

Total Knee Arthroplasty in Patients 40 Years and Younger

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Abstract

Total knee arthroplasty (TKA) is a procedure with excellent clinical results in older patients with a primary diagnosis of osteoarthritis. Many younger patients undergo unicompartmental or high tibial osteotomy rather than TKA, but are not always good candidates for these joint-preserving procedures. The purpose of this study was to review the outcomes of patients 40 years of age and under who underwent TKA. We identified 33 patients (38 knees) who were 40 years of age or less at the time of surgery. These patients had a mean age of 36 years (range, 23 to 40 years), and were followed for a mean of 49 months (range, 16 to 101 months). The survival rate in the study cohort was 97%. For the young patient who is not a candidate for other types of joint preserving procedures, in the senior authors' experience total knee arthroplasties have performed well.

Keywords

- ▶ total knee arthroplasty
- ▶ indications
- ▶ young patients
- ▶ under 40

Total knee arthroplasty (TKA) is a successful procedure with reported survivorship near 92% for long-term follow-up.¹ Much attention has been spent in the literature regarding the treatment of end-stage osteoarthritis with TKA. As the general population continues to age, there will be an increasing need for the procedure in the next 20 years; additionally, it has been projected that the percentage of all patients who receive TKA who are under 65 years of age will increase from 25 to greater than 50% by 2030.² However, another patient population that can require surgical treatment for end-stage joint disease is the young patient population. The orthopedic literature has numerous reports on TKA in the "young" patient population; these populations are typically defined as a patient cohort with a mean age less than 65 years.^{3–7} A small subset of this group is the patient cohort that is less than 40 years of age with end-stage disease.

Although it is extremely uncommon for patients less than 40 years of age to require surgical treatment, there are instances where it is necessary, and the appropriate course

for the extremely young patient with end-stage degenerative disease of the knee is controversial. High tibial osteotomy has been used in this patient population, with acceptable short-term outcomes.^{3,8,9} However, the reported success rates of high tibial osteotomy decrease as the patients continue to age. These patients will often ultimately require a revision to a TKA, which can be a complicated procedure due to the abnormal anatomy created by prior surgeries.⁹ One report suggests that patients may have similar results to high tibial osteotomy when a TKA is performed in a patient population under 40 years of age.¹⁰ There are no reports, however, that report extremely successful outcomes of TKA in a patient cohort with a maximum age of 40 years at the time of implantation.

The purpose of this study was to assess the clinical outcomes of patients 40 years of age and under who underwent TKA. We addressed the following questions: (1) What were clinical outcomes, specifically, failure rates and Knee Society and function scores; (2) What were the complication rates,

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including manipulation under anesthesia and reoperation with retention of components; (3) What were the modes of failure, if any; and (4) What were the radiographic findings?

Patients and Methods

A review of the databases from three experienced arthroplasty surgeons from two institutions were used to identify patients who were 40 years of age or younger at the time of TKA. We identified 38 knees (33 patients) operated on between 2001 and 2008. There were 15 men and 18 women who had a mean age of 36 years (range, 23 to 40 years) and a mean body mass index of 30.5 kg/m² (range, 15.1 to 44.4 kg/m²). All patients were followed both clinically and radiographically with a mean duration of 49 months (range, 16 to 101 months). The hospital records for all patients were reviewed, including data from preoperative studies, operative reports, radiographs, and postoperative office visits. All patients received Triathlon (Stryker Orthopaedics, Mahwah, NJ) components. Institutional Review Board approval was obtained for the study of these patients from both institutions.

No patients were lost to follow-up. However, one patient was excluded from this study because of deep periprosthetic infection. Infection was confirmed using the Leone and Hanssen criteria.¹¹ This infection was a chronic infection, presenting at 6 months after surgery with (intractable) pain, erythema, and a draining sinus tract. At 24 months following two-stage revision, the patient remains infection free.

Preoperative and postoperative clinical evaluations for the treatment group were performed by three authors (P.M.B, R.E. D., and M.A.M.) using the Knee Society and function scoring system.¹¹ Patients returned for postoperative evaluations at 6 weeks, 6 months, 1 year, and annually thereafter. Radiographic analysis was performed using standard anteroposterior (AP) and lateral radiographs at each clinical visit for all patients. One author (S.A.S.) reviewed all radiographs for the patient cohort.

