

# PROGRESSIVE EXERCISE-BASED REHABILITATION AND KNEE FLEXION RECOVERY FOLLOWING TOTAL KNEE ARTHROPLASTY: A CASE REPORT

Anjana Singh<sup>1</sup>, Km. sheelnidhi<sup>2</sup>, Anjana<sup>3</sup>, Anjana<sup>4</sup>, Neha<sup>5</sup>, Annapurna<sup>6</sup>, Neha Rani<sup>7</sup>

<sup>1</sup>Bachelor of Physiotherapy, Department of Physiotherapy, Mangalayatan University, Beswan Aligarh

<sup>2</sup>Bachelor of Physiotherapy, Department of Physiotherapy, Mangalayatan University, Beswan Aligarh

<sup>3</sup>Bachelor of Physiotherapy, Department of Physiotherapy, Mangalayatan University, Beswan Aligarh

<sup>4</sup>Bachelor of Physiotherapy, Department of Physiotherapy, Mangalayatan University, Beswan Aligarh

<sup>5</sup>Bachelor of Physiotherapy, Department of Physiotherapy, Mangalayatan University, Beswan Aligarh

<sup>6</sup>Assistant Professor, Department of Physiotherapy, Mangalayatan University, Beswan Aligarh

<sup>7</sup>Assistant Professor, Department of Physiotherapy, Mangalayatan University, Beswan Aligarh

E-mail id: anjanasinghas7535531@gmail.com, sheelnidhimahour2001@gmail.com, anjanakumar5866@gmail.com, neha\_mahourneha02@gmail.com, annapurnafzd1995@gmail.com, nehpal580@gmail.com

\*Corresponding author: Annapurna, email id: annapurnafzd1995@gmail.com

## ABSTRACT

**Background:** Total knee arthroplasty (TKA) is a surgical procedure intended to improve joint function and mobility in selected patients. Postoperative rehabilitation plays an important role in restoring knee range of motion (ROM) and facilitating functional recovery. Rehabilitation may be particularly challenging in patients with a history of distal femoral fracture and internal fixation.

**Case Presentation:** This case report describes the rehabilitation progress of a 22-year-old male patient with a documented history of right distal femoral fracture and subsequent plate-and-screw fixation, who later underwent right total knee arthroplasty. Serial clinical assessments recorded progressive changes in knee range of motion during the rehabilitation period from 26 July to 10 October 2025.

**Results:** Knee flexion improved from 50° at the initial documented assessment on 26 July 2025 to 125° on 10 October 2025, representing an overall gain of 75°. The recorded knee extension measurements also showed progressive improvement, reaching 0° at the final assessment, subject to verification of the original measurement notation. These findings indicate substantial improvement in the documented knee range of motion over the observation period.

**Conclusion:** This case highlights the importance of serial range-of-motion assessment in monitoring postoperative rehabilitation following right TKA in a patient with a history of distal femoral fracture and internal fixation. Although the observed improvements suggest favourable changes in knee mobility, conclusions regarding overall functional recovery and treatment effectiveness are limited by the absence of additional standardized outcome measures and detailed rehabilitation protocol data.

**KEYWORDS:** Total knee arthroplasty; distal femoral fracture; physiotherapy; postoperative rehabilitation; knee range of motion; case report.

## INTRODUCTION

Total knee arthroplasty (TKA) is an established surgical procedure used to relieve pain and improve joint function in patients with advanced knee joint pathology. Although it is most commonly performed in older adults, TKA may also be required in younger patients with severe joint damage arising from selected traumatic or non-traumatic conditions. Evidence suggests that younger patients can achieve improvements in knee function following arthroplasty; however, long-term implant survival, activity demands, and the potential need for revision remain important considerations [1,2].

