Majalah Ilmiah Fisioterapi Indonesia
Indonesian Scientific Journal of Physiotherapy

Case Reports / Case Studies
ISSN (Print): 2303-1921
ISSN (Online): 2722-0443
Volume 14, Number 03, Pages 985-991 (2026)
DOI: https://doi.org/10.24843/mifi.000002035

Physiotherapy Rehabilitation for Shoulder Stiffness Following ORIF of Proximal Humerus Fracture: A Case Report

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Received 24 May 2026; Revised 29 May 2026; Accepted 30 May 2026; Published 28 September 2026.

Background: Shoulder stiffness is a common complication following proximal humerus fracture, particularly in older adults who undergo postoperative immobilization after open reduction and internal fixation (ORIF). This condition may result in pain, reduced range of motion (ROM), muscle weakness, and impaired functional performance.
Objective: To describe the clinical outcomes of a physiotherapy rehabilitation program in an older adult with shoulder stiffness following ORIF for a proximal humerus fracture.
Methods: A case report was conducted in a 65-year-old male with right shoulder stiffness following ORIF for a closed proximal humerus fracture. Physiotherapy was initiated after postoperative immobilization and consisted of transcutaneous electrical nerve stimulation (TENS), active and passive ROM exercises, stretching, diaphragmatic breathing exercises, and progressive resisted exercise. Outcomes were assessed using the Numeric Rating Scale (NRS), Manual Muscle Testing (MMT), shoulder ROM measurements, and the Shoulder Pain and Disability Index (SPADI) over four treatment sessions.
Results: Movement pain decreased from 4/10 to 3/10, while tenderness decreased from 2/10 to 1/10. Muscle strength improved from MMT grade 2+ to 3−. Active shoulder flexion increased from 75° to 90°, active shoulder abduction increased from 75° to 87°, and passive shoulder abduction increased from 95° to 106°. Functional status improved, with the SPADI score decreasing from 65.00% to 57.69%.
Conclusion: The rehabilitation program was associated with improvements in pain, shoulder mobility, muscle strength, and functional ability. This case highlights the potential value of individualized physiotherapy rehabilitation for postoperative shoulder stiffness, even when treatment is initiated after a period of immobilization.

Keywords
Proximal Humeral Fractures; Shoulder Stiffness; Range of Motion; Physical Therapy Modalities; Shoulder Pain; Aged

Introduction

Population aging is associated with progressive declines in musculoskeletal function, bone quality, and physiological reserve, increasing susceptibility to falls, fractures, disability, and loss of independence. Fragility fractures represent a major public health concern because they are associated with prolonged functional limitations, reduced quality of life, increased healthcare utilization, and higher mortality rates among older adults. As the global elderly population continues to increase, fractures among older adults remain an important clinical and public health concern, highlighting the need for appropriate management and recovery strategies.[1–5]

Proximal humerus fracture (PHF) is one of the most common upper extremity fractures in older adults, accounting for approximately 5–6% of all fractures and representing the third most common osteoporotic fracture after hip and distal radius fractures. 3 PHFs commonly occur following low-energy falls and are strongly associated with osteoporosis, impaired balance, advanced age, and multiple comorbidities. Because the proximal humerus plays a crucial role in glenohumeral stability and upper limb movement, injuries affecting this region may substantially impair shoulder function and limit the performance of daily activities.[6,7]

For displaced or unstable fractures, open reduction and internal fixation (ORIF) is frequently performed to restore anatomical alignment and mechanical stability. Although surgical fixation can facilitate fracture healing, postoperative recovery may be complicated by pain, immobilization, muscle weakness, and restricted shoulder mobility. Prolonged immobilization may reduce synovial fluid circulation, increase capsular tightness, promote periarticular adhesions, and decrease soft tissue extensibility, thereby contributing to the development of shoulder stiffness.[8,9] Shoulder stiffness is characterized by restricted active and passive range of motion (ROM), pain during movement, muscle weakness, and impaired functional performance, all of which may delay recovery and reduce independence in older adults.[9]

