

## Clinical Results of Posterior Cruciate Ligament–Retaining Total Knee Arthroplasty in Patients with Rheumatoid Arthritis: A 5- to 13-Year Follow-up Study

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### Abstract

**Aim:** Total knee arthroplasty (TKA) is commonly performed to relieve pain and improve function in patients with rheumatoid arthritis (RA). However, treatment with posterior cruciate ligament–retaining (CR-type) TKA is thought to be controversial, particularly in patients with RA. In the present study, we aimed to investigate the clinical results of CR-type TKA and evaluate the efficacy of this type of prosthesis in patients with RA.

**Methods:** In our hospital, 77 CR-type TKA procedures were performed in 59 patients with RA between January 2001 and 2008. In total, we assessed 45 CR-type TKA procedures in 30 patients with RA who underwent follow-up for at least 5 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 8 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:** Although additional long-term follow-up studies are required, the results of our medium-term follow-up study indicate that CR-type TKA was not problematic, even in patients with RA.

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

### Introduction

The affected joints in patients with rheumatoid arthritis (RA) are known to exhibit chronic proliferative synovitis, which is implicated in the destruction of articular cartilage and bone, resulting in joint disability. Good clinical results of total knee arthroplasty (TKA) involving the use of several types of prosthesis have been reported in patients with RA. However, no consensus has been established on whether the posterior cruciate ligament (PCL) should be replaced or retained, since Laskin and O'Flynn reported that posterior cruciate ligament–retaining (CR-type) TKA might result in postoperative posterior instability of >10 mm [1].

In the present study, we clinically evaluated a consecutive series of patients with RA who underwent CR-type TKA by a single surgeon between January 2001 and 2008. Thus, we aimed to investigate the clinical results of CR-type TKA and evaluate the efficacy of this type of prosthesis in patients with RA.

### Methods

**Patients:** A total of 77 primary CR-type TKAs were performed in 59 patients with RA by a single surgeon in our hospital between January 2001 and 2008. In the present study, we assessed 45 TKAs that were

performed in 30 patients with RA who underwent follow-up clinical evaluations for >5 years (Table 1). The mean follow-up period was 8 years (range, 5–13 years). The study population comprised 25 women and 5 men with a mean age of 66.1 years (range, 47–79 years) at the time of surgery. All patients fulfilled the 1987 diagnostic criteria of the American College of Rheumatology [2]. Moreover, all patients were receiving oral therapy for RA at the time of surgery and none had received biologic therapy prior to surgery.

**Operative procedure:** All operative procedures involved the use of a tourniquet. An anterior midline or lateral parapatellar skin incision was made, and the knee joint was opened through a midvastus or medial parapatellar approach. The PCL was preserved in all cases.

The synovium attached to the suprapatellar pouch, bilateral gutters, and posterior capsule as well as that surrounding the cruciate ligaments was resected as much as possible. The femur and tibia were cut using an intramedullary rod and extramedullary rod, respectively. Two types of prosthesis—the Foundation Total Knee System (Encore, CA, USA) and the Flexible Nichidai Knee (FNK; Nakashima Medical, Okayama, Japan)—were used randomly (Figure 1). The tibial stem of the former has a wing-keel design, whereas that of the latter has a cross-shaped design. Cancellous bone chips were used to fill bony defects. The 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 were managed with a foot pump rather than by chemical thromboprophylaxis. Range of motion exercise and full weight-bearing transfer to a wheelchair were initiated on the second postoperative day, and patients gradually initiated routine physiotherapy with weight bearing, as tolerated. Patients were discharged when they could walk with a T-cane and tolerate stair climbing or were transferred to another hospital for 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.