Distal femoral fractures are significant musculoskeletal injuries that may affect knee mobility, lower-limb alignment, and functional independence. Depending on the fracture pattern and clinical presentation, surgical management may involve internal fixation using plates and screws. Despite fracture fixation, some patients may experience persistent stiffness, restricted range of motion (ROM), pain, or post-traumatic degenerative changes. In selected cases, TKA may be considered when substantial post-traumatic joint damage results in persistent symptoms and functional limitations. A systematic review by Saleh et al. reported improvements in pain, ROM, and functional scores following TKA for post-traumatic arthritis, while also identifying a greater potential for complications in this complex patient group [3]. A subsequent systematic review similarly reported increased complication rates and potentially less favourable patient-reported outcomes in patients undergoing TKA following previous fracture treatment around the knee [4].

Postoperative physiotherapy is an important component of recovery following TKA. Rehabilitation commonly focuses on improving knee ROM, restoring muscle strength, facilitating mobility, and promoting independence in activities of daily

living. Evidence-based clinical practice guidelines recommend individualized physical therapist management based on the patient's clinical presentation, functional limitations, and rehabilitation goals [5]. A systematic review by Konnyu et al. examined rehabilitation interventions following TKA and highlighted the importance of evaluating outcomes across physical function, patient-reported measures, and healthcare utilization [6]. Consequently, serial assessment of knee flexion and extension can provide useful objective information about changes in joint mobility throughout rehabilitation.

The recovery of knee ROM following TKA may vary between individuals and may be influenced by preoperative mobility, surgical factors, postoperative stiffness, and the rehabilitation programme. Research examining the trajectory of knee ROM after TKA has demonstrated that flexion and extension may follow different patterns of recovery, supporting the importance of repeated assessment rather than relying on a single measurement [7]. ROM measurements should nevertheless be interpreted alongside other clinical indicators, including pain, muscle strength, gait, functional performance, and patient-reported outcomes. This broader assessment is particularly relevant in patients with a history of significant trauma and previous surgical fixation.

The present case report describes the rehabilitation progress of a 22-year-old male patient with a documented history of right distal femoral fracture and subsequent plate-and-screw fixation, who later underwent right total knee arthroplasty. Serial knee ROM assessments were documented between 26 July and 10 October 2025. The primary objective of this report is to describe the recorded changes in knee flexion and extension during the documented observation period and to highlight the clinical value of serial physiotherapy assessment in monitoring postoperative knee mobility. As this report describes a single patient, the findings represent an individual clinical course and cannot establish the effectiveness of a specific rehabilitation intervention or be generalized to other patients.

### Case Presentation

The present case study describes a 22-year-old male patient with a history of a right distal femoral fracture, as indicated by the available radiographic records. The initial radiograph, dated 15 April 2025, demonstrates a fracture involving the distal femur, while subsequent radiographs show internal fixation with a plate-and-screw construct. The available clinical record describes a progressive physiotherapy Programme following total knee arthroplasty (TKA), focusing on improving knee joint mobility, lower-limb muscle performance and weight-bearing capacity. At the initial assessment on 26 July 2025, the patient's knee flexion range of motion was recorded as 50°. Following physiotherapy, knee flexion improved to 125° at the final assessment on 10 October 2025, indicating a total gain of 75°. However, the supplied clinical documentation did not include the exact date and indication for surgery, preoperative functional status, relevant comorbidities, details of the TKA implant, or postoperative complications.

### Clinical Examination and Outcome Measurement

Knee range of motion (ROM) was assessed actively to evaluate the patient's ability to perform knee flexion and extension independently. The patient underwent a progressive physiotherapy Programme following the reported total knee arthroplasty (TKA), focusing on improving knee mobility, lower-limb muscle performance and weight-bearing capacity. The initial recorded active knee flexion was 50° on 26 July 2025, which improved to 125° at the final assessment on 10 October 2025, representing an overall gain of 75°. Although active knee flexion values were documented, specific numerical measurements of active knee extension were not available in the clinical records. Information regarding the measurement instrument, patient positioning, examiner details and procedures for ensuring measurement reliability was also not provided. Furthermore, data on pain intensity, muscle strength, joint swelling, wound status, gait pattern, assistive-device use and validated functional outcome measures were unavailable. Therefore, the documented findings demonstrate an improvement in active knee flexion following the physiotherapy programme; however, the overall effects of the intervention on knee extension and functional recovery cannot be fully determined from the available records.

