

Average 10.1-year follow-up of cementless total knee arthroplasty in patients with rheumatoid arthritis

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DOI: 10.1503/cjs.000910

Background: Total knee arthroplasty (TKA) using a cemented technique has been recommended in patients with rheumatoid arthritis owing to the initial stability of the fixation and long-term durability of the components; however, similar long-term follow-up results have been reported in patients who have undergone cementless TKA. The purpose of this study was to evaluate the radiologic and clinical outcomes of cementless TKA in patients with rheumatoid arthritis.

Methods: We enrolled patients undergoing cementless TKA from March 1990 to February 2000. Clinical and radiologic evaluations were performed using the Knee Society clinical rating system and radiographic evaluation and scoring system.

Results: We included the cases of 112 patients who underwent 179 cementless TKA procedures in our analysis. Their mean age was 62.3 years, and the mean follow-up period was 10.1 years. The final survival rate was 0.968 at the 15.5-year follow-up. Regarding radiologic results after surgery, the mean total valgus angle was 6.7°, the mean femoral flexion angle was 97.5° and the mean tibial angle was 89.2° on the anteroposterior radiographs. On the lateral films, the mean femoral flexion angle was 1.6° and the mean tibial angle was 89.2°. At the last follow-up, the mean total valgus angle was 6.5°, the mean femoral flexion angle was 97.4° and the mean tibial angle was 89.1°, as seen on the anteroposterior view. On the lateral views, the mean femoral flexion angle was 1.4° and the mean tibial angle was 89.0°. Regarding the clinical outcome, the mean knee score and function score on the Knee Society clinical rating system were also enhanced from 47.5 and 43.6, respectively, before the operation to 91.2 and 82.3, respectively, at the last follow-up.

Conclusion: On radiologic and clinical follow-up of cementless TKA for patients with rheumatoid arthritis, there were no serious complications, and the results of the operation were satisfactory with improvement in range of motion and clinical symptoms.

Contexte : On a recommandé l'arthroplastie totale du genou (ATG) fixée par ciment orthopédique chez les patients souffrant de polyarthrite rhumatoïde, en raison de la stabilité initiale de la fixation et de la longue durabilité des composantes. Or, des résultats similaires ont été enregistrés au suivi à long terme chez des patients qui ont subi une ATG non cimentée. Cette étude avait pour but d'évaluer l'issue radiologique et clinique de l'ATG non cimentée chez des patients souffrant de polyarthrite rhumatoïde.

Méthodes : Nous avons recruté des patients soumis à une ATG entre mars 1990 et février 2000 et procédé à des examens cliniques et radiologiques appuyés sur les systèmes d'évaluation clinique et radiographique et de notation de la Knee Society des États-Unis.

Résultats : Nous avons inclus dans notre analyse 112 patients totalisant 179 interventions pour ATG non cimentée. Leur âge moyen était de 62,3 ans et le suivi a duré en moyenne 10,1 ans. Le taux final de survie était de 0,968 au suivi à 15,5 ans. Pour ce qui est des résultats radiologiques après la chirurgie, l'angle valgus total moyen était de 6,7°, l'angle de flexion fémorale moyen, de 97,5° et l'angle tibial moyen, de 89,2°, aux radiographies antéropostérieures. Sur les clichés latéraux, l'angle de flexion fémorale moyen était de 1,6° et l'angle tibial moyen, de 89,2°. Au dernier suivi, l'angle valgus total moyen était de 6,5°, l'angle de flexion fémorale moyen, de 97,4° et l'angle tibial moyen, de 89,1°, observés aux clichés antéropostérieurs. Aux clichés latéraux, l'angle de flexion fémorale moyen était de 1,4° et l'angle tibial moyen, de 89,0°. En ce qui a trait aux résultats cliniques, le score moyen global pour le genou et le score fonctionnel selon le système d'évaluation clinique de la Knee Society étaient aussi améliorés, passant de 47,5 et 43,6 respectivement, avant l'intervention, à 91,2 et 82,3 respectivement, au moment du dernier suivi.

Conclusion : Le suivi radiologique et clinique des ATG non cimentées chez des patients souffrant de polyarthrite rhumatoïde n'a révélé aucune complication grave et les résultats de l'intervention ont été satisfaisants, avec des améliorations de l'amplitude de mouvement et des symptômes cliniques.

