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Physical Therapy Rehabilitation After Total Knee Replacement: A Case Report

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Abstract

Background: Advanced knee osteoarthritis frequently leads to severe pain and functional limitation, often requiring total knee replacement (TKR). Postoperative rehabilitation is essential to restore joint mobility and muscle strength.
Objective: To describe the clinical outcomes of a structured multimodal physical therapy program in a patient following TKR due to grade 4 knee osteoarthritis.
Methods: This case report was prepared in accordance with CARE guidelines. A 71-year-old woman initiated outpatient physical therapy approximately 12 weeks after left TKR. The intervention consisted of four sessions including infrared therapy, transcutaneous electrical nerve stimulation (TENS), and progressive therapeutic exercise. Outcomes included Numeric Rating Scale (NRS), knee range of motion (ROM), Manual Muscle Testing (MMT), and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).
Results: After four sessions, knee flexion improved from 125° to 130° (+5°). Pain during movement decreased from 4/10 to 1/10 (–3 points). Muscle strength improved from MMT grade 4/5 to 5/5. WOMAC score increased from 55 to 70 (+15 points).
Conclusion: In this single case, multimodal physical therapy was associated with reduced pain and improved knee function during early outpatient rehabilitation following TKR. Findings should be interpreted cautiously due to the single-case design.

Keywords
Osteoarthritis, Knee; Arthroplasty, Replacement, Knee; Rehabilitation; Physical Therapy Modalities; Range of Motion, Articular

Introduction

Knee osteoarthritis (OA) is a highly prevalent degenerative joint disorder and a major contributor to disability among older adults worldwide.[1] Progressive deterioration of articular cartilage, subchondral bone remodeling, osteophyte formation, and synovial inflammation results in chronic pain, joint stiffness, and functional limitation.[2] In advanced disease stages, particularly Kellgren Lawrence grade 4, structural joint damage becomes severe and frequently leads to substantial impairment in mobility and quality of life.[3]

Although conservative management, including pharmacotherapy, physical therapy, and lifestyle modification, may alleviate symptoms in early stages, patients with end-stage OA often experience persistent pain and progressive functional decline despite non-operative treatment.[3] In such cases, total knee replacement (TKR) represents the definitive surgical intervention aimed at restoring joint alignment, relieving pain, and improving mechanical function.[4]

Despite the well-documented effectiveness of TKR in reducing pain, postoperative recovery remains multifactorial. Patients commonly present with residual impairments, including decreased knee range of motion, quadriceps weakness, altered proprioception, and gait asymmetry during the early and intermediate phases following surgery.[5] These impairments may persist for several weeks after hospital discharge and can limit reintegration into daily activities.

Current international clinical practice guidelines emphasize early mobilization, progressive range-of-motion exercises, quadriceps strengthening, and functional task training as core components of post-TKR rehabilitation.[5] Structured physical therapy programs have been associated with improved pain control, enhanced joint mobility, and better functional outcomes.[6] However, most high-level evidence derives from randomized controlled trials conducted in developed healthcare systems, where rehabilitation pathways may differ substantially from outpatient practice settings in developing countries.

In Indonesia, detailed clinical documentation describing structured multimodal rehabilitation protocols, particularly those combining electrotherapy modalities with progressive therapeutic exercise, remains limited in peer-reviewed literature.[7] Furthermore, few case reports explicitly quantify short-term outcome changes using standardized instruments such as the Numeric Rating Scale (NRS), goniometric range-of-motion measurement, Manual Muscle Testing (MMT), and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).[8]

Documenting individual clinical trajectories is valuable for illustrating practical implementation of evidence-based rehabilitation principles within real-world outpatient settings. Case reports do not aim to establish causality but may provide clinically meaningful insights regarding intervention feasibility, response patterns, and early functional adaptation.

Therefore, this case report aims to describe the structured multimodal physical therapy management and short-term quantified clinical outcomes of a 71-year-old patient undergoing outpatient rehabilitation approximately 12 weeks after TKR for grade 4 knee osteoarthritis. By presenting objective pre and post–data and contextualizing findings within current rehabilitation principles, this report contributes to the clinical documentation of post-TKR rehabilitation practice in Indonesia.

