ORIGINAL RESEARCH

Clinical Efficiency of Fixed-Bearing Unicompartmental Knee Arthroplasty Versus Total Knee Arthroplasty For Lateral Compartment Knee Osteoarthritis and the Effect on Recovery of Motor Function

Xudong Gou, MSc; Yuqing Mao, MSc; Guohong Wang, BSc

ABSTRACT

Objective • To evaluate the clinical efficiency of fixed-bearing unicompartmental knee arthroplasty (UKA) versus total knee arthroplasty (TKA) for lateral compartment knee osteoarthritis and the effect on the recovery of motor function.

Methods • A total of 54 patients who underwent surgery for lateral compartment knee osteoarthritis and satisfied the inclusion criteria from September 2018 to February 2021 at our hospital were recruited and assigned to receive either UKA (UKA group, n=30) or TKA (TKA group, n=24) via random number table method. Among them, the randomization was carried out using an online web-based randomization tool (freely available at http://www.randomizer.org/). Inclusion criteria: 1) patients with lateral compartment knee osteoarthritis diagnosed by clinically relevant tests; 2) patients with structural and functional integrity of the knee ligaments; 3) all with a single knee lesion. Outcome measures included operative time, the reduction ratio of Hb 1d postoperatively, visual analog scale (VAS) score 7d postoperatively, length of hospital stay, postoperative Keen society score (KSS), Oxford knee score (OKS), range of motion (ROM), forgotten joint score (FJS), motor function recovery, and adverse events.

Results • All patients were followed up postoperatively for 12-33 (21.71±7.45) months. Patients in the UKA group showed significantly shorter operative indices, a lower reduction ratio of Hb 1d postoperatively, and VAS scores of 7d postoperatively ($P < .05$). At 1 month and 6 months postoperatively, UKA resulted in significantly better KSS scores, OKS scores, ROM, and motor function recovery versus TKA ($P < .05$), while the difference of the above indices did not come up to the statistical standard at 1 year postoperatively ($P < .05$). At 1 year postoperatively, patients receiving UKA were associated with significantly higher FJS scores versus those given TKA. No documented thrombosis, knee, or prosthesis-related adverse events were observed during hospitalization and follow-up.

Conclusion • In comparison to TKA, UKA resulted in smaller surgical incisions, improved postoperative healing, and greater restoration of knee function. Both arthroplasties are successful in alleviating pain and increasing knee function, although they are less effective in recovering patients' motor capabilities. (*Altern Ther Health Med.* 2024;30(7):114-121).

Xudong Gou, MSc, Orthopaedics Department, Chengdu second people's hospital, Chengdu, China. **Yuqing Mao, MSc,** Chengdu University of Information Technology, Chengdu, China. **Guohong Wang, BSc,** Emergency Department, Chengdu second people's hospital, Chengdu, China.

Corresponding author: Xudong Gou, MSc
E-mail: goub59551@163.com

INTRODUCTION

Knee osteoarthritis is one of the common clinical diseases, and the main clinical symptoms are recurrent knee pain and joint deformation. The disease constitutes a disability rate of 53% and poses an immense impact on the quality of life of patients. Knee osteoarthritis is more common in the elderly, and the incidence in China has been on the rise year by year. Due to the high recurrence of the disease and the decline of various body functions in the elderly, knee osteoarthritis inflammation substantially affects the normal life of patients. Clinically, the treatment of patients with knee osteoarthritis is highly valued, and timely and effective treatment is of great significance in ensuring the health of patients. As previously reported, the pathogenesis of knee osteoarthritis is closely related to the abnormal apoptosis. When pannus is formed in the synovial membrane of knee osteoarthritis, the proliferation of blood vessels plays an important role in promoting the disease progression, and the more central process is the proliferation and migration of vascular endothelial cells.

In managing knee osteoarthritis, treatment approaches are tailored to the severity of arthritis and the extent of the lesion.[1] Two primary surgical interventions for knee osteoarthritis are total knee arthroplasty (TKA) and fixed-

bearing unicompartmental knee arthroplasty (UKA). It's essential to weigh the advantages and disadvantages of each procedure when determining the appropriate course of action. The current clinical treatment for patients with knee osteoarthritis is largely tailored to the grading of the patient's arthritis and the involvement of the lesion. TKA is a widely adopted method; however, it may disrupt normal knee compartments and ligaments in patients with unicompartmental knee injuries, potentially leading to diminished postoperative knee recovery,[2] whereas UKA maintains the ligament structure of the patient's knee joint. In recent years, there has been a surge in the usage of UKA in knee replacements .[3] TKA is associated with larger surgical wounds, longer operative time, a slightly higher risk of adverse events, and reduced knee mobility compared to UKA.[4] Despite these drawbacks, it remains a suitable treatment option for some cases of knee osteoarthritis. In recent years, UKA has gained popularity in knee replacements due to its benefits, including smaller surgical wounds, shorter operation duration, reduced adverse events, improved knee mobility, and better preservation of bone volume compared to TKA.[4] These advantages contribute to faster postoperative recovery and superior overall outcomes. UKA is particularly effective in cases of medial compartment knee osteoarthritis.

However, UKA for lateral compartment knee osteoarthritis is relatively less common, accounting for only 4%-7% of all UKAs.[5] With the advent of advanced prosthetic designs and surgical techniques, the treatment landscape for lateral compartment knee osteoarthritis has transformed. Surgeons now have more options at their disposal, including enhanced lateral UKA protocols, which were historically less favored due to complications related to motion and anatomical characteristics.[6] As clinical practices evolve, it becomes imperative to evaluate the effectiveness of these newer techniques and compare them to established treatments like TKA. Nonetheless, with advancements in prosthesis design and a deeper understanding of knee joint anatomy and kinematics, clinicians are increasingly exploring the effectiveness of lateral UKA for patients with lateral compartment knee osteoarthritis.[7] Therefore, the primary goal of any orthopedic procedure is to maximize patient outcomes. A comprehensive comparison of UKA and TKA for lateral compartment knee osteoarthritis can help identify which approach is best suited for different patient profiles. This information can lead to more personalized treatment decisions, ultimately improving the quality of care and patient satisfaction. To gain a clearer understanding of the surgical techniques involved in both lateral UKA and TKA, and their respective strengths and limitations, we will provide a more detailed description of these procedures below. Therefore, in this context, comparing the outcomes of lateral UKA and TKA in cases involving lateral compartment knee osteoarthritis holds great significance. Such a comparison can provide valuable insights into the suitability of these surgical approaches and help guide clinical decision-making, ultimately improving the quality of care and outcomes for patients with lateral compartment involvement.

