



# Inferior outcomes of primary total knee arthroplasty in patients with rheumatoid arthritis compared to patients with osteoarthritis

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## Abstract

**Purpose** The purpose of this study was to compare the functional outcomes, activity levels, mortalities, implant survival rates, and complications of total knee arthroplasty (TKA) in patients with rheumatoid arthritis (RA) with those in patients with osteoarthritis (OA) over a minimum 10-year follow-up period.

**Methods** Between January 2007 and December 2009, 90 TKAs performed in 57 patients with RA (RA group) were retrospectively reviewed and matched with a control group of 180 TKAs performed in 114 patients with OA. The functional outcomes (Knee Society Score), activity levels (Koval grade), mortalities, implant survival rates, and complications were compared between the two groups with a minimum 10-year follow-up period. The mean follow-up periods were 12.3 years in the RA group and 12.6 years in the OA group.

**Results** The mean Knee Society knee scores in the RA and OA groups improved from  $37.7 \pm 5.4$  to  $38.2 \pm 5.3$  preoperatively to  $72.9 \pm 22.8$  to  $83.1 \pm 11.0$  points, respectively, at the final follow-up ( $p < 0.05$ ). At the final follow-up, 38 of 48 (79.2%) in the RA group and 105 of 109 (96.3%) in the OA group ( $p < 0.05$ ) were outdoor ambulatory patients. The cumulative mortality rates in the RA and OA groups were 15.8% (9/57) and 4.4% (5/114) ( $p < 0.05$ ) at the final follow-up, respectively. Kaplan–Meier survivorship analysis with revision of either component as an endpoint in the RA and OA groups estimated 94.4% and 98.3% chance of survival for 10 years, respectively.

**Conclusion** TKA in patients with RA had worse functional outcomes and higher mortality over a minimum 10-year follow-up period, compared with TKA in patients with OA.

*Level of evidence* IV

**Keywords** Total knee arthroplasty · Rheumatoid arthritis · Osteoarthritis · Outcomes · Mortality

## Introduction

Rheumatoid arthritis (RA) is the most common form of chronic inflammatory joint disease that can destroy cartilage and erode joints, leading to significant pain and functional disability [1]. Its prevalence varies significantly among different populations, ranging from 0.2 to 1.0% [2, 3]. Nearly 28.5 new patients per 100,000 individuals are diagnosed each year in Korea [4].

Current RA medical therapy has markedly improved the function and quality of life in many patients, while they can still face progressive musculoskeletal comorbidity, such as irreversible knee joint destruction. With the increased ages of RA patients, there might be an increase in the number and complications of total knee arthroplasties (TKAs) performed in RA patients.

RA of the knee is different from osteoarthritis (OA) in pathogenesis, prognosis, and medical treatment, resulting in variable expected outcomes after TKA. End-stage knee damage from RA is not a localized problem and is only one component of a systemic disease. These differences affect TKA outcomes [5]. It is reasonable to expect that, as RA progresses, most patients undergoing TKA will experience other joint physical disabilities and complications. Although several studies have reported on TKA results in RA patients, limited data are available on the long-term

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follow-up outcomes of TKA in patients with RA compared to those with OA [6, 7].

Therefore, the aim of this retrospective case–control study was to compare the functional outcomes, activity levels, mortalities, implant survival rates, and complications of TKA in patients with RA with those in patients with OA over a minimum 10-year follow-up period. Our hypothesis was that TKAs in patients with RA would have poorer clinical outcomes and higher risk of mortality and revision surgery compared to those in patients with OA.