Physiotherapy plays a central role in postoperative rehabilitation following PHF by addressing pain, mobility limitations, muscle weakness, and functional disability.[8] Rehabilitation programs commonly include transcutaneous electrical nerve stimulation (TENS), active and passive ROM exercises, stretching, strengthening exercises, and functional training.[8,10] Previous studies have demonstrated that progressive mobilization and therapeutic exercise may improve shoulder mobility, reduce disability, and facilitate functional recovery following proximal humerus fracture.[8,10] In addition, electrotherapy modalities may help reduce pain and facilitate participation in rehabilitation programs.[11]

The rehabilitation process may become more challenging in older adults with hypertension, one of the most prevalent chronic conditions in this population. Exercise prescription in hypertensive individuals requires careful consideration because excessive training intensity may increase cardiovascular demand, whereas inadequate exercise may delay functional recovery. Evidence suggests that appropriately prescribed low- to moderate-intensity exercise can safely improve physical function while maintaining cardiovascular stability in older adults with hypertension.[12] Consequently, rehabilitation programs should be individualized according to both musculoskeletal and cardiovascular considerations.

Although evidence supporting rehabilitation after PHF continues to expand, evidence regarding physiotherapy management of postoperative shoulder stiffness in older adults with concomitant hypertension remains limited.[13] Furthermore, clinical evidence regarding recovery following rehabilitation initiated after a period of immobilization is still relatively scarce.[13,14] This clinical scenario is encountered in physiotherapy practice and presents challenges related to pain management, restoration of mobility, exercise progression, and patient safety. Therefore, this case report aimed to describe the clinical outcomes of a physiotherapy rehabilitation program consisting of TENS, ROM exercises, stretching, diaphragmatic breathing exercises, and progressive resisted exercise in an older adult with shoulder stiffness following ORIF for a proximal humerus fracture and a history of hypertension.

Methods

This study was conducted using a case report design and was prepared in accordance with the CARE (CAse REport) Guideline to ensure transparent and systematic reporting of clinical findings and rehabilitation outcomes.[15] A case report design was selected because it enables detailed documentation of the clinical presentation, rehabilitation process, and treatment outcomes of a patient with shoulder stiffness following open reduction and internal fixation (ORIF) for a proximal humerus fracture, a condition that remains clinically relevant in geriatric musculoskeletal rehabilitation.

The patient was a 65-year-old male diagnosed with right shoulder stiffness following ORIF for a closed proximal humerus fracture. The patient received physiotherapy treatment at the Medical Rehabilitation Outpatient Clinic of Fatmawati Mother Hospital, Surakarta. Information regarding hand dominance, previous physical activity level, psychosocial factors, and medication history was not available in the clinical record and therefore could not be reported. This limitation is acknowledged to maintain the accuracy and integrity of the clinical data presented.

Data collection consisted of subjective and objective physiotherapy assessments. Subjective assessment included the history of injury, surgical history, chief complaints, functional limitations, and relevant medical history. Objective assessment included observation, palpation, pain assessment, muscle strength testing, range of motion (ROM) measurement, and functional outcome evaluation.

Pain intensity was assessed using the Numeric Rating Scale (NRS), a valid and reliable instrument ranging from 0 (no pain) to 10 (worst imaginable pain).[16] Muscle strength was evaluated using Manual Muscle Testing (MMT), which grades muscle performance on a scale from 0 to 5 according to the patient's ability to perform movement against gravity and resistance.[17] Shoulder mobility was assessed through active and passive ROM measurements using standard goniometric procedures.[18] Functional status was evaluated using the Shoulder Pain and Disability Index (SPADI), a validated patient-reported outcome measure consisting of pain and disability domains, with higher scores indicating greater impairment.[19]

Written informed consent for treatment and publication of anonymized clinical information was obtained from the patient before preparation of this case report. Patient confidentiality was maintained throughout the reporting process. Because this study represents a retrospective description of routine clinical management involving a single patient without experimental intervention, formal ethical approval was not required according to institutional policy; however, all procedures were conducted in accordance with ethical principles for clinical reporting.[20]

Figure 1 illustrates the clinical course from the initial fall-related injury and subsequent surgical management of the proximal humerus fracture to postoperative complications, physiotherapy intervention, and final evaluation. The timeline includes the initial physiotherapy assessment (T1), intervention sessions (T1–T4), and final evaluation at T4.

