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Original Article

Amputation after failure or complication of total knee arthroplasty: prevalence, etiology and functional outcomes☆,☆☆

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ABSTRACT

Objective: Identify the etiology and incidence, as well to assess functional outcomes of patients, undergoing lower limb amputation after failure or complication of total knee arthroplasty. These patients were treated at the Center for Knee Surgery at the National Institute of Traumatology and Orthopedics (INTO), during the period of January 2001 to December 2010.

Methods: The patients were interviewed and their charts were retrospectively analyzed to evaluate their functional outcome.

Results: The incidence of amputation due to failure or complication of total knee arthroplasty was 0.41% in 2409 cases. Recurrent deep infection was the cause of amputation in 81% of cases, being *Staphylococcus aureus* and *Pseudomonas aeruginosa* the most frequent germs. Vascular complications and periprosthetic fracture associated to metaphyseal bone loss were also causes of amputation. In our study, 44% of amputees patients were using orthesis and 62.5% have had the ability to walk.

Conclusion: Incidence of 0.41%, being the main cause recurrent infection. The functional outcome is limited, and the fitting achieved in 44% of patients and only 62.5% are ambulatory.

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☆☆ Study conducted at the Knee Surgery Center, Instituto Nacional de Traumatologia e Ortopedia, Rio de Janeiro, RJ, Brazil.

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Amputação após falha ou complicação de artroplastia total de joelho: incidência, etiologia e resultados funcionais

Palavras-chave:
Complicações pós-operatórias
Amputação
Artroplastia do joelho

RESUMO

Objetivo: Identificar a etiologia e a incidência da amputação do membro inferior após falha ou complicação da artroplastia total de joelho e avaliar os resultados funcionais dos pacientes tratados pelo Centro de Cirurgia de Joelho do Instituto Nacional de Traumatologia e Ortopedia (Into) entre janeiro de 2001 e dezembro de 2010.

Métodos: Os prontuários foram retrospectivamente analisados para coleta dos dados e entrevista para avaliação do resultado funcional.

Resultados: A incidência de amputação em decorrência de falha ou complicação após 2.409 artroplastias totais de joelho foi de 0.41%. Infecção profunda recorrente foi causa de amputação em 81% dos casos. Os germes mais frequentes foram *Staphylococcus aureus e Pseudomonas aeruginosa*. Complicações vasculares e fratura periprotética associada a perda óssea metafisária representaram indicação em menor número de casos. Em nosso estudo, 44% dos pacientes amputados apresentam–se protetizados e 62.5% apresentavam capacidade de deambulação.

Conclusões: Incidência de 0.41% e principal causa infecção recorrente. O resultado funcional é limitado, a protetização foi alcançada em 44% dos pacientes e somente 62.5% são deambuladores.

Introduction

The concept of improving joint function through modification of its surface was proposed by Verneuil[1] in 1860, by means of interposition of soft tissues for joint reconstruction. In this procedure, despite pain reduction and increased mobility, the joint stability achieved was unsatisfactory and gave rise to impaired functional results.

Today, total knee arthroplasty (TKA) is an effective option, with a high success rate in treating cases of advanced destruction of this joint caused by primary or secondary osteoarthrosis. It provides considerable pain relief, correction of deformities and improvement of limb function, and consequently better quality of life for these patients.[2,3]

In medium and long-term clinical evaluations, several authors have demonstrated good or excellent results in more than 90% of their patients who received knee prostheses.[4–6] In other studies, the degree of satisfaction reported by patients has been analyzed, and these reports have corroborated the satisfactory data, with good or excellent results in around 90% of the patients.[7–9]

In several centers around the world, the durability of these implants with maintenance of joint adequate function has been shown to be greater than 92%, 13–15 years after the initial surgery.[8–12]

Because of the satisfactory results, the increased life expectancy among the population and the better quality of life that is sought, the numbers of TKA procedures is currently increasing. In 2002, in the United States, there was a 5% increase in the number of TKAs performed in relation to the previous years.[13] Kurtz et al.[14] estimated that by the year 2030, the number of primary TKA procedures performed in that country would increase by 670%.

In some cases, after several years of durability and adequate functioning, arthroplasty may present failure. In such cases, revision surgery becomes necessary, and satisfactory clinical results are often obtained.[15,16] In other cases, arthroplasty may present failure or complications that are difficult to deal with.

Recurrent infection at prosthesis sites, cutaneous or vascular complications and significant loss of bone stock are challenging problems that are difficult to solve and which sometimes have unsatisfactory results. In these situations, arthrodesis and resection arthroplasty are management options for limb salvage. However, in some cases, the treatment may be unsuccessful and these patients become candidates for limb amputation.