### Knee Flexion & Extension Measurements

Table.1 Presents all recorded knee flexion & extension values:

| Assessment date   | Knee flexion (°) | Change from previous record (°) | Knee Extension (°) |
|-------------------|------------------|---------------------------------|--------------------|
| 26 July 2025      | 50°              | +17 <sup>0</sup>                | -15 <sup>0</sup>   |
| 2 August 2025     | 60°              | +10 <sup>0</sup>                | -12 <sup>0</sup>   |
| 4 August 2025     | 68°              | +8 <sup>0</sup>                 | -10 <sup>0</sup>   |
| 16 August 2025    | 76°              | +8 <sup>0</sup>                 | -8 <sup>0</sup>    |
| 23 August 2025    | 85°              | +9 <sup>0</sup>                 | -7 <sup>0</sup>    |
| 30 August 2025    | 92°              | +7 <sup>0</sup>                 | -5 <sup>0</sup>    |
| 7 September 2025  | 100°             | +8 <sup>0</sup>                 | -5 <sup>0</sup>    |
| 14 September 2025 | 105°             | +5 <sup>0</sup>                 | -4 <sup>0</sup>    |
| 21 September 2025 | 110°             | +5 <sup>0</sup>                 | -3 <sup>0</sup>    |
| 28 September 2025 | 114°             | +4 <sup>0</sup>                 | -2 <sup>0</sup>    |
| 8 October 2025    | 120°             | +6 <sup>0</sup>                 | -1 <sup>0</sup>    |

|                 |      |     |    |
|-----------------|------|-----|----|
| 10 October 2025 | 125° | +5° | 0° |
|-----------------|------|-----|----|

Table 1. Recorded knee flexion & extension values. Measurement type active.

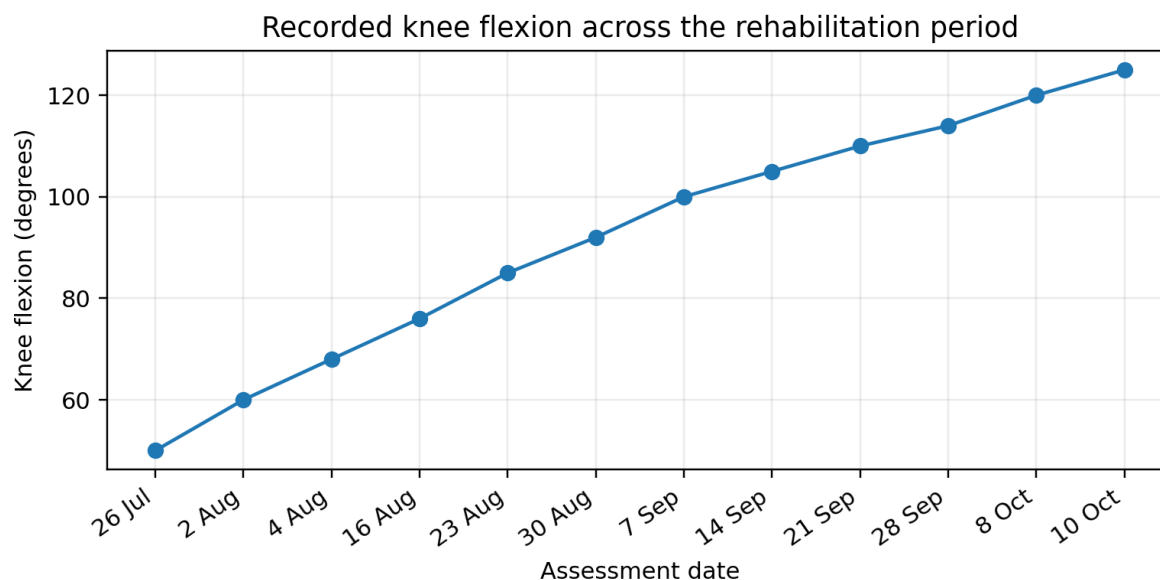


Figure 1. Serial recorded knee flexion measurements between 26 July and 10 October 2025.