Reportedly, traditional Chinese medicine decoction combined with Western medicine can improve the clinical symptoms of patients as a whole. The main causes are the internal resistance of wind, cold, dampness, and the obstruction of joints and meridians, resulting in the symptoms of poor blood circulation and blocked channels. The treatment should activate qi and promote blood circulation, removing blood stasis and relieving pain. In pursuit of this objective, we meticulously selected a total of 54 patients who underwent surgical intervention for lateral compartment knee osteoarthritis and met stringent inclusion criteria. Our patient recruitment process spanned from September 2018 to February 2021 at our hospital. The selection of patients for our study followed a rigorous procedure to ensure the relevance and accuracy of our findings. The specific criteria used to recruit patients encompassed the following key parameters: (1) Diagnosis of Lateral Compartment Knee Osteoarthritis: All patients included in the study were diagnosed with lateral compartment knee osteoarthritis through clinical evaluation, radiographic imaging, and other relevant diagnostic procedures. This ensured that the study population exclusively comprised individuals with this specific orthopedic condition. (2) Surgical Intervention: Patients who had undergone surgical treatment for lateral compartment knee osteoarthritis were considered eligible for inclusion in our study. The types of surgical interventions encompassed both UKA and TKA, reflecting the core focus of our research. (3) Temporal Inclusion Period: Our recruitment period extended from September 2018 to February 2021. This time frame was chosen to provide a contemporary representation of clinical practices and to include patients who underwent surgery during the specified period. (4) Satisfaction of Inclusion Criteria: Only patients who conformed to the inclusion criteria were included in the study. These criteria were determined based on their clinical presentations, imagin. By adhering to these strict selection criteria, we aims to evaluate and compare the clinical efficiency of two surgical treatments, unicompartmental knee arthroplasty (UKA) and total knee arthroplasty (TKA), in patients with lateral compartment knee osteoarthritis. Specifically, the study focuses on understanding how these surgical procedures impact the recovery of motor function in such patients. By conducting this research, we seek to provide insights into the most effective treatment approach for lateral compartment knee osteoarthritis and its influence on patients' postoperative motor function, ultimately contributing to improved clinical decision-making and patient care.

MATERIALS AND METHODS

Participants

A total of 54 patients who underwent surgery for lateral compartment knee osteoarthritis and satisfied the inclusion criteria from September 2018 to February 2021 at our hospital were recruited and assigned to receive either UKA (UKA group, n=30) or TKA (TKA group, n=24) via random number table method.

Ethical considerations were paramount in the planning and execution of our study. The study protocol received the formal approval of the Ethics Committee of Chengdu Second People's Hospital (Approval No. MJ-KI20180505). All aspects of the research adhered rigorously to the principles outlined in the Declaration of Helsinki, ensuring the welfare and rights of the study participants. Prior to their enrollment in the study, informed consent was diligently obtained from all patients, as well as their families, to ensure complete transparency regarding the study's objectives, procedures, and potential risks. This meticulous ethical approach underscores our commitment to upholding the highest standards in conducting this research.

The randomization was carried out using an online web-based randomization tool (freely available at http://www.randomizer.org/). For concealment of allocation, the randomization procedure and assignment were managed by an independent research assistant who was not involved in the screening or evaluation of the participants.

The original sample size calculation estimated that 25 patients in each group would be needed to detect a 3-point difference between groups in a 2-sided significance test with a power of 0.8 and an alpha error level of 0.05. However, the decision to increase the sample size in the UKA group to 30 patients was primarily motivated by two key factors. Firstly, it was intended to enhance the statistical power of the study. A larger sample size in this group could potentially provide a more robust basis for detecting any subtle differences in clinical outcomes between UKA and TKA, thus strengthening the study's ability to draw meaningful conclusions. Secondly, it took into account potential attrition or dropout rates that might occur during the course of the study, ensuring that a sufficient number of patients would remain for valid statistical analysis even if some patients were unable to complete the study.

Inclusion and exclusion criteria

Inclusion criteria: 1) Diagnosis of Lateral Compartment Knee Osteoarthritis: Patients were included in the study based on a diagnosis of lateral compartment knee osteoarthritis. This diagnosis was established through a comprehensive evaluation that incorporated clinically relevant tests, although specific details of the diagnostic tests were not previously provided. To address this concern, it is important to clarify the diagnostic methods used, which may include radiographic imaging, joint examination, or other relevant clinical assessments. Such additional information ensures the transparency and reproducibility of the diagnostic process; 2) Structural and Functional Integrity of Knee Ligaments: Inclusion criteria stipulated that patients must have structural and functional integrity of their knee ligaments. Further elaboration on the specific assessments or tests used to determine ligament integrity would provide clarity and transparency regarding patient eligibility; 3) Single Knee Lesion: All enrolled patients were required to have a single knee lesion. Clarification on the nature of this lesion, whether it pertains to the location or type of pathology within the knee, would enhance understanding.