Materials and methods

The aims of this study were to identify the etiology and incidence of lower-limb amputation after failure of or complications from TKA, and to evaluate the functional results among patients treated at the Knee Surgery Center of the National Institute of Traumatology and Orthopedics (INTO) between January 2001 and December 2010.

This study was submitted for evaluation and approval by the Research Ethics Committee of INTO and was conducted at the Knee Surgery Center of this institution.

The patients included in this study underwent amputation of all or part of a lower limb consequent to failure or complications after conventional primary TKA. Patients who underwent amputation due to failure of or complications from surgical procedures other than knee prosthesis implantation were excluded.

The medical files were retrospectively analyzed in order to gather demographic data, indications for primary

arthroplasty, date when arthroplasty was performed, durability of the implant, surgical risk (ASA), postoperative complications, TKA failure mechanism, number of reoperations and treatments for complications and the amputation level.

The total number of knee arthroplasty procedures performed over the period was obtained from the computerized records of INTO.

To evaluate the functional results, the patients were interviewed and were asked whether they were using a prosthesis, whether they were capable of walking, what distance they were able to walk and whether some form of support was needed for walking.

Results

Between January 2001 and December 2010, 2409 TKA procedures were performed. Among these cases, 10 patients underwent amputation due to failure or complications relating to the prosthesis, and thus the incidence presented was 0.41%.

Over the course of this period, a total of 16 amputations were performed at INTO as a consequence of failure of or complications from TKA. However, some of these patients were excluded from the incidence calculation, given that four amputations were performed on patients who had undergone primary TKA at other services and two cases had received the primary prosthesis before the study period started (Fig. 1).

Amputation was performed on eight male patients and eight female patients. The patients' mean age at the time of this procedure was 67.1 years, with a range from 53 to 80 years. In 11 cases, the right knee was operated and in five cases, the left knee. Primary gonarthrosis was the indication for a prosthesis in ten of these patients (62.5%), rheumatoid arthritis in three (18.75%) and post-traumatic arthrosis in three (18.75%).

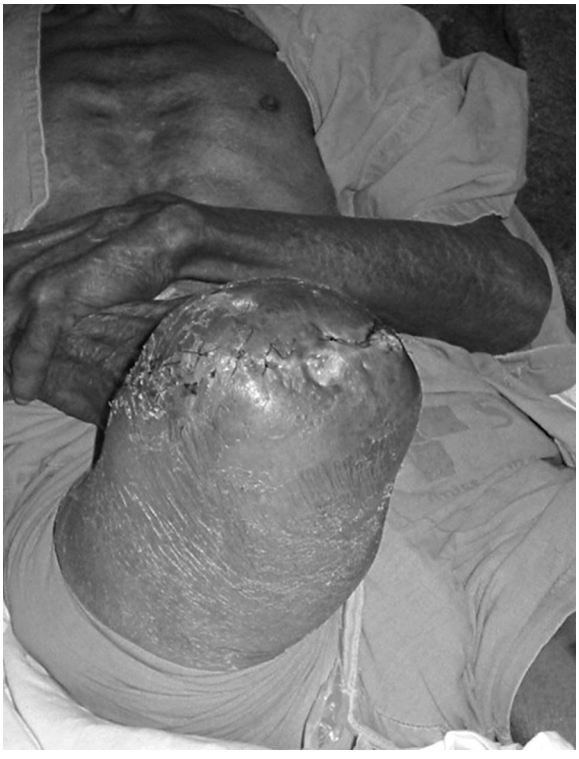

Fig. 1 – Patient amputated due to infection after TKA.

In this series, in two cases the amputation was performed on patients who had undergone revision of primary surgery and presented implants with a major degree of constriction of nails. In 14 patients, the complications or failures occurred before exchanging the prosthetic components. In 10 patients, arthrodesis was performed as a limb salvage measure, but with unsatisfactory results.

The mean time that elapsed between the primary arthroplasty and the amputation was approximately 4.5 years, with a range from one day to 12 years. The mean length of follow-up after the amputation was 6.7 years, with a range from two to nine years.

In accordance with the anesthetic risk criteria of the American Society of Anesthesiology (ASA), 87.5% were classified as ASA II and 6.25% as ASA III, while 6.25% did not present any clinical comorbidities (ASA I).

Recurrent deep infection was identified as the main etiology for amputation following TKA. This occurred in 13 cases, which represented 81% of the sample. Acute arterial occlusion was identified as the cause of amputation in two cases (12.5%) and periprosthetic fracture associated with metaphyseal bone loss (type III in the classification of the Anderson Orthopedic Research Institute, AORI) occurred in one case (6.5%). The infection was diagnosed after osteosynthesis (Table 1).

