

Postoperative Functional Mobility and Quality of Life in Patients with Anteromedial Osteoarthritis of the Knee Treated with MB-UKA versus TKA

Shu-Ming Li, Bo-Ran Liang, Kai Xiao, Chong-Yi Fan, Dan Li, Fei-Fei Han, Jing Chen

Department of Orthopaedic, Aerospace Center Hospital, Beijing, 100049, People's Republic of China

Correspondence: Jing Chen, Department of Orthopaedic, Aerospace Center Hospital, No. 15 Yuquan Road, Haidian District, Beijing, 100049, People's Republic of China, Email chenjing724222a@126.com

Background: Knee osteoarthritis (OA), a common degenerative joint disease. Anteromedial osteoarthritis (AMOA) specifically targets the knee's medial compartment. We compared total knee arthroplasty (TKA) and mobile-bearing unicompartmental knee arthroplasty (MB-UKA) regarding postoperative functional mobility and quality of life in patients with AMOA.

Methods: A retrospective comparative analysis was conducted on 193 AMOA patients who received TKA (n=101) or MB-UKA (n=92) treatment between January 2020 and December 2024. Patient outcomes were evaluated two years postoperatively using range of motion (ROM), visual analog scale (VAS) for pain, the simplified Chinese version of the Forgotten Joint Score (SC-FJS), Hospital for Special Surgery (HSS) Knee Score, Oxford Knee Score (OKS), Knee Injury and Osteoarthritis Outcome Score (KOOS), and SF-36 quality of life questionnaire.

Results: MB-UKA demonstrated superior functional outcomes. MB-UKA showed significantly greater improvement in ROM (124.44° vs 121.94° , $P<0.001$) and SC-FJS scores (90.52 vs 89.25 , $P=0.002$) at two years. Mechanical axis alignment was also significantly better in the MB-UKA group ($178.65^\circ \pm 0.35^\circ$ vs $178.53^\circ \pm 0.41^\circ$, $P=0.025$). Functional mobility was enhanced with MB-UKA, as indicated by higher HSS ($P=0.003$), OKS ($P=0.002$), and KOOS ($P=0.002$) scores. MB-UKA patients reported better physical functioning (PF score: 68.98 vs 66.52 , $P=0.008$) and vitality (VT score: 81.14 vs 78.96 , $P=0.009$) on the SF-36.

Conclusion: MB-UKA offers enhanced functional mobility and quality of life compared to TKA for patients with AMOA, while maintaining a comparable safety profile. MB-UKA should be considered a favorable surgical option for appropriately selected patients seeking optimized functional recovery.

Keywords: anteromedial osteoarthritis, total knee arthroplasty, unicompartmental knee arthroplasty, functional outcomes, quality of life

Introduction

Osteoarthritis (OA) of the knee is a prevalent degenerative joint disease characterized by the deterioration of articular cartilage, subchondral bone remodeling, and inflammation of synovial membranes.^{1,2} Affecting millions worldwide, knee OA leads to pain, reduced joint function, and impaired quality of life, posing a significant burden on healthcare systems.^{3,4} Beyond biomechanical factors, systemic metabolic conditions are recognized contributors to OA pathogenesis. Hyperglycemia, for instance, has been linked to accelerated joint degeneration through the promotion of advanced glycation end-products and oxidative stress.⁵ Similarly, dysregulated inflammation and oxidative pathways are implicated in bone and cartilage homeostasis, affecting tissue repair and resilience.⁶ Among the various subtypes, anteromedial OA (AMOA) specifically affects the medial compartment of the knee, sparing the lateral compartment and posterior aspects, which often remains functionally intact.⁷ Managing such focal OA presents unique challenges and opportunities in surgical intervention, particularly when considering total knee arthroplasty (TKA) and unicompartmental knee arthroplasty (UKA), including both mobile-bearing (MB-UKA) and fixed-bearing (FB-UKA) as treatment modalities.

TKA has long been a gold standard for addressing end-stage OA of the knee, offering comprehensive joint resurfacing and pain relief by replacing all three compartments with prosthetic components.⁸ Despite its efficacy, TKA is associated with certain drawbacks, including substantial bone and soft tissue disruption, loss of physiological joint kinematics, and extended recovery periods.⁹ Furthermore, the procedure also entails risks of complications such as stiffness, instability, and component wear over time, which can impact postoperative functionality and quality of life.¹⁰

In response to the limitations of TKA, UKA emerges as a less invasive surgical option designed to treat isolated compartmental OA by replacing only the affected medial compartment while preserving the rest of the knee's natural components, including the anterior and posterior cruciate ligaments.¹¹ This preservation allows for more physiological knee function and proprioceptive feedback, promoting superior joint kinematics and potentially facilitating faster rehabilitation and return to activity.

Notably, MB-UKA offers additional advantages over both TKA and FB-UKA due to its mobile-bearing design, which allows for greater congruency between the femoral and tibial components, thereby reducing contact stresses and improving load distribution across the joint. These features contribute to better long-term outcomes and potentially lower rates of revision surgery compared to TKA and FB-UKA.^{12–14} Compared to TKA, UKA results in reduced complications, although it requires precise surgical technique and patient selection. Given the risks associated with over-correction of deformities, which is a much more significant issue than under-correction, and potential component misalignment, failure can occur if not expertly performed.¹⁵

Although both TKA and MB-UKA aim to alleviate symptoms and improve quality of life for patients with AMOA, they represent differing philosophies of surgical intervention. The comprehensive nature of TKA, with its established track record for durable pain relief, contrasts with the joint-preserving aims of MB-UKA, which prioritize maintaining natural knee mechanics. Comparing these approaches necessitates a thorough examination of their respective impacts on functional mobility and quality of life outcomes—a paramount consideration in guiding clinical decisions.

Functional mobility post-surgery encompasses various dimensions of patient capability, including knee range of motion (ROM), pain levels, and stability during movement.¹⁶ These parameters were crucial for determining the success of knee arthroplasty, as superior functional outcomes directly correlate to better patient satisfaction and overall life quality. Similarly, quality of life measures, encompassing both physical and psychological states, were essential proxies for evaluating the broader impacts of surgical interventions on patient well-being. Instruments such as the Hospital for Special Surgery (HSS) Knee Score, Oxford Knee Score (OKS), and Knee Injury and OA Outcome Score (KOOS) provide comprehensive assessments of these domains, facilitating direct comparisons between treatment modalities.