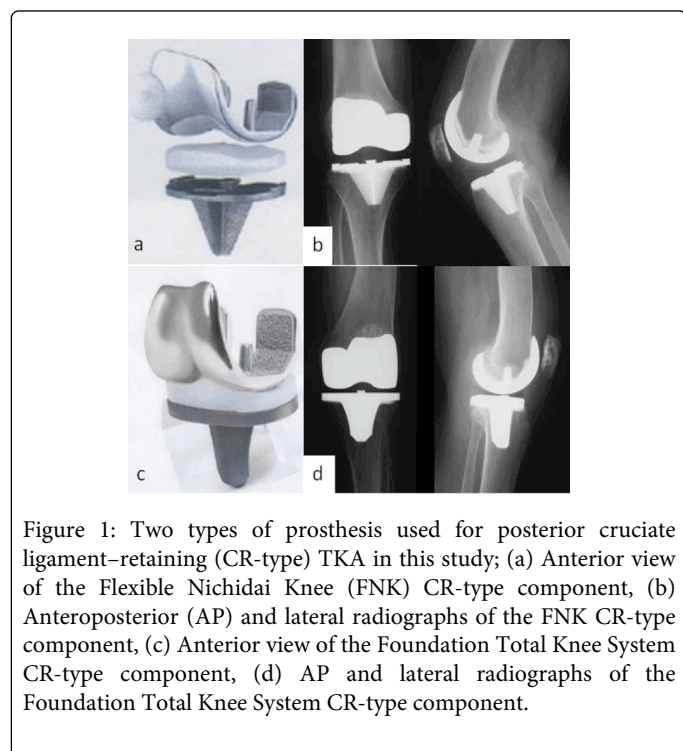


Figure 1: Two types of prosthesis used for posterior cruciate ligament-retaining (CR-type) TKA in this study; (a) Anterior view of the Flexible Nichidai Knee (FNK) CR-type component, (b) Anteroposterior (AP) and lateral radiographs of the FNK CR-type component, (c) Anterior view of the Foundation Total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

**Evaluation:** Clinical evaluations were performed using the Knee Society clinical score (KSS) [3], which separately assesses the mechanical and functional aspects of the knee joint. All patients were evaluated preoperatively and postoperatively by an orthopedic surgeon—other than the surgeon who performed the operation—at 1, 3, and 6 months, and then at yearly intervals. Weight-bearing anteroposterior (AP), lateral, and skyline radiographs were obtained at each follow-up visit according to standard protocol described previously [4]. The postoperative femorotibial angle (FTA) of the knee joint was measured on weight-bearing AP radiographs. Radiolucencies were evaluated according to the zone described by the Knee Society (Figure 2) [4]. AP and mediolateral instability were also evaluated at each visit. Standard AP and lateral radiographs at the final follow-up visit were evaluated for the presence of loosening, a radiolucent line, and subsidence

according to the Knee Society TKA roentgenographic evaluation and scoring system [4]. The occurrence of complications, including infection and fracture, were also assessed.

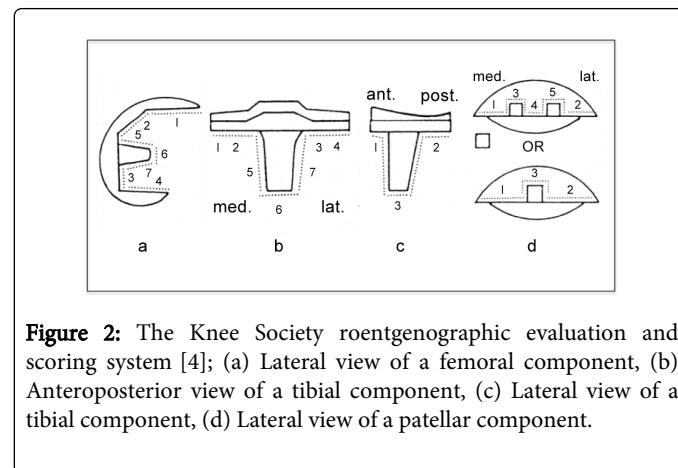


Figure 2: The Knee Society roentgenographic evaluation and scoring system [4]; (a) Lateral view of a femoral component, (b) Anteroposterior view of a tibial component, (c) Lateral view of a tibial component, (d) Lateral view of a patellar component.

