

Psychosocial Impact of Knee Joint Pain and Experimental Analysis of Platelet-Rich Plasma (PRP) Treatment

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Abstract. Knee joint pain is one of the primary causes of mobility impairments and reduced quality of life globally. With the aging of the population and the increase in sports-related injuries, the incidence of knee joint pain has risen significantly. Common types of knee joint pain are classified as either pathological or physiological, encompassing conditions such as osteoarthritis, synovitis, meniscus injuries, cartilage wear, and ligament tears. These chronic and progressive pains exert negative consequences and impacts on patients' personal psychology, social activities, family burdens, and socio-economic status. In recent years, Platelet-Rich Plasma (PRP) therapy, an innovative biological treatment, has demonstrated remarkable effectiveness in treating numerous knee conditions. PRP is a biological agent prepared by extracting and concentrating platelets from the patient's own blood. It's rich in growth factors and cytokines such as PDGF, VEGF, EGF, SDF1- α , etc., and has the potential to promote tissue repair and regeneration. This study not only focuses on the physiological improvements achieved through PRP therapy but also delves into its positive effects on patients' psychological state and the synergistic role of psychological interventions in this process. Psychological interventions, including psychological education and cognitive-behavioral therapy, can enhance patients' treatment compliance, reduce pain perception, facilitate the rehabilitation process, and improve psychological well-being. The combination of PRP therapy and psychological interventions provides a more comprehensive and effective treatment regimen for patients with knee joint pain, potentially enhancing their quality of life and alleviating socio-economic burdens.

Keywords: knee joint pain, PRP therapy, psychological intervention.

1. Introduction

As of July 2024, according to publicly available statistical data on the Internet, as well as relevant studies and reports, the following trends and estimates can be summarized regarding the number of people suffering from knee joint diseases in China:

The number of people suffering from knee joint diseases in China is substantial, especially those with osteoarthritis (OA). According to the *White Paper on the Prevention and Treatment of Osteoarthritis in China* and related research, among the population aged 40 and above in China, the prevalence rate of osteoarthritis is approximately 10% to 15%, among which knee osteoarthritis accounts for the highest proportion. Based on the population base, it is estimated that among the population aged 40 and above in China, the number of patients with knee osteoarthritis may exceed 100 million. Among the population aged 60 and above, the prevalence rate of knee osteoarthritis is even higher, approximately 50%, and the prevalence rate among females is higher than that among males.

Due to the aging of the population, the rising obesity rate, and the increase in sports injuries, the incidence rate of knee joint diseases has been rising year by year. The number of newly diagnosed patients with knee osteoarthritis is expected to be between 5 million and 10 million each year, and the specific figures vary depending on differences in regions, ages, and lifestyles. Among them, knee joint diseases caused by sports injuries (such as meniscus injuries and ligament injuries) have also significantly increased among the younger population, with the number of new cases potentially reaching nearly one million each year^[1].

2. Psychosocial impacts brought about by knee osteoarthritis pain

Knee joint pain can cause individuals to encounter various difficulties in daily life. For example, basic activities such as walking, dressing, and taking a shower become more arduous to complete. The decline in the ability to perform these daily activities directly affects an individual's quality of life. In addition, patients experiencing pain may feel frustrated and isolated due to physical limitations, which also has a negative impact on their mental health^[2].

Many patients with pain reported in the survey that knee pain also disrupts their sleep quality, leading to insufficient sleep or a decline in sleep quality. Prolonged lack of sleep not only affects an individual's mental state but may also trigger a series of health problems.

In order to relieve pain and treat related diseases, patients may need to bear expensive medical costs, including medications, physical therapy, surgeries, and so on. Moreover, due to the decrease in productivity caused by the pain, patients may face the problem of reduced income, further exacerbating their economic burden.

Long-term or chronic pain, such as knee joint pain, has been proven to be closely related to mental health problems, such as depression and anxiety disorders. Some studies have shown that people with chronic pain are more likely to develop these mental illnesses, and those with these mental illnesses are also more prone to chronic pain. This two-way relationship indicates that pain and mental conditions may exacerbate each other, forming a vicious cycle.

