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RESEARCH ARTICLE

# Comparative Effectiveness of Ultrasound-Guided Platelet-Rich Plasma Versus Corticosteroid Injection in Chronic Shoulder Tendinopathy: A Randomized Controlled Trial

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**Abstract:** ***Background:*** Chronic shoulder tendinopathy, particularly of the rotator cuff, causes persistent pain, functional limitation, and reduced quality of life. Conservative treatments often provide limited relief, while corticosteroid injections offer short-term benefits but may weaken tendons and lead to symptom recurrence. Platelet-rich plasma (PRP), an autologous concentration of growth factors, promotes collagen synthesis, angiogenesis, and tendon healing, showing superior short-term pain and functional improvement in previous studies. ***Methods:*** In this prospective, randomized controlled trial, 60 patients with chronic shoulder tendinopathy were assigned to receive ultrasound-guided PRP (n = 30) or corticosteroid (n = 30) injections. Outcomes pain (VAS), shoulder function (ASES), range of motion, tendon healing on ultrasound, and adverse events were assessed at baseline, 6 weeks, 3 months, and 6 months. Data were analyzed using t-tests, chi-square tests, and ANOVA; $p < 0.05$ was considered significant. ***Results:*** Baseline characteristics were similar between groups. Both treatments improved pain and function, but PRP provided significantly greater pain relief at 3 months (VAS 2.3 vs 3.5; $p = 0.01$) and 6 months (1.9 vs 3.1; $p < 0.001$), and higher functional scores at 3 months (ASES 78.6 vs 70.3; $p = 0.002$) and 6 months (85.9 vs 75.2; $p < 0.001$). PRP also resulted in superior shoulder abduction (48° vs 34°; $p = 0.01$) and external rotation (19° vs 11°; $p = 0.02$), and higher rates of tendon healing on ultrasound (echotexture 63.3% vs 33.3%; $p = 0.03$; hypo echogenicity 56.7% vs 30.0%; $p = 0.04$). Both interventions were safe, with only mild transient pain or swelling and no serious complications. ***Conclusion:*** Ultrasound-guided PRP injections provide superior mid-term pain relief, functional improvement, shoulder mobility, and tendon healing compared to corticosteroids in chronic shoulder tendinopathy, with comparable safety, supporting PRP as a regenerative alternative for long-term management.

**Keywords:** Ultrasound-Guided Platelet-Rich Plasma, Corticosteroid Injection, chronic Shoulder Tendinopathy.

## INTRODUCTION

Shoulder pain is one of the most common musculoskeletal complaints, which is affecting up to 70% of individuals at some point in their lifetime, and for the treatment of this pain requires a significant number of orthopedic consultations [1]. Among the various causes, chronic shoulder tendinopathy particularly involving the rotator cuff which causes a leading contributor to persistent pain, functional impairment, and disability [2]. This condition primarily occurs from degenerative changes and failed tendon healing rather than acute inflammation, often resulting from repetitive overload, microtrauma, and poor tendon vascularity [3,4]. The chronic nature of the disorder leads to ongoing pain, restricted range of motion, muscle weakness, and a marked decline in overall quality of life, making effective management essential to restore function and reduce disability.

Conservative management strategies, including rest, structured physiotherapy, nonsteroidal anti-inflammatory drugs (NSAIDs), and activity modification, are primarily considered the first-line approach for chronic shoulder tendinopathy [5]. These treatments main aim to reduce pain, improve range of motion, and restore shoulder function. However, despite adherence to these interventions, a significant proportion of patients continue to experience persistent pain, functional limitations, and reduced quality of life. In such cases, corticosteroid injections are often considered as a second-line option, providing short-term symptomatic relief through their potent anti-inflammatory effects. Nevertheless, repeated corticosteroid use has been developed some potential adverse effects, including tendon degeneration, weakening of the rotator cuff, and a high risk of symptom recurrence [6,7]. These limitations underscore the need for alternative therapies that not only alleviate

pain but also promote tendon healing and which need long-term functional recovery.

Platelet-rich plasma (PRP) has been introduced as a promising regenerative therapy for chronic tendinopathies. PRP is an autologous concentration of platelets containing growth factors such as PDGF, VEGF, and TGF-β, which promote collagen synthesis, angiogenesis, and tendon repair [8,9]. A randomized controlled trial conducted abroad compared ultrasound-guided platelet-rich plasma (PRP) and corticosteroid injections in 99 patients with chronic rotator cuff tendinopathy or partial-thickness tears.[10]. Patients were randomized to receive a single ultrasound-guided injection of PRP (n = 47) or corticosteroid (n = 52) and followed at 6 weeks, 3 months, and 12 months. Outcomes included pain (VAS) and functional scores (ASES, WORC). During the 3 months, the PRP group showed significantly greater pain relief and functional improvement compared to corticosteroids. However, by 12 months, there was no significant difference between groups. Both treatments were safe, but PRP provided superior short-term benefit, highlighting its potential as a regenerative alternative for chronic shoulder tendinopathy.

