

# Outcomes in revision total knee arthroplasty (Review)

MIHAI DAN ROMAN<sup>1\*</sup>, OCTAV RUSSU<sup>2</sup>, CALIN MOHOR<sup>1</sup>, RADU NECULA<sup>3</sup>, ADRIAN BOICEAN<sup>1</sup>,  
ADRIAN TODOR<sup>4</sup>, COSMIN MOHOR<sup>1\*</sup> and SORIN RADU FLEACA<sup>1\*</sup>

<sup>1</sup>Department of Orthopedic and Trauma Surgery, 'Lucian Blaga' University, 550276 Sibiu;

<sup>2</sup>Department of Orthopedic Surgery, 'George Emil Palade' University of Medicine, Pharmacy,  
Science and Technology, 540142 Targu Mures; <sup>3</sup>Department of Orthopedic Surgery,  
'Transilvania' University, 500036 Brasov; <sup>4</sup>Department of Orthopedic Surgery,  
'Iuliu Hatieganu' University of Medicine and Pharmacy, 400012 Cluj-Napoca, Romania

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**Abstract.** Revision total knee arthroplasty (TKA) is a challenging surgical procedure. Although good results are presented, the outcomes are worse in comparison with those of primary TKA, with a higher failure rate. The main reasons for the failure of revision TKA include: sepsis, loosening and instability. There are multiple variables linked to these results, and it is difficult to determinate the exact cause as it is often a multifactorial issue. These variables may be related to the quality of the index-procedure (TKA), to the revision procedure or to patient characteristics. The purpose of this review was to highlight the outcomes of revision knee arthroplasty and main factors that may influence the results. Considerable progress has been made during the last 30 years regarding infection treatment and prevention, complex revision prosthetic design and surgical technique development. Although the outcomes have improved over time, patients who undergo revision TKA may need further re-operations in the future.

## Contents

1. Introduction
2. Search strategy
3. Revision TKA
4. Conclusions

## 1. Introduction

Revision total knee arthroplasty (TKA) is a laborious, technically difficult surgery with poorer results than (in) primary TKA which has become a routine intervention for treating advanced osteoarthritis (1).

The actual estimates showed that a 7-fold increase in revision TKA surgery is expected between 2005 and 2030, while primary knee replacement surgeries will rise by approximately 174% (2). Although good results after this procedure have been presented, the outcomes are worse in comparison with those of primary TKA, with a higher failure rate (2,3).

## 2. Search strategy

The literature search for original articles and review articles published in English language was carried out using ScienceDirect, PubMed, and Google Scholar based on the key words: 'total knee arthroplasty', 'revision', 'survival', 'failure', 'outcome', 'analysis'. A total of 114 articles were reviewed. From these, 39 articles were selected.

## 3. Revision TKA

The results after revision TKA are influenced by several factors: quality of the index-procedure (TKA), aspects related to the revision procedure, patient related factors such as age, sex, physical condition, comorbidities, and degree of obesity.

Unfortunately, it is often difficult to accurately assess the main factors related to the surgical revision procedure due to the lack of sufficient data that demonstrate a clear relationship with the results after this intervention. On the other hand, it is hard to draw conclusion from different studies because of the different implants used and the various types of revision surgery performed.

Because revision TKA is extremely difficult from a technical point of view and requires adequate equipment and generates high costs, these interventions are challenging for both the patient and the surgeon and the results are worse than in primary TKA (3-6).

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*Correspondence to:* Dr Mihai Dan Roman, Department of Orthopedic and Trauma Surgery, 'Lucian Blaga' University, 8 Moldoveanu Street, 550276 Sibiu, Romania  
E-mail: mihaidanroman@yahoo.com

\*Contributed equally

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In order to obtain better results in revision TKA, it is extremely important to make a rigorous analysis of the causes that lead to the deterioration of the primary implant-failure analysis. It is also necessary to do a proper patient selection; an in-depth evaluation of the patients who may successfully undergo such a difficult and demanding surgery.

Depending on the local situation at the revision time, surgery may involve some intra-operative compromises. If proper alignment, similar size of the prosthesis, a good soft part balance, stability and type of fixation and the same level of the joint line like in primary TKA can be obtained, very good results can be expected (7).

Otherwise, if we deal with a case with multiple revisions, knee stiffness, significant bone loss or with a potential septic complication, surgeons may be forced to choose less conventional technical procedures and surgical tricks. It is often necessary to somewhat compromise in order to achieve fixation and stability over other issues.

The vast majority of patients will have improved outcomes after revision surgery but it is extremely important that their expectations must be lower than in primary TKA (7,8).

Complications in revision TKA surgery vary between 5-50% depending on the literature. The most common are: persistent pain joint stiffness, neuro-vascular problems, impairment of the extensor mechanism, complications related to surgical wound healing, occurrence of skin necrosis, and tibial tubercle fracture. Thrombosis and infection are two times more common than in primary TKA (9,10).

Survival of the revision implant at 10 years varies between 75-80%. It is found that with progression over time, the duration of the survival of the implant tends to decrease in all the analyzed studies (endpoint, re-revision of prostheses) (11-14).

Although the results are not as successful as in primary TKA, they cannot be compared as more complex procedures and patients with different biological profiles are being dealt with.