While there is a substantial body of research comparing TKA and various types of UKA, the specific focus on mobile-bearing MB-UKA for AMOA remains critical. Despite extensive research in this area, direct comparisons focusing specifically on functional mobility and quality of life between MB-UKA and TKA for AMOA remain valuable. Therefore, this retrospective comparative study aimed to directly evaluate and compare postoperative functional mobility and patient-reported quality of life in patients with AMOA undergoing either MB-UKA or TKA.

Materials and Methods

Participants Selection

We included 193 patients who underwent knee joint AMOA surgery at the Aerospace Center Hospital between January 2020 and December 2024 in the study analysis. These patients were categorized into two groups based on the surgical procedure they received. The first group, consisting of 101 patients, underwent TKA and was labeled as the TKA group. The second group, comprising 92 patients, underwent MB-UKA and was defined as the MB-UKA group. All participants completed a follow-up period of two years. The study protocol was approved by our Institutional Review Board and Ethics Committee (No. 2019(133)) and abided by the ethical guidelines of the Declaration of Helsinki. All patients gave informed consent and signed an informed consent form.

Inclusion and Exclusion Criteria

Patients were eligible for inclusion if they met the diagnostic criteria for AMOA of the knee¹⁷ and had undergone either MB-UKA or TKA on a single knee. Eligible participants were required to be at least 18 years old, possess a complete lateral intercompartment gap, and have an intact anterior cruciate ligament. Additionally, they needed to present with a flexion contracture of less than 15°, knee mobility of 90° or greater, and a varus deformity of less than 15°. Only those with an American Society of Anesthesiologists (ASA) physical status classification of III or lower, who completed a two years follow-up, and had comprehensive medical records and follow-up data were included in the study.

Exclusion criteria included valgus deformity, a history of rheumatoid arthritis, previous knee infections or osteomyelitis, prior significant knee surgeries (excluding arthroscopy), and personal histories of trauma, tumors, skeletal conditions, or neuromuscular disorders that might influence clinical outcomes. Patients who had undergone minor procedures such as arthroscopic meniscectomy, debridement, or cartilage repair were not excluded unless these procedures resulted in complications or significant structural changes affecting the current surgery.

Surgical Methods

Patient Selection Criteria for TKA and MB-UKA

The criteria for selecting patients for TKA included the presence of advanced osteoarthritis affecting multiple compartments of the knee, failure of conservative treatments such as physical therapy, nonsteroidal anti-inflammatory drugs (NSAIDs), and intra-articular corticosteroid injections, and radiographic evidence of severe joint space narrowing and osteophyte formation in more than one compartment. Additionally, patients experiencing persistent pain, stiffness, and functional limitations that significantly impacted their quality of life were considered. Patients with contraindications to total knee replacement surgery, such as active infection or severe cardiovascular disease, were excluded from the TKA group.

For MB-UKA, the selection criteria were more specific. Patients eligible for MB-UKA had isolated AMOA confined to the medial compartment of the knee with minimal involvement of other compartments. An intact anterior cruciate ligament (ACL) was confirmed through clinical examination and magnetic resonance imaging (MRI). Patients with normal alignment or mild varus deformity (<10°) correctable by soft tissue release were considered suitable candidates. A ROM greater than 90° and less than 15° of fixed flexion deformity were also required. Exclusion criteria included inflammatory arthritis or significant patellofemoral joint involvement. Patients who preferred a less invasive surgical option with potentially faster recovery and better postoperative function compared to TKA were also considered for MB-UKA.

Surgical Procedure

Under general anesthesia or intrathecal anesthesia, patients were positioned supine with a tourniquet applied to the thigh. The leg was stabilized in a lower limb brace, maintaining 30° of hip flexion and slight abduction, allowing the calf to hang naturally. The surgical incision was made using a medial parapatellar approach, starting from the superior medial border of the patella, extending distally 3 cm below the joint line, and terminating at the medial border of the tibial tuberosity, followed by a medial para-articular capsular incision on the knee. Joint movement and stability were assessed using a trial prosthesis, after which the appropriate implant was selected and affixed with bone cement. For the TKA group, the procedure was conducted using the Advance knee prosthesis (Wright, USA). For the MB-UKA group, the third-generation Oxford UKA prosthesis (Zimmer Biomet, Warsaw, IN, USA) was used. All surgeries were performed by experienced orthopedic surgeons specializing in knee arthroplasty. These surgeons were each having performed over 100 knee arthroplasty procedures annually. This ensured a consistent level of surgical expertise and minimized variability in surgical outcomes.

Data Collection

Patient data, encompassing demographic characteristics, baseline disease attributes, intra-operative details, postoperative recovery outcomes, functional mobility, quality of life, and complications, were collected via the medical record system.

The Kellgren-Lawrence classification¹⁸ was employed to categorize the severity of AMOA of the knee: Grade 0 indicates no signs of OA; Grade I suggests possible joint space narrowing and potential osteophyte formation; Grade II confirms osteophyte formation with potential joint space narrowing; Grade III shows definite joint space narrowing,

moderate osteophyte formation, some sclerosis, and possible bone end deformity; Grade IV was characterized by large osteophyte formation, severe joint space narrowing, marked sclerosis, and definite bone end deformity.

Furthermore, the American Society of Anesthesiologists (ASA) classification was used to evaluate the preoperative overall health status of patients. The ASA classification ranges from ASA I (class 1), representing healthy individuals without significant systemic disease, to ASA VI (class 6), which applies to brain-dead patients intended for organ retrieval procedures. Higher ASA scores indicate more severe health conditions. The ASA classification demonstrated moderate inter-rater reliability, with a kappa (κ) value of 0.61.¹⁹

Assessment of Surgical Efficacy and Postoperative Recovery Outcomes

Postoperative recovery was evaluated using the Visual Analog Scale (VAS) and the simplified Chinese version of the Forgotten Joint Score (SC-FJS). The VAS was utilized to measure patients' postoperative pain levels, where patients indicated their pain intensity by marking a point on a hidden side of a ruler. Physicians then determined the pain score based on the patient's mark. The VAS rating ranges from 0 to 10: 0 indicates no pain and no impact on sleep; a score of 3 or less denotes mild pain not disturbing sleep; scores between 4 and 6 indicate moderate pain that affects sleep; and scores between 7 and 10 represent severe pain leading to insomnia or painful awakenings.²⁰