Extensive skin necrosis was observed in two cases. However, in both of them this complication occurred after the infectious condition had been proven. A myocutaneous flap was needed in the cases of both patients.

In the patients who underwent amputation due to recurrent infection, cultures presented growth of more than one bacterial agent in 38% of the cases.

The most prevalent germ was *Staphylococcus aureus*, which was identified in 54% of the cultures. Methicillin-resistant *S. aureus* was isolated in 31%. Methicillin-sensitive *S. aureus* presented growth in 23% of the patients. *Pseudomonas aeruginosa* was identified in 38% of the cultures and in 31% it was associated with another bacterial species. *Acinetobacter baumanii* and *Klebsiella pneumoniae* were identified in two cases (15%), but were not verified as a single agent. *Serratia marsens* was noted in two patients (15%) and in one as a single infectious agent. *Proteus mirabilis* was noted in one case of polymicrobial infection (7.5%).

The mean number of surgical procedures prior to amputation was 6.8. When only the patients who underwent amputation due to infection were taken into consideration, the number of previous procedures ranged from 3 to 22, with a mean of 7.6.

All of the patients underwent transfemoral amputation. In one case, which was of vascular etiology, an amputation at tarsometatarsal joint level was initially performed, but because of failure in attempts to perform thromboembolectomy, it was necessary to raise the level of the amputation. In two cases, it was necessary to revise and raise the bone resection because of an infectious condition in the amputation stump.

Over the course of the functional evaluations, three patients died for reasons unrelated to the amputation. The

Table 1 – Amputations due to failure of or complications from TKA.

	Age	Sex	Diagnosis	ASA	Cause	Duration	No. of procedures	Bacteria
1	62	F	OA	II	Infection	2 years	8	MRSA
2	64	F	RA	II	Infection	10 years	3	*Pseudomonas aeruginosa* + *Proteus mirabillis*
3	69	F	OA	II	Infection	9 years	6	MSSA + *Klebsiella pneumoniae*
4	42	M	RA	II	Infection	11 years	6	*Pseudomonas aeruginosa* + *Serratia marsens*
5	61	M	TRAUMA	II	Infection	6 years	8	*Serratia marsens*
6	65	M	TRAUMA	II	Infection	3 years	4	MRSA
7	80	F	OA	III	Infection	0	5	MSSA
8	66	F	OA	II	Infection	2 years	6	*P. aeruginosa* + *K. pneumoniae* + *Acinetobacter baumanii*
9	68	M	OA	I	Infection	0	11	MRSA
10	62	F	OA	II	Vascular	0	2	
11	75	M	OA	II	Fracture	1 year	7	
12	66	M	OA	II	Vascular	0	0	
13	62	F	OA	II	Infection	12 years	7	MSSA
14	51	M	TRAUMA	II	Infection	4 years	8	MRSA
15	62	M	OA	II	Infection	1 year	22	*P. aeruginosa*
16	51	F	RA	II	Infection	7 years	5	*P. aeruginosa* + *A. baumanii*

F, female; M, male; OA, osteoarthrosis; RA, rheumatoid arthritis; MRSA, methicillin-resistant *Staphylococcus aureus*.

data were obtained from the last follow-up consultation analyzed.

Among the 16 patients who underwent amputation, only seven were fitted with prostheses (44%). All of these individuals were said to be able to walk, although with the exception of one patient, all of them required aids such as a pair of crutches or a walking frame. Two patients who had been fitted with prostheses said that their capacity to walk was limited to their homes, while the other five said that they were capable of walking for distances greater than a block (Table 2).

Among the nine patients who were not fitted with prostheses (56%), six were incapable of walking and remained restricted to a wheelchair. One patient said that he was able to walk around his home with help. Another two patients were capable of walking with help for distances greater than a block.

We did not identify any statistical relationship between age, the diagnosis that caused the failure and motivated the arthroplasty, and the functional results from fitting the prosthesis or from walking.

Discussion

Many different studies in the literature have dealt with the main complication that can occur after TKA. However, there are few data on the incidence of amputations due to failures of or complications from knee prostheses. Out of more than 9000 knee prostheses assessed, Rand et al.[16] described two cases (0.02%) of infrapatellar amputation related to vascular insufficiency.

After performing 12,118 TKAs, Bengston and Knutson[17] studied 357 patients who evolved with deep infection. In this sample, 23 patients had to under transfemoral amputation. Thus, the incidence found was 0.18% out of all the cases and 6% when only the infected arthroplasty cases were taken into consideration. Isiklar et al.[10] reported an incidence of 0.18%, i.e. nine amputations after 5045 arthroplasty procedures performed. In the study by Sierra et al.[15] on 25 patients, the cause of the amputation was related to prosthetic replacement of the knee, which corresponded to a prevalence of 0.14%.

