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Clinical and functional outcomes of total knee arthroplasty in rheumatoid arthritis patients: A longitudinal study

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Abstract
Introduction: Total Knee Arthroplasty (TKA) is effective for managing severe knee involvement in Rheumatoid Arthritis (RA) patients. This study evaluates the clinical, functional, and radiographic outcomes of TKA in RA patients.
Material and Methods: A longitudinal study was conducted on 50 RA patients undergoing TKA at Mamata Medical College. Outcomes were assessed at baseline, discharge, 3 months, 6 months, and 1 year postoperatively using VAS for pain, KSS for knee function, WOMAC, SF-36, radiographic evaluations, patient satisfaction, and activity levels.
Results: VAS scores improved from 8.4 to 1.1, and KSS scores increased from 51.2 to 83.1 (both $p < 0.001$). WOMAC and SF-36 scores showed significant functional and quality of life improvements. Radiographic outcomes indicated stable implants with no major complications. Patient satisfaction and activity levels rose significantly.
Conclusions: TKA significantly improves pain, function, and quality of life in RA patients, with high patient satisfaction and stable radiographic results.

Keywords: Total knee arthroplasty, rheumatoid arthritis, clinical outcomes, functional outcomes, patient satisfaction

Introduction

Total Knee Arthroplasty (TKA) is a well-established surgical intervention for alleviating pain and restoring function in patients with end-stage knee arthritis, including those with Rheumatoid Arthritis (RA) [1]. RA is a chronic inflammatory disease characterized by persistent synovitis, leading to joint destruction, pain, and functional impairment. While TKA has proven to be highly effective in osteoarthritis patients, outcomes in RA patients can be more variable due to factors such as severe joint deformities, systemic inflammation, and the use of disease-modifying antirheumatic drugs [2]. Understanding the clinical and functional outcomes of TKA in RA patients is crucial, as these patients often present with more complex cases and may experience different recovery trajectories compared to those with osteoarthritis.

Despite the widespread use of TKA in RA patients, there is a lack of comprehensive longitudinal data specifically addressing the clinical and functional outcomes in this population. Most existing studies have focused on short-term outcomes or have included heterogeneous patient populations, limiting the ability to draw specific conclusions about RA patients [3]. Moreover, factors such as the impact of biologic therapies, perioperative management of immunosuppression, and the influence of systemic disease activity on post-operative outcomes remain underexplored [4]. This study aims to fill these gaps by providing detailed longitudinal data on TKA outcomes in RA patients, focusing on both clinical parameters (pain, mobility) and functional status (daily activities, quality of life).

Previous studies have demonstrated that TKA can significantly improve pain and function in RA patients; however, the extent of these benefits and the long-term durability of the implants can vary [5]. Earlier studies indicate that RA patients may experience slightly lower implant survival rates and higher complication rates compared to osteoarthritis patients [6]. Studies such as those by Chmell *et al*. (1999) and Nelissen (2003) have reported on the benefits of TKA in RA patients, noting improvements in pain and physical function yet have highlighted a potential increase in infection and revision rates due to the underlying immunosuppressive state [7, 8]. These findings underscore the need for more targeted research that specifically addresses the RA population and evaluates outcomes over an extended period.

The aim of this study is to evaluate the clinical and functional outcomes of TKA in RA patients over a longitudinal follow-up period. This study will specifically assess pain relief, functional recovery, quality of life improvements, and implant survival rates in RA patients undergoing TKA. By providing a detailed analysis of these outcomes, the study aims to inform clinical decision-making and optimize perioperative management strategies tailored to the unique needs of RA patients. Additionally, the study seeks to identify predictors of successful outcomes and potential complications, thereby contributing to the refinement of patient selection criteria and postoperative care protocols for this challenging patient population.

Materials and methods

Study design and setting

This longitudinal study was conducted at the Department of Orthopaedics, Mamata Medical College, Khammam. The study involved 50 patients diagnosed with Rheumatoid Arthritis (RA) who underwent Total Knee Arthroplasty (TKA) between January 2020 and December 2023. Ethical approval was obtained from the Institutional Ethics Committee, and written informed consent was obtained from all participants.

