

Total Knee Arthroplasty in Rheumatoid Arthritis patients with a medial stabilized prosthesis – A retrospective analysis

Rajesh Malhotra, Ritvik Janardhanan, Sahil Batra *

Department of Orthopaedics, All India Institute of Medical Sciences (AIIMS), New Delhi, 110029, India



ARTICLE INFO

Article history:

Received 12 June 2021

Received in revised form

11 August 2021

Accepted 14 August 2021

Available online 17 August 2021

Keywords:

Medial stabilized

Total knee arthroplasty

Clinical

Radiological

Rheumatoid arthritis

ABSTRACT

Background: Total Knee Arthroplasty (TKA) has been described as an effective and successful mode of treatment in alleviation of pain and restoration of function in patients with Rheumatoid Arthritis (RA). The array of bone and soft tissue deformities in RA patients can impact initial success and long term durability of TKA. Medial Pivot (MP) prosthesis is fixed bearing asymmetric pivoting design that provides anterior-posterior stability without any post and conserves bone on the femoral side. There are few reports of suitability of experience with MP in RA.

Methods: Twenty six patients (average age 55 years) with end stage arthritis secondary to RA operated with MP prosthesis were retrospectively followed up. At a minimum follow up of three years, all patients were assessed using Knee Society Score (KSS), Oxford Knee Score (OKS), Pain Catastrophising Scale (PCS) and radiological outcomes.

Results: At final follow-up, patients reported significant improvement in mean KSS-Objective and Functional scores, Oxford Knee Score and Pain Catastrophising Scale ($p < 0.05$). The mean range of motion achieved at the end of two years ranged from 0 (extension) to 109.4 (full flexion). There was no evidence of loosening or osteolysis at minimum follow up of three years.

Conclusion: These results endorse satisfactory clinical and radiological outcomes at minimum follow up of three years following Medial Pivot Prosthetic Knee design in RA patients. Further long term follow up is needed to determine the survival analysis of MP design in these patients.

© 2021 Delhi Orthopedic Association. All rights reserved.

1. Introduction

Rheumatoid arthritis (RA) is a progressive auto-immune disorder damaging articular cartilage and bone, resulting in joint destruction. The knee joint is involved in 90% of the patients with RA.¹ Total Knee Arthroplasty (TKA) has been described as an effective treatment for alleviation of pain and restoration of function in patients with rheumatoid arthritis. Rheumatoid arthritis patients pose a challenge to surgeons due to osteopenia and synovitis in the surrounding tissue leading to disuse atrophy.² The variety of bony, soft tissue deformities and joint laxity can hinder the initial success and long term results of TKA in these patients. There is always debate regarding the implant selection in these patients. The preference to use Posterior Stabilized (PS) design in

these patients was based on the study from Hospital for Special Surgery that reported 50% instability with Cruciate Retaining (CR) design.³ However reports from various others centre contrary this result.^{4–6} Miller et al. reported 69% survivorship in their series (end point being revision for any cause) with CR design in RA patients at final follow up of 25 years with only two patients revised for instability.⁶

The structural integrity of posterior cruciate ligament (PCL) has always been the matter of debate in RA patients. Histopathological studies have demonstrated intactness of PCL even in grade 3 and 4 of the disease.⁷ On the contrary; the tensile strength of PCL has been reported as one-sixth of the normal knee in RA patients operated for TKA.⁸ Larger flexion gap seen in RA patients due to the advanced stage of the disease is very difficult manage with CR design.⁹ The PS design necessitates the obligatory box cut which further weakens the already osteopenic bone leading to increased chances of periprosthetic fracture.¹⁰

Thus, the desirable implant for RA should provide anterior-posterior stability without compromising the bone stock and be

* Corresponding author. Department of Orthopaedics, All India Institute of Medical Sciences (AIIMS), New Delhi 110029, India.

E-mail addresses: rmalhotra62@gmail.com (R. Malhotra), doctoratlarge2018@gmail.com (R. Janardhanan), sahilbatra25@gmail.com (S. Batra).

independent of PCL for femoral roll back. The PCL sacrificing Medial Pivot (MP) TKA is in clinical use since 1998 and its long term clinical success has been well documented.^{11–14} This study aimed to evaluate clinical and radiological results of PCL sacrificing MP TKA prosthesis in RA patients.

