Current concepts review

Re-revision Total Knee Arthroplasty: Causes, Risk Factors and Results

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Abstract

The rate of re-revision total knee arthroplasty (TKA) ranges between 4% and 10%, depending on the cause of the procedure. Periprosthetic joint infection (PJI) and periprosthetic fracture are the main causes of re-revision TKA. The likelihood of implant survival of re-revision TKA diminishes with each subsequent revision, with PJI being the main cause of multiple revisions. Acute early aseptic revision TKA (within 90 days of surgery) involves a high risk of re-revision at 2 years and a high risk of subsequent PJI. The use of antibiotic-loaded cement is associated with lower risk of re-revision. Patients younger than 50 years experiencing aseptic revision TKA have a 1 in 3 risk of re-revision. Patients revised for instability or having prior TKA revisions have the highest risk of re-revision at 10 years. Patients younger than 55 years experiencing revision TKA have a 5-year revision-free survival of 80%.

Level of evidence: III

Keywords: Causes, Incidence, Re-revision, Results, Risk factors, Total knee arthroplasty

Introduction

The aim of this study was to assess the incidence, risk factors, and causes leading to re-revision total knee arthroplasty (TKA), and the results (survivorship) of re-revision TKA. To this end, a search was performed in PubMed on April 20, 2023, using "re-revision TKA" as a keyword. Ninety-two articles were found, 16 of which were selected because, in my opinion, they were the most important and were strictly related to the title of this article. The remaining 76 were excluded. This article is therefore not a systematic literature review but rather a narrative review.

It is important to note that, in specialized arthroplasty, hospital periprosthetic joint infection (PJI) was the most common reason for re-revision TKA.[1] Also, Halder et al found evidence of a higher risk for re-revision surgery in hospitals with fewer than 25 revision TKAs per year.[2]

Main body

Incidence and causes of re-revision TKA

Regarding two-stage revision TKAs in infected TKA, Bonanziga et al reported a 17% re-revision rate (11% due to infection and 6% for aseptic reasons).[3] In cases of revision TKA for ligamentous instability treated with a mobile-bearing varus-valgus constrained (VVC) implant, a re-revision rate of 7% has been reported.[4] With regard to revision TKA with severe bone defects for which metaphyseal sleeves are required, the published re-revision rate has been 4%.[5] In 2021, Meyer et al analyzed 235 aseptic revision TKAs; 14.8% had undergone re-revision at a mean follow-up of 8.3 years.[6] Ultimately, published re-revision rates are between 4% and 17%, depending on the type of TKA revision performed (e.g., aseptic, septic, ligamentous instability, bone loss treated with metaphyseal sleeves) [Table 1].[3-6] [Table 2] summarizes the main causes and rates of re-revision TKA in the literature.[3-6]

Risk factors and results of re-revision TKA

Various risk factors of TKA re-revision have been reported, depending primarily on the cause of the intervention. [Table 3] summarizes the main risk factors associated with re-revision TKA.[2, 7-11] Results of re-revision TKA in terms of implant survival are shown in [Table 4].[6, 8, 10, 12-16]

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Table 1. Reported rates of re-revision total knee arthroplasty (TKA) in the literature

