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EDITORIAL

Analysis of causes for revision in unicompartmental knee arthroplasty

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Abstract

The study by Zhao *et al* identifies the factors leading to the failure of unicompartmental knee arthroplasty (UKA) in their patients. These factors include substandard suturing of the wound, the presence of osteophytes and intra-articular loose bodies causing impingement, premature loosening of the tibial component, choosing unsuitable patients for the procedure, dislocation of the movable insert, and damage to the anterior cruciate ligament and medial collateral ligament. The findings suggest that employing the correct surgical techniques and indications is essential for successful outcomes in the UKA.

Key Words: Unicompartmental knee arthroplasty; Arthroplasty; Knee; Failure; Conversion TKA

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Core Tip: The study by Zhao *et al* investigates revision causes after unicompartmental knee arthroplasty (UKA), noting frequent failures due to surgical technique issues. UKA, used for single-compartment knee osteoarthritis, offers benefits like bone preservation and quicker recovery, with superior outcomes but a higher revision rate than TKA. Registry data show surgeon experience and procedural volume significantly affect outcomes, with optimal results when UKA comprises at least 20% of knee arthroplasties. Common revision causes include component dislocation, loosening, and poor candidate selection. The study stresses proper technique, patient selection, and follow-up for UKA success.

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INTRODUCTION

In this editorial, we provide insight into the recent study by Zhao *et al*[1], which explores the causes of primary revisions following unicompartmental knee arthroplasty (UKA)[1]. UKA serves as a viable treatment option for knee osteoarthritis patients with single-compartment involvement, offering numerous advantages such as bone stock preservation, enhanced proprioception through anterior cruciate ligament retention, improved range of motion, expedited recovery, simplified rehabilitation, and reduced postoperative blood transfusions[2,3]. The total or partial knee arthroplasty trial (TOPKAT, a randomized controlled trial) demonstrated that one year after surgery, patients undergoing UKA experienced slightly better functional improvements, as measured by the Oxford knee score (OKS), compared to those having TKA[4]. Furthermore, individuals with UKA were more inclined to report improvements and were willing to undergo the procedure again. These observations were well accepted, as the trial had sufficient power to assess clinical outcomes effectively. Our previous meta-analysis also demonstrated a better forgotten joint score in UKA than TKA[5].

Large datasets have also demonstrated a superior functional outcome in UKA patients compared to TKA. In an analysis of 100000 knee procedures using data from the National Joint Registry and other national databases, UKAs were compared to TKAs at a 1:3 ratio based on 20 factors[6]. Among a subset of this group, where patient-reported outcome measures were available, the improvement in OKS mirrored the results seen in the TOPKAT study. UKAs significantly increased the likelihood of achieving excellent OKS scores [odds ratio (OR) 1.6] and high patient satisfaction (OR 1.3), along with better EuroQol-5D scores. Additionally, the average hospital stay for UKA patients was shorter by 1.4 d. The occurrence of intraoperative complications (OR: 0.73), hospital readmissions within the first year (OR: 0.65), and the need for transfusions (OR: 0.25) were also less common in UKA patients. Significantly fewer major medical complications were reported among the UKA group, including thromboembolism (OR: 0.49), infection (OR: 0.5), stroke (OR: 0.37), and myocardial infarction (OR: 0.53). Furthermore, the mortality rate following UKA was significantly lower at 30 d [hazard ratio (HR), 0.23; HR at 90 d, 0.46; HR at eight years, 0.87]. However, it's important to note that UKAs had a 2.1 times higher rate of revision and a 1.4 times higher rate of reoperation compared to TKAs.

HIGHER REVISION RATE IS A MAJOR CONCERN WITH UKA

It seems the UKA has more advantages over TKA in all aspects except a higher revision rate[7-10]. In this context, the statement of Murray *et al*[7] appears more appealing: "Should 100 patients undergo UKA rather than TKA, the outcome would likely include approximately one less death and an additional three reoperations within the first four years post-surgery." Disappointingly, registry data also reveal a high revision rate for UKA, in contrast to individual studies that report similar revision rates between UKA and TKA. This includes the recent TOPKAT trial by Beard *et al*[4], which found comparable re-operation rates for both UKA and TKA groups. In their analysis, Murray *et al*[7] noted that the difference in the revision rates of UKA observed between joint registry data and individual studies may be because data for joint registries come from a broad range of surgeons. In contrast, individual studies typically originate from centers of expertise.

In the registry data, the highest number of UKA surgeries performed by most surgeons was one, followed by two, with an average of five surgeries. Research has indicated that a surgeon's experience with UKA is crucial in determining the revision rate. For optimal outcomes and minimal reoperations, it is recommended that at least 20% of a surgeon's knee arthroplasties consist of UKA procedures[7]. The study by Zhao *et al*[1] mentioned the causes of revision in UKA, but failed to provide information about the percentage of failure of UKA and the expertise of the surgeon in terms of volume. However, the reasons for failure in their study indicate an improper surgical technique in all patients[1], reinforcing the observations made by Murray and Parkinson regarding the significant impact of surgeon experience and volume on the success rates of UKA[7]. Also, continuous training and education are crucial for surgeons performing UKA, as they directly enhance success rates. Ongoing educational programs help surgeons stay updated with the latest surgical techniques and technologies, promoting better patient outcomes. Advanced training sessions, including hands-on workshops and simulation-based learning, allow surgeons to refine their skills and adapt to new challenges. Furthermore, peer-reviewed research and collaborative learning through conferences and seminars foster an environment

of continuous improvement and innovation in UKA procedures.