Methods

This study was designed as a descriptive single-case report and prepared in accordance with the CARE (CAse REport) guidelines.[9] The objective was to systematically document the patient's clinical presentation, structured physical therapy intervention, and short-term functional outcomes following total knee replacement (TKR).

Patient Information and Baseline Clinical Findings

A 71-year-old woman underwent left total knee replacement in June 2025 due to end-stage knee osteoarthritis classified as Kellgren–Lawrence grade 4. The diagnosis was established based on persistent pain and functional limitation, supported by radiographic findings demonstrating severe joint space narrowing, multiple osteophytes, subchondral sclerosis, and joint deformity. The patient had a history of type 2 diabetes mellitus managed with oral hypoglycemic medication (glimepiride). No postoperative complications were reported.

Outpatient physiotherapy was initiated approximately 12 weeks (±3 months) after surgery following orthopedic confirmation of wound healing and clinical stability. At the initial physiotherapy session, the patient reported movement-related knee pain and difficulty with prolonged walking and stair negotiation. She ambulated using a single cane. Physical examination revealed no signs of acute inflammation or joint effusion, and the surgical incision had healed completely. Baseline clinical characteristics are summarized in Table 1.

Table 1. Baseline Patient Characteristics at Initial Physiotherapy Evaluation

Variable	Value
Age	71 years
Sex	Female
Diagnosis	Post left TKR due to KL grade 4 knee osteoarthritis
Time since surgery	12 weeks
Comorbidity	Type 2 diabetes mellitus
Assistive device	Single cane
NRS (rest)	1/10
NRS (movement)	4/10
Knee flexion ROM	125°
Knee extension ROM	0°
MMT – Knee flexors	4/5
MMT – Knee extensors	4/5
WOMAC score	55

As shown in Table 1, primary impairments at baseline included movement-related pain, limited knee flexion, and reduced quadriceps strength accompanied by moderate functional limitation.

Pain intensity was assessed using the Numeric Rating Scale (NRS). Knee range of motion (ROM) was measured with a universal goniometer. Muscle strength was evaluated using Manual Muscle Testing (MMT) on a 0–5 grading scale. Functional status was assessed using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), a validated instrument with reported Cronbach's alpha values ranging from 0.77 to 0.96.[10] All measurements were performed at baseline and repeated after the fourth physiotherapy session using identical procedures.

The patient underwent four outpatient physiotherapy sessions delivered twice weekly over a two-week period. Each session consisted of a multimodal approach combining electrotherapy and progressive therapeutic exercises. Infrared therapy was applied to the anterior knee region for 15 minutes at a distance of 45–60 cm to facilitate superficial tissue warming.[11] Transcutaneous Electrical Nerve Stimulation (TENS) was administered for 15–20 minutes using high-frequency parameters (80–100 Hz) at sensory-level intensity without visible muscle contraction.[12] Therapeutic exercises included active-assisted knee flexion–extension movements, quadriceps strengthening exercises (quadriceps setting and straight leg raises), and closed kinetic chain functional training such as mini-squats and sit-to-stand exercises. Exercise dosage followed the FITT principle and is detailed in Table 2.

Table 2. Structured Physiotherapy Intervention Protocol (FITT Principle)

Component	Frequency	Intensity	Time	Description
Infrared therapy	2×/week	45–60 cm distance	15 min	Applied to anterior knee
TENS	2×/week	80–100 Hz, sensory-level	15–20 min	No visible contraction
ROM exercise	2×/week	Active-assisted	2–3 sets × 8–10 reps	Knee flexion–extension
Strengthening	2×/week	Progressive, pain-free	2–3 sets × 8–10 reps	Quadriceps activation
Functional training	2×/week	Partial weight-bearing	2–3 sets × 8–10 reps	Sit-to-stand, mini-squat

As shown in Table 2, the intervention emphasized pain modulation followed by progressive muscle activation and functional retraining. Exercise intensity was progressed within pain-free tolerance. The chronological sequence of clinical events from diagnosis to completion of physiotherapy is presented in Table 3.

