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# The Combination of Hip Abductor Strengthening and Quadriceps Strengthening Exercise is Effective in Reducing Pain and Muscle Stiffness in Grade 3 Genu Dextra Osteoarthritis

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## ABSTRACT
Knee osteoarthritis is a degenerative joint disease that commonly causes pain, stiffness, and decreased functional capacity, particularly in older adults. This study aims to evaluate the effect of physiotherapy interventions in the form of Hip Abductor Strengthening Exercise and Quadriceps Strengthening Exercise on reducing pain and muscle stiffness in patients with grade 3 right knee osteoarthritis. A case report design was used involving a 57-year-old male patient who underwent a physiotherapy program consisting of three treatment sessions, with an exercise dosage of 10 repetitions in 2 sets and a holding time of 5 seconds for each repetition. Pain intensity was assessed using the Numeric Rating Scale (NRS), while muscle stiffness was evaluated through measurements of joint range of motion (ROM) to assess joint mobility and Manual Muscle Testing (MMT) to assess muscle strength. The results demonstrated a reduction in pain intensity from NRS 5 to 3, accompanied by an increase in knee flexion range of motion from 80° to 100° and an improvement in muscle strength from MMT grade 2+ to grade 4. These findings indicate a reduction in muscle stiffness and an improvement in the patient's motor function. In conclusion, the combination of Hip Abductor Strengthening Exercise and Quadriceps Strengthening Exercise is effective in reducing pain and muscle stiffness and in improving knee joint function in patients with grade 3 right knee osteoarthritis.
**Keywords**: knee osteoarthritis; hip abductor strengthening exercise; quadriceps strengthening exercise; pain; muscle stiffness; physiotherapy

## INTRODUCTION
Knee osteoarthritis (OA) is the most prevalent degenerative joint disease and represents one of the leading causes of pain and functional disability among older adults. Since the mid-20th century, the prevalence of OA has reportedly doubled, and its incidence is expected to continue rising in the coming decades due to aging populations and increasing life expectancy [1]. In Indonesia, the prevalence of osteoarthritis has been reported to be 5% among individuals younger than 40 years, increasing to 30% in the 40–60 year age group, comprising 15.5% in men and 12.7% in women, and reaching 65% among individuals aged over 61 years. The highest prevalence has been observed in individuals aged ≥75 years, with a reported rate of 54.8% [2].

Globally, osteoarthritis affects more than 500 million individuals and continues to pose a significant public health burden. The prevalence of knee osteoarthritis has increased substantially over recent decades, with epidemiological studies reporting a continuous rise in both incidence and disability-adjusted life years associated with the condition. Knee osteoarthritis is the most common type due to its role as a major weight-bearing joint, contributing significantly to functional limitations and reduced quality of life [3].

The severity of osteoarthritis is determined based on radiological abnormalities observed in the joint. Various scoring systems have been developed to classify the severity of osteoarthritis. One of the most widely used systems for grading knee osteoarthritis is the Kellgren–Lawrence classification [4]. The Kellgren–Lawrence (KL) classification is assessed using anteroposterior (AP) radiographic images of the knee joint. Each radiographic finding is assigned a score ranging from 0 to 4, reflecting the increasing severity of osteoarthritis. Osteoarthritis is classified as Grade 0, indicating no radiographic signs of osteoarthritis; Grade 1, characterized by doubtful joint space narrowing and possible osteophyte formation; Grade 2, showing possible joint space narrowing with definite osteophyte formation; Grade 3, marked by definite joint space narrowing, moderate osteophyte formation, subchondral sclerosis, and possible deformity of the bone ends; and Grade 4, characterized by large osteophyte formation, severe joint space narrowing, marked sclerosis, and definite deformity of the bone ends [5].

