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Physiotherapy Outcomes in Chronic Femoral Osteomyelitis Following Reconstructive ORIF: A Case Report

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Abstract

Background: Chronic femoral osteomyelitis following Open Reduction and Internal Fixation (ORIF) is associated with prolonged immobilisation and persistent functional impairment. Evidence regarding physiotherapy during periods of active chronic infection remains limited.

Objective: To describe the effects of a structured physiotherapy program on joint mobility, muscle strength, and lower extremity function in a patient with chronic femoral osteomyelitis after reconstructive ORIF.

Methods: This CARE-compliant case report involved a 26-year-old female with chronic left femoral osteomyelitis. The patient received a three-week physiotherapy program consisting of Transcutaneous Electrical Nerve Stimulation, knee range-of-motion exercises, resistance-band strengthening, and stretching. Outcomes included knee range of motion, Manual Muscle Testing, and the Lower Extremity Functional Scale (LEFS). Data were analysed descriptively.

Results: Active and passive knee flexion increased by 7° each. Quadriceps and hamstring muscle strength improved from grades 3+ and 3− to grade 4−. The LEFS score increased from 60 to 67. No adverse events were observed.

Conclusion: Structured physiotherapy may be safely implemented and contribute to functional improvement in patients with chronic femoral osteomyelitis following reconstructive ORIF.

Keywords
Osteomyelitis; Femur; Open Reduction and Internal Fixation; Physical Therapy Modalities; Range of Motion

Introduction

Femoral fractures represent a significant global health burden and are among the most severe injuries encountered in orthopaedic and trauma practice. Recent epidemiological data indicate that more than 178 million new fracture cases occur worldwide each year, with femoral fractures contributing substantially to morbidity, disability, and healthcare costs.[1,2] Owing to their association with high-energy trauma, complex biomechanical demands, and prolonged recovery, femoral fractures frequently require surgical stabilisation to restore alignment and enable early mobilisation.[3]

Open Reduction and Internal Fixation (ORIF) remains the preferred surgical approach for displaced or unstable femoral fractures, as it provides mechanical stability, facilitates fracture healing, and supports earlier functional rehabilitation.[4] However, despite advances in surgical techniques and perioperative care, postoperative complications remain a major concern. Among these, fracture-related infection—particularly osteomyelitis—poses one of the most serious challenges, as it is associated with prolonged treatment, repeated surgical interventions, and compromised functional outcomes.[5,6]

Osteomyelitis following ORIF most commonly arises through contiguous spread from infected soft tissues or implanted hardware rather than haematogenous dissemination.[7] When infection persists beyond six weeks, it is classified as chronic osteomyelitis, a condition characterised by necrotic bone formation, persistent inflammatory responses, and bacterial biofilm development that limits antibiotic penetration and host immune clearance.[8,9] These pathological features often necessitate staged surgical management, including repeated debridement, implant removal or replacement, and prolonged antimicrobial therapy, thereby extending periods of immobilisation and delaying rehabilitation.[10,11]

The functional consequences of chronic femoral osteomyelitis extend beyond skeletal pathology. Persistent inflammation, pain, and prolonged unloading contribute to muscle atrophy, joint stiffness, impaired neuromuscular control, and altered movement patterns.[12,13] Patients frequently experience difficulty performing basic functional activities such as walking, stair negotiation, and prolonged standing, resulting in reduced independence and diminished quality of life.[12] These impairments are often compounded by fear of movement, repeated hospitalisations, and uncertainty regarding safe loading of the affected limb.[14]

Physiotherapy is a core component of postoperative management following femoral fractures and ORIF, with established benefits for restoring joint mobility, muscle strength, and functional capacity.[12] In uncomplicated cases, rehabilitation typically emphasises progressive weight-bearing, strengthening, and task-specific functional training. However, in the presence of chronic osteomyelitis, rehabilitation strategies must be modified to prioritise symptom-guided progression, joint protection, and close clinical monitoring.[7] Adjunctive modalities such as Transcutaneous Electrical Nerve Stimulation (TENS) may be incorporated to support pain modulation and facilitate participation in therapeutic exercise.[15,16]

Despite the recognised importance of rehabilitation, the majority of existing literature focuses on physiotherapy following fracture healing or after infection resolution.[4,5] Evidence describing physiotherapy interventions during periods of active or persistent chronic osteomyelitis—particularly following repeated reconstructive ORIF of the femur—remains scarce.[17,18] As a result, clinical decision-making regarding the timing, safety, and expected benefits of physiotherapy in this population is often extrapolated from non-infected or post-resolution cohorts, which may not adequately reflect the complexity of ongoing infection-related pathology.