2. Material and methods

A retrospective analysis of prospectively collected database of adult patients with end-stage knee arthritis secondary to RA (diagnosed by American College of Rheumatology criteria) operated in a University Teaching Hospital between January 2016 to December 2016 using MP TKA (ADVANCE® Medial Pivot, Micro Port Orthopedics, Arlington, TN, USA) with a minimum follow up of three years were analysed.¹⁵ The inclusion criteria for the study was adult patients with rheumatoid arthritis and willing to undergo TKA using medial stabilized prosthesis and the exclusion criteria was prior history of patellectomy, High Tibial osteotomy and refusal to give consent. Institution Review Board approval was taken for the study. The primary outcome measure for this study was clinical evaluation using American Knee Society Score- 2011 (KSS). The secondary outcome measures were Oxford Knee Score (OKS) and Pain Catastrophising Scale (PCS) and radiological assessment using MP Prosthesis.

All the patients underwent TKAs using standard medial parapatellar approach. Antibiotic prophylaxis (Cefuroxime axetil 1.5 g) was given intravenously 30–45 min prior to start of surgery. All patients were given intravenous tranexamic acid (15 mg/kg) 10 min prior to tourniquet deflation. Distal femoral valgus cut angle was calculated on the basis of preoperative radiograph. Femoral external rotation was decided on the basis of whiteside line and posterior condylar axis. Out of 36 knees, 22 knees exhibited valgus deformity (Grade 1) in which lateral release was done in the sequence of Iliotibial band, posterior ligament complex, LCL and popliteus if required to balance the knees. PCL was sacrificed in all the cases and Palacos® bone cement was used to fix the implants. In case whenever there was medio-lateral overhang with appropriate anterior-posterior sized femoral component, the authors used corresponding STATURE™ femoral component (With Narrower medio-lateral dimensions) available with this prosthesis. STATURE™ femoral component was used in 65% of the patients and the most common size of Femur and Tibia used was size 2. Patella was denervated and patelloplasty was done. Perioperative management was standardised as per standard protocol.

For each patient, preoperative score was documented from the patient record while post-operative evaluation was done at the latest follow up using KSS, OKS, PCS, range of motion (measured using goniometer) and flexion deformity, if any, were also recorded. Modern Knee Society Radiographic Evaluation System was used to evaluate serial standard radiographs by an independent radiologist both preoperatively and post-operatively.¹⁶ (Fig. 1, Fig. 2 and Fig. 3). A TKA was considered loose when there was a complete radiolucent line of more than 2 mm in width, a visible cement mantle fracture around the components, or a change in component position. The interclass correlation coefficient was excellent for both clinical (0.95) as well as radiographic evaluation (0.91).¹⁷

2.1. Statistical analysis

Baseline characteristics were described using mean \pm standard deviation/Median (range) or frequencies/percentages as appropriate. Primary and Secondary outcome measures were compared preoperatively and post operatively using paired *t*-test and Wilcoxon rank sum test as applicable. All analyses were conducted using Stata 13.0 (Stata Corp LLC, Texas, and USA). A *p* value < 0.05



Fig. 1. Preoperative radiograph showing Grade 4 end stage arthritis (B/L).

was considered statistically significant.

3. Results

All the patients reported improved satisfaction and functional improvement with the TKA at an average follow up of 45 months. The average age at the time of TKA was 55 years and 92% of the patients were females. Ten patients underwent bilateral TKA so total knees were thirty six. The mean BMI was 26.3 (Table 1).

The mean preoperative KSS- Objective, Function, OKS and PCS scores were 46.8 ± 14.6 (15–74), 42.8 ± 8.2 (30–57), 13.6 ± 1.9 (11–20) and 41.6 ± 2.2 (36–44) respectively and post-operatively at latest follow up were 86 ± 8.9 (50–95), 86.5 ± 4.6 (76–100), 42.1 ± 2 (38–46) and 5.9 ± 1 (4–8) respectively. The mean range of motion showed a statistically significant improvement from $78.9^\circ \pm 25.5^\circ$ (10° – 110°) to $106.8^\circ \pm 13.2^\circ$ (90° – 120°). Five knees had flexion deformity of less than 10° at the final follow up. Patients reported clinically and statistically significant ($p < 0.001$) improvements in all patient reported outcome measures (PROMs) (Table 2). None of the patient developed any symptomatic anteroposterior instability. There was no case of reinfection in the post-operative period or at the latest follow up.

