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Clinical Analysis of Minimally Invasive Arthroscopic Surgery in the Treatment of Knee Osteoarthritis

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Abstract: *Objective:* This paper aims to analyze the effect of minimally invasive arthroscopic surgery on knee osteoarthritis (KOA). *Methods:* A total of 60 patients with KOA admitted to the hospital between January 2021 and February 2023 were selected. They were divided into two groups by table of random numbers, 30 cases in the study group were treated with minimally invasive arthroscopic surgery, and 30 cases in the control group were treated conservatively. The treatment effects of the groups were compared. *Results:* The total effective rate of the study group was higher than that of the control group ($P < 0.05$). Before treatment, there was no difference in knee joint function scores between the groups ($P > 0.05$). After treatment, the knee joint function score in the study group was higher than that in the control group ($P < 0.05$). The complication rate and recurrence rate in the study group were lower than those in the control group ($P < 0.05$). *Conclusion:* Minimally invasive arthroscopic surgery for KOA patients can improve the overall curative effect, significantly restore knee joint function, and reduce complications and recurrence.

Keywords: Minimally invasive arthroscopic surgery; Knee osteoarthritis; Knee function score; Complications

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1. Introduction

Knee osteoarthritis (KOA) is a chronic joint disease with a high incidence rate. The etiology is knee cartilage degeneration and articular surface wear, and the symptoms are knee joint pain, stiffness, and dysfunction [1]. Treatment for this condition varies and includes conservative treatment (drug therapy, physical therapy, injections) and surgery. Among them, conservative treatment has the advantages of less pain and high patient compliance. However, its long-term recurrence rate is high, and it has significant treatment limitations, thus other treatment methods are needed [2]. Minimally invasive arthroscopic surgery is a new treatment method, which can use small incisions to insert arthroscopic and minimally invasive surgical instruments to directly observe and treat knee joint lesions, which has significant therapeutic advantages [3]. Therefore, this study selected 60 patients with KOA to analyze the therapeutic effect of minimally invasive arthroscopic surgery.

2. Materials and methods

2.1. General information

A total of 60 patients with KOA admitted to the hospital between January 2021 and February 2023 were selected. Table of random numbers was used to divide them into study group and control group. There were 30 cases in the study group, with 19 male and 11 female, the age ranged from 51 to 72 years old, with a mean age of 28.65±2.17. Their course of disease ranged from 2 to 11 years, with a mean of 6.42±1.08 years. Among them, 15 cases were in the right knee, 9 cases in the left knee, and 6 cases in both knees. There were 30 cases in the control group, with 18 male and 12 female, the age ranged from 50 to 74 years old, with an average of 28.71±2.55 years old. Their course of disease ranged from 3 to 12 years, with an average of 6.81±1.34 years. Among them, there were 14 cases in the right knee, 10 cases in the left knee, and 6 cases in both knees. After the data were compared, it was recorded as $P > 0.05$.

2.2. Methods

The study group was treated with minimally invasive arthroscopic surgery. The patient was asked to stay in the supine position, combined with spinal epidural anesthesia, and a tourniquet was tied on the thigh of the affected side. An arthroscope is placed into the incision to detect the condition of the knee joint, observe the suprapatellar bursa, patellar joint, and meniscus, and after determining the location of cartilage damage, the damaged area was grinded and trimmed. The joint loose bodies and inflammatory synovium were removed, meniscal diseased areas were trimmed and polished, and bone spurs were removed. If the movement of the patellar joint is limited, the ligament is released, and the patellar joint is fully flushed with sodium chloride solution (0.9%) to ensure that the pain-causing substances are completely removed. Then it is pressurized and bandaged, and the patient was instructed to take oral antibiotics.

The control group received conservative treatment. The affected knee area was disinfected, local infiltration anesthesia was done by using an appropriate amount of lidocaine (10%), 2ml of sodium hyaluronate was taken for injection treatment, once a week for 5 consecutive weeks, anti-inflammatory drugs and pain relievers were prohibited.

2.3. Observation indicators

The New York Hospital for Special Surgery-Scoring System (HSS) was used to evaluate knee joint function, including pain (record 30 points), muscle strength (record 10 points), function (record 22 points), activity (record 18 points), knee flexion deformity (record 10 points), and stability (record 10 points), a total of 100 points positive scoring.