This lack of targeted evidence represents a critical gap in the rehabilitation literature. Understanding whether physiotherapy can be safely implemented and contribute to functional improvement during active chronic osteomyelitis is essential for optimising multidisciplinary care, preventing secondary musculoskeletal complications, and supporting patient-centred recovery. Case reports play an important role in addressing this gap by providing detailed clinical insights into rare or complex presentations where higher-level evidence is limited.

Therefore, the purpose of this case report is to describe the functional outcomes of a structured physiotherapy program in a patient with chronic femoral osteomyelitis following reconstructive Open Reduction and Internal Fixation. The report focuses on changes in knee joint mobility, muscle strength, and lower extremity functional performance, with the aim of informing clinical practice and highlighting considerations for safe rehabilitation in complex orthopaedic cases complicated by persistent infection.

Methods

This study was designed as a single-patient case report describing a structured physiotherapy intervention and its functional outcomes in a patient with chronic osteomyelitis of the left femur following reconstructive Open Reduction and Internal Fixation (ORIF). The case report was prepared and reported in accordance with the CARE (CAse REport) guidelines to ensure transparency, methodological clarity, and completeness of reporting.

The intervention and clinical assessments were conducted in October 2025 at Prof. Dr. R. Soeharso Orthopaedic Hospital, Indonesia. The patient received outpatient physiotherapy as part of a multidisciplinary management approach involving orthopaedic surgeons, rehabilitation physicians, and physiotherapists. All assessments and interventions were performed in the hospital's physiotherapy department using standard clinical equipment and established clinical procedures.

The patient was a 26-year-old female diagnosed with chronic osteomyelitis of the left femur following multiple reconstructive ORIF procedures over an 18-month period. The initial surgical procedure, performed on June 20, 2024, consisted of surgical debridement, insertion of antibiotic-impregnated cement, and internal fixation. A second debridement with cement replacement was carried out on February 3, 2025. The most recent procedure, conducted on August 19, 2025, involved removal of the internal fixation hardware. At the time of physiotherapy assessment, the patient presented with persistent local signs of infection, including swelling and discomfort around the surgical site. However, vital signs were stable, no systemic infection was identified, and radiological evaluation indicated ongoing bone regeneration. Functionally, the patient reported reduced knee mobility, decreased lower limb strength, and difficulty performing daily activities.

Eligibility for participation in physiotherapy was determined collaboratively by the orthopaedic and rehabilitation teams. Inclusion criteria comprised a confirmed diagnosis of chronic femoral osteomyelitis following reconstructive ORIF, clinical stability after the most recent surgery, absence of systemic infection, stable vital signs, and the ability to actively participate in supervised physiotherapy. Exclusion criteria included uncontrolled systemic illness, mechanical instability of the femur, poorly healing surgical wounds, severe pain limiting exercise participation, neurovascular compromise of the affected limb, or any medical condition contraindicating therapeutic exercise. Written informed consent was obtained from the patient prior to participation and publication of anonymised clinical data.

In accordance with CARE recommendations, the clinical course and rehabilitation timeline of the patient are summarised in Table 1, including key surgical events, baseline assessment, intervention period, safety monitoring, and post-intervention evaluation.

