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Physiotherapy Management of Distal Radius Fracture Using Infrared and Hold-Relax: A Case Report

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Abstract

Background: Distal radius fracture is a common upper extremity injury that often results in pain, limited range of motion (ROM), muscle weakness, and impaired hand function following immobilization or surgical intervention.

Objective: To describe the effects of combined infrared therapy and hold-relax technique on pain, joint mobility, muscle strength, and functional ability in a patient with distal radius fracture.

Methods: This clinical case report involved a 48-year-old female patient following open reduction and internal fixation (ORIF) of a distal radius fracture. The patient received six physiotherapy sessions over two weeks, consisting of infrared therapy (10–15 minutes/session) and hold-relax technique targeting wrist flexor and extensor muscles, combined with active-assisted exercises. Outcomes were assessed using the Numeric Rating Scale (NRS) for pain, goniometric measurement for ROM, Manual Muscle Testing (MMT) for muscle strength, and Wrist Hand Disability Index (WHDI) for functional ability at baseline (T1), mid-intervention (T2), and post-intervention (T3).

Results: Pain intensity decreased from NRS 6 to 3 (Δ = −3). ROM improved, particularly wrist extension (30° to 40°, Δ = +10°), supination (50° to 60°, Δ = +10°), and radial deviation (5° to 15°, Δ = +10°). WHDI scores improved from 72% to 65% (Δ = −7%). Muscle strength remained unchanged at MMT grade 3.

Conclusion: The combination of infrared therapy and hold-relax technique was associated with reduced pain and improved joint mobility and functional ability in early rehabilitation after distal radius fracture, although no improvement in muscle strength was observed during the short intervention period.

Keywords
Distal Radius Fracture; Infrared Therapy; Proprioceptive Neuromuscular Facilitation; Range of Motion; Rehabilitation

Introduction

Distal radius fracture is one of the most common upper extremity fractures encountered in clinical practice, accounting for approximately 16% of all fractures treated in emergency departments.[1] This injury frequently occurs due to a fall on an outstretched hand (FOOSH), where axial loading forces are transmitted through the wrist, resulting in fracture of the distal radius.[2] The high incidence of this condition is particularly evident in adult and older populations, making it a significant concern in orthopedic and rehabilitation settings.[3]

Following fracture and subsequent immobilization or surgical intervention such as open reduction and internal fixation (ORIF), patients commonly develop a range of impairments, including pain, joint stiffness, reduced range of motion (ROM), muscle weakness, and functional limitations of the hand.[4] These impairments may substantially affect daily activities such as grasping, writing, eating, and performing self-care tasks, thereby reducing overall quality of life.

Physiotherapy plays a critical role in post-fracture rehabilitation by addressing these impairments through targeted interventions aimed at reducing pain, restoring joint mobility, improving muscle strength, and enhancing functional recovery. Structured rehabilitation programs have been shown to significantly improve clinical outcomes and accelerate recovery following distal radius fracture.[5]

One commonly used modality in physiotherapy is infrared therapy, a form of superficial heat application that promotes vasodilation, enhances local blood circulation, increases tissue metabolism, and reduces muscle spasm.[6] These physiological effects contribute to pain reduction and improve tissue extensibility, thereby preparing the musculoskeletal system for subsequent therapeutic exercises.

In addition to physical modalities, therapeutic exercise is a fundamental component of rehabilitation. The hold-relax technique, a method within Proprioceptive Neuromuscular Facilitation (PNF), involves an isometric contraction followed by muscle relaxation, facilitating increased flexibility and ROM through autogenic inhibition mechanisms.[7] This technique is particularly useful in reducing muscle stiffness and improving joint mobility in musculoskeletal conditions.

Although both infrared therapy and hold-relax techniques have demonstrated effectiveness as standalone interventions, evidence regarding their combined application in distal radius fracture rehabilitation remains limited, particularly within the context of detailed clinical case reports. Existing studies have primarily focused on individual modalities or generalized rehabilitation programs, with limited emphasis on specific combined protocols and their short-term clinical outcomes.