Common problems experienced by patients with knee osteoarthritis include knee joint pain, limited range of motion (ROM), decreased quadriceps muscle strength, and difficulties in performing functional activities [6]. In advanced stages, osteoarthritis can lead to overall biomechanical disturbances of the knee joint. Knee osteoarthritis causes alterations in pressure distribution that play a role in balance and movement, resulting in significant knee biomechanical dysfunction and potentially leading to hip abductor muscle weakness, which may trigger postural changes in the lower extremities [7].

Exercise therapy is widely recognized as a cornerstone in the conservative management of knee osteoarthritis. Clinical guidelines strongly recommend structured exercise programs as first-line treatment due to their effectiveness in reducing pain and improving physical function. Evidence from systematic reviews and meta-analyses has demonstrated that exercise interventions significantly improve pain, joint mobility, and functional outcomes in patients with knee osteoarthritis [8].

The strength of the hip abductor muscles plays an important role in controlling the knee adduction moment. Weakness in these muscles has been associated with increased medial knee joint loading and disease progression. In addition to quadriceps strengthening, increasing attention has been given to hip abductor strengthening as an essential component in knee osteoarthritis rehabilitation. Previous studies have shown that combining hip abductor and quadriceps strengthening exercises provides greater improvements in pain reduction and functional performance compared to isolated exercise approaches [9].

Quadriceps activation, performed through static or isometric contractions, is a key component in maintaining the function of the knee extensor mechanism. This exercise helps improve lubrication of the patellofemoral joint, facilitates the superior glide of the patella required to achieve maximal knee extension, and maintains or increases quadriceps muscle strength. Adequate quadriceps activation at full knee extension is essential for producing a normal gait pattern. Strengthening exercises for the hip abductor muscles also play an important role in reducing the knee adduction moment by stabilizing the pelvis and preventing contralateral pelvic drop during the single-leg stance phase of the gait cycle. Theoretically, improved hip abduction capacity influences the distribution of adduction moments at the distal knee, thereby reducing pain and improving functional performance in patients with knee osteoarthritis [10].

Physiotherapy is an integral component of healthcare services that focuses on improving health status through the optimization of physical capacity and functional ability of individuals. Within the healthcare system, physiotherapy plays an important role in supporting public health development efforts in accordance with its professional competencies and scope of practice [11]. Based on preliminary observations conducted at RSUD Dr. Harjono Ponorogo, a considerable number of patients with knee osteoarthritis, particularly those classified as Grade 3, present with complaints of pain, stiffness, and decreased functional mobility. Many patients also exhibit reduced quadriceps and hip abductor muscle strength, which further contributes to limitations in daily activities. Despite the availability of physiotherapy services, exercise-based interventions targeting both hip and knee muscles are not yet optimally implemented or specifically tailored to address these impairments. This highlights the need for evidence-based and targeted physiotherapy interventions within the local clinical context to optimize patient outcomes. Therefore, it is necessary to explore the effectiveness of combined hip abductor and quadriceps strengthening exercises as a physiotherapy intervention to address these clinical problems in this setting.

Previous studies have consistently demonstrated that strengthening exercises, particularly quadriceps strengthening, are effective in reducing pain and improving function in patients with knee osteoarthritis. Recent evidence has also highlighted the role of hip abductor strengthening in reducing knee joint loading and improving lower limb biomechanics. However, most existing studies have been conducted using experimental or randomized controlled trial designs, with limited focus on detailed clinical outcomes in real-world case-based settings, particularly in patients with grade 3 osteoarthritis.

Furthermore, although combined hip abductor and quadriceps strengthening has been shown to provide superior outcomes compared to isolated exercises, there is still a lack of evidence describing its practical implementation and short-term clinical effects in hospital-based physiotherapy settings, especially in Indonesia. Therefore, this case report provides a clinical perspective on the effectiveness of combined strengthening exercises in addressing pain, stiffness, and functional limitations in a patient with grade 3 knee osteoarthritis.

This study aims to evaluate the effect of physiotherapy interventions in the form of hip abductor and quadriceps strengthening exercises on reducing pain and stiffness in patient with grade 3 right knee osteoarthritis (genu dextra).

