ORIGINAL RESEARCH

Efficacy and Safety Analysis of Joint Replacement in the Treatment of Senile Knee Degenerative Osteoarthritis

Huanbin Zhou, MM; Jiaquan Yang, MM

ABSTRACT

Objective • To study the effectiveness and safety of joint replacement in the clinical treatment of elderly patients with knee degenerative osteoarthritis. To compare the results of arthroplasty with arthroscopic debridement and to investigate the overall effect of arthroplasty on various parameters.

Methods • We included patients whose diagnostic criteria for mid-knee osteoarthritis involved relevant content, and excluded patients with other diseases such as the immune system. The medical records of 90 patients (senile degenerative knee osteoarthritis, 2021.1-2022.12) were selected for retrospective analysis, and patients were grouped according to the surgical treatment plan, and those treated with arthroscopic debridement surgery were included in the control group (a total of 45 cases), those treated with joint replacement were included in the observation group (45 cases in total). The changes in the levels of kinematic parameters, osteoarthritis indicators, quadriceps strength, inflammation indicators, and knee joint function indicators were compared between the groups, and the daily living abilities of the two groups were compared.

Results • The active flexion angle of the observation group was greater than that of the control group, and the varus inclination was smaller than that of the control group, with $P < .05$; the joint function scores, pain scores, and stiffness scores of the observation group were all lower than those of the control group, with $P < .05$; the muscle strength of the voluntary movement of the bilateral quadriceps muscle and the maximum muscle strength under isometric contraction was higher than those of the control group, with $P < .05$; the measured values of interleukin-6, C-reactive protein, and white blood cell count (IL-6, CRP, WBC) in the observation group were lower than those of the control group, with $P < .05$; the scores of knee joint function and daily living ability in the observation group were higher than those in the control group, with $P < .05$.

Conclusion • The curative effects of joint replacement in the treatment of senile knee degenerative osteoarthritis are significant, which can promote the improvement of early postoperative kinematic parameters and the recovery of joint function and reduce the inflammatory response. It also promotes the recovery of knee joint function, improves knee joint function, improves patient prognosis, and also improves the daily living abilities of elderly patients with knee joint degenerative osteoarthritis. (*Altern Ther Health Med.* 2024;30(5):209-215)

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INTRODUCTION

Knee osteoarthritis is a chronic degenerative disease of the knee joint with a very high incidence in orthopedics clinics, and most patients have varying degrees of bone hyperplasia.[1] In recent years, the clinical incidence of knee degenerative osteoarthritis has increased significantly with the increase in the elderly population, with 250 million people worldwide suffering from the disease to date, and the number of people suffering from the disease is still rising year by year. Knee joint swelling, pain and stiffness are the main clinical manifestations of the disease, which can seriously affect the physical and mental health and quality of life of patients.[2] Pathological changes in knee joint structures are a complex problem involving multiple tissues and cells. One of the most prominent disease features is pathologic changes in the knee joint structures, including cartilage erosion, synovial inflammation, subchondral sclerosis, and osteophytes. Although conservative drug treatment can alleviate the symptoms related to disease, such as exercise, weight loss, and topical nonsteroidal anti-inflammatory drug (NSAIDs) therapy, these treatments are only indicated for early-stage patients, are clinically ineffective, and can make it difficult to

achieve the desired therapeutic effect in patients with more severe disease.[3-5] Joint replacement surgery is placing an artificial knee joint through surgery to replace the diseased joint, which can significantly improve the range of motion and function of the patients' knee joint,[6] so joint replacement surgery becomes an alternative treatment option. The purpose of this study was to investigate the effectiveness and safety of joint replacement surgery in improving knee function and reducing symptoms in elderly patients with severe degenerative osteoarthritis of the knee. So a total of 90 cases of patients admitted to our hospital were selected for comparison. See the text for details.

DATA AND METHODS

Data

A total of 90 elderly patients with knee degenerative osteoarthritis admitted to our hospital from January 2021 to December 2022 were selected as research objects. The medical records of the patients were collected and analyzed retrospectively. Patients were grouped according to the surgical plan. It can be seen from the data in Table 1 and Figure 1 that there was no significant difference in the data presented in the study between the control group (n = 45) and the observation group (n = 45), with $P > .05$. This study has obtained ethical approval from the hospital.

