophalangeal Joint Fractures with Complex Regional Pain Syndrome Features: A Case Report

**Jestin Thomas**
KMCT College of Allied Health Sciences, Kozhikode, India https://orcid.org/0009-0000-4378-4309
**Binoy Mathew K V**
binoy9797@gmail.com

Composite Regional Centre for Skill Development Rehabilitation and Empowerment of Persons with Disabilities, Kozhikode, India https://orcid.org/0000-0002-9637-1214
**Gladies Kamalam S**
KMCT College of Allied Health Sciences, Kozhikode, India https://orcid.org/0000-0001-9384-0380
**Santheep S**
KMCT College of Allied Health Sciences, Kozhikode, India https://orcid.org/0009-0005-8715-6554

**Case Report**

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## Abstract

# Background:

Metacarpophalangeal (MCP) joint fractures are clinically significant due to their impact on joint congruity, hand biomechanics, and functional performance. Multiple displaced intra-articular MCP fractures accompanied by Complex Regional Pain Syndrome (CRPS) symptoms pose significant rehabilitation obstacles, despite the fact that metacarpal fractures are common.

# Objective:

To assess how well a patient with multiple displaced MCP joint fractures compounded by CRPS-like symptoms responds to intensive physical therapy rehabilitation in terms of pain, range of motion (ROM), and functional outcomes.

# Methods:

A 47-year-old male carpenter presented with swelling, severe pain, restricted motion, and extensor lag following displaced fractures of the dorsal aspect of the left second to fifth MCP joints managed conservatively with immobilization. After three weeks of casting, clinical findings included 30° extensor lag, MCP flexion limited to 30°, grade 4 edema, paresthesia, skin discoloration, temperature variation, and high pain intensity (NPRS 9/10 on palpation, 4/10 at rest). Features suggestive of early CRPS were noted in the third and fourth digits. A structured physiotherapy program was implemented for 12 weeks, five sessions per week, including graded joint mobilization (Grade I–IV), edema management, desensitization, range of motion exercises, and functional training. Outcomes were assessed using Numeric Pain Rating Scale (NPRS), goniometric ROM measurements, and QuickDASH questionnaire.

# Results:

There was a noticeable improvement after the intervention. From 4/10 at rest and 9/10 on palpation, NPRS scores decreased to 4/10 during activity and 0/10 at rest. MCP joint range of motion increased, extensor lag decreased, and edema decreased. There was an improvement in QuickDASH scores from 40.9/100 (moderate disability) to 22.7/100 (mild disability). Despite the fact that paresthesia remained and full range of motion was not fully returned, the patient was able to independently perform activities of daily living and grip and hold objects.

# Discussion:

This case highlights the difficulty of treating several MCP fractures made more difficult by characteristics of CRPS. Functional recovery was greatly aided by structured graded mobilization and early detection of post-traumatic problems. Conservative care and focused physiotherapy can result in significant pain reduction and functional improvement, even though full range of motion restoration may not always be possible in such complex instances.

# INTRODUCTION

Metacarpophalangeal (MCP) joint–related fractures represent an important subset of hand injuries due to their direct impact on joint congruity, hand biomechanics, and functional performance. Hand fractures account for approximately 10–20% of all skeletal fractures, with metacarpal fractures comprising nearly 30–40% of all hand fractures, making them the most frequently injured bones in the hand[1][3][4]. Fractures involving the MCP joint include fractures of the metacarpal head, fractures of the base of the proximal phalanx extending into the joint, and complex intra-articular fractures disrupting the articular surface[6][7]. Although extra-articular metacarpal fractures are more common, intra-articular MCP joint fractures are clinically significant due to their propensity to cause joint stiffness, extensor tendon adhesions, reduced grip strength, and post-traumatic osteoarthritis if anatomical reduction and early rehabilitation are not achieved [6][8].

The incidence of metacarpal fractures demonstrates a clear ulnar-side predominance, with the fifth metacarpal being the most commonly fractured, accounting for approximately 35–45% of all metacarpal fractures [4][5]. Large epidemiological studies report that males constitute nearly 70–76% of metacarpal fracture cases, particularly in younger age groups, reflecting higher exposure to occupational, sports-related, and interpersonal trauma [1][3]. The high frequency of fifth metacarpal fractures is attributed to its increased mobility, relatively weaker ligamentous support, and its vulnerability to axial loading forces during punching or falls. Fractures of the fifth metacarpal neck, commonly referred to as Boxer's fractures, are the single most common fracture pattern at the MCP level and are estimated to account for up to 10% of all hand fractures [5][6].

