



# Functional And Clinical Results Of Posterior Cruciate Ligament–Retaining Total Knee Arthroplasty In Patients With Rheumatoid Arthritis: A 3- To 5-Year Follow-Up Study

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## ARTICLE INFO

## ABSTRACT

**Aim:** Total knee arthroplasty (TKA) is frequently carried out to alleviate pain and enhance mobility in individuals suffering from rheumatoid arthritis (RA). Nonetheless, the utilization of posterior cruciate ligament–retaining (CR-type) TKA is subject to debate, particularly among RA patients. This study endeavors to scrutinize the clinical outcomes of CR-type TKA and assess its effectiveness in managing RA patients.

**Methods:** In our hospital, 77 CR-type TKA procedures were performed in 59 patients with RA between January 2018 and dec 2019. In total, we assessed 45 CR-type TKA procedures in 30 patients with RA who underwent follow-up for at least 4 years. The assessment was based on the Knee Society clinical score (KSS) and an independent radiographic analysis

**Results:** During a mean follow-up period of 4 years, 2 patients developed late infection and 2 other patients experienced supracondylar fracture after each TKA procedure. After surgery, the KSS improved significantly among the patients and 87% of the patients did not experience any pain. Moreover, the mean postoperative maximum flexion angle was 114.8°, whereas the maximum extension angle was -4.2°.

**Conclusion:** Despite the necessity for further long-term follow-up investigations, our findings from the medium-term follow-up study suggest that CR-type TKA posed no significant issues, even in patients diagnosed

**Keywords:** Clinical results; Posterior cruciate ligament–retaining type; Rheumatoid arthritis; Total knee arthroplasty

## Introduction

Patients with rheumatoid arthritis (RA) often suffer from chronic proliferative synovitis in their affected joints, leading to the degeneration of articular cartilage and bone, ultimately causing joint disability. Although total knee arthroplasty (TKA) has shown favorable clinical outcomes in RA patients using various prosthetic options, there remains a lack of consensus regarding the optimal management of the posterior cruciate ligament (PCL). This uncertainty arises from reports by Laskin and O'Flynn, suggesting that posterior cruciate ligament-retaining (CR-type) TKA may lead to postoperative posterior instability exceeding 10 mm [1].

In this study, we conducted a clinical evaluation of a consecutive series of RA patients who underwent CR-type TKA performed by a single surgeon between January 2001 and 2008. Our objective was to investigate the clinical outcomes of CR-type TKA and assess the effectiveness of this prosthetic approach in RA patients.

