



Arthroplasty in patients with rare conditions

Outcomes of Total Knee Arthroplasty with a Prior Contralateral Above-Knee Amputation: A Report of 10 Cases

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ABSTRACT

Background: Total knee arthroplasty (TKA) in the setting of a prior contralateral above-knee amputation (AKA) represents a rare scenario with limited reported outcomes. As such, it is difficult for surgeons to effectively counsel these patients relative to risks and expected outcomes after TKA. We report outcomes for a series of 10 such patients.

Methods: We retrospectively reviewed all patients at our institution from 2005 to 2018 who underwent a primary TKA and prior contralateral AKA and had a minimum 12-month follow-up. Data regarding complications, ambulatory status, reported pain, patient demographics, length of follow-up, and comorbidities were obtained.

Results: Ten patients met criteria. Follow-up ranged from 1 to 8 years. Six reported no pain or improved pain with weight-bearing. Ambulatory status worsened for 5 patients, remained unchanged for 3, and improved for 2. Five patients had significant postoperative complications: infection requiring repeat surgery (3), quadriceps tendon rupture (1), and revision for implant failure and instability (1). Patients in this cohort had a median of 3 medical comorbidities known to affect postoperative outcomes and complication rates.

Conclusions: While a contralateral AKA is not an absolute contraindication to TKA, these results should influence patient counseling. Most of our cohort benefited from improved pain, but only 2 of 10 had improved ambulation and half had significant complications. Medical comorbidities may have contributed to these complications. Surgeons contemplating TKA in this situation might consider modified postoperative recovery protocols and aggressive preoperative optimization of medical comorbidities to lower the risk of complication in this high-risk population.

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Introduction

Primary total knee arthroplasty (TKA) in the setting of a prior contralateral above-knee amputation (AKA) is an uncommon occurrence, and only limited data with respect to outcomes in this scenario have been published [1,2]. However, it has been reported that patients with a history of a transfemoral amputation are twice as likely to develop symptomatic contralateral osteoarthritic knee pain compared with nonamputees [3]. Another study demonstrated patients with a 5-year history of a unilateral traumatic amputation (transtibial, knee disarticulation, or transfemoral) had

greater than 16 times higher prevalence of osteoarthritis (OA) in the intact knee than a control-matched population [4]. It has also been reported that the intact knee sustains higher net joint moments in patients with a contralateral AKA [5]. Despite the increased incidence of OA and increased mechanical loads in the intact knee, little has been reported regarding outcomes after TKA in this patient population. Amanatullah et al. [1] reported results of a combined series of 12 TKAs contralateral to a lower extremity amputation, but only 6 of those patients had a contralateral AKA. We found only one other case report in the literature [2].

Because so little has been reported regarding outcomes in this patient population, it is difficult for surgeons to effectively counsel these patients relative to risks and expected outcomes after TKA. We retrospectively reviewed our institutional database and report outcomes for patients who underwent primary TKA in the setting of a contralateral AKA.

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Material and methods

All patients who underwent a TKA between 2005 and 2018 at the authors' institution and also had a pre-existing diagnosis of a contralateral AKA were retrospectively identified by International Classification of Disease codes for an AKA and Current Procedural Terminology codes for TKA. Once a list of patients was obtained, each patient's chart was reviewed for correlating time of AKA to time of TKA. Only patients whose AKA occurred before their contralateral TKA and who had at least 12 months of follow-up were included in the study. Data regarding patient demographics, follow-up clinic visits, complications, and comorbidities were collected from chart review. Additional outcome data including revision procedures, changes in ambulatory status, and reported knee pain were also retrieved from the medical record. Ambulatory ability and pain were recorded preoperatively and at 2 years. For the 3 patients with less than 24-month follow-up, ambulatory ability and pain were recorded at the most recent follow-up (2 at 12 months and 1 at 17 months). The study was approved by the institutional review board before beginning the study.

