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ORIGINAL RESEARCH

Effect of leukocyte-rich PRP on interstitial or partial tear of rotator cuff of shoulder

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ABSTRACT

Background: Rotator cuff tears are a common musculoskeletal injury, and platelet-rich plasma (PRP) therapy has emerged as a potential treatment. This study evaluates the efficacy of leukocyte-rich PRP in treating interstitial or partial rotator cuff tears. **Methods:** A prospective study was conducted on 100 patients with diagnosed interstitial or partial rotator cuff tears. Patients were divided into two groups: one receiving leukocyte-rich PRP injections and the other receiving saline injections as a control. Outcome measures included pain scores, functional assessment using the Constant-Murley score, and MRI evaluations at baseline, 3 months, and 6 months post-treatment. **Results:** Significant improvements in pain and function were observed in the PRP group compared to the control group at both 3 and 6 months. MRI findings also showed better healing responses in the PRP group. **Conclusion:** Leukocyte-rich PRP is an effective treatment for interstitial or partial rotator cuff tears, providing significant improvements in pain relief, function, and tissue healing.

Keywords: Leukocyte-rich PRP, Rotator cuff tear, Interstitial tear, Shoulder injury, Platelet-rich plasma therapy

INTRODUCTION

Rotator cuff injuries are prevalent, particularly among athletes and the elderly, leading to substantial morbidity and functional impairment. The rotator cuff is comprised of four muscles and their tendons, which stabilize the shoulder joint and enable a range of motions. Tears can occur due to acute trauma or chronic degenerative changes, often resulting in significant pain and dysfunction [1]. Interstitial and partial tears of the rotator cuff are particularly challenging to treat due to their insidious onset and complex nature.

Traditional management options for rotator cuff tears include physical therapy, corticosteroid injections, and surgical repair. However, these treatments often have limited efficacy and can be associated with significant complications. Recently, biologic therapies such as platelet-rich plasma (PRP) have gained attention for their potential to enhance tissue healing and reduce inflammation [2].

PRP is an autologous blood product that is centrifuged to concentrate platelets, which release growth factors and cytokines that promote tissue repair. Leukocyte-rich PRP, which contains a higher concentration of white blood cells, has been hypothesized to further enhance the healing process by augmenting the immune response and reducing microbial contamination [3]. Despite the theoretical benefits, clinical evidence regarding the efficacy of leukocyte-rich PRP in treating rotator cuff tears is still emerging.

This study aims to evaluate the clinical and radiological outcomes of leukocyte-rich PRP injections in patients with interstitial or partial rotator cuff tears. By comparing PRP treatment to a control group receiving saline injections, this research seeks to provide robust evidence on the effectiveness of PRP therapy in this patient population.

The pathophysiology of rotator cuff tears involves a complex interplay of mechanical, biological, and environmental factors. Mechanical overload, especially in repetitive overhead activities, can lead to microtrauma and subsequent degeneration of the tendon [4]. This degeneration is often exacerbated by a reduced vascular supply, particularly in the critical zone of the supraspinatus tendon, making the healing process arduous. In addition to mechanical factors, biological processes such as inflammation and

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apoptosis play crucial roles in the progression of tendon pathology [5].

Conventional treatments primarily focus on alleviating symptoms rather than addressing the underlying pathology. Physical therapy aims to strengthen the surrounding musculature and improve joint mechanics but does not directly promote tendon healing [6]. Corticosteroid injections provide short-term pain relief by reducing inflammation but may impair tendon repair and increase the risk of tendon rupture with repeated use [7]. Surgical interventions, while effective in restoring tendon integrity, are associated with risks such as infection, stiffness, and a prolonged recovery period [8].

Biologic therapies, including PRP, offer a novel approach by harnessing the body's intrinsic healing mechanisms. The rationale for using PRP in musculoskeletal injuries stems from its high concentration of growth factors, such as platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), and vascular endothelial growth factor (VEGF), which have been shown to enhance cell proliferation, matrix synthesis, and angiogenesis [9]. Leukocyte-rich PRP, in particular, contains leukocytes that contribute to the anti-inflammatory and antimicrobial properties, potentially leading to better clinical outcomes [10].

Previous studies on PRP therapy for rotator cuff tears have yielded mixed results, with variations in PRP preparation methods, injection protocols, and outcome measures contributing to the heterogeneity [11]. Some studies have reported significant improvements in pain and function, while others have shown no benefit compared to placebo [12]. The presence of leukocytes in PRP preparations is also a subject of debate, with some researchers suggesting that leukocytes may exacerbate inflammation and others arguing that they enhance the therapeutic effects [13].

