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Research Article

Efficacy Evaluation of the Combined Platelet-Rich Plasma and Hyaluronic Acid after Arthroscopic Joint Debridement in Treating Knee Osteoarthritis

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Objective. The study is aimed at observing the efficacy of the combined platelet-rich plasma and hyaluronic acid after arthroscopic joint debridement in treating knee osteoarthritis (KOA). *Methods*. 126 patients with KOA admitted to the Affiliated People's Hospital of Ningbo University and Taizhou Orthopaedic Hospital from 2018-11 to 2021-11 were selected. All nominees were grouped by random drawing; group B (63 cases) received arthroscopic joint debridement while group A (63 cases) received platelet-rich plasma and hyaluronic acid based on group B. The following metrics are counted, including total efficiency, knee joint pain and function, inflammatory cytokines levels, and oxidative stress indicator levels; the complication rate is counted. *Results*. The total effective rate of group A (93.65%) was higher than that of group B (77.78%) ($P < 0.05$), and there was no significant difference in the incidence of complications between the groups ($P > 0.05$). Three months after treatment, knee joint pain and function, inflammatory cytokine levels, and oxidative stress indicators levels in group A were better than in group B ($P < 0.05$). *Conclusion*. The combined platelet-rich plasma and hyaluronic acid after arthroscopic joint debridement in treating KOA can achieve significant effects, reduce knee pain, accelerate the recovery of knee joint function, relieve inflammation, and inhibit oxidative stress and has high safety.

1. Introduction

Knee osteoarthritis (KOA) is common in orthopedics, with an incidence of approximately 20% in people over 45 years of age [1]. At present, the use of step-by-step, individualized treatment and surgery is an indispensable means for the treatment of middle and advanced KOA. Arthroscopic joint debridement is one of the commonly used surgical methods; cleaning up the diseased tissue in the joint cavity can achieve the purpose of relieving clinical symptoms [2]. Besides, drug injection is also a definitive therapy. For example, commonly used drugs are hyaluronic acid and platelet-rich plasma. The former plays a role in lubricating joints through its unique physicochemical properties and molecular structure. At the same time, the latter contains many growth factors, which can stimulate cell proliferation, induce vascular formation, and promote tissue healing [3, 4]. However, there is a lack of research on the effect of arthroscopic joint debridement combined with platelet-rich plasma and hyaluronic acid in treating KOA in China. Herein, this current study focuses on this topic to provide a clinical reference. The report is as follows.

2. Material and Methods

2.1. General Information. 126 patients with KOA admitted to the Affiliated People's Hospital of Ningbo University and Taizhou Orthopaedic Hospital from 2018-11 to 2021-11 were selected; all nominees were grouped by random drawing. Group B consisted of 63 cases, with a male-to-

female ratio of 21 : 42; aged 43-70 years (average age, 55.46 ± 6.03 years); disease duration 0.5-11.0 years (average disease duration, 5.45 ± 2.37 years); and side: 30 left and 33 right. Group A consisted of 63 cases, with a male-to-female ratio of 24 : 39; aged 45-68 years (average age, 57.39 ± 5.21 years); disease duration of 0.5-12.5 years (average disease duration, 6.09 ± 2.68 years); and side: 26 left and 37 right. The general data of the two groups were comparable ($P > 0.05$).

2.2. Selection Criteria

(1) The following are the inclusion criteria: the study conforming to KOA diagnostic guidelines [5]; Kellgren-Lawrence grades which are III to IV; conservative treatment which is ineffective for 3 to 6 months, with indications for arthroscopic joint debridement; and unilateral disease

(2) The following are the exclusion criteria: combined with other joint diseases, such as rheumatoid arthritis and rheumatoid arthritis; skin damage in the injection area; combined with knee joint trauma; accompanied by the abnormal liver and kidney function, infectious diseases, coagulation dysfunction, severe cardiovascular and cerebrovascular diseases, malignant tumors, diseases of the immune system, and diseases of the nervous system; previous knee surgery; received medication within the past one month; poor compliance; and lack of clinical data