Exclusion criteria: 1) History of Knee Trauma or Knee Surgery: Excluding patients with a history of knee trauma or surgery is a common practice to ensure that study results are not confounded by prior interventions or injuries; 2)Combined Serious Organ Disease: To enhance clarity, it is advisable to specify which serious organ diseases were considered as exclusion criteria; 3) Inflammatory Arthritis: Elaboration on the definition or criteria for inflammatory arthritis would provide a clear basis for exclusion; 4) Less Than 12 Months of Follow-up or Loss of Access: Providing reasons for the specific duration of follow-up and the circumstances leading to "loss of access" would offer a better understanding of these criteria; 5) Use of Medications Affecting the Study: Clarification regarding how certain drugs might affect the study, as well as the rationale behind the one-week timeframe for drug exclusion, would enhance transparency; 6) Rheumatism, Tumors, and Other Diseases: Providing more details on the specific diseases or conditions included in this criterion would be beneficial; 7) Mental Illness: A brief description of the rationale behind excluding patients with mental illness would be informative; 8) Liver and Kidney Insufficiency: Adding specific criteria or thresholds for liver and kidney insufficiency would improve understanding; 9) Allergic to Non-Steroidal Anti-Inflammatory Drugs: To clarify, specifying the relevance of this criterion to the study would be helpful; 10) Lactating and Pregnant Women: The rationale for excluding lactating and pregnant women should be included, as this is a standard exclusion criterion in many clinical studies.

Treatment methods

(1) Patients in the UKA group received a fixed-bearing UKA: The patient was treated with lumbar anesthesia in the supine position, and the ZUK fixed-bearing UKA system was used for surgery. A lateral parapatellar longitudinal incision was made and the patient was osteotomized sagittally and horizontally at the lateral edge of the anterior cruciate ligament stop of the intercondylar ridge. The thickness of the osteotomy was about 3-5 mm, and the posterior tilt was controlled within 3°. The patient's extension gap was measured, and the distal femur was osteotomized using a distal femoral osteotomy guide, followed by the reconfirmation of the size of the extension gap and the measurement of the femoral prosthesis. The midline of the tibial plateau was used as a marker for the midline of the femoral condylar prosthesis, the femoral condyle osteotomy guide was placed, and the posterior femoral condyle and posterior bevel were osteotomized, followed by flexion and extension gap testing. Lateral tibial treatment was performed, and trial molds of the femoral and tibial prostheses were placed, followed by an examination of the patient's joint stability. The femoral condyle and tibial prosthesis were fixed using bone cement, followed by the placement of a shim. The wounds were sutured, and postoperative pressure bandages were applied without the placement of drainage tubes.[8]

(2) Patients in the TKA group received TKA: The patient received lumbar anesthesia in the supine position, and the

Persona PS TKA system was used for surgery. A medial parapatellar approach was performed with a median incision. The tibia was positioned using the extramedullary method, the femur was positioned using the intramedullary method, and the soft tissues of the patient were balanced using the gap balancing method, followed by fixation of the patient's prosthesis using bone cement, prior to suturing and postoperative pressure dressing without placement of drainage tubes.[9] All procedures were performed by the same group of joint surgeons.

Both patient groups received the Hanjing Decoction as part of their treatment regimen. The Hanjing Decoction, a traditional herbal formulation, was composed of the following ingredients: Radix Aconiti 15g, Ramulus Cinnamomi 12g, radix liquiritiae 10g, Ephedra, Centipede, Ginger 8g each, Asarum, Scorpion 6g. Patients were instructed to consume the Hanjing Decoction as follows: Take 200 ml at 9:00 after breakfast; in case of no sweating, take another 200 ml every 3 hours until sweating. Otherwise, take it again the next day, the same way as the previous day. In case of not meeting the standard, take 2 doses on the third day. If there is no sweating after taking 6 doses in 3 days, stop taking it to observe the indicators.

The administration of the Hanjing Decoction followed three specific methods to facilitate sweating: drink hot gruel, cover with a quilt, and take in a continuous manner. The standard of sweating: the normal sweating method means, i.e. perspiration is normal and the pulse spasm is stopped. Normal sweating is slightly sweating, which can be persistent for 2 to 5 hours and self-constraint, and the pulse tends to ease after the treatment of pulse spasm and sweating. The treatment course of both groups was 4 weeks. The Hanjing Decoction was an integral component of their treatment, aimed at assisting the recovery process and achieving the desired clinical outcomes.

Perioperative management

Patients in both groups received analgesic, anticoagulant, and infection prevention treatment according to the recommended protocol of Accelerated Rehabilitation of Hip and Knee Arthroplasty in China.[10] The patient was given an intravenous infusion of tranexamic acid (15 mg/kg) before the skin incision and received an intra-articular injection of tranexamic acid at the time of incision closure. When the patient was conscious and recovered, the affected limb was elevated, and the patient was then given functional ankle training by the same rehabilitation physician.[11]

Outcome measures

Perioperative indices: 1) Operative Time: Recording the duration of the surgical procedure helps gauge the efficiency and complexity of the surgery; 2) Reduction Ratio of Hb 1d Postoperatively: Monitoring postoperative hemoglobin reduction provides insights into blood loss, an important factor in assessing surgical impact; 3) VAS Score at 7d Postoperatively: The VAS score at 7 days post-surgery is a standard measure of pain, helping assess immediate postoperative comfort; 4) Length of Hospital Stay: The length of hospital stay is indicative of postoperative recovery and resource utilization.

