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Comparison of the Effect of Unicondylar Knee Replacement and Total Knee Replacement

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Abstract: To investigate the recent clinical efficacy of unicondylar replacement (unicom partmental knee arthroplasty (UKA)) versus total knee arthroplasty (total knee arthroplasty (TKA)) for the treatment of patients with osteoarthritis of the medial intercondylar compartment of the knee. METHODS: The elderly patients with medial knee unicompartmental interphalangeal osteoarthritis in the Department of Joint Surgery of the First People's Hospital of Jingzhou City during the period of December 2018 to December 2022 were selected and divided into the UKA group and the TKA group based on the randomized average method, and there were 40 cases in each of the two groups. Observations such as operation time, intraoperative bleeding, hospitalization time, time from the end of the operation to the first walk, and the incidence of postoperative complications were recorded for all patients; the Hospital for Special Surgery of the United States (HSS) scores, visual analog scoring method (VAS) scores, knee mobility (ROM), hemoglobin, and postoperative complications for the patients of the two groups were measured preoperatively and at 3, 6, and 12 months postoperatively, blood transfusion rate and indicators related to patient hospitalization time were compared. RESULTS: The operation time, total length of hospitalization, length of surgical incision, intraoperative bleeding, and postoperative drainage were less in the UKA group than in the TKA group, and the differences were statistically significant ($P < 0.05$). the differences in preoperative HSS score, VAS score, ROM score, and hemoglobin were not statistically significant when comparing the patients in the two groups ($P > 0.05$). the differences in HSS score, VAS score, ROM score, and hemoglobin were not statistically significant in the patients of the two groups when the patients were followed-up at the final visit. score ROM score differences were not statistically significant ($P > 0.05$). The research results showed that there was a statistically significant difference ($P<0.05$) in ROM scores between the UKA group and the TKA group; The UKA group had a better hemoglobin score compared to the TKA group; In terms of the incidence of complications, transfusion rate, and length of hospital stay, the UKA group was significantly lower than the TKA group. Nursing satisfaction in the UKA group reached 97.5%, significantly surpassing the 87.5% reported in the TKA group. This discrepancy was statistically significant ($P < 0.05$), indicating a notable difference in satisfaction levels between the two groups. CONCLUSION: The short-term efficacy of UKA for unicompartmental osteoarthritis (OA) of the knee in the elderly is better than that of TKA, and it can shorten the hospitalization time, reduce the trauma, reduce the blood transfusion, reduce the postoperative complications, and promote the rehabilitation.

Keywords: Unicondylar Knee Replacement; Total Knee Replacement; Effect; Comparison.

1. Introduction

Osteoarthritis (OA) is a common disease associated with long-term exercise and rapid wear of the knee joint, mainly characterized by degenerative changes in the articular cartilage. The composition of the knee joint consists of several small chambers. This lesion can involve any compartment in any location, but in most cases, it is limited to one compartment in the early stages of the disease and is mainly located in the middle zone. Unicompartmental knee arthroplasty (UKA) refers to a surgical procedure that only replaces the affected medial compartment. In the early stages, due to inadequate surgical methods and prosthesis design, it resulted in a high failure rate [1]. In 1978, Laskin et al. first proposed a novel artificial knee joint prosthesis, with a complication rate of up to 35% [2]. Since the 1990s, due to the continuous improvement of people's understanding of knee joint function, surgical techniques, and prostheses, the survival rate and effectiveness of knee joint fixators have gradually been recognized by people [3]. Currently, total knee arthroplasty (TKA) is the most ideal surgical approach in clinical practice. Artificial knee replacement surgery is a relatively mature surgical procedure, and its long-term survival rate and treatment effectiveness are gradually being recognized by people [4-5]. However, there are also some patients whose arthritis only occurs in one compartment, especially the medial compartment. For these patients, there are still different understandings at home and abroad about whether they should skip unicompartmental joint replacement and directly undergo knee joint replacement [6-8]. However, more scholars now consider unicompartmental replacement as an ideal treatment for unilateral knee osteoarthritis, especially for patients with concomitant medial compartment lesions [9]. Meanwhile, with the passage of time, the scope of indications for patellofemoral joint replacement surgery is constantly expanding, and indicators that were previously considered absolute contraindications, such as weight, age, and patellofemoral joint function, are gradually disappearing [10].