## Materials and methods

The design and protocol of this retrospective study were approved by the Institutional Review Board of our hospital, which waived the requirement for informed consent. Between January 2007 and December 2009, a consecutive series of 98 primary TKAs was performed for 63 patients with confirmed diagnoses of RA at our hospital. Of these 63 patients, 6 (8 knees) were excluded from the study due to follow-up loss. The final cohort consisted of 51 females (79 knees) and 6 males (11 knees) (RA group). A total of 33 patients (57.9%) underwent staged bilateral procedures every week. The RA group was matched with a control group at a one-to-two ratio using the propensity score method. The control group was created according to the following matching criteria: sex, age, body mass index, and diagnosis of OA. One-hundred fourteen sex-, age-, body mass index-, and diagnosis-matched patients with OA who had undergone primary TKA between January 2008 and December 2008 (3172 TKAs) at our hospital were used as the control group. In total, 180 TKAs were included in 114 patients (12 men and 102 women) (OA group). Demographic data of sex, age,

initial diagnosis, body mass index, pre-operative status as Koval category (activity levels) [8], and pre-operative Knee Society Score (clinical evaluations) [9] were obtained by reviewing medical records (Table 1). The mean follow-up periods were  $12.3 \pm 1.1$  years (range, 10.3–13.9 years) in the RA group and  $12.6 \pm 0.3$  years (range, 12.0–12.9 years) in the OA group.

All surgical procedures were performed by three senior surgeons using the standard medial parapatellar approach, with sacrifice of the anterior and posterior cruciate ligaments in all patients. All patients were treated using the posterior-stabilized Scorpio nonrestrictive geometry (NRG) total knee prosthesis (Stryker Orthopaedics, Mahwah, NJ, USA). All implants were inserted with cement. Patients were mobilized with immediate weight-bearing as tolerated, and active exercise was initiated under supervision of a physiotherapist. Patients underwent clinical and radiographic follow-up at post-operation 2 and 6 weeks; 3, 6, 9, and 12 months; and annually thereafter. During follow-up evaluations, patients who did not return for scheduled visits were contacted by telephone. Two nurses and one private doctor found and visited non-responders.

Clinical results of Knee Society Score were classified as excellent (80–100), good (70–79), fair (60–69), or poor (<60). Changes in patient activity and mortality within a minimum of 10 years were compared between the two groups. Activity levels were defined as follows: I, independent community ambulatory; II, community ambulatory with cane; III, community ambulatory with walker/crutches; IV, independent household ambulatory; V, household ambulatory with cane; VI, household ambulatory with walker/crutches, and VII, nonfunctional ambulatory [8]. In the analysis, Koval grades I, II, and III cases were classified as outdoor ambulatory patients who can walk outside, whereas

**Table 1** Demographics of patients

	RA group	OA group	<i>p</i> value
Number of patients	57	114	
Sex (female)	51/57 (89.5%)	102/114 (89.5%)	
Age (years) (mean $\pm$ SD)	60.2 $\pm$ 10.0 (38–80)	60.3 $\pm$ 6.0 (46–81)	n.s
Body mass index	24.6 $\pm$ 3.4 (17.4–33.3)	24.6 $\pm$ 2.0 (18.3–29.4)	n.s
Diagnosis			
Rheumatoid arthritis	57 (100%)	0	
Osteoarthritis	0	114 (100%)	
Koval grade of pre-operative status			
I	50 (87.7%)	102 (89.5%)	
II	7 (12.3%)	12 (10.5%)	
III–VI	0	0	
Pre-operative			
Knee Society knee score	37.7 $\pm$ 5.4 (21–60)	38.2 $\pm$ 5.3 (19–55)	
Function score	36.4 $\pm$ 4.6 (29–55)	37.1 $\pm$ 7.2 (20–60)	

RA rheumatoid arthritis, OA osteoarthritis, SD standard deviation, n.s. not significant

Koval grades IV, V, VI, and VII cases were classified as shut-in patients who walk only at home. Radiographic analysis included long-leg standing radiography from the pelvis to the ankle joint for evaluating the axis, weight-bearing anteroposterior view, non-weight bearing anteroposterior view, lateral view at 30° flexion, and skyline view of the patella. Each radiograph was assessed for any radiolucent lines using the Knee Society Roentgenographic Evaluation and Scoring System [10]. Analyses of mortality status and implant survival were conducted using hospital records and/or via interviews with family members. Patients unable to attend follow-up evaluations were interviewed by telephone. During the follow-up evaluations, the same caregiver previously interviewed during the patient's hospitalization was questioned.