There was no evidence of implant failure or subsidence in any of the postoperative radiographs. Out of 36 knees, 22 knees exhibited valgus deformity (Grade 1), in which mean tibio-femoral angle improved from $3.8^\circ \pm 2.7^\circ$ valgus preoperative to $4.5^\circ \pm 0.5^\circ$ valgus at the final follow up. In rest of 14 varus knees, the mean tibio-femoral angle improved from $1.5^\circ \pm 1.2^\circ$ varus preoperative to $3.5^\circ \pm 0.6^\circ$ valgus at the final follow up (Table 3).

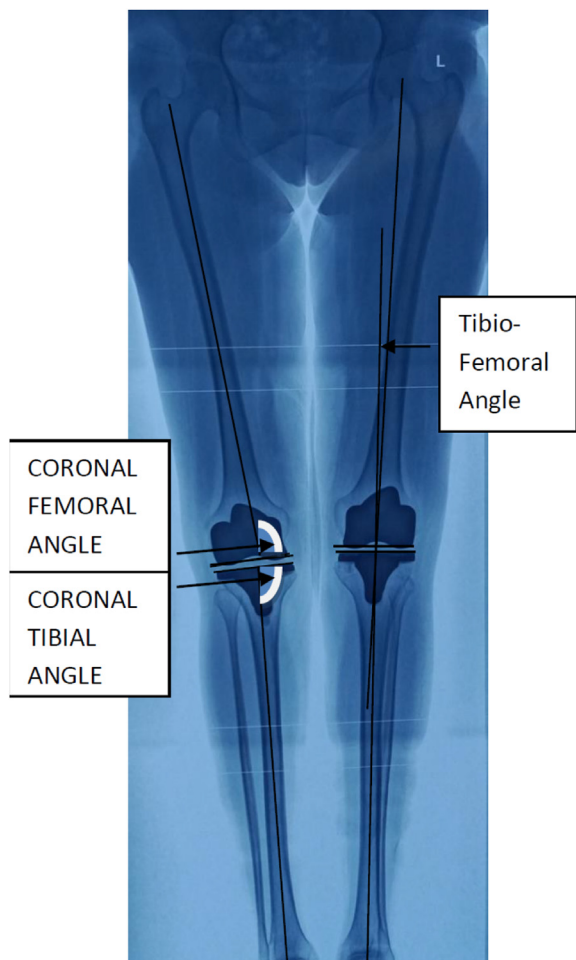


Fig. 2. Post-operative radiograph showing Tibio-Femoral Angle, Coronal Femoral Angle and Coronal Tibial Angle.

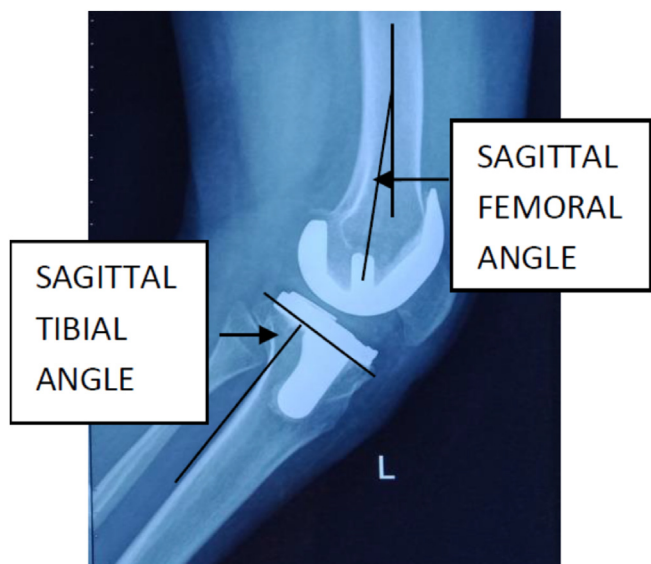


Fig. 3. Post-operative radiograph showing Sagittal Femoral Angle and Tibial Angle.

Table 1
Patient demographic data.

Parameter	Value
Female/Male ^a	92 (24)/8(2)
Age (Years) ^b	55 ± 10.1
BMI(Kg/m ²) ^b	26.3 ± 2
Follow up (Months) ^b	44.7 ± 5.2

^a The values are given as percentage with number of patients in parenthesis.