Results

A total of 4459 consecutive primary TKAs were identified from 2005 to 2018. Of those patients, 99 also had the diagnosis of an AKA in their chart. A review of each patient's chart revealed 12 patients (0.3% of the total) who had undergone an AKA on the contralateral extremity before their TKA procedure. Five patients underwent their AKA at the authors' institution, and 5 were identified by the diagnosis code on their chart's past medical and surgical histories. Two patients were lost to follow-up in the early postoperative period (2 weeks and 6 weeks) without complications over that brief interval. No updated contact information was discovered for these 2 patients, and they were ultimately excluded from the study. The remaining 10 patients had a minimum of 12 months of follow-up (range, 12 months to 103 months). Six different surgeons contributed cases to this cohort. Patient information is summarized in Table 1. Only one patient (patient 4) had stemmed implants placed as part of the initial TKA.

Etiologies for the contralateral AKA were heterogeneous and included sequelae of an infected TKA (3), traumatic injury (2), sarcoma (2), peripheral vascular disease (2), and a painful knee fusion with the patient electing for AKA (1). The median follow-up was 27.5 months (standard deviation [SD] of 29 months). The median age was 61 years (SD, 10 years). The median time between AKA and contralateral TKA was 1.8 years (SD, 16.1 years). The median body mass index (BMI) was 34 (SD, 7.4). With regard to comorbidities at the time of TKA, 7 had hypertension, 5 were active smokers, 3 had coronary artery disease, 4 had depression, 3 had

diabetes mellitus, 2 had a BMI greater than 40, 2 had peripheral vascular disease, 2 had chronic obstructive pulmonary disease, 1 had chronic kidney disease, 1 had a history of a stroke without deficits, and 1 had rheumatoid arthritis. All these comorbidities are known to adversely affect outcomes and/or increase complication rates after TKA [6–8]. This cohort had a median of 3 such comorbidities per patient.

Pain

Outcome results are summarized in Table 2. All 10 patients had end-stage OA as an indication for TKA. Postoperatively, 6 of 10 reported improved knee pain. Of these 6 patients, 3 reported complete resolution of preoperative knee pain and 3 reported improvement without complete resolution of knee pain. The other 4 patients saw no improvement compared with preoperative pain.

Ambulatory status

Only 2 of 10 patients showed any evidence of improvement in ambulatory ability. One went from a prosthesis and cane to prosthesis only. The other transitioned from using a wheelchair and prosthesis to exclusively using her prosthesis. Both had no reported complications. Three patients had no change in ambulatory ability, and 5 had worsened ambulatory abilities at the last follow-up. Of note, of the 4 patients who used a wheelchair preoperatively, only one reported ceasing to use the wheelchair postoperatively. In addition, 2 patients who did not use a wheelchair preoperatively were unable to give up using a wheelchair postoperatively.

Complications

Five of 10 patients had significant complications requiring at least one additional procedure. Two underwent 2-stage reconstructions for infection; 1 underwent a poly swap for an early wound dehiscence and infection (also experienced instability after the revision); 1 underwent revision for mechanical failure and instability (instability remained); and 1 underwent quadriceps tendon repair for an acute, traumatic rupture in the early postoperative period. An additional patient suffered a greater trochanter fracture after an early postoperative fall, which healed nonoperatively. However, this patient had a poor ambulatory ability outcome going from prosthesis only to wheelchair bound. Of note, of the 4 patients who had no complications, only 2 had improved ambulatory status at the last follow-up. None of the patients in this study were found to have early aseptic loosening.

Table 1
Patient demographics and significant preoperative comorbidities.

Patient number	Sex	Reason for AKA	Age at TKA	Years to TKA	Months of follow-up	BMI	Preoperative comorbidities
1	Female	Infections of TKA	64	1.0	21	35.7	HTN, CAD, DM, CKD, depression
2	Male	Infections of TKA	66	2.0	37	26.1	CAD, COPD, smoker
3	Male	Infections of TKA	53	4.9	36	46.0	HTN, CAD, DM, stroke
4	Male	Traumatic Injury	59	10.2	103	35.5	–
5	Female	Traumatic Injury	54	27.2	17	31.5	HTN, smoker
6	Male	Sarcoma	40	1.6	12	43.5	HTN, depression
7	Male	Sarcoma	76	49.6	12	29.4	HTN, COPD, smoker
8	Male	Peripheral vascular disease	56	1.2	26	21.8	PVD, smoker
9	Female	Peripheral vascular disease	69	1.6	71	30.6	HTN, PVD, depression, RA
10	Male	Painful knee fusion who elected for AKA	63	1.0	34	35.9	HTN, DM, smoker, depression

HTN, hypertension; CAD, coronary artery disease; DM, diabetes mellitus; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; PVD, peripheral vascular disease; RA, rheumatoid arthritis; smoker, current tobacco user.