### Statistical analysis

To balance the differences in the basic clinical characteristics between the RA and OA groups, the propensity score matching method was used. Propensity scores were calculated for age, sex, body mass index, and diagnosis. RA and OA groups were matched 1:2 based on propensity scores, for which the matching tolerance was 0.01% (Table 2). Cumulative crude mortality rate was calculated at 3, 6, and 10 years and compared between the two groups. Kaplan–Meier survival analysis was performed for both groups for a minimum 10-year follow-up period, using mortality as the primary end point. Additionally, Kaplan–Meier survival analysis was performed for all knees for a minimum 10-year follow-up period with revision of either component as an endpoint. The correlation of survival rates in the groups was tested using the log-rank test. Student's t-test was used to analyze age and body mass index, and the Mann–Whitney test was used to analyze Koval grade. The chi square test was used to analyze sex, Knee Society knee and function scores, and

cumulative mortality. The analyses were carried out using IBM SPSS Statistics software version 18.0 (IBM, Armonk, New York, USA). All reported *p* values were two-sided, and  $p < 0.05$  was considered statistically significant.

### Results

The mean Knee Society knee scores in the RA and OA groups improved from 37.7 and 38.2 points preoperatively to 72.9 and 83.1 points at the final follow-up, respectively ( $p < 0.05$ ). Mean preoperative function scores in the RA and OA groups improved from 36.4 and 37.1 points to 70.3 and 88.6 points at the final follow-up, respectively ( $p < 0.05$ ). Better outcomes were observed in the OA group, with significant differences for the Knee Society knee score ( $p < 0.05$ ) and function score ( $p < 0.05$ ) (Table 3).

Among 48 surviving patients in the RA group at a minimum follow-up period of 10 years, 38 (79.2%) were outdoor ambulatory, and 10 (20.8%) were shut-in patients (Table 3). However, among 109 surviving patients in the OA group, 105 (96.3%) were outdoor ambulatory, and four (3.7%) were shut-in patients (Table 3). The cumulative mortality rates in the RA and OA groups were 15.8% (9/57) and 4.4% (5/114) at the final follow-up, respectively ( $p < 0.05$ ) (Fig. 1 and Table 3).

A non-progressive radiolucent line (radiographic demarcation  $\geq 2$  mm) was observed in one femoral component and two tibial components in the RA group (3.3%) and one femoral and four tibial components in the OA group (2.8%) during serial follow-up. All femoral and tibial components in both groups were well fixed without loosening, and no obvious tibial insert polyethylene wear was observed at the final follow-up.

Regarding postoperative complications, periprosthetic joint infections in the RA and OA groups were observed

**Table 2** Demographics and clinical characteristics of the RA and OA groups before and after propensity score matching

	Before PSM			After PSM		
	RA group	Law group	<i>p</i> value	RA group	OA group	<i>p</i> value
Number of patients	57	2023		57	114	
Age, years (range)	60.2 (38–80)	67.2 (46–84)	<0.05	60.2 (38–80)	60.3 (46–81)	n.s
Sex						
Male	6 (10.5%)	162 (8.0%)	n.s	6 (10.5%)	12 (10.5%)	n.s
Female	51 (89.5%)	1861 (92.0%)		51 (89.5%)	102 (89.5%)	
Body mass index (mean $\pm$ SD)	24.6 $\pm$ 3.4	26.7 $\pm$ 3.5	<0.05	24.6 $\pm$ 3.4	24.6 $\pm$ 2.0	n.s
Diagnosis						
RA	57 (100%)	17 (0.8%)	<0.05	57 (100%)	0	
OA	0	2002 (99.0%)		0	114 (100%)	
Osteonecrosis	0	4 (0.2%)		0	0	

PSM propensity score matching, SD standard deviation, RA rheumatoid arthritis, OA osteoarthritis, n.s. not significant