Rheumatoid arthritis is an autoimmune inflammatory disease that is progressive and shows systemic manifestations. The course of rheumatoid arthritis varies greatly from mild, even self-limiting disease, to a severe, destructive variant that progresses rapidly.¹ It invades the knee joint in more than about 90% of patients with long-term rheumatoid arthritis. Since recent improvements in total knee arthroplasty (TKA), the procedure has been performed in many patients for the amelioration of the pain in the knee joint and the recovery of its function, and good follow-up results have been reported.²⁻⁷ However, the quality of the bones in patients with rheumatoid arthritis, especially around the affected joints, and the surrounding soft tissue is often quite poor owing to the synovial process and disuse atrophy. These patients usually have osteopenia in the knees and may present with an array of bone and soft tissue deformities, each of which can impact the initial success and long-term durability of a total knee replacement. When performing TKA, cemented designs give immediate fixation, whereas cementless designs need a period of bone ingrowth onto the surface irregularities of the implants. Therefore, a cemented technique has generally been recommended for the initial stability of fixation and long-term durability of the components.^{5,8-10} However, long-term follow-up results in patients who have undergone cementless TKA have been similar to those of patients who have undergone procedures using cement.¹¹⁻¹⁴

The purpose of this retrospective study was to evaluate the long-term clinical and radiographic results and to perform a survivorship analysis of the primary cementless TKAs performed in patients with rheumatoid arthritis.

METHODS

This study involved patients who underwent cementless TKA for rheumatoid arthritis at our hospital from March 1990 to February 2000. During the follow-up period, we evaluated patients regularly beginning at least 6 months after surgery.

We used 1 of the following types of posterior cruciate ligament (PCL)-retained semiconstrained prosthesis in all patients: Tricon-M (Smith and Nephew), Genesis (Smith and Nephew) and Advantim (Wright Medical Technology). Each prosthesis is made of cobalt-chrome alloy. The femoral component of the Tricon-M prosthesis is made of cobalt-chrome-molybdenum, and the tibial component consists of a flat cobalt-chrome alloy baseplate mated with a contoured polyethylene articular surface with 2 "flex-lok" pegs protruding through the baseplate for fixation. The

undersurface of the component is covered with sintered layers of beads forming 250- μ m pores. The Genesis system features an anatomic, chrome-cobalt femoral component and a porous-coated titanium tibial component with a stemmed baseplate, as well as 2 holes for cancellous screws or polyethylene pegs. Both the baseplate and polyethylene-bearing surface of the tibial component are asymmetric, with the medial condyle larger than the lateral condyle, in an attempt to maximize tibial bone coverage. The Advantim prosthesis features the raised lateral condyle of the femoral implant, as compared with other prostheses. It provides the greatest resistance to lateral subluxation of the patella. The durability of the Advantim system has been enhanced by the manufacturer by optimizing the femoro-tibial contact area and reducing the roughness of all articulating surfaces.

The TKA procedure involved a midline skin incision and a medial parapatellar quadriceps-splitting incision according to the manufacturer's guideline. The distal femur was cut at a 7° valgus, and the proximal tibia was cut perpendicular to the shaft. We completed a synovectomy, and we applied the cementless technique in all patients. For enhanced fixation, 2 cancellous screws were used in the tibial components of the Genesis and the Advantim prostheses. The patella was resurfaced by a cemented technique in all patients. If needed, we performed a lateral retinacular release after checking the alignment of the patellofemoral joint. The day after the operation, patients began straight leg-raising exercises, and continuous passive knee-motion exercises began on the third day. Weight-bearing was allowed 6 weeks after surgery.

For the clinical evaluation using the Knee Society clinical rating system,¹⁵ we assessed and compared the knee score and the function score. A score of 90 points was considered an excellent outcome, 80-89 points a good outcome, 70-79 points a fair outcome and less than 70 points a poor outcome.¹⁶ For radiologic evaluation using the Knee Society radiographic evaluation and scoring system,¹⁷ we checked the total valgus angle of the knee joint, the location of the femoral and tibial prostheses on the sagittal and coronal planes and the width of the radiolucency between the bone and prosthesis. We calculated the total scores of the radiolucent lines of each component, as assessed using a picture archiving communication system (PACS), and divided the scores into 3 groups: a score of 4 points or less had no significance, 5-9 points meant closed observation, and 10 or more points meant the possibility of failure. In addition, we measured and compared the subsidence of the tibial prosthesis over time. Prosthesis survival was assessed

by performing Kaplan–Meier survival analysis with SPSS statistical software, with failure defined as removal or revision of any component for any reason.

The statistical significance of the change according to the passage of time from the preoperative status to the last follow-up was analyzed using a paired *t* test, and the comparison of the result of the last follow-up in each group was done using an unpaired *t* test. We considered results to be significant at *p* < 0.05.