Regarding the failure of the revision TK prosthesis, the Norwegian arthroplasty registry identified (1994-2011) that 14% failed and the most common reasons included: damage to the tibial component (17%), instability (26%), deep infection (28%), and persistent pain (10%). The average time until failure of the revision TKA was 4.6 years and 61% experienced deterioration in the first two years (15).

Results in revision TKA surgery are likely to be influenced by a combination of factors related to the index procedure (TKA), the prosthetic revision procedure and other factors such as the time elapsed between the index procedure and revision, characteristics of the patient (sex, age, obesity) at the time of revision, total or partial revision, the presence of radiolucent lines, problems in postoperative patellar tracking, and alignment in the coronal plane (13,16).

Given the multitude of factors involved, it is extremely difficult to demonstrate a clear relationship with the results after revision TKA. Even so, failure analysis is essential and mandatory. We must have a complete diagnosis that includes the reason for prosthesis failure before starting the complex revision procedure (16).

It appears that the reasons that led to the failure of the primary prosthesis do not have a significant influence on the incidence of damage after revision of the total knee prosthesis (17).

Regarding the time elapsed between the index primary TKA and its failure, it appears that revisions performed after a late primary failure have significantly better results than those performed after the early failure of the primary TKA (17).

Analyzing the KS (Knee Society) scores it was found that patients with lower scores before the revision TKA also showed lower results after the operation (initial KS <30,  $\geq$ postoperative: 62.7, initial KS >30, postoperative:  $\geq$ 79.0). It is worth mentioning that the improvement gradient of the KS scores was significantly higher in patients with lower preoperative scores (mean improvement 54.0 points (<30 KS group): 35.0 points (>30 KS group) (17).

Arthrofibrosis is a good predictor of postoperative mobility in revision TKA (18-20). Patients with preoperative arthrofibrosis show after revision increased joint mobility by approximately 30 to 40 degrees and reach postoperative mobilities of up to 80 to 85 degrees. These results continue to improve after two years. It is extremely important to do a correct and rigor patient counselling regarding results and possible remaining limitations in their daily activities so the patient's satisfaction scores can be improved (18-20).

Osteotomy of the tibial tubercle (TTO) is found in approximately 27% of revisions and is usually performed due to fear of patellar tendon avulsion in the context of a rigid extensor apparatus. TTO is a safe and reproducible procedure if a consistent and accurate surgical technique is performed, with a proper fixation at the end. A good bone healing is generally to be expected (21). A noteworthy aspect is that the revision of only one prosthetic component (femoral or tibial) presents a 1.7 times higher risk of revision than in complete revisions (22). This is probably due to residual malalignment or instability in the context of a single component overhaul. Even if the component appears intact intra-operatively and has a seemingly good clinical and radiological appearance, the revision of both components can and should be taken into account (22-26).

Regarding the fixation (cemented, non-cemented, hybrid), there is still no consensus regarding the optimal fixation. Hybrid and cemented fixation apparently provide equal stability and comparative results in both experimental and clinical settings (27-29). Furthermore, the use of (dual) antibiotic-loaded bone cement has been found to be more effective in preventing periprosthetic joint infection (PJI) and proved to be cost-efficient (30-34). In the case of non-cemented implants, there is too little available data to draw a firm conclusion (29).

The separate analysis related to the brand of prosthesis used in over 50 revisions did not show significant influence on the survival rate of these prostheses according to the Norwegian arthroplasty registry (25).

Regarding patient characteristics, some conclusions can be drawn according to the National Endoprosthetic Registry in Norway. Patients under the age of 60 years who underwent a TKA revision, had a 1.6 times higher risk of re-revision than patients over 70 years. Men had an increased risk for re-revision. This may be due to the fact that younger and male patients perform more intense physical activities and this may be related to increased risk of failure (25).

Obesity has a negative impact on the results of primary and revision TKA, and morbid obesity has a much more dramatic

effect by reducing the success rate of these operations, leading to much lower postoperative scores and, consequently, lower levels of satisfaction (35).

Smoking and type 2 diabetes significantly increase the risk of infections, wound complications and re-operations. Therefore revision surgery results are negatively influenced (36,37).

#### 4. Conclusions

TKA revision surgery significantly reduces the symptomatology of operated patients and improves their function. The overall survival rate is approximately 90% at 5 years and 75-80% at 10 years decreasing progressively over time. Although good results after this procedure are presented, the outcomes are poorer than in primary TKA, with a higher failure rate. The main reasons for failure of revision surgery are: sepsis, loosening and instability. It is mandatory to perform failure analysis and careful planning when we are faced with such an intervention. Patient information about the expected results and potential evolution are extremely important. TKA revisions are technically extremely difficult and are usually associated with high costs. There is a higher intra-operative complication risk and therefore, these interventions must be performed by experienced surgical teams. As the incidence of revision TKA is increasing, more scientific information is needed in order to improve the results.

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MDR, SRF, and CoM had major contributions to the conception of the study and writing the manuscript. OR, AB, AT, CaM and RN analyzed and interpreted the patient data and searched the literature for similar work and articles and contributed to writing the manuscript. All authors read and approved the final manuscript for publication.

#### Ethics approval and consent to participate

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#### Competing interests

The authors declare no conflict or competing interests.

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