Psychological stress is also one of the important factors affecting knee joint pain. Long-term psychological pressure may lead to muscle tension and poor blood circulation, thereby exacerbating joint pain. After experiencing major life events or continuous work pressure, individuals are more likely to develop symptoms of knee joint pain.

Psychosocial factors such as emotional disorders like depression and anxiety are closely related to the severity of knee joint pain. These emotional disorders may lead to an enhanced perception of pain in individuals, causing them to feel intense pain even under mild pain stimuli.

Social support is an important psychosocial factor influencing the perception of knee joint pain. Research shows that knee joint pain patients with a good social support system can better cope with the psychological stress brought about by pain and improve their life quality. Social support includes support from family members, friends, colleagues, and the community. Such support can help patients build a positive mindset and enhance their confidence in dealing with pain. In contrast, patients lacking social support are more likely to develop psychological problems such as depression and anxiety, which in turn affect the management of pain and the rehabilitation process. Therefore, establishing and improving the social support system is of great significance for improving the mental health of knee joint pain patients.

The family is an important source of social support for patients. The understanding, care, and companionship of family members play an important role in relieving the pain and psychological stress of patients. Family members can help patients better cope with pain by providing emotional support, daily care, and material assistance.^[3]

3. Significance and value of the research

In the ladder treatment of diseases related to knee joint pain, Platelet-Rich Plasma (PRP) mainly serves as a transitional option between conservative treatment and surgical intervention. It is suitable for patients who do not respond to conventional conservative treatment but have not yet met the surgical indications. PRP is rich in growth factors and cytokines, which can promote cartilage repair, reduce inflammation, and improve the intra-articular environment. Regarding its therapeutic effects, PRP is superior to hyaluronic acid in relieving pain and improving joint function. However, the efficacy varies from person to person, generally lasting for 6 to 12 months. For young patients with high levels of physical activity, PRP may delay the progression of the disease and postpone the time of surgery.^[4]

4. Experimental materials and research methods

We first conducted an experiment to prepare PRP. The experimental materials were obtained from our own venous blood. We needed to draw 20 milliliters (the amount required for each knee), and finally, 3 to 3.5 milliliters of PRP were extracted. If preparing PRP for personal use, it is necessary to use one's own venous blood to avoid reactions such as rejection. After drawing the blood, a pipette gun was used to transfer the blood into the tubes for centrifugation. Ten milliliters of blood were put into each of the two tubes, and the two tubes must be placed symmetrically in the centrifuge.

First Experiment: The blood was centrifuged at 400g for ten minutes, but the result was not satisfactory. So, it had to be centrifuged again at 420g for 15 minutes, barely separating the serum from the red blood cells. Then, the serum was drawn out, and care was taken not to suck up the red blood cells. Then the serum was centrifuged again at 2000g for 15 minutes. After that, 1 milliliter was left in each of the two tubes, and the PRP at the bottom of the tubes (in a solid gel-like state) was mixed with the serum using a pipette gun. The red blood cell content measured for the first time was 0.02. In the subsequent second experiment, the whole blood was only centrifuged once. Finally, the red blood cell content in the PRP was only 0.01. For the above experiments, our group consisting of three people carried out multiple experiments respectively and all obtained similar results.

The results of Western Blot showed that PRP could significantly increase the expression levels of type I and type II collagens in chondrocytes. This indicates that PRP can not only promote cell proliferation but also facilitate the synthesis of collagen, thereby accelerating the repair and regeneration of cartilage tissue.

PRP can significantly promote neovascularization around chondrocytes. This may be due to the effects of growth factors such as Vascular Endothelial Growth Factor (VEGF) in PRP, which promote the formation of new blood vessels, thus enhancing the blood supply to the cartilage tissue and being beneficial to tissue repair and regeneration.