AUTHORS [REFERENCE]	YEAR	METHODS	RESULTS	CONCLUSIONS
Bonanziga et al (3)	2019	In a systematic review with level 4 of evidence, 904 patients with 928 metaphyseal sleeves were assessed at a mean follow-up of 45 months. Overall 1,413 sleeves, 888 in the tibia and 525 in the femur, were implanted.	Five sleeves were found to be loose during septic re-revision (0.35% rate of septic loosening of the sleeves). An aseptic re-revision of the prosthetic components was performed 27 (3%) times. Ten sleeves were found to be loose during aseptic re-revision (0.7% rate of aseptic sleeve loosening).	There were 36 septic re-revisions of the prosthetic components (4% re-revision rate).
Bongers et al (4)	2020	These authors analyzed 113 two-stage revision TKAs in infected TKA, performed between 2003 and 2013, with a minimum follow-up of 2 years.	After a mean follow-up of 94 months, infection recurred in 23 (23%) cases. Of these, 9 (9%) cases were defined as relapse (same microorganism as the index revision), and in 14 cases another causative agent was found (14%). In 11 patients, DAIR successfully eradicated the re-infection.	The reported a re-revision rate was 17% (11% due to infection and 6% for aseptic reasons).
Reina et al (5)	2020	This study analyzed 337 patients (367 TKAs) who had undergone revision TKA for compromised ligamentous stability with a mobile-bearing VVC implant. The mean age at revision was 67 years. The mean follow-up was 4 years.	The 5-year cumulative incidences of any re-revision or re-revision for aseptic loosening were 9% and 3%, respectively.	Twenty-six (7%) knees were re-revised: 15 for infection, 6 for aseptic loosening, and 5 for other causes.
Meyer et al (6)	2021	This multicenter, retrospective study included 235 aseptic RTKAs. Individuals were excluded if the revision was for PJI or they had previously experienced revision surgery. Minor revisions not involving the tibial or femoral components were also excluded.	Survivorship of RTKA was 93% at 2 years and 83% at 8 years. Average age at revision was 72.9 years. The most frequent reasons for failure following RTKA were PJI (40%), periprosthetic fracture (25.7%) and aseptic loosening (14.3%). Of those whose RTKA failed, the average survival was 3.33 years. No demographic or surgical factors were encountered to influence RTKA survival.	Of 235 aseptic RTKAs identified, 14.8% experienced re-revision at mean follow-up of 8.3 years.

DAIR = debridement antibiotics and implant retention; VVC = varus-valgus constrained; RTKA = revision total knee arthroplasty; PJI = periprosthetic joint infection

Table 2. Main causes and rates of re-revision total knee arthroplasty (TKA)

CAUSES	RATES
Periprosthetic joint infection (PJI)	Between 10% and 47.8%
Aseptic loosening	Between 14.3% and 21.9%
Periprosthetic fracture	Between 13.7% and 25.7%
Instability	12%
Polyethylene (PE) wear	11%
Malpositioning	8%

Table 3. Main risk factors of re-revision total knee arthroplasty (TKA).

Hospital volume had a substantial impact on 1-year re-revision percentage (2).
Smoking, right-sided prosthesis, and large femoral canal diameter augmented the risk of aseptic loosening, while tantalum cone and impaction grafting diminished this risk in individuals who experienced re-revision surgery with rotating hinge (RH) prosthesis following TKA (7).
Younger and male individuals had a higher risk of re-revision following aseptic revision TKA (8).
Individuals less than 50 years experiencing aseptic revision TKA had a 1 in 3 risk of re-revision. Individuals specifically revised for instability or had prior TKA revisions had the highest risk of re-revision at 10 years (9).
Individuals who experienced early aseptic revision TKA within 90 days of surgery had a high risk of re-revision and infection at 2 years (10).
Prior knee arthroscopy was associated with a higher likelihood of requiring re-revision TKA (11).