2.3. Methods

(1) Group B received arthroscopic joint debridement, spinal anesthesia, supine position, routine disinfection, and drape, and an incision was made on the anterolateral and anteromedial aspects of the knee joint, and the arthroscope was placed through the anterolateral approach; observe the suprapatellar capsule, intermuscular groove, and patellar articular surface in sequence; assist the patient in bending the knee to 90°; observe the cruciate ligament, articular cartilage, and meniscus; place the planer from the anteromedial approach; then, inflammatory synovium, proliferative tissue, osteophyte and necrotic cartilage were cleaned with a planer under the microscope. The edge of the meniscus and the cartilage defect area were trimmed, the debris in the joint cavity was sucked, the incision was closed, and finally, pressure bandaging was performed

(2) Group A received platelet-rich plasma and hyaluronic acid based on group B. Platelet-rich plasma needs to be prepared first. The instrument uses a sterile centrifuge and a platelet-rich plasma preparation kit produced by Shandong Weigao Medical Equipment Co. Ltd. 30 min before arthroscopic joint debridement; collect and centrifuge 40 mL of the patient's cubital venous blood (1500 r/min, 19 cm, 10 min); remove the lower 1/5 red blood cell layer and continue centrifugation (centrifugation conditions are the same as above); add calcium chloride (2 mL) to the remaining 1/4 liquid, and mix well to obtain 4 mL of platelet-rich plasma. Before closing the incision under arthroscopic joint debridement, platelet-rich plasma was injected into the joint cavity from the anterolateral entrance, and 2 mL of hyaluronic acid was injected at 10 min intervals (Chinese Medicine Zhunzi: H10960136); close the incision, and apply a pressure dressing. Clean once during the operation, 2 weeks, 4 weeks and 6 weeks after the operation, a total of 4 times

2.4. Observation Indicators

(1) Efficacy: it is assessed by the improvement rate of the Western Ontario and McMaster university osteoarthritis index (WOMAC) score (improvement rate = (pretreatment score − treatment posttreatment score) /pretreatment score × 100%). Improvement rates of ≥75%, 30% to 74%, and ≤29% represent markedly effective, practical, and ineffective [6]. The sum of practical efficiency and apparent efficiency is the total effective efficiency

(2) Knee joint pain and function: visual analog scales (VAS) and WOMAC score were used to evaluate the knee joint pain and function in group A and group B. The total score on the VAS scale is 0-10, with 0 representing no pain and 10 representing severe pain. WOMAC includes 24 items and percentage system; the lower the score, the better the function of the knee joint [7, 8]. The evaluation was performed once before treatment and three months after treatment

(3) Levels of inflammatory cytokines and oxidative stress indicators: before treatment and three months after treatment, 5 mL of joint cavity fluid was collected from the affected side of the patient. The supernatant was centrifuged to determine inflammatory cytokines by ELISA (interleukin-6 (IL-6), tumor necrosis factor-α (TNF-α), and interleukin-1β (IL-1β) levels and malondialdehyde (MDA), superoxide dismutase (SOD), and other oxidative stress index levels)

(4) Complication rate: pay attention to thromboembolism, wound infection and lower limb swelling

2.5. Statistical Methods. The data were analyzed by SPSS 22.0, and the test level was $\alpha = 0.05$.

3. Results

3.1. Curative Effect. The curative effect of group A was better than that of group B ($P < 0.05$), as shown in Table 1.

3.2. Knee Joint Pain and Function. Three months after treatment, the VAS and WOMAC score of group A were lower than that of group B ($P < 0.05$), as shown in Table 2.

Table 1: Curative effects (n (%)).

Group	Number of cases	Effective	Efficient	Invalid	Total efficiency
Group A	63	24 (38.10)	35 (55.56)	4 (6.35)	59 (93.65)
Group B	63	17 (26.98)	32 (50.79)	14 (22.22)	49 (77.78)
χ^2					6.481
P					0.011

Table 2: Knee joint pain and function ($\bar{x} \pm s$, points).

Group	Number of cases	VAS score		WOMAC score	
		Before treatment	Three months after treatment	Before treatment	Three months after treatment
Group A	63	6.69 ± 0.90	2.35 ± 0.22	57.28 ± 8.33	35.14 ± 5.62
Group B	63	6.45 ± 0.83	3.21 ± 0.38	55.57 ± 7.64	41.68 ± 6.47
t		1.556	15.546	1.201	3.205
P		0.122	<0.001	0.232	0.002

Table 3: Levels of inflammatory cytokines ($\bar{x} \pm s$).