Although both surgical methods can effectively treat medial unicompartmental arthritis of the knee, there is a lack of controlled studies for elderly patients, especially recent clinical outcomes. Therefore, this article selects elderly patients with single compartment osteoarthritis of the knee joint and compares the short-term effects using UKA and TKA surgical methods, in order to help improve the current situation in clinical practice.

2. Materials and Methods

2.1. General

This study selected 40 elderly patients with medial single compartment osteoarthritis of the knee joint (12 males and 28 females, aged 70.0-81.0) admitted to our orthopedic department from 2018 to December 2022, with an average age of (74.5 ± 3.5) years, as the UKA group. At the same time, 40 elderly patients with medial single compartment osteoarthritis of the knee joint (14 males and 26 females, aged 72.0-80.0, with an average age of (75.5 ± 2.5) years) were selected as the TKA group. There was no significant difference in the general condition between the two groups of patients (P>0.05). Both patient surgeries were performed by the same group of physicians.

Inclusion criteria: (1) Age over 70 years old; (2) Meets the diagnostic criteria for single compartment osteoarthritis of the knee joint: no obvious history of trauma; The main clinical manifestation is medial compartment pain in the knee, which is poorly treated or worsened by conservative therapy. It can be caused after exercise and can be relieved after rest; The X-ray shows that under weight-bearing conditions, the cartilage on the inner side of the knee joint degenerates and the gap shrinks; Other joint diseases that cause medial compartment pain in the knee have been ruled out; (3) The knee joint is stable, and physical examination confirms that the anterior and posterior cruciate ligaments, as well as the inner and outer collateral ligaments, are normal; (4) All patients' clinical manifestations meet the diagnostic criteria of the "Guidelines for the Diagnosis and Treatment of Osteoarthritis"; I haven't had any knee joint cavity puncture or injection surgery recently; All participants agreed to participate in the trial and signed after obtaining informed consent.

Exclusion criteria: (1) History of bone and joint system diseases, deformities, or surgical history caused by other etiologies; (2) Individuals with neurological complications, mental disorders, or malignant lesions; (3) Excluded patients with abnormal erythrocyte sedimentation rate and C-reactive protein, as well as those with heart and lung dysfunction, severe organ damage, and postoperative complications; (4) Due to personal reasons, research cannot be conducted. Exclusion criteria: (1) History of bone and joint system diseases, deformities, or surgical history caused by other etiologies; (2) Individuals with neurological complications, mental disorders, or malignant lesions; (3) Excluded patients with abnormal erythrocyte sedimentation rate and C-reactive protein, as well as those with heart and lung dysfunction, severe organ damage, and postoperative complications; (4) Due to personal reasons, research cannot be conducted.

2.2. Treatment Method

1. Preoperative preparation: After admission, the patient will undergo a comprehensive physical examination and relevant auxiliary examinations. For patients who took aspirin before admission, they will be given 5000U of low molecular weight heparin sodium once a day as a replacement after discontinuation of the medication. Perform cardiopulmonary function and general condition testing on all patients. For patients with underlying internal medicine diseases, corresponding diagnosis and treatment should be carried out to ensure that all auxiliary indicators are within the allowable range of surgery. Guide patients to perform functional exercises on the affected limbs, ankles, and ankles (understand and become proficient in this exercise method for easy postoperative use). Preoperative routine preparation of the surgical area, catheterization, and preparation of 2-4U of homologous blood cells. Patients who receive heparin supplements should stop using heparin one day before surgery. One hour before surgery, intravenous infusion of 0.9% saline 100mL+tranexamic acid 1.0g was administered. To prevent massive postoperative bleeding, antibiotics were intravenously infused 0.5 hours before surgery to prevent infection.