**Table 3** Comparison of mortality, Koval grade, and Knee Society Score between the RA and OA groups

	RA group	OA group	<i>p</i> value
3 years	0/57 (0%)	0/114 (0%)	
6 years	3/57 (5.3%)	0/114 (0%)	
10 years	9/57 (15.8%)	5/114 (4.4%)	
Mortality at final f/u	9/57 (15.8%)	5/114 (4.4%)	<0.05
Koval grade at final f/u			<0.05
I–III	38 (79.2%)	105 (96.3%)	
IV–VII	10 (20.8%)	4 (3.7%)	
Post-operative			
Knee Society knee score	72.9 ± 22.8	83.1 ± 11.0	<0.05
Excellent or good	34 pts (70.8%)	102 pts (93.6%)	
Fair	4 pts (8.4%)	3 pts (2.8%)	
Poor	10 pts (20.8%)	4 pts (3.6%)	
Function score	70.3 ± 26.1	88.6 ± 16.1	<0.05
Excellent or good	34 pts (70.8%)	102 pts (93.6%)	
Fair	4 pts (8.4%)	2 pts (1.8%)	
Poor	10 pts (20.8%)	5 pts (4.6%)	

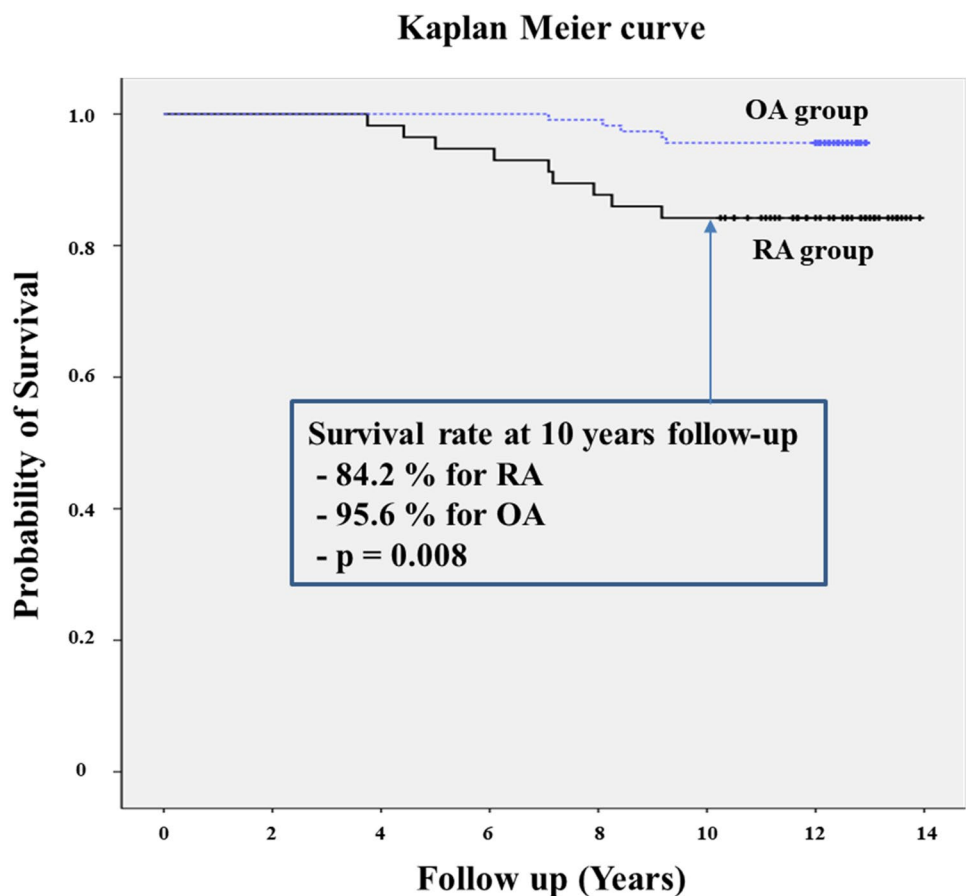
RA rheumatoid arthritis, OA osteoarthritis, f/u follow up, pts patients

in four (7.0%) and two patients (1.8%), respectively. All patients were treated by two-stage revision arthroplasty. Aseptic loosening was observed in one patient from each group (1.8%, 0.9%). All cases of aseptic loosening primarily involved the tibial component, and only the tibial component was replaced. No revision surgery was needed for any other reason, such as component malalignment, liner wear, instability, or stiffness. Periprosthetic fracture of the femoral shaft was observed in three patients (5.3%) in the RA group and one patient (0.9%) in the OA group. Kaplan–Meier survivorship analysis with revision of either component as an endpoint in the RA and OA groups estimated 94.4% (95% confidence interval, 91.8% to 98.0%) and 98.3% (95% confidence interval, 97.3% to 99.3%) chances of survival for 10 years, respectively (Fig. 2).