RESULTS

We included 131 patients who underwent 202 cementless TKAs for rheumatoid arthritis in our study. Nineteen patients (23 cases) were lost to follow-up, and the remaining 112 patients (179 cases; 89% of the 202 eligible cases) were available for clinical and radiographic evaluation after surgery. There were 11 men (16 cases) and 101 women (163 cases) with a mean age of 62.3 (range 38.5–73.4) years and a mean body mass index (BMI) of 23.8 (range 18.4–29.3). Three patients were in their 30s, 14 were in their 40s, 43 were in their 50s, 37 were in their 60s and 15 were in their 70s. Sixty-seven patients underwent bilateral surgery, and 45 patients underwent unilateral surgery. A previous operation, including open or arthroscopic synovectomies of their knees, had been performed in 18 patients (21 knees). We used the Tricon-M prosthesis in 39 knees, the Genesis in 58 knees and the Advantim in 82 knees. The mean follow-up period in our study was 10.1 (range 4.6–15.5) years.

Radiologically, on the anteroposterior radiographs taken immediately after surgery, the mean femoral flexion angle (α) was 97.5° and the mean tibial angle (β) was 89.2°. On the lateral radiographs, the mean femoral flexion angle (γ) was 1.6°, the mean tibial angle (δ) was 89.2°, and the mean total valgus angle Ω was 6.7°. At the last follow-up, the mean α angle was 97.4°, the mean β angle was 89.1°, the mean γ angle was 1.4°, the mean δ angle was 89.0°, and the mean Ω angle was 6.5°. Comparing the values obtained at last follow-up with those obtained immediately after surgery, we detected no significant differences, and there were no significant differences between the components. The mean preoperative femorotibial angle was varus 4.7°,

and it was revised to 4.1° at the last follow-up. When the radiolucent lines of each component were examined, 23 knees (12.8%) were observed to have radiolucent lines in the femoral components at the last follow-up, and their widths were 2 mm or less in all cases. Forty-three knees (24%) had radiolucent lines in the tibial components, and these were seen on the anteroposterior view in 32 cases and on the lateral view in 11 cases (Table 1). The lines were 2 mm in width on 6 of the 32 knees with radiolucent lines on the anteroposterior view and 1 of the 11 knees with radiolucent lines on the lateral view, and loosening had developed in 1 knee 8.4 years postoperatively. Twelve of 179 knees (6.7%) showed radiolucencies both in the femoral and tibial components. There were no radiolucent lines in the patellar components. At the last follow-up the average width of radiolucent lines was 1.4 mm, and 1 knee showed a radiolucent line of 5 mm or more.

Based on the Knee Society clinical rating system, the knee score increased from a mean of 47.5 points preoperatively to a mean of 91.2 points at the last follow-up, and the mean function score improved from an average of 43.6 points preoperatively to 82.3 points at last follow-up (*p* = 0.032; Fig. 1, Table 2). At the last follow-up, the knee scores showed good or excellent results in 166 knees (92.7%) and the function scores showed good or excellent results in 163 knees (91.1%; Table 3).

During the follow-up period, subsidence of the tibial prosthesis was seen on radiographs obtained 3 months postoperatively for 19 knees (6 with the Tricon-M, 7 with

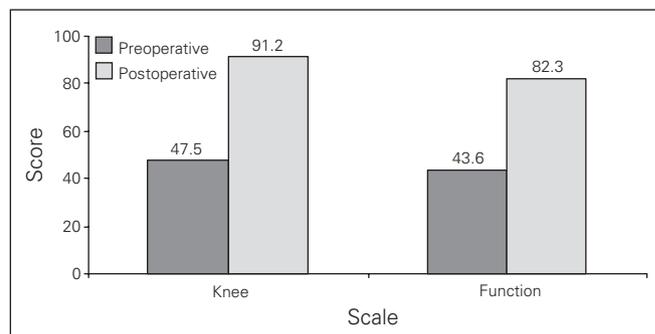


Fig. 1. Average scores were improved at the last follow-up using the Knee Society clinical rating system, compared with the preoperative condition.