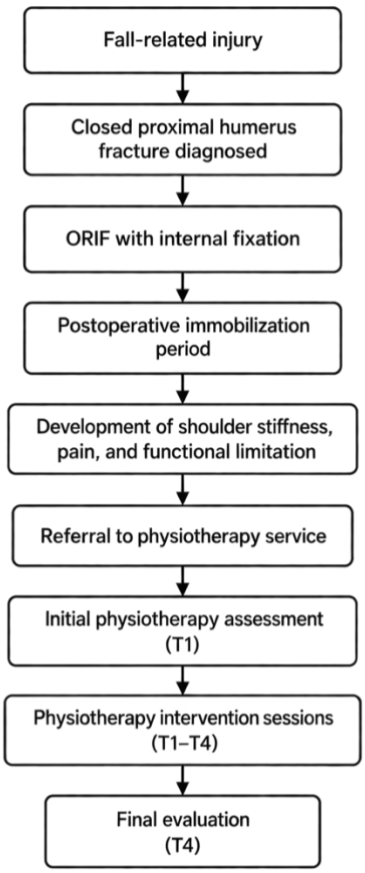

Figure 1. Clinical Timeline of Physiotherapy Management

The rehabilitation program was designed to reduce pain, improve shoulder mobility, increase muscle strength, and restore functional ability. The intervention consisted of transcutaneous electrical nerve stimulation (TENS), active and passive ROM exercises, stretching exercises, wall climbing exercise, broomstick-assisted exercise, pendulum exercise, diaphragmatic breathing exercise, and progressive resisted exercise.

TENS was administered before exercise sessions as an adjunct modality for pain management and exercise preparation. Although the clinical record confirmed the use of conventional TENS, detailed parameters such as pulse duration, stimulation frequency, and treatment intensity were not documented. Consequently, these parameters cannot be reported and should be considered a limitation of this case report. Nevertheless, stimulation intensity was adjusted according to patient comfort and sensory tolerance during treatment sessions.

ROM exercises were performed using active, active-assisted, and passive movement patterns focusing primarily on shoulder flexion and abduction. Pendulum exercise, wall climbing exercise, broomstick-assisted stretching, and open-arm chest stretching were selected to improve joint mobility, increase soft tissue extensibility, and reduce movement restrictions associated with postoperative shoulder stiffness. The selection of these interventions was based on evidence supporting progressive mobilization and restoration of shoulder movement following proximal humerus fracture rehabilitation.[8,13]

Progressive strengthening exercises were introduced using low-intensity resistance according to the patient's physical capacity and clinical tolerance. Resistance exercises focused on shoulder stabilizing musculature and rotator cuff function through internal and external rotation movements. The specific resistance level of the elastic band used during treatment was not documented in the clinical record and therefore could not be reported. Diaphragmatic breathing exercises were incorporated to facilitate relaxation and support safe exercise participation in the presence of hypertension.[12]

The intervention was delivered over four treatment sessions. ROM exercises were prescribed at a frequency of five to seven sessions per week with a duration of approximately 15–30 minutes per session. Resistance exercises were performed two to three times per week using six sets of twenty repetitions with one minute of rest between sets. Exercise progression was guided by pain response, movement quality, exercise tolerance, and achievement of treatment goals.

Throughout rehabilitation, patient safety was monitored through observation of symptom responses, exercise tolerance, perceived exertion, and general clinical condition. No adverse cardiovascular symptoms, dizziness, excessive fatigue, or exercise-related complications were documented during treatment. However, detailed blood pressure monitoring records were not available in the clinical documentation. Information regarding home exercise prescription and adherence outside supervised physiotherapy sessions was also unavailable and therefore could not be evaluated.

The patient reported that shoulder movement became easier during daily activities compared with the initial assessment. The patient also perceived a reduction in discomfort during arm movement and expressed satisfaction with the gradual improvement achieved throughout the rehabilitation period. Although a standardized patient experience questionnaire was not administered, these subjective observations were consistent with the objective improvements observed during follow-up assessments.

Written informed consent was obtained from the patient for the publication of anonymized clinical information and rehabilitation outcomes contained in this case report.

