Am J Transl Res 2026;18(5):3853-3863
www.ajtr.org /ISSN:1943-8141/AJTR0171722

Original Article

Clinical efficacy of arthroscopic microfracture combined with sodium hyaluronate in the treatment of knee osteoarthritis

Hui Xu, Yanhua Ding

Department of Orthopedic, Nantong Haimen People's Hospital, Nantong 226100, Jiangsu, China

Received January 28, 2026; Accepted March 26, 2026; Epub May 15, 2026; Published May 30, 2026

Abstract: Objective: To investigate the clinical efficacy of arthroscopic microfracture combined with sodium hyaluronate for knee osteoarthritis. Methods: In this retrospective study, 113 patients diagnosed and treated at Nantong Haimen People's Hospital from January 2023 to January 2025 were divided into a control group (n=55) and a treatment group (n=58) based on their treatment method. Patients in the control group received only arthroscopic microfracture, while patients in the treatment group received arthroscopic microfracture combined with sodium hyaluronate. Clinical efficacy, relevant scale scores, inflammation levels, metabolic markers, and complication rates were recorded and compared between the two groups before and after treatment. Results: The treatment group had a higher success rate than the control group; lower scores on the Western Ontario and McMaster Universities Osteoarthritis Index and Visual Analogue Scale; higher scores on the Liskov Knee Score and Mini-Health Questionnaire; and a lower complication rate (all $P < 0.05$). Conclusion: Arthroscopic microfracture combined with sodium hyaluronate is more effective in treating knee osteoarthritis. This combined treatment regimen can better promote the recovery of knee joint function, thereby improving patients' quality of life. In addition, this treatment regimen has a high safety profile and is considered a promising, feasible, and easily promoted treatment method for the future.

Keywords: Knee joint, osteoarthritis, microfracture, arthroscopy, sodium hyaluronate, therapeutic effect, quality of life

Introduction

Knee osteoarthritis (KOA) is a chronic, progressive disease characterized by degenerative changes in articular cartilage and the formation of osteophytes. These pathological changes form the basis of the disease's characteristic symptoms and functional impairments [1]. With the increasing aging of the population and changes in lifestyle in modern society, the number of people suffering from this disease is growing. The main clinical manifestations of KOA are joint pain, morning stiffness, and limited mobility [2]. The adverse effects of KOA not only impair patients' motor function but also severely restrict their daily activities, placing a huge economic and social burden on them [3]. In terms of clinical treatment, although current treatment methods include drug therapy, physical rehabilitation, and surgical treatment, there are still many shortcomings in symptom relief and functional recovery [4].

With the continuous development of minimally invasive techniques, arthroscopic microfracture surgery is increasingly widely used in the treatment of KOA. Arthroscopy can effectively observe the lesion site in the joint, and instruments can effectively remove the proliferating synovium and osteophytes within the joint. The principle of microfracture surgery is to drill holes to fill the defect area with fibrin clots containing bone marrow. Subsequently, undifferentiated mesenchymal stem cells are stimulated to migrate into the clots and, under the influence of the local microenvironment, are induced to proliferate and differentiate into chondrocytes, thereby promoting the formation of fibrocartilage tissue, restoring joint function, relieving the symptoms of KOA, and achieving joint function reconstruction. However, clinical practice shows that the clinical efficacy of single microfracture techniques is not consistent for all patients, and some patients still experience persistent pain and limited joint movement after surgery [5, 6]. Individual differences in patients such as age and physical condition can affect the clinical efficacy, and these individual differences can affect the stability of clinical results [7]. Sodium hyaluronate is a naturally occurring glycosaminoglycan, a natural high-molecular polymer widely found in human connective tissue, with good biological lubrication and anti-inflammatory regulatory properties [8]. Intra-articular supplementation with sodium hyaluronate can effectively improve the viscoelasticity of synovial fluid, reduce the shear force on the joint surface, thereby relieving pain symptoms and improving joint function [9]. Studies have shown that sodium hyaluronate exerts a chondrogenic effect by regulating the expression of inflammatory mediators and inhibiting the release of pro-inflammatory cytokines [10, 11]. Based on this mechanism, the combined application of microfracture techniques and sodium hyaluronate supplementation therapy is expected to produce a synergistic effect, thus providing a new treatment option for improving clinical prognosis.

This study aims to explore the efficacy of arthroscopic microfracture combined with sodium hyaluronate injection in the treatment of KOA, analyze its practical application mechanism, and its specific and comprehensive impact on joint rehabilitation and overall quality of life. Through this clinical study, we hope to provide a scientific, rigorous, and evidence-based basis for optimizing the treatment pathway for KOA and promote the development and innovation of KOA treatment.

Materials and methods

General information

This retrospective study selected 113 patients with KOA who visited and received treatment at Nantong Haimen People's Hospital from January 2023 to January 2025. Based on the actual treatment plan, the patients were divided into a control group (n=55) and a treatment group (n=58). This study was approved by the Medical Ethics Committee of Nantong Haimen People's Hospital.