In this study, we hypothesize that leukocyte-rich PRP will provide superior clinical outcomes compared to saline injections in patients with interstitial or partial rotator cuff tears. We aim to assess the efficacy of this treatment modality by evaluating changes in pain levels, functional scores, and MRI findings over a six-month period. The results of this study could have significant implications for the management of rotator cuff tears and contribute to the growing body of evidence supporting the use of biologic therapies in orthopedics.

The primary objective of this study is to determine whether leukocyte-rich PRP injections result in greater improvements in pain and shoulder function compared to saline injections in patients with interstitial or partial rotator cuff tears. Secondary objectives include evaluating the effect of PRP on tendon healing as evidenced by MRI and assessing the safety profile of PRP therapy.

MATERIALS AND METHODS

This prospective, randomized controlled trial was conducted at a single center. A total of 100 patients with clinically and radiologically confirmed interstitial or partial rotator cuff tears were enrolled between January 2022 and December 2022. The inclusion criteria were adults aged 18-65 years, presence of an interstitial or partial tear of the rotator cuff confirmed by MRI, and persistent shoulder pain for more than three months despite conservative treatment. Exclusion criteria included complete rotator cuff tears, previous shoulder surgery, systemic inflammatory conditions, and contraindications to PRP therapy.

Patients were randomly assigned to receive either leukocyte-rich PRP injections (PRP group) or saline injections (control group). Randomization was performed using a computer-generated sequence, and allocation was concealed using sealed envelopes.

PRP was prepared using a standardized protocol. Peripheral blood (20 mL) was drawn from each patient and centrifuged at 1500 rpm for 10 minutes to separate the plasma. The plasma layer was collected and centrifuged again at 2000 rpm for 10 minutes to concentrate the platelets and leukocytes. The final PRP product (3 mL) contained a high concentration of platelets and leukocytes.

Injections were performed under ultrasound guidance. Patients in the PRP group received a single injection of leukocyte-rich PRP into the site of the tear, while patients in the control group received a saline injection. All patients were advised to avoid strenuous shoulder activities for two weeks post-injection and followed a standardized physical therapy protocol.

Outcome measures included pain assessment using the Visual Analog Scale (VAS), functional evaluation using the Constant-Murley score, and MRI assessment of tendon healing. Assessments were conducted at baseline, 3 months, and 6 months post-injection.

Statistical analysis was performed using SPSS software (version 25.0). Continuous variables were expressed as mean ± standard deviation and compared using the independent t-test. Categorical variables were expressed as frequencies and compared using the chi-square test. A p-value of <0.05 was considered statistically significant.

Ethical approval was obtained from the institutional review board, and informed consent was obtained from all participants prior to enrollment.

RESULTS

A total of 100 patients were enrolled and randomized, with 50 patients in each group. Baseline characteristics, including age, sex, and baseline pain and functional scores, were similar between the two groups (Table 1).

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Table 1: Baseline Characteristics of Patients

Characteristic	PRP Group (n=50)	Control Group (n=50)
Age (years)	45.3 ± 10.2	46.1 ± 9.8
Male/Female ratio	28/22	30/20
Baseline VAS score	7.2 ± 1.1	7.3 ± 1.0
Baseline Constant-Murley score	52.3 ± 7.8	51.7 ± 8.0

At 3 months, the PRP group showed significant improvements in VAS and Constant-Murley scores compared to the control group (Table 2). The mean VAS score in the PRP group decreased from 7.2 to 3.5, while the control group showed a reduction from 7.3 to 5.6 ($p<0.001$). The Constant-Murley score improved from 52.3 to 72.8 in the PRP group, compared to an improvement from 51.7 to 62.5 in the control group ($p<0.001$).

Table 2: Outcomes at 3 Months

Outcome	PRP Group (n=50)	Control Group (n=50)	p-value
VAS score	3.5 ± 1.2	5.6 ± 1.4	<0.001
Constant-Murley score	72.8 ± 10.5	62.5 ± 11.2	<0.001

At 6 months, the PRP group continued to show superior outcomes (Table 3). The mean VAS score further decreased to 2.1 in the PRP group, while the control group had a mean score of 4.8 ($p<0.001$). The Constant-Murley score in the PRP group improved to 82.1, compared to 68.7 in the control group ($p<0.001$). MRI evaluations revealed better tendon healing in the PRP group, with 80% showing partial or complete healing compared to 55% in the control group ($p<0.01$).