Table 1. Radiolucent line of each component based on the Knee Society radiographic evaluation and scoring system for 112 patients who underwent 179 cementless total knee arthroplasties from March 1990 to February 2000

Prosthesis	Average thickness, mm	Zone																				
		1			2			3			4			5			6			7		
		T	G	A	T	G	A	T	G	A	T	G	A	T	G	A	T	G	A			
Femur	1.2	2	2	2	2	1	1	2	1	2	1	2	1	1	1					1	1	
Tibia, anteroposterior view	1.6	6	6	5	3	4	3	1	2	1			1									
Tibia, lateral view	1.4	2	2	3	1	2	1															

A = Advantim; G = Genesis; T = Tricon-M.

the Genesis and 6 with the Advantim prostheses). The depth of subsidence was 1.2 mm on average, and it increased to a mean of 2.4 mm 12 months postoperatively. One knee (with a Tricon-M prosthesis) showed further progression on the subsequent follow-up radiographs, and aseptic loosening occurred 8.4 years postoperatively. The patients underwent revision TKA. Further progression or loosening was not observed in the other patients. As for other complications, postoperative infection was observed in 3 knees (1 with the Tricon-M, 1 with the Genesis and 1 with the Advantim prostheses). One infection (with the Tricon-M prosthesis) that developed 3 weeks postoperatively was well-treated with irrigation, débridement and appropriate antibiotics. The others were observed at 4.6 years and 6.8 years postoperatively, respectively. They were treated with 2-stage revision surgery using the cement technique. Polyethylene wear of the tibial insert was observed in 1 knee (with the Tricon-M prosthesis) at the 10.5-year follow-up. Polyethylene exchange and débridement was performed. At postoperative 8.5 years, posttraumatic periprosthetic fracture occurred above the femoral component in 1 knee (with the Advantim prosthesis). Bony union was achieved by conducting open reduction and internal fixation with a plate, and the prosthesis was well-maintained.

On Kaplan–Meier survival analysis, the survival rate of the Tricon-M group was 0.880 at the 15.5-year follow-up, and that of the Genesis group was 0.983 at the 12.5-year follow-up. The survival rate in the Advantim group was 0.988 at the 12.5-year follow-up. The final survival rate associated with cementless TKA was 0.968 at the 15.5-year follow-up (Fig. 2).

DISCUSSION

Total knee arthroplasty is the proper treatment for relieving pain and improving function in patients with rheumatoid arthritis. The following factors should be considered when performing TKA in these patients. First, since rheumatoid arthritis is a multicentric disease, it causes problems in both the knee joints and the upper limb joints. Therefore, the rehabilitation processes, including the weight-bearing time, are delayed in many patients. Second, unlike in patients with osteoarthritis, release of the lateral structure is required in the knees with valgus and external rotation deformity owing to the long-term contracture of the knee joint and secondary joint deformity. Third, rheumatoid arthritis is often accompanied by severe osteoporosis. Therefore, the bone should be resected as little as possible, and the bone defect area should be reinforced by bone graft or using bone cement. Finally, it is better to prevent dissociation using a minimally constrained prosthesis and retaining the posterior cruciate ligaments to lessen shear or rotation force between the weak bone and the prosthesis.^{3,18} To prevent such shortcomings, cemented TKAs have been performed widely.^{5,8–10,19}

The survival associated with cemented TKA may differ from that of cementless TKA. If the results of cementless TKA are equal to or exceed those of cemented TKA, several advantages could be gained. These advantages include better bone stock in the case of revision attributable to conservative bone cuts and a lack of biologic response to polymethylmethacrylate, shorter tourniquet and operating times and a lack of cement extrusion and cement-wear debris.²⁰ During TKA in patients with rheumatoid arthritis,

Table 2. Clinical evaluation at last follow-up based on the Knee Society clinical rating system for 112 patients who underwent 179 cementless total knee arthroplasties from March 1990 to February 2000

Score	Preoperative				Last follow-up			
	Tricon-M	Genesis	Advantim	Total average*	Tricon-M	Genesis	Advantim	Total average*
Knee	47.0	48.9	46.6	47.5	90.2	90.8	92.6	91.2
Function	44.2	44.5	42.1	43.6	82.6	82.4	81.9	82.3

*p = 0.032.

Table 3. Final results at the last follow-up based on the Knee Society clinical rating system for 112 patients who underwent 179 cementless total knee arthroplasties from March 1990 to February 2000

Result	Knee score				Function score			
	Tricon-M	Genesis	Advantim	Total average	Tricon-M	Genesis	Advantim	Total average
Excellent	25	28	25	78	21	22	19	62
Good	29	28	31	88	33	33	35	101
Fair	4	5	4	13	6	5	5	16
Poor	—	—	—	—	—	—	—	—

the correction of the valgus deformity has an effect on the success rate. It has been reported that it is desirable to obtain about 7° valgus of the femorotibial angle.^{21,22} Total knee arthroplasty using a PCL-retaining prosthesis in patients with rheumatoid arthritis could induce posterior instability or genu recurvatum deformity.²³ In our study, the mean knee score was 91.2 points, and the mean function score was 82.3 points; these scores are similar or better results compared with those reported in previous studies.^{5,12} The mean 6.5° valgus angle of the femorotibial angle was well-maintained at the last follow-up, and instability or genu recurvatum deformity was not observed.

