

ABOVE-THE-KNEE AMPUTATION AFTER A TOTAL KNEE REPLACEMENT

PREVALENCE, ETIOLOGY, AND FUNCTIONAL OUTCOME

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Background: Despite modern surgical techniques, salvage of a failed total knee replacement remains a challenge. In certain situations, when other treatment options have been exhausted, patients with a failed total knee replacement may become candidates for above-the-knee amputation. The objective of this study was to assess the prevalence, etiology, and functional outcome of above-the-knee amputation performed proximal to an ipsilateral total knee replacement.

Methods: From 1970 to 2000, 18,443 primary total knee replacements were performed at our institution; sixty-seven (0.36%) were eventually followed by above-the-knee amputation. Forty-two of the amputations were performed for a cause unrelated to the total knee replacement, most commonly peripheral vascular disease (twenty-four knees). The remaining twenty-five above-the-knee amputations were performed for causes related to the total knee replacement: nineteen were done for uncontrollable infection; two, for periprosthetic fracture; two, for pain; one, for severe bone loss; and one, for a vascular complication.

Results: The twenty-five above-the-knee amputations performed for causes related to the total knee replacement were done at an average of 8.6 years (range, eight days to 23.6 years) after the replacement. The prevalence of above-the-knee amputations done for causes related to total knee replacement was 0.14%. Complications after the above-the-knee amputation included deep infection in five patients and superficial infection and skin necrosis in one each; there was also one perioperative death. Nine of the twenty-five limbs were fitted with an above-the-knee prosthesis, but only five patients were walking even to a limited degree with the prosthesis at the time of the last follow-up.

Conclusions: The overall prevalence of amputation after total knee arthroplasty at our tertiary care center was 0.36%. The majority (63%) of the amputations were performed for reasons not attributable to complications of the arthroplasty. The functional outcome after amputation performed above a total knee replacement is poor. A substantial percentage of the patients were never fitted with a prosthesis, and those who were seldom obtained functional independence.

Level of Evidence: Prognostic study, Level II-1 (retrospective study). See Instructions to Authors for a complete description of levels of evidence.

Usually, when a total knee replacement fails, revision total knee replacement is a reliable treatment with durable results¹. Unfortunately, salvage of a failed total knee replacement in the presence of recurrent infection or severe bone loss remains difficult and, in extreme situations, alternatives such as above-the-knee amputation, arthrodesis, or resection arthroplasty must be considered^{2,3}.

Both patients and surgeons regard above-the-knee amputation as a last resort for the treatment of a failed total knee replacement. The prevalence, etiology, and outcomes of above-the-knee amputations after failed total knee replacement are

not well documented. The objective of this study was to report those findings.

Materials and Methods

Data Collection

All patients who underwent a primary total knee replacement at the Mayo Clinic, Rochester, Minnesota, and subsequently had an above-the-knee amputation proximal to the arthroplasty between 1970 and 2000 were identified from our total joint registry. Demographic information was obtained, and the patients (or family members if the patient had died) were contacted by telephone. We collected information from the records on the hospitalization for the primary total knee replacement, which included the underlying diagnosis, the number and type of previous surgical procedures on the knee,



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and pathological conditions affecting the concomitant hip, knee, or ankle. The overall medical condition of the patient was evaluated on the basis of comorbid medical conditions and calculation of a Charlson comorbidity index⁴, which identifies nineteen comorbid conditions and weighs each condition with integer weights. The American Society of Anesthesia score was used as an indication of preoperative medical risk⁵.

Functional outcome was assessed with use of specific items from the Functional Independence Measure⁶. This score has been used to document the severity of physical disability and to measure the outcomes of patients undergoing rehabilitation. In addition, data regarding the use of aids for walking, the distance that the patient could walk, the ability to go up stairs, and the ability to get out of a chair with or without a lower-extremity prosthesis were collected.

Results

Prevalence, Etiology, and Demographic Data

From 1970 to 2000, 18,443 primary total knee replacements were performed at the Mayo Clinic, and review of our total joint registry in 2001 demonstrated that sixty-seven (0.36%) of those replacements were eventually followed by above-the-

knee amputation (Fig. 1). All of the index total knee replacements were performed at the Mayo Clinic, but not all of the amputations were performed there; information about the amputations was obtained at the time of scheduled follow-up or from our total joint registry. The staff maintaining our registry regularly makes queries (at one, two, five, ten, and fifteen years) about all of the patients who have undergone joint replacement at the Mayo Clinic.