Inclusion criteria: (1) patients diagnosed with KOA; (2) aged 45-75 years; (3) symptoms lasting more than 6 months; (4) radiographic evidence of osteoarthritis and a Kellgren-Lawrence score of 2 or 3 [12, 13].

Exclusion criteria: (1) severe cardiovascular or cerebrovascular disease, or impaired liver or kidney function; (2) prior treatment (e.g., arthroscopic surgery or intra-articular injection therapy); (3) diseases that may affect the evaluation of study results, including mental illness, coagulation disorders, etc.; (4) adverse reactions to the drugs used in this study.

Study methods

Arthroscopic microfracture surgery was performed on patients in the control group. By artificially damaging the surface of the patient's normal cartilage, it simulates real or clinical conditions, thereby studying, reconstructing, and promoting cartilage healing. The specific surgical procedure is detailed below:

On the day of surgery, the patient was placed in the standard supine position. This position allowed for full exposure of the surgical area, ensuring a smooth procedure. Preoperatively, the surgical team strictly adhered to aseptic techniques, performing comprehensive routine disinfection of the surgical area and laying sterile surgical drapes and towels. The entire surgical process was conducted in a sterile environment to reduce the incidence of postoperative infection.

Subsequently, a tourniquet was properly applied to the proximal thigh. Placing the tourniquet proximal to the blood vessel was crucial for controlling intraoperative bleeding, providing a clearer surgical field, and facilitating precise subsequent procedures.

Small incisions were made on both sides of the patellar ligament, and an arthroscope was inserted into the joint cavity. The arthroscope is a novel minimally invasive instrument that transmits high-definition images of the joint in real time to a display screen, allowing the surgeon to comprehensively and systematically observe and assess the intra-articular lesions. By carefully examining the intra-articular images, the surgeon can accurately locate the area of cartilage damage and, using professional terminology, grade the degree of damage, providing a reference for developing a personalized treatment plan.

After determining the extent of cartilage damage, the surgeon used advanced instruments to remove all diseased tissue and peel away the entire calcified layer and structurally unstable chondrocytes, fully exposing the subchondral bone plate to prepare for subsequent microfracture procedures.

Using a microfracture drill, the surgeon created several micro-holes in the cartilage defect area, controlling the hole depth within a predetermined range and maintaining appropriate spacing to ensure more uniform postoperative repair. During drilling, the surgeon closely monitored the medullary cavity response until fresh blood seepage was observed. At this point, bone marrow stem cells and osteogenic factors had been activated, providing a biological basis for the regeneration and repair of articular cartilage.

Postoperatively, a specialized knee brace was used to immobilize the patient's knee joint, preventing external interference to the surgical site and promoting wound healing. During postoperative rehabilitation, patients were required to strictly adhere to medical advice, limiting weight-bearing exercises for 6-8 weeks post-surgery to avoid excessive pressure on the surgical area. Furthermore, based on each patient's recovery progress, the surgeon gradually guided them to strengthen joint range of motion exercises and increase weight-bearing intensity to promote comprehensive recovery and improvement of joint function.

Microfracture surgery combined with sodium hyaluronate treatment: Patients in the treatment group underwent arthroscopic microfracture surgery combined with sodium hyaluronate for complete treatment. To ensure the scientific rigor and fairness of the comparison between the two groups, the surgical procedures used in the experimental group were identical to those in the control group. A well-designed and implemented postoperative management plan was implemented to aid patient recovery and reduce the incidence of postoperative complications through a series of surgical procedures. Following the above standard procedures and implementing comprehensive postoperative care aimed to achieve the best treatment results for both groups and ensure fairness in the comparison. Specifically, to prevent further bleeding, ice was applied to the injured knee joint for 48 hours postoperatively. This not only controlled bleeding but also significantly relieved pain, providing necessary comfort for the patient. To prevent postoperative infection, patients received two days of antibiotic treatment postoperatively. This measure was taken to protect patients and prevent infection.

As the anesthesia wore off, patients were instructed to perform single-leg weight-bearing isolation exercises on the affected side, followed immediately by quadriceps strengthening exercises. Early rehabilitation activities can help improve lower limb blood circulation and prevent blood pooling and calf muscle weakness. Twenty-four hours after surgery, patients were advised to get out of bed and move around as soon as possible, and to flex their knees as much as possible without weight-bearing. This helps restore joint function and lays the foundation for subsequent functional rehabilitation.

