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Multimodal Physiotherapy After Fifth Proximal Phalanx ORIF: A Case Report

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Abstract

Background: Postoperative fifth proximal phalanx fractures treated with open reduction and internal fixation (ORIF) commonly result in pain, joint stiffness, reduced range of motion (ROM), muscle weakness, and impaired hand function. Physiotherapy plays a crucial role in restoring functional capacity.

Objective: To evaluate the clinical outcomes of a multimodal physiotherapy intervention on pain, ROM, muscle strength, and functional ability in a patient following ORIF of the fifth proximal phalanx.

Methods: This study was a single-case report involving a 22-year-old female patient with a left fifth proximal phalanx fracture following ORIF. The intervention was conducted over three weeks (three sessions per week), with assessments performed at baseline (T0) and weekly until T3. Outcome measures included the Numeric Rating Scale (NRS) for pain, goniometric measurement for ROM, Manual Muscle Testing (MMT) for muscle strength, and the Wrist Hand Disability Index (WHDI) for functional ability. Data were analyzed descriptively.

Results: Pain at rest decreased from 2/10 to 0/10, movement pain from 5/10 to 3/10, and tenderness from 6/10 to 4/10. MCP joint ROM improved from S 10°–0°–60° to 15°–0°–70°. Muscle strength increased from grade 3/5 to 4/5. Functional disability improved from 54% (moderate disability) to 40% (minimal disability). These findings indicate clinically meaningful improvement despite residual limitations.

Conclusion: A multimodal physiotherapy program consisting of infrared therapy, ultrasound, paraffin bath, and active-assisted exercise was effective in improving clinical outcomes and hand function in a patient following ORIF of the fifth proximal phalanx.

Keywords
Phalangeal fractures; Hand injuries; Physiotherapy modalities; Exercise therapy; Ultrasonic therapy

Introduction

Hand fractures are among the most common musculoskeletal injuries and can substantially impair functional performance, particularly when involving the phalanges. The proximal phalanx of the fifth digit plays a critical role in grip strength, hand coordination, and fine motor activities.[1] Fractures in this region are frequently caused by trauma such as falls, direct impact, or motor vehicle accidents, and are often associated with pain, joint stiffness, reduced range of motion (ROM), and compromised hand function.[2]

Surgical management using open reduction and internal fixation (ORIF) is widely employed to restore anatomical alignment and provide mechanical stability in displaced fractures. Although ORIF is effective in achieving bone union, postoperative complications remain common.[3] These include persistent pain, joint stiffness, soft tissue adhesions, reduced muscle strength, and delayed functional recovery, all of which may significantly limit a patient's ability to perform daily activities.[4] These impairments are closely associated with postoperative immobilization, inflammatory processes, and adaptive changes in surrounding soft tissues.[5]

From an epidemiological perspective, fractures continue to represent a major global health burden. Data from the Global Burden of Disease study indicate that fractures contribute substantially to disability worldwide, with a rising incidence across both younger and older populations.[6] In Asia, the burden of fractures has shown a consistent upward trend, reflecting increased exposure to trauma and demographic transitions.[6] These findings highlight the growing need for effective post-fracture rehabilitation strategies aimed not only at structural recovery but also at restoring functional independence.

Physiotherapy plays a central role in postoperative fracture rehabilitation by addressing pain, mobility limitations, muscle weakness, and functional deficits. Various modalities are commonly used, including infrared therapy, therapeutic ultrasound, paraffin bath, and active-assisted exercise.[7] Infrared therapy produces superficial thermal effects that promote vasodilation and improve local circulation, contributing to pain reduction.[8] Therapeutic ultrasound has been shown to enhance tissue healing, increase collagen extensibility, and modulate inflammatory responses, particularly in tissues with high collagen content.[9] Additionally, paraffin bath therapy improves tissue elasticity and reduces joint stiffness, facilitating improved joint mobility.[10] Active-assisted exercise further supports gradual restoration of joint movement and muscle activation while minimizing excessive mechanical stress on healing tissues.[11]

Recent evidence suggests that multimodal physiotherapy approaches may provide superior outcomes compared with single-modality interventions, as they target multiple aspects of impairment simultaneously, including pain modulation, tissue extensibility, and neuromuscular activation.[10] However, most existing studies have focused on general hand fractures or mixed phalangeal injuries without distinguishing specific anatomical locations. Furthermore, there is limited evidence specifically addressing rehabilitation outcomes following ORIF of the fifth proximal phalanx using combined physiotherapy modalities.