Inclusion criteria: Patients who were consistent with the relevant content involved in the diagnostic criteria of knee osteoarthritis in the 2018 edition of the "Guidelines for the Diagnosis and Treatment of Osteoarthritis"; Patients who had no relevant treatment history in the past 3 months; Patients with unilateral knee joint disease and fully obtained informed consent from the patients.

Exclusion criteria: Patients with immune system diseases; Patients with abnormal coagulation function; Patients with infectious diseases; Patients with bone diseases or other types of joint diseases. Patients who have undergone surgery or trauma within 1 month prior to enrollment and any factors that may affect the efficacy assessment, such as patients with psychiatric disorders.

Methods

Control group: The subjects in this group were treated with arthroscopic debridement surgery. Surgical incisions were made according to the patient's condition, then arthroscopy was placed in the local area. Knee arthroscopy is performed mainly through the suprapatellar bursa to visualize the synovial membrane, free bodies, and lesions of the patella and meniscus. Corresponding treatment was given according to the investigation situation to clear inflammatory exudation.

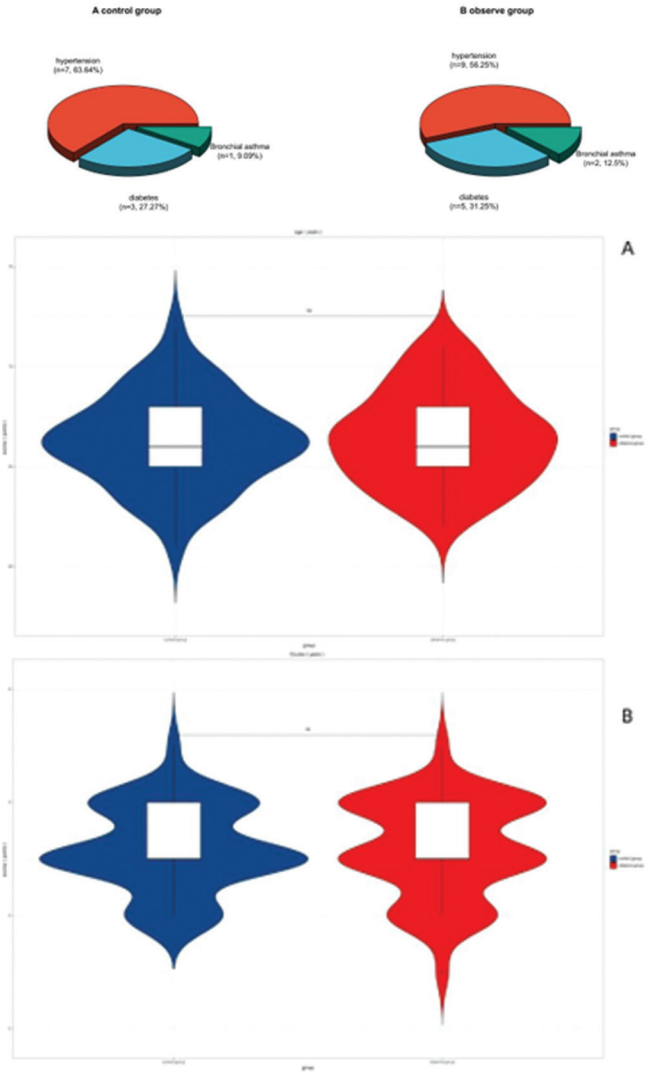
Observation group: The subjects included in this group were treated with joint replacement. The patients were adjusted to the supine position under general anesthesia. The surgical incision was made at the anteromedial part of the diseased knee joint, and the approach was the medial side of the patella. Then, the tissues were incised layer by layer to expose the meniscus, anterior cruciate ligament, etc. fully and resection was performed. At the same time, the adjacent tissues were cleaned up, and osteotomy was performed. Bone resection was performed on the distal femur - anterior tibial dislocation platform - intercondylar femur, and then the residual tissues, osteophytes behind the joint cavity, etc., were cleaned up. Subsequent joint replacement steps were performed according to the technical manual provided by the manufacturer.

The above two groups of patients were followed up for 6 months after treatment.