2. Surgical treatment: (1) UKA group underwent unicompartmental knee arthroplasty; This study aims to incise the skin and subcutaneous tissue of the patellofemoral medial side layer by layer through the patellofemoral medial approach. Without removing the medial collateral ligament, the osteophyte of the medial femoral condyle, intercondylar fossa, and medial tibial plateau will be removed. At the same time, without removing the medial collateral ligament, the medial tibial plateau and medial femoral condyle will be osteotomy and ground to achieve flexion, flexion, flexion, and stability of the hip flexion, extensor, and flexor muscles. An appropriate thickness of meniscus pad artificial knee joint will be selected. When closing the incision, 2.0g of tranexamic acid will be injected into the joint cavity to stop bleeding. There will be no drainage tube, and the incision will be pressure bandaged. (2) The TKA group underwent embedded artificial knee replacement surgery. Preoperative midline incision, patellar resection, removal of anterior cruciate ligament and inner and outer meniscus, removal of osteophyte to correct deformities such as flexion and inversion, adjustment of anterior and posterior joint function, implantation of appropriate size of bone cement, and placement of appropriate thickness of tibial septum. The other operations are the same as those of the UKA group.

2.3. Postoperative Treatment

Both groups of patients received anticoagulant therapy after surgery. Remove the drainage tube 1-2 days after surgery. Regularly check blood routine, C-reactive protein, erythrocyte sedimentation rate and other indicators. After removing the drainage tube, use a CPM machine to perform passive bending movements of the knee joint twice a day, first bending 0-30 °, and then gradually increasing until it reaches a tolerable level. 2-3 days after surgery, provide lower limb muscle strength training, such as ankle pump exercise, quadriceps and hamstring muscle training, 3 times a day for 30 minutes each time. On the third day after surgery, knee joint range of motion, lower limb muscle strength training, and physical sensory function recovery training will be carried out. Five days after surgery, the patient can walk on the ground with the help of crutches.

2.4. Observation Indicators and Efficacy Evaluation

Observation indicators and efficacy evaluation: (1) Surgical related indicators, including intraoperative blood loss, surgical time, time from the end of surgery to the first walk, and length of hospital stay; (2) Knee joint function and pain evaluation indicators, including knee range of motion (ROM), Hospital of Special Surgery Knee Score (HSS), and Visual Analog Scale (VAS) for pain assessment; (3) The incidence of postoperative complications includes delayed wound healing, skin or deep infections, and lower limb venous thrombosis.

2.5. Statistical Analysis

The research data was analyzed using SPSS 19.0 software. Metric data were expressed as mean ± standard deviation (± s), while count data were expressed as percentages (%). t-tests and chi square tests were used, with P<0.05 indicating statistically significant differences.

3. Result

Both groups of patients underwent successful surgical procedures and were followed up for 12 months. Observing the postoperative X-ray, it can be seen that both groups of patients have good performance in terms of prosthesis position and force line alignment.

3.1. Comparison of Perioperative Data Between Two Groups

During the research process, all 40 patients have been followed up. The follow-up period was 12 months, and the average follow-up calculated was (11.1 ± 1.1) months. Both groups of patients underwent surgery smoothly and safely. Comparing the relevant data during the perioperative period, the various data of patients in the UKA group were inferior to those in the TKA group. The results showed that the differences were statistically significant (P<0.05), as detailed in Table 1 below.

Table 1. Comparison of perioperative data between two groups ($\bar{x}$±s)

Group	Operative time(min)	Cut length (cm)	Intraoperative bleeding volume(mL)	Postoperative drainage volume(mL)	Hemoglobin ($\bar{x}$±s g/L) Preoperative	Hemoglobin ($\bar{x}$±s g/L) 24 hours after surgery
UKA	87.63±3.30	7.85±1.13	75.38±33.11	111.77±83.63	124.52±8.69	97.14±5.77
TKA	78.56±6.31	11.73±1.51	157.13±108.63	136.71±133.77	127.09±9.33	89.24±5.14
t	8.656	15.173	3.681	3.775	1.462	7.356
P	<0.05	<0.05	<0.05	<0.05	>0.05	<0.05

3.2. Comparison of Preoperative and Final Follow-up Clinical Indicators

Comparing the preoperative indicators of two groups of patients, specifically HSS score, VAS score, and knee joint range of motion, the results showed that there was no statistically significant difference (P>0.05). Based on the above indicators, a comparison was made again between the last follow-up of the two groups of patients. Compared with preoperative results, there was a significant improvement trend, and the results showed that the differences were statistically significant (P<0.05). In the comparison process of the last follow-up, the HSS scores and VAS scores of the patient groups were compared, and it was found that the differences were not statistically significant (P>0.05). In terms of knee joint mobility, the UKA group has more advantages compared to the TKA group, and the difference is statistically significant (P<0.05). Please refer to Table 2 for specific details.

