Section: Orthopedics

Original Research Article

FUNCTIONAL RECOVERY IN ELDERLY PATIENTS FOLLOWING TOTAL KNEE ARTHROPLASTY: A PROSPECTIVE OBSERVATIONAL STUDY OF RECOVERY TRAJECTORIES OVER THREE MONTHS

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Received : 08/07/2025
Received in revised form : 23/08/2025
Accepted : 10/09/2025

Keywords:
Arthroplasty, Replacement, Knee, Recovery of Function, Aged, Pain Measurement, Postoperative Care.

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DOI: 10.47009/jamp.2025.7.5.63

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (5); 316-320

ABSTRACT

Background: Total knee arthroplasty (TKA) is a common and effective procedure for managing end-stage knee osteoarthritis, particularly in elderly patients. However, functional recovery in this population can be variable due to comorbidities and age-related physiological decline. **Aim:** To assess the early functional recovery in elderly patients undergoing primary TKA by evaluating pain, mobility, range of motion, and knee function over a three-month postoperative period. **Materials and Methods:** A prospective observational study was conducted involving 50 elderly patients (≥65 years) undergoing unilateral primary TKA. Patients were assessed at four time points: preoperatively (T0), 1 week (T1), 6 weeks (T2), and 3 months (T3) postoperatively. Outcome measures included Visual Analog Scale (VAS) for pain, Timed Up and Go (TUG) test, 6-Minute Walk Test (6MWT), range of motion (ROM), and Knee Society Score (KSS). Data were analyzed using repeated measures ANOVA with a significance threshold of $p<0.05$. **Result:** There was a significant reduction in pain scores from T0 (mean VAS: 7.8) to T3 (1.6) ($p<0.001$). Functional mobility improved, with TUG decreasing from 18.4s to 11.2s and 6MWT distance increasing from 210.3m to 320.6m. Mean ROM improved from 89.6° at T0 to 112.9° at T3. KSS increased from 48.6 to 84.7 ($p<0.001$). **Conclusion:** Elderly patients undergoing TKA demonstrate significant functional recovery within 3 months postoperatively. Structured rehabilitation and early mobilization play a key role in optimizing outcomes in this population.

INTRODUCTION

Total knee arthroplasty (TKA) is widely recognized as an effective surgical solution for end-stage knee osteoarthritis, particularly in elderly populations. With increasing life expectancy and the global rise in osteoarthritis prevalence, the demand for TKA is projected to grow significantly among individuals aged 65 and above (1). While the procedure offers substantial pain relief and improved joint function, elderly patients present unique challenges due to age-related decline in muscle strength, joint flexibility, and overall functional capacity.[2,3]

The early postoperative period is especially critical in determining long-term outcomes. Most patients experience an initial decline in mobility and strength in the first week after TKA due to pain, inflammation, and reduced neuromuscular control.[4] However, this is typically followed by gradual functional improvements, especially when supported by structured rehabilitation programs. Studies have shown that most patients regain substantial mobility and achieve functional independence within 6 to 12 weeks postoperatively.[5,6]

Pain reduction is central to postoperative recovery and directly impacts mobility and participation in rehabilitation. Multimodal pain management strategies, including nerve blocks and non-opioid analgesics, have shown effectiveness in reducing pain and enabling earlier ambulation.[7] Monitoring pain using tools like the Visual Analog Scale (VAS) allows clinicians to assess recovery progression and adjust interventions accordingly.[8]

Functional recovery in TKA patients is commonly evaluated through both objective performance-based tests and subjective assessments. Performance tests such as the Timed Up and Go (TUG) and the 6-Minute Walk Test (6MWT) are well-established,

ISSN (O): 2687-5365; ISSN (P): 2753-6556

reproducible tools that assess lower limb function, balance, and endurance.[9,10] These tests are especially relevant in elderly populations, where mobility limitations are often multifactorial.