## METHODS

This study employed a case report design to evaluate the effects of physiotherapy interventions consisting of hip abductor strengthening exercise and quadriceps strengthening exercise on pain reduction and muscle stiffness in a patient diagnosed with grade 3 right knee osteoarthritis (genu dextra). The intervention program was conducted over three therapy sessions, and the outcomes were evaluated using clinical assessment parameters before and after the intervention. The study was conducted at the Department of Medical Rehabilitation, Dr. Hardjono Regional General Hospital, Ponorogo, East Java, Indonesia. The physiotherapy interventions and clinical assessments were performed in the hospital's rehabilitation unit under professional supervision.

This case involved a 57-year-old male patient diagnosed with grade 3 osteoarthritis of the right knee (genu dextra) based on radiological findings using the Kellgren–Lawrence classification. The patient reported right knee pain accompanied by muscle stiffness, muscle weakness around the knee joint, limited knee flexion movement, and reduced active and passive mobility. These impairments resulted in decreased functional capacity, particularly during daily activities such as walking, climbing stairs, and standing up from a sitting position. Based on these complaints and clinical findings, the patient was referred for a physiotherapy rehabilitation program.

Inclusion criteria comprised patients diagnosed with knee osteoarthritis grade 3 based on the Kellgren–Lawrence classification, experiencing knee pain and muscle stiffness, having limited knee range of motion and decreased muscle strength, and being able to follow and perform physiotherapy exercise programs. Exclusion criteria included history of recent knee surgery or acute trauma,Presence of severe neurological disorders affecting lower limb function,Patients with systemic inflammatory joint diseases (e.g., rheumatoid arthritis)

The physiotherapy management focused on therapeutic exercise interventions, specifically hip abductor strengthening exercise and quadriceps strengthening exercise. These exercises were designed to reduce pain, improve knee joint stability, enhance neuromuscular control, and decrease muscle stiffness and weakness contributing to limited joint movement. The intervention program was performed in three therapy sessions. Each exercise was administered with a dosage of 10 repetitions for 2 sets, with a 5-second hold for each repetition to optimize muscle activation and gradually improve muscle strength and endurance. The program aimed to improve knee joint function, enhance joint stability, and support overall functional recovery, thereby contributing to improved quality of life.

The primary outcome of this study was pain reduction, which was measured using the Numeric Rating Scale (NRS). The NRS is a validated tool used to assess pain intensity on a scale from 0 to 10, where higher scores indicate greater pain intensity. The secondary outcomes focused on evaluating the reduction of muscle stiffness and improvements in musculoskeletal function, including Joint mobility, assessed using Range of Motion (ROM) measurements to evaluate knee flexion and extension capability,Muscle strength, assessed using Manual Muscle Testing (MMT) to determine the strength of muscles surrounding the knee joint.

## RESULTS

### Participant follow-up and intervention adherence

During the physiotherapy program, the patient demonstrated good participation and adherence to the prescribed intervention protocol. All therapy sessions were completed according to the planned schedule, consisting of three treatment sessions. The entire intervention program was carried out without any additional complaints, adverse effects, or complications either during or after the physiotherapy procedures.

All rehabilitation sessions were conducted under the direct supervision of a physiotherapist, ensuring correct exercise performance, patient safety, and appropriate adjustment of exercise intensity according to the patient's clinical condition. Continuous monitoring also enabled periodic evaluation of the patient's response to the therapy. This approach ensured that the intervention remained within the patient's tolerance limits while supporting the achievement of physiotherapy goals in a safe and effective manner.

### Daily clinical assessment

Clinical assessments were performed during each therapy session using the following parameters: pain intensity measured by the Numeric Rating Scale (NRS), joint mobility assessed through Range of Motion (ROM), and muscle strength evaluated using Manual Muscle Testing (MMT). The results of the clinical evaluations throughout the rehabilitation program are presented in Table 1.