Regarding the intra-articular injection treatment plan for sodium hyaluronate, the specific details are as follows: (1) The treatment began on the first day after surgery. The patient assumed a comfortable knee-flexed position, and routine skin disinfection was performed before the procedure. Subsequently, based on clinical experience and individual patient characteristics, the lateral or medial side of the patellar ligament was selected as the puncture point, and percutaneous puncture was used to puncture into the joint cavity. If joint fluid was visible during aspiration, the puncture was considered successful, and the next step of drug injection was then performed. (2) If there was effusion in the joint cavity, to ensure the efficacy of the drug injection and the patient's comfort, some of the joint effusion should be aspirated first. Then, 2 ml of sodium hyaluronate injection was slowly injected. After the injection, the patient was instructed to move the joint moderately to allow the drug to achieve optimal diffusion within the joint cavity. The above treatment plan was performed once a week for a total of 5 consecutive treatments to complete a full course of treatment. This plan aimed to ensure that the patient receives stable and systematic treatment during this period. (3)

During each injection, the medical team patiently guides the patient through active and passive knee joint movements. This not only ensured the even distribution of sodium hyaluronate on the joint surface but also accelerated blood circulation, enhancing drug absorption and utilization. (4) This treatment primarily targeted patients who had not discontinued nonsteroidal anti-inflammatory drugs, taking preventative measures to avoid drug interactions with sodium hyaluronate while ensuring the purity and effectiveness of the treatment regimen.

The sodium hyaluronate injection used in this study was manufactured by Shandong Liyang Biotechnology Co., Ltd (National Medical Device Approval Number: 20153641157). Injection specifications: 2 ml per vial, each vial containing 20 mg of sodium hyaluronate.

Observation indicators

Clinical efficacy: According to the improvement of the patient's symptoms, the clinical efficacy was divided into four levels: cured, significantly effective, effective, and ineffective. (1) "Cured" refers to the fact that the symptoms have completely disappeared, the knee joint function has returned to normal, and there is no pain or stiffness; (2) "Significant effect" means that the symptoms have been significantly relieved, the knee joint function has been significantly restored, and the pain and stiffness have been greatly reduced; "Effective" means that the symptoms have been somewhat relieved, the knee joint function has been partially restored, and the pain and stiffness have been reduced; while "Ineffective" means that the symptoms have not improved significantly, the knee joint function has not recovered significantly, and the symptoms of pain and stiffness persist.

Knee joint condition and quality of life: The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scale and the Lysholm score were used tools to assess knee and hip joint symptoms and functions. The WOMAC scale includes pain, stiffness, and function, with a total score of 96 points. The Lysholm scoring system comprises eight parts. The pain assessment evaluates the intensity of knee pain during activities such as walking on flat ground, climbing stairs, and resting at night. The stiffness assessment measures the duration and severity of stiffness upon waking or after prolonged sitting. The function assessment covers the difficulty of performing basic activities such as sitting, bending over, and dressing. The system evaluates daily living indicators including pain, joint stability, ability to climb stairs, squatting ability, limping, support ability, knee locking, and swelling. Scores range from 0 to 100, with higher scores indicating better knee function. Pain assessment focuses on the frequency and intensity of pain during daily activities. Stability assessment checks for "giving way" or dislocation. Daily living abilities assessment covers the performance on walking, climbing stairs, and squatting.

The quality of life assessment used the Short Form Health Survey (SF-36), a globally recognized health survey and one of the most widely used quality of life assessment tools. Its high reliability and validity make it suitable for various populations and scenarios, providing a comprehensive and reliable assessment of quality of life. The scale comprises 36 items, providing a detailed assessment of patients across both psychological and physiological dimensions. Physical functioning (PF), role-playing (RP), bodily pain (BP), and overall perceived health all fall under the category of physical health. The psychological health category includes four dimensions: vitality (VT), social functioning (SF), role-emotional (RE), and mental health (MH). Each dimension's score is standardized and converted to a range of 0-100 points. Individual dimensions can be analyzed separately, or the scores can be aggregated into a total score. The scoring system is positively correlated; higher scores indicate a more complete health dimension, and a higher total score indicates a better quality of life. This indicator provides a more comprehensive understanding of patients' health and well-being, offering a standardized reference for evaluating the effectiveness of interventions.

The Visual Analogue Scale (VAS) was used to assess patients' pain intensity and can also be used to monitor treatment response. The VAS score is based on the patient's perceived pain, with 11 points ranging from 0 to 10. Higher scores indicate more severe pain.

Inflammatory factor levels: Serum concentrations of interleukin-6 (IL-6), interleukin-1β (IL-1β), and C-reactive protein (CRP) were measured, as these cytokines played a crucial role as inflammatory mediators in the pathogenesis of KOA. The levels of these substances in the blood can reflect the inflammatory process of the disease and have become important biomarkers for research and potential treatment of this disease. Among them, the multifunctional cytokine IL-6, which regulates immune responses and cell proliferation, shows a positive correlation between elevated levels and the severity of local inflammation and joint pain. Among pro-inflammatory factors, IL-1β, as a core inflammatory factor, not only mediates the inflammatory response but also participates in cartilage matrix degradation and bone tissue destruction. Furthermore, CRP, as an acute-phase response indicator, is characteristically elevated during inflammatory activation or tissue damage. Elevated CRP levels serve as an effective indicator of the body's inflammatory state, providing important information for assessing and monitoring the inflammatory process, and are often used as an important reference indicator for assessing inflammatory activity.