The Knee Society Score (KSS) is another important tool used to assess postoperative outcomes, offering a comprehensive evaluation of knee function, pain, and alignment. It also incorporates patient-reported elements to reflect perceived functional gains, making it a valuable measure in elderly patients where quality of life is a key outcome.[11]

A growing area of focus in elderly surgical patients is frailty, a condition marked by reduced physiological reserve and increased vulnerability to stressors such as surgery. Evidence suggests that frailty is a stronger predictor of postoperative complications and delayed recovery than chronological age alone.[12,13] Tools like the Clinical Frailty Scale (CFS) and Modified Frailty Index (mFI) are increasingly used for preoperative risk stratification and perioperative planning.[14,15]

Studies have shown that frail patients undergoing TKA are more likely to experience prolonged hospital stays, delayed mobilization, increased readmissions, and poorer functional outcomes compared to their robust counterparts.[16] Despite this, frailty should not be viewed as a contraindication to surgery, as selected patients can still achieve meaningful improvement with tailored care strategies.[17,18]

Given the complex interplay between age, comorbidities, and recovery potential, there is a need for prospective studies that monitor early postoperative outcomes specifically in elderly TKA patients. While long-term outcomes are well-documented, fewer studies have focused on the critical early recovery period—particularly the first three months, when pain control, ROM improvement, and mobilization efforts are most intensive.

This prospective observational study aims to assess early functional recovery in elderly patients undergoing primary TKA using validated measures including VAS, TUG, 6MWT, ROM, and KSS. By evaluating these outcomes at four key time points—preoperatively, 1 week, 6 weeks, and 3 months postoperatively—we aim to characterize the recovery trajectory and identify practical implications for optimizing rehabilitation protocols in the elderly population.

MATERIALS AND METHODS

This prospective observational study was conducted at the Department of Orthopedics, Mata Gujri Memorial medical college and Lions seva kendra hospital, kishanganj, bihar, from november 2023 to february 2025. Ethical approval was obtained from the Institutional Ethics Committee, and written informed consent was obtained from all participants prior to enrollment. The study adhered to the principles of the Declaration of Helsinki and Good Clinical Practice (GCP) guidelines.

A total of 50 elderly patients scheduled to undergo primary total knee arthroplasty (TKA) were enrolled. Patients were selected using a consecutive sampling method based on the eligibility criteria and willingness to participate in the study.

Inclusion Criteria: Patients aged ≥65 years undergoing primary unilateral TKA for osteoarthritis. Ability to ambulate (with or without aids) prior to surgery. Ability to understand instructions and participate in rehabilitation. Provision of informed consent.

Exclusion Criteria: Revision TKA or bilateral knee replacement during the study period. Pre-existing neuromuscular disorders or severe cognitive impairment. Uncontrolled systemic illness (e.g., cardiac, renal, or hepatic disease) precluding safe participation in rehabilitation. Incomplete follow-up or withdrawal of consent.

Data were collected at four pre-defined time points:

T0 (Baseline): Within 1 week prior to surgery

T1: 1 week postoperatively

T2: 6 weeks postoperatively

T3: 3 months postoperatively

Methodology

At baseline, demographic and clinical characteristics including age, gender, BMI, comorbidities, and baseline functional status were recorded. All patients underwent standard surgical procedures by the same orthopedic team using a posterior-stabilized knee prosthesis, under spinal or general anesthesia, as clinically indicated.

Postoperative rehabilitation protocols were standardized for all patients, including mobilization from post-operative day 1 under the supervision of a physiotherapist. Functional recovery was assessed using: -Timed Up and Go (TUG) Test, Knee Society Score (KSS), Visual Analog Scale (VAS) for pain, Range of Motion (ROM) of the operated knee, 6-Minute Walk Test (6MWT), Data were collected by trained assessors blinded to prior results at each follow-up point (T1, T2, T3).