The SC-FJS was a disease-specific questionnaire designed to evaluate how easily patients can forget their artificial joint during daily activities. This 12-item survey utilizes a response scale ranging from "never" to "almost never", "seldom", "sometimes", "mostly", and "not relevant to me", corresponding to scores from 4 to 0 points, with missing values documented separately. The total score was calculated by averaging the responses to all answered questions and then multiplying by 25 to convert it to a percentage scale of 0–100 points. Higher scores indicate a better outcome, reflecting a greater degree of "forgetting" the joint and reduced awareness of its presence.²¹

Assessment of Functional Mobility

Patient functional mobility was assessed using the HSS Knee Score, the OKS, and the KOOS. The HSS Knee Score²² evaluates knee joint function by assessing pain, mobility, muscle strength, deformity, stability, and other relevant factors. Scores were classified into categories: 85–100 for excellent performance, 70–84 for good performance, 60–69 for fair performance, and below 60 for poor outcomes.²³

The OKS consists of 12 items divided into two subscales that evaluate pain perception and function, with each item offering five Likert-scale responses from 0 (worst) to 4 (best). The total OKS score ranges from 0 (worst outcome) to 48 (best outcome).²⁴

The KOOS was a 42-item assessment that evaluates knee-related clinical symptoms and function across five domains: pain, symptoms, activities of daily living (ADL), sport and recreation function, and knee-related quality of life. Each domain uses a five-point Likert scale from 0 (least severe) to 4 (most severe). Scores were normalized from 0 to 100, where 100 indicates no symptoms or functional limitations and 0 indicates extreme symptoms and significant impairment. Higher KOOS scores indicate better patient outcomes and functionality.²⁵

Assessment of Quality of Life

The quality of life two years after treatment was assessed using the SF-36 questionnaire. This instrument evaluates eight domains: Physical Functioning (PF), Role Limitations due to Physical Health (RP), Bodily Pain (BP), General Health Perceptions (GH), Vitality (VT), Social Functioning (SF), Role Limitations due to Emotional Problems (RE), and Mental Health (MH). Each domain was scored on a scale from 0 to 100, with higher scores indicating a better quality of life.²⁶

Statistical Analysis

The sample size was determined using G*Power (version 3.1.9.7), setting a power ($1-\beta$) of 0.95, an effect size of 0.5, and a two-tailed significance level (α) of 0.05. It was calculated that at least 88 patients were needed in each group. Statistical analysis was conducted using SPSS 29.0 (SPSS Inc., Chicago, IL, USA). Categorical data were expressed as [n (%)] and chi-square tests or Fisher's exact tests were performed. Continuous variables were assessed for normal distribution using the Shapiro–Wilk test. Normally distributed continuous data were presented as ($\bar{X} \pm s$). A P value of < 0.05 was considered

statistically significant. For between-group comparisons of continuous variables, the mean difference along with its 95% confidence interval (CI) was calculated. Additionally, to quantify the magnitude of significant differences, effect sizes (Cohen's d^*) were computed, with 0.2, 0.5, and 0.8 representing small, medium, and large effects, respectively.

Results

Demographic Characteristics

When comparing demographic characteristics between the TKA group ($n=101$) and the MB-UKA group ($n=92$), no significant differences were found in age, BMI, gender, smoking history, drinking history, hypertension, diabetes, educational level, or marital status (all $P>0.05$) (Table 1). Overall, the baseline demographic characteristics were homogeneous between the two groups, ensuring that subsequent comparisons of outcomes were not confounded by these factors.

The distribution of pre-operative Kellgren-Lawrence classifications was comparable, with 36.63% of TKA patients and 38.04% of MB-UKA patients classified as grade III, and 63.37% and 61.96% classified as grade IV, respectively ($\chi^2=0.041$, $P=0.840$) (Table 2). The surgical site, whether left or right, was similarly non-significant, with 48.51% of surgeries performed on the left knee in the TKA group and 51.09% in the MB-UKA group ($\chi^2=0.127$, $P=0.721$). The ASA grade distribution across both groups also showed no significant variance, with grades 1, 2, and 3 distributed as follows: TKA group had 16.83%, 65.35%, and 17.82%, while the MB-UKA group had 15.22%, 72.83%, and 11.96% respectively ($\chi^2=1.571$, $P=0.456$). These findings indicate homogeneity in baseline disease characteristics between the two groups, enabling unbiased subsequent comparisons of postoperative outcomes.

Intra-Operative Features

The TKA group exhibited a longer mean incision length of 13.02 ± 1.26 cm compared to 10.17 ± 1.53 cm in the MB-UKA group, with statistical significance ($t=14.122$, $P<0.001$) (Figure 1A, incision length). Operative time was notably shorter for MB-UKA, averaging 59.18 ± 12.63 minutes, compared to 64.36 ± 12.73 minutes for TKA ($t=2.835$, $P=0.005$).

Table 1 Comparison of Demographic Characteristics Between Two Groups

Parameters	TKA Group ($n=101$)	MB-UKA Group ($n=92$)	t/χ^2	P
Age (years)	61.52 ± 6.03	61.94 ± 6.15	0.477	0.634
BMI (kg/m^2)	23.18 ± 2.27	22.99 ± 2.36	0.569	0.570
Gender (Male) [n (%)]	50 (49.5%)	49 (53.26%)	0.272	0.602
Smoking history [n (%)]	28 (27.72%)	27 (29.35%)	0.062	0.803
Drinking history [n (%)]	24 (23.76%)	18 (19.57%)	0.498	0.480
Hypertension [n (%)]	27 (26.73%)	22 (23.91%)	0.202	0.653
Diabetes [n (%)]	10 (9.9%)	7 (7.61%)	0.315	0.575
Educational level (junior high school or below/senior high school or above) [n (%)]	70 (69.31%) / 31 (30.69%)	59 (64.13%) / 33 (35.87%)	0.582	0.446
Marital Status (Married/Unmarried or Divorced) [n (%)]	93 (92.08%) / 8 (7.92%)	80 (86.96%) / 12 (13.04%)	1.360	0.244

Abbreviations: TKA, Total knee arthroplasty; MB-UKA, mobile-bearing unicompartmental knee arthroplasty; BMI, Body Mass Index.

Table 2 Comparison of Baseline Disease Characteristics Between Two Groups

Parameters	TKA Group ($n=101$)	MB-UKA Group ($n=92$)	χ^2	P
Pre-operative Kellgren-Lawrence classification (III/IV) [n (%)]	37 (36.63%) / 64 (63.37%)	35 (38.04%) / 57 (61.96%)	0.041	0.840
Surgical site (Left/Right) [n (%)]	49 (48.51%) / 52 (51.49%)	47 (51.09%) / 45 (48.91%)	0.127	0.721
ASA grade (I/2/3) [n (%)]	17 (16.83%)/66 (65.35%)/18 (17.82%)	14 (15.22%)/67 (72.83%)/11 (11.96%)	1.571	0.456

Abbreviations: TKA, Total knee arthroplasty; MB-UKA, mobile-bearing unicompartmental knee arthroplasty; ASA, American Society of Anesthesiologists.