A systematic evaluation of existing literature and clinical studies indicates that the treatment with PRP demonstrates significant efficacy in the management of knee joint diseases. Whether for osteoarthritis, meniscus injury or ligament tear, PRP shows good therapeutic effects, which can effectively relieve pain, improve function and promote tissue repair. Compared with traditional treatment methods, the PRP therapy indeed has the advantages of minimal invasiveness, a short recovery period and few side effects. Due to the limited internship time, we did not conduct further human clinical practice and follow-up evaluation.

Table 1. Case Investigation of Shenzhen Sibao Integrated Traditional Chinese and Western Medicine Clinic

Patient's name	Age	Occupation	Duration of illness	Condition	Treatment history
Mr. Yuan	54	Business owner	2 years	Cartilage wear	Hyaluronic acid injection
Miss Xiao	27	PE teacher	1 year	Meniscus injury	None
Ms. Lai	59	Housewife	3 years	Degenerative lesion	None
Ms. Huang	61	Housewife	1 year	Degenerative lesion	None
Ms. Zhang	72	Retired	5 years	Osteoarthritis, Degenerative lesion	Post-operation

5. Impact of PRP treatment on patient' psychological state and the synergistic effect of psychological intervention

In the process of exploring the treatment of knee joint pain with PRP, while the improvement of patients' physiological functions is undoubtedly important, the potential changes in patients' psychological state and the synergistic effect of psychological interventions should not be overlooked.

5.1. Positive impact of PRP treatment on patients' psychological state

As an effective non-surgical treatment method, PRP therapy can significantly relieve knee joint pain and improve joint function. This positive change at the physiological level often has a profound positive impact on the psychological state of patients. Specifically:

5.1.1. Self-confidence and optimistic emotions

The reduction in pain and improvement in mobility enable patients to have a more positive evaluation of their physical condition and the treatment effect. As a result, their self-confidence and optimistic emotions are enhanced, which helps to break the vicious cycle between pain and psychological problems.

5.2. Alleviation of fear and anxiety

Due to the minimally invasive nature and fewer side effects of PRP treatment, compared with traditional surgery, patients do not need to endure surgical trauma and a long recovery period. This relatively stress-free treatment experience allows patients to feel more psychologically relaxed.

5.3. Reduction of economic burden and psychological pressure

PRP treatment can quickly improve symptoms, enabling patients to return to their normal life and work earlier, and reducing the economic burden and psychological pressure caused by pain.

5.4. Synergistic effect of psychological intervention and PRP therapy

Although PRP therapy has a remarkable effect in relieving knee joint pain, relying solely on physiological treatment methods may not be sufficient to comprehensively address the accompanying psychological problems of patients. Combining psychological intervention with PRP therapy is expected to achieve more superior therapeutic effects. Psychological intervention can work synergistically with PRP therapy in the following aspects:

5.4.1. Enhancing treatment compliance

Through psychological education and cognitive-behavioral therapy, psychological intervention helps patients establish correct treatment concepts and expectations. This process enables patients to have a deeper understanding of the mechanism of action and expected outcomes of PRP therapy, thereby enhancing their trust and compliance with the treatment. Medical staff explain in detail to patients the principles, advantages, and possible treatment cycles and frequencies of PRP therapy, so that patients have a clear understanding of the treatment process. This effectively reduces the resistance caused by the uncertainty and fear of treatment, ensuring that the treatment proceeds smoothly and achieves the best results.

5.4.2. Reducing pain perception

Psychological intervention methods, such as relaxation training and cognitive-behavioral therapy, can help patients better cope with pain and discomfort during the PRP therapy process. By regulating the patients' psychological state, their sensitivity to pain is reduced, thereby enhancing the analgesic effect of PRP treatment. For example, during PRP injection, patients may experience certain pain or discomfort, and relaxation training and positive self-suggestion can help relieve tension, reduce pain perception, and improve the tolerance to treatment.