Table 4. Results of re-revision TKA in terms of implant survival

AUTHORS [REFERENCE]	YEAR	METHODS	RESULTS	CONCLUSION
Bingham et al (12)	2019	Thirty-four individuals revised with an RH for arthrofibrosis were matched to 68 individuals revised without an RH. The mean age was 63 years, 62% were female, mean BMI was 31 kg/m^2, and mean follow-up was 6 years.	The mean arc of motion increased 20° in the RH cohort versus 12° in the non-RH cohort. Two MUAs were carried out in the RH cohort compared to 9 in the non-RH cohort. Knee Society scores increased significantly in both groups. Forty percent of the revisions in the RH cohort were related to insert and bushing exchanges.	In patients with severe arthrofibrosis revised with an RH prosthesis, implant survivorship free of any revision at 10 years was 54% in the RH cohort (versus 90% in the non-RH cohort).
Chalmers et al (13)	2019	These authors retrospectively reviewed 135 nononcologic RTKAs performed in individuals ≤50 years. Mean age was 43 years, and mean BMI was 31 kg/m^2. Mean follow-up was 7 years. There were 99 (73%) first-time revisions, and 36 (27%) with prior revisions. Indications for revision included instability (47%), aseptic loosening (29%), and arthrofibrosis (9%).	Forty-three (32%) TKAs underwent re-revision including 10 (7%) for PJI. Survivorship free of re-revision for instability was 88% at 10 years, with revision for instability, male gender, and multiply revised TKAs having poorer survival. Of the 64 TKAs revised for instability, 24 (38%) experienced re-revision, including 14 (22%) for recurrent instability.	In patients ≤50 years, implant survivorship free of all-cause re-revision was 66% at 10 years, with multiply revised TKAs having the poorest survival.
Meyer et al (6)	2021	This multicenter, retrospective study included all aseptic RTKAs performed at three tertiary referral hospitals. Patients were excluded if the revision was for PJI or they had previously undergone revision surgery. Minor revisions not involving the tibial or femoral components were also excluded.	Of 235 aseptic RTKAs identified, 14.8% underwent re-revision at mean follow-up of 8.3 years. Average age at revision was 72.9 years. The most common reasons for failure following RTKA were PJI (40%), periprosthetic fracture (25.7%) and aseptic loosening (14.3%). Of those whose RTKA failed, the average survival was 3.33 years. No demographic or surgical factors were found to influence RTKA survival.	Survivorship of re-revision TKA was 93% at 2 years and 83% at 8 years.
Chalmers et al (9)	2021	These authors retrospectively identified 49 individuals, including 34 after primary TKA (primary group), 9 after revision TKA, and 6 conversions for failed ORIF (revision group) that underwent DFR for a periprosthetic femur fracture. The mean age was 76 years, and 40 patients (82%) were female. The mean follow-up was 4 years. Femoral fixation included 44 cemented stems (90%) and 5 cementless stems (10%).	Survivorship free from any re-revision at 5 years in the primary and revision group was 93% and 18%, respectively. The revision group had a 5.3× higher risk of re-revision. Survivorship free from re-revision for aseptic loosening at 5 years in the primary and revision group was 93% and 53%, respectively. Two of the 3 individuals with cementless stems in the primary group experienced early re-revision for aseptic loosening.	Patients with periprosthetic fractures around prior primary TKAs treated with DFRs with cemented femoral fixation had a 97% 5-year implant survivorship free from any re-revision.
Chalmers (14)	2021	These authors retrospectively reviewed 197 revision TKAs at a mean follow-up of 5 years. Mean age was 49 years; mean BMI was 31 kg/m^2. Twenty-seven (14%) individuals had at least one prior revision TKA. The most frequent indications for revision included instability (29%), arthrofibrosis (26%), and aseptic loosening (24%). Constraint included the following: 59 PS (30%), 123 VVC (62%), and 15 hinged (8%). Components revised included the following: 93 femur/tibia (47%), 68 polyethylene-only (35%), 19 femur-only (10%), and 17 other (9%).	A prior revision, an isolated polyethylene exchange, and a hinged prosthesis were significant risk factors for lower revision-free survival. Forty-two patients (21%) underwent re-revision, most commonly for PJI (7%), instability (6%), and aseptic loosening (5%). Re-revision occurred in 18/68 (26%) patients undergoing an isolated polyethylene exchange.	In patients younger than 55 years who underwent aseptic revision TKA, implant survivorship free from any re-revision at 5 years was 80%.