Patient Selection

Patients were included in the study if they met the following criteria:

- Diagnosed with RA based on the American College of Rheumatology (ACR) criteria.

- Indication for TKA due to severe knee pain, functional impairment, and radiographic evidence of joint destruction.
- Age between 40 and 80 years.
- Willingness to participate in the study and follow-up visits.

Exclusion criteria included:
- Previous knee surgery on the affected side.
- Active infection or uncontrolled systemic disease.
- Severe comorbid conditions that could significantly affect postoperative rehabilitation or outcomes.

Surgical Procedure

All surgeries were performed by experienced orthopaedic surgeons at Mamata Medical College using a standard TKA protocol. A midline skin incision with a medial parapatellar approach was used in all cases. Both cemented and uncemented prostheses were used based on the surgeon's discretion and intraoperative findings. Postoperative care included pain management, thromboprophylaxis, and physiotherapy starting on the first postoperative day.

Data Collection

Data were collected at baseline (preoperative), at discharge, and at follow-up intervals of 3 months, 6 months, 1 year, and annually thereafter. The primary outcomes assessed were:
- **Clinical Outcomes:** Pain was evaluated using the Visual Analog Scale (VAS), and knee function was assessed using the Knee Society Score (KSS), which includes both clinical and functional components.
- **Functional Outcomes:** The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and the 36-Item Short Form Survey (SF-36) were used to assess overall functional status and quality of life.
- **Radiographic Outcomes:** Standard anteroposterior and lateral knee radiographs were taken at each follow-up to evaluate implant position, alignment, and signs of loosening or other complications.

Statistical Analysis

Descriptive statistics were used to summarize the demographic and clinical characteristics of the patients. Continuous variables were presented as means and standard deviations, while categorical variables were summarized as frequencies and percentages. Paired t-tests were used to compare preoperative and postoperative outcomes, and repeated measures ANOVA was employed to evaluate changes over time. Kaplan-Meier survival analysis was used to estimate implant survival rates. Statistical significance was set at $p < 0.05$. All analyses were conducted using SPSS software, version 25.0.

Results

Table 1: Demographic and Comorbidity Profile of TKA Patients

Parameter	Count	Percentage (%)
Age Mean (years)	65	-
Age SD (years)	8	-
Gender - Male	32	64
Gender - Female	18	36
Hypertension	12	24
Diabetes	13	26
None	13	26
Both	12	24

The study included 50 patients with a mean age of 65 years (SD: 8 years) who underwent Total Knee Arthroplasty (TKA) for Rheumatoid Arthritis. The cohort comprised 64% male (n=32) and 36% female (n=18) patients, reflecting a slightly higher prevalence of TKA among males in this population. Comorbidity data revealed that 24% of the patients had hypertension, 26% had diabetes, 26% had no comorbidities, and 24% had both hypertension and diabetes. This distribution highlights the diverse comorbid profiles in the study group, which could influence perioperative management and outcomes. Understanding the demographic and comorbidity profile is crucial for tailoring patient care and optimizing the outcomes of TKA in RA patients (Table 1).

Table 2: Clinical Outcomes of TKA in RA Patients

Time Point	VAS Mean	VAS SD	KSS Mean
Baseline	8.40	0.92	51.20
Discharge	5.00	0.56	60.28
3 Months	2.94	0.66	70.11
6 Months	1.99	0.60	77.12
1 Year	1.09	0.59	83.05

The clinical outcomes of Total Knee Arthroplasty (TKA) in patients with Rheumatoid Arthritis were assessed using the Visual Analog Scale (VAS) for pain and the Knee Society Score (KSS) for knee function at multiple time points. At baseline, the mean VAS score was 8.40 (SD: 0.92), indicating severe pain, and the mean KSS was 51.20, reflecting poor knee function. Following surgery, there was a significant reduction in pain, with VAS scores dropping to 5.00 (SD: 0.56) at discharge, 2.94 (SD: 0.66) at 3 months, 1.99 (SD: 0.60) at 6 months, and 1.09 (SD: 0.59) at 1 year. Correspondingly, knee function improved markedly, with KSS scores rising to 60.28 at discharge, 70.11 at 3 months, 77.12 at 6 months, and 83.05 at 1 year. These results underscore the effectiveness of TKA in significantly reducing pain and enhancing knee function over time in RA patients (Table 2).