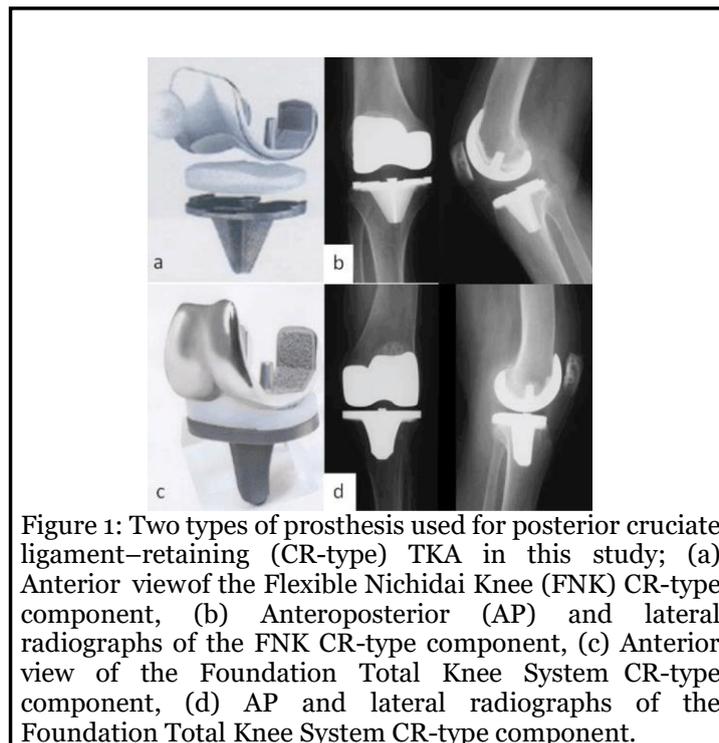
## Methods

A total of 77 primary posterior cruciate ligament-retaining (CR-type) total knee arthroplasties (TKAs) were conducted on 59 rheumatoid arthritis (RA) patients by a single surgeon at our hospital between January 2018 and 2019. For this study, we focused on evaluating 45 TKAs performed on 30 RA patients who underwent follow-up clinical assessments for more than 4 years (see Table 1). The average follow-up period was 8 years, ranging from 3 to 5 years. The study cohort consisted of 25 female and 5 male patients, with an average age of 66.1 years at the time of surgery, ranging from 47 to 79 years. All patients met the 1987 diagnostic criteria of the American College of Rheumatology for RA. Additionally, all patients were on oral therapy for RA at the time of surgery, and none had received biologic therapy prior to the operation.

Operatively, a tourniquet was utilized in all cases. An anterior midline or lateral parapatellar skin incision was made, and access to the knee joint was gained through either a midvastus or medial parapatellar approach. Preservation of the posterior cruciate ligament (PCL) was maintained in all surgeries. Resection of synovial tissue attached to the suprapatellar pouch, bilateral gutters, posterior capsule, and surrounding the cruciate ligaments was performed as thoroughly as possible. The femur and tibia were cut using an intramedullary rod and extramedullary rod, respectively. Two types of prostheses were randomly used: the Foundation Total Knee System (Encore, CA, USA) and the Flexible Nichidai Knee (FNK; Nakashima Medical, Okayama, Japan). The former features a wing-keel design for its tibial stem, while the latter has a cross-shaped design. Cancellous bone chips were employed to fill any bony defects. Patellae were fixed with all-polyethylene components and cement. Tibial and femoral components were fixed with cement only in cases of severe osteoporosis. Postoperative antibiotic therapy (cefmetazole sodium, 1 g) was administered twice daily for 3 days. All Patients underwent thromboprophylaxis management using a foot pump instead of chemical methods. Range of motion exercises and full weight-bearing transfers to a wheelchair began on the second day after surgery. Subsequently, patients gradually started routine physiotherapy with weight-bearing activities as tolerated. Discharge occurred when patients could walk with a T-cane and tolerate stair climbing, or they were transferred to another hospital for further rehabilitation

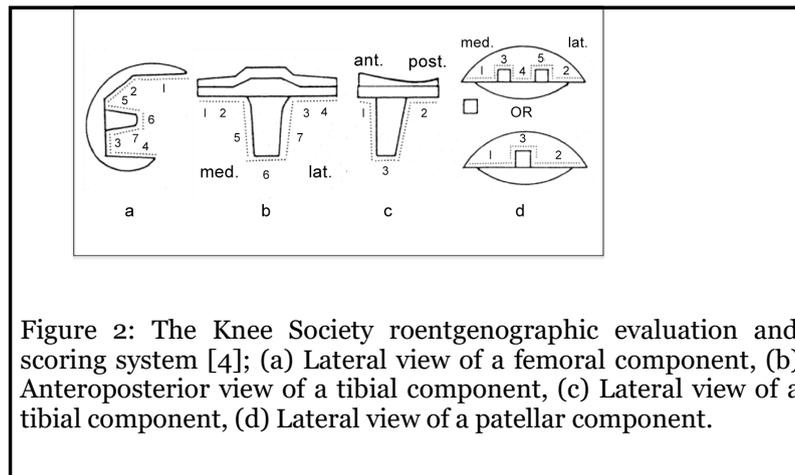
Knees (Patients)	45 knees (30 patients)
Mean age (years)	66.1 (47 to 79)
Male/female (%)	16.7 / 83.3
Duration of follow-up (years)	8.2 (5 to 13)
Cement/cementless (knees)	39 / 6
FNK/ The Foundation Total Knee System (knees)	17 / 28