Table 1. Timeline of Clinical Course and Physiotherapy Intervention

Time Point	Event	Description
Pre-intervention	Medical history	Chronic osteomyelitis of the left femur following reconstructive ORIF
Baseline (Week 0)	Initial assessment	Evaluation of knee range of motion, Manual Muscle Testing, and LEFS
Week 1	Physiotherapy session	Initiation of range-of-motion and strengthening exercises
Week 2	Physiotherapy session	Progressive range-of-motion and strengthening exercises
Week 3	Physiotherapy session	Continued exercise progression and monitoring
During intervention	Safety monitoring	No adverse events or clinical instability observed
Post-intervention	Final assessment	Re-evaluation of knee range of motion, muscle strength, and LEFS

Table 1 outlines the sequence of clinical management and rehabilitation from baseline assessment through completion of the physiotherapy program. The physiotherapy program was delivered three times per week over a three-week period, resulting in a total of nine supervised sessions. Each session lasted approximately 40–60 minutes and followed a structured sequence consisting of electrotherapy followed by therapeutic exercises. Exercise selection and progression were guided by clinical judgement, patient tolerance, and the absence of symptom exacerbation. Given the presence of ongoing chronic infection, exercise intensity and loading progression were intentionally conservative to minimise the risk of clinical deterioration.

The therapeutic exercise program focused on improving knee joint mobility and strengthening periarticular muscles of the affected limb. Active and assisted knee flexion–extension exercises were performed using a quadriceps board within the patient's pain-free range. Resistance-band strengthening exercises targeting the quadriceps and hamstring muscles were implemented to enhance voluntary muscle activation and strength, while gentle stretching exercises were included to address periarticular muscle tightness. Each exercise was performed in two sets of eight repetitions per session, with progression based on patient tolerance and perceived exertion.

Transcutaneous Electrical Nerve Stimulation (TENS) was applied at the beginning of each physiotherapy session to support pain modulation and facilitate participation in therapeutic exercise. TENS was administered using a conventional high-frequency protocol with stimulation parameters set at approximately 80–100 Hz and a duration of 20–30 minutes. Stimulation intensity was adjusted to produce a strong but comfortable sensory perception without visible muscle contraction. The purpose of TENS application was symptom management rather than direct facilitation of tissue healing.

Outcome measures included knee joint range of motion, muscle strength, and lower extremity functional performance. Active and passive knee flexion were measured using a universal goniometer. Muscle strength of the quadriceps and hamstring muscles was assessed using Manual Muscle Testing based on the Medical Research Council grading scale. Functional performance was evaluated using the Lower Extremity Functional Scale (LEFS). Baseline assessments were conducted prior to initiation of the physiotherapy program, and post-intervention assessments were performed at the end of the three-week intervention period using identical procedures. Outcome data were analysed descriptively without inferential statistical testing.

This study was conducted in accordance with international research ethics principles. Ethical approval was obtained from the Health Research Ethics Committee of the Faculty of Health Sciences, Universitas Muhammadiyah Surakarta (Ethical Approval

No. 1930/KEPK-FIK/I/2026). Written informed consent was obtained from the patient for participation in the intervention and publication of anonymised clinical data.

Results

The patient completed the three-week physiotherapy program as scheduled and attended all nine supervised sessions. Adherence to the prescribed home exercise program was confirmed during follow-up visits, and no session cancellations or protocol deviations were recorded.

Throughout the intervention period, the patient remained clinically stable. Monitoring conducted before, during, and after each physiotherapy session revealed no adverse events, symptom exacerbation, or complications related to the intervention. No signs of worsening local infection or systemic instability were observed.

Changes in knee joint range of motion observed before and after the physiotherapy intervention are presented in Table 2. At baseline, limitations in knee flexion were evident during both active and passive assessments. Following completion of the intervention, increases in knee flexion were recorded.

Table 2. Knee Joint Range of Motion Before and After Physiotherapy Intervention

Measurement	Pre-intervention (°)	Post-intervention (°)	Absolute Change (°)
Active knee flexion	80	87	+7
Passive knee flexion	83	90	+7

As shown in Table 2, both active and passive knee flexion increased by 7° over the three-week intervention period. Muscle strength of the quadriceps and hamstring muscles assessed using Manual Muscle Testing before and after the intervention is summarised in Table 3. At baseline, reduced muscle strength was observed in both muscle groups.

Table 3. Manual Muscle Testing Scores Before and After Physiotherapy Intervention

Muscle Group	Pre-intervention	Post-intervention
Quadriceps	3+	4−
Hamstrings	3−	4−

Table 3 demonstrates an improvement of one clinical grade in both quadriceps and hamstring muscle strength following the physiotherapy program. Lower extremity functional performance evaluated using the Lower Extremity Functional Scale (LEFS) before and after the intervention is presented in Table 4. The baseline assessment indicated a moderate level of functional limitation.

