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Evaluation of Platelet-Rich Plasma Combined with Minimally Invasive Arthroscopic Surgery for the Treatment of Degenerative Knee Joints

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Abstract: *Objective:* To evaluate the effect of platelet-rich plasma and arthroscopic minimally invasive surgery treatment in patients with degenerative knee joint lesions. *Methods:* From July 2015 to July 2022, 80 patients with degenerative knee joint lesions were selected and randomly divided into two groups. Group A received platelet-rich plasma and minimally invasive arthroscopic surgery treatment while group B received only minimally invasive arthroscopic surgery treatment. The treatment efficacy, visual analog scores (VAS), knee osteoarthritis severity index (ISOA), knee function scores (KSS), and Lysholm knee scores were compared. *Results:* The treatment efficacy in group A was higher than that in group B ($P < 0.05$); at 3 and 6 months after surgery, the VAS and ISOA scores of group A were lower than those of group B ($P < 0.05$), while the KSS and Lysholm scores of group A were higher than those of group B ($P < 0.05$); the treatment satisfaction in group A was higher than that in group B ($P < 0.05$). *Conclusion:* Patients with knee joint degeneration receiving platelet-rich plasma and minimally invasive arthroscopic surgery treatment can restore knee joint function and reduce local pain, which is efficient and feasible for clinical application.

Keywords: Knee joint degeneration; Minimally invasive arthroscopic surgery; Platelet-rich plasma; Efficacy

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1. Introduction

The risk of knee joint degeneration is higher in the senior population, and arthroscopic examination is performed to observe synovial membrane hyperplasia in the knee joint. There are common problems in knee joint degeneration such as fiber bundle adhesion, osteophytes, and cartilage surface exfoliation. Blind selection of hormonal drug treatment can lead to the aggravation of degenerative lesions [1]. At present, the clinical treatment of this disease is mostly minimally invasive arthroscopy, which has the characteristics of small incision, less secondary damage to the knee joint cavity, and low intraoperative bleeding. This approach can shorten the recovery time of postoperative knee function. However, it is still an invasive operation with a high risk of postoperative complications, thus some scholars suggest the addition of platelet-rich plasma treatment to restore the physiological function of the knee joint [2]. In this paper, 80 patients with degenerative knee joints

admitted from July 2015 to July 2022 were taken as samples to explore the efficacy of platelet-rich plasma and minimally invasive arthroscopic surgery.

2. General information and methods

2.1. General information

From July 2015 to July 2022, 80 patients with degenerative knee joint lesions were selected and randomly divided into two groups. The information of patients in group A is comparable to group B, $P > 0.05$ (**Table 1**).

Table 1. Analysis of patient data

Group	n	Gender		Age (years)		Disease duration (years)	
		Male	Female	Interval	Average value	Interval	Average value
Group A	40	27 (67.50)	13 (32.50)	60–84	63.25 ± 1.14	1–9	39.81 ± 1.25
Group B	40	28 (70.00)	12 (30.00)	61–85	63.27 ± 1.12	1–10	39.82 ± 1.27
χ^2/t	-	0.1623		0.0270			
P	-	0.6870		0.9785			

Inclusion criteria included no history of knee joint pathology or operation history; platelet count >150 × 10^9/L; informed consent; hemoglobin count > 100g/L.

Exclusion criteria were knee deformity; injection of sodium citrate and glucocorticoids before enrollment; immunosuppressants use before enrollment.

2.2. Treatment method

Group A was treated with platelet-rich plasma:

(1) The preparation tool used in this paper was platelet-rich plasma (PRP) preparation set (Weihai Lian Sheng Medical Instrument Co., Ltd.), and the preparation process was as follows. 45 ml of venous blood was obtained and placed into the preparation set, and then 5 ml of anticoagulant sodium citrate solution was added for anticoagulation. After completion, another cannula was removed to complete the leveling operation. The centrifugation process was set at 2500 rpm/min for 15 minutes. After centrifugation, the red blood cell layer was removed, retaining white blood cells and platelet layers. After the second leveling process, centrifugation was performed at 3200 rpm/min for 12 minutes. The platelet-poor plasma in the upper layer was removed and then the remaining platelet-rich layer was prepared for use.

(2) Injection: The patients with degenerative knee joints were instructed to maintain the sitting position, with the knee joint partially receding. The knee joint was punctured and 5 ml of platelet-rich plasma was injected, followed by local anesthesia under the C-arm, and then injected in the joint cavity, the stopping point of the tendon of the goosefoot, and the medial-lateral femoral muscle near the patella and other areas, with 1.5 ml injection at each point. After injection, the patients were instructed to avoid weight-bearing for 24 hours.