Table 3. Clinical Timeline of the Patient (CARE-Compliant)

Time Point	Clinical Phase	Key Events
June 2025	Preoperative	Diagnosis of KL grade 4 knee osteoarthritis
June 2025	Surgery	Left total knee replacement performed
July–August 2025	Early Postoperative Phase	Surgical recovery and wound healing
September 2025 (Week 12)	Start of Rehabilitation	Outpatient physiotherapy initiated
Session 1	Baseline Evaluation	NRS, ROM, MMT, WOMAC assessed
Sessions 1–4	Intervention	Multimodal physiotherapy delivered
Session 4	Post-Intervention Evaluation	Reassessment of all outcomes

Physiotherapy was initiated approximately 12 weeks after surgery and consisted of four structured outpatient sessions delivered over a two-week period. Written informed consent was obtained from the patient prior to publication. All identifying information was removed to maintain confidentiality. As this report describes routine clinical care without experimental procedures, formal institutional ethical approval was not required under local policy.

Results

All outcome measures were reassessed after completion of four physiotherapy sessions using identical measurement procedures. No adverse events were reported. Pain intensity decreased progressively throughout the intervention period. Session-by-session changes are presented in Table 4.

Table 4. Session-by-Session Pain Intensity (NRS)

Session	NRS (Rest)	NRS (Movement)
Session 1 (Baseline)	1	4
Session 2	1	3
Session 3	0	2
Session 4	0	1

Movement-related pain decreased consistently across sessions, while resting pain resolved by the third session. Knee flexion increased progressively, while full extension was maintained. Detailed progression is presented in Table 5.

Table 5. Session-by-Session Knee Range of Motion

Session	Knee Flexion (°)	Knee Extension (°)
Session 1 (Baseline)	125	0
Session 2	127	0
Session 3	128	0
Session 4	130	0

Manual Muscle Testing demonstrated improvement in both knee flexors and extensors as shown in Table 6.

Table 6. Pre–Post Muscle Strength Changes (MMT)

Muscle Group	Baseline	Session 4	Change
Knee Flexors	4/5	5/5	+1 grade
Knee Extensors	4/5	5/5	+1 grade

Functional status improved progressively across sessions as presented in Table 7.

Table 7. Session-by-Session WOMAC Score Progression

Session	WOMAC Score
Session 1 (Baseline)	55
Session 2	60
Session 3	65
Session 4	70
Total Change	+15

A summary of baseline and final outcomes is presented in Table 8.

Table 8. Baseline and Post-Intervention Summary

Outcome Measure	Baseline	Session 4	Absolute Change
NRS (Rest)	1	0	−1
NRS (Movement)	4	1	−3
Knee Flexion	125°	130°	+5°
Knee Extension	0°	0°	0
MMT Flexors	4/5	5/5	+1
MMT Extensors	4/5	5/5	+1
WOMAC	55	70	+15

Findings are presented descriptively due to the single-case design.

Discussion

This case report described short-term improvements in pain, knee range of motion, muscle strength, and functional status following a structured multimodal physical therapy program initiated approximately 12 weeks after total knee replacement (TKR). Although the duration of intervention was limited to four sessions, measurable clinical changes were observed across all primary outcomes.

Movement-related pain decreased by three points on the Numeric Rating Scale. In musculoskeletal populations, a reduction of ≥2 points is generally considered clinically meaningful.[13] The magnitude of pain reduction observed in this case therefore exceeded commonly reported minimal clinically important difference (MCID) thresholds. From a physiological perspective, pain reduction in the early rehabilitation phase may be attributed to multiple mechanisms, including peripheral modulation through TENS, improved tissue extensibility following superficial heat application, and gradual neuromuscular adaptation induced by progressive exercise.[11,12] However, spontaneous postoperative recovery and natural healing processes likely also contributed to symptom improvement, particularly given that rehabilitation began at 12 weeks post-surgery when inflammatory responses had largely subsided.

Knee flexion improved by 5°, while full extension was maintained. Although a 5° increase may appear modest, small improvements in flexion can significantly influence functional tasks such as stair climbing, sit-to-stand transitions, and gait efficiency in older adults.[14] Previous studies have demonstrated that even limited gains in flexion following TKR may improve perceived function when combined with enhanced quadriceps activation.[5] In this case, the absence of extension loss is also clinically relevant, as persistent extension deficits are associated with altered gait biomechanics and increased joint loading.