Table 4. Lower Extremity Functional Scale Scores

Assessment Time Point	LEFS Score
Pre-intervention	60
Post-intervention	67

As shown in Table 4, the LEFS score increased from 60 at baseline to 67 following the three-week physiotherapy intervention. For ease of reference, all physiological and functional outcomes assessed before and after the intervention are consolidated in Table 5 to provide an overview of observed changes across outcome domains.

Table 5. Summary of Physiological and Functional Outcomes

Outcome Measure	Pre-intervention	Post-intervention
Active knee flexion (°)	80	87
Passive knee flexion (°)	83	90
Quadriceps strength (MMT)	3+	4−
Hamstring strength (MMT)	3−	4−
LEFS score	60	67

Table 5 summarises the observed pre–post changes in joint mobility, muscle strength, and lower extremity functional performance following the physiotherapy intervention.

Discussion

Chronic femoral osteomyelitis following reconstructive Open Reduction and Internal Fixation (ORIF) represents a complex clinical condition characterised by persistent infection, repeated surgical trauma, prolonged immobilisation, and delayed functional recovery. In the present case, a structured and carefully monitored physiotherapy program was associated with measurable improvements in knee joint mobility, muscle strength, and lower extremity functional performance over a three-week intervention period, without evidence of adverse events or clinical deterioration. These findings provide clinically relevant insight into the potential role of physiotherapy during periods in which chronic infection has not been fully resolved, an area that remains underrepresented in the rehabilitation literature.[8,10,13]

Restricted knee joint mobility is a common sequela following femoral fractures treated surgically, particularly in cases complicated by infection and repeated operative procedures. Prolonged immobilisation, periarticular soft tissue involvement, postoperative pain, and inflammatory processes may collectively contribute to capsular stiffness, muscle shortening, and impaired neuromuscular coordination.[12,14] In this case, improvements were observed in both active and passive knee flexion following the physiotherapy intervention. Although the absolute magnitude of change was modest, even small gains in knee flexion are clinically meaningful, as adequate knee mobility is essential for walking, stair negotiation, and sit-to-stand activities.[19,20] Previous studies have emphasised that early, low-load joint mobilisation may help prevent secondary stiffness and promote functional recovery after orthopaedic surgery.[20,21] The findings of this case suggest that carefully controlled, symptom-guided mobilisation may also be feasible in patients with chronic osteomyelitis when clinical stability is ensured.

Muscle weakness of the quadriceps and hamstring muscles is frequently reported following femoral fractures and ORIF procedures. Prolonged unloading, pain-related inhibition, inflammatory responses, and repeated surgical trauma may impair voluntary muscle activation and delay strength recovery.[13,15,19]In the present case, both muscle groups demonstrated improvement of one clinical grade on Manual Muscle Testing following the intervention period. Early improvements in muscle strength during rehabilitation are often attributed to neural adaptations rather than structural hypertrophy, particularly when exercise intensity is deliberately conservative.[21,22] This mechanism is especially relevant in patients with chronic infection, where excessive mechanical loading may

increase the risk of symptom exacerbation or tissue compromise. The observed strength gains support the use of low-intensity, symptom-guided strengthening exercises as a safe and potentially effective strategy in complex postoperative conditions.[14,16]

Lower extremity functional performance, as assessed using the Lower Extremity Functional Scale (LEFS), also improved following the physiotherapy program. LEFS is widely used to capture patient-perceived difficulty in performing daily activities and has demonstrated good reliability and responsiveness in musculoskeletal populations.[22] However, the observed increase in LEFS score did not reach the previously reported minimal clinically important difference of approximately nine points.[22] This finding suggests that, while functional gains were present, the extent of improvement may have been limited by the short duration of the intervention, the persistence of local infection, and the cumulative impact of repeated surgical procedures. Similar patterns have been reported in patients with chronic or infection-related musculoskeletal conditions, in whom functional recovery often occurs gradually and may require prolonged or staged rehabilitation.[14,16]