Clinical outcome: The collection of specific patient-reported and clinical measures to evaluate the overall success and effectiveness of the surgical interventions. The following outcome measures were employed: Knee Society Score (KSS) is a widely recognized clinical assessment tool used to evaluate the functional and symptomatic status of the knee joint. It includes two components: the knee function score, which assesses a patient's functional capabilities and activity level, and the knee pain score, which quantifies the level of knee pain. A higher KSS score indicates better knee function and reduced pain. Oxford Knee Score (OKS) is a patient-reported outcome measure designed to assess the quality of life and functional limitations associated with knee osteoarthritis. It quantifies the patient's self-perceived knee function and pain levels. A higher OKS score signifies improved knee-related quality of life and function. Knee mobility (ROM) is a crucial clinical parameter that measures the extent to which a patient can flex and extend their knee joint. It is a key indicator of joint function and mobility recovery following surgery. Improved ROM reflects enhanced joint mobility and function. Patient's Artificial Joint Obliteration (FJS) Score: The FJS score evaluates the patient's satisfaction and overall experience with their artificial joint. It provides insights into how well the patient perceives their joint replacement in terms of function and quality of life. A higher FJS score indicates greater patient satisfaction with the artificial joint. These outcome measures were assessed at specific postoperative time points, including 1 month, 3 months, and 1 year after surgery. By utilizing these measures, we aimed to comprehensively evaluate and quantify the clinical progress and outcomes of the patients in our study.[12] This approach allows for a more nuanced understanding of the impact of surgical interventions on various aspects of knee health, function, and patient satisfaction.

Recovery of motor function: The recovery of the patient's knee joint motor ability was evaluated by using our homemade questionnaire, and the patient's ability to perform cycling, brisk walking, jogging, going up and down stairs, and fast squatting was determined 1 year after surgery. Each item was scored 1 point if the item could be completed or superior to the preoperative condition, and 0 points for failure to complete. The total score of the questionnaire was 5, with 0-2 indicating unsatisfactory recovery of motor ability, 3-4 indicating moderate recovery of motor ability, and 5 indicating excellent recovery of motor ability. While this questionnaire was a specific tool created for our study, it was not independently validated. Given that the questionnaire was developed for our research, no external references or validations are available. The intention behind its use was to provide insights into the practical functional improvements experienced by patients in their everyday lives following surgery.

Adverse reactions: the frontal and lateral X-rays of the patient's knee joints were examined by the same physician to assess the function of the knee joints and the position of the prosthesis. Adverse events were recorded in both groups, which included incision, thrombosis, knee, and prosthesis-related adverse events.[13]

Statistical analysis

SPSS26.0 was used for data management and analyses, and GraphPad Prism 8 was adopted to visualize the data into required graphics. Normally distributed measurement data were expressed as ($\bar{x} \pm s$) and analyzed using the independent sample t-test. The count data were expressed as rates (%) and subject to the chi-square test. We established a significance threshold of $P < .05$, in line with conventional statistical practice, to determine statistical significance. This threshold ensures that the observed differences between groups are unlikely to occur by random chance and helps in drawing meaningful conclusions from the data.

RESULTS

Patient characteristics

A total of 54 patients were included in this study, including 30 patients in the UKA group and 24 patients in the TKA group. The differences in patient characteristics including sex, age, BMI, disease duration, lesion side, VAS score, KSS score, OKS score, and ROM between the two groups were comparable ($P > .05$). (Table 1) The determination of our sample size was based on careful consideration of the study's objectives and statistical power requirements. We aimed to ensure that our sample size would be adequate to detect meaningful differences between the two surgical procedures if they existed.

Perioperative indices

Patients in the UKA group had considerably shorter operating indices, as well as a smaller decrease ratio of Hb 1d and VAS ratings 7d postoperatively ($P < .05$) (Table 2). These outcomes suggest that UKA may have advantages in terms of less invasive procedures and early postoperative recovery, which could potentially lead to reduced pain and blood loss.

Clinical efficiency

At 1 month and 6 months postoperatively, UKA resulted in substantially improved KSS scores, OKS scores, ROM, and motor function recovery compared to TKA, although the difference in the aforementioned indices did not reach statistical significance at 1 year postoperatively. ($P < .05$). The significant improvement in FJS scores at 1 year postoperatively for the UKA group is noteworthy, indicating higher patient satisfaction with the artificial joint. These findings suggest that UKA may offer better short-term clinical outcomes and satisfaction, although the long-term differences between the procedures become less distinct.

Motor function recovery

At 1 year after surgery, the total score of knee motion recovery was (3.7±1.2) in the UKA group and (3.7±1.1) in the TKA group, and the difference did not come up to the statistical standard ($P > .05$) (Table 3). This implies that both procedures result in similar improvements in motor function at the one-year postoperative mark.

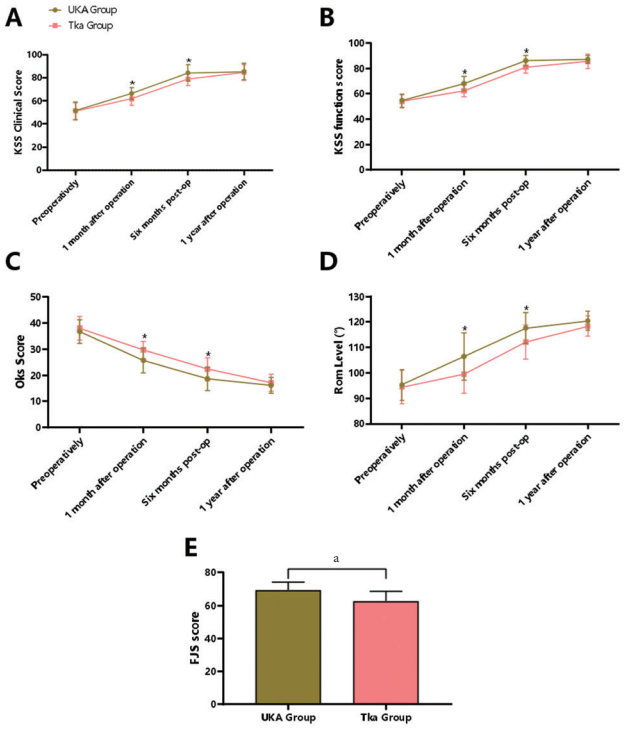
Table 1. Patient characteristics [$\bar{x} \pm s$, n(%)]

