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Comparison in Efficacy Of Ultrasound Guided Injections of Dextrose Prolotherapy and Platelet Rich Plasma (PRP) In Rotator Cuff Tendinopathy Based on Clinical Functional and Radiological Assessment

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ABSTRACT

Background: Rotator cuff tendinopathy is a leading cause of shoulder pain, often involving subacromial bursitis, tendinitis, or impingement syndromes. Conventional management frequently fails, prompting interest in alternative therapies like prolotherapy and platelet-rich plasma (PRP) injections. This study aimed to compare the effectiveness of ultrasound-guided dextrose prolotherapy and PRP injections in patients with rotator cuff tendinopathy.

Methods: In a double-blind randomized controlled trial conducted over 18 months at the Department of Anaesthesia, Pain and Critical Care Medicine, S. N. Medical College, Agra, 60 patients aged 40–50 years with ultrasound-confirmed rotator cuff tendinopathy unresponsive to conservative therapy were enrolled. Patients were randomized into two groups: Group 1 received 10 ml of 25% dextrose with lidocaine; Group 2 received 5 ml of PRP. Injections were administered twice, two weeks apart. Pain and function were evaluated using the Visual Analog Scale (VAS) and the Western Ontario Rotator Cuff (WORC) index. Secondary outcomes included range of motion (ROM) and musculoskeletal ultrasound findings.

Results: Baseline characteristics were comparable between groups. Prolotherapy (Group 1) showed significantly greater improvement in WORC scores ($p < 0.001$), VAS scores, and shoulder ROM ($p = 0.003$) than PRP (Group 2). Ultrasound imaging post-treatment showed better tendon healing and fewer cases of persistent tendinopathy or bursitis in the prolotherapy group ($p < 0.001$). Both groups had similar outcomes in resolving bicipital tenosynovitis.

Conclusion: Ultrasound-guided dextrose prolotherapy demonstrated superior efficacy over PRP in managing rotator cuff tendinopathy, offering broader functional and structural improvements.

Keywords*: Shoulder pain; Rotator cuff tendinopathy; Prolotherapy; Platelet rich plasma; Ultrasound-guided injections; Musculoskeletal disorders; Treatment outcomes.*

INTRODUCTION

Shoulder discomfort is a common musculoskeletal complaint, ranking third after neck and lower back pain (1). It significantly impacts daily activities, work, and recreation, with up to 67% of individuals experiencing shoulder pain during their lifetime. Prevalence rates vary widely, ranging from 6.7% to 66.7%, depending on age and population;

however, there is limited data regarding its prevalence in the Indian population. Several risk factors, such as age, gender, diabetes, and alcohol use, have been associated with shoulder pain. It is more frequently observed in adults and tends to increase with age (2,3). Rotator cuff tendinopathy is a leading cause of shoulder pain, often resulting in discomfort and weakness during external rotation and arm elevation (4). This condition includes subacromial bursitis, rotator cuff tendinitis/tendinosis, and shoulder impingement syndrome, leading to substantial socioeconomic burdens such as work absenteeism and high treatment costs (5).

Although conservative therapies remain the first-line treatment, evidence suggests passive interventions like shockwave and laser therapy, and various injections often have limited efficacy. While exercise therapy has demonstrated some benefits, approximately 40% of patients do not respond adequately and may develop chronic symptoms (6). Emerging treatments such as prolotherapy and platelet-rich plasma (PRP) injections have shown promise. Prolotherapy, which uses hypertonic dextrose, promotes fibroblast proliferation and collagen synthesis (9,10). PRP, containing growth factors like FGF2, VEGF, and TGF-β, supports tenocyte proliferation and tendon regeneration while reducing oxidative stress (7,8).

This study aims to compare the efficacy of ultrasound-guided dextrose prolotherapy and PRP in treating rotator cuff tendinopathy, with objectives focused on clinical, functional, and radiological outcomes using VAS, WORC index, range of motion, and ultrasound findings.

MATERIAL AND METHODS

Following approval from the Institutional Ethics Committee (SNMC/IEC/2024/310), a double-blind, randomized controlled trial was conducted at the Department of Anaesthesia, Pain, and Critical Care Medicine, Sarojini Naidu Medical College, Agra. The study spanned 18 months, from December 2022 to May 2024, and included 60 patients diagnosed with rotator cuff tendinopathy. Eligible participants were classified as American Society of Anesthesiologists (ASA) physical status I or II, with a mean age range of 40 to 50 years. All patients had a confirmed diagnosis of rotator cuff tendinopathy using musculoskeletal ultrasound (MSUS), experienced symptoms persisting for more than three months, and had not responded to at least four weeks of formal medical and physical therapy.