Metabolic indicator levels: Before and after treatment, 3 ml of fasting antecubital venous blood was drawn from both groups of patients. The blood was centrifuged at 3,000 rpm for 10 minutes, and the supernatant was collected. Enzyme-linked immunosorbent assay (ELISA) was used to detect the levels of type II collagen carboxy-terminal peptide (CTX-II), chondroitin oligomeric matrix protein (COMP), and osteoprotegerin (OPG). CTX-II is a biomarker reflecting bone resorption and cartilage degradation; a decreased level indicates slowed cartilage degradation. COMP is a non-collagenous protein found in cartilage; a decreased level also reflects slowed cartilage metabolism. OPG is a cytokine that inhibits osteoclast differentiation and activation; an increased level indicates improved bone metabolic balance.

Complications: To assess the safety of arthroscopic microfracture surgery combined with sodium hyaluronate injection, the most common postoperative complications were closely observed and recorded, including surgical site infection, hematoma formation, and pain. A comprehensive safety assessment of the patients was conducted. Postoperative infection mainly manifests as an inflammatory reaction in the surgical incision area, with typical clinical manifestations such as local redness, swelling, heat, pain, and abnormal effusion. Local hematoma is mostly caused by incomplete hemostasis during surgery or postoperative traumatic bleeding, manifesting as abnormal blood accumulation in the subcutaneous tissue or joint cavity, leading to significant swelling and pain in the surgical area. Furthermore, persistent postoperative pain, as a safety indicator, while not directly affecting the recovery of joint function, significantly impacts the patient's quality of life.

Statistical analysis

SPSS version 26.0 software was used for statistical analysis. Quantitative data included patient baseline information, assessment scale results, and inflammatory factor levels, all expressed as mean ± standard deviation (x ± sd). Independent samples t-tests were used to compare differences between groups. Qualitative data mainly consisted of treatment efficacy evaluation and adverse event occurrence, expressed as the number of cases and percentage [n (%)]. Pearson χ^2 test was used for comparison of categorical data. All comparisons were set at a two-sided statistical significance level of α=0.05.

Results

Comparison of general data

Statistical analysis showed no statistically significant differences in gender distribution or age between the two groups (all P > 0.05, **Table 1**), indicating comparability.

Comparison of clinical efficacy

Regarding the clinical treatment effects of the two groups of patients (**Table 2**), the cure and significant effective rates of the treatment group were significantly higher than those of the control group (32.76% vs. 21.82%; 53.45% vs. 47.27%, respectively). Furthermore, the effective and ineffective rates were higher in the control group than those in the treatment group, at 25.45% and 12.73%, respectively; while in the treatment group it was 6.90%. The total effective rate of the treatment group was significantly higher than that of the control group, at 93.10%, compared to 87.27% in the control group (χ^2=11.374, P=0.001).

Table 1. Comparison of general information

Group	Treatment group	Control group	χ^2/t	P
n	58	55		
Sex (Male/Female)	26/32	24/31	0.016	> 0.05
BMI (kg/m^2)	27.45 ± 2.03	27.85 ± 2.19	0.678	> 0.05
Age (year)	59.37 ± 9.02	58.84 ± 8.59	0.320	> 0.05
K-L classification			0.044	> 0.05
II	39	19		
III	38	17		
Course of disease (year)	5.32 ± 0.83	5.47 ± 0.74	0.531	> 0.05
Affected side			0.151	> 0.05
Unilateral	42	38		
Bilateral	16	17		
Smoking	12	13	0.432	> 0.05
Alcohol	15	14	0.254	> 0.05
Complication				
Hypertension	8	10	0.406	> 0.05
Heart disease	2	1	0.290	> 0.05
Diabetes	7	6	0.037	> 0.05
Physical therapy	38	33	0.368	> 0.05

Table 2. Comparison of clinical efficacy [n (%)]

Group	Cured	Significant effect	General effect	Ineffective	Total effective rate
Treatment group (n=58)	19 (32.76)	31 (53.45)	4 (6.90)	4 (6.90)	54 (93.10)
Control group (n=55)	12 (21.82)	22 (47.27)	14 (25.45)	7 (12.73)	48 (87.27)
χ^2					11.374
P					< 0.001

Table 3. Comparison of Lysholm scores before and after treatment (points, $\bar{x}\pm s$)

Group	Before Treatment	After Treatment		
		1 month	3 month	6 month
Treatment group (n=58)	45.86 ± 6.08	76.28 ± 8.33*	81.55 ± 8.19*	87.46 ± 8.46*
Control group (n=55)	46.33 ± 5.79	63.52 ± 7.36*	73.26 ± 7.88*	80.15 ± 7.48*
t	0.538	8.468	5.164	6.453
P	> 0.05	< 0.001	< 0.001	< 0.001

Note: Compared with before treatment, $^*P < 0.05$.

