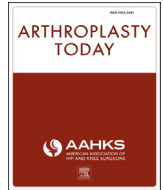




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Original research

Adolescent total knee arthroplasty

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ABSTRACT

Background: Management of adolescent patients with end-stage arthritis is challenging. Nonoperative treatments may be ineffective and total knee arthroplasty (TKA) is rarely performed. Currently, minimal long-term data are available on the outcomes in this patient population. Our goal was to describe TKA for patients with end-stage arthritis who were aged 20 years and younger.**Methods:** The Joint Registry at our institution was used to identify 19 patients (29 TKAs) aged 20 years and younger that underwent a primary TKA. The average age was 18 years (range 14–20 years) and follow-up was 14.5 years (range: 2.1–25.5 years).**Results:** The preoperative diagnoses were juvenile idiopathic arthritis (n = 19), avascular necrosis (n = 4), sepsis (n = 2), trauma (n = 2), dysplasia (n = 1), and hemophilia (n = 1). There was a decrease in the number of TKAs performed for inflammatory arthritis over the last several decades. Implant survivorship at 5 and 10 years was 96% and 94%, respectively.**Conclusions:** We identified a 95% 10-year implant survivorship utilizing standard TKA components in pediatric patients. Performing a TKA in adolescent patients has long-term potential risks including infection and bone loss but may provide pain relief and good long-term results and should be used with caution. Copyright © 2017 Published by Elsevier Inc. on behalf of American Association of Hip and Knee Surgeons. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Total knee arthroplasty (TKA) in patients less than 20 years old is a very rarely performed procedure. At our institution, this patient population comprises approximately 0.09% of all patients undergoing TKA. However, severe debilitating gonarthrosis has limited treatment options in adolescent patients. Most commonly, nonoperative modalities are recommended initially, which include activity modification, nonsteroidal anti-inflammatory agents, and knee braces. In some patients, nonoperative modalities do not provide enough pain relief and patients may experience an unacceptable decrease in quality of life. Current operative interventions

are limited, and long-term outcomes are poorly defined. The goal of this project was to define these outcomes for TKA in this unique patient population.

Surgical indications for adolescent TKA have been inadequately defined, and this operation should likely be reserved for a very specific subset of patients. Common pathologies that lead to severe joint destruction include juvenile rheumatoid arthritis, avascular necrosis (AVN), infection, and trauma.

There has been very limited research on adolescent TKA [1–3]. Most of the studies include a wide variety of patient populations encompassing both total hip arthroplasty patients and patients over 20 years old. One recent study specifically examined 105 patients 21 years and younger who underwent primary TKA [4]. However, most of this cohort had joint replacement surgery performed secondary to a preoperative diagnosis of tumor.

The aim of our present study was to determine the long-term outcomes in a subset of patients 20 years or younger who underwent TKA for end-stage arthritis. We specifically limited our patient population to patients who underwent TKA with primary knee replacements (excluding distal femoral replacements and hinges) and excluded patients with underlying

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malignancy or oncology diagnosis. We identified the most common complications and mechanisms of failure in this patient population. Finally, we determined the overall implant survivorship in this cohort.

Material and methods

The Total Joint Registry at our institution was evaluated from 1979 to 2013 to identify all cases of primary TKA performed on patients 20 years or younger. Institutional review board approval was obtained per institutional guidelines, and patients who denied research authorization were excluded. Both demographic and clinical data are routinely updated from inpatient and outpatient electronic medical records to ensure accurate and up-to-date information on patient outcomes in the Joint Registry. Selection criteria for our study included (1) primary TKA, (2) minimum follow-up of 2 years, and (3) age 20 years or less. Patients with an underlying diagnosis of tumor were excluded. Utilizing these criteria, we identified 19 patients (29 knees).

Demographic data were recorded for each patient including age at the time of the index surgery, sex, body mass index, and preoperative diagnosis. Underlying diagnoses were categorized as posttraumatic arthritis, inflammatory arthritis, degenerative arthritis, congenital conditions, and other diagnoses (including osteonecrosis). Standard patient follow-up included a 3-month, 1-year, 2-year, 5-year, and every subsequent 5-year recheck with clinical and radiographic evaluation at each time interval. Complications and reoperations were recorded on a continuous basis throughout the duration of the study. Complications were separated into intraoperative and postoperative as well as type of complication. Due to the complexity of the various complication codes entered into the Joint Registry Database, an all cause complication rate as well as the most common complication diagnoses were recorded.