^b Data are presented as mean and standard deviation.

Table 2
Descriptive statistics of KSS, OKS, PCS and Range of motion preoperatively and at the latest follow up.

MP (n = 36)	Preoperative	Latest follow up	P value
KSS-Objective	46.8 ± 14.6	86 ± 8.9	<0.001
KSS-Function	42.8 ± 8.2	86.5 ± 4.6	<0.001
Oxford Knee Score	13.6 ± 1.9	42.1 ± 2	<0.001
Pain Catastrophising Scale	41.6 ± 2.2	5.9 ± 1	<0.001
Range of Motion	78.9° ± 25.5°	106.8° ± 13.2°	<0.001

Data are presented as mean and standard deviation.

3.1. Complications

None of the patients were lost to follow up or died due to surgery related causes. One knee required manipulation under anaesthesia for stiff knee.

4. Discussion

The long term results of TKA in RA patients are well documented with excellent long term survivorship.^{6,18–21} The decision to excise or retain PCL in RA patients is a matter of debate. MP design is a fixed bearing pivoting design with a congruous medial side and a relatively flat lateral compartment to minimise anterior-posterior translation in the medial compartment while allowing femoral roll back in the lateral compartment.²² The PS type of Advance Medial Pivot does not require box cut for post-cam mechanism. This preserves bone stock in already smaller bones in Asian patients and, if required, for future revision surgery which is more likely in RA patients since they undergo surgery at a relatively younger age as compared to Osteoarthritis (OA) patients.²³

This is the first study to our knowledge evaluating the role of MP design in RA patients. Patient Reported Outcome Measures (PROM) are now considered important tool as higher levels of functionality are expected by patients post-operatively. Based on the PROMs, the patients with MP Prosthesis had satisfactory outcome without any major complications at minimum follow up of three years. Medial Pivot TKA has been shown to improve knee kinematics and it may be the reason for significant improvement in KSS and Oxford Knee Score.²⁴ Marked alleviation of pain was seen in patients after TKA as evident by improved PCS. This is because nociceptive type pain secondary to joint inflammation in RA patients is relieved by TKA.^{25,26} The average age in present study was 55 years (32–70 years) which is similar to other studies.^{3–6,27,28} The present study has demonstrated superior clinical and radiological outcome of PCL sacrificing type of MP design, although Bae et al reported no difference in clinical and radiological results of TKA with MP design regardless of whether PCL was retained (67 Knees) or sacrificed (70 knees).²⁹

Most of the patients in our setting present at a very late stage with fixed flexion deformities and PCL is often attenuated. So achieving a well balanced knee as required by CR knee designs is very difficult to achieve leading to frequent sacrifice of PCL. None of

Table 3
Descriptive analysis of radiological outcomes.

MP (n = 36)		Preoperative	Latest Follow up	P value
Tibio-Femoral Angle(°) ^a	Valgus Group (n = 22)	-3.8° ± 2.7°	-4.5° ± 0.5°	0.16
	Varus Group (n = 14)	1.5° ± 1.2°	-3.5° ± 0.6°	0.001
Position of Implants				Post-Operative
Coronal Femoral Angle°				95 ± 0.4
Coronal Tibial Angle°				90.3 ± 1.2
Sagittal Femoral Angle°				2.5 ± 0.7
Sagittal Tibial Angle°				86 ± 0.9

¥Data are presented as median (min-max), “-” suggests Valgus.

^a Data are presented as mean and standard deviation.

our patients developed late symptomatic anterior-posterior instability. The absence of anterior knee pain in the series can be attributed to better patello-femoral joint kinematics as observed with this design.³⁰ The authors choose not to resurface the patella as RA patients are sedentary with limited mobility and had osteopenic patellae with limited thickness and there is always risk of fracture if resurfaced.³¹ Tibial component loosening in PS design due to the transmission of increased forces to the cement-bone interface through cam-post mechanism remains a concern in RA patients due to poor bone quality.³² This issue can be easily mitigated in MP design as its ultra-congruent polyethylene with anterior lip provides anterior-posterior stability without any post.