Table 1. Comparison of the data between the two groups of elderly patients with knee degenerative osteoarthritis

Group	n	Male (n)	Female (n)	Age (Years)	Disease duration (years)	High blood pressure (n)	Diabetes (n)	Bronchial asthma (n)
Control group	45	23	22	66.31±2.27	3.17±0.74	7	3	1
Observation group	45	26	19	66.44±2.35	3.17±0.86	9	5	2
χ^2/t	-	0.403		0.059	0.365	0.304	0.549	0.345
P value	-	.525		.953	.716	.581	.459	.557

Figure 1. Data analysis of data between groups



Observation indicators

The changes of kinematic parameters of the included subjects in the two groups were counted, and the varus inclination and active flexion angle of the knee joint were measured with a standard hand-held goniometer before the operation and 1 month after the operation.

The improvement of the levels of osteoarthritis indicators between the two groups was analyzed. The osteoarthritis indexes of Western Ontario University and Maxmaster University were used to evaluate it before and 1 month after the operation. Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) stiffness scores at 2, 4, 8, 12, and 24 weeks.

The changes of quadriceps strength of patients in the two groups were observed, and the muscle strength of the voluntary movement of bilateral quadriceps muscle and the maximum muscle strength under isometric contraction were measured before and 3 months after surgery.

The changes in the levels of inflammatory indicators in the two groups were counted. Before the operation and one month after the operation, fasting venous blood (4 ml) was collected from the patients in the morning, and part of the blood samples were taken and centrifuged at the speed of 3000r/min for 10 min, then the serum was collected and stored in a refrigerator at -20°C. The levels of C-reactive protein (CRP) and interleukin-6 (IL-6) were determined by enzyme-linked immunosorbent assay; white blood cell count (WBC) was determined by automatic blood cell analyzer by taking part of the whole blood sample.

The improvement of the knee joint function index levels of the two groups of subjects was analyzed. Before the operation and 6 months after the operation, the Knee Rating Scale of American Hospital for Special Surgery (HSS) was used to evaluate, including pain dimension (30 points total), activity dimension (18 points total), muscle strength dimension (10 points total), deformity dimension (10 points total) and function dimension. The higher the HSS score, the better the knee function.

The change in daily living ability between groups was counted, which was assessed by the daily life activity index 3 months after surgery. This study used the manner of stair negotiation (i.e., use of handrail, step-over-step, step-by-step) as a proxy for functional ability.

The incidence of complications between the two groups was recorded, such as incision infection, deep vein thrombosis, and knee joint instability.