Given the functional importance of the fifth digit in grip strength and hand stability, targeted rehabilitation strategies for this specific fracture type are clinically relevant.[12] Despite this, the literature lacks detailed clinical reports describing the short-term outcomes of structured multimodal physiotherapy in such cases.

Therefore, this case report aims to evaluate the clinical outcomes of a multimodal physiotherapy program on pain intensity, joint range of motion, muscle strength, and functional ability in a patient following ORIF of a fifth proximal phalanx fracture.

Methods

This study was conducted as a descriptive single-case report to evaluate the clinical outcomes of a multimodal physiotherapy intervention in a patient following open reduction and internal fixation (ORIF) of a fifth proximal phalanx fracture. The report followed the CARE (Case Report) guidelines to ensure completeness and transparency of clinical reporting.

The subject was a 22-year-old female student who sustained a left fifth proximal phalanx fracture following a motorcycle accident in April 2024 and underwent ORIF in February 2025. Physiotherapy was initiated in September 2025 in an outpatient setting at Dr. Moewardi Regional General Hospital, Surakarta. At baseline, the patient presented with pain, joint stiffness, limited range of motion (ROM) of the fifth metacarpophalangeal (MCP) joint, decreased muscle strength, and impaired hand function, particularly during grasping activities. No contraindications to physiotherapy interventions were identified.

Outcome measures included pain intensity assessed using the Numeric Rating Scale (NRS), joint ROM measured with a universal goniometer, muscle strength evaluated using Manual Muscle Testing (MMT), and functional ability assessed using the Wrist Hand Disability Index (WHDI). Pain was recorded under three conditions: at rest, during movement, and upon palpation. ROM was documented in degrees using the extension–neutral–flexion format. Muscle strength was graded on a 0–5 scale. WHDI scores were expressed as percentages, with higher values indicating greater disability. All measurements were performed at baseline (T0) and at weekly intervals until the final evaluation (T3), with assessments conducted by the same physiotherapist to ensure consistency.

The intervention was delivered over three weeks with a frequency of three sessions per week, resulting in a total of nine treatment sessions. Each session consisted of a multimodal physiotherapy program combining physical modalities and therapeutic exercises. Infrared therapy was applied for 15 minutes at a distance of 30–45 cm to produce superficial thermal effects aimed at reducing pain and improving local circulation. Therapeutic ultrasound was administered at a frequency of 1 MHz with an intensity of 1.0 W/cm² in continuous mode for 5 minutes to enhance tissue healing, improve collagen extensibility, and reduce stiffness. Paraffin bath therapy was applied using a repeated immersion technique (approximately eight layers) until a comfortable level of warmth was achieved, with the aim of improving tissue elasticity and reducing joint stiffness prior to exercise.

Following the application of physical modalities, active-assisted exercises were performed to facilitate gradual restoration of MCP joint mobility and muscle activation. The exercises focused on controlled flexion and extension of the fifth digit and were performed in 10–15 repetitions with a holding time of 5–10 seconds per repetition. Exercise intensity was maintained at a moderate level to avoid excessive mechanical stress on healing tissues while promoting neuromuscular activation and functional recovery.

To clarify the procedural sequence, the study flow was as follows: baseline assessment (T0) was conducted prior to intervention; the patient then underwent nine physiotherapy sessions over three weeks; outcome evaluations were performed at the end of each week (T1, T2, and T3); and the final evaluation (T3) represented the post-intervention condition.

Data were analyzed descriptively by comparing outcomes across time points (T0–T3) to identify trends in pain intensity, joint mobility, muscle strength, and functional ability. No inferential statistical analysis was performed due to the single-case design. No adverse events were reported during the intervention period.

The patient provided written informed consent for the use of anonymized clinical data for publication. Patient confidentiality was maintained, and no identifiable information was disclosed. Ethical approval was not required, as this report describes routine clinical management without experimental procedures.

Results

This study evaluated changes in pain intensity, joint range of motion (ROM), muscle strength, and functional ability following a multimodal physiotherapy intervention in a patient after ORIF of a fifth proximal phalanx fracture. Measurements were recorded at four time points (T0–T3) to document short-term clinical progression.