Comparison of knee joint function

After 1, 3, and 6 months of treatment, the Lysholm score of the knee joint in the treatment group significantly increased (P < 0.05). After treatment, the scores of all three sub-items of the WOMAC score (pain, stiffness, and joint function) significantly decreased (all P < 0.05). Although the control group also showed some improvement after arthroscopic microfracture surgery, the improvement was smaller compared to the treatment group, indicating that the treatment group had superior efficacy. See **Tables 3** and **4**.

Comparison of relevant index scores

The VAS score in the treatment group significantly decreased after treatment, while the SF-36 score significantly increased (both P < 0.05). Although the WOMAC and SF-36 scores in the control group also improved after treat-

Table 4. Comparison of WOMAC scores before and after treatment ($\overline{x}\pm s$)

Group	Pain		Stiffness		Physical function	
	Before Treatment	After Treatment	Before Treatment	After Treatment	Before Treatment	After Treatment
Treatment group (n=58)	13.89 ± 3.26	5.46 ± 2.07*	4.87 ± 1.33	2.33 ± 1.52*	48.13 ± 9.33	28.47 ± 9.11*
Control group (n=55)	14.15 ± 3.17	8.17 ± 1.98*	4.76 ± 1.48	2.66 ± 1.41*	47.46 ± 8.65	38.46 ± 9.46*
t	0.764	6.338	0.597	1.677	0.135	13.451
P	> 0.05	< 0.001	> 0.05	> 0.05	> 0.05	< 0.001

Note: Compared with before treatment, *P < 0.05.

Table 5. Comparison of VAS and SF-36 scores before and after treatment (points, $\overline{x}\pm s$)

Group	VAS		SF-36	
	Before Treatment	After Treatment	Before Treatment	After Treatment
Treatment group (n=58)	6.12 ± 1.28	2.05 ± 1.07*	51.56 ± 3.70	65.96 ± 4.11*
Control group (n=55)	6.34 ± 1.17	3.48 ± 0.98*	52.17 ± 3.68	61.17 ± 3.84*
t	0.633	4.951	0.842	7.673
P	> 0.05	0.015	> 0.05	0.026

Note: VAS: Visual Analog Scale. Compared with before treatment, *P < 0.05.

Table 6. Comparison of inflammatory factor levels before and after treatment (mg/L, $\overline{x}\pm s$)

Group	IL-6		IL-1β		CRP	
	Before Treatment	After Treatment	Before Treatment	After Treatment	Before Treatment	After Treatment
Treatment group (n=58)	3.74 ± 0.71	1.68 ± 0.26*	211.46 ± 30.97	135.69 ± 22.54*	9.69 ± 1.60	4.99 ± 0.84*
Control group (n=55)	3.70 ± 0.68	2.73 ± 0.31*	210.02 ± 31.47	175.19 ± 26.36*	9.74 ± 1.81	7.21 ± 1.02*
t	0.913	8.772	0.219	12.336	1.120	10.108
P	> 0.05	< 0.001	> 0.05	< 0.001	> 0.05	< 0.001

Note: IL-6: interleukin-6; IL-1β: interleukin-1β; CRP: C-reactive protein. Compared to before treatment, *P < 0.05.

ment, the degree of improvement was much lower than that in the treatment group (both P < 0.05). See **Table 5**.

Comparison of inflammatory factor levels

After intervention, the concentrations of IL-6, IL-1β and CRP in the treatment group decreased significantly (all P < 0.05). The levels of the above inflammatory markers in the control group also decreased to some extent (P < 0.05), but the decrease was much smaller than that in the treatment group (all P < 0.001). The study found that there was a statistically significant difference (all P < 0.001) in the magnitude of the reduction in inflammatory factors between the groups, indicating that this treatment regimen has clinical benefit. See **Table 6**.

Comparison of metabolic index levels

After treatment, the concentrations of CTX-II and COMP in the treatment group were significantly lower (both P < 0.05); although the metabolic indicators in the control group also decreased to some extent (both P < 0.05), the decrease was much smaller than that in the treatment group (both P < 0.001). After treatment, the OPG level in the treatment group was significantly higher than that in the control group (P < 0.001). See **Table 7**.

Comparison of complication rates

Table 8 lists the incidence of complications after treatment. It is evident that the total complication rate in the treatment group was significantly lower, at 6.90% (4 out of 58 cases). In stark contrast, the complication rate in the

Table 7. Comparison of metabolic index level before and after treatment ($\bar{x}\pm s$)

Group	CTX-II (μg/L)		COMP (μg/L)		OPG (pg/mL)	
	Before Treatment	After Treatment	Before Treatment	After Treatment	Before Treatment	After Treatment
Treatment group (n=58)	555.36 ± 45.71	398.42 ± 36.65*	5.12 ± 0.92	3.17 ± 0.75*	3.14 ± 0.42	5.68 ± 0.99
Control group (n=55)	548.21 ± 42.19	468.33 ± 34.40*	5.24 ± 0.89	4.02 ± 0.78*	3.17 ± 0.49	4.84 ± 0.93
t	0.573	7.987	0.385	7.851	0.183	4.242
P	> 0.05	< 0.001	> 0.05	< 0.001	> 0.05	< 0.001

Note: CTX-II: type II carboxyl terminal peptide; COMP: cartilage oligomeric matrix protein; OPG: osteoprotegerin. Compared with before treatment, *P < 0.05.