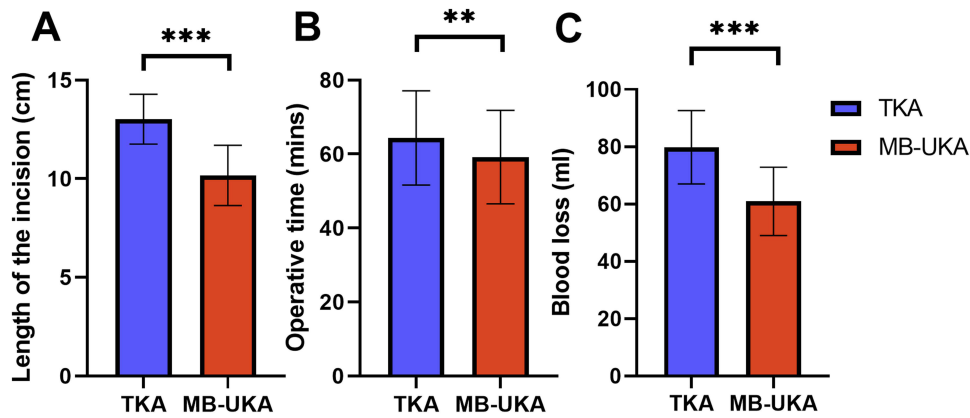


Figure 1 Comparison of intra-operative features between two groups. **(A)** Length of the incision; **(B)** Operative time; **(C)** Blood loss. **Abbreviations:** TKA, Total knee arthroplasty; MB-UKA, mobile-bearing unicompartmental knee arthroplasty.

(Figure 1B, operative time). Intra-operative blood loss was also reduced in the MB-UKA group, with an average of 60.94 ± 11.92 mL, compared to 79.82 ± 12.77 mL in the TKA group ($t=10.586$, $P<0.001$) (Figure 1C, blood loss). These results indicate that MB-UKA was associated with less surgical trauma and reduced recovery needs compared to TKA.

Surgical Efficacy and Postoperative Recovery Outcomes

Both groups started with similar baseline ROM metrics (TKA: $110.44 \pm 5.36^\circ$, MB-UKA: $111.58 \pm 5.52^\circ$; $t=1.453$, $P=0.148$) (Table 3). However, at the 2-year follow-up, the MB-UKA group exhibited significantly greater improvement in ROM, reaching $124.44 \pm 3.27^\circ$ compared to $121.94 \pm 3.67^\circ$ in the TKA group ($t=4.975$, $P<0.001$). Baseline mechanical axis alignment was similar between the groups (TKA: $176.32 \pm 0.71^\circ$, MB-UKA: $176.46 \pm 0.71^\circ$; $t=1.323$, $P=0.187$). At the 2-year follow-up, both groups showed improvement in mechanical axis alignment, but the MB-UKA group had a significantly better alignment (TKA: $178.53 \pm 0.41^\circ$ vs MB-UKA: $178.65 \pm 0.35^\circ$; $t=2.264$, $P=0.025$). Additionally, baseline VAS scores for pain were similar between the groups (TKA: 6.55 ± 0.82 , MB-UKA: 6.52 ± 0.79 ; $t=0.258$, $P=0.796$), and at the 2-year mark, both groups reported similar VAS scores (TKA: 1.68 ± 0.51 , MB-UKA: 1.71 ± 0.57 ; $t=0.466$, $P=0.641$), indicating comparable pain reduction. These results highlight the potential benefits of MB-UKA in achieving superior joint function and alignment outcomes compared to TKA.

When comparing postoperative recovery outcomes between the TKA group and the MB-UKA group, no significant differences were observed in the time to return to work (TKA: 9.46 ± 1.87 weeks vs MB-UKA: 9.32 ± 1.95 weeks, $P=0.609$) or return to sports (TKA: 12.85 ± 1.52 weeks vs MB-UKA: 12.74 ± 1.74 weeks, $P=0.640$) (Table 4). However, at the 2-year follow-up, the MB-UKA group showed significantly higher SC-FJS scores (90.52 ± 2.44) compared to the TKA group (89.25 ± 3.13)

Table 3 Comparison of Surgical Efficacy Between Two Groups

Parameters	TKA Group (n=101)	MB-UKA Group (n=92)	t	P
ROM (°)				
Baseline	110.44 ± 5.36	111.58 ± 5.52	1.453	0.148
At 2 years follow-up	121.94 ± 3.67	124.44 ± 3.27	4.975	< 0.001
Mechanical Axis Alignment (°)				
Baseline	176.32 ± 0.71	176.46 ± 0.71	1.323	0.187
At 2 years follow-up	178.53 ± 0.41	178.65 ± 0.35	2.264	0.025
VAS				
Baseline	6.55 ± 0.82	6.52 ± 0.79	0.258	0.796
At 2 years follow-up	1.68 ± 0.51	1.71 ± 0.57	0.466	0.641

Abbreviations: TKA, Total knee arthroplasty; MB-UKA, mobile-bearing unicompartmental knee arthroplasty; ROM, Range of motion; VAS, Visual analog scale.

Table 4 Comparison of Postoperative Recovery Outcomes Between Two Groups

Parameters	TKA Group (n=101)	MB-UKA Group (n=92)	t	P
Return to work (weeks)	9.46 ± 1.87	9.32 ± 1.95	0.512	0.609
Return to sports (weeks)	12.85 ± 1.52	12.74 ± 1.74	0.469	0.640
SC-FJS at 2 years follow-up	89.25 ± 3.13	90.52 ± 2.44	3.157	0.002

Abbreviations: TKA, Total knee arthroplasty; MB-UKA, mobile-bearing unicompartmental knee arthroplasty; SC-FJS, simplified Chinese version of the Forgotten Joint Score.

($t=3.157$, $P=0.002$). This indicates that patients in the MB-UKA group experienced better joint awareness and function at 2 years postoperatively. These results highlight the potential benefits of MB-UKA in achieving better long-term joint function.