CAUSES OF REVISION IN UKA

Understanding the root causes of re-operations in UKA is crucial for minimizing revision rates and optimizing patient functional outcomes. The retrospective study by Zhao *et al*[1] outlines the reasons of failures following UKA. In these 13 cases, the primary cause of failure was identified as issues related to surgical execution across all instances. The leading reasons for undergoing revision surgery after UKA included incorrect closure of the surgical site in one patient, the presence of osteophytes in two patients, intra-articular loose bodies in two patients, loosening of the tibial prosthesis in two patients, rheumatoid arthritis in one patient, dislocation of the gasket in three patients, injury to the anterior cruciate ligament in one patient, and injury to the medial collateral ligament along with leftover bone cement in one patient[1].

The most frequent cause for revision, gasket dislocation, was complicated by impingement, a mismatch in flexion-extension, and suboptimal femoral component positioning. For the two patients who experienced loosening of the tibial prosthesis at 8 and 16 months after surgery, the possibility of substandard cementing technique contributing to the loosening cannot be ruled out, as aseptic loosening within the first two years commonly occurs because of inadequate surgical execution.

Additionally, complications such as osteophytes, residual bone cement, and loose bodies inside the joint accounted for 15.35% of the revisions, highlighting the importance of proper surgical execution. An instance of medial collateral ligament damage due to improper positioning of the tibial prosthesis further underscores this point. Although a minimally invasive approach in UKA is the dictum, we believe a bigger surgical incision could mitigate these intraoperative challenges. Practically, the decision on incision size should be guided by the surgeon's preference and expertise since perceptions of "size" vary individually. Whatever incision is chosen, it must adhere to surgical principles. Given the global increase in life expectancy, the likelihood of needing a revision after UKA is significant. Therefore, the initial incision should facilitate future revisions, ensuring easy access to crucial landmarks for bone cuts and soft tissue balancing. The approach should allow the surgery to proceed without complications, as handling tissues improperly can lead to suboptimal outcomes, undermining the purpose of minimally invasive surgery. The incision should also allow for a thorough evaluation of the anterior cruciate ligament condition and any arthritis in other compartments, enabling the surgeon to perform precise tibial and femoral cuts and effective cementation comfortably[11].

Selecting inappropriate candidates for UKA, such as patients with a deficient anterior cruciate ligament or those with rheumatoid arthritis, significantly influenced the likelihood of surgical failure in this article by Zhao *et al*[1]. In 1989, Kozinn *et al*[12] established strict criteria for UKA, ideal for patients with isolated medial compartment osteoarthritis knee, < 60 years of age, minimally active, under 82 kg, with < 15-degree angular deformity, intact cruciate ligaments, flexion possible up to 90 degrees, less than 5-degree flexion contracture and without evidence of chondrocalcinosis or patellofemoral arthritis[12]. Inflammatory arthritis was a contraindication. In contrast, the Oxford group proposed a broader set of criteria, focusing on patients with specific types of knee osteoarthritis, regardless of factors like age (age is a no bar for UKA), weight (even can be done in obese), patellofemoral joint status and activity level. They recommended UKA for symptomatic anteromedial osteoarthritis (AMOA) or avascular osteonecrosis of the knee. AMOA is a specific pattern of knee osteoarthritis characterized by bone-on-bone wear in the medial compartment while maintaining functionally intact anterior cruciate and medial collateral ligaments and preserving full-thickness cartilage in the lateral compartment. These inclusive criteria mean a larger proportion of patients could qualify for UKR today compared to the more conservative estimates based on the older criteria. Despite this expansion, certain conditions like infections, severe ligament issues, and specific surgical histories still disqualify candidates from UKR[13].

Kornilov *et al*[14], in their study encompassing 142 UKA procedures with 18 revisions, identified traumatic factors like ACL rupture and condylar fractures alongside bearing dislocation from trauma as primary revision triggers. Additional causes included aseptic loosening, disease progression, and infection.

Kim *et al*[15] systematic review of 17 studies revealed a 4.6% revision rate for UKA, with bearing dislocation ranking as the most prevalent cause for re-operation followed by component loosening. Lisowski *et al*[16] highlighted bearing dislocation as a common reason for reoperations in UKA. The bearing dislocation was mostly due to malposition of component, posterior impingement by remaining meniscus or osteophyte, and medial collateral ligament laxity due to excessive release. Notably, component loosening was frequently associated with malalignment issues, particularly in fixed-bearing designs[17]. The UKA patients need a diligent follow-up at regular intervals to identify problems and intervene early for sustained patient satisfaction and procedural success.

CONCLUSION

The study emphasizes the necessity of adhering to proper surgical techniques for UKA, highlighting that the primary causes for revision surgeries are mainly related to dislocation of components and loosening of the femoral or tibial components, which are often due to malalignment during the initial operation. The significance of choosing the right patients for UKA is also underlined, with the study pointing out instances of revision surgery due to the selection of unsuitable candidates. The research stresses the importance of careful surgical execution, judicious selection of patients, and thorough post-surgery follow-up to reduce the risk of revisions and improve the long-term outcomes of UKA. It brings attention to various factors contributing to the need for revising UKA and suggests ways to avoid them. Nonetheless, the study is limited by its lack of a broad perspective on the total number of UKA surgeries conducted and

an in-depth analysis of the outcomes following revision surgeries. Future studies should aim to collect more comprehensive data and involve larger cohorts to understand better the reasons behind UKA revision surgeries and their subsequent outcomes.

FOOTNOTES

Author contributions: Tripathy SK, Pradhan SS, and Khan S evaluated the manuscript and analyzed the reasons for failure in UKA; Patel H and Khan S reviewed the literature; Pradhan SS and Tripathy SK prepared the initial manuscript; Tripathy SK, Khan S, and Patel H provided intellectual content; all authors read the manuscript and approved it for publication.

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