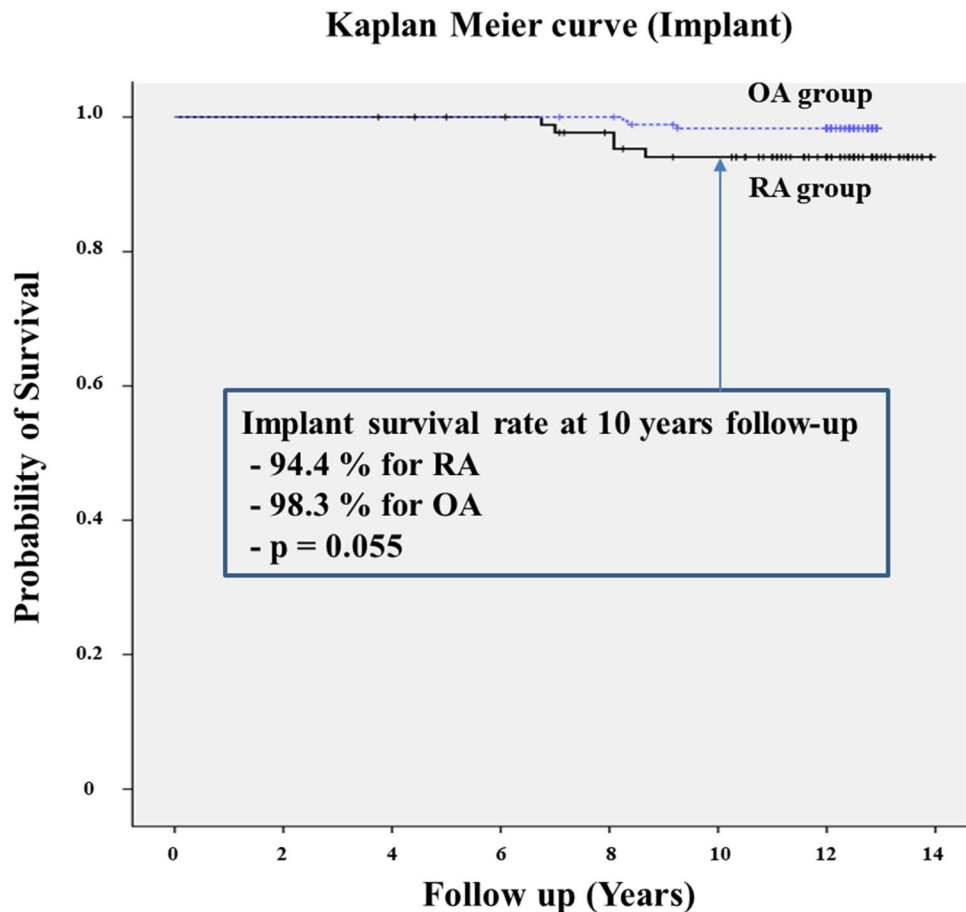
### Discussion

The most important finding of this study was that TKAs in patients with RA showed worse functional outcomes and higher rates of mortality and revision owing to periprosthetic infections at a minimum of 10 years of follow-up.

**Fig. 1** Kaplan–Meier survival analysis of mortality comparing the rheumatoid arthritis (RA) group (black) and the osteoarthritis (OA) group (blue)



**Fig. 2** Kaplan–Meier survival analysis of implant comparing the rheumatoid arthritis (RA) group (black) and the osteoarthritis (OA) group (blue)



A significant difference was observed between the two groups for the postoperative Knee Society knee score (10.2 points,  $p < 0.05$ ) and function score (18.3 points,  $p < 0.05$ ), with better results for the OA group. To draw clinically meaningful interpretation of the change in measures, the minimal clinically important difference (MCID) needs to be applied [11]. The MCID is between 6.1 and 6.4 for the Knee Society knee score and between 5.3 and 5.9 for function score [12]. Therefore, it was concluded that the postoperative clinical outcomes are different between the two groups.