**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

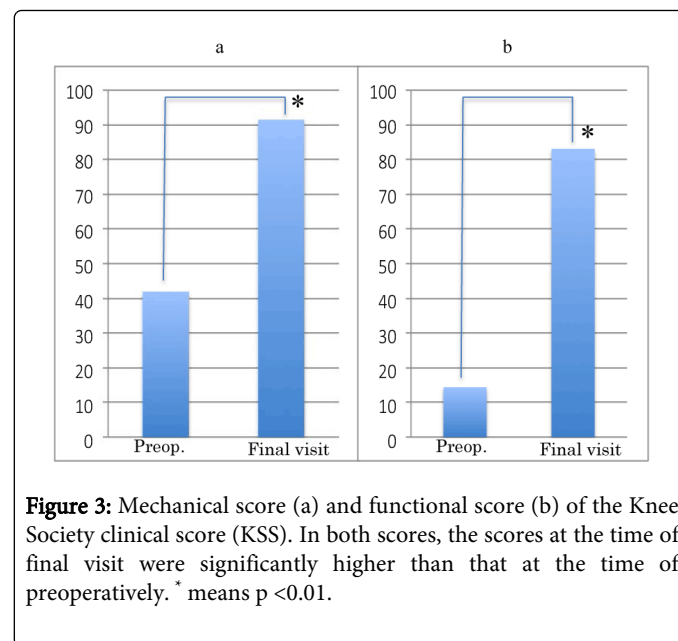
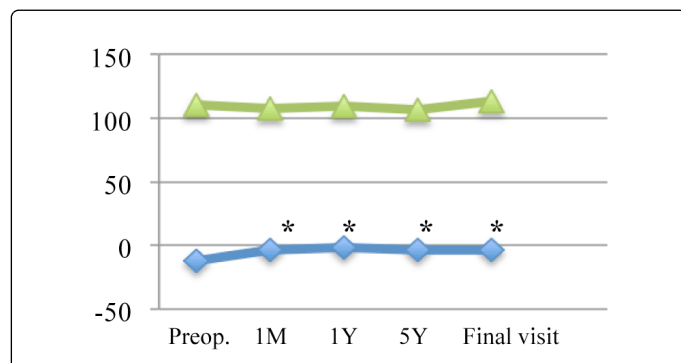


Figure 3: Mechanical score (a) and functional score (b) of the Knee Society clinical score (KSS). In both scores, the scores at the time of final visit were significantly higher than that at the time of preoperatively. \* means *p* < 0.01.

The average Knee Society knee rating score improved from 41.9 (range, 12–69) preoperatively to 91.3 (range, 73–100) at the final follow-up evaluation (*p* < 0.01). The average Knee Society function score also improved from 14.4 (range, 0–40) preoperatively to 83.1 (range, 60–100) at the final follow-up evaluation (*p* < 0.01) (Figure 3). During the postoperative period, 39 knees (87%) were pain free, whereas 6 knees (13%) had mild or occasional pain. The mean preoperative maximum flexion angle was 110.3° (range, 70°–150°), whereas that at the final follow-up was 114.8° (range, 80°–125°). The

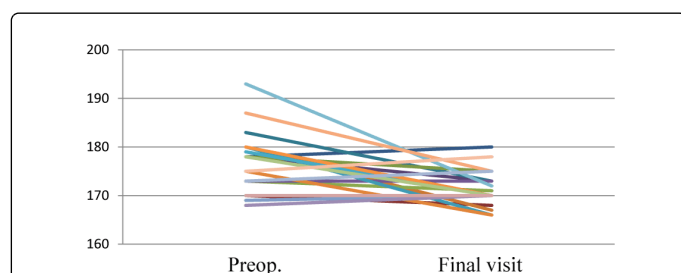
mean preoperative and final follow-up maximum extension angles were  $-13.4^\circ$  (range,  $-40^\circ$  to  $0^\circ$ ) and  $-4.2^\circ$  (range,  $-60^\circ$  to  $0^\circ$ ), respectively ( $p < 0.01$ ) (Figure 4). We noted that good valgus–varus stability was maintained manually throughout the follow-up period in all the patients.