There are several advantages to a design such as MP for RA in Asian patients. It makes the knee feel stable in activities requiring deep flexion due to its medial conformity and allows increased range of motion important for satisfaction after TKA in Asian patients.³³ The availability of STATURE™ femoral component with this design is extremely useful in case of mismatch between medio-lateral and anterior-posterior dimensions. The presence of stem option in tibia in primary design often needed due to poor bone quality and/or bone defects is not always present with other designs.

The current study demonstrated significant improvement in the range of motion at the latest follow up as compared to pre-operative range of motion. The results are comparable to other studies also.^{3-6,9,27,28} A range of motion arc of 100° or upper limb support is required by patients to stand from sitting position. This is particularly important for RA patients due to severe polyarthritis often seen.

Our study has several limitations such as single centre study, small number of patients, retrospective study design, absence of control group and relatively short follow up. Also, only patients with ASA 1 and 2 grades were included in our study. It is yet to be established whether normal kinematics will lead to improved long-term outcomes. However, there are indications that advance secondary osteoarthritis of the knee in RA disease with severe deformities in short Asian patients with small osteoporotic bones can be effectively managed by MP design.

5. Conclusion

These results endorse satisfactory clinical and radiological outcomes at minimum follow up of three years following Medial Pivot Prosthetic Knee design in RA patients. Further long term follow up is needed to determine the survival analysis of MP design in these patients.

Declaration of competing interest

On behalf of all the authors, the corresponding author states that there is no conflict of interest.

Acknowledgements

Not applicable.

References

- Kajino A, Yoshino S, Kameyama S, Kohda M, Nagashima S. Comparison of the results of bilateral total knee arthroplasty with and without patellar replacement for rheumatoid arthritis. A follow-up note. *J Bone Joint Surg Am.* 1997;79(4):570-574.
- Lee JK, Choi CH. Total knee arthroplasty in rheumatoid arthritis. *Knee Surg Relat Res.* 2012;24(1):1-6.
- Laskin RS, O'Flynn HM. The Insall Award. Total knee replacement with posterior cruciate ligament retention in rheumatoid arthritis. Problems and complications. *Clin Orthop Relat Res.* 1997;345:24-28.
- Gill GS, Joshi AB. Long-term results of retention of the posterior cruciate ligament in total knee replacement in rheumatoid arthritis. *J Bone Joint Surg Br.* 2001;83(4):510-512.
- Archibeck MJ, Berger RA, Barden RM, et al. Posterior cruciate ligament-retaining total knee arthroplasty in patients with rheumatoid arthritis. *J Bone Joint Surg Am.* 2001;83(8):1231-1236.
- Miller MD, Brown NM, Della Valle CJ, Rosenberg AG, Galante JO. Posterior cruciate ligament-retaining total knee arthroplasty in patients with rheumatoid arthritis. *J Bone Joint Surg Am.* 2011;93(22), e130.
- Nelissen RG, Hogendoorn PC. Retain or sacrifice the posterior cruciate ligament in total knee arthroplasty? A histopathological study of the cruciate ligament in osteoarthritic and rheumatoid disease. *J Clin Pathol.* 2001;54(5):381-384.
- Hagena FW, Hofmann GO, Mittlmeier T, Wasmer G, Bergmann M. The cruciate ligaments in knee replacement. *Int Orthop.* 1989;13(1):13-16.
- Tang WM, Chiu KY, Ng TP, Yau WP. Posterior cruciate ligament-substituting total knee arthroplasty in young rheumatoid patients with advanced knee involvement. *J Arthroplasty.* 2004;19(1):49-55.
- Haas SB, Nelson CL, Laskin RS. Posterior stabilized knee arthroplasty: an assessment of bone resection. *Knee.* 2000;7(1):25-29.
- Karachalios T, Roidis N, Giotikas D, Bargiotas K, Varitimidis S, Malizos KN. A mid-term clinical outcome study of the Advance Medial Pivot knee arthroplasty. *Knee.* 2009;16(6):484-488.
- Fitch DA, Sedacki K, Yang Y. Mid- to long-term outcomes of a medial-pivot system for primary total knee replacement: a systematic review and meta-analysis. *Bone Joint Res.* 2014;3(10):297-304.
- Chinzei N, Ishida K, Tsumura N, et al. Satisfactory results at 8 years mean follow-up after ADVANCE® medial-pivot total knee arthroplasty. *Knee.* 2014;21(2):387-390.
- Macheras GA, Galanakis SP, Lepetsos P, Anastasopoulos PP, Papadakis SA. A long term clinical outcome of the medial pivot knee arthroplasty system. *Knee.* 2017;24(2):447-453.
- Arnett FC, Edworthy SM, Bloch DA, et al. The American rheumatism association 1987 revised criteria for the classification of rheumatoid arthritis. *Arthritis Rheum.* 1988;31(3):315-324.
- Meneghini RM, Mont MA, Backstein DB, Bourne RB, Dennis DA, Scuderi GR. Development of a modern knee society radiographic evaluation system and methodology for Total knee arthroplasty. *J Arthroplasty.* 2015;30(12):2311-2314.
- Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of chiropractic medicine.* 2016;15(2):155-163.
- Ranawat CS, Padgett DE, Ohashi Y. Total knee arthroplasty for patients younger than 55 years. *Clin Orthop Relat Res.* 1989;248:27-33.
- Dalury DF, Ewald FC, Christie MJ, Scott RD. Total knee arthroplasty in a group of patients less than 45 years of age. *J Arthroplasty.* 1995;10(5):598-602.
- Abram SG, Nicol F, Hullin MG, Spencer SJ. The long-term outcome of un cemented Low Contact Stress total knee replacement in patients with rheumatoid arthritis: results at a mean of 22 years. *Bone Joint Lett J.* 2013;95-B(11):1497-1499.
- Scuderi GR, Insall JN, Windsor RE, Moran MC. Survivorship of cemented knee