Results

The patient's clinical outcomes were evaluated across four physiotherapy sessions (T1–T4) using the Numeric Rating Scale (NRS), Manual Muscle Testing (MMT), shoulder range of motion (ROM), and the Shoulder Pain and Disability Index (SPADI). These outcome measures were selected to assess changes in pain intensity, muscle strength, shoulder mobility, and functional ability throughout the rehabilitation period. To facilitate interpretation, the results are presented systematically according to functional outcomes, pain intensity, muscle strength, and shoulder ROM.

Functional status was assessed using the SPADI to determine the impact of shoulder symptoms on daily activities. The results presented in Table 1 demonstrate a gradual reduction in disability scores throughout the intervention period. This trend indicates progressive improvement in shoulder function and reduced activity limitation during daily tasks.

Table 1. Changes in SPADI Scores During Rehabilitation

Assessment	SPADI Score (%)	Clinical Interpretation
T1	65.00	Moderate to severe disability
T2	65.00	Moderate to severe disability
T3	60.00	Moderate disability
T4	57.69	Moderate disability

The SPADI score decreased from 65.00% at baseline to 57.69% at the final evaluation, representing an absolute reduction of 7.31 percentage points. This finding suggests a positive trend toward functional improvement, although the magnitude of change remained relatively modest. Considering the short duration of intervention and the absence of long-term follow-up, the observed improvement should be interpreted as an early functional response rather than a complete recovery of shoulder function. Furthermore, although improvement approached values reported for the minimal clinically important difference (MCID) in SPADI, definitive conclusions regarding clinical significance should be interpreted cautiously due to the single-case design and limited observation period.[21]

Pain intensity was evaluated using the NRS during rest, movement, and palpation. The results presented in Table 2 demonstrate a gradual reduction in movement-related pain and tenderness throughout the rehabilitation period.

Table 2. Changes in NRS Scores During Rehabilitation

Assessment	T1	T2	T3	T4
Resting pain	0	0	0	0
Movement pain	4	4	3	3
Tenderness	2	2	1	1

No resting pain was reported at any assessment point. However, movement pain decreased from 4/10 to 3/10, while tenderness decreased from 2/10 to 1/10. Although the numerical reduction was relatively small, these changes may have facilitated greater participation in therapeutic exercise and shoulder mobilization activities. Reduced pain during movement is clinically relevant because pain is a major factor limiting shoulder use and participation in rehabilitation following proximal humerus fracture surgery.

Muscle strength was assessed using MMT to evaluate the patient's ability to generate active movement against gravity and resistance. Table 3 summarizes changes in muscle performance throughout the intervention period.

Table 3. Changes in MMT Scores During Rehabilitation

Assessment	MMT Grade	Clinical Interpretation
T1	2+	Partial movement with limited antigravity control
T2	2+	Partial movement with limited antigravity control
T3	2+	Partial movement with limited antigravity control
T4	3−	Near-complete antigravity movement

Muscle strength remained stable during the first three evaluations and improved at the final assessment. The progression from grade 2+ to grade 3− indicates improved antigravity movement capability and greater neuromuscular control of the shoulder musculature. Functionally, this improvement may contribute to enhanced ability to perform activities requiring active arm elevation, reaching, and positioning of the upper extremity during daily activities.

Shoulder ROM was measured to evaluate recovery of mobility following postoperative stiffness. The results are presented in Table 4 to illustrate changes in active and passive shoulder movements across the intervention period.

Table 4. Changes in Right Shoulder ROM During Rehabilitation

Movement	T1	T2	T3	T4
Active flexion	75°	75°	87°	90°
Passive flexion	95°	95°	98°	95°
Active abduction	75°	75°	80°	87°
Passive abduction	95°	95°	98°	106°

Improvements were observed in both active and passive ROM measurements. Active flexion increased by 15°, active abduction increased by 12°, and passive abduction increased by 11° over the course of treatment. The greatest improvement was observed in active shoulder flexion, suggesting progressive restoration of voluntary shoulder movement. Although passive flexion remained relatively stable, the overall ROM findings indicate reduced movement restriction and improved shoulder mobility following rehabilitation.