Data were entered and analyzed using IBM SPSS Statistics version 20.0. Descriptive statistics were used to summarize demographic and clinical characteristics. Categorical variables were analyzed using Chi-square or Fisher's exact test. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 50 elderly patients (≥65 years) undergoing primary unilateral TKA were enrolled in the study and completed follow-up assessments at all four time points (T0 – baseline, T1 – 1 week, T2 – 6 weeks, T3 – 3 months).

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 1: Demographic and Baseline Clinical Characteristics (n = 50)

Variable	Mean ± SD / n (%)
Age (years)	69.8 ± 4.5
Gender (Female)	32 (64%)
BMI (kg/m²)	28.1 ± 3.2
Comorbidities	
– Hypertension	38 (76%)
– Diabetes mellitus	24 (48%)
– Cardiovascular disease	10 (20%)
Preoperative VAS (0–10)	7.8 ± 1.2
Preoperative Knee ROM (degrees)	89.6 ± 11.4
Preoperative TUG (sec)	18.3 ± 3.5
Preoperative 6MWT (meters)	211.5 ± 34.7
Knee Society Score (KSS)	48.6 ± 8.9

Table 1 summarizes the demographic and baseline clinical characteristics of the study cohort. The mean age of participants was 69.8 years, with a predominance of females (64%). Most patients had comorbid hypertension (76%) or diabetes (48%). Baseline functional scores showed reduced mobility and moderate pain prior to surgery.

Table 2: VAS Pain Scores at Each Time Point (Mean ± SD)

Time Point	VAS Score (0–10)
T0	7.8 ± 1.2
T1	5.6 ± 1.4
T2	3.2 ± 1.1
T3	1.6 ± 0.8
p-value	<0.001 (ANOVA)

Table 2 presents changes in VAS pain scores at different time points. Pain levels decreased significantly over time ($p < 0.001$). The most notable reduction occurred between T1 and T2, reflecting early postoperative recovery and response to rehabilitation. By T3 (3 months), VAS scores had decreased by nearly 80% from baseline.

Table 3: TUG and 6MWT Outcomes Over Time

Time Point	TUG (sec)	6MWT (meters)
T0	18.3 ± 3.5	211.5 ± 34.7
T1	24.6 ± 4.1	145.2 ± 29.8
T2	16.2 ± 2.9	256.7 ± 41.3
T3	13.1 ± 2.5	312.4 ± 38.5
p-value	<0.001 (ANOVA)	<0.001 (ANOVA)

Functional performance measured by the Timed Up and Go (TUG) test and 6-Minute Walk Test (6MWT) is presented in Table 3. TUG scores initially worsened at T1 (mean: 24.6 sec), reflecting early postoperative limitation, but showed steady improvement by T2 and T3. Similarly, 6MWT distance decreased postoperatively but exceeded baseline values by T2, with significant functional gains evident at 3 months ($p < 0.001$ for both metrics).

Table 4: Knee Society Score and ROM Over Time

Time Point	KSS (0–100)	ROM (degrees)
T0	48.6 ± 8.9	89.6 ± 11.4
T1	55.2 ± 10.1	75.8 ± 9.3
T2	72.4 ± 8.6	101.3 ± 10.5
T3	84.7 ± 6.2	112.9 ± 8.7
p-value	<0.001 (ANOVA)	<0.001 (ANOVA)

Table 4 displays improvement in the Knee Society Score (KSS) and range of motion (ROM). KSS scores demonstrated continuous improvement, with significant increases between each time point. Range of motion followed a similar pattern, showing an initial dip at T1 followed by progressive enhancement, exceeding preoperative values by T2. The average ROM at 3 months reached 113°, suggesting good surgical and rehabilitative outcomes.

