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Original Article

Comparison of unicompartmental knee arthroplasty and total knee arthroplasty on joint function in elderly patients with knee osteoarthritis

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Abstract: With the aging of the population, the number of patients with knee osteoarthritis rapidly increases. This study aimed to compare knee joint function of elderly patients after unicompartmental knee arthroplasty (UKA) vs. total knee arthroplasty (TKA). Patients with medial compartment osteoarthritis treated with arthroplasty in our hospital from October 2015 to November 2016 were divided into two groups based on the treatment, including UKA group and TKA group. Basic information, intraoperative blood loss, operation time, and length of stay were recorded. Joint mobility, HSS knee score, and WOMAC score at 1 month, 6 months, and last follow-up in both groups were compared. The UKA group exhibited significantly shorter operative time, length of hospital stay and more intraoperative blood loss compared with UKA group ($P < 0.001$). The HSS score and ROM at 1 month, 6 months after operation, and the last follow-up were apparently higher than those before surgery no matter in the UKA group or the TKA group ($P < 0.05$). Compared with the TKA group, the HSS score and ROM were markedly higher in the UKA group at 1 month, 6 months postoperatively, and the last follow-up ($P < 0.001$). At the last follow-up, UKA group exhibited a higher proportion of knee flexion ≥ 120° than TKA group ($\chi^2 = 4.029$, $P < 0.05$). WOMAC score at the final follow-up was significantly lower than before surgery ($P < 0.001$). UKA treatment presented shorter operative time, shorter hospital stay, less intraoperative blood loss, better knee function recovery, and less pain.

Keywords: Elderly, knee osteoarthritis, unicompartmental knee arthroplasty, total knee arthroplasty

Introduction

Osteoarthritis (OA) is a chronic degenerative osteoarthropathy characterized by degeneration of articular cartilage, joint margins, and subchondral bone hyperplasia [1, 2]. OA lesions can cause joint swelling and pain, joint deformities, and dysfunction that seriously affect the quality of life [3, 4]. OA is a degenerative bone-joint disease with a marked increase in prevalence with age. People over 60 years old are high-risk for OA, accounting for 60% to 70% [1, 5].

For patients with knee OA lesions, arthroscopic debridement or prosthetic knee replacement is currently used in clinic. Artificial knee replacement is divided into total knee arthroplasty (TKA) and unicompartmental knee arthroplasty (UKA) [6]. TKA is an effective method for the treatment of severe knee osteoarthritis (KOA). However, the long-term knee joint pain and dysfunction before surgery, and the huge surgical trauma and osteotomy, cause difficulties for the second-phase revision.

UKA is a treatment method for localized damage to the knee compartment, which was proposed in the 1950s and developed in the 1970s. UKA only replaces the lateral joint compartment of the knee joint, which has the advantages of retaining the cruciate ligament, less trauma, less bleeding, faster recovery, fewer complications, and lower cost [7-9]. In the early stage, there was controversy over the pros and cons of UKA. The technology was also questioned by clinicians. However, with the improvement of UKA surgical technique, the improvement of prosthesis design, and the selection and optimization of UKA surgical indications, the surgical treatment effect of UKA and the survival rate of postoperative long-term

prostheses have been significantly improved, and its superiority has gradually been accepted and approved by clinicians [10].

Therefore, this study aimed to compare the therapeutic effects of UKA and TKA on knee OA. A total of 60 elderly patients with medial compartment OA who were treated in our hospital from May 2016 to May 2017 were collected including 32 received UKA and 28 received TKA. The patients' data were collected during the follow-up period and compared to discuss the difference between the two treatment methods.