	UKA (n = 30)	TKA (n = 24)	t/χ^2	*P* value
Sex	30	24	0.065	.799
Male	11	8		
Female	19	16		
Age (years)	51-82	50-83		
Mean age (years)	65.41±4.27	65.28±4.16	0.112	.911
BMI (kg/m^2)	25.14±3.06	25.07±3.01	0.084	.933
Duration of disease (months)	21-66	22-64		
Mean duration of disease (months)	36.33±4.12	36.45±4.27	-0.105	.917
Side of lesion			0.561	.454
Left knee	13	8		
Right knee	17	16		
VAS score(points)	7.82±0.73	7.78±0.75	0.198	.844
KSS clinical score(points)	51.62±7.65	51.29±7.43	0.16	.873
KSS functional score(points)	54.82±5.23	53.94±5.07	0.623	.536
OKS score(points)	36.79±4.47	38.15±4.56	-1.101	.276
ROM (°)	95.32±6.07	94.48±6.68	0.483	.631

Table 2. Perioperative indices ($\bar{x} \pm s$)

Group	n	Operative time (min)	Reduction ratio of Hb 1d postoperatively (%)	VAS score 7d postoperatively (points)	Length of stay (d)
UKA	30	54.95±8.76	8.41±3.26	3.12±0.74	8.76±1.34
TKA	24	69.74±8.43	13.25±6.76	4.31±0.85	11.72±2.55
t	-	-6.268	-3.457	-5.497	-5.489
P value	-	<.001	.001	<.001	<.001

Figure 1 Clinical efficiency ($\bar{x} \pm s$)



[a]indicates the presence of significant differences ($P < .05$).

Table 3 Motor function recovery [n (%)]

Group	n	Cycling	Brisk walking	Jogging	Going up and down stairs	Fast squating	Total score of knee motion recovery
UKA	30	28(93%)	25(83%)	22(73%)	15(50%)	11(37%)	3.7±1.2
TKA	24	23(96%)	21(88%)	17(71%)	8(33%)	8(33%)	3.7±1.1
χ^2	-	0.159	0.183	0.042	1.515	0.065	-
P value	-	.69	.668	.839	.218	.799	-

Postoperative complication

One patient in the UKA group had intraoperative patellar ligament injury, which was sutured during surgery and no postoperative effects on knee function were observed. In the TKA group, a different patient encountered postoperative necrosis of the incisional skin margin. This complication was promptly addressed through a specialized symptomatic intensive healing treatment regimen. As a result, the necrotic tissue was successfully managed, and the incisional skin margin ultimately healed. Importantly, this issue did not lead to any long-term consequences or adverse effects on the patient's overall health or knee function. Throughout the hospitalization and follow-up periods, there were no documented instances of thrombosis or any adverse events related to the knee or the prosthetic joint. The patients' recovery and outcomes were closely monitored, and no issues in these areas were observed.

DISCUSSION

Pathogenesis and Clinical Manifestations

Knee osteoarthritis, a degenerative disease, is common in middle-aged and elderly people. Based on the damage to articular cartilage, knee osteoarthritis is highly destructive. Under the long-term progression of the disease, the cartilage structure can be destroyed, and patients often have synovial degeneration, injuries of the medial and lateral meniscus, and loose bodies, resulting in joint deformity and functional disability.[14] In recent years, with the continuous development of the economy and the continuous improvement of living standards, the aging structure in China has increasingly aggravated, and the incidence of various senile diseases such as diabetes, coronary heart disease, hypertension, and joint degeneration has been on the rise. Among them, joint degenerative diseases are more common, so the clinical treatment of such diseases has attracted considerable attention.[15]

To our best understanding, the progression of knee osteoarthritis was related to the patient's weight-bearing, trauma, and other factors. The main clinical manifestations were knee swelling and pain, pain when going up and down stairs, knee pain, and discomfort when sitting, standing, and walking, with arthralgia being the common complaint. Without timely medical treatment, patients are vulnerable to disability, compromising their daily activities and normal quality of life.[16-17] With the above background, the main purpose of current clinical treatment is to reduce joint inflammation and control the deterioration of joint lesions, which is of great significance for reducing irreversible bone parenchyma destruction and improving clinical symptoms.

Traditional Chinese Medicine Perspective

Research has shown that lateral UKA is associated with many postoperative adverse events and mediocre outcomes due to the immaturity of the UKA technique, resulting in a significantly higher incidence of re-operation than the TKA protocol.[18] In recent years, the continuous development of the prosthetic technique and surgical technology has yielded satisfactory clinical results of UKA for lateral compartment knee osteoarthritis.[19] The traditional Chinese medicine meridian differentiation classifies knee osteoarthritis as arthralgia. In the "Huangdi Neijing", it is mentioned that "wind, cold and dampness are mixed together, and they are mixed to form arthralgia. In "Plain Questions: The Essence of Pulse Essentials", it is recorded that "If the knee is unable to bend or stretch, and the back is always bent over when walking and the sinews will be exhausted. Therefore, all knee pains are due to liver and kidney deficiency, and wind, cold and dampness will strike in case of deficiency." To sum up, arthritis of the knee is caused by the obstruction of the meridians by the pathogens of wind, cold, dampness, and heat, resulting in poor qi and blood, showing symptoms such as joint pain, swelling, and inconvenience of movement. The early symptoms of the disease are atypical, and most patients visit a doctor because of persistent pain in the knee joint. The main goal of treatment is to relieve pain symptoms, improve the quality of life of patients, and maintain joint function. In traditional Chinese medicine, treatment methods such as invigorating the liver and kidney, expelling wind and removing dampness, invigorating qi and invigorating blood are often used to treat the root cause, and expelling wind, dispelling cold, clearing the meridians and activating collaterals to treat the symptoms.[20-21]