Table 2. Comparison of preoperative and final follow-up clinical indicators between two groups ($\bar{x}$±s)

	HSS		Rom (°)		VAS	
Group	Preoperative	Last follow-up (12 months)	Preoperative	Last follow-up (12 months)	Preoperative	Last follow-up (12 months)
UKA	52.2±8.5	88.7±4.5	97.52±7.92	118.62±6.21	7.1±1.0	1.5±0.2
TKA	52.0±10.1	87.1±5.1	96.63±6.22	114.95±5.83	7.0±1.0	1.8±0.4
t	0.158	1.058	0.651	5.463	0.458	-1.888
P	>0.05	>0.05	>0.05	<0.05	>0.05	>0.05

3.3. Comparison of Postoperative Complications, Transfusion Rate, and Length of Hospital Stay

Table 3. Comparison of postoperative complications, transfusion rate, and hospital stay between two groups ($\bar{x}$±s)

Group	Number of cases	Incision	Cardiovascular and cerebrovascular	Urinary system	Respiratory system	Acute mental disorders	Digestive system	Deep vein thrombosis	Iincidence rate[cases(%)]	Transfusion rate[cases(%)]	Length of hospital stay (d) ($\bar{x}$±s)
UKA	40	0	0	0	0	0	0	0	0(0.0)	1(2.5)	7.5±1.2
TKA	40	1	0	1	0	0	0	2	4(10.0)	10(25.0)	10.3±1.7
t											-7.528
χ^2									4.221	8.538	
P									<0.05	<0.05	<0.05

The incidence of complications in the UKA group was 3 cases (7.5%), which showed a significant downward trend

compared to the TKA group [10 cases (25.0%)]. The results showed that this difference was statistically significant (P<0.05). In terms of transfusion rate, the TKA group significantly exceeded the UKA group by a lot. The results showed that this difference was statistically significant (P<0.05). In terms of hospitalization time, the UKA group was significantly shorter than the TKA group, and the results showed that this difference was statistically significant (P<0.05). Please refer to Table 3 for specific details.

3.4. Comparison of Nursing Satisfaction

From the perspective of nursing satisfaction between the two groups of patients, the nursing satisfaction rate of 97.5% in the UKA group was significantly higher than that of 87.5% in the TKA group, with statistical significance (P<0.05).

Table 4. Nursing Satisfaction of Two Groups of Patients ($\bar{x}$±s)

Group	Total	Satisfaction	General satisfaction	Dissatisfaction	Nursing satisfaction
UKA	40	23(57.5)	16(40.0)	1(2.5)	97.5%
TKA	40	15(37.5)	20(50.0)	5(12.5)	87.5%
χ^2					5.621
P					<0.05

4. Discuss

Knee osteoarthritis (OA) is a typical chronic disease, characterized by degeneration, destruction, or osteophyte formation in the articular cartilage, accompanied by reactive proliferation of ligaments and subchondral bone around the joint, leading to joint pain, deformity, and functional impairment. It mostly occurs in middle-aged and elderly people. Guo Qiang pointed out that knee osteoarthritis (OA) is a common chronic degenerative disease, and its pathogenesis is not yet clear. According to WHO data, knee osteoarthritis (OA) accounts for 50% of people over 50 years old and 80% of people over 70 years old. The number of elderly patients with knee osteoarthritis in China is the first in the world, and its incidence rate gradually increases with age, which has seriously affected the quality of life and physical and mental health of the elderly.