Based on anatomical location, metacarpal fractures are classified into head, neck, shaft, and base fractures, with neck fractures being the most prevalent, accounting for approximately 50–60% of cases, followed by shaft fractures (30–40%) [5][6]. In contrast, metacarpal head fractures, which directly involve the MCP joint, constitute only 5–10% of metacarpal fractures, but are associated with a significantly higher risk of long-term functional impairment due to articular surface disruption [6][8]. Fracture configurations may be transverse, oblique, spiral, comminuted, or impacted, and may be further categorized as extra-articular or intra-articular based on joint involvement [7]. Intra-articular fractures are of particular concern, as even minimal displacement can alter joint biomechanics and predispose the patient to stiffness and degenerative changes [8][9].

From a physiotherapy and rehabilitation perspective, MCP joint fractures present unique challenges due to the need to balance fracture stability with early joint mobilization. Prolonged immobilization is associated with capsular tightness, intrinsic muscle shortening, extensor tendon adhesions, and reduced grip and pinch strength, all of which significantly impair hand function[8][9]. Early controlled mobilization, edema management, scar tissue prevention, and progressive strengthening are therefore essential components of post-fracture rehabilitation protocols[10]. A thorough understanding of the epidemiology, fracture distribution, and classification of MCP joint fractures provides the foundation for evidence-based physiotherapy interventions aimed at restoring joint mobility, optimizing functional outcomes, and minimizing long-term disability in affected individuals [6][8]. This case study aimed to provide information regarding the features of the multiple MCP joints fractures and highlight conservative treatment's effectiveness in managing the condition.

# CASE REPORT

A 47-year-old male who was a carpenter was presented to a physiotherapist with a complaint of swelling and restricted movements on the left hand in the past one month. The patient met with a worksite accident which caused displaced fracture in dorsal aspect of left second, third, fourth and fifth metacarpophalangeal joints (Fig. 1). The patient got dressed over anesthesia as a primary treatment and presented for surgery after five hours. Since the fracture was located at the distal aspect of the metacarpophalangeal joint, internal fixation was not feasible. The soft tissues were meticulously approximated, followed by immobilization using a Plaster of Paris cast. After 3 weeks of immobilization patient appeared to have extensor lag of about 30°, grade 4 edema, paresthesia and restricted movements (flexion 30°). The pain was acute in onset and the patient was marked 9/10 pain on the Numeric Pain Rating Scale (NPRS) on palpation and 4/10 at rest. There was grade 4 tenderness marked in the fractured areas. There was a variation in skin temperature and discoloration in the fourth phalanx.

During subsequent visits, physiotherapist noted that the patient showing Complex Regional Pain Syndrome (CRPS) symptoms in third and fourth phalanx (Fourth > Third). The goal was to improve the range of motion and breaking the adhesions. Mobilizations starting from grade 1 and grade 2 was applied initially for two weeks and gradually implied grade 3 and grade 4 mobilization exercises toeach metacarpophalangeal joint (MCP), Proximal Interphalangeal joints(PIP) and Distal Interphalangeal joints (DIP) along with closed chain exercises and functional training for metacarpophalangeal joints (Fig. 2a and 2b).The sessions were carried out five days a week for 12 weeks.

The post-intervention assessment was performed two months after the initial consultation. The patient reported a satisfactory effect after 8 weeks of physiotherapy treatment. Range of motion improved in all metacarpophalangeal joints, edema reduced and there were minimal adhesions over proximal interphalangeal joint(Fig. 3). Paresthesia sustained. Patient could graband hold objects as part of daily activity training. The NPRS were reported as 4/10 over activity and 0/10 at rest (Fig. 4). QuickDASHwere used for the functional assessment of hand. Quick Dash marked 40.9/100 which means moderate

disability, in the initial stage. After 8 weeks of physiotherapy intervention QuickDASH marked 22.7/100 which indicates mild disability (Fig. 5).

# DISCUSSION

A considerable amount of upper extremity trauma presenting to emergency rooms is caused by hand fractures, one of the most frequent skeletal injuries seen in clinical practice[1][3][4]. In particular, metacarpal fractures account for a significant portion of these injuries and often affect people who perform manual labour [1][4]. A 47-year-old carpenter's hand function and ability to perform his job were severely impaired in this instance due to multiple displaced fractures over the dorsal aspect of the second to fifth metacarpophalangeal joints.