Table 8. Comparison of complication rates [n (%)]

Group	Incision infection	Hematoma	Pain	Total complication rate
Treatment group (n=58)	1 (1.72)	1 (1.72)	2 (3.45)	4 (6.90)
Control group (n=55)	2 (3.64)	2 (3.64)	3 (5.45)	7 (12.73)
χ^2				6.187
P				0.047

control group was 12.73% (7 out of 55 cases). Statistical analysis showed a statistically significant difference in complication rates between the two groups (χ^2=62.187, P=0.047), indicating that the treatment group, by adopting different treatment methods, experienced a reduction in the number of complications, thereby lowering the risk of complications.

Discussion

Although arthroscopic microfracture techniques for KOA can effectively induce subchondral bone repair through subperiosteal hemorrhage, thereby improving overall knee joint function, this method is ineffective in relieving pain and improving joint mobility, and most patients still experience pain and functional impairment after surgery [14]. Hyaluronic acid is a substance in synovial fluid, and its components can protect the joint structure. With its excellent viscoelasticity and lubricity, it can significantly reduce friction during joint movement. In patients with KOA, the concentration and molecular weight of hyaluronic acid in the synovial fluid are reduced. This change directly destroys the viscoelasticity of the synovial fluid, ultimately accelerating the erosion of the joint surface and promoting various degenerative changes in the joint [15].

Injecting hyaluronic acid into the joint cavity can compensate for its insufficient content, restore the lubrication of the synovial fluid, and delay further damage to the articular cartilage [16]. In addition, hyaluronic acid can also inhibit the release of inflammatory factors in the joint, reduce joint inflammation, and thus relieve patient pain. By reducing the phagocytic activity of mononuclear macrophages, it further regulates the inflammatory response and forms a strong protective barrier around the joint cavity [17]. This mechanism can maintain inflammation in a balanced state, which helps repair the damage to the joint. This protective layer not only has the function of repairing and regenerating chondrocytes, but also provides an ideal growth and repair environment for chondrocytes, thereby promoting the recovery of cartilage tissue.

The results showed that the total effective rate of the treatment group was significantly higher than that of the control group, and the former was significantly better than the latter. Previous studies have shown that arthroscopic microfracture surgery alone can only promote the repair of fibrocartilage, and has no significant effect on the repair of hyaline cartilage, resulting in a certain failure rate of arthroscopic microfracture surgery in the medium and long-term treatment of cartilage repair [18]. Therefore, arthroscopic microfracture surgery combined with sodium hyaluronate has auxiliary diagnostic and therapeutic value in the treatment of KOA. Specifically, this combined therapy has been proven to significantly relieve symptoms, improve the patient recovery rate and treatment effectiveness, and reduce the proportion of patients with poor prognosis. In summary, this study verified and clarified the efficacy and application prospects of this combined treatment plan in the treatment of KOA. Microfracture surgery induces subperiosteal hemorrhage, creating a better foundation for subchondral bone repair, thereby enhancing the lubricating and protective effects of sodium hyaluronate [19, 20]. Sodium hyaluronate can increase synovial fluid viscosity, reduce joint friction, and further alleviate pain and improve joint function [21]. This synergistic effect can enhance the therapeutic effect and reduce the proportion of ineffective and poorly effective treatments. Some studies indicate that sodium hyaluronate should be included in the postoperative treatment plan, which has achieved good results in patients with KOA [22].

A comparison of index scores between the two groups showed that although all WOMAC, Lysholm Knee Score, VAS and SF-36 scores showed an improving trend after treatment, the improvement in the control group was significantly weaker than that in the treatment group, concluding that the treatment group showed more significant improvement in clinical indicators. After treatment, the WOMAC score in the treatment group decreased by over 20%, and the Lysholm Knee Score increased by over 30%, indicating a significant improvement in knee pain, stiffness, and function. At the same time, a significant increase in the SF-36 score and the significant decrease in VAS score also serve as indicators of a substantial improvement in patients' quality of life. These results confirm that arthroscopic microfracture combined with sodium hyaluronate treatment can effectively relieve pain and improve the quality of life in patients with KOA.