Of the sixty-seven amputations, forty-two (63%) were performed for causes unrelated to the total knee replacement. The indications for those forty-two amputations included peripheral vascular disease in twenty-four, tumor recurrence in thirteen, and diabetic neuropathy in five. Twenty-five above-the-knee amputations were performed for causes related to the total knee replacement. Thus, the prevalence of above-the-knee amputations directly related to complications of total knee replacement was 0.14% (twenty-five of 18,443). The reasons for those amputations included uncontrollable infection in nineteen knees (76%), periprosthetic fracture in two (8%), intractable pain in two (8%), and severe bone loss and a vascular complication in one (4%) each. These twenty-five cases are the primary focus of the current study (Table I).

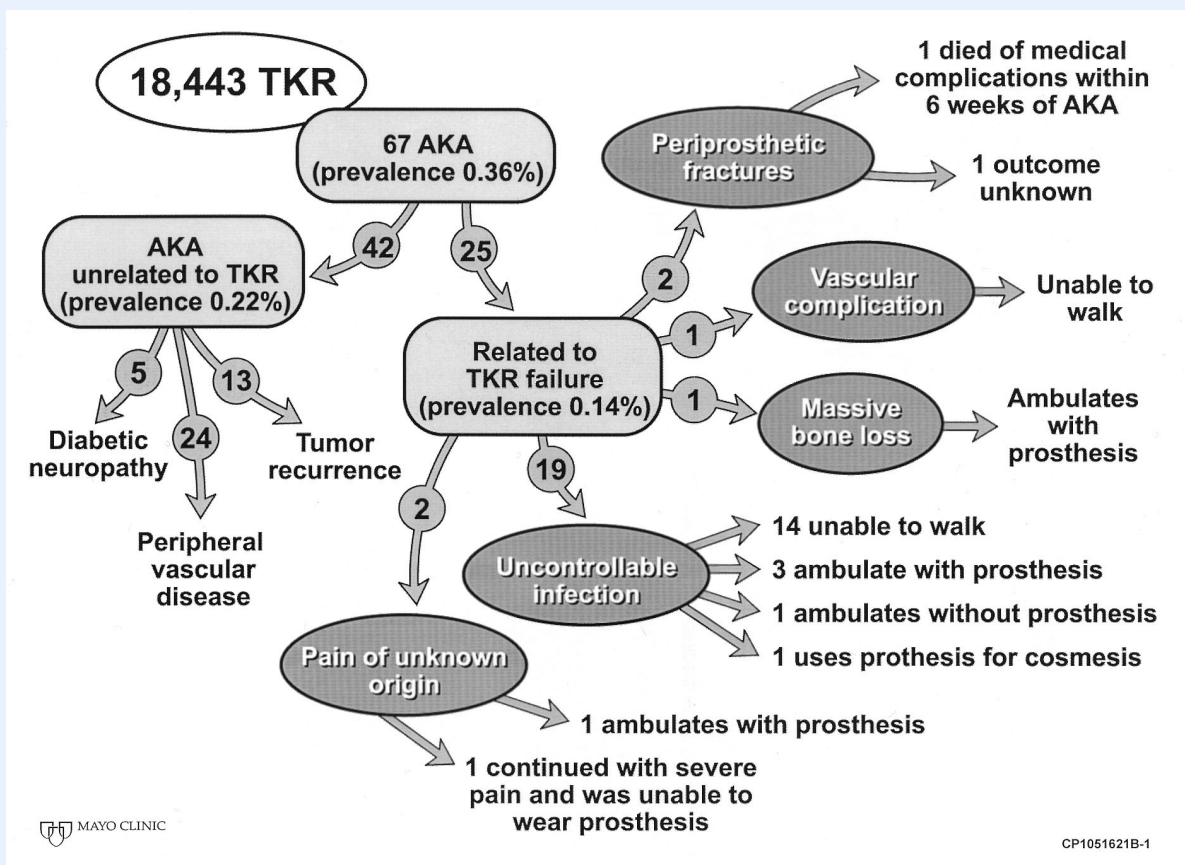


Fig. 1

Above-the-knee amputations (AKA) following total knee replacement (TKR) performed at the Mayo Clinic between 1970 and 2000. (Printed with permission of the Mayo Foundation.)

TABLE I Patients with Above-the-Knee Amputation Performed for Problems Directly Related to the Total Knee Replacement