Clinical Outcomes and Comparative Analysis

In the present study, at 1 month and 6 months postoperatively, UKA resulted in significantly better KSS scores, OKS scores, ROM, and motor function recovery versus TKA, which is consistent with results of previous research, indicating that UKA was associated with better knee function and ROM of patients at 6 months postoperatively. The explanation for this might be that UKA only osteotomized the patient's lateral compartment, resulting in less osteotomy and stress, which expedited postoperative healing, effectively avoided injury to normal knee tissues, and protected the integrity of the cruciate ligament. However, the difference between the above indices did not meet the statistical standard at 1 year postoperatively. This lack of statistical significance can be attributed to what is known as a 'ceiling effect.' A ceiling effect occurs when a substantial number of patients achieve either optimal or worst-case scores in a given assessment, which can make it challenging to distinguish meaningful differences among patients.[22] Since the above metrics contribute to undetectable differences in patient scores, the above metrics are suboptimal in assessing patients' postoperative outcomes. To avoid the ceiling effect of the conventional knee score, the FJS score was used herein for effectiveness comparison. Herein, UKA resulted in higher FJS scores versus TKA at 1 year postoperatively. The results of a study by HA et al.[23] showed that at 2 and 3 years postoperatively, patients with UKA had significantly higher FJS scores than those who underwent TKA, and the results of this study were similar to the present study. In summary, the observed improvements in KSS, OKS, ROM, and FJS scores

in the UKA group have significant clinical implications. They suggest that UKA offers not only early but also sustained benefits in terms of knee function, quality of life, and patient satisfaction. These outcomes are indicative of improved mobility, reduced pain, and a positive impact on the overall well-being of patients who undergo UKA, highlighting its clinical value for individuals with lateral compartment knee osteoarthritis.

Recovery of Knee Mobility

The use of fixed-bearing other than mobile-bearing UKA in the present study is ascribed to a high complication rate of dislocation.[24] Stabilization of the mobile-bearing UKA relies mainly on the ligament tension, and the lateral interval plays a different role than the medial one due to the flexion and extension of its ligaments, which leads to an imbalance in the flexion-extension gap and thus an increased incidence of dislocation complications.[25] A prior study[26] analyzed 287 patients who underwent lateral mobile-bearing UKA, in which 41 patients underwent reoperation, out of which 27 patients were due to dislocation. The current study also used a fixed-bearing lateral UKA, and all patients did not experience any prosthesis-related complications. There have been few clinical findings on the recovery of knee mobility in individuals with lateral compartment knee osteoarthritis. To that purpose, at 1 year postoperatively, a questionnaire was devised and utilized to assess the recovery of the five motor activities of cycling, brisk walking, running, going up and down stairs, and quick squatting in both groups. The findings revealed that there was no statistically significant difference in overall knee motion capacity recovery ratings between the two groups, indicating the limits of the two treatments for improving knee motion ability, despite their enrichment for KSS, OKS, and ROM. The explanation might be that surgical repair cannot entirely restore elements impacting motor ability.[27]

Integrative Medicine Approach

After the operation, we also used Chinese herbal medicine. We believe that the syndrome differentiation of pathogenic cold mainly includes the pulse is deep and tight, i.e, spasm, pain, and aversion to cold. Those who satisfy all three points are classified as cold syndrome, and can be treated with sweating method. In the differentiation of calming pulse, 80% of them are spasms, 10% are pain, 5% are aversion to cold, and 5% are others.[28] Hanjing Decoction is composed of Guigan Jiangzao Ma Xinfu Decoction in the "Golden Chamber", plus Zhijing Sanshen centipede and whole scorpion. When taking it, it should be used in conjunction with the "three methods of assisting sweat", namely sipping porridge, warming it, and taking it frequently.[29] Guigan Jiang Zao Ma Xin Fu Decoction warms Yang and disperses cold, Ma, Xin, Gui, Ginger can relieve cold condensation, Cao Zao nourishes stomach qi. Studies have shown that Gui Gan Jiang Zao Ma Xin Fu Decoction can reduce joint inflammation in rats and reduce joint inflammation. The degree of swelling has an inhibitory effect on the hyperplasia of the synovial membrane of the joints; centipedes and scorpions are often used in traditional Chinese medicine to suppress wind and stop spasms, and have the functions of attacking toxins and dissipating knots, activating meridians and relieving pain, etc. In the treatment of paralysis, the effect is quite good. Although centipedes and whole scorpions are toxic, excessive doses will cause adverse reactions such as nausea, vomiting, diarrhea, and even life-threatening, clinical studies have proved that it can effectively reduce its toxicity given rational drug use, proper compatibility, and dose control and medication time. Consistently, the results of this study show that the treatment method of integrated traditional Chinese and Western medicine is effective.[30]

Study Limitations and Future Research

We acknowledge that our study has several limitations, including a small sample size and a relatively short follow-up period. These limitations may impact the precision of our findings. Importantly, our study did not assess the long-term adverse effects of the two surgical procedures or provide information about the survival of the prosthetic joints in both groups. Given the importance of evaluating the long-term outcomes and potential complications associated with these procedures, we recognize the need for future in-depth follow-up studies with larger clinical sample sizes. Furthermore, it's essential to recognize that our study may have been subject to various potential sources of bias. For instance, patient selection and individual characteristics may have introduced bias as patients were assigned to either the UKA or TKA group through randomization. Additionally, other uncontrolled variables, such as patient lifestyle, compliance with postoperative care, and underlying comorbidities, could have influenced the results to some extent. We acknowledge that these factors may contribute to variations in patient outcomes. These studies will be essential to provide a more comprehensive understanding of the extended effects and prosthesis survival rates associated with the surgical interventions under investigation. Such research will contribute significantly to the ongoing assessment of the safety and efficacy of these procedures in the long term

Clinical Implications

Above all, in real-world clinical settings, these findings can help healthcare professionals make more informed decisions when recommending surgical procedures for patients with lateral compartment knee osteoarthritis. The choice between UKA and TKA should be tailored to the patient's specific needs, considering factors such as short-term vs. long-term outcomes, postoperative recovery speed, and patient satisfaction. Ultimately, the goal of treatment remains consistent: to alleviate pain, improve the quality of life, and maintain joint function. These findings support the notion that UKA, with its early and sustained benefits, is a valuable option for individuals dealing with lateral compartment knee osteoarthritis. Healthcare providers can now use this evidence to guide their clinical recommendations, leading to more personalized and effective care for patients.