**Table 1: Clinical data of 30 patients with RA.**



**Figure 1: Two types of prosthesis used for posterior cruciate ligament-retaining (CR-type) TKA in this study; (a) Anterior view of the Flexible Nichidai Knee (FNK) CR-type component, (b) Anteroposterior (AP) and lateral radiographs of the FNK CR-type component, (c) Anterior view of the Foundation Total Knee System CR-type component, (d) AP and lateral radiographs of the Foundation Total Knee System CR-type component.**

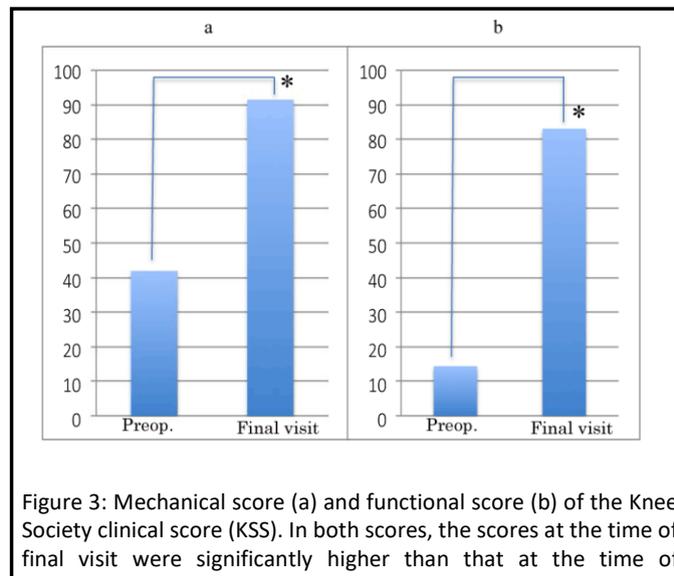
Evaluation: Clinical evaluations were conducted using the Knee Society clinical score (KSS), which assesses both the mechanical and functional aspects of the knee joint [3]. Preoperative and postoperative assessments were performed by an orthopedic surgeon other than the operating surgeon at 1, 3, and 6 months, followed by yearly intervals. Weight-bearing anteroposterior (AP), lateral, and skyline radiographs were obtained at each follow-up visit as per the standard protocol described previously [4]. The postoperative femorotibial angle (FTA) of the knee joint was measured on weight-bearing AP radiographs. Radiolucencies were assessed based on the zone described by the Knee Society [4]. AP and mediolateral instability were also evaluated at each visit. Standard AP and lateral radiographs at the final follow-up visit were examined for the presence of loosening, radiolucent lines, and subsidence following the Knee Society TKA roentgenographic evaluation and scoring system [4]. The occurrence of complications, including infection and fracture, was also monitored and recorded.



Statistical analysis: Statistical analysis was performed using the Student's *t* test for the comparison of preoperative and postoperative clinical scores. A *p*-value of  $<0.05$  was considered statistically significant

