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Arthroscopic patellar denervation with microfracture for treating patellofemoral arthritis in cold weather conditions: a retrospective clinical analysis

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Abstract

Objective: To evaluate the clinical efficacy of combining arthroscopic patellar denervation with microfracture in the treatment of patellofemoral arthritis under cold weather conditions. **Methods:** A total of 134 patients with patellofemoral arthritis who underwent treatment between June 2019 and June 2021 were included in this study. Patients were randomly divided into two groups: the control group, which received standard arthroscopic debridement and conventional therapy, and the study group, which underwent additional peripatellar denervation and microfracture procedures. Clinical outcomes, including Tegner scores, hospital for special surgery (HSS) scores, and treatment-related adverse events, were evaluated and compared between the two groups. **Results:** The study group achieved a significantly higher excellent treatment rate (95.52%, 64/67) compared to the control group. Post-treatment Tegner scores (5.48 ± 1.86) and HSS scores (86.37 ± 11.25) were also significantly better in the study group than in the control group. Furthermore, the incidence of adverse reactions was lower in the study group (4.48%, 3/67), with statistically significant differences observed ($P < 0.05$). **Conclusions:** Arthroscopic patellar denervation combined with microfracture markedly improves clinical outcomes, including Tegner and HSS scores, in the treatment of patellofemoral arthritis, particularly under cold weather conditions. The procedure is effective and safe, supporting its broader clinical application.

Keywords

arthroscopy; patella; denervation; microfracture; patellofemoral arthritis; cold weather

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1 Introduction

Patellofemoral arthritis (PFA) is a common condition characterized by pain and dysfunction in the knee joint, primarily affecting the patellofemoral compartment. This condition often results from a combination of mechanical, biological, and inflammatory factors, leading to cartilage degradation and joint pain. The prevalence of PFA is particularly notable among active populations and can significantly impair quality of life, limiting mobility and participation in daily activities[1].

Conventional treatment options for PFA typically begin with conservative measures, including physical therapy, analgesics, and corticosteroid injections. However, for patients who do not respond to these conservative treatments, surgical interventions may be warranted. Arthroscopic techniques have emerged as effective methods for addressing PFA, with procedures such as patellar denervation and microfracture gaining attention for their potential to alleviate pain and promote cartilage regeneration[2-3].

Arthroscopic patellar denervation aims to reduce pain by interrupting nociceptive signals from the patellar tissues, while microfracture is employed to stimulate the repair of damaged cartilage by creating small fractures in the subchondral bone, facilitating the release of marrow-derived stem cells and growth factors. Both procedures can be performed simultaneously, potentially yielding synergistic effects that enhance clinical outcomes[4].

Cold weather conditions can exacerbate symptoms of arthritis,

leading to increased discomfort and functional limitations for affected individuals. The impact of temperature on joint pain is well-documented, with many patients reporting heightened sensitivity and exacerbation of symptoms in colder climates. Given the unique challenges posed by cold weather, it is essential to evaluate the efficacy of surgical interventions designed to treat PFA under these conditions[5-6].

This retrospective clinical analysis aims to assess the outcomes of patients undergoing arthroscopic patellar denervation with microfracture for the treatment of patellofemoral arthritis specifically in cold weather conditions. By examining clinical results, including pain relief, functional improvement, and overall patient satisfaction, this study seeks to provide valuable insights into the efficacy of these surgical techniques in a demographic that may experience exacerbated symptoms due to environmental factors.