Group	Number of cases	IL-6 (ng/L)		TNF-α (μg/L)		IL-1β (ng/L)	
		Before treatment	Three months after treatment	Before treatment	Three months after treatment	Before treatment	Three months after treatment
Group A	63	105.34 ± 10.27	75.90 ± 7.46	9.71 ± 2.56	4.22 ± 1.29	2.78 ± 0.33	1.32 ± 0.16
Group B	63	102.82 ± 9.44	88.59 ± 8.23	9.13 ± 2.08	6.34 ± 1.67	2.69 ± 0.30	1.88 ± 0.24
t		1.434	9.068	1.396	7.974	1.602	15.410
P		0.154	<0.001	0.165	<0.001	0.112	<0.001

Table 4: Levels of oxidative stress indicators ($\bar{x} \pm s$).

Group	Number of cases	MDA (μmol/L)		SOD (U/mL)	
		Before treatment	Three months after treatment	Before treatment	Three months after treatment
Group A	63	14.15 ± 1.79	5.88 ± 1.02	88.65 ± 6.69	120.32 ± 8.73
Group B	63	13.72 ± 1.53	9.34 ± 1.27	86.58 ± 6.17	104.41 ± 7.24
t		1.449	16.860	1.805	11.923
P		0.150	<0.001	0.073	<0.001

Table 5: Complication rate (n (%)).

Group	Number of cases	Thromboembolism	Wound infection	Lower extremity swelling	Total incidence
Group A	63	0 (0.00)	2 (3.17)	2 (3.17)	4 (6.35)
Group B	63	1 (1.59)	2 (3.17)	3 (4.76)	6 (9.52)
χ^2					0.434
P					0.510

3.3. Levels of Inflammatory Cytokines. Three months after treatment, the levels of IL-6, TNF-α, and IL-1β in group A were lower than those of group B ($P < 0.05$), as shown in Table 3.

3.4. Levels of Oxidative Stress Indicators. Three months after treatment, the levels of MDA and SOD in group A were better than those in group B ($P < 0.05$), as shown in Table 4.

3.5. Complication Rate. There was no significant difference in the incidence of complications between the two groups ($P > 0.05$), as shown in Table 5.

4. Conclusion

With the acceleration of the aging process in China, KOA has gradually become a common disease. However, its pathogenesis has not been fully elucidated. It is believed by the most scholars that KOA are involved in mechanical stress, oxidative stress, and chronic inflammation [9, 10]. Arthroscopic joint debridement is an effective procedure for the treatment of KOA. For instance, arthroscopic joint debridement can remove loose bodies and osteophytes, reduce cartilage wear, and joint pain and optimize joint function. Besides, it can clean up inflammatory and proliferative tissue and inhibit its erosion of other parts. Cleaning the joint cavity can prevent inflammatory cytokines from entering the blood affecting other joints. However, the effect of single arthroscopic joint debridement is limited. Hence, it is usually used in combination with other drugs.

Hyaluronic acid is a high molecular weight polysaccharide that exists widely in various tissues in the body. Hyaluronic acid can combine with glycoproteins to form aggregates, improve the stability of collagen fiber scaffolds and synovial cells, and improve the viscoelasticity of tissue matrix and synovial fluid when injected into the knee joint cavity. At the same time, hyaluronic acid can reduce mechanical friction and wear, provide nutrition for articular cartilage, repair damaged cartilage, and relieve joint pain. After the platelet-rich plasma is injected into the joint cavity, a large number of growth factors are released, which can accelerate the proliferation of chondrocytes and the synthesis of cartilage matrix and stimulate the activation of vascular endothelial cells, facilitate the formation of new capillaries and increase the blood supply of damaged tissues, thereby repairing damaged cartilage. It is obtained by centrifugation of autologous blood, which can avoid immune rejection with high safety. The literature has reported that platelet-rich plasma is rich in platelets; activated platelets can release a variety of antimicrobial peptides, which play a role of bacteriostatic and bactericidal [11, 12]. It can be seen from this study that the combined treatment method has a significant effect and can improve the symptoms and function of knee joint pain in KOA patients. The reason may be that the combination of the above two drugs can stimulate the proliferation of chondrocytes and rebuild the defective cartilage based on surgical treatment of internal lesions of the knee joint. The drug is injected once every two weeks, which has a sustained effect; it can relieve pain and dysfunction significantly.