Observation of joint hematoma, intestinal reaction, infection, and other complications in the groups was also performed. The patients were followed-up for 1 to 6 months to evaluate the recurrence rate of the disease. The recurrence criteria were continuous knee pain, abnormal articular cartilage, osteophyte, or synovial hyperplasia on MRI examination.

2.4. Efficacy evaluation criteria

“Basic cure” means no pain and other symptoms, and the knee joint can move freely. “Significant improvement” means slight pain and limp. “Preliminary improvement” means more obvious pain and limp. “No improvement” means severe pain and limp, and the condition remains unchanged.

2.5. Statistical analysis

The data were processed by using SPSS28.0 software, the measured values were compared and tested by *t*

value, and the counted values were compared and tested by x^2 value. Statistically significant was defined as P value less than 0.05.

3. Results

3.1. Comparison of the total effective rate

The total effective rate of the study group was significantly higher than that of the control group ($P < 0.05$), as shown in **Table 1**.

Table 1. Comparison of total effective rate between the two groups [n (%)]

Group	Basic cure	Significant improvement	Preliminary improvement	No improvement	Total effective rate
Study group ($n = 30$)	18 (60.00)	8 (26.67)	3 (10.00)	1 (3.33)	96.67 (29/30)
Control group ($n = 30$)	11 (36.67)	7 (23.33)	5 (16.67)	7 (23.33)	76.67 (23/30)
x^2	-	-	-	-	5.192
P	-	-	-	-	0.023

3.2. Comparison of knee joint function scores

Before treatment, there was no difference in knee joint function scores between the groups ($P > 0.05$). After treatment, the functional score of the study group was significantly higher than that of the control group ($P < 0.05$), as presented in **Table 2**.

Table 2. Comparison of knee joint function scores between the two groups (mean ± standard deviation/min)

Group	Pain		Muscle strength		Function		Activity		Knee deformity		Stability	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Study group ($n = 30$)	15.32±2.62	22.68±3.75	5.23±0.75	8.16±0.94	12.36±2.88	18.65±1.74	10.23±1.54	15.32±1.64	4.26±0.88	7.29±1.22	4.16±0.82	7.95±0.97
Control group ($n = 30$)	15.39±2.71	18.26±3.62	5.26±0.77	7.02±0.91	12.40±2.89	15.08±1.66	10.29±1.55	13.22±1.50	4.30±0.81	6.07±1.17	4.11±0.80	5.98±0.91
t	0.102	4.645	0.153	4.773	0.054	8.131	0.150	5.175	0.183	3.953	0.239	8.113
P	0.919	0.000	0.879	0.000	0.957	0.000	0.881	0.000	0.855	0.000	0.812	0.000

3.3. Comparison of complication rates

Based on **Table 3**, the complication rate in the study group was significantly lower than that in the control group ($P < 0.05$).

Table 3. Comparison of complication rates between the two groups [n (%)]

Group	Arthrodesis	Gut reaction	Infection	Incidence rate
Study group ($n = 30$)	1 (3.33)	1 (3.33)	0	6.67 (2/30)
Control group ($n = 30$)	3 (10.00)	3 (10.00)	2 (6.67)	26.67 (8/30)
x^2	-	-	-	4.320
P	-	-	-	0.038

3.4. Comparison of recurrence rates

During the follow-up of 1 to 6 months, the recurrence rate of the study group was lower than that of the control group ($P < 0.05$), as displayed in **Table 4**.

Table 4. Comparison of recurrence rates between the two groups [n (%)]

Group	Follow-up for 1 month	Follow-up for 2 months	Follow-up for 3 months	Follow-up for 4 months	Follow-up for 5 months	Follow-up for 6 months
Study group (n = 30)	0	0	1 (3.33)	1 (3.33)	1 (3.33)	2 (6.67)
Control group (n = 30)	4 (13.33)	4 (13.33)	6 (20.00)	7 (23.33)	7 (23.33)	8 (26.67)
x^2	4.286	4.286	4.043	5.192	5.192	4.320
P	0.038	0.038	0.044	0.023	0.023	0.038