## Evaluation of pain, joint mobility, and muscle strength

The evaluation results showed a gradual improvement in the patient's clinical condition throughout the physiotherapy program. Pain intensity decreased from 5 on the NRS during the first session to 3 by the third session (Figure 1).

Improvements were also observed in knee joint range of motion, where knee flexion increased from 80° in the first session to 100° in the third session. In addition, muscle strength improved, as indicated by the increase in the MMT score from 2+ to 4 over the course of the intervention.

These findings indicate that the physiotherapy intervention contributed to improvements in pain levels, joint mobility, and muscle strength during the rehabilitation period.

Table 1. Daily evaluation

| Session 1 | | | |
|---|---|---|---|
| Date | Pain (NRS) | ROM (Knee) | MMT |
| 1 November 2025 | 5/10 | S: 0° – 0° – 80° | 2+ / 5 |
| Session 2 | | | |
| | | | |
| Date | Pain (NRS) | ROM (Knee) | MMT |
| 10 November 2025 | 5/10 | S: 0° – 0° – 90° | 3/5 |
| Session 3 | | | |
| Date | Pain (NRS) | ROM (Knee) | MMT |
| 15 November 2025 | 3/10 | S: 0° – 0° – 100° | 4/5 |

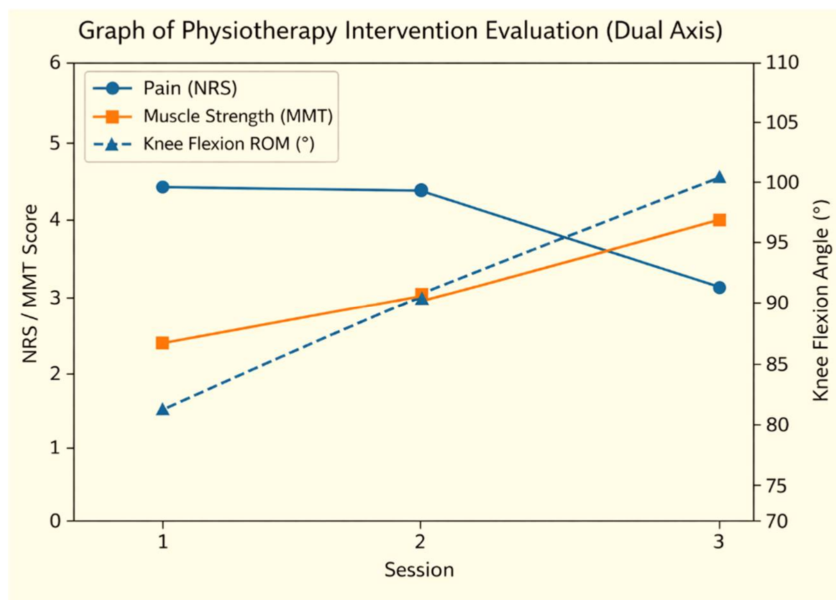


Figure 1. Changes in pain intensity (NRS), muscle strength (MMT), and knee flexion range of motion across three physiotherapy sessions following hip abductor strengthening and quadriceps strengthening exercises.

# DISCUSSION

Knee osteoarthritis is a degenerative joint disease that may lead to disability, as it affects both functional capacity and psychological well-being. One of the major contributing factors to disease progression is muscle weakness, particularly involving the hip abductor and quadriceps muscles. Reduced strength in these muscle groups can decrease the ability to generate propulsive force at the tibiofemoral joint during weight-bearing activities, thereby increasing mechanical loading on the medial compartment of the knee and potentially accelerating the progression of knee osteoarthritis [11].

The results of this case study demonstrated that the combination of hip abductor strengthening exercise and quadriceps strengthening exercise was associated with a reduction in pain intensity and improvements in joint mobility and muscle strength. Pain intensity decreased from NRS 5 to 3, knee flexion range of motion improved from 80° to 100°, and muscle strength increased from MMT grade 2+ to grade 4 following the intervention. These findings indicate that the implemented physiotherapy program contributed to improvements in the patient's clinical condition.