Table 3: Outcomes at 6 Months

Outcome	PRP Group (n=50)	Control Group (n=50)	p-value
VAS score	2.1 ± 0.9	4.8 ± 1.3	<0.001
Constant-Murley score	82.1 ± 9.8	68.7 ± 10.5	<0.001
MRI healing rate	80%	55%	<0.01

No significant adverse events were reported in either group, indicating that leukocyte-rich PRP is a safe and effective treatment for interstitial or partial rotator cuff tears.

DISCUSSION

The findings of this study demonstrate that leukocyte-rich PRP significantly improves pain, function, and tendon healing in patients with interstitial or partial rotator cuff tears compared to saline injections. These results are consistent with previous studies that have highlighted the potential benefits of PRP therapy in musculoskeletal injuries [14].

The mechanism by which PRP exerts its therapeutic effects involves the release of growth factors and cytokines that promote cell proliferation, matrix synthesis, and angiogenesis. Leukocyte-rich PRP, in particular, may offer additional benefits by enhancing the immune response and providing antimicrobial properties [15]. This study supports the hypothesis that leukocyte-rich PRP can enhance tendon healing and improve clinical outcomes in rotator cuff injuries.

Comparative literature has reported mixed results regarding the efficacy of PRP in rotator cuff tears. A systematic review by Hurley et al. [16] found that PRP injections were associated with significant improvements in pain and function compared to placebo. Similarly, a meta-analysis by Cai et al. [17] concluded that PRP significantly improved functional outcomes and reduced re-tear rates after rotator cuff repair surgery.

However, not all studies have reported positive results. A randomized controlled trial by Weber et al. [18] found no significant difference in outcomes between PRP and saline injections in patients undergoing arthroscopic rotator cuff repair. The discrepancies in findings may be attributed to variations in PRP preparation methods, injection protocols, and patient populations.

The inclusion of leukocytes in PRP preparations remains a topic of debate. Some researchers argue that leukocytes may exacerbate inflammation and impair healing, while others suggest that they enhance the therapeutic effects by augmenting the immune response [19]. Our study indicates that leukocyte-rich PRP is effective in promoting tendon healing and improving clinical outcomes, suggesting that the benefits of leukocytes may outweigh the potential drawbacks.

The use of MRI to assess tendon healing is a strength of this study, providing objective evidence of tissue repair. Previous studies have primarily relied on subjective measures of pain and function, which may be influenced by placebo effects [20]. The MRI findings in our study correlate well with the clinical improvements, supporting the efficacy of leukocyte-rich PRP in promoting tendon healing.

The safety profile of leukocyte-rich PRP observed in this study is also noteworthy. No significant adverse events were reported, indicating that PRP is a safe treatment option for rotator cuff tears. This is

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consistent with previous studies that have reported low complication rates associated with PRP therapy [21].

Despite the promising results, this study has some limitations. The sample size is relatively small, and the follow-up period is limited to six months. Long-term studies with larger sample sizes are needed to confirm the durability of the observed benefits. Additionally, the study did not evaluate the cost-effectiveness of PRP therapy, which is an important consideration for clinical practice.

Future research should focus on optimizing PRP preparation methods and injection protocols to maximize clinical benefits. Standardizing these procedures will facilitate comparisons across studies and enhance the generalizability of findings. Furthermore, exploring the underlying mechanisms of PRP action at the molecular level could provide insights into how PRP promotes tissue repair and guide the development of more targeted therapies [22].

CONCLUSION

This study demonstrates that leukocyte-rich PRP is an effective and safe treatment for interstitial or partial rotator cuff tears. Patients treated with PRP experienced significant improvements in pain relief, shoulder function, and tendon healing compared to those receiving saline injections. The results support the use of leukocyte-rich PRP as a promising therapeutic option for enhancing the repair of rotator cuff injuries. These findings contribute to the growing body of literature supporting the use of biologic therapies in orthopedics and suggest that leukocyte-rich PRP may be a valuable addition to the treatment options for rotator cuff tears. Further research with larger sample sizes and longer follow-up periods is needed to confirm these findings and establish standardized protocols for PRP therapy. The positive outcomes observed in this study underscore the potential of biologic therapies in orthopedic practice, offering a valuable alternative to traditional treatment modalities for rotator cuff tears.

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