Patients and methods

Study objects

Sixty patients with medial compartment osteoarthritis undergoing arthroplasty in Wuxi People's Hospital from May 2016 to May 2017 were selected. All the subjects were diagnosed in accordance with the diagnostic criteria of osteoarthritis of knee joint developed by American College of Rheumatology. Inclusion criteria: ① knee OA mainly confined to the medial medial compartment lesions; ② invalid after formal conservative treatment; ③ no knee flexion or varus deformity; ④ no obvious lesions and symptoms on patellofemoral joint; ⑤ joint activity limited as varus less than 15° and flexion contracture less than 15°. Exclusion criteria: ① cardiopulmonary failure cannot tolerate surgery; ② osteoarthritis involving multiple compartments; ③ inflammatory arthritis such as rheumatoid arthritis ④ ⑤ ⑥ ⑦. There were 32 cases in UKA group, including 12 males and 20 females with mean at 68.6 ± 5.7 (62-72) years old and body weight at 66.9 ± 8.2 Kg. There were 28 cases in TKA group, including 11 males and 17 females with average age at 69.2 ± 7.3 (61-75) years old and body weight at 65.8 ± 9.3 Kg.

The study protocol was approved by the Re search Ethics Committee of Wuxi People's Hospital, and all patients gave their informed consent before study commencement.

Surgical treatment methods

UKA: The patients in the supine position received epidural anesthesia. The thigh was tied with an electric balloon tourniquet to stop bleeding. A straight incision was made in the median position of the knee joint and an arc incision was made on the medial side of the tibia. The patella was retracted to reveal the medial compartment of the knee. The joint capsule was separated from the tibia to the inferior of medial collateral ligament. The medial meniscus was excised without releasing the medial soft tissue. The outside bone marrow was positioned to perform the medial tibial plateau osteotomy. The size of the tibial component was measured. The femoral condyle osteotomy was guided by the die and the position of the prosthesis was confirmed by drilling. The size of the medial compartment was tested and the tibial and femoral prosthesis were installed successively. After fixed with bone cement, the knee joint activity and stability were tested. Next, the tourniquet was released and the drainage tube was placed. At last, the knee was sutured and wrapped at bent-knee position.

TKA: The patients in the supine position received epidural anesthesia. The thigh was tied with an electric balloon tourniquet to stop bleeding. A straight incision was made in the median position of the knee joint. The patella was opened to expose the knee, remove the medial and lateral meniscus, and cruciate ligament. Extramedullary positioning of tibial osteotomy and intramedullary positioning of femoral osteotomy were performed in turn. The tibial prostheses and femoral prostheses were installed sequentially. The tourniquet was released and the drainage tube was placed. At last, the knee was sutured and wrapped at bent-knee position.

Postoperative treatment

The drainage tube was removed after 24 hours. The patients received routine anticoagulation for 7 days and antibiotics for 3 days. The subjects began knee joint function exercise from the 2nd day after the operation. The knee joints were flexed and extended, and then gradually transferred to walking exercise.

Observation index

The intraoperative blood loss, operation time, and length of hospital stay were recorded in both groups.

The patients were reviewed on the 1, 6, and over 12 months after operation. Hospital for Special Surgery (HSS) scoring system was