5.4.3. Promoting the rehabilitation process

Psychological intervention plays an important role in promoting the rehabilitation process. It helps patients establish a positive mindset and good rehabilitation behavior habits. Through psychological education and behavior modification, patients are encouraged to actively participate in rehabilitation exercises after PRP therapy and adjust their lifestyle according to the doctor's advice, such as controlling their weight and avoiding excessive exercise. These positive rehabilitation behaviors not only accelerate the repair and regeneration of damaged tissues but also further enhance the therapeutic effect of PRP therapy, promoting the overall rehabilitation of patients.

5.4.4. Improving psychological state

Psychological intervention directly targets the treatment of patients' psychological problems, such as alleviating emotional disorders like depression and anxiety and improving sleep quality. The improvement of these psychological problems not only reduces the patients' suffering but also creates a more favorable psychological environment for PRP therapy, enabling the physiological therapeutic effect to be exerted more fully. For example, through cognitive-behavioral therapy, the negative cognition of patients towards pain can be corrected and depressive emotions can be relieved. As a result, patients may participate more actively in the treatment process and better cooperate with the guidance of medical staff, thus enhancing the treatment effect. It can be seen that the synergistic effect of psychological intervention and PRP treatment provides a more comprehensive and effective treatment plan for patients with knee joint pain.

6. Conclusion

The experimental results indicate that Platelet-Rich Plasma (PRP) has demonstrated remarkable therapeutic effects on knee joint diseases during subsequent clinical observations. A systematic evaluation of existing literature and clinical studies has further confirmed the effectiveness and safety of the PRP therapy. When treating knee joint diseases such as osteoarthritis, meniscus injury, and ligament tear, PRP has shown excellent therapeutic effects. It significantly reduces the pain score and improves the patients' mobility and life quality. Compared with traditional drug treatment and surgical intervention, the minimally invasive and highly efficient nature of the PRP therapy avoids surgical trauma and complications, reduces the risk of allergic and rejection reactions, and enhances the precision and effectiveness of the treatment.

The potential value of psychology in the management of knee joint pain and its future research directions have become important topics in current clinical research. The predictive role of psychological factors in the therapeutic effect of PRP urgently needs in-depth study. The psychological state of patients, such as the levels of anxiety and depression and their expectations of treatment, has been proven to significantly affect their response to PRP therapy. Patients with a high level of anxiety are often more sensitive to pain, which in turn reduces their satisfaction with the treatment effect. It is particularly crucial to use psychological assessment tools to evaluate the baseline psychological state of patients, providing important references for clinicians so that they can formulate more targeted treatment plans. At the same time, the application of psychological intervention in different types of knee joint diseases should also be a key focus of future research. For young patients with meniscus injuries caused by sports injuries, psychological intervention can focus on alleviating their anxiety about the recovery of their athletic ability. For elderly patients suffering from pain caused by osteoarthritis, psychological intervention needs to pay more attention to the improvement of their quality of life and their adaptability to chronic pain.

The long-term effects of psychological intervention are also one of the key directions for future research. Most current studies focus on the evaluation of the effects of short-term psychological intervention, and the impact of long-term psychological intervention on patients' rehabilitation processes and life quality remains unclear. Long-term psychological intervention may further enhance the long-term therapeutic effects of PRP therapy by improving patients' psychological

resilience, enhancing their sense of social support, and optimizing their coping strategies. For example, continuous psychological support and cognitive-behavioral therapy can help patients better cope with the rehabilitation challenges after treatment and reduce the risk of pain recurrence.

Incorporating psychological assessment and intervention into the routine treatment process for knee joint pain can not only improve patients' pain perception and psychological state but also significantly enhance the treatment effect and life quality. Future research should further explore the interaction mechanism between psychological factors and physiological treatments, providing more comprehensive theoretical support and practical guidance for clinical practice. Through multidisciplinary collaboration and the combination of psychological intervention with physiological treatment methods such as PRP, it is expected to bring more precise and effective treatment plans for patients with knee joint pain, thereby improving their overall prognosis and bringing benefits to a large number of patients.

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