Figure 2 presents the clinical outcomes observed before and after the physiotherapy intervention. The comparison includes movement pain, tenderness, muscle strength, active and passive shoulder range of motion, and the Shoulder Pain and Disability Index (SPADI). Changes in each outcome were assessed by comparing the initial assessment (T1) with the final evaluation (T4), demonstrating changes in pain intensity, muscle strength, shoulder mobility, and functional status following the physiotherapy intervention.

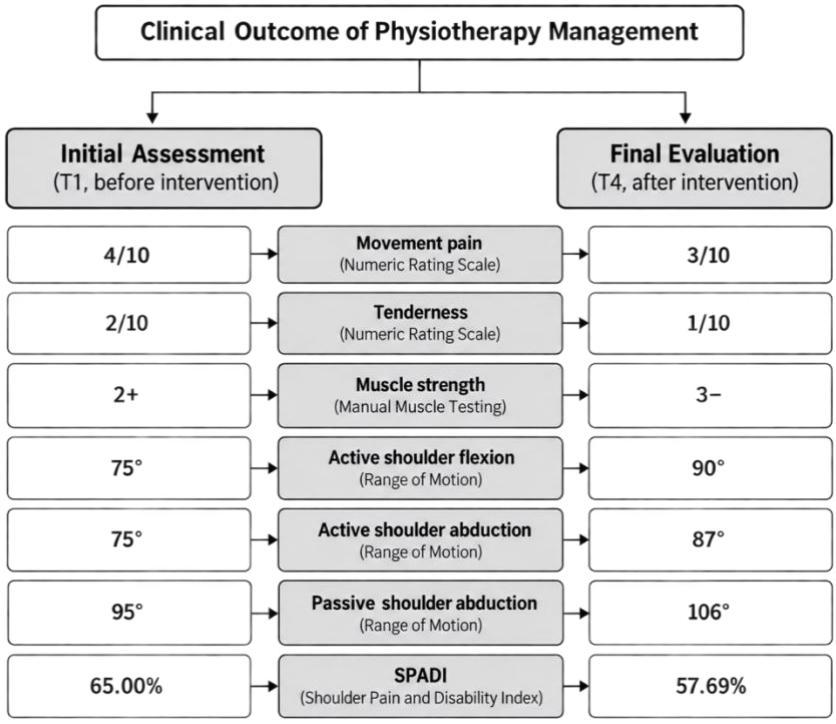

Figure 2. Clinical Outcomes Before and After Physiotherapy Intervention

No adverse events were reported throughout the intervention period. Specifically, no increase in pain severity, excessive fatigue, dizziness, cardiovascular symptoms, or other clinically significant complications were documented during treatment sessions. This finding suggests that the rehabilitation program was well tolerated within the observed treatment period.

Overall, the findings demonstrate gradual improvements in pain, muscle strength, shoulder mobility, and functional ability following four sessions of physiotherapy intervention. Although the magnitude of change was modest and follow-up was limited to four treatment sessions, consistent positive trends were observed across all outcome measures. Because this report describes a single clinical case without a comparison group, the results should be interpreted as descriptive clinical outcomes rather than evidence of treatment effectiveness.

Discussion

This case report described the clinical outcomes of a multimodal physiotherapy rehabilitation program in a 65-year-old patient with shoulder stiffness following ORIF for a proximal humerus fracture and concomitant hypertension. Improvements were observed in pain intensity, shoulder mobility, muscle strength, and functional ability following four treatment sessions. Although the magnitude of improvement varied across outcome measures, the overall findings suggest that a structured rehabilitation program may contribute to functional recovery in patients experiencing postoperative shoulder stiffness after a period of immobilization.

One of the most notable findings was the improvement in shoulder ROM. Active shoulder flexion increased from 75° to 90°, active shoulder abduction increased from 75° to 87°, and passive shoulder abduction increased from 95° to 106°. These findings are clinically relevant because postoperative shoulder stiffness is commonly associated with prolonged immobilization, capsular tightness, periarticular adhesions, and reduced soft tissue extensibility.[8,22] Such impairments may substantially restrict upper extremity function and delay return to daily activities. Previous studies have reported that progressive mobilization and therapeutic exercise facilitate restoration of shoulder mobility by improving joint nutrition, maintaining soft tissue flexibility, and reducing the risk of persistent movement restriction.[8,10] The improvements observed in this case are therefore consistent with current evidence supporting the role of ROM exercise and progressive mobilization in postoperative shoulder rehabilitation.