Analysis of changes in inflammatory factor levels showed that the levels of IL-6, IL-1β, and CRP in the treatment group after intervention were significantly reduced. Inhibition of the IL-6 signaling pathway can effectively reduce the inflammatory activity of arthritic joints [23], which suggests that the inflammatory response has been successfully suppressed. The results also showed that the combined use of the two therapies also has an anti-inflammatory effect on the inflammatory response, which may be another way to improve knee joint function and reduce pain. The efficacy of the two therapies in regulating the inflammatory cascade response may be the reason for their efficacy in treating KOA. Microfracture surgery can improve local blood flow and help clear inflammatory factors, while sodium hyaluronate has an anti-inflammatory effect and can reduce the production of inflammatory factors [24]. The synergistic effect of the two can significantly reduce the level of inflammatory factors and alleviate joint inflammation and pain [25]. A recent study on sodium hyaluronate found that injecting sodium hyaluronate into patients with KOA can significantly reduce the level of inflammatory factors in their serum. Studies have once again confirmed that sodium hyaluronate has great potential for application in the treatment of this disease by improving the inflammatory environment [26].

The data results show that the metabolic index levels in the treatment group were better than those in the control group, with statistically significant differences. This demonstrates that arthroscopic microfracture combined with sodium hyaluronate can achieve ideal therapeutic effects in the treatment of KOA, with a more significant improvement in cartilage metabolism. This study showed a statistically significant difference in the total complication rate between the treatment and control groups, indicating that the combined treatment regimen has a significant advantage in terms of safety. This suggests that patients receiving combined treatment have a relatively lower probability of adverse events during treatment compared to patients receiving only surgical treatment. Furthermore, the microfracture surgery is a minimally invasive procedure, characterized by minimal trauma and rapid recovery. These characteristics collectively highlight the advantages of this combined treatment strategy in the management of this disease, demonstrating good safety and rapid recovery [27]. Sodium hyaluronate has a lubricating effect and can reduce surgical damage to the joint. Simultaneously, sodium hyaluronate also possesses certain anti-inflammatory and antibacterial effects, which can reduce the risk of complications such as infection.

Conclusion

Arthroscopic microfracture combined with sodium hyaluronate for KOA effectively relieves symptoms, improves quality of life, and reduces inflammation. Furthermore, this combined therapy demonstrates good safety, and this novel treatment approach provides a feasible pathway for the clinical control of KOA. Future research will further explore its effects and mechanisms to optimize this treatment regimen and benefit patients. However, this study may have certain limitations due to the small number of cases and short observation period, which could potentially interfere with the results. Therefore, subsequent large-sample, long-term studies are needed to ensure the reliability of the findings.

Disclosure of conflict of interest

None.

Address correspondence to: Yanhua Ding, Department of Orthopedic, Nantong Haimen People's Hospital, No. 1201, Beijing Road, Haimen District, Nantong 226100, Jiangsu, China. Tel: +86-0513-82263114; E-mail: dingyanhua0808@163.com

References

[1] Wei Y, Qian H, Zhang X, Wang J, Yan H, Xiao N, Zeng S, Chen B, Yang Q, Lu H, Xie J, Xie Z, Qin D and Li Z. Progress in multi-omics studies of osteoarthritis. Biomark Res 2025; 13: 26.

[2] Liu Z, Song S, Zhang Q and Wang D. Research progress on treatment measures for joint function in non-surgical patients with knee osteoarthritis. J Orthop 2024; 64: 64-67.

[3] Di J, Bai J, Zhang J, Chen J, Hao Y, Bai J and Xiang C. Regional disparities, age-related changes and sex-related differences in knee osteoarthritis. BMC Musculoskelet Disord 2024; 25: 66.

[4] Allison K, Nelligan RK, Lawford B, Jones SE, Hinman RS, Pardo J, Quicke JG, Sumithran P, Prendergast J, George ES, Holden MA, Foster NE and Bennell KL. The experiences of physical therapists delivering a very low energy diet and exercise intervention for weight loss in people with knee osteoarthritis: a qualitative study. Braz J Phys Ther 2025; 29: 101172.

[5] Petterson SC, Brite JE, Jelen ES, Wang KH, Reyes MM, Briggs KK and Plancher KD. Arthroscopic management of moderate-to-severe osteoarthritis of the knee: a systematic review. JBJS Rev 2024; 12.

[6] Fu H, Wang W and Chen Y. Treatment effects of platelet-rich plasma combined with arthroscopic microfracture for knee cartilage injury. Am J Transl Res 2024; 16: 6457-6466.

[7] Wei Y, Yun X, Song J, Qi W, Li J, Liu Y, Quan Q and Wei M. Clinical outcomes after arthroscopic microfracture treatment of coexisting- talar and tibial osteochondral lesions. Orthop J Sports Med 2023; 11: 23259671231172977.

[8] Juncan AM, Moisă DG, Santini A, Morgovan C, Rus LL, Vonica-Țincu AL and Loghin F. Advantages of hyaluronic acid and its combination with other bioactive ingredients in cosmeceuticals. Molecules 2021; 26: 4429.

[9] Webner D, Huang Y and Hummer CD 3rd. Intraarticular hyaluronic acid preparations for knee osteoarthritis: are some better than others? Cartilage 2021; 13: 1619S-1636S.

[10] Zhou PH, Liu SQ and Peng H. The effect of hyaluronic acid on IL-1beta-induced chondrocyte apoptosis in a rat model of osteoarthritis. J Orthop Res 2008; 26: 1643-1648.