CONCLUSION

Our study demonstrates that UKA offers several clinical advantages over TKA for patients with lateral compartment knee osteoarthritis. Specifically, UKA stands out as the superior choice, yielding a trifecta of essential benefits: a smaller surgical incision, accelerated postoperative recovery, and markedly improved knee function restoration compared to TKA. These findings have direct implications for clinical practice and can guide orthopedic surgeons in making informed decisions regarding the selection of the most appropriate surgical procedure.

For orthopedic surgeons, the choice between UKA and TKA should consider the specific needs and goals of individual patients. Patients who prioritize smaller surgical incisions, quicker postoperative recovery, and optimal knee function restoration may be better candidates for UKA. Conversely, TKA remains a viable option for patients whose primary concern is pain relief, as both procedures effectively alleviate pain and improve knee function.

In clinical practice, shared decision-making between surgeons and patients should take into account the patient's overall health, lifestyle, and expectations. Orthopedic surgeons can use the insights from this study to engage in informed discussions with patients, helping them make choices aligned with their unique preferences and clinical profiles. Moreover, these findings underscore the importance of a multidisciplinary approach to patient care, where surgeons work collaboratively with physiotherapists and rehabilitation specialists to optimize postoperative motor capability for patients undergoing either procedure.

While our study offers valuable insights into the advantages of UKA over TKA for lateral compartment knee osteoarthritis, it is important to acknowledge the need for further research in this field. Long-term studies with larger sample sizes are warranted to comprehensively assess the extended effects and prosthesis survival rates associated with these surgical interventions. These future investigations will provide a more robust foundation for evidence-based decision-making in orthopedic practice.In summary, our study contributes valuable insights that can assist orthopedic surgeons in tailoring their approach to lateral compartment knee osteoarthritis management. By considering the specific advantages of UKA in terms of smaller wounds, faster recovery, and improved knee function, surgeons can offer personalized treatment options that align with each patient's goals and expectations.

FUNDING

The authors received no financial support for the research authorship or publication of this article.

CONFLICT OF INTEREST

All authors declared that they have no financial conflict of interest.

DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this published article.

CONSENT FOR PUBLICATION

All authors have read and approved this manuscript to be considered for publication.