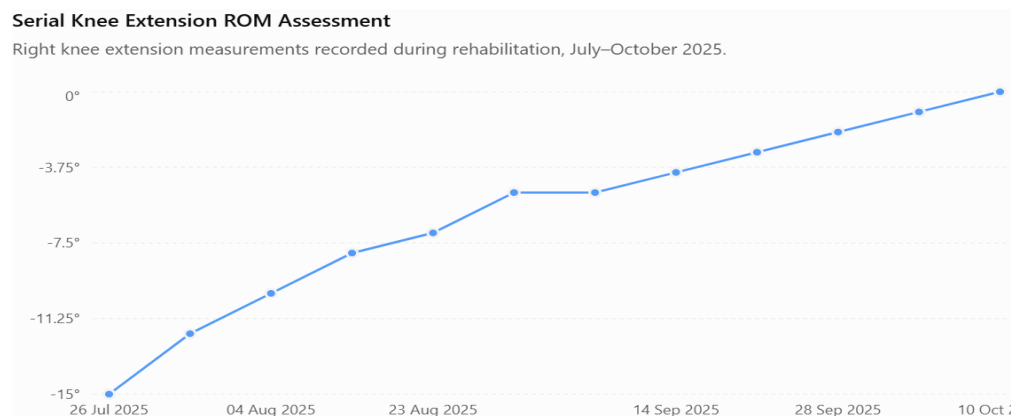


Figure 2: Serial Knee Extension range of motion during the documented rehabilitation period. The interpreted extension deficit decreased from 15° at the initial assessment to 0° at the final assessment on 10 October 2025.

The recorded assessments indicate progressive improvement in knee extension during rehabilitation. The interpreted extension deficit decreased from 15° on 26 July 2025 to 0° on 10 October 2025, corresponding to a 15° improvement.

### Surgical and Medical Management

Mr. Robin, a 22-year-old male, presented with a history of a right distal femoral fracture, documented on radiographic examination dated 15 April 2025. The available radiographs demonstrate the fracture and subsequent internal fixation using a plate-and-screw construct. The patient's subsequent clinical records describe rehabilitation following total knee arthroplasty (TKA) of the right knee. Total knee arthroplasty is a surgical procedure in which damaged articular surfaces of the knee are replaced with prosthetic components to improve joint function and facilitate mobility. The procedure generally involves replacement of the femoral and tibial articular surfaces, with patellar resurfacing performed when indicated. In this case, the exact date of TKA, specific surgical indication, prosthesis type, operative findings, and details of the surgical technique were not available in the supplied records. Therefore, these details require verification from the operative notes before being documented as confirmed surgical facts. Following the surgical procedure, the patient underwent a progressive physiotherapy programme aimed at improving right knee range of motion, lower-limb muscle performance, and weight-bearing capacity. At the initial documented physiotherapy assessment on 26 July 2025, right knee flexion was 50°. By the final assessment on 10 October 2025, flexion had improved to 125°, representing a total gain of 75°. This improvement suggests a favourable change in knee mobility during the documented rehabilitation period. Further details regarding postoperative pain, wound status, weight-bearing restrictions, and surgical complications should be obtained from the medical record to complete the surgical management section.



**Fig.:1 surgery (Arthroplasty)**



**Fig.: 2: X-ray Post-operative**

### **Medical management**

#### **Postoperative Medical Management**

Following right total knee arthroplasty (TKA), postoperative medical management generally focuses on pain control, prevention of complications, wound healing, and facilitating early mobilization. Analgesic medications may be prescribed to manage postoperative pain and improve tolerance to physiotherapy. Thromboprophylaxis may be provided according to the patient's risk profile to reduce the risk of venous thromboembolism. Antibiotics may be administered perioperatively as indicated by the surgical protocol, while wound care and regular monitoring help identify signs of infection or other complications. Additional medications, such as anti-inflammatory agents or gastroprotective drugs, may be used when clinically indicated.