4. Discussion

KOA is a common chronic and degenerative joint disease, and its pathogenic factors are complex. For example, aging will cause gradual thinning and degeneration of articular cartilage, which will lead to KOA [4]. The knee joint is subjected to high load for a long time, or repeated use, such as standing for a long time, high-intensity exercise, carrying heavy objects, etc., will also increase the risk of the disease. In addition, a history of serious injury to the knee joint such as fracture or meniscus injury can lead to articular cartilage lesions, which then progress into KOA [5]. The typical symptoms of the disease are joint pain, and the pain becomes worse after activity or prolonged weight carrying. Painful symptoms persist as the disease progresses. Joint stiffness and swelling are common symptoms of this disease, and these are accompanied by structural changes or severe wear of knee articular cartilage in some patients, and there may be dysfunction in going up and down the stairs or walking [6].

Sodium hyaluronate injection is a common treatment for this disease [7]. Sodium hyaluronate is a high-molecular-weight polysaccharide naturally present in joint fluid, which can form a thick lubricating film in joints, reduce joint friction, and improve joint lubrication. By lubricating the joints, the drug can increase the range of motion of the joints, thereby improving the mobility of the patient's knee joints and restoring their self-care abilities such as walking, and going up and down stairs [8]. More importantly, although sodium hyaluronate cannot restore the damaged cartilage structure, it can inhibit inflammatory response, regulate joint stability, and delay the degeneration of articular cartilage. However, long-term injection of sodium hyaluronate may lead to joint hematoma or intestinal reactions, and even drug dependence, and the dosage needs to be increased to maintain the therapeutic effect.

Minimally invasive arthroscopic surgery is an ideal treatment for this disease. It can directly observe and remove the inflammatory tissue in the joint, reduce the inflammatory response, and relieve symptoms such as joint pain and swelling [9,10]. In arthroscopic surgery, doctors can repair or trim the articular cartilage to reduce the damaged surface of the cartilage and improve joint function. Minimally invasive arthroscopic surgery can clean and repair the synovial tissue in the joint, promote the production of synovial fluid, thereby improving the lubrication function of the joint, reducing the friction between the joints, and relieving joint pain [11]. In addition, the irregular bone surface and cartilage fragments need to be removed during the operation to avoid infection caused by stimulation of the bone surface or fragments, thus the success rate of the operation is high and the recurrence rate is low. The advantages of this surgical method are minimally invasive and high accuracy. In this minimally invasive surgery, arthroscopes and surgical instruments are placed through small incisions, thus avoiding large incisions and tissue damage in traditional open surgery, which can reduce surgical trauma and shorten postoperative recovery time [12]. In addition, doctors can observe the intra-articular lesions through the arthroscopic lens, to clearly locate and accurately treat the lesion, thereby reducing the risk of tissue damage [13].

The results showed that the total effective rate of the study group was higher than that of the control group.

After treatment, the knee function score of the study group was higher than that of the control group, and the complication rate and recurrence rate of the study group were lower than those of the control group ($P < 0.05$). The reason is that arthroscopic surgery can accurately locate and treat knee articular cartilage damage, bone spurs, and joint loose bodies during the operation, and completely remove the diseased tissue, hence the total effective rate is high [14]. Spinal and epidural anesthesia before the operation can ensure a smooth operation and improve the patient's surgical tolerance. In addition, the surgical operation has the advantages of standardization and high precision, thus there are fewer postoperative complications. After the operation, the patient can resume activities in a short period of time, and then carry out early rehabilitation training, hence the patient's knee joint function score is excellent [15]. In addition, this surgical method can carry out individualized treatment according to the specific lesion of the patient, and the surgical plan can be flexibly adjusted based on the degree of lesion observed by arthroscopy during the operation. Therefore, the surgical flexibility and pertinence are strong, it can completely treat the disease with less long-term recurrence.

In summary, minimally invasive arthroscopic surgery can be used as a routine surgery for patients with KOA. It can effectively improve the curative effect of surgery and maximize the recovery of knee joint function. It is also safe and beneficial, and less prone to adverse events such as disease recurrence. Surgical practicality and feasibility are high, thus it can be applied in clinical practice for the treatment of KOA.

Disclosure statement

The authors declare no conflict of interest.

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