Fracture stability, displacement, rotational deformity, and soft tissue involvement are all important factors in the treatment of metacarpal fractures. However, in cases of unstable or severely displaced fractures, surgical fixation with plates and screws is recommended[5][10].Internal fixation may present technical difficulties in cases of distal fractures involving the metacarpophalangeal joint. Additionally, after plate fixation, issues with adhesions, stiffness, and tendon irritation have been documented[9]. Therefore, the best stabilization techniques should strike a balance between early mobilization, soft tissue integrity preservation, and fracture stability[8]. In the present case, internal fixation was deemed not feasible, and immobilization with a Plaster of Paris cast following meticulous soft tissue approximation was performed.

Prolonged hand immobilization is strongly linked to joint stiffness, extensor lag, edema, and periarticular adhesions, despite the fact that immobilization is necessary for fracture healing[6][7]. The patient experienced severe discomfort, restricted flexion (30°), grade 4edema, and a 30° extensor lag following three weeks of casting, all of which were signs of soft tissue tightness and post-immobilization stiffness. In order to prevent capsular contracture and intrinsic muscle shortening, regulated early mobilization is crucial in the rehabilitation of hand diseases [7]. In this instance, the observed functional restrictions were probably caused by the delayed commencement of movement. Additionally, the patient showed signs of early Complex Regional discomfort Syndrome (CRPS), such as discolouration, edema, disproportionate discomfort, and variations in skin temperature.

Hand fractures are known to cause post-traumatic problems such stiffness and heightened inflammatory reactions, especially when many digits are affected [6]. In order to avoid long-term functional impairment and chronic disability, early detection and physiotherapy management are essential.

From Grade 1 and 2 to Grade 3 and 4 procedures, graded joint mobilization was applied gradually. While higher-grade mobilizations seek to stretch periarticular adhesions and restore accessory joint motion, lower-grade mobilizations are proven to help in pain management [7]. Restoring joint play is crucial for regaining functional range of motion and grip strength in cases with metacarpal and phalangeal

fractures, according to rehabilitation principles [7][8]. The structured progression of mobilization over 12 weeks in this case facilitated improvement in flexion, reduction in edema, and restoration of grasp function.

The patient's Numeric Pain Rating Scale (NPRS) scores and QuickDash questionnaire scoresdecreased and their ability to use their hands for everyday tasks improved, indicating a functional recovery.Considering that hand fractures have a major impact on work performance, particularly for manual labourers [1].One consequence that is clinically significant is the restoration of grip and object handling skills. Overall functional improvements indicate successful neuromuscular adaptation and soft tissue remodelling, despite the persistence of paraesthesia.

The significance of customized therapy after multiple metacarpophalangeal fractures is highlighted by this instance. Although surgical stabilization is still a possibility for unstable fractures[5][10]. When used properly, conservative treatment in conjunction with organized physical therapy can produce positive results. In order to maximize rehabilitation and reduce long-term disability, graded mobilization techniques and early detection of problems including stiffness and CRPS-like symptoms are essential.The result of this case study could not be generalized as it was performed in a single subject.

This case report has several limitations. The rehabilitation approach was made considerably more difficult by the existence of multiple metacarpophalangeal (MCP) joint fractures linked to symptoms suggestive of Complex Regional Pain Syndrome (CRPS). The patient's ability to reach complete range of motion (ROM) was hampered by pain, hypersensitivity, edema, and stiffness, which reduced their tolerance to rigorous mobilization approaches.

Even though there was a noticeable improvement in joint mobility from the first day after the immobilization was removed, full ROM restoration was not possible during the course of treatment. The main obstacles to the best possible functional rehabilitation were the chronic joint stiffness and pain response brought on by CRPS characteristics.

Furthermore, the results cannot be applied to all individuals with comparable fracture patterns because this is a single case study. The little follow-up period also makes it more difficult to evaluate CRPS symptom recurrence and long-term functional outcomes. Standardized rehabilitation techniques for such complex presentations will require more research with larger sample sizes and long-term follow-up.