Functional Mobility

At baseline, the HSS knee score was 38.47 ± 5.13 for the TKA group and 39.27 ± 5.53 for the MB-UKA group ($t=1.043$, $P=0.298$) (Figure 2A, HSS at baseline). Similarly, the OKS was comparable between the groups, with the TKA group scoring 22.21 ± 3.45 and the MB-UKA group scoring 21.61 ± 3.54 ($t=1.183$, $P=0.238$) (Figure 2B, OKS at baseline). The KOOS also showed no significant difference, with scores of 39.34 ± 5.86 for TKA and 39.35 ± 6.82 for MB-UKA ($t=0.012$, $P=0.99$) (Figure 2C, KOOS at baseline). At the 2-year follow-up, the HSS knee score was significantly higher for the MB-UKA group at 88.22 ± 4.21 compared to 86.45 ± 4.05 in the TKA group ($t=2.972$, $P=0.003$) (Figure 2D, HSS at follow-up). The OKS reflected similar trends, with the MB-UKA group scoring 41.72 ± 2.41 versus 40.56 ± 2.74 for the TKA group ($t=3.112$, $P=0.002$) (Figure 2E, OKS at follow-up). Additionally, the KOOS was greater in the MB-UKA

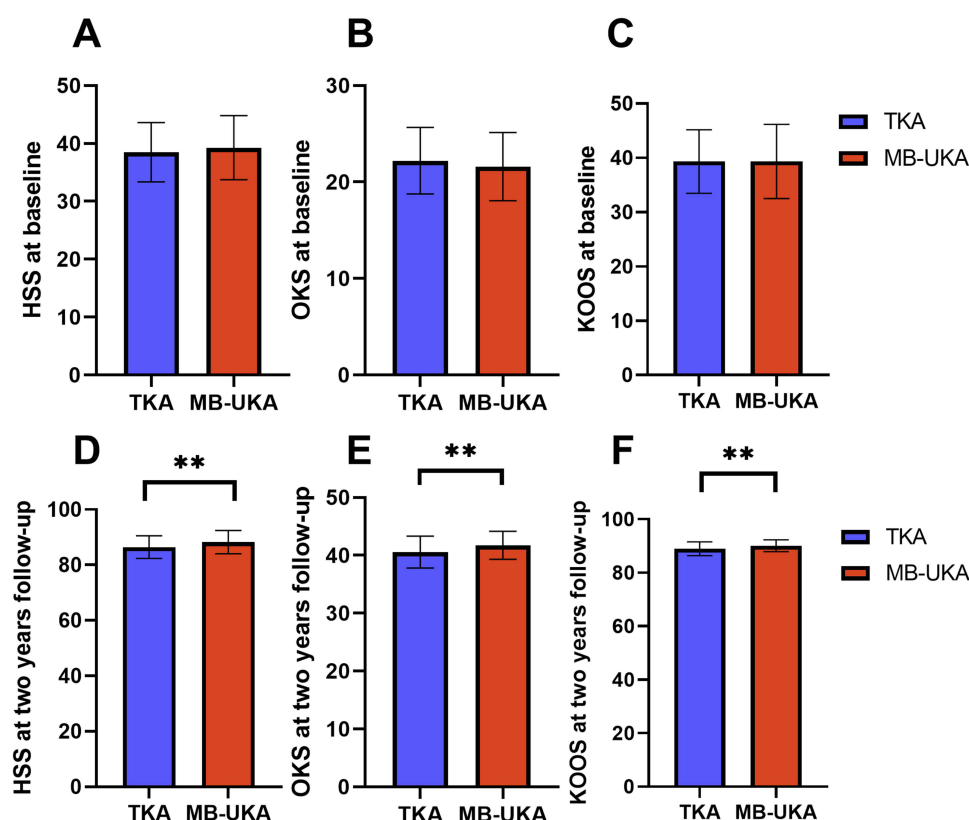


Figure 2 Comparison of functional mobility between two groups. (A) HSS at baseline; (B) OKS at baseline; (C) KOOS at baseline; (D) HSS at two years follow-up; (E) OKS at two years follow-up; (F) KOOS at two years follow-up.

Abbreviations: TKA, Total knee arthroplasty; MB-UKA, mobile-bearing unicompartmental knee arthroplasty; HSS, Hospital for special surgery knee score; OKS, Oxford Knee Score; KOOS, Knee Injury and Osteoarthritis Outcome Score; ns, no significant difference.

group, at 90.07 ± 2.23 , compared to 88.97 ± 2.56 in the TKA group ($t=3.16$, $P=0.002$) (Figure 2F, KOOS at follow-up). These results suggest that the MB-UKA procedure may offer enhanced functional mobility outcomes at two years postoperatively compared to TKA.

Quality of Life

The PF score was significantly higher for the MB-UKA group at 68.98 ± 6.37 compared to 66.52 ± 6.44 for the TKA group ($t=2.673$, $P=0.008$) (Table 5). VT also favored the MB-UKA group, with a score of 81.14 ± 5.67 versus 78.96 ± 5.75 in the TKA group ($t=2.641$, $P=0.009$). Other domains such as RP, GH, BP, SF, RE, and MH did not show statistically significant differences between the groups, with P-values of 0.721, 0.364, 0.186, 0.698, 0.489, and 0.758, respectively. These findings suggest that the MB-UKA group may experience better PF and VT postoperatively compared to the TKA group, although other aspects of quality of life remain similar.

Complications

In the TKA group, complications included two cases of deep vein thrombosis (1.98%) and two instances of poor healing of the incision (1.98%), with no cases reported in the MB-UKA group for these issues ($\chi^2=0.416$, $P=0.519$ for both) (Table 6). Bearing dislocation occurred in 2 patients (2.17%) of the MB-UKA group, while none were reported in the TKA group, though not reaching statistical significance ($\chi^2=0.605$, $P=0.437$). Aseptic loosening was noted in one MB-UKA patient (1.09%) but not in the TKA group ($P=0.477$). Stiffness was consistent, with two cases in the TKA group (1.98%) and none in the MB-UKA group ($\chi^2=0.416$, $P=0.519$). Given the sample size of each group, the study was underpowered to detect statistically significant differences in the rates of individual, low-frequency complications. Overall complication rates were similar across groups, with the TKA group experiencing complications in 6 (5.94%) cases compared to 3 (3.26%) in the MB-UKA group ($\chi^2=0.292$, $P=0.589$), indicating comparable safety profiles for both surgical interventions.