TNF-α, IL-6, and IL-1β, as inflammatory cytokines, are involved in the inflammatory response during the KOA occurrence [13]. TNF-α and IL-1β can stimulate the production of chondrocytes and synovial cells as well as secrete prostaglandins and collagenase. Furthermore, it causes the degradation and destruction of articular cartilage. IL-6 is an amplifying factor for the biological effects of TNF-α and IL-1β and can also reflect the severity of the body's inflammatory response [14, 15]. Relevant studies have confirmed that the concentration of IL-1β in the joint cavity positively correlates with the severity of KOA [16]. Some scholars have pointed out that high levels of TNF-α in the joint cavity can promote the activation of polymorphonuclear cells, increase the secretion of prostaglandin E_2, cause the aggregation of inflammatory cells, increase vascular permeability, and increase local edema [17]. In this study, combining surgery and drugs can reduce the inflammatory response. The reason is that, on the one hand, hyaluronic acid can inhibit matrix metalloproteinases and interleukins and resist the invasion of inflammatory cytokines. On the other hand, platelet-rich plasma enters the lesion, and anti-inflammatory factors are released, which can inhibit the excessive activation of nuclear factor κB; it can stimulate the production of many inflammatory cytokines and trigger an inflammatory response.

Oxidative stress plays a massive role in the pathogenesis of KOA. In healthy people, oxygen-free radicals are generated and eliminated in a balanced state. In contrast, in KOA patients, excessive oxygen free radicals hinder the proliferation of chondrocytes and promote the degradation of the cartilage matrix, resulting in cartilage damage [18]. Under the action of disproportionation, SOD can scavenge oxygen free radicals and prevent cell lysis and apoptosis, and its level is proportional to the body's antioxidant capacity. MDA is one of the membrane lipid peroxidation products, which will aggravate membrane damage and reflect the degree of tissue peroxidative damage [19, 20]. This study confirms that combining surgery and drugs can reduce oxidative stress in KOA patients. The reason may be related to the activation of the Keap1/Nrf2/HO1 signaling pathway by platelet-rich plasma to increase the expression of SOD. The elevated SOD level can effectively scavenge excess oxygen free radicals and reduce oxidative stress. In addition, the safety of the treatment regimen in this study was confirmed.

To sum up, arthroscopic joint debridement combined with platelet-rich plasma and hyaluronic acid in treating KOA achieves significant effects; can reduce knee pain, accelerate the recovery of knee joint function, relieve inflammation, and inhibit oxidative stress; and has high safety. Hence, it is worthy of promotion and application.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

Min Lu and Yanquan Jin contributed equally to this work and should be considered the co-first authors.

References

[1] S. C. Liu, X. F. Qiao, Q. X. Tang et al., "Therapeutic efficacy of extracorporeal shock wave combined with hyaluronic acid on knee osteoarthritis," *Medicine (Baltimore)*, vol. 98, no. 8, article e14589, 2019.

[2] Q. Lu, L. Linlin, Z. Zuzhong et al., "The efficacy of arthroscopic debridement combined with platelet-rich plasma injection in treating knee osteoarthritis [J]," *Laboratory Medicine and Clinic*, vol. 18, no. 13, pp. 1915–1918, 2021.

[3] H. Xie, B. Wang, F. Weimin, L. Zhangn, and D. Pan, "Effect evaluation of platelet-rich plasma combined with sodium hyaluronate in the treatment of knee osteoarthritis during arthroscopy [J]," *Chinese Journal of Clinicians*, vol. 48, no. 3, pp. 325–328, 2020.

[4] C. Ma, "Observe the efficacy of intra-articular injection of platelet-rich plasma and hyaluronic acid in treating knee osteoarthritis [J]," *Shanxi Medicine Journal*, vol. 47, no. 17, pp. 2083–2085, 2018.

[5] Joint Surgery Group of Orthopaedic Branch of Chinese Medical Association, "Guidelines for diagnosis and treatment of osteoarthritis (2018 edition) [J]," *Chinese Journal of Orthopedics*, vol. 38, no. 12, pp. 705–715, 2018.

[6] L. Shuo, L. Xiao, C. Lin, S. Chen, D. Li, and F. Chen, "A retrospective study on the efficacy of ultrasound-guided intraarticular injection of platelet-rich plasma in the treatment of knee osteoarthritis [J]," *West China Medicine*, vol. 35, no. 5, pp. 568–573, 2020.

[7] J. Yichang, C. Xiangyu, B. Wang, S. Qiang, D. Shen, and L. Li, "Effect of fumigation and washing with modified Haitongpi decoction on VAS score in patients with knee osteoarthritis [J]," *Chinese Medicine Journal*, vol. 48, no. 8, pp. 43–47, 2020.