Case	Age at Amputation (yr)	Gender	Index Diagnosis	Reason for Amputation	Charlson Index ¹	Prosthesis Fitted	Able to Walk at Last Follow-up	Comments
1	85	M	Posttraum. arth.	Infection	4	No	Unable	
2	84	M	Osteoarth.	Vascular complication	8	Yes	Unable	
3	70	F	Osteoarth.	Infection	4	Yes	Unable	
4	74	M	Rheum. arth.	Infection	5	No	Unable	Contralat. amputation above native knee
5	60	M	Osteoarth.	Severe bone loss	3	Yes	<5 blocks, cane full-time	
6	78	M	Rheum. arth.	Infection	5	Yes	Unable	
7R	70	M	Rheum. arth.	Infection	4	No	Unable	Bilat. above-the-knee amputation
7L	74	M	Rheum. arth.	Infection	4	No	Unable	Bilat. above-the-knee amputation
8	62	F	Rheum. arth.	Infection	3	No	Unable	
9R	59	F	Rheum. arth.	Infection	2	No	Unable	Bilat. above-the-knee amputation
9L	59	F	Rheum. arth.	Infection	2	No	Unable	Bilat. above-the-knee amputation
10	87	F	Posttraum. arth.	Infection	4	No	In house, 2 crutches	No prosthesis
11	81	F	Osteoarth.	Infection	5	No	Unable	Arthrodesis, contralat. knee
12	58	F	Rheum. arth.	Infection	2	Yes	Unable	Prosthesis for cosmetic reasons
13	76	F	Osteoarth.	Periprosthetic fract.	7	No	Unable	Periop. death
14	90	F	Osteoarth.	Pain, unknown origin	7	No	Unable	Persistent severe pain
15	77	F	Rheum. arth.	Periprosthetic fract.		Unknown	Unknown	
16	77	F	Osteoarth.	Infection	6	No	Unable	Previous below-the-knee amputation on ipsilat. side
17	76	M	Posttraum. arth.	Infection	4	Yes	<5 blocks, no aids	
18	77	F	Osteoarth.	Infection	9	No	Unable	
19	64	M	Posttraum. arth.	Infection	5	Yes	Housebound, 2 crutches	
20	57	M	Pigmented villonodular synovitis	Pain, unknown origin	3	Yes	Unlimited, cane full-time	
21	60	M	Posttraum. arth.	Infection	2	Yes	<5 blocks, 2 crutches	
22	64	M	Osteoarth.	Infection	5	No	Unable	
23	66	F	Posttraum. arth.	Infection	2	No	Unable	

The twenty-five above-the-knee amputations performed for causes related to the total knee replacement were performed in eleven men and twelve women with an average age of 71.5 years at the time of the amputation. Fifteen patients were still alive at the time of final follow-up. The average age at the last follow-up examination was seventy-five years. The average duration between the amputation and the time of final follow-up or death was 4.5 years. The average time between the index total knee replacement and the amputation was 8.6 years (range, eight days to 23.6 years).

The underlying diagnosis prior to the total knee replacement was osteoarthritis in nine knees, rheumatoid arthritis in nine, posttraumatic arthritis in six, and pigmented villonodular synovitis in one. The index total knee replacement was performed during the 1970s in eleven knees, during the 1980s in nine, and during the 1990s in five. Eleven knees had undergone one or more previous operations, which included four proximal tibial osteotomies, three cheilectomies and débridements, three open reductions with internal fixation for a fracture, and two unicompartmental knee replacements. Complications associated with the index total knee replacement included deep infection in nineteen knees, periprosthetic fracture in four, patellar tendon rupture in four, component loosening in three, urinary tract infection in association with two, hematoma formation in one, arthrofibrosis in one, and arterial vascular injury in one. Prior to the amputation, thirteen knees (52%) had not required a revision total knee replacement, four had had one revision, six had had two revisions, and two had had three or more.

Comorbid Medical Conditions

The patients had multiple medical conditions, most commonly heart, lung, and peripheral vascular disease. The Charlson comorbidity index, which we were able to calculate for all patients except one, averaged 4.375 (range, 2 to 9) (Table I). The average American Society of Anesthesia physical status score at the time of the initial total knee replacement was 2.8.

Prosthetic Fitting and Functional Outcome

After amputation, only nine knees were fitted with a prosthesis. These nine knees included two of the nine with rheumatoid arthritis, three of the nine with osteoarthritis, three of the six with posttraumatic arthritis, and the knee affected by pigmented villonodular synovitis. At the time of the last follow-up, only five patients wore the prosthesis for walking, and only one of the twenty-two patients for whom follow-up information was available was able to walk independently without the use of aids. Of those who did use a prosthesis, one patient could walk an unlimited distance; three, less than five blocks; and one, within the confines of his house. Two of these patients used two crutches, and two used a cane at all times to get around. The patients who were fitted with a prosthesis and were walking at the time of the last follow-up were on the average younger (63.4 years) than the group as a whole (71.4 years) at the time of the amputation.

Complications

Eight knees (32%) had a complication after the amputation. These included five deep infections (with revision to a more proximal level in two), one superficial infection, one case of skin necrosis, and one perioperative death.