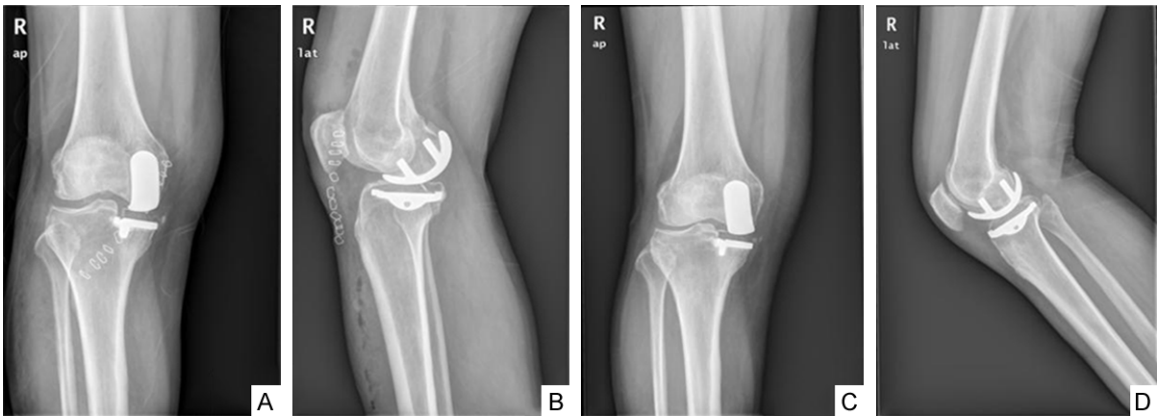

Figure 1. A 63 years old female patient received right UKA and followed up for 48 h (A, B) and 1 month (C, D).

adopted to assess the knee joint pain and function, which contained pain, function, activity range, muscle strength, flexion deformity, and joint stability. The subjects were defined as excellent at 85-100 points, good at 70-84 points, fair at 60-69 points, and poor at < 60 points. Higher score referred to better knee function.

The range of motion (ROM) of the two groups before and after surgery was compared, which meant the maximum range of curvature that can be reached when the patient's joints were active.

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) was first proposed by Bellamy *et al.* in 1988 [11]. This score system was based on the patient's related symptoms and signs to evaluate the severity of knee arthritis and its therapeutic efficacy. It mainly reflected the patient's subjective assessment: 0~14 was classified as excellent, 15-28 as good, 29-38 as fair, and > 38 as poor. The WOMAC scores of both groups before and after surgery were recorded to reflect the arthritis index.

Statistical analysis

SPSS 18.0 software was used for statistical analysis. The measurement data were expressed as mean ± standard deviation and compared using t-test or One-way ANOVA. The enumeration data were presented as percentage and compared by chi-square test (χ^2-test). $P < 0.05$ was considered as statistically significant.

Results

General information

All patients were followed up for more than one year. The mean follow-up time for UKA group was 22.9 (15-36) months, and it was 24.1 (17-34) months in TKA group. The mean follow-up time of the two groups was balanced. In the UKA group, one patient developed postoperative infection and recovered after the anti-infective treatment. Two patients had mild joint pain, but the drug control effect was good. In the TKA group, one patient suffered from deep phlebitis of the lower extremities and disappeared after being treated in time. One patient presented slight wear of the pad, but the prosthesis did not loosen or cause pain. One case appeared mild joint pain, which was relived after drug treatment. There were no serious complications, such as periprosthetic fracture, vascular nerve injury, dislocation of cushion, loosening, fracture, or prosthesis loosening during the follow-up period.

As shown in **Figure 1**, the joint prosthesis was in good position after UKA.

Operation related index comparison

The UKA group exhibited significantly shorter operative time, length of hospital stay and more intraoperative blood loss compared with UKA group ($P < 0.001$) (**Table 1**).

HSS pain score comparison

There was no significant difference in preoperative HSS score between the two groups ($P > 0.05$). The HSS score at 1 month, 6 months

Table 1. Comparison of Operation time, blood loss, and length of hospital stay

Group	Cases	Operation time (min)	Blood loss (mL)	Hospital stay (day)
UKA	32	89.6 ± 12.5	108.3 ± 22.6	7.8 ± 1.9
TKA	28	106.7 ± 15.7	179.5 ± 29.4	10.2 ± 2.6
t		4.693	10.587	4.116
P		< 0.001	< 0.001	< 0.001

after operation, and the last follow-up were apparently higher than those before surgery no matter in the UKA group or the TKA group ($P < 0.05$). Compared with the TKA group, the HSA score were markedly higher in the UKA group at 1 month, 6 months postoperatively, and the last follow-up ($P < 0.001$) (**Table 2**).

Joint motion comparison

There was no significant difference in preoperative ROM between the two groups ($P > 0.05$). The ROM at 1 month, 6 months after operation, and the last follow-up were apparently higher than those before surgery no matter in the UKA group or the TKA group ($P < 0.05$). Compared with the TKA group, the ROM were markedly higher in the UKA group at 1 month, 6 months postoperatively, and the last follow-up ($P < 0.001$) (**Table 3**).