The observed reduction in pain also represents an important clinical outcome. Movement-related pain decreased from 4/10 to 3/10, while tenderness decreased from 2/10 to 1/10. Although these changes were modest, pain reduction may have improved the patient's ability to participate actively in exercise and functional movement training. Pain is a major factor limiting shoulder use and may affect participation in rehabilitation following proximal humerus fracture surgery.[23] The inclusion of TENS before exercise sessions may have contributed to symptom reduction by modulating pain perception and potentially improving tolerance to therapeutic activity.[24,25] Previous studies have suggested that TENS combined with exercise may provide analgesic benefits during rehabilitation and may support engagement in movement-based interventions.[26]

Muscle strength improved from MMT grade 2+ to grade 3− during the intervention period. This change indicates progression from limited active movement toward the ability to perform movement against gravity with improved neuromuscular control. From a functional perspective, greater muscle strength may enhance the ability to perform activities requiring arm elevation, reaching, and positioning of the upper extremity during daily tasks. The improvement observed in this case may be related to the introduction of progressive resisted exercise and repeated active shoulder movement throughout rehabilitation. Similar findings have been reported in studies demonstrating the beneficial effects of strengthening exercises on upper extremity function following shoulder injury and surgical intervention.[8]

Functional improvement was reflected by the reduction in SPADI score from 65.00% to 57.69%. The decrease of 7.31 percentage points indicates reduced disability and improved shoulder-related function. However, interpretation of this finding requires careful consideration. Previous studies have reported that the minimal clinically important difference (MCID) for SPADI varies depending on the patient population, clinical condition, and methodology used to determine clinically meaningful change.[27] Therefore, although the observed change approached clinically meaningful thresholds, it may represent an early positive trend rather than a definitive clinically important improvement. This interpretation highlights the importance of evaluating both statistical values and their practical relevance to patient function when assessing rehabilitation outcomes.

An important consideration in this case is the patient's advanced age and history of hypertension. Older adults often experience slower recovery due to age-related declines in muscle mass, tissue healing capacity, and overall physiological reserve.[28–30] In addition, hypertension may influence exercise prescription because excessive exercise intensity can increase cardiovascular demand and potentially compromise patient safety.[12] For this reason, the rehabilitation program emphasized low- to moderate-intensity exercise progression with close observation of symptom responses and exercise tolerance. No adverse cardiovascular symptoms, excessive fatigue, dizziness, or treatment-related complications were reported during the intervention period. This finding is consistent with evidence suggesting that appropriately prescribed exercise can be safely implemented in older adults with hypertension while supporting musculoskeletal recovery.[12]

The positive outcomes observed in this case should not be attributed solely to physiotherapy intervention. Fracture healing is a dynamic biological process involving inflammation, callus formation, and bone remodeling that continues for several months following injury and surgery. 6 Consequently, some degree of improvement may have occurred as part of the natural healing process. Nevertheless, physiotherapy may have contributed to optimizing recovery by addressing secondary impairments such as pain, stiffness, muscle weakness, and functional disuse.[8] Recognizing the combined influence of natural recovery and rehabilitation is important because case reports are not designed to establish causal relationships.

The patient's subjective feedback also provides useful clinical context. During rehabilitation, the patient reported that shoulder movement became easier and daily activities could be performed with less difficulty compared with the initial assessment. Although a standardized patient-reported experience measure was not administered, these observations were consistent with the objective improvements observed in pain, ROM, muscle strength, and SPADI outcomes. Incorporating patient perspective is important because perceived improvement may influence motivation, treatment adherence, and engagement in rehabilitation.[31]

Several limitations should be acknowledged. First, this report describes a single patient, limiting external validity and preventing generalization of the findings to broader populations. Second, the intervention period consisted of only four treatment sessions, which may not have been sufficient to capture the full rehabilitation potential of the patient. Third, long-term follow-up data were unavailable, preventing evaluation of the sustainability of treatment outcomes. Fourth, several clinically relevant variables, including detailed TENS parameters, antihypertensive medication history, imaging findings, psychosocial factors, home exercise adherence, and detailed cardiovascular monitoring data, were not documented in the original clinical record. Finally, the absence of a comparison group precludes determination of the specific contribution of physiotherapy relative to natural recovery.