This case is clinically relevant because it demonstrates the application of combined thermal and PNF-based interventions during the early rehabilitation phase following ORIF of a distal radius fracture, where pain, stiffness, and functional limitation are predominant concerns. Therefore, this study aims to describe and evaluate the clinical outcomes of combined infrared therapy and hold-relax technique on pain, range of motion, muscle strength, and functional ability in a patient with distal radius fracture.

Methods

This study was conducted as a clinical case report following the CARE (CAse REport) guidelines to describe the physiotherapy management of a patient with distal radius fracture. The approach was descriptive and focused on documenting clinical findings, interventions, and outcomes over a defined treatment period. The patient was a 48-year-old female who presented with complaints of pain, stiffness, swelling, and limited movement of the right wrist. The condition occurred following a fall from a bicycle approximately two months prior to physiotherapy referral, during which the patient used her right hand to support the body.

The patient was subsequently diagnosed with a distal radius fracture and underwent surgical management with open reduction and internal fixation (ORIF) using plate and screw fixation. No significant comorbidities were reported, and there was no prior history of similar musculoskeletal disorders. The patient had completed the initial postoperative immobilization phase before starting physiotherapy.

Physiotherapy intervention was initiated approximately three months postoperatively in an outpatient rehabilitation setting at the Physiotherapy Unit of RSUD dr. Hardjono Ponorogo between October and November 2025. The intervention program was delivered over two weeks, consisting of six treatment sessions with a frequency of three sessions per week. At baseline, the patient reported pain during movement with a Numeric Rating Scale (NRS) score of 6/10, while no pain was reported at rest (0/10) and mild pain on palpation (3/10).

Objective examination revealed limited wrist range of motion, particularly in flexion, extension, and deviation movements. Muscle strength of the wrist was graded as 3/5 using Manual Muscle Testing (MMT), indicating the ability to move against gravity but not against resistance. Functional assessment using the Wrist Hand Disability Index (WHDI) yielded a score of 72%, indicating severe disability affecting several aspects of daily life.

Outcome measures included pain intensity assessed using the Numeric Rating Scale (NRS), joint mobility measured using a goniometer for range of motion (ROM), muscle strength evaluated using Manual Muscle Testing (MMT), and functional ability assessed using the Wrist Hand Disability Index (WHDI). The NRS is a widely used and valid tool for assessing pain intensity in musculoskeletal conditions. ROM measurement using a goniometer has demonstrated good reliability in clinical practice, while MMT is commonly applied for assessing muscle strength in rehabilitation settings. The WHDI is a functional outcome measure designed to evaluate wrist and hand disability, although detailed psychometric properties for this specific population remain limited. [Perlu referensi tambahan: validitas dan reliabilitas WHDI]

Clinical evaluations were performed at three time points: baseline before intervention (T1), mid-intervention after three sessions (T2), and post-intervention after six sessions (T3). This timeline allowed observation of short-term clinical changes in response to the intervention. The physiotherapy intervention consisted of a combination of infrared therapy and the hold-relax technique, supported by active-assisted exercises. Infrared therapy was applied to the distal radius and wrist region with the patient in a relaxed sitting position and the affected arm supported. The distance between the infrared source and the skin was maintained at approximately 45–50 cm. Each session lasted 10–15 minutes and aimed to increase local circulation, reduce pain, and prepare soft tissues for stretching.

The hold-relax technique, a component of Proprioceptive Neuromuscular Facilitation (PNF), was applied to the wrist flexor and extensor muscle groups. The joint was positioned at the end of the available pain-free range. The patient performed an isometric contraction against resistance for 5–7 seconds, followed by relaxation and passive stretching for 10–15 seconds. This sequence was repeated for 3–5 repetitions per session. The intervention was applied progressively based on patient tolerance, although no formal resistance progression was introduced during the short intervention period. Additional exercises included active-assisted range of motion exercises for the wrist and fingers, as well as light strengthening exercises such as scapular setting and gentle gripping activities to support functional recovery. No adverse events or complications were reported during the intervention period, and the patient tolerated all procedures well.