At the last follow-up, the proportion of knee flexion ≥ 120° in UKA group increased from 28.12% before operation to 71.87% after surgery, while it elevated from 25.00% to 46.43% in TAK group. The UKA group exhibited a higher proportion of knee flexion ≥ 120° than TKA group ($\chi^2 = 4.029$, $P < 0.05$) (**Table 4**).

WOMAC score comparison

There was no statistical difference in WOMAC scores before and after the final follow-up in both groups ($t = 1.491$, $P > 0.05$). WOMAC score at the final follow-up was significantly lower than before surgery ($P < 0.001$) (**Table 5**).

Discussion

OA, also known as degenerative arthritis, senile arthritis, or hypertrophic arthritis, is caused by many factors such as age, obesity, strain, trauma, congenital joint deformity, and abnormalities. It is a degenerative osteoarthropathy characterized by degeneration of articular cartilage, and joint margins and subchondral bone-responsive hyperplasia [12, 13]. OA lesions can affect articular cartilage, subchondral bone, synovial membrane, joint capsule, and surrounding muscle tissue, leading to clinical symptoms and signs such as joint swelling, joint deformity, and active and functional disorders, which serious impacts the labor ability and life [14]. Around the world, OA has a relatively high incidence rate. According to statistics from relevant departments, the overall prevalence of OA is 15%, and it is 10-17% in people over 40 years old, 50% in people over 60 years old, and 80% in people over 70 years old [15, 16]. The number of OA in China is about 150 million, and the final morbidity rate is 53%, which has constituted the main cause of mobility disorders in the elderly [17, 18].

Senile KOA is one of the major causes of mobility disorders in the elderly. It can make a serious impact on the daily activities and spiritual life of patients. Currently, TKA is a commonly used clinical treatment with definite clinical efficacy. However, TKA will destroy the normal lateral compartment and antero-cruciate ligament in the course of treatment, and affect the functional recovery of patients with single compartment osteoarthritis [19]. Compared with TKA, UKA has a certain technical advantage in the treatment of unicompartmental knee osteoarthritis. UKA uses minimally invasive and small incision techniques. It does not require patella ectropion, does not damage the normal meniscus and cruciate ligament, and greatly reduces the amount of resection, which is beneficial to the recovery of the knee after surgery [20]. Cao Z *et al.* [21] conducted a meta-analysis of UKA and found that UKA treatment has the advantages of low repair rate, less complications, and more slight postoperative pain on KOA. Iacono F *et al.* [22] analyzed the clinical effects of UKA treatment on single-compartmental knee osteoarthritis in elderly over 75 years old and believed that UKA treatment of single compartment knee osteoarthritis has a significant effect. Appropriate UKA treatment can reduce complications and improve survival in the elderly according to the specific conditions. Although there are many reports on the advantages of UKA in the treatment of KOA, clinical indications and therapeutic effects of UKA on KOA have not been clearly defined or extensively developed in clinical applications. Based on the above theoretical basis, this stu-

Table 2. HSS pain score comparison

Groups	Cases	HSS score			
		Before operation	1 month after operation	6 months after operation	Last follow-up
UKA	32	57.6 ± 4.8	86.2 ± 7.9[a,d]	91.3 ± 8.2[b,d]	93.5 ± 8.7[c,d]
TKA	28	58.1 ± 5.1	78.4 ± 6.8[d]	85.5 ± 7.6[d]	89.2 ± 8.3[d]

a: $P < 0.001$, compared with TKA; b: $P < 0.01$, compared with TKA; c: $P < 0.05$, compared with TKA; d: $P < 0.001$, compared with before operation.