**Figure 4:** Range of motion after posterior cruciate ligament–retaining (CR-type) TKA. Upper (triangle mark) and lower (diamond mark) lines indicate maximum flexion and maximum extension angles of the knee at the time of preoperatively (Preope.), one month (1M), one year (1Y), five year (5M), and final visit, respectively. \* means  $p < 0.01$ .

### 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.



**Figure 5:** The femorotibial angle (FTA) after posterior cruciate ligament–retaining (CR-type) TKA. The points of left mean FTA at the time of preoperatively and those of right mean FTA at the time of final visit.

### 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

TKA is a reliable form of treatment to relieve pain and improve function in patients with RA. However, it remains unclear whether it is best to retain or excise the PCL because the choice of the method employed—CR-type or posterior-stabilized (PS-type)—is based on limited data. Since Laskin and O’Flynn [1] described a series of 98 knees in patients with RA who were managed with CR-type TKA, this type of TKA has been believed to be a relative contraindication in cases of RA. In their paper, it was reported that 50% of knees developed postoperative posterior instability of  $>10$  mm. Based on those results, many surgeons presently prefer treatment with PS-type TKA for patients with RA. Also, PS-type TKA involves an easier operative technique and results in better range of motion as compared to CR-type TKA for patients with RA. In addition, in their study of PS-type TKA, Shai et al. [5] reported a prosthesis survival rate of 97% at 13 years, and Rodriguez et al. [6] also reported a good survival rate of 91% at 15 years.

However, several modern studies comparing cruciate–retaining with cruciate-substituting designs have demonstrated similar results with regard to range of motion, aseptic loosening, proprioception, gait patterns, polyethylene wear, and stability [7,8]. Furthermore, a number of recent studies have demonstrated good medium-term results following CR-type TKA in patients with RA [9–11]. Additionally, Conditt et al. [12] reported that the substitution of the PCL using a spine and cam mechanism might not completely restore the functional capacity of the PCL, particularly in high-demand activities that may involve deep flexion, squatting, and kneeling, such as gardening. In the present study on CR-type TKA, both the mechanical and functional KSS scores were found to improve significantly after the procedure (Figure 3). Although complications developed in 10% of knees, none of the cases required revision surgery. At least in this follow-up period, it was no problem after the operation. Based on our results, we believe that CR-type TKA could be the first method of choice for patients with RA, with certain exceptions. However, we believe that PS-type TKA should be selected in cases where the PCL is not robust and mutilating-type RA, severe deformity, severe knee stiffness, or severe knee instability is noted.

However, the disease state of RA at the time of TKA might determine whether the PCL should be retained or sacrificed. Posterior instability generally develops in advanced rheumatoid disease; however, recently, combination therapy with disease-modifying antirheumatic drugs and/or biologic agents has substantially improved the control of RA. Furthermore, there have been reports from Western

countries and Japan that the rates of total joint replacement, including that of the hip and knee, and other RA-related surgeries have been constant or decreased in patients with RA due to the availability of new medications, including biologic agents [13]. In the present study, none had received biologic agents for RA control at the time of TKA although 9 patients (20%) used them at the final follow-up visit. Then, both the clinical score—including an evaluation of posterior instability—and laboratory data were unchanged or had improved. These indicate that advancements in systemic disease control could effect on postoperative results.

In the present study, there were no problems associated with the retention of the PCL. However, surgeons should carefully consider the potential development of such complications in future cases. Thus, the appropriate selection of patients based on the RA status, prosthesis type, and operative technique may lead to good clinical results, even when using CR-type TKA.

## Conclusion

In conclusion, although our study did not evaluate whether CR-type TKA is superior to PS-type TKA, our results indicate that CR-type TKA did not result in any problems in patients with RA during the follow-up period. However, additional long-term follow-up studies are required.

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