Table 5 Comparison of SF-36 Score Between Two Groups

Parameters	TKA Group (n=101)	MB-UKA Group (n=92)	t	P
PF	66.52 ± 6.44	68.98 ± 6.37	2.673	0.008
RP	53.35 ± 5.61	53.07 ± 5.24	0.357	0.721
BP	72.26 ± 5.15	73.26 ± 5.31	1.326	0.186
GH	73.65 ± 5.25	74.36 ± 5.54	0.909	0.364
VT	78.96 ± 5.75	81.14 ± 5.67	2.641	0.009
SF	83.63 ± 4.36	83.88 ± 4.58	0.389	0.698
RE	59.74 ± 4.76	60.21 ± 4.53	0.693	0.489
MH	72.34 ± 6.53	72.63 ± 6.42	0.309	0.758

Abbreviations: TKA, Total knee arthroplasty; MB-UKA, mobile-bearing unicompartmental knee arthroplasty; SF-36, the short form 36 health survey questionnaire; PF, Physical Functioning; RP, Role-Physical; BP, Bodily Pain; GH, General Health; VT, Vitality; SF, Social Functioning; RE, Role-Emotional; MH, Mental Health.

Table 6 Comparison of Complications Between Two Groups

Parameters	TKA Group (n=101)	MB-UKA Group (n=92)	χ^2 /Fisher	P
Deep vein thrombosis [n (%)]	2 (1.98%)	0 (0%)	0.416	0.519
Poor healing of the incision [n (%)]	2 (1.98%)	0 (0%)	0.416	0.519
Bearing dislocation [n (%)]	0 (0%)	2 (2.17%)	0.605	0.437
Aseptic loosening [n (%)]	0 (0%)	1 (1.09%)	None	0.477
Stiffness [n (%)]	2 (1.98%)	0 (0%)	0.416	0.519
Total [n (%)]	6 (5.94%)	3 (3.26%)	0.292	0.589

Abbreviations: TKA, Total knee arthroplasty; MB-UKA, mobile-bearing unicompartmental knee arthroplasty.

Table 7 Measurement Tools and Their Psychometric Properties

Assessment Tool	Reported Reliability
VAS	0.796
SC-FJS	0.907
HSS	High reliability and validity reported
OKS	
KOOS	0.64–0.88 (subscales)
SF-36	>0.70 (all domains)

Abbreviations: VAS, Visual analog scale; SC-FJS, simplified Chinese version of the Forgotten Joint Score; HSS, Hospital for special surgery knee score; OKS, Oxford Knee Score; KOOS, Knee Injury and Osteoarthritis Outcome Score; SF-36, the short form 36 health survey questionnaire.

Table 8 Effect Sizes and Confidence Intervals for Significant Between-Group Differences in Continuous Outcomes at 2-Year Follow-Up

Parameters	95% CI for Mean Difference	Cohen's d
ROM (°)	(1.51 to 3.49)	0.717
Mechanical Axis Alignment (°)	(0.02 to 0.22)	0.326
SC-FJS Score	(0.48 to 2.06)	0.450
HSS Score	(0.62 to 2.92)	0.428
OKS Score	(0.43 to 1.89)	0.448
KOOS Score	(0.41 to 1.79)	0.455
PF	(0.65 to 4.27)	0.385
VT	(0.55 to 3.81)	0.381

Abbreviations: ROM, Range of motion; SC-FJS, simplified Chinese version of the Forgotten Joint Score; HSS, Hospital for special surgery knee score; OKS, Oxford Knee Score; KOOS, Knee Injury and Osteoarthritis Outcome Score; PF, Physical Functioning; VT, Vitality.

The reliability coefficients for all patient-reported outcome measures are summarized in Table 7. Effect sizes and 95% confidence intervals for significant between-group differences in continuous outcomes are presented in Table 8.

Discussion

In this study, we conducted a detailed investigation comparing MB-UKA and TKA in terms of postoperative functional mobility and quality of life for patients with AMOA of the knee. Our results highlight several critical differences between the two procedures that can potentially influence clinical decision-making and patient outcomes.

One of the most notable findings was the superior ROM achieved by patients in the MB-UKA group at the two years follow-up. This improvement could be attributed to the less invasive nature of MB-UKA, which preserves the cruciate ligaments and retains more natural knee kinematics.²⁷ By maintaining the integrity of the ligaments, MB-UKA more closely mimics the natural biomechanics of the knee, potentially leading to better functional mobility.²⁸ In contrast, TKA involves a larger incision and typically sacrifices the ACL, which might contribute to a reduced knee ROM postoperatively.²⁹ This preservation of anatomical structures in MB-UKA not only aids in achieving better ROM but also supports improved proprioception and joint feedback, which were crucial for daily functional activities.³⁰

We observed a notable improvement in mechanical axis alignment in the MB-UKA group compared to the TKA group. The better alignment achieved by MB-UKA could be attributed to the preservation of natural knee structures, which allows for more physiological joint function and potentially reduces stress on surrounding tissues. Proper alignment is crucial for maintaining joint stability and preventing complications such as implant loosening and wear, which can lead to revision surgery.^{28,31} Therefore, the superior mechanical axis alignment seen in MB-UKA suggests its potential advantage in promoting long-term joint health and functionality.

On examining the overall awareness of the artificial joint, the MB-UKA group demonstrated significantly higher scores on the SC-FJS, indicating that patients were less cognizant of their artificial joint during daily activities. This could be an outcome of the MB-UKA's ability to maintain closer-to-natural knee function, allowing patients to more easily "forget" the joint's artificial nature. The MB-UKA's focus on preserving the natural joint line and the less invasive approach might contribute to a more organic feeling knee, thus resulting in these superior SC-FJS outcomes.³²

Functional mobility outcomes strongly favored MB-UKA, as evidenced by higher scores on both the HSS Knee Score and the OKS at the two years follow-up. These findings suggest that MB-UKA supports a high level of functional recovery, potentially because of its less aggressive approach and the preservation of more bone stock and knee structures.³³ This may enable faster and more complete rehabilitation, providing a significant advantage for patients who value a return to physical activity post-surgery.

Quality of life assessments using the SF-36 further reflect the nuances of these surgical options. While the MB-UKA group excelled in PF and VT, other aspects such as mental health, GH, and BP showed no significant difference between the groups. The improved PF in MB-UKA patients could be inherently linked to the better ROM and joint adaptability, allowing for a more active lifestyle. However, the lack of difference in broader quality of life domains suggests that both surgical options can adequately support a patient's overall well-being post-surgery, depending on individual expectations and lifestyle priorities.