At baseline (T0), the patient presented with pain at rest, during movement, and upon palpation. Joint mobility of the fifth metacarpophalangeal (MCP) joint was limited, and muscle strength of both flexor and extensor muscles was reduced. Functional assessment using the Wrist Hand Disability Index (WHDI) indicated moderate disability. These baseline findings established the initial clinical status prior to intervention. To provide a comprehensive overview of clinical progression across sessions, serial outcome measurements are presented in Table 1.

Table 1. Changes in Clinical Outcomes Across Treatment Sessions (T0–T3)

Outcome	T0	T1	T2	T3
Pain (NRS) – Rest	2	2	1	0
Pain (NRS) – Movement	5	4	4	3
Pain (NRS) – Palpation	6	5	5	4
MCP V ROM (°)	S 10–0–60	S 10–0–60	S 10–0–65	S 15–0–70
Muscle Strength (MMT) Flexor	3/5	3/5	3/5	4/5
Muscle Strength (MMT) Extensor	3/5	3/5	4/5	4/5
WHDI (%)	54	—	—	40

The data presented in Table 1 demonstrate progressive changes across all outcome measures over the intervention period. To further describe joint mobility changes in relation to reference values, goniometric measurements of MCP V motion are summarized in Table 2.

Table 2. MCP V Range of Motion Compared with Reference Values

Time Point	MCP V (Extension–Flexion)	Reference Value
T0	S 10–0–60	S 45–0–90
T1	S 10–0–60	S 45–0–90
T2	S 10–0–65	S 45–0–90
T3	S 15–0–70	S 45–0–90

Muscle strength progression for both flexor and extensor groups is presented in Table 3.

Table 3. Muscle Strength of MCP V (MMT Scale)

Muscle Group	T0	T1	T2	T3
Flexor	3/5	3/5	3/5	4/5
Extensor	3/5	3/5	4/5	4/5

Pain intensity across different conditions is further detailed in Table 4.

Table 4. Pain Intensity (NRS) Across Conditions

Condition	T0	T1	T2	T3
Rest	2	2	1	0
Movement	5	4	4	3
Palpation	6	5	5	4

Functional ability based on WHDI components is presented in Table 5.

Table 5. WHDI Component Scores

Item	T0	T3
Pain intensity	3	2
Numbness/tingling	3	2
Personal care	3	2
Strength	3	3
Writing/typing tolerance	2	2
Work	2	1
Driving	4	3
Sleep	2	0
Household tasks	3	3
Recreation/sport	2	2
Total (%)	54	40

Across all time points, changes were observed in pain, ROM, muscle strength, and functional ability. No adverse events were reported during the intervention period.

Discussion

This case report evaluated the short-term clinical outcomes of a multimodal physiotherapy intervention in a patient following ORIF of a fifth proximal phalanx fracture. The findings demonstrated consistent improvements across all measured domains, including pain intensity, joint range of motion (ROM), muscle strength, and functional ability over a three-week intervention period. These results highlight the potential clinical value of combining physical modalities and therapeutic exercise in the early rehabilitation phase following hand fracture surgery.

The observed reduction in pain across all conditions may be explained by the combined physiological effects of infrared therapy and therapeutic ultrasound. Infrared therapy produces superficial thermal stimulation that enhances local blood circulation and activates thermoreceptors, which may modulate nociceptive input through mechanisms consistent with the gate control theory of pain.[8] In parallel, therapeutic ultrasound contributes to both thermal and non-thermal effects, including increased tissue metabolism, improved collagen extensibility, and modulation of inflammatory processes.[9] Evidence from previous studies supports the role of ultrasound in reducing musculoskeletal pain and facilitating tissue repair, particularly in post-traumatic and post-surgical conditions.[13] Furthermore, recent clinical investigations have reported that ultrasound may accelerate bone healing through stimulation of osteogenesis and callus formation, thereby indirectly contributing to pain reduction and functional recovery.[14] The progressive decrease in pain intensity observed in this case is therefore consistent with the synergistic effects of these modalities.