High tibial osteotomy, UKA, and TKA are commonly used treatment options in clinical practice. The high tibial osteotomy technique can correct knee inversion, restore lower limb line of force, reduce medial knee cavity pressure, and achieve the goal of relieving knee pain. However, its indications are relatively narrow, suitable for patients with normal bone density, under the age of 65, and the affected limb cannot fully bear the load in the short term after surgery. Moreover, the bed rest time and rehabilitation exercise time are higher than the other two surgical methods. Total knee arthroplasty (TKA) is a mature surgical method, which can effectively eliminate or alleviate the pain caused by articular cartilage damage, correct the lower limb force line, flexion, varus and other deformities, improve the quality of life of patients, and has been recognized by most doctors. However, this operation has a certain degree of trauma. Because the elderly patients have decreased multiple organ functions, decreased body functions, and accompanied by basic diseases such as hypertension, diabetes, etc., it does not have an ideal tolerance to surgery, and therefore has deepened the intensity of perioperative risk bearing. In addition, there is a significant amount of bone loss during TKA surgery, and long-term complications of the prosthesis increase the difficulty of reconstruction. UKA was first proposed by scholar McKeever in the 1950s, but due to various factors such as lack of experience, operational skills, and prosthesis design, its clinical efficacy is poor and the revision rate is high, which has become a bottleneck restricting its development and clinical application [11]. Schroer et al. pointed out that in patients with knee osteoarthritis, the recurrence rate of UKA surgery can reach 13%, which is much higher than that of total knee replacement surgery. In recent years, with the development of UKA technology, improvement of application materials, and strict control of surgical indications, UKA has been increasingly widely used in clinical practice and has achieved good therapeutic effects [12]. The 10-year and 20-year survival rates after UKA surgery are 85% -95% and 80% -90%, respectively. Vasso et al. published their research results in 2015, which showed that the 10-year survival rate of UKA prosthesis could reach 97%, and there were similarities between UKA and TKA compared to TKA (P>0.05) [13].

Compared with total knee joint KA, UKA is a surgical procedure with less "destruction" and only performs surface replacement in the medial compartment of the knee joint. It can repair local tissue defects of the knee joint, reconstruct damaged joint surfaces and mechanical axes without affecting the patellofemoral joint and lateral compartment of the knee joint. UKA is a method of maintaining the anterior and posterior cruciate ligaments and normal joint compartments of the knee joint, which can not only preserve the original shape of the knee joint, but also maintain its original shape to the greatest extent possible. At the same time, it can reduce the amount of osteotomy required, preserve more bone, and facilitate long-term revision. UKA technology has the characteristics of minimally invasive, minimally invasive, few complications, low postoperative blood transfusion ratio, and short recovery time, and plays an important role in the treatment of single compartment osteoarthritis (OA) of the knee joint in the elderly.

Although this group of cases underwent short-term follow-up, all patients showed reduced postoperative pain, improved knee joint mobility and quality of life, and achieved satisfactory clinical efficacy. The statistical results of postoperative indicators in the two groups are as follows: HSS score, VAS score, last follow-up HSS score, VAS score and other indicators showed no significant difference (P>0.05), while the knee joint range of motion in the UKA group was significantly better than that in TKA at the last follow-up, which is statistically significant and consistent with

Arirachakara et al.'s literature. Liddle et al. analyzed data from the England Joint Registry database and found that UKA can achieve good therapeutic effects in elderly patients with medial unicompartmental osteoarthritis of the knee joint, with fewer complications and faster recovery. It is particularly suitable for elderly patients with systemic functional decline, weak surgical tolerance, and related internal diseases [14]. The research conducted by the joint registration institutions of the UK and Sweden shows that UKA has advantages such as minimally invasive and rapid recovery, especially in terms of mortality and infection rates, which are superior to total knee replacement surgery. Total knee arthroplasty has disadvantages such as high trauma and high risk, while UKA technology has been widely used due to its minimally invasive and safe advantages. UKA can be used as an effective method for elderly patients with single compartment osteoarthritis of the knee joint.