From a clinical perspective, the improvements observed in this case suggest that even a short-duration intervention can provide meaningful benefits when exercises are appropriately targeted. The combination of proximal (hip) and distal (knee) muscle strengthening appears to create a more comprehensive biomechanical effect, improving joint alignment and reducing compensatory movement patterns, which is consistent with previous findings on hip and knee strengthening in osteoarthritis rehabilitation [23].

Compared to previous studies that implemented longer intervention periods, the present case demonstrates that early improvements can already be observed within a limited number of sessions. This finding is clinically relevant, particularly in hospital settings where patient adherence and time constraints often limit long-term intervention programs. Similar short-term improvements have also been reported in recent clinical studies involving combined strengthening interventions [24]. However, the magnitude of improvement in this case was relatively moderate, particularly in pain reduction (NRS 5 to 3), which may indicate that longer intervention duration is required to achieve optimal outcomes. This is consistent with previous literature suggesting that exercise therapy effects tend to increase progressively over time [25].

The improvement observed in this case may be explained by the synergistic effect of hip abductor and quadriceps strengthening exercises. Strengthening of the quadriceps muscle contributes to improved knee joint stability and shock absorption during weight-bearing activities, thereby reducing joint loading and pain perception. In addition, hip abductor strengthening plays a crucial role in stabilizing the pelvis and controlling lower limb alignment, which helps reduce excessive knee adduction moment and medial compartment loading. This biomechanical improvement is likely responsible for the reduction in pain and enhancement of joint mobility observed in this patient [13].

The findings of this study are consistent with previous research, which has demonstrated that strengthening exercises targeting the hip abductors and quadriceps muscles play an important role in the management of knee osteoarthritis. A study by Yuenyongviwat et al. (2020) reported that the combination of hip abductor strengthening and quadriceps strengthening exercises resulted in greater improvements in pain compared with quadriceps strengthening alone [9]. Similarly, systematic reviews and meta-analyses have shown that these exercises contribute to improved functional outcomes and reduced pain intensity by enhancing neuromuscular control and joint stability [14]. These findings suggest that addressing both proximal and distal muscle groups within the kinetic chain provides greater therapeutic benefits compared to isolated strengthening approaches.

Clinically, these findings highlight the importance of incorporating both hip abductor and quadriceps strengthening exercises into physiotherapy programs for patients with knee osteoarthritis, particularly in moderate to advanced stages. A combined exercise approach may provide a more comprehensive strategy for improving joint stability, reducing pain, and enhancing functional performance in daily activities. However, this study

has several limitations. First, it was conducted as a single case report, which limits the generalizability of the findings. Second, the intervention duration was relatively short, consisting of only three therapy sessions, which may not fully represent long-term outcomes. Third, the absence of a control group makes it difficult to establish a definitive causal relationship between the intervention and the observed improvements. Therefore, further studies with larger sample sizes, longer intervention periods, and more rigorous research designs are required to confirm the effectiveness of this combined exercise intervention. This case report may serve as a simple evidence-based reference for physiotherapy practice in clinical settings.

## CONCLUSION

This case report showed that combining hip abductor and quadriceps strengthening exercises within a physiotherapy program improved clinical outcomes in a patient with grade 3 right knee osteoarthritis. The intervention reduced pain intensity, increased knee joint range of motion, and enhanced muscle strength during rehabilitation. These findings indicate that strengthening the hip abductor and quadriceps muscles may contribute to better joint stability, neuromuscular control, and functional recovery in knee osteoarthritis. Incorporating these exercises into physiotherapy programs may therefore help reduce symptoms and improve joint function. However, as this report describes a single case, further research with larger samples and more rigorous designs is needed to confirm the effectiveness of this intervention.

## Ethical consideration, competing interest and source of funding

-This study received ethical approval from the Health Research Ethics Committee of Dr. Harjono S. Ponorogo Regional General Hospital (No. 0054213502221132025102200002/X/KEPK/2025).
-There is no conflict of interest related to this publication.
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