Exclusion criteria included a history of shoulder surgery, presence of full-thickness rotator cuff tears, recent corticosteroid injections in the affected shoulder within the previous six months, use of anticoagulants, prior platelet-rich plasma (PRP) treatment, bleeding disorders, preoperative platelet counts below 50,000/µL, diabetes mellitus, rheumatic or hematological diseases, and the presence of metastatic or tumor-related conditions. Patients meeting these exclusion criteria were not enrolled in the trial.

Upon enrollment, all patients underwent a comprehensive history-taking process focusing on the mechanism of injury, patterns of overuse, spontaneous symptom onset, and any resulting activity limitations. Clinical examination included measurement of both active and passive range of motion (ROM) of the shoulder, including flexion, extension, abduction, and internal and external rotation using a standard goniometer. Routine laboratory investigations, including blood sugar levels, were also performed. Provocative orthopedic tests—Neer's test, Hawkins' test, and the drop arm test—were used to support clinical diagnosis. Pain levels were assessed using the Visual Analog Scale (VAS), a 10-point scale ranging from 0 (no pain) to 10 (worst imaginable pain). Disease-specific quality of life was evaluated using the Western Ontario Rotator Cuff (WORC) Index, which comprises 21 items across five domains: physical symptoms, sports/recreation, work, lifestyle, and emotions. Each item was rated using a 100-mm visual analog scale, with a total score ranging from 0 (best possible function) to 2100 (worst possible outcome).

Radiological evaluation included plain X-rays of the shoulder to rule out bone abnormalities. Diagnostic musculoskeletal ultrasound (MSUS) was performed using a high-frequency linear transducer probe (3–12 MHz) to identify structural abnormalities such as bursitis, tendinosis, tendinitis, and tenosynovitis of the rotator cuff. After the intervention phase, follow-up assessments were conducted at three months, including reevaluation of shoulder ROM, pain intensity using the VAS, disease-specific quality of life using the WORC Index, and repeat MSUS examination to assess anatomical and functional improvement.

Patients were randomly assigned using the closed-envelope method into two equal groups, each receiving two ultrasound-guided injections at a two-week interval.

Group 1: Thirty patients received 10 ml of 25% dextrose solution (8 ml of 25% dextrose and 2 ml lidocaine).

Group 2: Thirty patients received 5 ml of PRP, which was prepared by drawing 20 ml of venous blood mixed with 2 ml of 10% sodium citrate. The blood sample was centrifuged at 1500 rpm for 15 minutes, resulting in the separation of the plasma, buffy coat, and red blood cell layers. The plasma and buffy coat were collected into a sterile tube and re-centrifuged at 3500 rpm for 10 minutes, producing a platelet plug and platelet-poor plasma. The platelet-poor plasma was discarded, leaving 5 ml of PRP with a platelet concentration 5-7 times higher than that of whole blood.(11)

The drug was injected into subacromial-subdeltoid bursa and needle was visualized as a thin hypoechoic (or anechoic, if fluid is present) line above the supraspinatus tendon by ultrasound. Patients were instructed to restrict shoulder movement for 48 hours after the injection and to take acetaminophen for pain relief if necessary. Follow-up evaluations took place after three months, assessing shoulder range of motion (ROM), pain using the VAS, the WORC index, and diagnostic musculoskeletal ultrasound (MSUS).
This consort diagram is shown in figure 1**:**