Table 2 – Functional result.

	Prosthesis use	Walking	Aid	Distance
1	No	No: limited to wheelchair		
2	No	No: limited to wheelchair		
3	No	No: limited to wheelchair		
4	Yes	Yes	2 crutches	>1 block
5	Yes	Yes	2 crutches	>1 block
6	Yes	Yes	2 crutches	>1 block
7	No	No: limited to wheelchair		
8	Yes	Yes	2 crutches	>1 block
9	Yes	Yes	No	>1 block
10	Yes	Yes	2 crutches	At home
11	No	No: limited to wheelchair		
12	No	No: limited to wheelchair		
13	Yes	Yes	Walking frame	At home
14	No	Yes	2 crutches	>1 block
15	No	Yes	Walking frame	At home
16	No	Yes	2 crutches	At home

In our series, the incidence was 0.41%, i.e. 10 amputations after 2409 arthroplasty procedures. However, we had difficulty in identifying amputations among our patients that took place at other healthcare units, either as a complication from TKA or due to unrelated causes.

In the study by Isiklar et al.,[10] deep infection was identified in seven of the eight cases of amputation. Data presented by Sierra et al.[15] identified infection as the main cause of amputation after TKA, which occurred in 74% of the patients. Infection was the main cause of amputation identified in our series and occurred in 81% of the cases.

S. aureus has been the germ most frequently isolated in postoperative infections in several international centers.[18] In eight cases of amputation due to infection, Isiklar et al.[10] identified *S. aureus* in three patients and *S. epidermitis* in four. Our sample was concordant with the reports in the literature: *S. aureus* was isolated in 54% of the cultures from patients amputated due to infection.

Cutaneous complications such as extensive necrosis may evolve with deep infection after TKA in up to a quarter of the patients, as reported in different studies.[10,15] In our study, out of the 16 patients who underwent amputation, two cases presented cutaneous necrosis after deep infection had been diagnosed.

Vascular complications after knee arthroplasty are rare events and generally have catastrophic results. Smith et al.[19] noted that the prevalence of complications due to vascular causes was between 0.03% and 0.17%. These usually occur in patients with previously undiagnosed atherosclerotic disease and, among these cases, 25–43% evolve with amputation. In our sample, two patients needed amputation because of ischemia of the limb shortly after an arthroplasty procedure.

Periprosthetic fracturing associated with bone loss that compromised the metaphyseal bone (type III of AORI classification) was identified as the initial event that led to amputation in 6.5% of our sample (one case). We emphasize that infection of the surgical site developed after treating the fracture. In the study by Sierra et al.,[15] this cause represented the lowest prevalence of occurrences of amputation after TKA.

The patients underwent an average of 6.8 procedures prior to amputation. Taking only the cases of infection into consideration, this mean rose to 7.6. However, the number of previous surgical procedures could be as high as 22, as found in one case of infection following TKA. These data were concordant with those published by Isiklar et al.[10] Nonetheless, these data seemed high in comparison with the mean of 2.8 procedures preceding amputation that was observed in the sample of Pring et al.[20]

Patients undergoing transfemoral amputation due to complications following arthroplasty present limited functional results, because of multifactorial causes. In most cases, these are elderly patients with multiple joint involvement and a variety of comorbidities. The energy consumption for locomotion is higher than in normal gait, and gives rise to difficulty in muscle and proprioceptive rehabilitation.

In our study, 44% of the amputated patients were fitted with prostheses. This finding is concordant with the study by Pring et al.[20] However, it is higher than what was presented in the series of Sierra et al.,[15] which documented a rate of only 20%, and the findings of Isiklar et al.,[10] who reported that 12.5% of the patients were fitted with a prosthesis after amputation, following TKA.

Pring et al.[20] reported that only 30% of the patients who underwent amputation were capable of walking regularly. Isiklar et al.[10] corroborated these data and identified 35% of their sample as walkers.

In our series, 62.5% of the patients reported that they were capable of walking, although they needed an aid. Among the patients without a prosthesis, only 33% reported that they were walking regularly, while in the group fitted with prostheses, all of them were classified as walkers.

Conclusions

The incidence of amputation consequent to failure or complications after 2409 TKA procedures was 0.41%.

The main cause of amputation was recurrent deep infection, which occurred in 81% of the cases. Vascular complications and periprosthetic fractures associated with metaphyseal bone loss were the cause of amputation in 12.5% and 6.5%, respectively.

On average, 6.8 surgical procedures were performed prior to amputation.

The functional result was limited. Fitting of a prosthesis was achieved in 44% of the patients, and only 62.5% of the patients were capable of walking.

Conflicts of interest

The authors declare no conflicts of interest.

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