Statistical Analysis

The data were analyzed using GraphPad Prism software (version 5.0; GraphPad Software, San Diego, CA). Paired Student *t*-tests were used to compare preoperative and postoperative variables within the study group. The end point of survival was defined as either revision (removal or exchange of one or more components) for any reason or as revision for aseptic loosening. All *p* values less than 0.05 were considered significant. In addition, gender, body mass index, and the underlying risk factors leading to TKA were correlated with the functional outcomes of the patient cohort.

Results

There was a significant improvement in preoperative Knee Society and function scores within the patient cohort. At final follow-up, the mean Knee Society and function scores in the study group were 90 (range, 61 to 100 points) and 90 (range, 45 to 100 points) points, respectively, having improved from

47 (range, 34 to 69 points) and 50 (range, 5 to 80 points) points preoperatively ($p < 0.0001$ and $p < 0.0001$, respectively). In addition, there was no significant effect on the functional outcome when correlated with gender, body mass index, and underlying risk factors leading to TKA.

There were several minor complications that led to subsequent procedures performed. Nine knees (24%) underwent at least one manipulation under anesthesia, and three knees (8%) were operated on for arthrofibrosis, with retention of components. All patients reported improvements in Knee Society pain and function scores following subsequent treatments, and are doing well at most recent follow-up of minimum 2 years. There were no occurrences of periprosthetic fracture.

There was one failure in this cohort. This occurred secondary to intractable stiffness and arthrofibrosis. Two manipulations under anesthesia were performed, 2 weeks and 3 months, respectively, after the index knee arthroplasty. The patient then underwent an open debridement procedure for arthrofibrosis 9 months after index arthroplasty, followed by a Judet quadricepsplasty at 21 months, and a repeat manipulation under anesthesia at 22 months. The patient continued to have severe stiffness and pain, ultimately leading to prosthesis removal and knee fusion 28 months after index arthroplasty.

Evaluation of radiographs of the knees did not reveal any component malalignment or radiolucencies. No abnormalities of the tibiofemoral angle, distal femoral angle, or proximal tibial angle were noted in the coronal plane on any AP radiographs. On comparison of yearly radiographs, there were no progressive radiolucencies noted on zonal analysis around either the tibial or femoral component for any patients.

Discussion

Although TKA has been extremely successful in the aging population with end-stage degenerative joint disease, there is a paucity of information in the literature regarding the use and survivorship of TKA in extremely young patients less than 40 years of age. The purposes of this study were to answer the following questions: (1) What were clinical outcomes in this patient population; (2) What were the complication rates; (3) What were the modes of failure, if any; and (4) What were the radiographic findings?

There are several limitations of this study. The first limitation is that the study is a small cohort of patients. TKA is not routinely performed on patients under 40 years of age, and many surgeons may feel uncomfortable performing this procedure on a young patient. Additionally, there are very few patients less than 40 years who suffer from end-stage degenerative joint disease; the senior authors of this report are extremely experienced, high-volume joint surgeons. In future studies, it may be possible to perform a multicenter study and recruit more high-volume institutions to contribute patient results to the study. Additionally, because this is such a young patient population, it is critical that this patient cohort be followed closely as they age to provide long-term

Table 1 Summary of Previous Studies

Author (Year)	Patients (Knees)	Mean Age (Range)	Mean Follow-Up (Range)	Survivorship	Complication Rate	Mean Preoperative KSS Objective (Range)	Mean Preoperative KSS (Functional) (Range)	Mean Postoperative KSS Objective (Range)	Mean Postoperative KSS (Functional) (Range)
Stern et al ¹² (1990)	50 (68 knees)	51 years (range, 36–55)	6.2 years (range, 2–10)	100%		53 points ^a (range, NR)		90 points ^a (range, NR)	
Dalury et al ¹³ (1995)	67 (103 knees)	36 years (range, 20–45)	7.2 years (range, 5.5–13)	100%	One knee infected; two patellar revisions	37 points (range, 12–57)	38 points (range, 12–57)	93 points (range, 80–100)	79 points (range, 10–100)
Duffy et al ¹⁴ (1998)	54 (74 knees)	43 years (range, 22–55)	13 years (range, 10–17)	97%		36 points (range, 10–80)	45 points (range, 0–100)	84 points (range, 34–100)	66 points (range, 34–100)
Gill et al ¹⁵ (1997)	50 (68 knees)	50.7 years (range, 30–55)	9.92 years (range, 5–18)	97%		23 points (range, 4–50)		97 points (range, 70–100)	
Hofmann et al ¹⁶ (2002)	57 (75 knees)	42 years (range, 31–50)	9.25 years (range, NR)	100%		67 points (range, 55–80)	53 points (range, 45–70)	98 points (range, 50–100)	95 points (range, 72–100)
Mont et al ⁵ (2002)	30 (30 knees)	43 years (range, 31–50)	7.16 years (range, 5–9)	97%		49 points ^b (range, 14–60)		89 points ^b (range, 36–100)	

^aHSS score.^bKnee Society score.