Table 3: Functional Outcomes of TKA in RA Patients

Time Point	WOMAC Mean	WOMAC SD	SF-36 Mean
Baseline	69.06	4.95	40.31
Discharge	59.33	5.75	48.43
3 Months	49.46	5.61	59.32
6 Months	39.51	5.82	70.95
1 Year	31.11	5.60	81.06

The functional outcomes of Total Knee Arthroplasty (TKA) in Rheumatoid Arthritis patients were evaluated using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and the SF-36 survey, which assess overall functional status and quality of life. At baseline, the mean WOMAC score was 69.06 (SD: 4.95), indicating significant functional impairment, and the mean SF-36 score was 40.31, reflecting poor quality of life. Postoperatively, the WOMAC scores improved progressively, decreasing to 59.33 (SD: 5.75) at discharge, 49.46 (SD: 5.61) at 3 months, 39.51 (SD: 5.82) at 6 months, and 31.11 (SD: 5.60) at 1 year, showing substantial gains in function. Similarly, SF-36 scores increased to 48.43 at discharge, 59.32 at 3 months, 70.95 at 6 months, and 81.06 at 1 year, indicating significant improvements in the patients' quality of life. These findings highlight the positive impact of TKA on both functional status and overall well-being in RA patients (Table 3).

Table 4: Radiographic Outcomes of TKA in RA Patients

Time Point	Position Mean	Position SD	Alignment Mean
Discharge	0.91	0.052	3.54
3 Months	0.96	0.060	2.65
6 Months	1.03	0.030	2.11
1 Year	0.98	0.026	1.72

Radiographic assessments of Total Knee Arthroplasty (TKA) in Rheumatoid Arthritis patients were conducted to evaluate implant position and alignment over time. At discharge, the mean implant position was 0.91 (SD: 0.052), indicating near-optimal positioning, with an alignment mean of 3.54, suggesting some initial deviation from ideal alignment. By 3 months, the implant position improved to a mean of 0.96 (SD: 0.060), with alignment also improving to 2.65, reflecting better postoperative adjustment. At 6 months, the position was further optimized with a mean of 1.03 (SD: 0.030), and alignment improved to 2.11, indicating near-normal alignment. By 1 year, the mean implant position stabilized at 0.98 (SD: 0.026) with a further improved alignment mean of 1.72, showing excellent radiographic results. These outcomes demonstrate progressive stabilization and alignment improvements, underscoring the success of TKA in achieving and maintaining optimal implant positioning in RA patients (Table 4).

Table 5: Patient-Reported Outcomes of TKA in RA Patients

Time Point	Satisfaction Mean	Satisfaction SD	Activity Mean	Activity SD
Baseline	3.03	0.57	3.41	0.77
Discharge	4.04	0.51	4.50	0.88
3 Months	4.54	0.30	5.76	0.70
6 Months	4.76	0.15	6.38	0.82
1 Year	4.89	0.06	7.70	0.81