Medical management is coordinated with a progressive physiotherapy programme involving range-of-motion exercises, muscle activation, functional training, and gradual mobilization, according to the surgeon's recommendations and the patient's tolerance. In this case, knee flexion improved from 50° on 26 July 2025 to 125° on 10 October 2025, representing a documented increase of 75° during the rehabilitation period. However, the specific medications, dosages, duration of treatment, and postoperative complications were not available in the provided records and should be verified from the patient's prescription or discharge summary before publication.

### **Physiotherapy Management**

The following phases summarize interventions documented in the supplied notes. The notes did not provide a complete session-by-session prescription, sets, repetitions, frequency, duration, adherence or progression criteria; these have therefore not been inferred.

#### **Initial recorded phase — 26 July 2025**

Initial knee flexion was 50°. Recorded interventions included quadriceps isometric contractions, SLR, ankle dorsiflexion and plantarflexion, knee-bending exercises, and ultrasound (US) and continuous passive motion (CPM) as written in the supplied notes. Retain US and CPM only if the original treatment sheet confirms they were used.

#### **Progressive mobility phase — August 2025**

Knee flexion progressed from 60° on 2 August to 92° on 30 August. Recorded exercises included quadriceps isometrics, SLR with cuff-weight resistance, side-lying hip abduction and partial weight-bearing exercises. Sets, repetitions and frequency were not provided and should not be invented.

#### **Progressive strengthening phase — September 2025**

Knee flexion increased from 100° on 7 September to 114° on 28 September. The supplied notes record quadriceps isometrics, SLR with a 1 kg cuff weight, side-lying hip abduction with a 0.5 kg cuff weight and progression towards full weight-bearing activities, subject to surgical clearance and tolerance

#### **Final recorded phase — October 2025**

Knee flexion reached 120° on 8 October and 125° on 10 October. Continued rehabilitation should focus on maintaining ROM and progressing strength, gait, balance and functional activities as appropriate. These functional outcomes should be reported only if assessed.

| Phase / dates                              | Recorded knee flexion | Documented interventions                                                                                                                                                                                                     |
|--------------------------------------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Initial recorded phase (26 July 2025)      | 50°                   | Quadriceps isometrics, straight leg raises, ankle dorsiflexion/plantarflexion and knee-bending exercises. Ultrasound and continuous passive motion were mentioned in the notes; verify against the original treatment sheet. |
| Progressive mobility (August 2025)         | 60°–92°               | Quadriceps isometrics, straight leg raises with cuff-weight resistance, side-lying hip abduction and partial weight-bearing exercises.                                                                                       |
| Progressive strengthening (September 2025) | 100°–114°             | Quadriceps isometrics, straight leg raises with a 1 kg cuff weight, side-lying hip abduction with a 0.5 kg cuff weight and progression towards full weight-bearing, subject to documented clearance and tolerance.           |
| Final recorded phase (October 2025)        | 120°–125°             | Continued rehabilitation was documented alongside further improvement in recorded knee flexion. Specific additional exercise dosage and functional performance outcomes were not supplied.                                   |

Table 2: Physiotherapy intervention protocol



Fig: 3 During Flexion/Extension



Fig: 4 During CPM Done by patient

## RESULTS

### Improvement in Knee Flexion Range of Motion

Serial assessments demonstrated a progressive increase in recorded knee flexion during the documented rehabilitation period following total knee arthroplasty (TKA). At the initial assessment on 26 July 2025, knee flexion was recorded as 50°. Subsequent measurements showed a gradual increase to 60° on 2 August, 68° on 4 August, 76° on 16 August, and 85° on 23 August 2025. By the end of August, knee flexion had reached 92°. Further improvement was documented during September 2025, with flexion increasing from 100° on 7 September to 105° on 14 September, 110° on 21 September, and 114° on 28 September. In October, the recorded values increased to 120° on 8 October and 125° on 10 October 2025. Overall, the difference between the first and final recorded measurements was 75°, indicating a substantial increase in the documented knee flexion range of motion over the observation period. The recorded progression occurred alongside a physiotherapy programme comprising quadriceps isometric contractions, straight leg raises, ankle mobility exercises, knee-bending exercises, progressive resistance exercises and weight-bearing activities, as documented in the clinical notes. However, the available information does not establish a direct causal relationship between these interventions and the observed change in knee flexion.