All assessed functional outcomes—including pain, mobility, walking endurance, joint function, and ROM—showed statistically significant improvements across the study period ($p < 0.001$ for all). While early postoperative limitations were observed at 1 week (T1), marked recovery was evident by 6 weeks (T2), with near-complete functional restoration in most patients by 3 months (T3). No major complications or adverse events were reported during follow-up.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

DISCUSSION

This prospective observational study evaluated functional recovery in elderly patients undergoing total knee arthroplasty (TKA), with assessments conducted at baseline (T0), 1 week (T1), 6 weeks (T2), and 3 months (T3). The study revealed a pattern of initial postoperative decline in mobility and function, followed by significant recovery across all measured outcomes—including pain, functional mobility, range of motion (ROM), and the Knee Society Score (KSS)—by 3 months postoperatively. These findings align with established evidence describing the recovery trajectory in older adults post-TKA.

The early postoperative decline in Timed Up and Go (TUG) and 6-Minute Walk Test (6MWT) scores observed at T1 is consistent with previous studies showing that functional performance commonly deteriorates in the first 1–2 weeks following surgery due to pain, inflammation, and reduced mobility.[1,2] However, significant improvements by T2 and T3 reflect the impact of structured rehabilitation and the body's natural recovery. Our finding that ROM improved from an average of 89.6° at baseline to 112.9° at 3 months is in line with studies suggesting that 110° of flexion is sufficient for performing most daily activities.[3]

A study by Bade et al,[4] reported that while functional scores may dip immediately after surgery, substantial recovery typically occurs by 3 months, with many patients regaining baseline levels of mobility. However, functional capacity may still lag behind that of healthy older adults, particularly in high-demand tasks such as stair climbing and squatting.[4,5]

Pain, as measured by the Visual Analog Scale (VAS), showed a progressive decline from a mean of 7.8 at baseline to 1.6 at 3 months. These results are consistent with previous literature where patients report significant pain reduction within the first 3 months post-TKA.[6,7] Effective pain management is crucial, not only for comfort but also to facilitate early mobilization and enhance rehabilitation outcomes.[8]

Our study showed steady improvements in KSS over the study period, from a baseline of 48.6 to 84.7 at 3 months. These improvements reflect both subjective (pain and function) and objective (ROM and stability) recovery. Similar gains have been observed in other studies assessing short-term TKA outcomes in elderly populations.[9,10]

Frailty has emerged as a critical determinant of surgical outcomes in elderly patients undergoing joint replacement. Studies have shown that frailty, more than age alone, predicts poor postoperative outcomes including complications, delayed recovery, and increased hospital stay.[11,12] For example, patients identified as frail using the Clinical Frailty Scale (CFS) or Modified Frailty Index (mFI) are more likely to experience extended hospitalization, postoperative delirium, and higher readmission rates.[13,14]

A large population-based cohort study demonstrated that frailty is associated with increased healthcare utilization, costs, and poorer functional outcomes following total joint arthroplasty.[15] In contrast, robust older adults—defined by low frailty scores—can recover as effectively as younger cohorts when provided appropriate perioperative care.[11,16] Although frailty was not explicitly assessed in our cohort, the favorable recovery suggests that our participants may have been predominantly non-frail or mildly frail.

Early mobilization and physiotherapy are well-established components of postoperative care in TKA, especially within Enhanced Recovery After Surgery (ERAS) protocols.[17] Initiating movement on postoperative day one has been shown to improve function, reduce complications such as deep vein thrombosis, and shorten hospital stays.[18] Our findings support these protocols, with notable functional gains already evident by 6 weeks.

Programs targeting specific milestones—such as achieving 90° of knee flexion by week 2 and walking independently by week 6—appear achievable and clinically meaningful in this population. Our patients' functional recovery trajectory reinforces the importance of structured rehabilitation in elderly TKA recipients.

CONCLUSION

This study demonstrates that elderly patients can achieve significant functional recovery within 3 months of TKA, with improvements in pain, mobility, ROM, and clinical function. While frailty remains a key factor influencing recovery, carefully selected older adults can benefit substantially from TKA when supported by structured rehabilitation and early mobilization. Integrating frailty assessments into preoperative evaluation and optimizing rehabilitation strategies remain essential to enhancing outcomes in this growing patient population.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556

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ISSN (O): 2687-5365; ISSN (P): 2753-6556