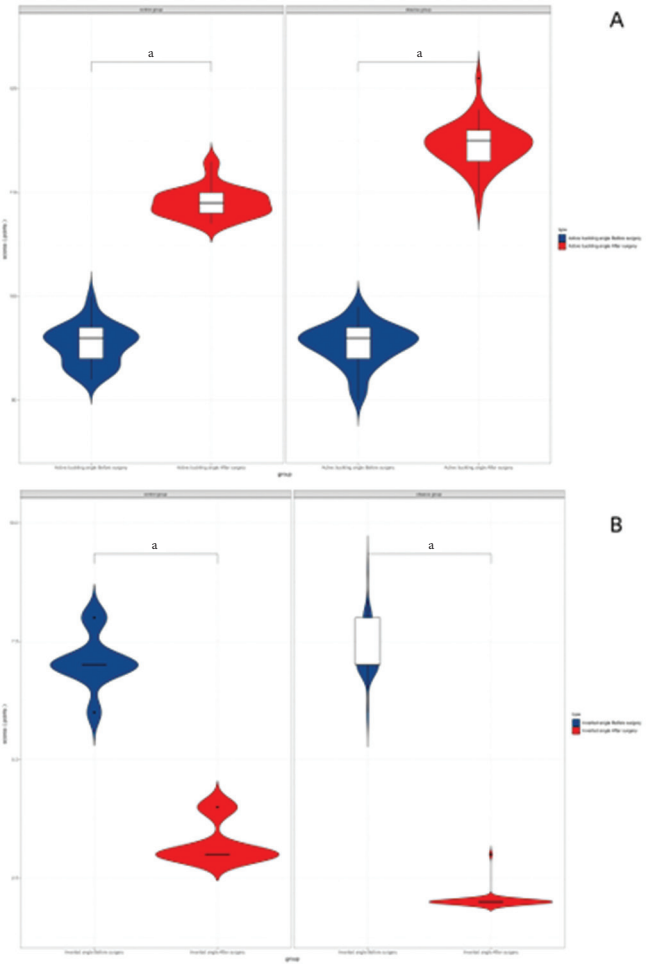
Statistical processing

The relevant data involved in the study were processed with SPSS20.0 after analysis and summary. The measurement data of the two groups were expressed in the form of ($\bar{x} \pm s$), and disordered outcome classification data (adverse events, gender) were represented by (%) and tested by Chi-square test and rank sum test was used for grade data (KOA X-ray classification). And take t to carry out the test, if $P < .05$, the difference between the data was statistically significant.

Table 2. Comparison of the changes in kinematic parameters between the two groups of elderly patients with knee degenerative osteoarthritis (n = 45, °)

Group	Active flexion angle		Varus inclination	
	Pre-operation	Post-operation	Pre-operation	Post-operation
Control group	95.33±1.89	109.04±1.42	7.08±0.55	3.24±0.43
Observation group	95.35±1.97	114.57±2.08	7.26±0.57	2.02±0.14
t	0.201	14.472	1.707	26.308
P value	.841	.001	.091	.001

Figure 2. Analysis of kinematic parameters between groups



[a]represents $P < 0.0001$.

RESULTS

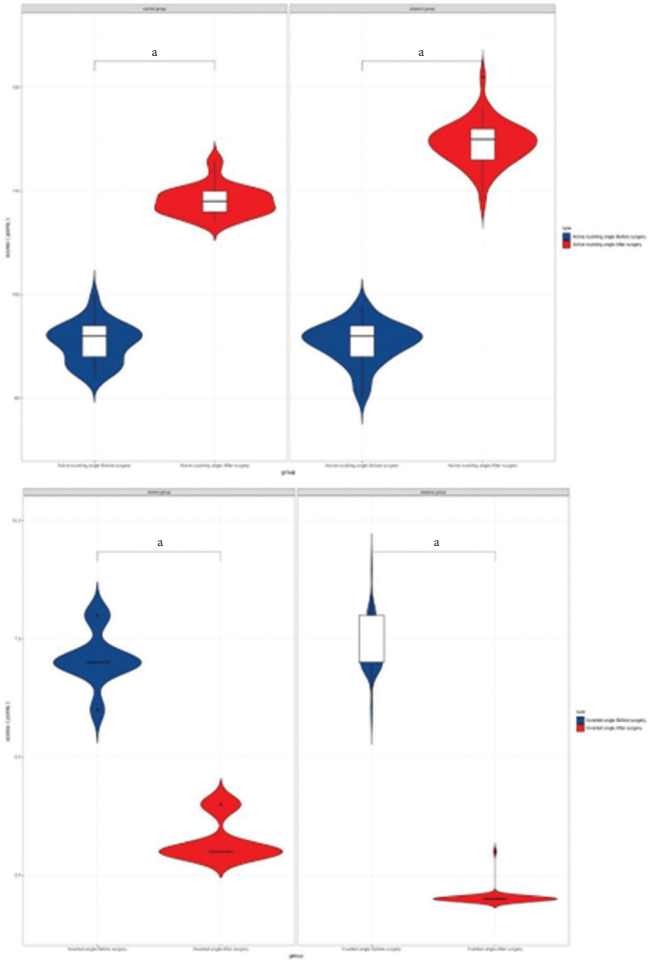
Comparison of kinematic parameters between the two groups

Analyzing the data in Table 2 and Figure 2, before the implementation of surgical treatment, the measured values of the active flexion angle and varus inclination of the subjects included in the observation group were not significantly different from those of the control group, with $P > .05$;one month after the surgical treatment, the measured value of the active flexion angle of the subjects included in the observation group (114.57±2.08) was higher than that in the control group (109.04±1.42), and the varus inclination in the observation group (2.02±0.14) was lower than that in the control group (3.24±0.43) by, with $P < .05$.