Despite these limitations, this case report provides clinically relevant information regarding the management of postoperative shoulder stiffness in an older adult with hypertension. The findings support the feasibility of combining pain management strategies, ROM exercises, stretching, diaphragmatic breathing exercises, and progressive strengthening within a structured rehabilitation program. Future studies involving larger samples, longer intervention periods, and long-term follow-up are needed to strengthen the evidence regarding physiotherapy rehabilitation following proximal humerus fracture surgery.

Clinical Implications

The findings of this case report suggest that a structured physiotherapy rehabilitation program consisting of pain management, ROM exercises, stretching, diaphragmatic breathing exercises, and progressive resisted exercise may support functional recovery in patients with shoulder stiffness following ORIF for proximal humerus fracture. The combination of these

interventions was associated with improvements in pain, shoulder mobility, muscle strength, and functional status within a relatively short rehabilitation period.

For clinical practice, rehabilitation programs should be individualized according to patient characteristics, fracture status, postoperative recovery stage, and comorbid conditions.[13] Particular attention should be given to older adults with hypertension, as exercise progression should balance functional restoration with cardiovascular safety. Continuous monitoring of symptom responses and exercise tolerance remains essential during rehabilitation.[12]

Study Limitations

Several limitations should be considered when interpreting the findings of this case report. First, the report involved only one patient, which limits external validity and prevents direct generalization to broader populations. Second, the intervention period consisted of only four treatment sessions, thereby limiting evaluation of long-term rehabilitation outcomes and sustainability of functional improvements.

Third, several clinically relevant variables were unavailable in the original clinical record, including detailed TENS parameters, antihypertensive medication history, dominant hand information, imaging findings following ORIF, psychosocial factors, and adherence to home exercise programs. Fourth, no long-term follow-up assessment was available to determine whether the observed improvements were maintained after completion of treatment. Finally, because this report describes a single clinical case without a comparison group, it is not possible to establish a causal relationship between physiotherapy intervention and the observed clinical improvements.

Conclusion

This case report demonstrated that a physiotherapy rehabilitation program consisting of TENS, ROM exercises, stretching, diaphragmatic breathing exercises, and progressive resisted exercise was associated with improvements in pain, shoulder mobility, muscle strength, and functional ability in a 65-year-old patient with shoulder stiffness following ORIF for a proximal humerus fracture and concomitant hypertension.

The observed improvements suggest that individualized physiotherapy rehabilitation may help address pain, movement restrictions, muscle weakness, and functional limitations that commonly occur after postoperative immobilization. The absence of adverse events during treatment also supports the feasibility of implementing a carefully monitored rehabilitation program in older adults with hypertension.

Given the single-case design, short intervention duration, and limited follow-up period, these findings should be interpreted as descriptive clinical outcomes rather than evidence of treatment effectiveness. Further studies involving larger samples, standardized rehabilitation protocols, and long-term follow-up are required to strengthen the evidence regarding physiotherapy management of postoperative shoulder stiffness following proximal humerus fracture surgery.

Author Contributions

Sri Qadijah: Conceptualization, Data Curation, Investigation, Formal Analysis, Writing – Original Draft Preparation.
Agus Widodo: Supervision, Methodology, Validation, Writing – Review and Editing.
Astuti: Supervision, Methodology, Validation, Writing – Review and Editing.

Acknowledgments

The authors would like to express their sincere gratitude to the patient who voluntarily participated in this case report and to the staff of the Medical Rehabilitation Outpatient Clinic of Ibu Fatmawati Soekarno Regional General Hospital, Surakarta, for their assistance during the rehabilitation process.

Conflict of Interest Statement

The authors declare that there are no conflicts of interest related to this study.

Funding Sources

This study received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Ethics Statement

Written informed consent was obtained from the patient for participation and publication of anonymized clinical information contained in this case report. This manuscript was prepared in accordance with the CARE (CAse REport) Guideline. As this study describes routine clinical management of a single patient without experimental intervention, formal ethical approval was not required according to institutional policy. If an ethics approval number is available, please insert it here.

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