Written informed consent was obtained from the patient for participation and publication of clinical data and images. This case report was conducted in accordance with institutional clinical practice and adhered to the principles of the Declaration of Helsinki. Formal ethical approval was not required for this type of single-case report according to institutional policy. Data analysis was performed descriptively by comparing changes in outcome measures across the three evaluation time points (T1, T2, and T3). Absolute changes (Δ) were calculated to describe clinical improvement. No inferential statistical analysis was conducted due to the nature of a single-case report.

Results

Clinical outcomes were evaluated at three time points: baseline (T1), mid-intervention after three sessions (T2), and post-intervention after six sessions (T3). Pain intensity measured using the Numeric Rating Scale (NRS) showed a progressive decrease over the intervention period (Table 1).

Table 1. Pain Intensity Measured by Numeric Rating Scale (NRS)

Parameter	T1 (Baseline)	T2 (3 Sessions)	T3 (6 Sessions)	Δ (T1–T3)
NRS (movement)	6	5	3	−3

Range of motion (ROM) measurements demonstrated gradual improvement in wrist, elbow, and hand joints across the evaluation period (Table 2).

Table 2. Range of Motion (ROM) Outcomes (Degrees)

Joint Movement	T1	T2	T3	Normal Value	Δ (T1–T3)
Wrist Extension	30°	35°	40°	60°	+10°
Wrist Flexion	25°	25°	25°	30°	0°
Radial Deviation	5°	10°	15°	20°	+10°
Ulnar Deviation	15°	15°	20°	30°	+5°
Pronation	60°	65°	70°	80°	+10°
Supination	50°	55°	60°	80°	+10°

Muscle strength assessed using Manual Muscle Testing (MMT) remained unchanged throughout the intervention period (Table 3).

Table 3. Muscle Strength (MMT Grade)

Muscle Group	T1	T2	T3	Δ (T1–T3)
Wrist Flexors	3	3	3	0
Wrist Extensors	3	3	3	0
Radial Deviators	3	3	3	0
Ulnar Deviators	3	3	3	0

Functional ability assessed using the Wrist Hand Disability Index (WHDI) demonstrated a reduction in disability level over time (Table 4).

Table 4. Functional Ability Based on Wrist Hand Disability Index (WHDI)

Parameter	T1	T2	T3	Δ (T1–T3)
WHDI (%)	72%	70%	65%	−7%

Overall, the results showed changes across all measured parameters from baseline (T1) to post-intervention (T3), including reductions in pain scores, improvements in joint range of motion, stable muscle strength, and decreased functional disability.

Discussion

This case report demonstrated that the combination of infrared therapy and hold-relax technique was associated with reductions in pain, improvements in joint mobility, and enhanced functional ability in a patient with distal radius fracture following ORIF. However, no observable improvement in muscle strength was noted during the short intervention period. The reduction in pain intensity observed in this case is consistent with the known physiological effects of infrared therapy. Infrared radiation produces superficial heat that promotes vasodilation, increases local blood flow, and enhances tissue metabolism, which collectively contribute to the reduction of pain and muscle spasm.[8] These effects may also facilitate improved oxygen delivery and removal of metabolic byproducts in the affected tissues, thereby supporting the healing process and reducing nociceptive input. Previous studies have reported that thermal modalities combined with therapeutic exercise can significantly reduce pain in patients with distal radius fracture during the post-immobilization phase.[9]

In addition to pain reduction, improvements in range of motion (ROM) were observed across multiple joints, particularly in wrist extension, supination, and deviation movements. These findings are consistent with the mechanisms underlying the hold-relax technique, which utilizes autogenic inhibition mediated by the Golgi tendon organ to reduce muscle tension and increase flexibility.[10] The application of repeated isometric contraction followed by relaxation likely contributed to decreased resistance in periarticular tissues, thereby allowing greater joint excursion. Evidence from randomized controlled trials has demonstrated that PNF techniques, including hold-relax, are effective in improving joint mobility and flexibility in musculoskeletal conditions.[11]

The observed improvements in hand and wrist mobility are clinically important, as joint stiffness is a common consequence of prolonged immobilization following distal radius fracture. Limited ROM can significantly impair hand function and delay return to daily activities. The progressive improvement in ROM observed in this case aligns with previous rehabilitation studies indicating that early and structured therapeutic exercise can enhance joint mobility and functional recovery after distal radius fracture.[12]