Table 3. Comparison of the changes in the levels of osteoarthritis indicators between the two groups of elderly patients with knee degenerative osteoarthritis (n = 45, points)

Group	Functional scores		Pain scores		Stiffness scores	
	Pre-operation	Post-operation	Pre-operation	Post-operation	Pre-operation	Post-operation
Control group	38.66±1.29	21.86±1.17	12.17±1.66	5.04±0.47	5.28±0.78	3.66±0.67
Observation group	38.53±1.28	19.04±0.82	12.28±1.75	3.02±0.33	5.28±0.89	2.13±0.45
t	0.620	14.477	0.200	31.288	0.302	17.141
P value	.537	.001	.842	.001	.764	.001

Figure 3. Analysis of the levels of osteoarthritis indicators between groups



[a]represents $P < .0001$.

Comparison of osteoarthritis indicators between the two groups

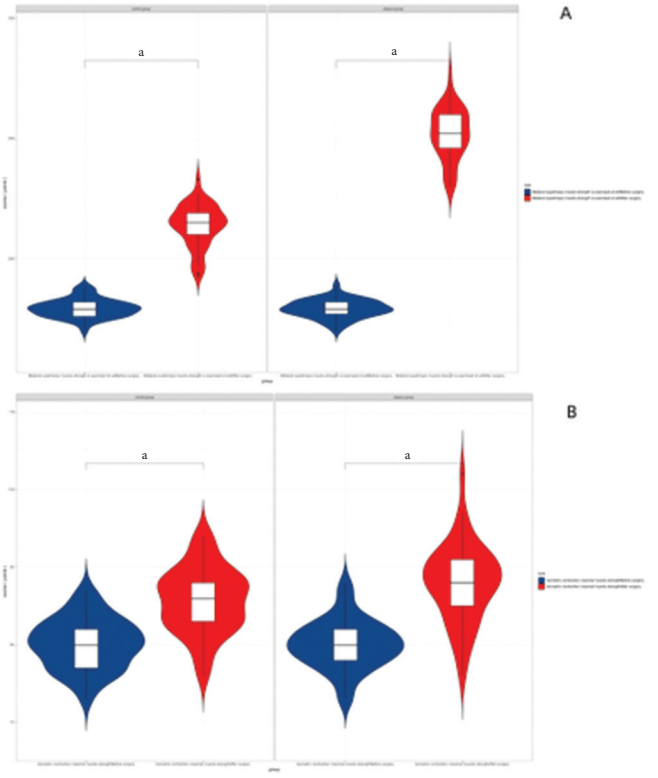
Analyzing the data in Table 3 and Figure 3, there was no significant difference in the joint function scores, pain scores, and stiffness scores between the two groups, with $P > .05$ before the implementation of relevant treatment matters.

Compared with the control group, the postoperative joint function scores of osteoarthritis patients in the observation group were lower, $P < .05$; the postoperative pain scores of patients in the observation group were significantly lower, $P < .05$; and the stiffness scores of patients in the observation group were also lower than those of the control group, $P < .05$.

Table 4. Comparison of quadriceps strength changes between the two groups of elderly patients with knee degenerative osteoarthritis (n = 45, points)

Group	Bilateral quadriceps voluntary movement strength		isometric maximal muscle strength	
	Pre-operation	Post-operation	Pre-operation	Post-operation
Control group	179.33±3.86	213.75±8.90	80.13±3.25	85.71±4.22
Observation group	179.13±3.79	251.86±10.61	80.06±3.17	87.93±5.02
t	0.175	18.455	0.103	2.300
P value	.861	.001	.918	.024

Figure 4. Analysis of quadriceps strength between groups



[a]represents $P < .0001$.

Comparison of quadriceps strength between the two groups

Analyzing the data in Table 4 and Figure 4, there was no significant difference in the measured values of the muscle strength of the voluntary movement of bilateral quadriceps muscle and the maximum muscle strength under isometric contraction between the two groups, with $P > .05$; compared with the control group, the various measured values of the patients in the control group accounted for a higher level, with $P < .05$.