The incorporation of Transcutaneous Electrical Nerve Stimulation (TENS) as an adjunctive modality aimed to support pain modulation and facilitate participation in therapeutic exercise. TENS has been reported to reduce pain perception by modulating nociceptive input at peripheral and central levels and is commonly used to improve exercise tolerance in postoperative and musculoskeletal populations.[17,18] In this case, TENS was applied to enhance comfort and adherence rather than to directly influence tissue healing. The absence of pain exacerbation or adverse events supports the safe integration of TENS when applied using conservative parameters and appropriate clinical monitoring. Nevertheless, TENS should be regarded as complementary to active rehabilitation rather than a substitute for therapeutic exercise.[17,18]

An important finding of this case report is the absence of adverse events or clinical deterioration throughout the physiotherapy intervention. This observation suggests that structured, symptom-guided rehabilitation may be safely implemented in selected patients with chronic femoral osteomyelitis following ORIF, provided that close multidisciplinary collaboration and ongoing clinical surveillance are maintained.[15,16] Effective communication among physiotherapists, orthopaedic surgeons, and rehabilitation physicians is essential to ensure timely identification of potential complications and appropriate adjustment of rehabilitation intensity.[15]

Despite these encouraging findings, several limitations must be acknowledged. This report describes a single patient and therefore does not permit generalisation of the results. The relatively short duration of the intervention limits conclusions regarding long-term functional recovery, and no follow-up imaging was performed to correlate functional improvements with structural bone healing. Future studies involving larger patient cohorts, extended follow-up periods, and integration of objective imaging or biomechanical assessments are needed to better define the role, optimal timing, and long-term impact of physiotherapy interventions in patients with chronic femoral osteomyelitis.

Conclusion

This case report demonstrates that a structured and carefully monitored physiotherapy program can be safely implemented in a patient with chronic femoral osteomyelitis following reconstructive Open Reduction and Internal Fixation, even in the presence of persistent local infection. Over a three-week intervention period, measurable improvements were observed in knee joint mobility, muscle strength, and lower extremity functional performance, without evidence of adverse events or clinical deterioration. These findings highlight the potential role of physiotherapy as a complementary component of care when surgical and medical management alone are insufficient to restore function.

Although the absolute improvements in knee range of motion were modest, such gains are clinically relevant, as adequate knee mobility is essential for basic functional activities including walking, stair negotiation, and sit-to-stand transfers. Improvements in quadriceps and hamstring muscle strength further supported enhanced lower limb control, while the increase in Lower Extremity Functional Scale score reflected the patient's perceived functional benefit. Together, these outcomes suggest that gradual, symptom-guided rehabilitation may help mitigate secondary musculoskeletal impairments associated with prolonged immobilisation and chronic infection.

This report underscores the importance of an individualised, multidisciplinary approach when initiating physiotherapy in complex orthopaedic cases complicated by chronic osteomyelitis. Conservative exercise progression, close clinical monitoring, and effective communication among healthcare providers are critical to ensuring patient safety and optimising outcomes. While conclusions are limited by the single-case design and short intervention duration, the findings support the consideration of physiotherapy during periods of active chronic infection in carefully selected patients. Further research involving larger cohorts, longer follow-up, and objective outcome measures is warranted to clarify the long-term effectiveness and optimal rehabilitation strategies for this population.

Author Contribution

Arum Cahyaningsih: Conceptualization, Methodology, Data curation, Formal analysis, Writing—original draft.
Arif Pristianto: Conceptualization, Methodology, Writing—review & editing, Supervision.
Prihantoro Larasati: Writing—review & editing, Supervision.
All authors have read and approved the final version of the manuscript.

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Conflict of Interest Statement

The authors declare that there are no conflicts of interest related to the conduct of this study or the preparation of this manuscript.

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Ethics Statement

This study was conducted in accordance with the principles of health research ethics and relevant international guidelines. Ethical approval was obtained from the Health Research Ethics Committee of the Faculty of Health Sciences, Universitas Muhammadiyah Surakarta (Ethical Approval No. 1930/KEPK-FIK/I/2026).

Prior to participation, the patient received a full explanation of the study objectives, procedures, potential risks, and benefits. Written informed consent was obtained for participation in the physiotherapy intervention and for the publication of anonymised clinical data. Patient confidentiality and privacy were strictly maintained throughout the study.

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