[8] Z. Zhu, B. Qiaolian, and B. Dong, "Effects of diclofenac sodium combined with acupuncture on WOMAC score, quality of life, and levels of inflammatory factors in elderly patients with knee osteoarthritis [J]," *Journal of Clinical Pathology*, vol. 41, no. 7, pp. 1604–1609, 2021.

[9] H. Guang, L. Jianfeng, Z. Jun, Q. Huang, Z. Miao, and L. Wang, "Clinical efficacy of ozone water in treating knee osteoarthritis and its effect on synovial fluid cytokines [J]," *Chinese Journal of Pain Medicine*, vol. 26, no. 2, pp. 150–152, 2020.

[10] Z. Hongmei, R. Wang, J. Ming, W. Rui, and D. Wang, "A multicenter, randomized controlled study on the efficacy and safety of Qizheng Xiaotong paste in treating knee osteoarthritis [J]," *Tianjin Traditional Chinese Medicine*, vol. 36, no. 3, pp. 234–237, 2019.

[11] S. Yuan, Z. Qishi, L. Yue, P. Yue, D. Guo, and Q. Yu, "Application of autologous platelet-rich plasma combined with bone grafting to repair bone defects with induced membrane technology [J]," *China Orthopaedic Surgery*, vol. 32, no. 4, pp. 302–307, 2019.

[12] H. Kaihua, Z. Wu, Z. Ziliang, Z. Xue, Z. Wang, and M. Yao, "Efficacy evaluation of hyaluronic acid, platelet-rich plasma and their combined application on knee osteoarthritis [J]," *Chinese Journal of Osteoporosis*, vol. 25, no. 12, pp. 1707–1711, 2019.

[13] J. He, Y. Chunlu, A. Fangyu, C. Wang, and H. Jin, "Research progress on the regulation mechanism of inflammatory factors and inflammatory factor-related signaling pathways in knee osteoarthritis [J]," *Chinese Journal of Clinical Pharmacology*, vol. 35, no. 12, pp. 1308–1311, 2019.

[14] G. Wei, "Effect of arthroscopic debridement combined with platelet-rich plasma in treating moderate to severe knee osteoarthritis [J]," *Journal of Hebei Medical University*, vol. 43, no. 4, pp. 402–406, 2022, 411.

[15] S. Ping, S. Yujuan, X. Wang, S. Jia, and O. Chen, "Observation on the therapeutic effect of "Shuanggu Yitong" warm acupuncture on knee osteoarthritis and its effect on the expression of serum inflammatory factors [J]," *Shandong Journal of Traditional Chinese Medicine*, vol. 39, no. 4, pp. 378–381, 2020.

[16] L. Yu, T. Fang, W. Ma, Y. Ma, J. Lin, and H. Lv, "Clinical efficacy of Jishe Qushi capsule in treating knee osteoarthritis and its effect on the expression of inflammatory factors in serum [J]," *Guangdong Medicine*, vol. 40, no. 2, pp. 234–237, 2019.

[17] Z. Wenjin, S. Zhihua, L. Yongji, O. Ji, Y. Jia, and X. Dou, "Effects of Danshen injection on the synovial fluid and inflammatory serum cytokine levels in knee osteoarthritis [J]," *Western Traditional Chinese Medicine*, vol. 32, no. 2, pp. 21–24, 2019.

[18] C. Yu, R. Wang, L. Jingxuan, H. Kong, S. Fu, and Z. Hu, "Effects of moxibustion on inflammatory and oxidative stress factors in patients with knee osteoarthritis: a randomized controlled study [J]," *China Acupuncture*, vol. 40, no. 9, pp. 913–917, 2020.

[19] T. Yuanping, S. Baozhen, Z. Quanyang, X. Jia, Q. Li, and S. Jin, "Curative effect of Chuanlonggushi tablet combined with celecoxib in treating knee osteoarthritis and its effect on oxidative stress [J]," *Modern Medicine and Clinical*, vol. 36, no. 8, pp. 1674–1677, 2021.

[20] C. Xuhan, B. Zixing, S. Chengyi, Q. Liu, Z. Mu, and Y. He, "Effects of external compound Nanxing Zhitong ointment on joint function and oxidative stress indicators in patients with knee osteoarthritis [J]," *Universal Chinese Medicine*, vol. 13, no. 11, pp. 1898–1901, 2020.