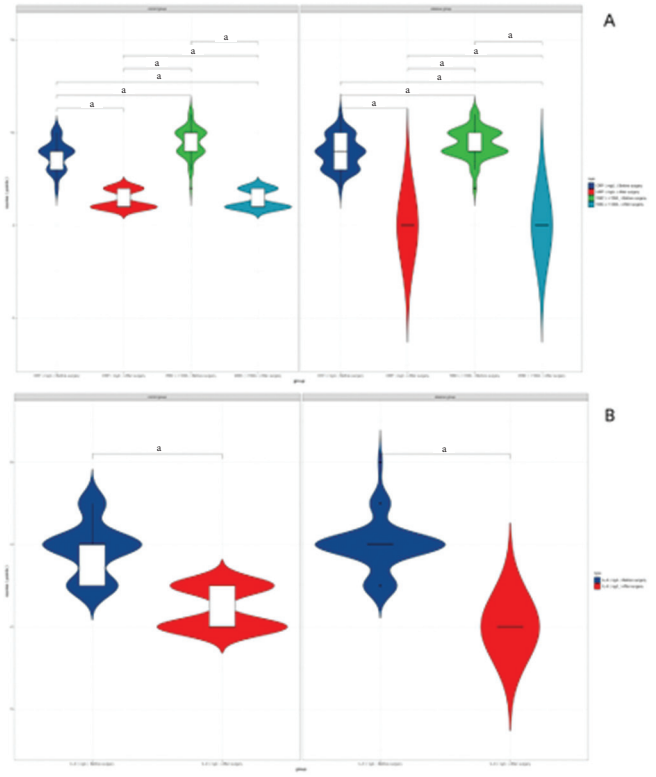
Comparison of inflammatory index levels between the two groups

Analyzing the data in Table 5 and Figure 5, before the operation, the measured values of CRP, IL-6 and WBC in the observation group were not significantly different from those in the control group, with $P > .05$; compared with the control group, the measured values of the above indicators in the observation group accounted for a lower level, with $P < .05$.

Table 5. Comparison of the changes in the levels of inflammatory indicators between the two groups of elderly patients with knee degenerative osteoarthritis (n = 45)

Group	CRP (mg/L)		IL-6 (ng/L)		WBC (×10 ⁹/L)	
	Pre-operation	Post-operation	Pre-operation	Post-operation	Pre-operation	Post-operation
Control group	8.77±0.76	6.37±0.49	3.86±0.66	2.44±0.50	9.46±0.81	6.37±0.49
Observation group	8.93±0.86	5.00±0.00	3.97±0.62	2.00±0.00	9.40±0.80	5.00±0.10
t	0.909	20.539	0.574	11.308	0.237	19.209
P value	.366	.001	.568	.001	.813	.001

Figure 5. Analysis of inflammatory indicators between groups



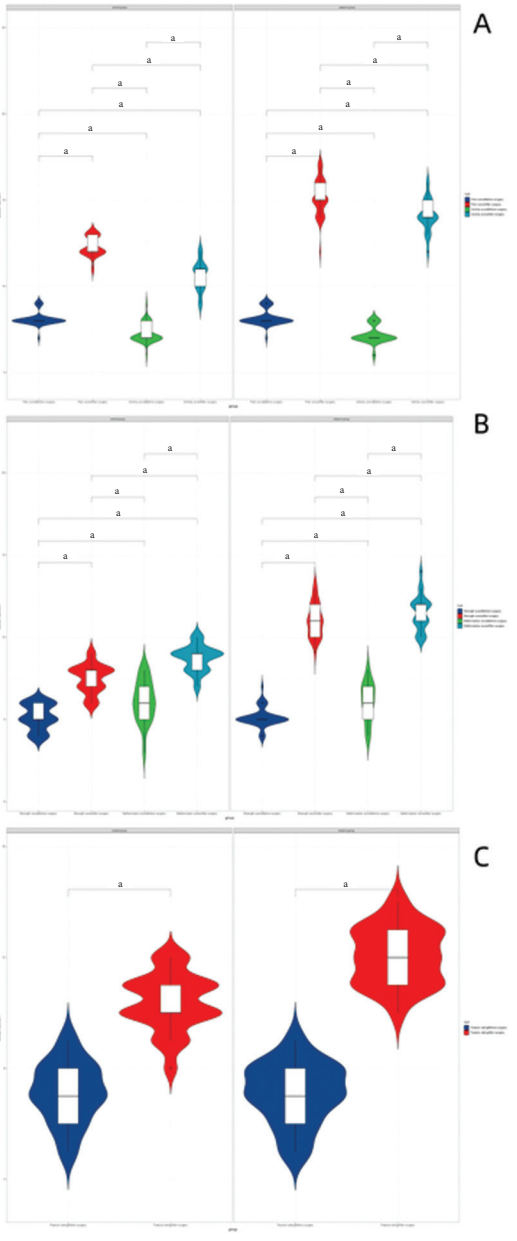
[a]represents $P < .0001$.