The comparable complication rates between the two groups suggest that both procedures were relatively safe when performed under appropriate conditions. However, it was pertinent to note specific complications like aseptic loosening in MB-UKA and stiffness in TKA, leading to distinct postoperative challenges. Aseptic loosening, often due to an inadequate cement interface or suboptimal load distribution in unicompartmental designs, can be mitigated with advancements in implant technology and surgical technique.³⁴ Meanwhile, stiffness in TKA can result from more extensive tissue disruption, which emphasizes the need for careful surgical planning and postoperative rehabilitation focused on maintaining flexibility and function. The long-term durability of MB-UKA is supported by studies such as the 15-year follow-up by Crawford et al,³⁵ which reported a survival rate comparable to TKA, with aseptic loosening being a noted reason for revision, aligning with our findings regarding the types of complications observed.

One limitation of this study was the relatively short follow-up period of two years, which may not fully capture the long-term functional outcomes and potential complications, such as aseptic loosening or wear, associated with both MB-UKA and TKA. Additionally, the study's sample size may not be large enough to generalize these findings to all populations or account for variability in surgical technique and postoperative care. While the total sample size met the pre-study power calculation for detecting differences in primary functional outcomes, the number of patients in each group limits the statistical power for analyzing and comparing low-frequency complications, as noted in the Results. Although all surgeries were performed by experienced surgeons, variations in individual surgical technique and postoperative rehabilitation protocols could represent unmeasured confounding factors. Furthermore, the study's reliance on self-reported measures like the VAS and quality of life assessments introduces a degree of subjectivity, potentially influencing the accuracy of the reported outcomes. Future prospective studies with larger cohorts, extended follow-up to assess long-term survivorship, standardized rehabilitation protocols, and cost-effectiveness analyses are warranted to confirm and extend these findings.

Conclusion

In conclusion, our study on postoperative functional mobility and quality of life in patients with AMOA of the knee treated with MB-UKA versus TKA indicates that MB-UKA offers several key advantages. These include superior range of motion and mechanical axis alignment, which may contribute to better long-term joint health and functionality. MB-UKA demonstrated higher scores on measures of joint awareness and functional mobility, suggesting a more natural feeling and improved daily activity performance. While both procedures provide comparable pain relief and overall quality of life improvements, MB-UKA demonstrated advantages in functional mobility and joint alignment for patients seeking enhanced physical function. This study also highlights challenges, including the need for precise patient selection and surgical technique in MB-UKA to mitigate risks such as bearing dislocation, as observed in our cohort. Future prospects should involve larger,

multicenter studies with extended follow-up to confirm long-term survivorship, cost-effectiveness analyses, and investigations into the impact of evolving implant designs and rehabilitation protocols on these functional outcomes.

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethics Approval and Consent to Participate

This study received approval from the Institutional Review Board and Ethics Committee of the Aerospace Center Hospital (No. 2019(133)) and abided by the ethical guidelines of the Declaration of Helsinki. All patients gave informed consent and signed an informed consent form.

Author Contributions

Shu-Ming Li and Bo-Ran Liang: Conceptualization, Formal analysis, Investigation. Kai Xiao: Methodology, Formal analysis, Data Curation. Chong-Yi Fan: Conceptualization, Formal analysis, Data Curation. Dan Li: Data Curation, Supervision. Fei-Fei Han: Data Curation, Methodology. Jing Chen: Investigation, Methodology, Writing-Original Draft.

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

There is no funding to report.

Disclosure

The authors have no conflicts of interest to declare in this work.

References

1. Abramoff B, Caldera FE. Osteoarthritis: pathology, diagnosis, and treatment options. *Med Clin North Am.* 2020;104:293–311. doi:10.1016/j.mcna.2019.10.007
2. Jiang Y. Osteoarthritis year in review 2021: biology. *Osteoarthritis Cartilage.* 2022;30:207–215. doi:10.1016/j.joca.2021.11.009
3. Bliddal H. Definition, pathology and pathogenesis of osteoarthritis. *Ugeskr Laeger.* 2020;182.
4. Atik I, Gul E, Atik S. Evaluation of the relationship between knee osteoarthritis and meniscus pathologies. *Malawi Med J.* 2024;36:48–52. doi:10.4314/mmj.v36i1.8
5. Aswinanand B, Balakrishnan J, Kumaradoss KM, et al. Thiazol-Sulfonyl derivative KM9 mitigates hyperglycemia associated steatotic liver injury in in-vitro and in-vivo models. *Med Microcol.* 2025;100151. doi:10.1016/j.medmic.2025.100151
6. Priya PS, Nayak SRR, Margesan T, et al. Investigating the osteoprotective effects of quercetin and rutin from *Terminalia chebula* in glucocorticoid-induced osteoporosis in vitro cell line and in vivo zebrafish model. *S Afr J Bot.* 2024;175:712–722. doi:10.1016/j.sajb.2024.10.060
7. Ten Noever de Brauw GV, Bayoumi T, Ruderman LV, Kerkhoffs G, Pearle AD, Zuiderbaan HA. Knees with anteromedial osteoarthritis show a substantial phenotypic variation prior and following medial unicompartmental knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc.* 2023;31:5579–5590. doi:10.1007/s00167-023-07603-9
8. Aljehani MS, Christensen JC, Snyder-Mackler L, Crenshaw J, Brown A, Zeni JA. Knee biomechanics and contralateral knee osteoarthritis progression after total knee arthroplasty. *Gait Posture.* 2022;91:266–275. doi:10.1016/j.gaitpost.2021.10.020
9. Jenny JY, Baldairon F, Hirschmann MT. Functional knee phenotypes of OA patients undergoing total knee arthroplasty are significantly more varus or valgus than in a non-OA control group. *Knee Surg Sports Traumatol Arthrosc.* 2022;30:2609–2616. doi:10.1007/s00167-021-06687-5
10. Fisher ND, Egol KA, Schwarzkopf R. Risk factors for wound complications following conversion TKA after tibial plateau fracture. *Indian J Orthop.* 2022;56:1751–1758. doi:10.1007/s43465-022-00709-1
11. Pongcharoen B, Timjang J. The outcomes of mobile bearing unicompartmental knee arthroplasty and total knee arthroplasty on anteromedial osteoarthritis of the knee in the same patient. *Arch Orthop Trauma Surg.* 2020;140:1783–1790. doi:10.1007/s00402-020-03527-y
12. Xia C, Zheng N, Gu T, et al. The in-vivo medial and lateral collateral elongation correlated with knee functional score and joint space following unicompartmental knee arthroplasty. *Orthop Traumatol Surg Res.* 2025;111:104052. doi:10.1016/j.otsr.2024.104052
13. Walker T, Freericks J, Mick P, et al. Long-term results of lateral unicompartmental knee arthroplasty with a mobile-bearing device. *Bone Joint J.* 2025;107-b:322–328. doi:10.1302/0301-620X.107B3.BJJ-2024-0859.R1
14. Shu J, Zheng N, Dai H, Wang Q, Tsai TY, Liu Z. Altered dynamic joint space in the lateral condyle compartment following medial unicompartmental knee arthroplasty. *Comput Methods Programs Biomed.* 2024;255:108330. doi:10.1016/j.cmpb.2024.108330