Table 3. ROM comparison

Groups	Cases	ROM (°)			
		Before operation	1 month after operation	6 months after operation	Last follow-up
UKA	32	98.8 ± 10.1	115.7 ± 7.2[a,b]	118.6 ± 6.5[a,b]	121.3 ± 6.1[a,b]
TKA	28	99.1 ± 10.6	107.6 ± 6.7[b]	113.4 ± 6.3[b]	114.9 ± 5.8[b]

a: $P < 0.001$, compared with TKA; b: $P < 0.001$, compared with before operation.

Table 4. Comparison of proportion of knee flexion ≥ 120°

Group	Before operation	χ^2	P	After operation	χ^2	P
UKA	9 (28.12%)	0.075	0.785	23 (71.87%)	4.029	0.044
TKA	7 (25.00%)			13 (46.43%)		

Table 5. WOMAC score comparison

Groups	Before operation (mean ± SD)	Last follow up (mean ± SD)
UKA	41.9 ± 5.3	13.8 ± 2.2
TKA	39.8 ± 5.6	14.6 ± 2.5
t	1.491	1.319
P	0.141	0.193

dy selected elderly people aged over 60 years to compare the clinical efficacy of UKA and TKA in the treatment of medial compartment osteoarthritis. It was found that the UKA group had significantly shorter operation time and hospital stay, whereas the blood loss was obviously fewer than that of TKA (P < 0.001). The results indicated that UKA has a certain technical advantage over TKA in the treatment of single compartment knee osteoarthritis.

Fabre-Aubrespy M *et al*. [23] compared the clinical efficacy of TKA and UKA in the treatment of unicompartmental osteoarthritis and observed that the UKA group exhibited higher KSS scores and KOOS scores, while the two methods showed no obvious difference on recurrence-free survival. Sweeney *et al.* [24] performed a follow-up analysis of 317 patients undergoing UKA and 425 patients undergoing TKA after operation. The result demonstrated that there were no significant differences on WOMAC scores, visual analogical scores, functional scores, and OKS scores. In the present study, the HSS score and ROM at 1 month, 6 months after operation, and the last follow-up were apparently higher than those before surgery no matter in the UKA group or the TKA group. Compared with the TKA group, the HSS score and ROM were markedly higher in the UKA group at 1 month, 6 months postoperatively, and the last follow-up. At the last follow-up, UKA group exhibited a higher proportion of knee flexion ≥ 120° than TKA group. These results suggested that UKA treatment of medial compartment osteoarthritis is more effective than TKA in knee function recovery and pain improvement. Faour-Mertin O *et al.* [25] considered that UKA did not destroy the normal compartments of the bones and joints during surgery, and as far as possible retained the normal knee joint structure and ligaments. Therefore, UKA treatment exhibited better knee joint function recovery and milder pain. In this study, there was no statistical difference in WOMAC scores before and after the final follow-up in both groups, suggesting the similar results in the efficacy of the two methods for the treatment of arthritis. Naouar N *et al.* [26] followed up young patients younger than 60 years old treated by TKA and UKA for up to 10 years and found no significant differences in the long-term clinical efficacy.

Although UKA has been found to have a good clinical effect on the treatment of unilateral knee osteoarthritis [7, 27], the postoperative efficacy of UKA therapy has a great dependence on the function of cruciate ligaments and the health status of joint and cartilage. Therefore, UKA indications and contraindications should be carefully grasped before operation. The advantage of this study was that all subjects underwent knee arthroscopy after admission, and they received a comprehensive assessment of the knee joint cavity, anterior

and posterior cruciate ligaments, and articular cartilage. It also achieved the desired therapeutic effect, but the disadvantage is that the selected sample size was small and all the subjects are collected from a single hospital. There is a certain bias in sample collection, which is a certain limit to the demonstration of the results. A larger scale study involved more hospitals and longer follow-up time may provide more definite conclusion.

Conclusion

Both UKA and TKA have good clinical efficacy in the treatment of medial compartmental osteoarthritis. UKA treatment presented shorter operative time, shorter hospital stay, less intraoperative blood loss, better knee function recovery, and less pain.

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Disclosure of conflict of interest

None.

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