Radiolucent lines observed around components are still open to dispute, but they are an important part of evaluating the results of TKA in most patients.^{24,25} Ecker and colleagues²⁴ reported that there was no statistically significant correlation between the occurrence of thin radiolucent lines in any location and the eventual postoperative clinical result and that radiolucent lines greater than 2 mm were associated with poor results. In our study, there were no radiolucent lines around patellar components, and we observed radiolucent lines in 12.8% of femoral components and 24% of tibial components. The mean width of radiolucent lines was 1.4 mm, and they were meaningless and nonprogressive in all but 1 knee, which showed late subsidence and loosening and required revision surgery.

In our study, the subsidence of the tibial component up to an average of 2.4 mm at 1 year postoperatively was observed in 19 knees, and aseptic loosening had developed in 1 knee. When performing TKA, prosthesis migration in

bone inevitably occurs for cemented and cementless components. Therefore, during cementless TKA the tibial tray should cover the bone cut as much as possible, and a bone-prosthesis index larger than 0.8 should be achieved to prevent subsidence.²⁶ Furthermore, both biomechanical²⁷ and clinical²⁸ investigations have supported the importance of a central tibial stem for better primary stability of fixation. Trieb and colleagues²⁹ reported good clinical and radiologic results in patients with rheumatoid arthritis without preference for the method of fixation or the patient's weight. We performed 4 revision surgeries during our follow-up period, but 2 of them were owing to infections. As a whole, the present study showed clinically and radiologically good results in more than 90% of the knees. It is thought that the relatively low survival rate of the Tricon-M group compared with other groups was because of the small number of cases and the long follow-up period.

CONCLUSION

The decision to use cement or not during TKA in patients with rheumatoid arthritis can be made according to the surgeons' experience and the patients' conditions. Our study revealed a final prosthesis survival rate of 96.8% at the 15.5-year follow-up, and there were no serious complications according to the radiologic and clinical evaluations. We think the cementless technique of TKA for patients with rheumatoid arthritis is also effective to relieve pain and to improve the function of the knee joint without serious complications.

Competing interests: None declared.

Contributors: Drs. Woo and Lee designed the study. All authors acquired the data, which Drs. Kim, Chung and Lee analyzed. Drs. Woo and Kim wrote the article, which Drs. Chung and Lee reviewed. All authors approved its publication.

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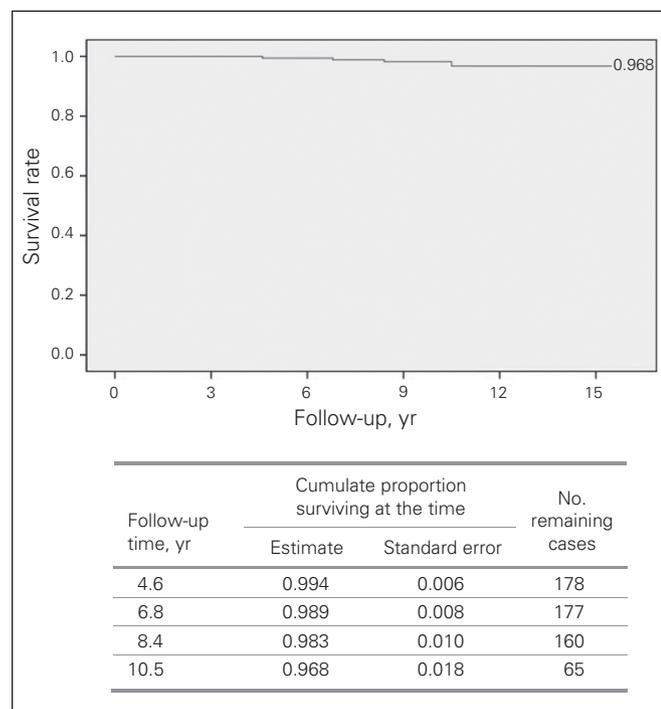


Fig. 2. Kaplan-Meier survivorship analysis shows 96.8% survival at the postoperative 15.5-year follow-up.

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