KSS, Knee Society score; HSS, Hospital for Special Surgery score; NR, not reported.

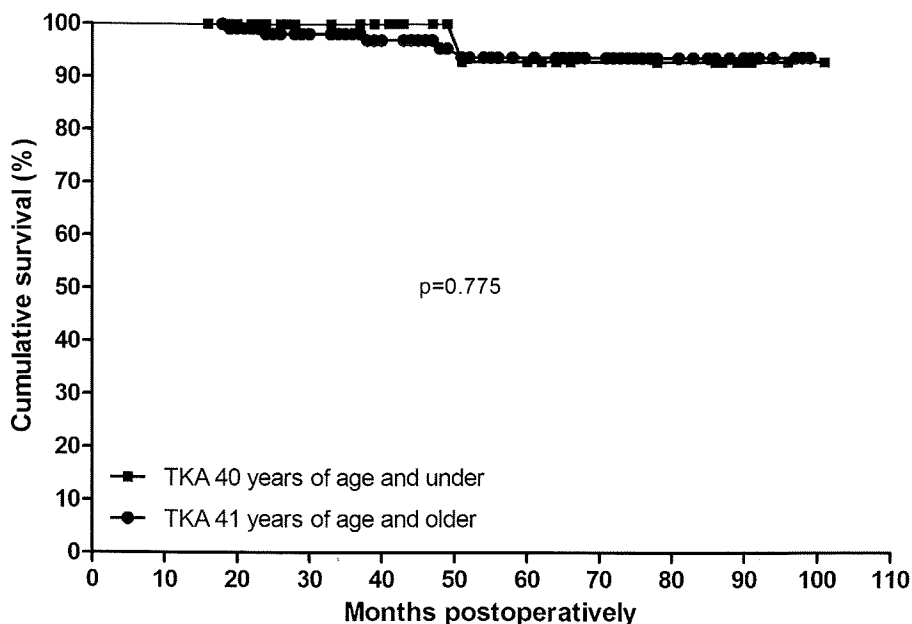


Figure 1 Kaplan-Meier survivorship curve.

follow-up on these patients. Although these early results are extremely promising, it is uncertain how well the implant will age as the patient ages.

There are several reports that report outcomes of “younger” patient populations, typically defined as a patient cohort with a mean age less than 65 years (Table 1). Revision rates ranged from 1 to 12.5%.³⁻⁷ In the largest of these studies, Gioe et al followed 1047 patients with a mean age of 49 years (maximum age of 55 years), with 14-year follow-up.⁴ The patients were operated on by 1 of 48 surgeons in a community hospital setting. There were 73 revision procedures performed for aseptic reasons, for a survivorship of 93%. Although the present study does not have follow-up to 14 years, our results show similar excellent results at short-term follow-up. The results of the study by Gioe et al are promising, in that TKA has reportedly performed well in a younger patient population at relatively long-term follow-up.

Alternative procedures are often considered for young patients with end-stage osteoarthritis. High tibial osteotomy is one such procedure.^{3,8,9} A large series by W-Dahl et al reported outcomes of both high tibial osteotomy and unicompartmental knee arthroplasty in patients.³ There were 450 high tibial osteotomies performed on patients whose ages ranged from 30 to 64 years. All patients were followed for 10 years. At final follow-up there was a reported revision rate of 17% (76 revisions) among patients who had undergone high tibial osteotomy. Although the maximum age was higher in the study by W-Dahl et al than the present study, the low survival rate of 83% indicates that in this patient population, a TKA may be a preferable treatment when compared with high tibial osteotomy.

Excellent clinical outcomes are reported for patients 40 years of age, or less, who have undergone TKA (►Fig. 1). For the young patient who is not a candidate for other types of joint conserving or preserving procedures, in the senior

authors' experience total knee arthroplasties have performed well.

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