Group B received minimally invasive arthroscopic surgery treatment. Patients with degenerative knee joint disease were given epidural anesthesia to carry out arthroscopic surgery to clean up the damaged meniscus, free bodies, inflammatory tissues, and synovial tissues, and simultaneously polish the local defective cartilage. Patellar support release surgery was carried out for patients with limited patellar movement; while expanding intercondylar notchplasty was carried out for patients with narrow intercondylar notch. After the operation, the patients were encouraged to carry out exercise early.

2.3. Observation index

(1) Treatment efficacy: Normal knee joint structure, restored physiological function, and no remaining complications were recorded as highly effective; improved knee joint structure and physiological function, and occurrence of slight complications after the operation were recorded as effective; severe knee joint pain and abnormal physiological function were recorded as ineffective [3].

(2) Visual analog scores (VAS) and knee osteoarthritis severity index (ISOA) scores: VAS (0–10 points) and ISOA (0–14 points) scores were positively correlated with the degree of knee joint pain and the severity of knee joint conditions.

(3) Knee function scores (KSS) and Lysholm knee scores: KSS (0–100 points) and Lysholm (0–100 points) scores were positively correlated with knee function.

(4) Treatment satisfaction: Treatment satisfaction was assessed by a self-constructed knee degenerative disease scale.

2.4. Statistical analysis

The data of those with degenerative knee joints were processed by SPSS21.0, % was recorded (χ^2 test) for the count data and mean ± standard deviation (SD) was recorded (*t* test) for the measure data. There was statistical differences if $P < 0.05$.

3. Results

3.1. Comparison of treatment efficacy in those with degenerative knee joint lesions

The treatment efficacy of those with degenerative knee joint lesions in group A (97.50%) was higher than that in group B (82.50%), $P < 0.05$. The results are shown in **Table 2**.

Table 2. Comparison of the efficacy of those with degenerative knee joint lesions (n, %)

Group	Highly effective	Effective	Ineffective	Total effective rate
Group A (n = 40)	34 (85.00)	5 (12.50)	1 (2.50)	97.50
Group B (n = 40)	23 (57.50)	10 (25.00)	7 (17.50)	82.50
χ^2	-	-	-	5.0000
P	-	-	-	0.0253

3.2. VAS and ISOA scores

At 3 and 6 months after surgery, VAS and ISOA scores were lower in group A than in group B, $P < 0.05$, as shown in **Table 3**.

Table 3. Comparison of VAS and ISOA scores in those with degenerative knee joints (points, mean ± SD)

Group	VAS score				ISOA score			
	Pre-operative	1 month after surgery	3 months after surgery	6 months after surgery	Pre-operative	1 month after surgery	3 months after surgery	6 months after surgery
Group A (n = 40)	6.58 ± 0.74	4.81 ± 0.65	2.17 ± 0.42	2.52 ± 0.51	12.18 ± 1.25	10.29 ± 1.02	8.05 ± 0.73	7.48 ± 0.51
Group B (n = 40)	6.59 ± 0.76	4.02 ± 0.62	3.08 ± 0.51	3.31 ± 0.57	12.19 ± 1.27	9.04 ± 0.83	8.49 ± 0.79	8.21 ± 0.64
t	0.0596	5.5622	8.7112	6.5325	0.0355	6.0118	2.5871	5.6417
P	0.9526	0.0000	0.0000	0.0000	0.9718	0.0000	0.0115	0.0000

3.3. KSS and Lysholm scores

At 3 and 6 months after surgery, the KSS and Lysholm scores of group A were higher than those of group B, $P < 0.05$, as presented in **Table 4**.

Table 4. Comparison of KSS and Lysholm scores in those with degenerative knee joints (points, mean ± SD)

Group	KSS score				Lysholm score			
	Pre-operative	1 month after surgery	3 months after surgery	6 months after surgery	Pre-operative	1 month after surgery	3 months after surgery	6 months after surgery
Group A (n = 40)	40.18 ± 2.11	50.69 ± 2.44	71.85 ± 2.82	88.42 ± 3.52	52.81 ± 3.85	53.51 ± 3.91	73.58 ± 4.15	85.36 ± 4.48
Group B (n = 40)	40.19 ± 2.13	58.43 ± 2.59	65.25 ± 2.73	69.87 ± 3.15	52.79 ± 3.83	58.16 ± 4.03	67.18 ± 4.11	79.64 ± 4.32
t	0.0211	13.7570	10.6350	24.8368	0.0233	5.2375	6.9301	5.8128
P	0.9832	0.0000	0.0000	0.0000	0.9815	0.0000	0.0000	0.0000

3.4. Treatment satisfaction of patients with degenerative knee joints

The treatment satisfaction of those with degenerative knee joint lesions in group A (97.50%) was higher than that in group B (85.00%), $P < 0.05$. The results are displayed in **Table 5**.