Another study of randomized clinical trial of 58 patients with rotator cuff tendinopathy compared ultrasound-guided platelet-rich plasma (PRP) injections to corticosteroid injections. [11] Both groups improved in pain and function, but at 3 months, the PRP group showed significantly greater pain reduction and improved shoulder motion. No significant differences were observed in tendon thickness. The study concluded that PRP provides superior short-term benefits compared to corticosteroids, highlighting its potential as a safer regenerative therapy.

Currently, there is no published randomized controlled trial from Bangladesh comparing ultrasound-guided platelet-rich plasma (PRP) versus corticosteroid injections for chronic shoulder tendinopathy. The aim of this study to compare the effectiveness of ultrasound-guided platelet-rich plasma (PRP) injection versus corticosteroid injection in patients with chronic shoulder tendinopathy in terms of pain relief and functional improvement.

# METHODOLOGY

### Study Design and Setting

This study was a prospective, randomized controlled trial conducted to compare the effectiveness of ultrasound-guided platelet-rich plasma (PRP) injections versus corticosteroid injections in patients with chronic shoulder tendinopathy. The study was carried out at the Department of Anesthesiology and ICU, National Institute of Traumatology and Orthopedic Rehabilitation (NITOR) with collaboration with AVA pain and Intervention center, Dhaka, Bangladesh, from July 2023 to December 2024. Ethical approval was obtained from the Institutional Review Board, and written informed consent was obtained from all participants prior to enrollment.

### Participants

A total of 60 patients diagnosed with chronic shoulder tendinopathy were enrolled. Inclusion criteria were adults aged 18–65 years with persistent shoulder pain for more than 3 months, failure of conservative therapy (rest, NSAIDs, and physiotherapy), and ultrasonographic confirmation of rotator cuff tendinopathy. Exclusion criteria included full-thickness rotator cuff tears, previous shoulder surgery, systemic inflammatory diseases, coagulopathy, infection at the injection site, or prior injection therapy within the past 6 months.

### Randomization and Group Allocation

Participants were randomly assigned in a 1:1 ratio to either the PRP group (n = 30) or the corticosteroid group (n = 30) using a computer-generated randomization schedule. Allocation concealment was ensured with sealed opaque envelopes.

### Intervention

**PRP Group:** Autologous platelet-rich plasma (PRP) was prepared from each patient's venous blood and administered under ultrasound guidance into the affected tendon. The PRP preparation protocol involved drawing 10 mL of venous blood using a syringe fitted with a red blood cell (RBC) separator. The sample underwent an initial centrifugation at 1,200 rpm for 5 minutes to separate plasma from erythrocytes, after which the RBC fraction was discarded. A second centrifugation at 1,200 rpm for 10 minutes was performed to further concentrate on the platelets. White blood cells were retained within the PRP fraction. The final yield was approximately 3 mL of PRP containing a platelet concentration four- to eight-fold higher than baseline physiological levels. PRP was administered in three sessions at two-week intervals.

**Corticosteroid Group:** A single ultrasound-guided injection comprising 40 mg of methylprednisolone acetate combined with 20 mg of lidocaine was administered into the affected tendon.

All injections were performed by an experienced musculoskeletal specialist using a standardized technique. Patients were instructed to rest for the first 48 hours post-injection and to avoid strenuous shoulder activity. Analgesia with paracetamol (maximum 3 g/day) and cold compression were permitted as needed for post-injection pain control. A structured home exercise program was initiated one week after the injection and continued for seven weeks. During the first three weeks, patients performed passive range-of-motion (ROM) exercises and Codman pendulum movements. Once pain subsided and movement was

tolerated, the program progressed to isotonic strengthening and stretching exercises for an additional four weeks.

**Outcome Measures**

Primary and secondary outcomes were assessed at baseline, 6 weeks, 3 months, and 6 months post-injection:

- Pain: Measured using the Visual Analog Scale (VAS).
- Function: Assessed with the American Shoulder and Elbow Surgeons (ASES) score.
- Shoulder Range of Motion (ROM): Measured in degrees for abduction, external rotation, and forward flexion using a goniometer.
- Tendon Healing: Evaluated with ultrasound for echotexture, hypo echogenicity, and tendon thickness.
- Safety: Adverse events, including post-injection pain, swelling, infection, or other complications, were recorded.

**Statistical Analysis**

Data were analyzed using SPSS version 27. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Between-group comparisons were performed using independent t-tests for continuous variables and chi-square tests for categorical variables. Repeated measures were analyzed using ANOVA where appropriate. A p-value < 0.05 was considered statistically significant.

# RESULTS:

A total of 60 patients with chronic shoulder tendinopathy were enrolled and randomized equally into the PRP and corticosteroid groups. Baseline demographic and clinical characteristics were comparable between the groups. Outcomes were assessed in terms of pain (VAS), shoulder function (ASES score), range of motion, ultrasonographic tendon changes, and adverse effects at 6 weeks, 3 months, and 6 months post-injection. The following results summarize the comparative effectiveness and safety of the two interventions.