Results

From 1979 to 2013, approximately 30,000 primary TKAs were performed at our institution. We identified 19 patients with 29 total knee arthroplasties with a minimum of 2-year follow-up (0.09% of all patients undergoing primary TKA). The average follow-up was 14.5 years (range 2–25). There were 24 TKAs (15 patients) with at least 5 years of follow-up and 17 TKAs (12 patients) available for follow-up at 10 years. Most patients were female ($n = 15$). The age at time of surgery ranged from 14 to 20 years old with an average age of 18 years old. Juvenile idiopathic arthritis was the most common underlying diagnosis for TKA ($n = 10$). Other underlying diagnoses included: AVN ($n = 3$), septic arthritis ($n = 2$), post-traumatic arthritis ($n = 2$), knee dysplasia ($n = 1$), and hemophilia ($n = 1$). Twenty-three of the 29 knees were posterior stabilized knees, 2 were constrained condylar knees, and 4 were unknown custom implants (Table 1).

Of the 19 knees that had a preoperative diagnosis of juvenile inflammatory arthritis, 8 were performed in the 1980s, 8 in the 1990s, 3 in the 2000s, and 0 in the 2010s (Fig. 1). In this group that underwent TKAs for inflammatory arthritis, no patients were on a biologic agent for inflammatory arthritis at the time of the TKA.

The overall revision free survival at 5 and 10 years was 96 and 94%, respectively. Twenty-two percent of knees required revision surgery ($n = 6$) at the time of final follow-up. The most common reasons for revision surgery included: aseptic loosening or polyethylene wear ($n = 4$) and infection requiring a 2-stage revision 16 years after the index procedure ($n = 1$) and one patient was revised at an outside facility for an unknown reason ($n = 1$) (Table 2). One patient had bilateral TKAs and developed significant polyethylene

Table 1
Patient demographic information.

TKA	Gender	Side	Diagnosis	Age at surgery	Implant	Follow-up (y)
1	Female	Right	AVN: steroid induced	15	PS ^a	5.90
2	Male	Left	AVN: steroid induced	18	PS	2.06
3	Female	Right	DJD	19	PS	9.50
4	Female	Left	DJD	19	PS	5.76
5	Male	Right	Inflammatory arthritis (JIA)	19	PS	2.30
6	Female	Left	Post-traumatic DJD	19	PS	5.54
7	Female	Right	DJD secondary to septic arthritis	20	PS	2.90
8	Male	Right	Blounts	19	PS ^a	5.51
9	Female	Left	Inflammatory arthritis (JIA)	15	CCK	16.19
10	Female	Right	Inflammatory arthritis (JIA)	15	CCK	16.19
11	Female	Left	Inflammatory arthritis (JIA)	16	PS	20.59
12	Female	Right	Inflammatory arthritis (JIA)	16	PS	20.59
13	Female	Right	Inflammatory arthritis (JIA)	19	PS ^a	15.26
14	Female	Left	Inflammatory arthritis (JIA)	20	PS	14.07
15	Female	Left	Post-traumatic DJD	19	PS	20.40
16	Female	Left	Inflammatory arthritis (JIA)	17	Custom	20.02
17	Female	Right	Inflammatory arthritis (JIA)	17	Custom	19.86
18	Female	Left	Inflammatory arthritis (JIA)	17	PS	19.84
19	Female	Right	Inflammatory arthritis (JIA)	17	PS	19.84
20	Female	Left	Inflammatory arthritis (JIA)	19	Custom	20.85
21	Female	Right	Inflammatory arthritis (JIA)	19	Custom	20.71
22	Female	Left	Inflammatory arthritis (JIA)	19	PS	22.57
23	Female	Right	Inflammatory arthritis (JIA)	19	PS	22.57
24	Female	Left	Inflammatory arthritis (JIA)	19	PS	25.54
25	Female	Right	Inflammatory arthritis (JIA)	19	PS	25.54
26	Female	Right	Inflammatory arthritis (JIA)	19	PS	6.01
27	Female	Left	Inflammatory arthritis (JIA)	19	PS	5.76
28	Female	Left	AVN: steroid induced	14	PS ^a	2.24
29	Female	Right	AVN: steroid induced	14	PS ^a	2.24

CCK, constrained condylar knees; DJD, degenerative joint disease; JIA, juvenile idiopathic arthritis; PS, posterior stabilized.

^a Designates rotating platform design.

wear at 12 years postoperatively, subsequently undergoing simultaneous bilateral polyethylene exchange. Two patients underwent revision surgery for aseptic loosening at 9 and 11 years post TKA.

In our studied patient population, 44% ($n = 11$) experienced a complication (Table 3). Stiffness was the most common complication with 15% of knees requiring a manipulation under anesthesia ($n = 4$). One of the knees requiring postoperative manipulation was noted to have had a preoperative diagnosis of arthrofibrosis requiring manipulation before the index TKA procedure. This patient had developed arthrofibrosis following an

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