Despite these positive outcomes, muscle strength, as measured by Manual Muscle Testing (MMT), did not show improvement throughout the intervention period. This finding may be explained by several factors. First, the duration of intervention was relatively short (two weeks), which may not be sufficient to induce measurable strength gains. Second, the rehabilitation program primarily focused on pain reduction and mobility restoration rather than progressive resistance training. Third, the patient was still in the early phase of rehabilitation, where bone healing and tissue recovery may limit the intensity of strengthening exercises. Previous literature suggests that muscle strengthening in post-fracture rehabilitation is typically introduced progressively after adequate pain control and mobility are achieved.[13]

Functional improvement, as reflected by the reduction in WHDI scores, indicates that the patient experienced a meaningful improvement in the ability to perform daily activities involving the hand and wrist. Although the level of disability remained within the severe category, the observed reduction suggests a positive trend in functional recovery. Functional outcomes in distal radius fracture are closely related to pain levels, joint mobility, and muscle performance, and improvements in these domains are expected to contribute to better overall hand function.[14]

When compared with previous studies, the findings of this case report are consistent with evidence suggesting that combined physiotherapy interventions, including physical modalities and therapeutic exercise, are effective in improving clinical outcomes after distal radius fracture.[15] However, most available evidence is derived from group-based studies or randomized trials, whereas detailed descriptions of combined interventions in individual clinical cases remain limited. This case therefore provides additional insight into the short-term clinical application of combined infrared and PNF-based interventions in a real-world setting.

From a clinical perspective, this case highlights the importance of integrating thermal modalities with neuromuscular facilitation techniques during the early phase of rehabilitation to address pain and mobility limitations. Such an approach may enhance patient participation in therapy and facilitate functional recovery. However, to achieve improvements in muscle strength, a longer rehabilitation duration with progressive resistance training appears necessary.

Several limitations should be considered when interpreting the findings of this case report. First, the study involved a single patient, which limits generalizability. Second, the short duration of intervention restricted the ability to observe long-term outcomes, particularly in muscle strength recovery. Third, no follow-up assessment beyond the intervention period was conducted, making it difficult to determine the sustainability of the observed improvements. Finally, the absence of comparative or control conditions limits the ability to attribute outcomes solely to the intervention.

Overall, this case suggests that the combination of infrared therapy and hold-relax technique may be beneficial in reducing pain and improving mobility and function in the early rehabilitation phase following distal radius fracture. However, further studies with larger sample sizes, longer follow-up periods, and controlled designs are needed to confirm these findings and establish stronger clinical evidence.

Conclusion

This case report demonstrated that the combination of infrared therapy and hold-relax technique was associated with reductions in pain, improvements in joint mobility, and enhanced functional ability in a patient with distal radius fracture during the early rehabilitation phase following ORIF. However, no meaningful improvement in muscle strength was observed over the short intervention period. These findings suggest that integrating thermal modalities with neuromuscular facilitation techniques may be

beneficial for addressing pain and mobility limitations in early-stage rehabilitation. Nevertheless, longer treatment duration and the incorporation of progressive strengthening exercises are likely required to achieve significant improvements in muscle strength.

As a single-case report, these results should be interpreted with caution due to limited generalizability and short follow-up duration. Future studies with larger samples and controlled designs are needed to establish stronger clinical evidence. Early-phase physiotherapy combining infrared therapy and hold-relax technique may effectively improve mobility and function, but muscle strengthening requires longer and more progressive intervention.

Author Contribution

Alissa Ana Sayida: Conceptualization, methodology, data collection, formal analysis, writing – original draft.
Totok Budi Santoso: Supervision, validation, methodology, writing – review and editing.
Kingkinarti: Investigation, data collection, resources, 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

Written informed consent was obtained from the patient for participation and publication of clinical data. This case report was conducted in accordance with the principles of the Declaration of Helsinki. Formal ethical approval was not required for this type of single-case report according to institutional policy.

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