Muscle strength improved from MMT grade 4/5 to 5/5 in both knee flexors and extensors. Quadriceps recovery is considered a central determinant of post-arthroplasty functional restoration.[5] Persistent quadriceps inhibition after TKR has been widely documented and is often attributed to arthrogenic muscle inhibition. Progressive strengthening and closed kinetic chain exercises, as implemented in this case, may facilitate improved neuromuscular activation and motor control. While Manual Muscle Testing has

inherent limitations in sensitivity, the observed change suggests restoration of functional muscle capacity sufficient to support improved mobility.

Functional status, assessed using the WOMAC index, increased by 15 points across four sessions. Reported MCID values for WOMAC in knee osteoarthritis populations range approximately between 10 and 12 points.[15] Therefore, the observed improvement exceeds commonly accepted clinical significance thresholds. Importantly, functional improvement progressed steadily across sessions rather than abruptly, suggesting a gradual adaptation process rather than isolated measurement variability.

The multimodal structure of the intervention may have contributed to the observed outcomes. Clinical guidelines recommend combining pain management strategies with progressive exercise rather than relying on passive modalities alone.[5] In this case, electrotherapy was used as an adjunct to facilitate active participation in strengthening and functional training. The emphasis remained on progressive exercise, consistent with evidence-based rehabilitation principles.

Despite these improvements, caution is required when interpreting findings. This report describes a single patient, and therefore causal inference cannot be established. The natural trajectory of recovery following TKR, patient motivation, adherence to possible home exercises, and psychosocial factors may all have influenced outcomes. Additionally, the short duration of follow-up limits conclusions regarding sustainability of improvements. Objective biomechanical measures such as gait analysis, dynamometry, or long-term reassessment were not performed, which restricts deeper evaluation of functional recovery.

Nevertheless, this case contributes clinically relevant documentation of structured outpatient rehabilitation in an Indonesian healthcare context, where published case-level data remain limited. By presenting quantified short-term outcomes within a CARE-compliant framework, this report illustrates practical implementation of multimodal physiotherapy principles after TKR and highlights measurable clinical changes during the early outpatient phase.

Future research should include larger sample sizes, longitudinal follow-up, and controlled comparisons between multimodal and exercise-only protocols to clarify the additive value of electrotherapy modalities. Incorporating objective strength measurements and biomechanical assessments would further strengthen evidence regarding post-TKR rehabilitation effectiveness.

Conclusion

This case report described the short-term clinical outcomes of a structured multimodal physical therapy program initiated approximately 12 weeks after total knee replacement in a 71-year-old patient with grade 4 knee osteoarthritis. Following four outpatient physiotherapy sessions, improvements were observed in pain intensity, knee flexion range of motion, muscle strength, and functional status as measured by standardized instruments.

The findings suggest that a rehabilitation approach combining electrotherapy for pain modulation with progressive therapeutic exercise may support functional recovery during the early outpatient phase after TKR. The integration of active strengthening and functional training appears particularly relevant for restoring quadriceps performance and enhancing daily activity capacity. However, these results must be interpreted cautiously due to the single-case design, short intervention duration, and absence of long-term follow-up. The observed improvements cannot establish causality and may have been influenced by natural postoperative recovery and individual patient factors.

Despite these limitations, this report provides structured, quantified documentation of post-TKR rehabilitation within a real-world outpatient clinical setting. By adhering to CARE guidelines and presenting measurable outcome changes, this case contributes to the growing body of clinical evidence describing practical implementation of multimodal physiotherapy in postoperative knee rehabilitation. Further controlled and longitudinal studies are required to determine the sustainability of improvements and to clarify the comparative effectiveness of multimodal versus exercise-focused rehabilitation strategies following total knee replacement.

Author Contribution

Adhinda Puteri Ayu Zahwany: Conceptualization, Methodology, Data Curation, Formal Analysis, Writing Original Draft Preparation.
Totok Budi Santoso: Conceptualization, Writing, Review & Editing, Supervision.
Galih Adhi Ishak Setiawan: Writing, Review & Editing.
All authors have read and approved the final version of the manuscript.

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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 prior to publication. All identifying information has been removed to ensure confidentiality. As this report describes routine clinical rehabilitation without experimental intervention, formal institutional ethical approval was not required according to local clinical policy.

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