Patient-reported outcomes for Total Knee Arthroplasty (TKA) in Rheumatoid Arthritis patients were measured using satisfaction scores and activity levels. At baseline, the mean satisfaction score was 3.03 (SD: 0.57) on a Likert scale, indicating moderate satisfaction levels prior to surgery, and the mean activity level was 3.41 (SD: 0.77), reflecting low activity participation. Postoperatively, patient satisfaction increased significantly, with a mean score of 4.04 (SD: 0.51) at discharge, 4.54 (SD: 0.30) at 3 months, 4.76 (SD: 0.15) at 6 months, and 4.89 (SD: 0.06) at 1 year, indicating very high satisfaction with the procedure over time. Similarly, activity levels improved markedly, with mean scores rising to 4.50 (SD: 0.88) at discharge, 5.76 (SD: 0.70) at 3 months, 6.38 (SD: 0.82) at 6 months, and 7.70 (SD: 0.81) at 1 year. These results demonstrate that TKA significantly enhances both patient satisfaction and activity levels, contributing to a better quality of life in RA patients (Table 5).

Discussion

This longitudinal study evaluated the clinical, functional, and radiographic outcomes of Total Knee Arthroplasty (TKA) in patients with Rheumatoid Arthritis (RA), with a focus on patient satisfaction and activity levels. The results demonstrate significant improvements in pain, knee function, patient satisfaction, and activity levels over the course of follow-up, reflecting the effectiveness of TKA in this challenging patient population.

The Visual Analog Scale (VAS) scores decreased significantly from a mean of 8.4 at baseline to 1.1 at one year, indicating substantial pain relief postoperatively. Knee Society Scores (KSS) improved from a baseline mean of 51.2 to 83.1 at one year, reflecting marked enhancement in knee function. These findings are consistent with previous studies such as by Choi (2016), which reported significant pain reduction and functional improvement in RA patients undergoing TKA, although the present study shows slightly better long-term functional scores possibly due to advances in perioperative care and rehabilitation protocols [9].

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores improved from a baseline mean of 69.1 to 31.1 at one year, showing significant gains in functional status. SF-36 scores, reflecting overall quality of life, increased from 40.3 at baseline to 81.1 at one year. These outcomes align with studies by da Silva *et al.* (2014), which observed comparable improvements in quality of life post-TKA in RA patients, highlighting the procedure's role in enhancing overall patient well-being [10].

Radiographic assessments showed stable implant positioning and alignment with no significant signs of loosening or complications across the follow-up intervals. The mean alignment scores improved from 5.2 at baseline to 1.7 at one year, while looseness scores reduced significantly, suggesting successful implant integration. These findings are comparable to those reported in a study by Kahn *et al.* (2013), which emphasized the importance of precise surgical technique and postoperative care in achieving optimal radiographic outcomes in TKA [11].

Patient satisfaction scores increased from a mean of 3.0 at baseline to 4.9 at one year, with activity levels also showing substantial improvements from 3.4 to 7.7 over the same period. These enhancements in patient-reported outcomes are crucial, as satisfaction and activity are directly correlated with overall quality of life and patient-perceived success of the surgery. Previous literature, such as the work by Bryan *et al.* (2018) [12], supports the positive impact of TKA on activity levels and satisfaction, though the present study observed slightly higher satisfaction scores, potentially due to advancements in RA management and individualized rehabilitation strategies.

The present study's outcomes are in agreement with earlier studies regarding the effectiveness of TKA in alleviating pain and improving function in RA patients. However, the slightly higher functional scores and patient satisfaction observed in this study could be attributed to improvements in surgical techniques, perioperative care, and personalized rehabilitation protocols tailored to the RA population. Earlier studies [13] have often reported higher complication rates and lower implant survival in RA patients compared to those with osteoarthritis, but the current findings suggest that with meticulous patient selection and modern surgical approaches, RA patients can achieve comparable outcomes.

Conclusion

This study demonstrates that TKA is a highly effective intervention for RA patients, resulting in significant improvements in pain relief, functional outcomes, and quality of life. The enhanced patient satisfaction and activity levels further validate the benefits of TKA, underscoring its role in the comprehensive management of advanced RA. Future studies should continue to explore the long-term

durability of these outcomes and the impact of evolving RA treatments on TKA success. Overall, TKA remains a cornerstone treatment for RA patients with severe knee involvement, offering substantial clinical and functional benefits that significantly enhance patient quality of life.

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