- replacements. *J Bone Joint Surg Br.* 1989;71(5):798–803.
22. Freeman MA, Pinskerova V. The movement of the normal tibio-femoral joint. *J Biomech.* 2005;38(2):197–208.
 23. Youm YS, Cho SD, Lee SH, Cho HY. Total knee arthroplasty using a posterior cruciate ligament sacrificing medial pivot knee: minimum 5-year follow-up results. *Knee Surg Relat Res.* 2014;26(3):135–140.
 24. Pritchett JW. Patients prefer a bicruciate-retaining or the medial pivot total knee prosthesis. *J Arthroplasty.* 2011;26(2):224–228.
 25. Lee YC, Chibnik LB, Lu B, et al. The relationship between disease activity, sleep, psychiatric distress and pain sensitivity in rheumatoid arthritis: a cross-sectional study. *Arthritis Res Ther.* 2009;11(5):R160.
 26. Lee YC, Nassikas NJ, Clauw DJ. The role of the central nervous system in the generation and maintenance of chronic pain in rheumatoid arthritis, osteoarthritis and fibromyalgia. *Arthritis Res Ther.* 2011;13(2):211.
 27. Lee JK, Kee YM, Chung HK, Choi CH. Long-term results of cruciate-retaining total knee replacement in patients with rheumatoid arthritis: a minimum 15-year review. *Can J Surg.* 2015;58(3):193–197.
 28. Yamanaka H, Goto KI, Suzuki M. Clinical results of Hi-tech Knee II total knee arthroplasty in patients with rheumatoid arthritis: 5-to 12-year follow-up. *J Orthop Surg Res.* 2012;7(1):9.
 29. Bae DK, Song SJ, Cho SD. Clinical outcome of total knee arthroplasty with medial pivot prosthesis a comparative study between the cruciate retaining and sacrificing. *J Arthroplasty.* 2011;26(5):693–698.
 30. Anderson MJ, Becker DL, Kieckbusch T. Patellofemoral complications after posterior-stabilized total knee arthroplasty: a comparison of 2 different implant designs. *J Arthroplasty.* 2002;17(4):422–426.
 31. Bhan S, Malhotra R, Eachempati KK. Total knee arthroplasty without patellar resurfacing in patients with rheumatoid arthritis. *Clin Orthop Relat Res.* 2006;450:157–163.
 32. Stern SH, Insall JN. Posterior stabilized prosthesis. Results after follow-up of nine to twelve years. *J Bone Joint Surg Am.* 1992;74(7):980–986.
 33. Ha C-W, Park Y-B, Song Y-S, Kim J-H, Park Y-G. Increased range of motion is important for functional outcome and satisfaction after total knee arthroplasty in asian patients. *J Arthroplasty.* 2016;31(6):1199–1203.