Table 4. Continued

Xiong et al (15)	2021	These authors retrospectively reviewed 189 consecutive individuals (202 knees) who experienced revision TKA for stiffness: 101 knees in the idiopathic stiffness group and 88 in the non-idiopathic stiffness group. In the idiopathic stiffness group, 42 knees experienced isolated tibial insert exchange and 59 knees experienced component revision.	The overall revision surgery results of the idiopathic stiffness group were worse than those of the non-idiopathic stiffness group with regard to maximum flexion (91.7° versus 100.1°) and flexion ROM (87.6° versus 97.1°). In the idiopathic stiffness group, isolated tibial insert exchange demonstrated greater maximum flexion (96.8° versus 88.4°) and flexion ROM (93.2° versus 83.9°).	In patients with idiopathic stiff TKA, isolated polyethylene exchange demonstrated re-revision percentages lower than component revision (16.7% versus 31%).
Shen et al (10)	2022	This study analyzed 414 individuals who experienced unilateral aseptic revision TKA within 90 days of the index procedure .A group of 414 individuals was compared with a control group of patients who experienced primary TKA without revision within 90 days. For the control group, 137,661 patients underwent primary TKA without early revision, with 13% (18,138) loss to follow-up at 2 years. Among these patients, 414 controls were matched using a one-to-one propensity score method; no differences in age, gender, and Charlson comorbidity index score were observed between the groups.	Two-year survivorship free from additional revision surgery was lower in the early aseptic revision group compared with the control (78% versus 98%). Among early revisions, 10% (43 of 414) of the patients underwent re-revision for PJI with an antibiotic spacer within 2 years. The reasons for early aseptic revision TKA were instability/dislocation (37%), periprosthetic fracture (23%), aseptic loosening (23%), pain (11%), and arthrofibrosis (6%).	Early aseptic revision for pain within 90 days after primary TKA was associated with higher odds of re-revision than early revisions performed for other causes (44% versus 29%).
Kirshbaum et al (16)	2022	This study analyzed 63 individuals (35 female, 28 male, mean age 64 years, mean follow-up 55 months) who experienced 157 re-revision TKA surgeries (range 2-5). The revision indications were divided up into main diagnoses.	The main overall reason for re-revision was PJI (48%), followed by instability (12%), polyethylene wear (11%), malpositioning (8%), and aseptic loosening (8%). While PJI was in 38% of all cases, the reason for the first revision, incidence increased constantly with the number of revisions (48% at second revision, 55% at third revision, 86% at fourth revision, and 100% at fifth revision. If PJI caused the first revision, patients showed an average of two more septic revisions at follow-up than patients with an aseptic first revision indication. In 36% of cases, the reason for follow-up surgery in case of PJI was again PJI.	Implant survivorship of re-revision TKA diminished with an increasing number of revision surgeries.

RH = rotating hinge; BMI = body mass index; MUA = manipulation under anesthesia; RTKA = revision total knee arthroplasty; PJI = periprosthetic joint infection; ORIF = open reduction and internal fixation; DFR = distal femoral replacement; PS = posterior stabilized; VVC = varus-valgus constrained; ROM = range of motion.

Conclusion

This narrative review of the literature has led to the following conclusions:

1) PJI and periprosthetic fracture are the main causes of re-revision surgery after aseptic revision TKA. In specialized arthroplasty hospitals, PJI is the most common reason for re-revision and third revision TKA.

2) The likelihood of implanted TKA survival is substantially diminished with each subsequent revision. PJI is the main cause of multiple revisions.

3) Acute early aseptic revision (within 90 days of surgery) TKA carries a high risk of re-revision at 2 years and a high risk of subsequent PJI.

4) The use of antibiotic-loaded cement is associated with lower risk of re-revision.

5) Patients younger than 50 years experiencing contemporary aseptic revision TKA have a 1 in 3 risk of re-revision. Patients specifically revised for instability or who had prior TKA revisions had the highest risk of re-revision at 10 years.

6) Patients younger than 55 years undergoing revision TKA have a 5-year revision-free survival of 80%. Patients with prior revision TKAs, RH type prostheses, and polyethylene-only revisions have higher revision rates.

7) The analysis of the risk factors for aseptic loosening in complex revision TKA cases using RH knee prostheses showed that smoking, right-sided prosthesis, and large femoral canal diameter increase the risk of re-revision, whereas tantalum cone and impaction grafting reduce this risk.

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