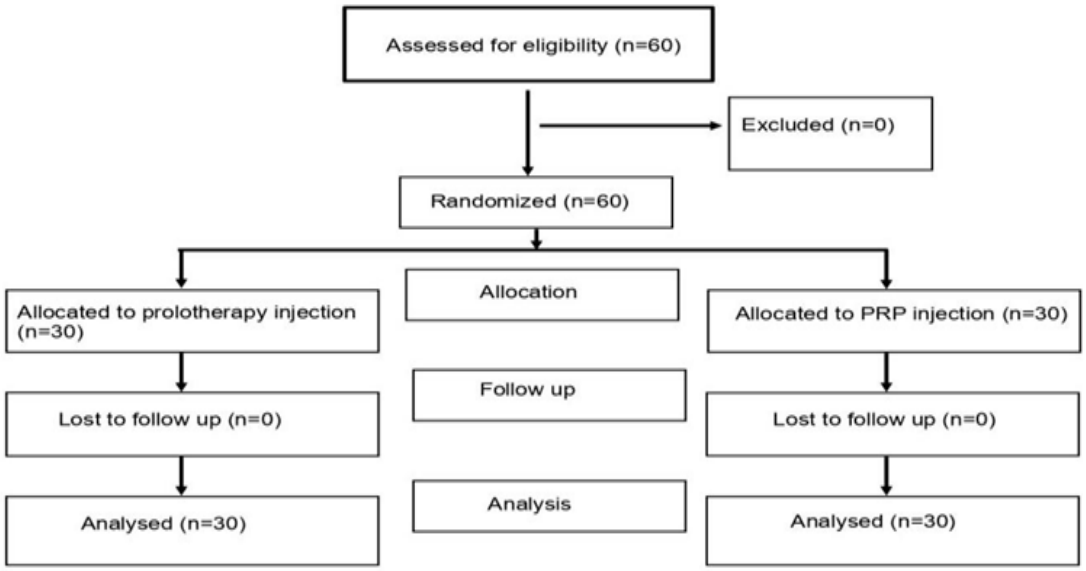

Figure 1. Consort diagram

Statistical Analysis
Data from all patients were analyzed with SPSS software version 23.0 for Windows. Quantitative variables were reported as mean ± standard deviation, while qualitative variables were presented as frequencies and percentages. Categorical data between the two groups were compared using the chi-square test. Intra-group variations were assessed using analysis of variance (ANOVA), with post hoc tests applied to examine changes over time. A p-value below 0.05 was considered to indicate statistical significance.

RESULTS
The study compared two groups of patients treated for shoulder pathology: Group 1 received Prolotherapy, and Group 2 received Platelet-Rich Plasma (PRP). Both groups had similar mean ages and sex distributions, with no significant differences ($p > 0.05$).
The affected side (right or left) and occupation (working or not working) also showed no significant differences between the groups. (Table 1).
Before treatment, the limitations in shoulder range of motion (ROM) were comparable, but after treatment, Group 1 showed significantly greater improvement ($p = 0.003$). (Table 2).

Group 1 showed significantly greater pain reduction (VAS scores) and better functional outcomes (WORC scores) compared to Group 2 ($p < 0.001$ and $p = 0.005$, respectively). (Table 3).

Before the intervention, there were no statistically significant differences between the groups in terms of MSUS findings ($p = 0.856$), with both groups showing similar distributions of normal, tendinitis, tendinosis, and partial tear conditions. Post-intervention, significant changes were observed in both groups. Group 1 exhibited a significant increase in the number of cases classified as normal (60.0%) compared to Group 2 (0.0%) ($p < 0.001$).
Conversely, Group 2 showed a higher incidence of tendinitis (40.0%) compared to Group 1 (6.7%) ($p = 0.046$). (Table 4).

Before the intervention, there was no significant difference in the prevalence of bursitis between the groups ($p = 0.584$). Both groups had similar proportions of patients with and without bursitis. After intervention, significant changes were observed. Group 1 showed a significant reduction in bursitis cases post-intervention, with 86.7% of patients showing no bursitis compared to 33.3% in Group 2 ($p < 0.001$). Conversely, Group 2 had a higher incidence bursitis post-intervention, with 66.7% of patients affected compared to 13.3% in Group 1 ($p < 0.001$). (Table 5).

However, there was no significant difference in resolving bicipital tenosynovitis between the groups. (Table 6).

Overall, Prolotherapy showed superior clinical, functional, and radiological outcomes compared to PRP in treating shoulder disorders.

TABLE 1. Comparison between the studied groups regarding demographic data

	Group 1 Prolotherapy (n=30)	**Group 2 PRP (n=30)**	**p value**
	45.07±13.97	43.97±13.24	0.755 (NS)
Male Female	21 (70.0%) 9 (30.0%)	20 (66.8%) 10 (33.3%)	0.781 (NS)
Right Left	16 (53.3%) 14 (46.7%)	19 (63.3%) 11 (36.7%)	0.432 (NS)
Not working Working	21 (70.0%) 9 (30%)	17 (56.7%) 13 (43.3%)	0.284 (NS)
Right Left	24 (80%) 6 (20%)	26 (86.7%) 4 (13.3%)	0.488 (NS)

TABLE 2 . Comparison of two groups regarding shoulder joint ROM before and after injection

		Group 1 Prolotherapy (n=30)	**Group 2 PRP (n=30)**	**p value**
Limitation in ROM before injection	No limitation One direction Two direction All direction	7 (23.3%) 3 (10.0%) 7 (23.3%) 13 (43.3%)	8 (26.7%) 8 (26.7%) 5 (16.7%) 9 (30%)	0.334 (NS)
Limitation in ROM after injection	No limitation One direction Two direction All direction	21 (70.0%) 2 (6.7%) 3 (10%) 4 (13.3%)	8 (26.7%) 8 (26.7%) 2 (6.7%) 12 (40.0%)	0.003 (S)
P value		0.003 (S)	0.634 (NS)	

TABLE 3. Comparison of two group regarding VAS and WORC index before and after injection

		Group 1 Prolotherapy (n=30)	**Group 2 PRP (n=30)**	**p value**
VAS Score	Before Intervention	8.07±1.23	7.87±1.53	0.579 (NS)
	After Intervention	2.57±2.10	6.17±1.66	<0.001 (S**)**
	p-value	<0.001(S)	0.068 (NS)	
WORC Score (%)				
	Before Intervention	32.20±16.56	30.10±12.06	0.577 (NS)
	After Intervention	68.30±22.04	52.60±19.99	0.005 (S)
	p-value	<0.001 (S)	<0.001 (S)	