Improvements in joint ROM observed in this study are likely associated with the combined effects of paraffin bath therapy and active-assisted exercise. Thermal therapy using paraffin has been shown to increase tissue temperature, improve collagen elasticity, and reduce joint stiffness, thereby facilitating greater joint mobility.[10] These findings are supported by systematic reviews demonstrating that paraffin bath therapy can significantly improve hand function and ROM in patients with musculoskeletal conditions affecting the hand.[10] In addition, early mobilization through active-assisted exercise plays a critical role in preventing joint contracture and promoting gradual restoration of movement.[11] The controlled application of movement allows for safe mechanical loading of healing tissues while minimizing the risk of reinjury.[15] The progressive increase in MCP joint motion observed across sessions reflects the effectiveness of combining thermal preparation with guided exercise in restoring joint mobility following immobilization.[16]

The increase in muscle strength from grade 3/5 to 4/5 indicates a positive response to the active-assisted exercise program. Postoperative immobilization is known to contribute to muscle atrophy and reduced neuromuscular activation, particularly in small intrinsic hand muscles.[17] Early activation through assisted movement helps maintain muscle recruitment, improve coordination, and facilitate recovery of voluntary contraction.[11] The observed improvements are consistent with established rehabilitation principles emphasizing gradual loading and neuromuscular re-education.[18] Although the intervention intensity was relatively low to protect healing structures, the consistent progression in muscle strength suggests that even moderate activation can produce meaningful functional gains in the early rehabilitation phase.[19]

Functional improvement, as reflected by the reduction in WHDI score from moderate to minimal disability, appears to be the cumulative effect of reduced pain, improved ROM, and increased muscle strength.[20] Functional recovery in hand rehabilitation is inherently multidimensional and depends on the integration of multiple physiological and biomechanical factors.[21] The findings of this case support the concept that addressing impairments simultaneously through a multimodal approach can facilitate more efficient recovery of functional performance. Previous studies have similarly emphasized that combined interventions targeting pain, mobility, and strength are more effective than isolated treatments in restoring upper limb function.[10]

From a clinical perspective, this case underscores the importance of early, structured, and multimodal physiotherapy following ORIF of phalangeal fractures. The fifth digit plays a significant role in grip strength and hand stability, and even minor impairments can substantially affect overall hand function.[12] Therefore, targeted rehabilitation strategies that address both impairment-level and functional-level outcomes are essential. The results of this report suggest that integrating physical modalities with therapeutic exercise may provide a practical and effective approach in outpatient rehabilitation settings.

Despite these promising findings, several limitations must be acknowledged. First, as a single-case report, the results cannot be generalized to a broader population. Second, the duration of intervention was limited to three weeks, which restricts conclusions regarding long-term outcomes and sustainability of improvement. Third, the study relied primarily on clinical outcome measures without incorporating objective imaging follow-up or advanced functional assessments. Additionally, the absence of a control condition limits the ability to isolate the specific contribution of each intervention component within the multimodal program.

Future research should focus on larger sample sizes using controlled study designs to evaluate the comparative effectiveness of multimodal versus single-modality interventions in post-ORIF hand fracture rehabilitation. Longitudinal studies are also needed to assess long-term functional outcomes and to determine optimal dosage and progression of physiotherapy interventions. Incorporating objective biomechanical and imaging assessments may further strengthen the evidence base and provide deeper insights into the mechanisms underlying recovery.

Conclusion

This case report demonstrated that a multimodal physiotherapy program consisting of infrared therapy, therapeutic ultrasound, paraffin bath, and active-assisted exercise resulted in improvements in pain intensity, joint range of motion, muscle strength, and functional ability in a patient following ORIF of a fifth proximal phalanx fracture. These findings directly support the study objective, indicating that a structured, multimodal rehabilitation approach may be effective in facilitating short-term recovery of hand function after surgical fixation.

From a clinical perspective, integrating physical modalities with progressive exercise may assist physiotherapists in addressing multiple impairments simultaneously during early rehabilitation.

Further research using larger sample sizes, controlled study designs, and longer follow-up periods is recommended to confirm the effectiveness and generalizability of these findings.

Author Contribution

Amara Kurnia Fitri Conceptualization, Methodology, Data Curation, Formal Analysis, Investigation, Writing Original Draft
Arif Pristianto Conceptualization, Methodology, Supervision, Validation, Writing Review and Editing
Leo Muchamad Dachlan Resources, Clinical Supervision, Writing Review and Editing

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Conflict of Interest Statement

The authors declare no conflict of interest.

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Ethics Statement

This case report was conducted in accordance with ethical standards for clinical reporting. The patient provided written informed consent for the use of anonymized clinical data for publication. Formal ethical approval was not required as the intervention was part of routine clinical care.

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