### Postoperative Radiographic Findings

The supplied radiographic image demonstrates anteroposterior and lateral views of the right knee following total knee arthroplasty. Prosthetic components are visible at the distal femur and proximal tibia, consistent with a replaced knee joint. The radiograph provides visual documentation of the postoperative prosthetic reconstruction.

## DISCUSSION

The present case report describes changes in knee range of motion (ROM) during the rehabilitation period of a 22-year-old male patient with a history of right distal femoral fracture, previous plate-and-screw fixation, and subsequent right total knee arthroplasty (TKA). The principal finding was an increase in knee flexion from 50° on 26 July 2025 to 125° on 10 October 2025, representing an overall gain of 75°. This improvement indicates a substantial change in the patient's documented knee mobility during the observation period. However, the findings should be interpreted cautiously because

the report concerns a single patient and the available records do not include comprehensive functional outcome measures or sufficient detail about the rehabilitation protocol.

Knee ROM is an important clinical parameter following TKA because it contributes to mobility and the performance of daily activities. Restricted flexion may affect sitting, transfers, stair negotiation, and other functional movements, while limited extension may interfere with standing and gait. Mutsuzaki et al. [8] examined the time course of knee ROM following TKA and highlighted the importance of monitoring flexion and extension separately during recovery. In the present case, the serial flexion measurements demonstrated progressive improvement throughout the recorded period. Nevertheless, the clinical significance of this change should also be assessed alongside pain, muscle strength, gait, balance, and functional independence.

The patient's history of distal femoral fracture and internal fixation is an important consideration in interpreting the rehabilitation course. Previous trauma and surgical intervention may be associated with altered joint mechanics, residual stiffness, and post-traumatic degenerative changes. Saleh et al. [9] reported that TKA can improve pain, ROM, and functional outcomes in patients with post-traumatic arthritis, although these patients may also face an increased risk of complications. Similarly, research examining TKA following previous fracture treatment has identified the complexity of managing patients with a history of significant knee trauma [10]. However, the available information in the present case does not establish that the earlier fracture was the direct indication for arthroplasty. The operative indication and relevant surgical findings should therefore be confirmed before drawing conclusions about the relationship between the fracture and the subsequent TKA.

Postoperative physiotherapy is an essential component of recovery following knee arthroplasty. Rehabilitation commonly includes progressive exercises, mobility training, strengthening, and functional activities, with the programme adjusted according to the patient's clinical status and surgical precautions. Jette et al. [11] emphasized the role of physical therapist management in addressing impairments and improving physical function after TKA. Konnyu et al. [12], in a systematic review of rehabilitation following TKA, examined evidence relating to rehabilitation interventions and patient outcomes. These publications support the importance of individualized rehabilitation and systematic outcome assessment. In the present case, repeated ROM measurements provided a record of changes in knee flexion; however, the specific contribution of physiotherapy cannot be established because the frequency, duration, intensity, and content of the rehabilitation programme have not been fully documented.

The improvement in knee flexion from 50° to 125° is a notable finding. However, ROM alone does not provide a complete picture of postoperative recovery. A patient may demonstrate improved joint mobility while continuing to experience limitations in muscle strength, walking endurance, balance, or participation in daily activities. Keeney et al. [13] discussed the evidence concerning TKA in younger patients and highlighted the importance of considering patient age and longer-term outcomes. Given the patient's age of 22 years, documentation of the surgical indication, functional demands, and longer-term follow-up would be particularly relevant. Further assessment using validated functional measures could help establish whether the observed improvement in ROM was accompanied by meaningful gains in independence and activity performance.