# CONCLUSION

Multiple metacarpophalangeal joint fractures can cause severe post-immobilization stiffness and functional impairment particularly in manual labourers. This case shows that even in the context of early CRPS-like symptoms, an organized, gradually graded physiotherapy program can successfully reduce pain, improve range of motion, and restore functional hand usage. Optimal healing and the avoidance of permanent disability depend on early rehabilitation and careful monitoring of problems.

# Declarations

The participants provided written informed consent for participating in the study and publish the clinical findings.

### Ethical Considerations

Compliance with ethical guidelines

Informed consent was obtained from the patient.


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### Authors' contributions

All authors equally contributed to preparing the article.

### Conflict of interest

The authors declared no conflict of interest.

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# Figures




**Figure 1**

**Figure 1**. Showing radiographic findings of multiple displaced MCP fractures on left hand.





## Figure 2

**Figure 2a**. Closed chain exercises on MCP Joints. **2b**. Functional activity training .





**Figure 3**

**Figure 3**. After 8 weeks of Physiotherapy Intervention.

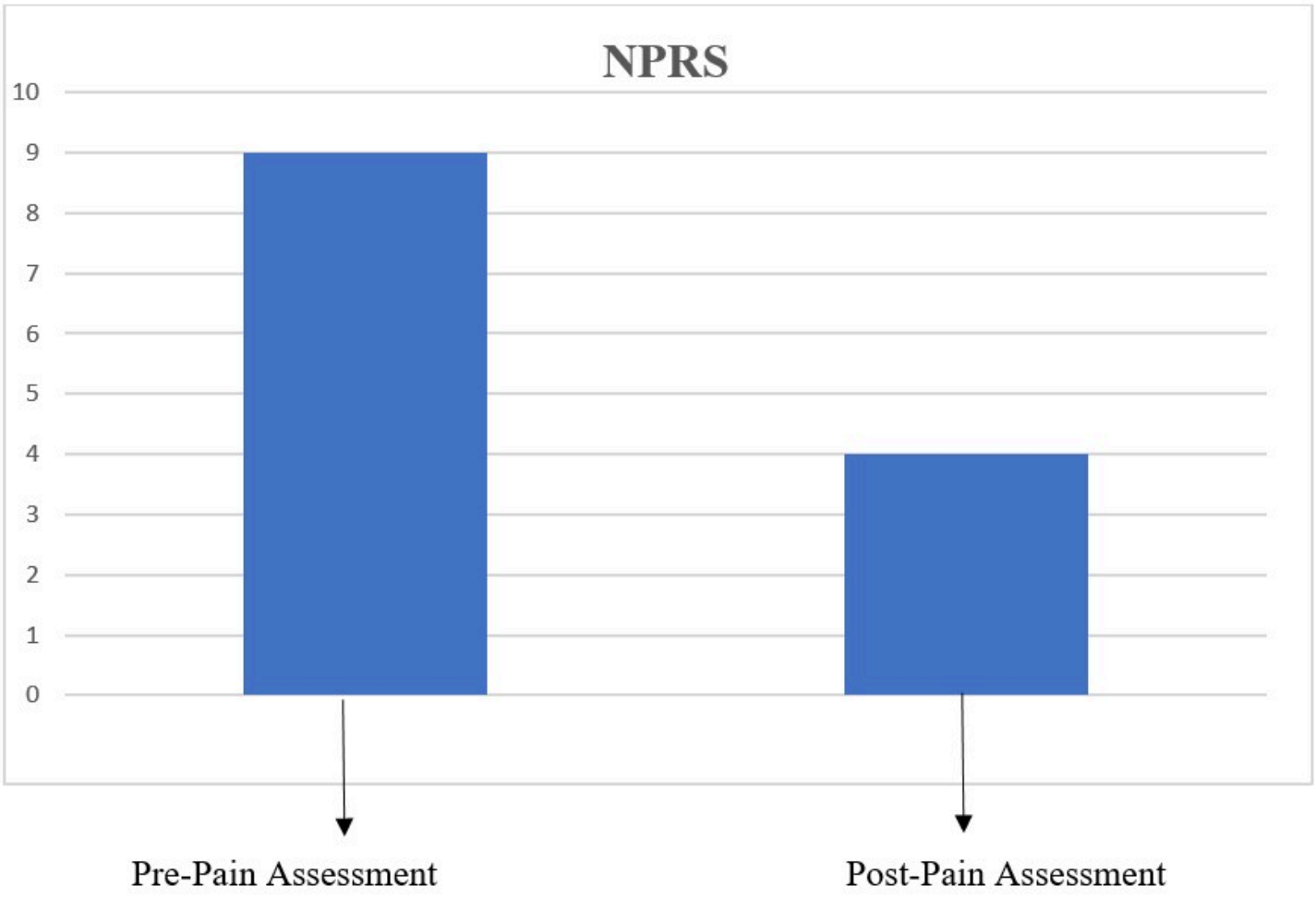
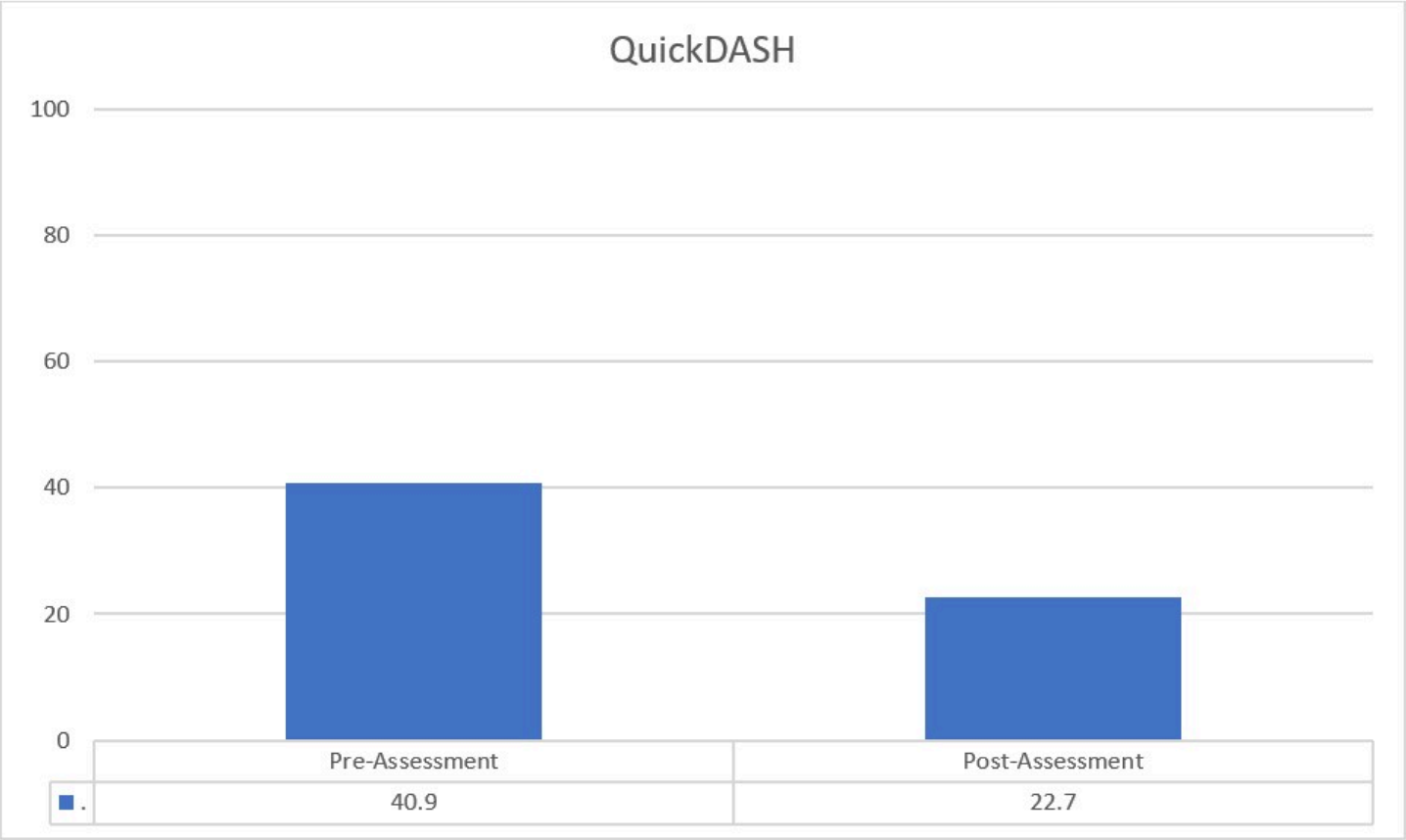



**Figure 4**

**Figure 4**. Pre-Post Pain Comparison




## Figure 5

**Figure 5**. Pre-Post QuickDASH comparison chart