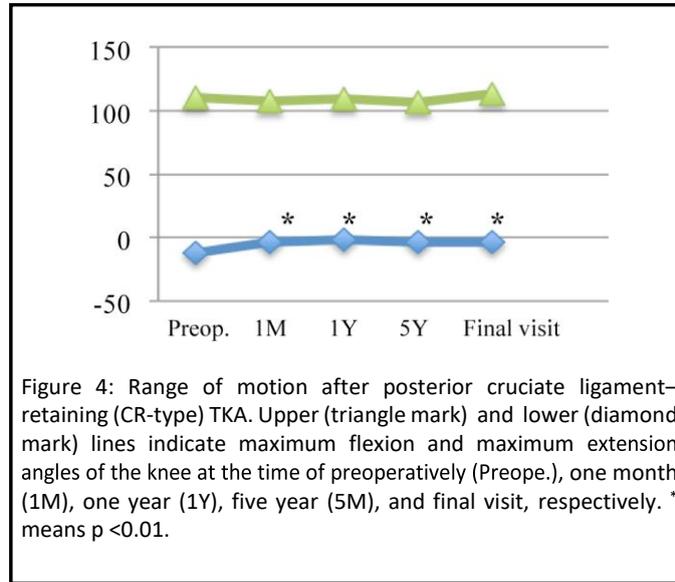
## Results

### Clinical results



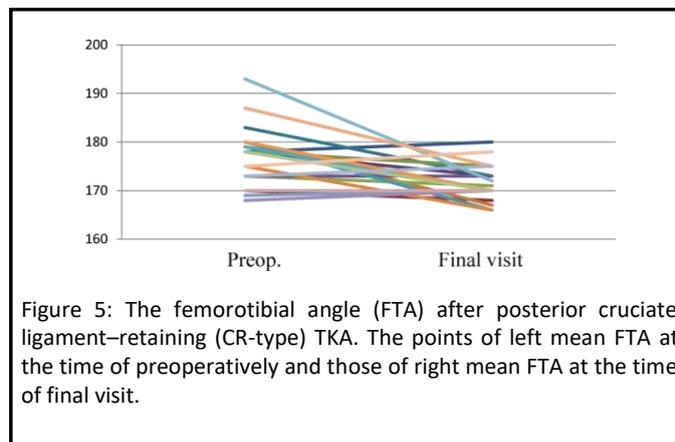
The average Knee Society knee rating score significantly improved from 41.9 (range: 12–69) preoperatively to 91.3 (range: 73–100) at the final follow-up evaluation ( $p < 0.01$ ). Similarly, the average Knee Society function score showed improvement, increasing from 14.4 (range: 0–40) preoperatively to 83.1 (range: 60–100) at the final follow-up evaluation ( $p < 0.01$ ) (see Figure 3). During the postoperative period, 39 knees (87%) were reported as pain-free, while 6 knees (13%) experienced mild or occasional pain. The mean preoperative maximum flexion angle was  $110.3^\circ$  (range:  $70^\circ$ – $150^\circ$ ), which increased to  $114.8^\circ$  (range:  $80^\circ$ – $125^\circ$ ) at the final follow-up.

The mean preoperative maximum extension angle was  $-13.4^\circ$  (range:  $-40^\circ$  to  $0^\circ$ ), which significantly improved to  $-4.2^\circ$  (range:  $-60^\circ$  to  $0^\circ$ ) at the final follow-up evaluation ( $p < 0.01$ ) (see Figure 4). It's noteworthy that good valgus-varus stability was consistently maintained manually in all patients throughout the follow-up period.



### Radiographic results

The mean preoperative FTA was  $177.5^\circ$  (range,  $168^\circ$ – $193^\circ$ ), whereas that at the final follow-up was  $171.8^\circ$  (range,  $166^\circ$ – $180^\circ$ ) (Figure 5). All the patients in the study were assessed for radiolucency at the bone-implant interface. Radiolucencies were identified in 18 knees (15 patients); 18 lesions were observed at the femoral component (zone 1, 9 knees; zone 2, 2 knees; and zone 4, 7 knees) and 25 lesions were observed at the tibial component (AP view: zone 1, 11 knees; zone 2, 6 knees; zone 3, 4 knees; and zone 4, 4 knees; lateral view: zone 1, 3 knees). All lesions were less than 1 mm in length and were nonprogressive. No radiolucent line was noted in the patellar component, and no evidence of radiographic loosening was observed at any follow-up visit. Moreover, no failures as a result of subsidence, tibial component loosening, or polyethylene wear were noted.



### Laboratory data

The serum levels of C-reactive protein (CRP), rheumatoid factor (RF) and matrix metalloproteinase-3 (MMP-3) improved from 3.71 mg/dl, 175.60 mg/dl and 616.00 ng/ml preoperatively to 2.15, 106.40 and 293.97 at 1 year after surgery and to 1.18 ( $p < 0.05$ ), 70.56 and 157.17 at the final follow-up, respectively.