5. Conclusion

In summary, the application of UKA and TKA in elderly patients with single compartment osteoarthritis can significantly reduce pain, improve knee joint function, and achieve good therapeutic effects. However, elderly patients have decreased systemic function and lower tolerance to surgery. Therefore, in terms of overall efficacy, UKA therapy can not only improve the clinical efficacy of patients, but also shorten hospitalization time, reduce trauma, decrease blood transfusion, reduce complications, and accelerate the recovery process. It is a method worth promoting in clinical practice.

References

[1] Zhang Dong Liang,Zhang Wei,Ren Yi Ming,Zhao Wen Jun,Sun He Jun,Tian Zheng Wei,Tian Meng Qiang. Arthroscopic debridement improves range of motion for heterotopic ossification after total knee replacement: a retrospective cohort study[J].Scientific Reports,2024, 14(1): 5882-5882.

[2] Ai Lin,Zhi Qun Liu,Jia Pei Yao,Yan Hui Liu,Huan Wan.A Review of the Extent of Pain Catastrophizing in Patients Who Have Undergone Total Knee Replacement.[J].Pain management nursing : official journal of the American Society of Pain Management Nurses,2024.

[3] Raelene M Cowie,Charles J Cullum,Simon N Collins,Louise M Jennings.The wear and kinematics of two medially stabilised total knee replacement systems.[J].The Knee,2024,47160-170.

[4] Alina Jurewicz,Agata Gasiorowska,Katarzyna Leźnicka, Maciej Pawlak, Magdalena Sochacka,Anna Machoy Mokrzyńska, Andrzej Bohatyrewicz,Agnieszka Maciejewska Skrendo,Grzegorz Pawlus.Individual Factors Modifying Postoperative Pain Management in Elective Total Hip and Total Knee Replacement Surgery[J].Life,2024,14(2).

[5] Chen Qiushi, Xie Huibin, Liang Qiuqiu Comparison of early efficacy of unicompartmental or total knee arthroplasty in the treatment of medial compartment osteoarthritis of the knee [J] Journal of Practical Orthopedics, 2023, 29 (10): 887-891+897.

[6] Wang Xiaoting, Yin Xuetong, Elsiding Abulaiti Comparison of the therapeutic effects of unicompartmental knee arthroplasty and total knee arthroplasty in the treatment of knee osteoarthritis [J] Journal of Clinical Orthopedics, 2023, 26 (03): 351-354.

[7] TAY M L,MONK A P,FRAMPTON C M,Hu Kongzu Comparison of indications for revision after total knee and unicompartmental replacement surgery [J] Journal of Clinical Orthopedics, 2023, 26 (03): 437.

[8] HELD M B,GAZGALIS A,SARPONG N O,Hu Kongzu Comparison of indications for revision after total knee and unicompartmental replacement surgery [J] Journal of Clinical Orthopedics, 2023, 26 (03): 437.

[9] Pan Yuhao, Yan Wei, Zhao Jie, Liu Xiaochen, Li Jinsong A case report of Klippel Trenaunay syndrome with severe knee degeneration and total knee replacement [J] Chinese Journal of Orthopedics, 2022,30 (16): 1534-1536.

[10] Xu Shangjun, Chang Xianghong, Wang Xinrui, An Xuebin The effect of ultrasound-guided adductor block combined with intravenous patient-controlled analgesia on postoperative analgesia in elderly patients undergoing total knee replacement surgery [J] Journal of Medical Imaging, 2022, 32 (07): 1263-1266.

[11] Yang Su, Wang Yuepeng, Han Pengfei Meta analysis of gap balancing technique and measurement osteotomy technique in total knee arthroplasty [J] Chinese Journal of Medicine and Clinical Medicine, 2022, 22 (07): 603-613.

[12] Liu Xiaodong, Nagi Yihui Clinical application progress of unicompartmental knee arthroplasty [J] Chinese Journal of Joint Surgery, 2010, 004 (006): 804-808.

[13] Cavolo S L ,Zhou C , Ketcham S A ,et al. Supplemental Materials [J]. 2015.

[14] Vasso,MicheleDel Regno,ChiaraD'Amelio,AntonioViggiano, DavideCorona, KatiaPanni, Alfredo Schiavone.Minor varus alignment provides better results than neutral alignment in medial UKA[J].The Knee, 2015, 22(2).