Table 5. Comparison of treatment satisfaction of patients with degenerative knee joint lesions (n, %)

Group	Very satisfied	Satisfied	Unsatisfied	Satisfaction rate
Group A (n = 40)	31 (77.50)	8 (20.00)	1 (2.50)	97.50
Group B (n = 40)	24 (60.00)	10 (25.00)	6 (15.00)	85.00
χ^2	-	-	-	3.9139
P	-	-	-	0.0479

4. Discussion

Knee degenerative joint disease, also known as osteoarthropathy, is related to continuous wear and tear of the joints and can be aggravated in wet and cold environments [4]. Patients with knee degenerative joint disease may suffer from pain, stiffness, swelling, weakness, impaired mobility, etc. If it is not diagnosed and treated as soon as possible, it may aggravate meniscus damage, increase knee pain, and even lead to knee deformation and restriction of joint activities [5]. At present, the clinical treatment of degenerative knee joints mostly involves arthroscopic surgery. Under arthroscopic guidance, free bodies and synovium are cleaned up and menisci are trimmed, thus optimizing the environment of the knee joint cavity and reducing inflammatory factors in the joint cavity, which is conducive to the reduction of swelling and pain and facilitates knee joint activities [6]. However, minimally invasive arthroscopic surgical treatment can reduce joint secretion, nutrients, and lubricants in the joint cavity, resulting in swelling and pain in the knee joint that is difficult to relieve. Coupled with the impact of postoperative trauma exudation, it can result in an increase in the degree of edema in the joint cavity, which affects the patient's prognosis [7]. In this paper, in addition to minimally invasive arthroscopic surgery, platelet-rich plasma therapy is carried out, which contains rich growth factors and promotes local tissue repair of the knee joint. Furthermore, intra-articular injection of platelet-rich plasma can stimulate cartilage differentiation and promote cartilage metabolism, which in turn can shorten the regeneration time of knee joint tissues. In recent years, some scholars have found that healthy cartilage and subchondral bone are intercommunicating, so the "intraosseous infiltration" treatment program is gradually used in the treatment of degenerative joint disease. During the treatment period, platelet-rich plasma is injected into the cancellous bone of the knee joint

by puncture method, and under the infiltration of the bone, it can enter into the deeper cartilage of the joint and restore the function of the cartilage of the knee joint [8].

Based on the results, the treatment efficacy of 97.50% in group A was higher than that of 82.50% in group B, with $P < 0.05$. It suggests that the addition of platelet-rich plasma has a better therapeutic effect. During the treatment of minimally invasive arthroscopic surgery, the local cartilage and ligament of the knee joint were freshly processed, and then platelet-rich plasma was injected, which could maximize the role of growth factors within the plasma. This was conducive to the repair and regeneration of the local tissues of the knee joint, and therefore the efficacy was higher than that without platelet-rich plasma [9]. Additionally, at 3 and 6 months after surgery, the VAS and ISOA scores of group A were lower than those of group B, with $P < 0.05$; at 3 and 6 months after surgery, the KSS and Lysholm scores of group A were higher than those of group B, with $P < 0.05$. It is suggested that platelet-rich plasma treatment can reduce knee joint pain and restore knee joint function. This may be due to that minimally invasive arthroscopic surgery is an invasive operation, in which oozing and swelling problems can easily occur after the operation. The long recovery cycle of the knee joint cartilage can be improved through promotion of the recovery of joint function by the injection of platelet-rich plasma [10]. However, it should be noted that there are inflammatory factors in platelet-rich plasma, thus the pain is aggravated in the early stage of injection and the recovery index is slightly worse, while the pain gradually decreases in 3 months and 6 months after the operation. Furthermore, the treatment satisfaction of patients with degenerative knee joints in group A (97.50%) was higher than that of group B (85.00%), with $P < 0.05$. This suggests that platelet-rich plasma treatment has a higher level of patient satisfaction. The reason for this is that as an invasive operation, the 5 mm-diameter arthroscope used in arthroscopic surgery can cause ligament and nerve damage. Therefore, platelet-rich plasma treatment can promote cartilage repair, hence the satisfaction of patients receiving this treatment is higher. However, it should be noted that the cartilage repair cycle is long and minimally invasive arthroscopic surgery can only delay joint degeneration, so it is necessary to increase the number of samples of knee degenerative joint lesions, extend the follow-up period, and deeply explore the effect of platelet-rich plasma treatment after minimally invasive arthroscopic surgery.

5. Conclusion

In conclusion, platelet-rich plasma therapy after minimally invasive arthroscopic surgery in patients with degenerative knee joints can reduce knee pain, restore knee function, and promote the regression of knee joint lesions. Therefore, it can be widely used in clinical practice.

Disclosure statement

The authors declare no conflict of interest.

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