2 Materials and methods

2.1 General information

This study was approved by the Institutional Ethics Committee of the Second Affiliated Hospital of Harbin Medical University, China (KY2024-157). All patients provided signed informed consent. A total of 134 patients diagnosed with patellofemoral arthritis and admitted between June 2019 and June 2021 were included in this study. These patients were randomly assigned to two groups: the study group consisted of 28 males and 39 females, aged between 50 and 79 years, with a mean age of 62.3 ± 10.4 years. The duration of illness ranged from 6 months to 7 years, with an average duration of 5.3 ± 1.6 years and the control group including 25 males and 42 females, aged between 52 and 76 years, with an average age of 64.7 ± 8.3 years. The duration of illness ranged from 6 months to 7 years, with an average duration of 5.7 ± 1.9 years. Inclusion Criteria: participants must be diagnosed with patellofemoral pain syndrome or related knee joint conditions. They must meet the surgical indications for arthroscopic patellar denervation and microfracture procedures. Participants should be able to understand the purpose of the study and provide informed consent by signing the consent form. Additionally, they should have undergone surgery within a specific time frame (for example, between June 2019 and June 2021). Exclusion Criteria: participants will be excluded if they have significant comorbidities, such as severe cardiovascular disease, diabetes, or other major health issues that could affect surgical outcomes. A history of prior surgeries on the knee joint (*e.g.*, knee replacement or other arthroscopic procedures) will also result in exclusion. Individuals with a recent history of joint or soft tissue infections will be excluded, as will those currently taking medications that may affect bone healing or postoperative recovery (*e.g.*, long-term use of corticosteroids). Finally, participants with severe mental health issues that impair their understanding or willingness to cooperate will be excluded from the study. There were no statistically significant differences in baseline characteristics between the two groups, indicating comparability ($P > 0.05$).

2.2 Treatment methods

The control group underwent arthroscopic debridement along with conventional treatment, while the study group received additional peripatellar denervation and microfracture procedures. The specific treatment steps were as follows. Conventional treatment: patients were instructed to perform isometric quadriceps exercises tailored to their individual conditions. Starting two days after extubation, knee flexion and extension exercises were gradually introduced based on the patient's recovery progress, with intensity progressively increased until normal knee function was restored. Patients were prescribed oral celecoxib capsules (200 mg once daily) for pain management and received intra-articular injections of 25 mg sodium hyaluronate once a week for four weeks. Arthroscopic debridement: patients underwent the procedure under epidural anesthesia. Following the onset of anesthesia, arthroscopy was performed to remove proliferative synovial tissue and smooth rough, uneven joint surfaces. Microfracture surgery: microfracture cones were used to create small holes in the patellar cartilage defects to stimulate healing through the formation of fibrocartilage. Peripatellar denervation: high-frequency radiofrequency ablation was performed to cauterize the patella and surrounding synovial tissue, reducing pain by disrupting nociceptive nerve signaling.

2.3 Observation indicators

The study recorded and evaluated the following indicators in both groups: (1) Treatment effects: the overall efficacy of the treatment was assessed. (2) Tegner scores: these scores, measuring activity level, were recorded both before and after treatment. (3) Hospital for special surgery (HSS) scores: HSS scores, assessing knee function, were evaluated before and after treatment. (4) Adverse reactions: the incidence of treatment-related adverse events was monitored and documented. A comparative analysis of these indicators was conducted upon completion of the study.

2.4 Statistical methods

Data analysis was performed using SPSS version 28.0 statistical software. Results were expressed as means ± standard deviation (SD) for continuous variables and as percentages for categorical variables. Statistical significance was determined using a threshold of $P < 0.05$, indicating a significant difference.

3 Results

3.1 Comparison of treatment effects between the two groups

The rate of excellent and good treatment outcomes was 95.52% (64/67) in the study group compared to 85.07% (57/67) in the control group. The study group demonstrated a significantly higher rate of excellent and good outcomes compared to the control group (χ^2 = 4.17, P = 0.041) (Table 1).

3.2 Comparison of Tegner score and HSS score before and after treatment

Before treatment, there was no significant difference in Tegner scores between the study group and the control group (t = 1.22, P = 0.224). After treatment, the Tegner score in the study group was significantly higher than that in the control group (t = 2.55, P = 0.012). Before treatment, the HSS scores of the study group and control group were not significantly different (t = 1.52, P = 0.131). After treatment, the HSS score in the study group was significantly higher than that in the control group (t = 3.31, P = 0.001) (Table 2).