Table 2
Patient complications and outcomes.

Patient number	Complications	Preoperative ambulatory status	Postoperative ambulatory status ^a	Pain outcomes ^a
1	Postoperative fall sustaining nonoperative greater trochanteric fracture	Prosthesis only	Wheelchair, independent transfers, unable to use prosthesis	Pain unchanged from preoperative
2	None	Prosthesis with cane	Prosthesis only	No pain
3	Two-stage revision for infection 6 months post-op	Wheelchair, independent transfers	Wheelchair, independent transfers	Pain unchanged from preoperative
4	Two-stage revision for infection 5 months postoperative	Prosthesis only	Prosthesis with a walker	No pain
5	None	Wheelchair and prosthesis, independent transfers	Prosthesis only	Pain present but improved from preoperative
6	Poly exchange 3 weeks postoperative for infection, instability in extension	Prosthesis only	Prosthesis only	Pain unchanged from preoperative
7	Acute, traumatic quadriceps tendon rupture in early postoperative period	Crutches	Wheelchair and prosthesis, independent transfers	No pain
8	None	Prosthesis only	Prosthesis with crutches	Pain present but improved from preoperative
9	None	Wheelchair, independent transfers	Wheelchair, independent transfers	Pain present but improved from preoperative
10	Revisions for flexion contracture, flexion instability, and extruded poly (pre-existing patellectomy)	Wheelchair and prosthesis, independent transfers	Wheelchair only, independent transfers	Pain unchanged from preoperative

^a Data recorded at 2 y postoperatively or last follow-up between 12 and 24 mo.

Discussion

TKA after contralateral AKA is a rare occurrence. The results of our retrospective review demonstrate that 6 of the 10 patients in this cohort experienced improvement of knee pain, with 3 of those reporting complete resolution of their preoperative knee pain. However, improved ambulatory abilities were limited to only 2 patients, and half of the patients in this cohort experienced significant complications. Only 1 of 10 patients had the ideal outcome of resolution of pain, improved ambulatory status, and no complications. Although a prior contralateral AKA is not a contraindication for TKA, this series demonstrates that a primary TKA in this situation is not a 'routine' primary TKA.

Within the United States, 29% of the greater than 450,000 adults who underwent an AKA for all etiologies from 1998 to 2013 were younger than 65 years [9], which is an average of about 8700 patients per year younger than 65 years. Depending on ambulatory capabilities, young amputees are more likely than the general population to eventually develop symptomatic contralateral osteoarthritic knee pain [3,4], leading some to seek relief with a TKA. For example, about 500 military deployment-related AKAs were reported from 2001 to mid-2017 in the United States military population, representing a young and active population who might be at risk for developing symptomatic knee pain and knee OA of the intact side [10]. Other young traumatic amputees or young tumor-related amputees may face a similar situation as they age. Thus, several thousand such patients may seek TKA for their symptomatic OA of their remaining knee in a given year in the United States, a small but not insignificant number.

Our cohort reflects the myriad indications for AKA, including trauma, malignancies, vascular compromise, congenital malformations, failed joint arthroplasties, and infection of various etiologies [11]. Regardless of etiology, amputations above the knee significantly affect both functional ability and quality of life compared with the general population, with factors such as the use of an assistive device, the use of a prosthesis, and medical comorbidities playing significant roles [12]. Energy usage required for daily activities increases after AKA [13], and healthy, active patients can compensate well with the use of a prosthesis or other devices and lead active lifestyles. However, as these patients age, aerobic capacity naturally decreases, and medical comorbidities and ambulatory ability may worsen with age [14,15]. Patients in our cohort had a median of 3 significant comorbidities, which have been shown to adversely

affect outcomes and/or increase complication rates after TKA. The small sample size in this unique population, and the wide range and combinations of comorbidities, precluded us from statistically analyzing the effects of comorbidities vs the mechanical effects of the AKA in a reliable case-control matched group.