REFERENCES

1. Wang L, Sun Z, Sun Y, Zhang D, Tian M, Feng S. [Determination of tibial bone resection thickness by lateral tibiofemoral joint 90° flexional gap in total knee arthroplasty for varus osteoarthritic knees]. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi*. 2014;28(12):1453-1458.
2. Mortensen JF, Rasmussen LE, Østgaard SE, et al. Randomized clinical trial of medial unicompartmentel versus total knee arthroplasty for anteromedial tibio-femoral osteoarthritis. The study-protocol. *BMC Musculoskelet Disord*. 2019;20(1):119. doi:10.1186/s12891-019-2508-1
3. Swank AM, Kachelman JB, Bibeau W, et al. Prehabilitation before total knee arthroplasty increases strength and function in older adults with severe osteoarthritis. *J Strength Cond Res*. 2011;25(2):318-325. doi:10.1519/JSC.0b013e318202e431
4. Koh IJ, Kim MS, Sohn S, Song KY, Choi NY, In Y. Patients undergoing total knee arthroplasty using a contemporary patella-friendly implant are unaware of any differences due to patellar resurfacing. *Knee Surg Sports Traumatol Arthrosc*. 2019;27(4):1156-1164. doi:10.1007/s00167-018-5120-2
5. Deroche E, Batailler C, Swan J, et al. No difference between resurfaced and non-resurfaced patellae with a modern prosthesis design: a prospective randomized study of 250 total knee arthroplasties. *Knee Surg Sports Traumatol Arthrosc*. 2022;30(3):1025-1038. doi:10.1007/s00167-021-06521-y
6. Wu LP, Mayr HO, Zhang X, Huang YQ, Chen YZ, Li YM. Knee Scores of Patients with Non-Lateral Compartmental Knee Osteoarthritis Undergoing Mobile, Fixed-Bearing Unicompartmental Knee and Total Knee Arthroplasties: A Randomized Controlled Trial. *Orthop Surg*. 2022;14(1):73-87. doi:10.1111/os.13111
7. Hommel H, Abdel MP, Perka C. Kinematic femoral alignment with gap balancing and patient-specific instrumentation in total knee arthroplasty: a randomized clinical trial. *Eur J Orthop Surg Traumatol*. 2017;27(5):683-688. doi:10.1007/s00590-016-1865-9
8. Wu J, Feng S, Chen X, et al. Intra-Articular Injection of Tranexamic Acid on Perioperative Blood Loss During Unicompartmental Knee Arthroplasty. *Med Sci Monit*. 2019;25:5068-5074. doi:10.12659/MSM.914817
9. Tian S, Wang B, Wang Y, Ha C, Liu L, Sun K. Combined unicompartmental knee arthroplasty and anterior cruciate ligament reconstruction in knees with osteoarthritis and deficient anterior cruciate ligament. *BMC Musculoskelet Disord*. 2016;17(1):327. doi:10.1186/s12891-016-1186-5
10. Zhu Y, Li Y, Yan C, Du X, Xing Z, Chen P. [Influence of lateral retinacular release on anterior knee pain following total knee arthroplasty]. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi*. 2017;31(5):541-546.
11. Hernigou P, Delambre J, Quiennec S, Poignard A. Human bone marrow mesenchymal stem cell injection in subchondral lesions of knee osteoarthritis: a prospective randomized study versus contralateral arthroplasty at a mean fifteen year follow-up. *Int Orthop*. 2021;45(2):365-373. doi:10.1007/s00264-020-04571-4
12. Chao J, Jing Z, Xuehua B, Peilei Y, Qi G. Effect of Systematic Exercise Rehabilitation on Patients With Knee Osteoarthritis: A Randomized Controlled Trial. *Cartilage*. 2021;13(1_suppl)(suppl):1734S-1740S. doi:10.1177/1947603520903443
13. Liao CD, Tsauo JY, Chiu YS, Ku JW, Huang SW, Liou TH. Effects of Elastic Resistance Exercise After Total Knee Replacement on Muscle Mass and Physical Function in Elderly Women With Osteoarthritis: A Randomized Controlled Trial. *Am J Phys Med Rehabil*. 2020;99(5):381-389. doi:10.1097/PHM.0000000000001344
14. Latourte A, Rat AC, Omorou A, et al. Do corticosteroids injections increase the risk of knee osteoarthritis progression over 5 years? [J]. *Arthritis Rheumatol*. 2022;74(8):1343-1351. doi:10.1002/art.42118
15. Kaszyński J, Bąkowski P, Kiedrowski B, et al. Intra-Articular Injections of Autologous Adipose Tissue or Platelet-Rich Plasma Comparably Improve Clinical and Functional Outcomes in Patients with Knee Osteoarthritis. [J]. *Biomedicines*. 2022;10(3):684. doi:10.3390/biomedicines10030684
16. Klinedinst NJ, Huang W, Nelson AK, et al. Inflammatory and Immune Protein Pathways Possible Mechanisms for Pain Following Walking in Knee Osteoarthritis. [J]. *Nurs Res*. 2022;71(4):328-335. doi:10.1097/NNR.0000000000000593
17. Ram A, Booth J, Thom JM, Jones MD. Exercise physiologists use of pain neuroscience education for treating knee osteoarthritis: A qualitative interview study. [J]. *Musculoskeletal Care*. 2022;20(4):821-830. doi:10.1002/msc.1631
18. Ismailidis P, Kuster MS, Jost B, Giesinger K, Behrend H. Clinical outcome of increased flexion gap after total knee arthroplasty. Can controlled gap imbalance improve knee flexion? *Knee Surg Sports Traumatol Arthrosc*. 2017;25(6):1705-1711. doi:10.1007/s00167-016-4009-1
19. Sled EA, Khoja L, Deluzio KJ, Olney SJ, Culham EG. Effect of a home program of hip abductor exercises on knee joint loading, strength, function, and pain in people with knee osteoarthritis: a clinical trial. *Phys Ther*. 2010;90(6):895-904. doi:10.2522/ptj.20090294
20. Yu X, Hui X, Qi X, et al. Research on the establishment of a model rat model of knee osteoarthritis with wind-cold-dampness syndrome based on prescription test [J]. *Journal of Hunan University of Traditional Chinese Medicine*. 2022;42(07):1091-1095.
21. Wan W, Xie Y, Wu G. Treatment of 33 cases of knee osteoarthritis with Duhuo Jizhi Decoction combined with Xiaoyan Powder [J]. *Hunan Journal of Traditional Chinese Medicine*. 2022;38(05):59-61.
22. Brett A, Bowes MA, Conaghan PG, et al. Automated MRI assessment confirms cartilage thickness modification in patients with knee osteoarthritis: post-hoc analysis from a phase II sprifermin study. *Osteoarthritis Cartilage*. 2020;28(11):1432-1436. doi:10.1016/j.joca.2020.08.005
23. Zuiderbaan HA, van der List JP, Khamaisy S, et al. Unicompartmental knee arthroplasty versus total knee arthroplasty: which type of artificial joint do patients forget? [J]. *Knee Surg Sports Traumatol Arthrosc*. 2017;25(3):681-686. doi:10.1007/s00167-015-3868-1
24. Kabiri S, Halabchi F, Angoorani H, Yekaninejad S. Comparison of three modes of aerobic exercise combined with resistance training on the pain and function of patients with knee osteoarthritis: A randomized controlled trial. *Phys Ther Sport*. 2018;32:22-28. doi:10.1016/j.ptsp.2018.04.001
25. Sershon RA, Fricka KB, Hamilton WG, et al. Early Results of a Randomized Controlled Trial of Partial Versus Total Knee Arthroplasty. *J Arthroplasty*. 2022;37(6S):S94-S97. doi:10.1016/j.arth.2022.02.076
26. Skou ST, Roos EM, Laursen MB, et al. A Randomized, Controlled Trial of Total Knee Replacement. *N Engl J Med*. 2015;373(17):1597-1606. doi:10.1056/NEJMoa1505467
27. McEwen PJ, Dlaska CE, Jovanovic IA, Doma K, Brandon BJ. Computer-Assisted Kinematic and Mechanical Axis Total Knee Arthroplasty: A Prospective Randomized Controlled Trial of Bilateral Simultaneous Surgery. *J Arthroplasty*. 2020;35(2):443-450. doi:10.1016/j.arth.2019.08.064
28. Zhang M, Zhang J, Yang Y. Theoretical discussion and clinical application of Chinese medicine master Li Shimao Hanjing Decoction [J]. *Zhongguo Xiandai Zhongyao*. 2016;23(06):11-12.
29. Hu Z, Ren W, Li Y, et al. Clinical observation of Li Shimao's sweating method in the treatment of 45 cases of knee osteoarthritis with cold condensation syndrome [J]. *World Chinese Medicine*. 2016;11(07):1233-1235.
30. Pi L, Li C. The efficacy of Hanjing Decoction in adjuvant treatment of knee osteoarthritis and its effects on joint function, peripheral blood immunoglobulin and MMP-3 levels [J]. *Sichuan Traditional Chinese Medicine*. 2018;36(09):139-141.