3.3 Comparison of adverse reactions between the two groups

The adverse reaction rate in the study group was 4.48% (3/67), significantly lower than the 14.93% (10/67) observed in the control group (t = 4.17, P = 0.041) (Table 3).

4 Discussion

Cartilage, an avascular tissue, has limited capacity for regeneration, which increases the likelihood of damage as individuals age. As cartilage wears down, it can significantly impact daily activities and overall quality of life. The patellofemoral joint, an essential part of the knee, is frequently affected, and patellofemoral arthritis is a leading cause of knee pain[7-9].

The exact mechanisms by which cold weather exacerbates patellofemoral arthritis remain unclear. It is hypothesized that cold temperatures lead to vasoconstriction, which reduces blood flow to the joint, potentially increasing pain and stiffness. Additionally, changes in atmospheric pressure and humidity may contribute to discomfort for some patients[10].

For patients with mild patellofemoral cartilage degeneration, a combination of medication and physical therapy is often effective. However, in more severe or persistent cases, surgical intervention may be necessary[11]. Arthroscopic debridement, when combined with microfracture, stimulates undifferentiated bone marrow mesenchymal stem cells to migrate to the blood clot. This process promotes cell proliferation and differentiation into chondrocytes, which form new cartilage and improve clinical outcomes[12-14]. Peripatellar denervation, achieved through high-frequency radiofrequency cauterization of the peripheral nerves around the patella, effectively reduces knee pain. This approach has been supported by studies related to knee replacement and arthroscopic surgery[15-16].

In our study, the control group, which received only symptomatic treatment and arthroscopic debridement, showed improvement. However, the study group, which received additional microfracture and peripatellar denervation treatments, experienced significantly better symptom relief and a lower incidence of adverse reactions.

Table 1 Comparison of treatment effects between the two groups

Group	Excellent	Good	Moderate	Poor	Excellent & Good rate
Study group (N = 67)	43 (64.18)	21 (31.34)	2 (2.99)	1 (1.49)	95.52 (64/67)
Control group (N = 67)	34 (50.75)	23 (34.33)	7 (10.45)	3 (4.48)	85.07 (57/67)
χ^2 value					4.17
P value					0.041

Data were presented as N(%).

Table 2 Comparison of Tegner score and HSS score between the two groups before and after treatment (χ ± S, score)

Group	Tegner score	HSS score
Study group (N = 67)		
Before treatment	2.36 ± 0.78	55.81 ± 10.27
After treatment	5.48 ± 1.86	86.37 ± 11.25
t value	12.66	16.42
P value	< 0.001	< 0.001
Control group (N = 67)		
Before treatment	2.19 ± 0.83	58.45 ± 9.86
After treatment	4.75 ± 1.13	79.68 ± 11.25
t value	14.95	11.11
P value	< 0.001	< 0.001
t value (Before treatment) P value	1.22/0.224	1.52/0.131
t value (After treatment) P value	2.55/0.012	3.31/0.001

Data were presented as Mean ± SD.

Table 3 Comparison of the occurrence of adverse reactions between the two groups

Group	Infection	articular hemorrhage	lower extremity venous thrombosis	incidence of adverse reactions
Study group (N = 67)	2 (2.99)	1 (1.49)	0	4.48 (3/67)
Control group (N = 67)	5 (7.46)	3 (4.48)	2 (2.99)	14.93 (10/67)
χ^2 value				4.17
P value				0.041

Data were presented as N (%).

While our study provides promising results, several limitations remain. First, factors such as patients' living habits and body mass index may influence treatment outcomes and should be controlled in future analyses. Second, the study would benefit from extended follow-up data to assess the long-term effects and stability of the treatment.

5 Conclusion

In conclusion, for patients with patellofemoral articular cartilage degeneration, combining arthroscopic microfracture and peripatellar denervation with symptomatic treatment offers significant clinical benefits, including enhanced symptom relief and improved outcomes. The low incidence of adverse reactions and the high safety profile further underscore the clinical value of this combined approach.