Discussion

The overall prevalence of above-the-knee amputation after primary total knee replacement originally performed at our institution was 0.36% (sixty-seven of 18,443). The above-the-knee amputations included those performed at our institution and other institutions, those done for medical conditions unrelated to the total knee arthroplasty, and those performed because of complications attributable to the total knee arthroplasty (twenty-five amputations; prevalence, 0.14%). Although the staff maintaining our total joint registry queries patients at regular intervals and specifically asks whether any additional surgery had been performed, we may have underestimated the true prevalences if we failed to capture data on some patients who had an amputation at another institution. Additionally, the prevalences may be skewed because our referral institution, in which many complex primary and revision arthroplasties are performed, may not be representative of a community practice.

We are aware of two previous studies that addressed the results of above-the-knee amputations after failed total knee replacement. Pring et al. reported on twenty-four patients who had had an above-the-knee amputation following ipsilateral total knee arthroplasty, but they did not estimate the prevalence of amputation following total knee arthroplasty.⁷ In another series, Isiklar et al.⁸ reported on nine above-the-knee amputations performed in eight patients during a ten-year period in which 5045 total knee replacements had been performed at their institution; the prevalence of above-the-knee amputation after total knee replacement was thus 0.18%.

We found that above-the-knee amputation after an ipsilateral total knee replacement was done far more frequently for causes unrelated to the total knee replacement than as a consequence of a failed arthroplasty. Most of the amputations that were unrelated to the arthroplasty were performed because of peripheral vascular disease or recurrence of a malignant tumor. Most of the amputations performed as a consequence of a failed total knee arthroplasty were done as a last resort to treat severe infection, pain, or massive bone loss. Three-fourths of the knees had an uncontrollable and occasionally life-threatening infection (with massive bone loss in some of them) that had not been eradicated by previous surgical and medical treatment. The most common underlying diagnosis for these knees was rheumatoid arthritis or posttraumatic arthritis. While some authors have reported that patients with those diagnoses are at higher risk for deep infection after total knee replacement, with the small numbers available we were unable to determine the relative risks of such diagnoses prior to total knee replacement resulting in the subsequent development of uncontrollable

infection culminating in above-the-knee amputation^{9,10}.

Severe periprosthetic fracture or massive bone loss constituted the second most common reason for amputation in the current series (three of twenty-five) as well as in the study by Pring et al. (five of twenty-three)⁷. Currently available modular total knee revision systems, particularly those designed for oncologic applications, can now address a wide array of bone deficiency problems. In some patients, however, the extent and location of the bone deficiency coupled with comorbid factors may still dictate above-the-knee amputation as the treatment of choice.

Arterial complications after total knee replacement are rare but dramatic and disconcerting problems for the patient and surgeon alike. The prevalence of vascular complications after total knee replacement is quite low, with reported rates ranging between 0.03% and 0.17%¹¹; the reported rates of amputations after these vascular complications have ranged between 25% and 43%. This complication most commonly occurs in patients with preexisting atherosclerotic disease. In the present series, only one patient underwent above-the-knee amputation secondary to vascular occlusion, eight days after a primary total knee replacement.

Our results showed that the functional outcome after above-the-knee amputation for patients with a failed total knee replacement is poor. In two prior studies, 43% and 12.5% of such patients used a lower-extremity prosthesis after an above-the-knee amputation^{7,8}. In our study, only nine of the knees were fitted with a prosthesis after the above-the-knee amputation, only five patients ever used it for walking, and all except one patient continued to need walking aids at the time of the last follow-up.

The reason for the poor functional results after amputation above a failed total knee arthroplasty is probably multifactorial. A majority of the patients in the present series had the above-the-knee amputation because of infection, and it is clear that patients with severe infection are often markedly debilitated and malnourished. Our patients also had substantial medical comorbidities, as reflected by an average comorbidity index of 4.45 prior to the index total knee replacement. This score was much higher than scores reported for other groups of patients

undergoing primary and revision total hip and knee replacement (mean, 2.7¹²). Walking with a prosthesis also requires substantially higher energy expenditure than does normal gait, and even after rehabilitation these patients may never regain the combination of strength and stamina needed to walk with a prosthesis. Similarly, a substantial subgroup of the patients in our study had an underlying diagnosis of rheumatoid arthritis, which is often associated with other medical comorbidities and with an increased risk of wound-healing problems. In addition, such patients may have multiple joint disease, which makes it difficult to put on and take off a prosthesis.

In conclusion, the prevalence of above-the-knee amputation after total knee arthroplasty at our institution was 0.36%. This prevalence may be somewhat biased by the fact that we are a large tertiary care center. The majority (63%) of the amputations were performed for reasons not attributable to complications of the arthroplasty.

The functional outcome after amputation above a total knee replacement is very poor. A substantial percentage of patients are never fitted with a prosthesis, and few are able to obtain functional independence. Although above-the-knee amputation may occasionally be required as the definitive treatment for a failed total knee replacement, both the patient and the surgeon should be aware of the substantial functional limitations that are likely to follow, especially in older patients with multiple comorbidities. ■

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