Knee extension is also an important outcome following TKA. The original clinical records in this case contain extension entries written in an unclear format, including values such as “-150,” “-120,” and “-100.” These entries should be verified against the original assessment sheets before conversion into degrees or interpretation as an extension deficit. Accurate and consistent goniometric measurement is necessary for reliable longitudinal comparison. Once the extension data have been confirmed, the findings can be presented alongside flexion measurements to provide a more complete account of the changes in knee mobility.

This case has several limitations. First, it describes the clinical course of one patient, limiting the generalizability of the findings. Second, the available data primarily concern knee ROM, with insufficient information about pain, muscle strength, gait, functional independence, and patient-reported outcomes. Third, the exact date and indication for TKA, the surgical details, and the rehabilitation protocol require confirmation from the original medical records. Finally, the extension measurements and the chronology of the postoperative radiograph should be verified before publication. Despite these limitations, the case illustrates the value of serial physiotherapy assessment for documenting changes in knee mobility and monitoring an individual patient's progress following TKA.

Overall, the documented increase in knee flexion from 50° to 125° demonstrates substantial improvement in the patient's recorded knee mobility during the observation period. The findings emphasize the importance of serial ROM assessment and comprehensive postoperative evaluation in patients with complex orthopaedic histories. Further conclusions regarding functional recovery and the effectiveness of rehabilitation require verified clinical measurements, detailed treatment documentation, and additional outcome measures.

## LIMITATIONS

This report is limited by missing demographic and surgical details, unclear active versus passive ROM measurement, absent measurement-method information, and lack of pain, strength and functional outcomes. Treatment dosage and adherence were not supplied. The report should be completed using the original clinical notes and should not present unverified details as patient-specific facts.

## CONCLUSION

The available record documents an increase in knee flexion from 50° to 125° between 26 July and 10 October 2025 following TKA and a recorded progressive physiotherapy programme. This 75° absolute increase describes the measured ROM trajectory only.

## Patient Consent

Written informed consent was obtained from the patient for publication of this case report and the accompanying clinical information. Identifying information has been omitted to maintain patient confidentiality.

## Funding

This research received no grant from any funding agency.

## ACKNOWLEDGMENT:

We would like to thank entire physiotherapist who will be assisting in the recruitment, assessment, and treatment of patterns in the study. We also acknowledge the Dr. Neha Rani & Dr. Annapurna, Assistant Professor, Mangalayatan University, Aligarh, Uttar Pradesh and Dr. Rajesh Agarwal for their valuable support.

## Conflicts of Interest

No potential conflicts of interest related to this article have been reported.