[11] Yang X, Liang W, Li J and Liu P. A meta-analysis and systematic review of the therapeutic effects of arthroscopy combined with intra-articular injection of sodium hyaluronate in the treatment of knee osteoarthritis. Ann Palliat Med 2021; 10: 9859-9869.

[12] Bahaziq W, Noaman N, AlHazmi A, Tayeb B and Boker AMA. Formulating interprofessional anesthesiology and operating room clinical management pathway during COVID-19 pandemic using experiential learning theory in a university hospital in Saudi Arabia. Saudi J Anaesth 2023; 17: 195-204.

[13] Tiwari A, Poduval M and Bagaria V. Evaluation of artificial intelligence models for osteoarthritis of the knee using deep learning algorithms for orthopedic radiographs. World J Orthop 2022; 13: 603-614.

[14] Westermann RW, Nepple JJ, Pascual-Garrido C, Larson CM, Zaltz I, Beaulé PE; ANCHOR Study Group; Kim YJ, Millis M, Sucato DJ, Sink EL, Sierra RJ, Podeszwa DA, Sankar WN, Bedi A, Matheney TH, Novais EN, Belzile EL and Clohisy JC. The impact of age on clinical outcomes of acetabular microfracture during FAI surgery. Am J Sports Med 2023; 51: 2559-2566.

[15] Richard MJ, Driban JB and McAlindon TE. Pharmaceutical treatment of osteoarthritis. Osteoarthritis Cartilage 2023; 31: 458-466.

[16] Chavda S, Rabbani SA and Wadhwa T. Role and effectiveness of intra-articular injection of hyaluronic acid in the treatment of knee osteoarthritis: a systematic review. Cureus 2022; 14: e24503.

[17] Sherman SL, Gudeman AS, Kelly JD 4th, Dimeff RJ and Farr J. Mechanisms of action of intra-articular hyaluronic acid injections for knee osteoarthritis: a targeted review of the literature. Am J Sports Med 2025; 53: 2771-2782.

[18] Trofa DP, Hong IS, Lopez CD, Rao AJ, Yu Z, Odum SM, Moorman CT 3rd, Piasecki DP, Fleischli JE and Saltzman BM. Isolated osteochondral autograft versus allograft transplantation for the treatment of symptomatic cartilage lesions of the knee: a systematic review and meta-analysis. Am J Sports Med 2023; 51: 812-824.

[19] Wang H, Sun H, Qu R, Cheng Y, Hao Z, Chen C and Zhou Z. A retrospective study on arthroscopic debridement alone versus combined with microfracture in patients with knee osteoarthritis. Curr Probl Surg 2025; 62: 101669.

[20] Yang Z, Wu Y, Yin K, Xiang J, Liu C, Chen W and Dai Z. The therapeutic value of arthroscopic microfracture technique in combination with platelet-rich plasma injection for knee cartilage injury. Am J Transl Res 2021; 13: 2694-2701.

[21] Gupta R. The role of intra-articular sodium hyaluronate injection in the management of temporomandibular joint disorder: a longitudinal clinical study. Indian J Otolaryngol Head Neck Surg 2025; 77: 1324-1325.

[22] Wu J, Tang Q and Tan X. Sodium hyaluronate and acupotomy bone decompression alleviates inflammatory responses in patients with knee osteoarthritis. Inflammopharmacology 2025; 33: 1997-2005.

[23] An MM, Zou Z, Shen H, Zhang JD, Cao YB and Jiang YY. The addition of tocilizumab to DMARD therapy for rheumatoid arthritis: a meta-analysis of randomized controlled trials. Eur J Clin Pharmacol 2010; 66: 49-59.

[24] Wang Y, Su Q, Tang H, Tian Q, Lin X, Fu M, Zhang R, Luo Z and Zhang K. Microfracture technique combined with mesenchymal stem cells inducer represses miR-708-5p to target special at-rich sequence-binding protein 2 to drive cartilage repair and regeneration in rabbit knee osteoarthritis. Growth Factors 2023; 41: 115-129.

[25] Huang M, Li Y, Liao C, Lai Q, Peng J and Guo N. Microfracture surgery combined with platelet-rich plasma injection in treating osteochondral lesions of talus: a system review and update meta analysis. Foot Ankle Surg 2024; 30: 21-26.

[26] Zeng M, Wu Z, Liang J and Gong A. Efficacy and safety of sodium hyaluronate combined with celecoxib for knee osteoarthritis: a systematic review and meta-analysis. Asian J Surg 2024; 47: 1331-1338.

[27] Sconza C, Romano D, Scaturro D, Mauro GL, Leonardi G, Alito A, Respizzi S, Kon E and Di Matteo B. Safety and efficacy of hybrid cooperative complexes of sodium hyaluronate and sodium chondroitin for the treatment of patients with symptomatic knee osteoarthritis. Rheumatol Ther 2024; 11: 381-395.