Table 6. Comparison of knee joint function changes between the two groups of elderly patients with knee degenerative osteoarthritis

Group	Pain scores		Activity scores		Muscle strength scores	
	Pre-operation	Post-operation	Pre-operation	Post-operation	Pre-operation	Post-operation
Control group	8.11±0.38	12.31±0.55	7.26±0.53	10.60±0.86	5.15±0.76	7.48±0.86
Observation group	8.17±0.44	15.20±1.05	7.17±0.49	14.11±0.90	5.11±0.57	11.04±0.99
t	0.763	16.650	0.789	20.647	0.616	18.963
P value	.447	.001	.433	.001	.540	.001

Group	Deformity scores		Functional scores	
	Pre-operation	Post-operation	Pre-operation	Post-operation
Control group	6.11±1.26	8.73±0.78	7.11±1.09	10.37±1.02
Observation group	6.08±1.18	11.48±1.05	7.08±1.10	12.04±1.04
t	0.281	15.597	0.183	7.786
P value	.779	.001	.855	.001

Figure 6. Analysis of knee joint function between groups



[a]represents $P < .0001$.

Comparison of knee joint function indicators between the two groups

Analyzing the data in Table 6 and Figure 6, before the implementation of surgical treatment, there was no significant difference in pain scores, activity scores, muscle strength scores, deformity scores, and function scores between the two groups, with $P > .05$; compared with the control group, the various values of the observation group accounted for a higher level, with $P < .05$.

Comparison of the daily living activities between the two groups

Analyzing the data in Table 7 and Figure 7, the daily living ability of the subjects in the observation group was significantly higher than that in the control group, with $P < .05$.

Comparison of the incidence of complications between the two groups

Analyzing the data in Table 8 and Figure 8, there was no

Table 7. Comparison of the daily living abilities between the two groups of elderly patients with knee degenerative osteoarthritis [n (%)]

Group	n	Completely independent	Light dependence	Moderately dependent	Heavy dependence	Completely dependent on
Control group	45	10 (22.22)	12 (26.67)	18 (40.00)	5 (11.11)	0 (0.00)
Observation group	45	16 (35.56)	18 (40.00)	10 (22.22)	1 (2.22)	0 (0.00)
Z	-	2.369				
P value	-	.018				

Figure 7. Analysis of daily living abilities between groups

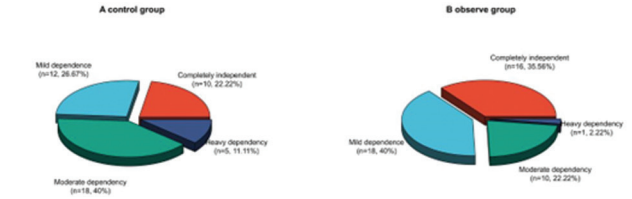


Table 8. Comparison of the incidence of complications between the two groups of elderly patients with knee degenerative osteoarthritis (n, %)

Group	n	Incision infection	Deep vein thrombosis	Knee instability	Total
Control group	45	1	1	1	6.67
Observation group	45	1	0	0	2.22
χ^2	-	-	-	-	1.047
P value	-	-	-	-	.306

Figure 8. Analysis of the incidence of complications between groups

significant difference in the incidence of complications in the observation group compared with the control group, with $P > .05$.

DISCUSSION

Knee osteoarthritis is one of the orthopedic diseases with a very high incidence in the elderly population, and the degeneration of articular cartilage is the main manifestation in the early stage of the disease.[7] Affected by the disease, patients may experience different degrees of limited knee joint movement, pain, and stiffness. In the past, physical and medication-conservative treatments were mainly used to improve disease symptoms and control disease progression. However, with the gradual deepening of clinical research, it is found that although the above treatment methods can obtain ideal short-term curative effects, it is difficult to solve the disease from the root cause and the ideal effects can not be obtained in improving the function of knee joint.[8] Arthroscopic debridement surgery can achieve ideal curative effects for patients with mild disease and early stage. This operation is minimally invasive. Medical staff can remove diseased tissues under arthroscopy, but it cannot correct the force line of the lower limbs of patients, which is unfavorable to the recovery of knee joint function in patients.[9]