## REFERENCES

1. Keeney JA, Eunice S, Pashos G, Wright RW, Clohisy JC. What is the evidence for total knee arthroplasty in young patients? A systematic review of the literature. *Clin Orthop Relat Res*. 2011;469(2):574–583. doi:10.1007/s11999-010-1536-9.
2. Bergstein VE, Weinblatt AI, Taylor WL 4th, Long WJ. Total knee arthroplasty survivorship and outcomes in young patients: a review of the literature and 40-year update to a longitudinal study. *Arch Orthop Trauma Surg*. 2024;144(9):4077–4083. doi:10.1007/s00402-024-05198-5.
3. Saleh H, Yu S, Vigdorchik J, Schwarzkopf R. Total knee arthroplasty for treatment of post-traumatic arthritis: systematic review. *World J Orthop*. 2016;7(9):584–591. doi:10.5312/wjo.v7.i9.584.
4. *Increased complications rates and inferior patient reported outcomes following total knee arthroplasty due to post-traumatic osteoarthritis with previous fracture treatment: a systematic review*. PubMed PMID: 37097470. Available from: <https://pubmed.ncbi.nlm.nih.gov/37097470/>
5. Jette DU, Hunter SJ, Burkett L, Langham B, Logerstedt DS, Piuze NS, et al. Physical therapist management of total knee arthroplasty. *Phys Ther*. 2020;100(9):1603–1631. doi:10.1093/ptj/pzaa099.
6. Konnyu KJ, Thoma LM, Cao W, Aaron RK, Panagiotou OA, Bhuma MR, et al. Rehabilitation for total knee arthroplasty: a systematic review. *Am J Phys Med Rehabil*. 2023;102(1):19–33. doi:10.1097/PHM.0000000000002008.
7. *Target range of motion for rehabilitation after total knee arthroplasty*. Available from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC5458350/>
8. Mutsuzaki H, Takeuchi R, Mataka Y, Wadano Y. Target range of motion for rehabilitation after total knee arthroplasty. *J Rural Med*. 2017;12(1):33–37. doi:10.2185/jrm.2923.
9. Saleh H, Yu S, Vigdorchik J, Schwarzkopf R. Total knee arthroplasty for treatment of post-traumatic arthritis: systematic review. *World J Orthop*. 2016;7(9):584–591. doi:10.5312/wjo.v7.i9.584.
10. *Increased complications rates and inferior patient reported outcomes following total knee arthroplasty due to post-traumatic osteoarthritis with previous fracture treatment: a systematic review*. PubMed PMID: 37097470. Available from: <https://pubmed.ncbi.nlm.nih.gov/37097470/>
11. Jette DU, Hunter SJ, Burkett L, Langham B, Logerstedt DS, Piuze NS, et al. Physical therapist management of total knee arthroplasty. *Phys Ther*. 2020;100(9):1603–1631. doi:10.1093/ptj/pzaa099.
12. Konnyu KJ, Thoma LM, Cao W, Aaron RK, Panagiotou OA, Bhuma MR, et al. Rehabilitation for total knee arthroplasty: a systematic review. *Am J Phys Med Rehabil*. 2023;102(1):19–33. doi:10.1097/PHM.0000000000002008.
13. Keeney JA, Eunice S, Pashos G, Wright RW, Clohisy JC. What is the evidence for total knee arthroplasty in young patients? A systematic review of the literature. *Clin Orthop Relat Res*. 2011;469(2):574–583. doi:10.1007/s11999-010-1536-9.
14. Bade MJ, Stevens-Lapsley JE. Early high-intensity rehabilitation following total knee arthroplasty improves outcomes. *J Orthop Sports Phys Ther*. 2011;41(12):932–941. doi:10.2519/jospt.2011.3734.
15. Pozzi F, Snyder-Mackler L, Zeni J. Physical exercise after knee arthroplasty: a systematic review of controlled trials. *Eur J Phys Rehabil Med*. 2013;49(6):877–892.
16. Artz N, Elvers KT, Lowe CM, Sackley C, Jepson P, Beswick AD. Effectiveness of physiotherapy exercise following total knee replacement: systematic review and meta-analysis. *BMC Musculoskelet Disord*. 2015;16:15. doi:10.1186/s12891-015-0469-6.
17. Minns Lowe CJ, Barker KL, Dewey M, Sackley CM. Effectiveness of physiotherapy exercise following total knee replacement: systematic review and meta-analysis. *BMJ*. 2007;335(7624):812. doi:10.1136/bmj.39311.460093.BE.
18. Fransen M, McConnell S, Harmer AR, Van der Esch M, Simic M, Bennell KL. Exercise for osteoarthritis of the knee. *Cochrane Database Syst Rev*. 2015;(1). doi:10.1002/14651858. CD004376.pub3.

19. Skou ST, Roos EM, Laursen MB, Rathleff MS, Arendt-Nielsen L, Simonsen O, et al. A randomized, controlled trial of total knee replacement. *N Engl J Med*. 2015;373(17):1597–1606. doi:10.1056/NEJMoa1505467.
20. National Institute for Health and Care Excellence. *Joint replacement (primary): hip, knee and shoulder*. NICE guideline NG157. London: NICE; 2020. Available from: <https://www.nice.org.uk/guidance/ng157>.