Author contributions

Ma X N drafted the manuscript and performed data analysis. Zhang X and Ma X N designed, organized, and conducted the study, serving as guarantors for the manuscript. Ma Y K contributed to the collection of resources and provided assistance in drafting the manuscript. Zhao Y H and Liu K participated in the literature review and critically revised the paper. All authors contributed to the development of the article and approved the final submitted version.

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Ethical approval

This study was approved by the Institutional Ethics Committee of the Second Affiliated Hospital of Harbin Medical University (KY2024-157).

Informed consent

All patients provided signed informed consent.

Conflict of interest

The authors have not identified any potential conflicts of interest.

Data availability statement

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

References

[1] Arias C, Lustig S. Physiopathology of patello-femoral osteoarthritis: current concepts. J ISAKOS, 2024; 9(4): 806-813.
[2] Rogers J T, Nolte J A, Strine B, *et al.* Short-term functional outcomes and complications of custom patellofemoral arthroplasty. Arthroplast Today, 2024; 26: 101335.
[3] Goshima K, Sawaguchi T, Horii T, *et al.* Patellofemoral osteoarthritis progression after open-wedge high tibial osteotomy does not affect the clinical outcomes or survivorship at minimum 7 years' follow-up. Arthroscopy, 2024; 40(1): 93-102.
[4] Janssen J, Selfe J, Gichuru P, *et al.* Hot and cold knees: exploring differences in patella skin temperature in patients with patellofemoral pain. Physiotherapy, 2020; 108: 55-62.
[5] Altaş E U, Günay Uçurum S, Ozer Kaya D. Acute effect of kinesiology taping on muscle strength, tissue temperature, balance, and mobility in female patients with osteoarthritis of the knee. Somatosens Mot Res, 2021; 38(1): 48-53.
[6] Timmermans E J, Schaap L A, Herbolsheimer F, *et al.* The influence of weather conditions on joint pain in older people with osteoarthritis: results from the european project on OSteoArthritis. J Rheumatol, 2015; 42(10): 1885-1892.
[7] Duong V, Oo W M, Ding C, *et al.* Evaluation and treatment of knee pain: a review. JAMA, 2023; 330(16): 1568-1580.
[8] Singh D, Lawton D, Weldon R H, *et al.* Severe patellofemoral arthritis does not compromise 6-month post-operative range of motion or function following unicondylar knee arthroplasty. Arch Orthop Trauma Surg, 2023; 143(11): 6791-6797.
[9] Blazey P, Scott A, Ardern C L, *et al*. Consensus methods in patellofemoral pain: how rigorous are they? A scoping review. Br J Sports Med, 2024; 58(13): 733-744.
[10] Janssen J, Selfe J, Gichuru P, *et al.* Hot and cold knees: exploring differences in patella skin temperature in patients with patellofemoral pain. Physiotherapy, 2020; 108: 55-62.
[11] Yao W P, Li Y J, Liu Z, *et al.* The effect of arthroscopic surgery on patellofemoral arthriti. Journal of Clinical Orthopedics, 2021; 24(3): 427-429.
[12] Akhtar M, Wen J, Razick D, *et al.* Outcomes of arthroscopic joint

preservation techniques for chondral lesions in the hip: an updated systematic review. Arthroscopy, 2024; 40(5): 1670-1686.
[13] Cotter E J, Sachs J P, Cole B J. Autologous minced repair of knee cartilage is safely and effectively performed using arthroscopic techniques. Arthroscopy, 2024; 20: S0749-8063(24)00460-2.
[14] Ganokroj P, Adriani M, Whalen R J, *et al*. Treatment of shoulder cartilage defects in athletes. Sports Med Arthrosc Rev, 2024; 32(2): 87-94.
[15] Zhou Y, Wang J, Zhu M Y, *et al*. Application of denervation in the treatment of anterior knee pain of patellofemoral arthritis. Chinese Journal of Endoscopy, 2017; 23(10): 53-57.
[16] Ma S S. Denervation for the treatment of intractable knee joint pain after knee replacement. Chinese Tissue Engineering Research, 2016; 20(31): 4589-4595.