15. Sang W, Qiu H, Xu Y, Pan Y, Ma J, Zhu L. Malposition is main cause of failure of Oxford mobile-bearing medial unicompartmental knee arthroplasty. *Bone Jt Open.* **2023**;4:914–922. doi:10.1302/2633-1462.412.BJO-2023-0135.R1
16. Jørgensen SL, Aagaard P, Bohn MB, et al. The effect of blood flow restriction exercise prior to total knee arthroplasty on postoperative physical function, lower limb strength and patient-reported outcomes: a randomized controlled trial. *Scand J Med Sci Sports.* **2024**;34:e14750. doi:10.1111/sms.14750
17. White SH, Ludkowski PF, Goodfellow JW. Anteromedial osteoarthritis of the knee. *J Bone Joint Surg Br.* **1991**;73:582–586. doi:10.1302/0301-620X.73B4.2071640
18. Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthrosis. *Ann Rheum Dis.* **1957**;16:494–502. doi:10.1136/ard.16.4.494
19. Sankar A, Johnson SR, Beattie WS, Tait G, Wijesundera DN. Reliability of the American Society of Anesthesiologists physical status scale in clinical practice. *Br J Anaesth.* **2014**;113:424–432. doi:10.1093/bja/aeu100
20. Slade GD. Derivation and validation of a short-form oral health impact profile. *Oral Epidemiol.* **1997**;25:284–290. doi:10.1111/j.1600-0528.1997.tb00941.x
21. Cao S, Liu N, Han W, et al. Simplified Chinese version of the Forgotten Joint Score (FJS) for patients who underwent joint arthroplasty: cross-cultural adaptation and validation. *J Orthop Surg Res.* **2017**;12:6. doi:10.1186/s13018-016-0508-5
22. Insall JN, Ranawat CS, Aglietti P, Shine J. A comparison of four models of total knee-replacement prostheses. *J Bone Joint Surg Am.* **1976**;58:754–765.
23. Wang X, Yang H, Xu C, Xu X, Zhang C, Jing J. Effect of Schatzker type VI tibial plateau fractures combined with a proximal fibular and/or posterolateral joint facet fracture on early postoperative functional recovery. *J Orthop Surg Res.* **2023**;18:412.
24. Chen C, Wang W, Wu H, et al. Cross-cultural translation and validation of the Chinese Oxford Knee Score and the Activity and Participation Questionnaire. *J Orthop Surg.* **2020**;28:2309499020910668.
25. Xie F, Li SC, Roos EM, et al. Cross-cultural adaptation and validation of Singapore English and Chinese versions of the Knee injury and Osteoarthritis Outcome Score (KOOS) in Asians with knee osteoarthritis in Singapore. *Osteoarthritis Cartilage.* **2006**;14:1098–1103. doi:10.1016/j.joca.2006.05.005
26. Yang Z, Li W, Tu X, et al. Validation and psychometric properties of Chinese version of SF-36 in patients with hypertension, coronary heart diseases, chronic gastritis and peptic ulcer. *Int J Clin Pract.* **2012**;66:991–998.
27. Okimura S, Suzuki T, Matsumura T, et al. Patient-reported outcome measures after mobile-bearing unicompartmental knee arthroplasty were better than medial opening-wedge high tibial osteotomy in early elderly patients with severe osteoarthritis. *Arch Orthop Trauma Surg.* **2023**;143:6339–6344. doi:10.1007/s00402-023-04888-w
28. Huang F, Wu D, Chang J, et al. A comparison of mobile- and fixed-bearing unicompartmental knee arthroplasties in the treatment of medial knee osteoarthritis: a systematic review and meta-analysis of 1,861 patients. *J Knee Surg.* **2021**;34:434–443. doi:10.1055/s-0039-1697901
29. Naoum S, Mitseas P, Koutserimpas C, Kotsapas M, Raptis K, Gantsos AS. Correlation of cruciate ligament histological findings with coronal plane deformities and characteristics of patients undergoing total knee arthroplasty. *Maedica.* **2022**;17:323–328. doi:10.26574/maedica.2022.17.2.323
30. Zheng N, Dai H, Zou D, Wang Q, Tsai TY. Safe bearing region for avoiding meniscal bearing impingement and overhang in mobile-bearing unicompartmental knee arthroplasty. *J Orthop Res.* **2024**;42:1200–1209. doi:10.1002/jor.25767
31. Bonano JC, Barrett AA, Aggarwal VK, et al. Supine knee positioning does not interfere with mobile-bearing unicompartmental knee arthroplasty performance. *J Knee Surg.* **2023**;36:1020–1025. doi:10.1055/s-0042-1748822
32. 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**;14:73–87. doi:10.1111/os.13111
33. Yue L, Lamontagne M, Xiong Z, et al. Evaluation of knee kinematics and moments during active deep flexion activity after oxford mobile-bearing medial UKA-A two-year follow-up study. *J Knee Surg.* **2022**;35:896–903. doi:10.1055/s-0040-1721033
34. Tay ML, Matthews BG, Monk AP, Young SW. Disease progression, aseptic loosening and bearing dislocations are the main revision indications after lateral unicompartmental knee arthroplasty: a systematic review. *J Isakos.* **2022**;7:132–141. doi:10.1016/j.jisako.2022.06.001
35. Crawford DA, Rutledge-Jukes H, Alexander JS, Lombardi AV, Berend KR. 15-year follow-up of mobile bearing medial unicompartmental knee arthroplasty. *J Arthroplasty.* **2023**;38:1257–1261. doi:10.1016/j.arth.2023.01.024

Journal of Pain Research

Publish your work in this journal

The Journal of Pain Research is an international, peer reviewed, open access, online journal that welcomes laboratory and clinical findings in the fields of pain research and the prevention and management of pain. Original research, reviews, symposium reports, hypothesis formation and commentaries are all considered for publication. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <https://www.dovepress.com/journal-of-pain-research-journal>

Dovepress
Taylor & Francis Group