Although several studies have reported good clinical outcomes after TKA in patients with RA [13–15], they provided no comparison with other control groups. Kirwan et al. [16] reported greater improvement in pain and function after TKA and total hip arthroplasty in OA patients compared to RA patients at a mean follow-up of 2.5 years. Another study reported that patients with RA had poor functional outcomes compared to those with OA at the 2- and 5-year follow-ups [17]. In this study, over a minimum 10-year follow-up period, functional outcomes might be worsened because of the progression of RA with physical disabilities. Therefore, it is assumed that inferior outcomes of TKA in patients with RA might be related to progression of the disease and the related complications in long-term follow-up.

The present study showed that the revision rate due to infectious cause was higher in RA than in OA patients, but there were no significant differences between the two groups in revision rates due to noninfectious causes such as aseptic loosening. Previous studies have demonstrated that patients with RA are at significantly higher risk of infection following TKA compared with patients undergoing TKA for OA [18, 19]. The increased risk of infection in RA patients can be attributed to the systemic effects of the disease itself and the frequent need for immunosuppressant treatment for RA [20]. The current study revealed a comparative increase in the risk of revision for periprosthetic infection.

In this study, the 15.8% mortality rate after TKA in patients with RA was higher than the 4.4% of patients with OA at a minimum follow-up period of 10 years. The higher mortality rate observed in the RA group compared to the OA group is consistent with the study reported by Mooney et al. [6]. Ohzawa et al. [7] performed a retrospective study using mortality following primary TKA in 134 patients and reported that 57.2% of the patients with RA and 95.5% of the patients with OA were surviving at 9-year follow-up. Patients suffering from RA were shown to have higher rates of pulmonary disease, cardiac morbidity, and higher mortality after surgery [21, 22]. Although direct comparison of

mortality between studies is difficult owing to differences in demographic data such as age, sex, medical comorbidity, and ethnic difference, mortality after TKA in patients with RA is higher than that in patients with OA [6, 7, 23].

Interestingly, there were more periprosthetic fractures in the RA group than in the OA group, and all occurred more than 5 years after the index arthroplasty (mean, 6.9 years). The prevalence of osteoporosis in RA patients usually ranges from 15 to 59% [24, 25], and RA is often accompanied by severe osteoporosis. It is presumed that bone loss due to medical treatment and physical impairment in RA patients can result in osteoporosis and related fractures [26]. Surgeons should be aware that patients with RA are likely to be at risk of periprosthetic fracture.

This study has several limitations. First, it was retrospectively designed, and RA disease activity and the status of modern systematic treatments were not routinely documented. Therefore, RA severity could not be correlated with clinical outcomes following TKA even if the modern treatments are associated with better outcomes in the patients. Second, because few patients with confirmed RA underwent TKA at a single center, the results might not be generalizable. Third, in the implant revision rates, there were no significant differences between the two groups in noninfectious causes, such as aseptic loosening. This could be due to the relatively low numbers of revisions in this small sample size study. Lastly, this study was not a single-surgeon series; however, all surgeons were high-volume knee surgeons and used the same surgical technique and consistent perioperative protocols. The strength of this study is that it is the first study with a follow-up of more than 10 years comparing the outcomes between RA and OA in patients receiving a TKA. In our study, patients with RA were found to have lower Knee Society Scores and higher mortality and revision rates after TKA compared to a control group of TKA performed in patients with OA only.

## Conclusion

In conclusion, TKA in patients with RA showed worse functional outcomes and higher mortality at a minimum follow-up period of 10 years compared to that in patients with OA. Therefore, the surgeon should accurately explain to RA patients planning to undergo TKA that, compared to OA patients, they are more likely to experience poor outcomes post-surgery.

## Declarations

**Conflict of interest** Each author certifies that he or she has no commercial association (e.g. consultancies, stock ownership, equity inter-

est, patent, licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

**Ethical approval** This study was approved by the Institutional Review Board (IRB) of Himchan hospital, Seoul, Republic of Korea.

**Informed consent** All patients provided written informed consent to use their medical records in advance.

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