TABLE 4. Comparison of two groups regarding MSUS Pre-intervention and Post-intervention

MSUS		**Group 1 Prolotherapy (n=30)**	**Group 2 PRP (n=30)**	**p value**
Pre-intervention	Normal Tendinitis Tendinosis Partial tear	0 (0.0%) 3 (10.0%) 10 (33.3%) 17 (56.7%)	0 (0.0%) 3 (10.0%) 7 (23.3%) 20 (66.7%)	0.856 (NS)
Post intervention	Normal Tendinitis Tendinosis Partial tear	18 (60.0%) 2 (6.7%) 9 (30.0%) 1 (3.3%)	0 (0.0%) 12 (40.0%) 7 (23.3%) 11 (36.7%)	<0.001 (S)
p-value		<0.001 (S)	0.046 (S)	

TABLE 5. Comparison of two groups regarding MSUS (Bursitis) finding before and after injections

MSUS (Bursitis)		**Group 1 Prolotherapy (n=30)**	**Group 2 PRP (n=30)**	**p value**
Pre-intervention	No Yes	11 (36.7%) 19 (63.3%)	9 (30.0%) 21 (70.0%)	0.584 (NS)
Post intervention	No Yes	26 (86.7%) 4 (13.3%)	10 (33.3%) 20 (66.7%)	<0.001 (S)
p-value		<0.001 (S)	0.781 (NS)	

TABLE 6. Comparison of two groups regarding MSUS (Bicipital tenosynovitis) finding before and after injections

MSUS (Bicipital tenosinovitis)		**Group 1 Prolotherapy (n=30)**	**Group 2 PRP (n=30)**	**p value**
Pre-intervention	No Yes	21 (70.0% 9 (30.0%)	19 (63.3%) 11 (36.7%)	0.584 (NS)
Post intervention	No Yes	26 (86.7%) 4 (13.3%)	23 (76.7%) 7 (23.3%)	0.317 (NS)
p-value		0.117 (NS)	0.260 (NS)	

DISCUSSION

Rotator cuff (RC) dysfunction, primarily due to supraspinatus tendinopathy, is the most common cause of shoulder pain and the third most prevalent musculoskeletal disorder.

We observed that group prolotherapy showed significant improvement in ROM and VAS score ($p = 0.005$).

Our findings align with those of Sabah et al(12), Lee DH et al(13), Seven MM et al(14), and Lin MT et al(15)**.** Hypertonic glucose injections are believed to trigger an inflammatory response, which boosts fibroblast proliferation, collagen production, and tissue repair. When glucose concentrations exceed 10%, it enhances the expression of transforming growth factor beta 1 (TGF-β1) and stimulates mesangial cell proliferation, aiding in the tightening and healing of tendons and other tissues.

In the present study before intervention MSUS findings were similar in both the groups. Post intervention normal USG scan of tendon is increased in 60% of patients receiving prolotherapy with significant reduction in bursitis. There was a decrease in incidence of partial tear more with PRP than with prolotherapy because of more healing of PRP.

A meta-analysis by Warth RJ et al. (16) on the effect of PRP in rotator cuff repair found that, while PRP significantly reduced the risk of re-tear for large (> 3 cm) tears, there were no differences in clinical outcomes between patients who received PRP and small those who did not. However, Vavken P et al. (17) found that PRP is effective in reducing the risk of re-tears following arthroscopic repair of small and medium-sized rotator cuff tears, but there was no evidence to suggest that it decreased the risk of re-tears in large and massive tears. Our study is consistent with Sabah et al which shows that PRP is effective in rotator cuff tendinopathy with partial tear and revealed no improvement in Range of motion.

Due to their regenerative power, we observed significant results in the current study when comparing PRP and dextrose prolotherapy for the healing of tendon injuries. These results included small partial tears and decreased tear size all the way up to complete healing for tendinosis. However, only prolotherapy had a substantial impact on bursitis and tenosynovitis, improving pain, range of motion, VAS, and WORC index. This effect may be attributed to prolotherapy's anti-inflammatory and pain-modulating properties as well as its regeneration potential. Prolotherapy injections did not cause any side effects or complications, with the exception of needle insertion discomfort. PRP incurred similar risks, but at an additional expense.

CONCLUSION

PRP injections enhance tendon healing and the WORC index, whereas prolotherapy injections increase shoulder range of motion, VAS, WORC index, and rotator cuff tendon healing. When treating rotator cuff tendinopathy, prolotherapy injection performed better than platelet-rich plasma. To sum up, prolotherapy is superior overall to treat Rotator cuff disorders.

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