Although a majority of the patients in this cohort reported improvement or even resolution of preoperative pain, ambulatory ability for most did not improve or in some cases even deteriorated postoperatively. Comorbidities such as renal disease, atherosclerosis, and diabetic neuropathy have been reported to be independent predictors of subsequent contralateral lower extremity amputations when present during a nontraumatic, nontumor lower extremity amputation [16], suggesting a higher incidence of functionally limiting pathology in the intact extremity in patients with these comorbidities. Furthermore, amputees have been shown to have an increased incidence of psychiatric comorbidities such as psychiatric disability and depression, which are known risk factors for adversely affecting pain and function after TKA [17,18]. Therefore, comorbidities may predict long-term outcomes and function with continued health deterioration in this population.

Correlation of this study's patient comorbidities, characteristics, complications, and AKA etiology with ambulatory status and pain outcomes suggests a multifactorial relationship. However, there were some trends in our data. All 4 patients with no complications experienced improved pain, but only 2 had improved ambulatory status. The 4 patients who had a prior AKA from either a traumatic injury or due to peripheral vascular disease had improvements in pain. Both patients with a BMI greater than 40 had no improvements in either ambulatory status or pain. On the other hand, all 3 patients with diabetes mellitus showed no improvement in either ambulatory status or pain, and all 5 patients with depression showed no improvement in ambulatory status. These trends can be kept in mind when evaluating patients preoperatively, especially those with a BMI greater than 40, diabetes mellitus, and/or depression.

Of the complications we report, implant failure and instability might also be due to biomechanical factors. Active patients with a transfemoral or transtibial amputation compensate for loss of that extremity by increasing net joint moments and power output on their contralateral limb [5]. It has been reported that joint moments in the knee increase after contralateral AKA [5]. However, we did not have a case of early aseptic loosening, such as has been reported by others in this population, and we do not disagree with those authors' recommendation for augmented tibial fixation in this

setting [1]. Four of our patients (patients 1, 6, 7, and 10) exhibited some form of mechanically related issue. While this increased demand on the intact knee may contribute to the increased incidence of OA in the knee [4], one must also wonder how that same increased load affects TKA postoperatively.

This is a retrospective chart review study and as such has all the inherent weaknesses of such a design. The weaknesses in our study are similar to those reported by Amanatullah et al. [1], which include fidelity of the record, variability among surgeons, and loss to follow-up. Low numbers in this study preclude us from statistically separating the effect of the AKA and the effects of comorbidities on outcomes. However, given the lack of data regarding this condition in the current literature, the amount of detail we were able to extract is still useful in better understanding this rare clinical situation and will be helpful in furthering the understanding and expectations for both surgeons and patients. This series more than doubles the reported cases of this population in the current literature. The only other series we identified includes 12 TKAs after contralateral amputation [1]. These authors combined data from 6 patients who underwent AKA and 6 patients who underwent below-knee amputation, making it difficult to compare our data directly to theirs. For 33% of their patients, the indication for the AKA was unknown. Other than an isolated single-patient case report, we could find no other series that reports results of TKA after a prior contralateral AKA [2].

Conclusions

This series represents a diverse group of patients undergoing primary TKA after prior contralateral AKA and more than doubles the number of reported cases in the literature. A majority of our cohort benefited from improved knee pain, but few had improved ambulation ability and half had significant complications. Prior contralateral AKA does not constitute a contraindication to TKA because many patients did report improvements in pain. However, patients and surgeons should be aware that few of these patients improved their ambulatory ability and that the risk of complication was high. Surgeons contemplating TKA in this situation might consider modified postoperative recovery protocols because of altered biomechanics and aggressive preoperative optimization of medical comorbidities to lower the risk of complication in this high-risk population.

Key Points

- TKA after prior contralateral AKA is a rarely reported occurrence.
- This report more than doubles the number of reported cases in the literature.
- TKA after contralateral AKA improved pain with weight bearing for some patients. TKA after contralateral AKA has high complication rates. TKA after contralateral AKA did not improve ambulatory ability for most patients.

Conflict of interest

The authors declare there are no conflicts of interest.

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