Joint replacement is to remove the diseased joint part through surgery, and place an artificial total knee joint to replace the function of the knee joint. This operation is suitable for treating patients with abnormal knee joint function and complicated extra-articular deformities, which can promote the improvement of knee joint function and reduce the risk of secondary osteotomy.[10] Joint replacement surgery can alleviate the pain symptoms caused by knee varus deformity, promote the recovery of joint mobility and the neutral axis of the lower limbs, and at the same time restore the soft tissue around the knee joint, stabilize the knee joint function of patients, and promote the recovery of joint function.[11]

In the study, the kinematic parameters, osteoarthritis index levels, and knee joint function index scores of the subjects in the observation group were significantly better than those in the control group. It shows that joint replacement surgery applied in elderly patients with degenerative knee osteoarthritis can significantly improve the motion parameters of their knee joints, reduce joint stiffness and the degree of pain, and promote the recovery of knee joint function.[12] This may be because knee replacement helps restore the patient's normal anatomy, while reducing the pain associated with inflammation may speed up the patient's recovery. Senile knee degenerative osteoarthritis is a chronic inflammatory disease that improves the body's inflammatory condition, promotes the apoptosis process of knee chondrocytes to normal, effectively inhibits the abnormal growth of cartilage, and has a positive effect on disease control.[13]

Both IL-6 and CRP are important reference indicators for the current clinical evaluation of the body's inflammatory response.[14] The narrowing of the joint space in patients can destroy the cartilage matrix and promote the increased expression levels of related inflammatory factors[15]; there is a close relationship between WBC and the body's inflammatory status, and the local inflammation of the knee joint can promote the increased expression level of WBC.[16] In the study, the levels of various inflammatory indicators in the observation group were significantly lower than those in the control group, suggesting that joint replacement applied in the treatment of senile knee degenerative osteoarthritis can promote the improvement of the inflammatory state of patients. Our analysis suggests that this phenomenon may be due to the fact that during the development of osteoarthritis, increased levels of cytokines, chemokines, inflammatory factors, mechanical stimuli, and innervation amplify the pain sensation. After performing arthroplasty, the source of inflammatory stimuli disappears and therefore the body inflammation improves.[17]

In the study, the postoperative quadriceps strength of the subjects in the observation group was significantly higher than that of the control group, suggesting that joint replacement applied in the treatment of senile knee degenerative osteoarthritis can improve patients' quadriceps

strength and joint function. The reasons are that the replacement of diseased joints with prostheses made of metal or polymer plastics can promote the structural reconstruction of joint anatomy, promote the recovery of physiological and anatomical structures, and significantly improve symptoms such as local pain and abnormal joint function.[18]

In recent years, with the improvement of the medical level, the technology of joint replacement surgery has been gradually optimized, the material and structural shape of the replacement prosthesis has been continuously improved, and the specifications of the prosthesis are diversified, which is conducive to the medical staff to choose the prosthesis with the highest fitness according to the needs of the patient's condition and guarantee therapeutic effects. Clinical studies have clearly pointed out[19] that the application of joint replacement in the clinical treatment of elderly patients with knee degenerative osteoarthritis can promote the reconstruction of joint function, and the replaced joint can play an exact replacement role, promote the recovery of knee joint function and improve the prognosis of patients. In the study, the daily living ability of the observation group was significantly better than that of the control group, suggesting that joint replacement surgery can improve the daily living ability of elderly patients with knee degenerative osteoarthritis, which may be related to the recovery of knee joint function, limb activity and local stiffness, pain relief and other factors.[20] In the study, there was no significant difference in the incidence of complications between the two groups, suggesting that the safety of joint replacement surgery is relatively high, which may be related to the small number of samples included in this study, this is also a limitation of this study. In future studies, we will further expand the sample size and compare in depth the degree of adaptation to arthroscopic surgery in patients of different ages. In addition, different treatment measures and clinical care experiences for senile degenerative knee osteoarthritis will be further investigated.

All in all, joint replacement surgery applied to elderly patients with degenerative knee osteoarthritis has a significant curative effect and high safety, which is worthy of further promotion and application.

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