### Complications

Among the knees examined, complications occurred in 4 knees (8.9%), including late deep infection in 2 knees and supracondylar fracture above the TKA in 2 knees. The 2 cases of infection required irrigation surgery, but none of the case required revision surgery. In addition, no cases of nerve palsy, pulmonary embolism, deep vein thrombosis, or patellar fracture were observed.

### Discussion

Total knee arthroplasty (TKA) stands as a dependable treatment option for alleviating pain and enhancing function in patients afflicted with rheumatoid arthritis (RA). Nonetheless, the optimal approach regarding the retention or excision of the posterior cruciate ligament (PCL) remains ambiguous, given the limited data available. Since the seminal work by Laskin and O'Flynn [1], wherein they presented outcomes from a series of 98 knees in RA patients managed with CR-type TKA, this method has been regarded as a relative contraindication in RA cases. Their findings indicated that 50% of knees developed postoperative posterior instability exceeding 10 mm. Consequently, many surgeons now favor the adoption of PS-type TKA for RA patients. PS-type TKA offers the advantage of simpler operative techniques and yields superior range of motion compared to CR-type TKA in RA patients.

Moreover, studies on PS-type TKA by Shai et al. [5] and Rodriguez et al. [6] have reported excellent prosthesis survival rates, with 97% at 13 years and 91% at 15 years, respectively

Recent studies comparing cruciate-retaining (CR) with cruciate-substituting designs have shown similar outcomes regarding range of motion, aseptic loosening, proprioception, gait patterns, polyethylene wear, and stability [7,8]. Moreover, several recent investigations have demonstrated favorable medium-term outcomes following CR-type TKA in RA patients [9-11]. Additionally, Conditt et al. [12] highlighted that substituting the posterior cruciate ligament (PCL) with a spine and cam mechanism may not fully restore its functional capacity, especially in activities involving deep flexion, squatting, and kneeling, such as gardening.

In our current study on CR-type TKA, both the mechanical and functional Knee Society Scores (KSS) significantly improved postoperatively (see Figure 3). Although complications arose in 10% of knees, none necessitated revision surgery. At least during the follow-up period, no issues were encountered postoperatively. Based on our findings, we believe that CR-type TKA could be the primary choice for RA patients, with some exceptions. However, we suggest opting for PS-type TKA in cases where the PCL is not robust, or in patients with mutilating-type RA, severe deformity, severe knee stiffness, or significant knee instability.

The disease stage of rheumatoid arthritis (RA) at the time of total knee arthroplasty (TKA) may dictate whether the posterior cruciate ligament (PCL) should be retained or sacrificed. Posterior instability typically arises in advanced rheumatoid disease; however, recent advancements in RA management, particularly through combination therapy with disease-modifying antirheumatic drugs and/or biologic agents, have significantly improved disease control. Moreover, reports from Western countries and Japan indicate that the rates of total joint replacement, including hip and knee replacements, and other RA-related surgeries have either remained constant or decreased due to the availability of new medications, such as biologic agents [13]. In our study, none of the patients were receiving biologic agents for RA control at the time of TKA, although 9 patients (20%) were using them at the final follow-up visit. Notably, both the clinical scores, including assessments of posterior instability, and laboratory data remained unchanged or had improved. These findings suggest that advancements in systemic disease control may impact postoperative outcomes.

In our study, we did not encounter any issues related to the retention of the PCL. However, surgeons should cautiously anticipate the potential development of such complications in future cases. Therefore, appropriate patient selection based on the RA status, prosthesis type, and operative technique may lead to favorable clinical outcomes, even when utilizing CR-type TK

#### Conclusion

In conclusion, while our study did not directly compare the outcomes of CR-type TKA with PS-type TKA, our findings suggest that CR-type TKA yielded satisfactory results without encountering significant issues in RA patients during the follow-up period. Nonetheless, further investigation through additional long-term follow-up studies is warranted to provide a more comprehensive understanding of the outcomes associated with CR-type TKA in this patient population.

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