**Table 1. Baseline Characteristics of Study Participants (n = 60)**

| Variables | PRP Group (n = 30) | Corticosteroid Group (n = 30) | *p*-value |
|---|---|---|---|
| Mean Age (years) | 46.5 ± 9.1 | 47.2 ± 8.8 | 0.74 |
| Gender (Male), n (%) | 17 (56.7%) | 18 (60.0%) | 0.79 |
| Dominant Arm Involved, n (%) | 14 (46.7%) | 13 (43.3%) | 0.81 |
| Duration of Symptoms (months) | 7.8 ± 2.4 | 8.1 ± 2.6 | 0.65 |
| Baseline VAS Pain Score | 7.2 ± 0.8 | 7.1 ± 0.7 | 0.64 |
| Baseline ASES Functional Score | 48.2 ± 6.4 | 47.6 ± 5.9 | 0.73 |

No significant differences were observed between groups at baseline. *Statistically significant ($p < 0.05$)

Table 1 presents the baseline demographic and clinical characteristics of the study participants in both the PRP and corticosteroid groups. The mean age of participants was comparable between groups (46.5 ± 9.1 years in the PRP group vs. 47.2 ± 8.8 years in the corticosteroid group; $p = 0.74$). The gender distribution was also similar, with males comprising 56.7% of the PRP group and 60.0% of the corticosteroid group ($p = 0.79$).

The duration of symptoms, involvement of the dominant arm, baseline pain intensity measured by the Visual Analog Scale (VAS), and functional status assessed by the American Shoulder and Elbow Surgeons (ASES) score showed no statistically significant differences between groups (all $p > 0.05$).

**Table 2. Comparison of Pain Scores (VAS) Between Groups Over Time**

| Follow-up Period | PRP Group (Mean ± SD) | Corticosteroid Group (Mean ± SD) | *p*-value |
|---|---|---|---|
| Baseline | 7.2 ± 0.8 | 7.1 ± 0.7 | 0.64 |
| 6 Weeks | 4.1 ± 0.9 | 3.6 ± 1.0 | 0.09 |
| 3 Months | 2.3 ± 0.8 | 3.5 ± 0.9 | **0.01*** |
| 6 Months | 1.9 ± 0.7 | 3.1 ± 0.8 | **<0.001*** |

*Statistically significant ($p < 0.05$)

Table 2 demonstrates the trend of pain reduction in both treatment groups throughout the follow-up period. At baseline, pain intensity was comparable between the PRP and corticosteroid groups (p = 0.64), confirming similar starting conditions.

At 6 weeks, both groups showed a marked decrease in pain scores, indicating effective short-term pain control; however, the difference was not statistically significant (p = 0.09). By 3 months, patients in the PRP group experienced significantly greater pain relief (mean VAS 2.3 ± 0.8) compared to those receiving corticosteroids (3.5 ± 0.9; p = 0.01).

At 6 months, the PRP group maintained a lower pain level (1.9 ± 0.7), whereas the corticosteroid group exhibited partial pain recurrence (3.1 ± 0.8; p < 0.001).

**Table 3. Comparison of Functional Improvement (ASES Score) Between Groups**

| Follow-up Period | PRP Group (Mean ± SD) | Corticosteroid Group (Mean ± SD) | *p*-value |
|---|---|---|---|
| Baseline | 48.2 ± 6.4 | 47.6 ± 5.9 | 0.73 |
| 6 Weeks | 65.4 ± 7.2 | 68.2 ± 8.1 | 0.27 |
| 3 Months | 78.6 ± 6.9 | 70.3 ± 7.8 | **0.002*** |
| 6 Months | 85.9 ± 5.8 | 75.2 ± 6.4 | **<0.001*** |

*Statistically significant ($p < 0.05$)

Table 3 illustrates the progression of shoulder function, measured by the American Shoulder and Elbow Surgeons (ASES) score, across different follow-up periods. At baseline, both groups had similar functional status (PRP: 48.2 ± 6.4 vs. corticosteroid: 47.6 ± 5.9; *p = 0.73*), confirming comparable pre-treatment conditions. At 6 weeks, functional improvement was observed in both groups without significant difference (p = 0.27). However, at 3 and 6 months, the PRP group showed significantly greater functional improvement than the corticosteroid group (p = 0.002 and p < 0.001).

**Table 4. Shoulder Range of Motion Improvement at 6 Months**

| Range of Motion (°) | PRP Group (Mean ± SD) | Corticosteroid Group (Mean ± SD) | *p*-value |
|---|---|---|---|
| Abduction | 48 ± 12 | 34 ± 10 | **0.01*** |
| External Rotation | 19 ± 6 | 11 ± 5 | **0.02*** |
| Forward Flexion | 42 ± 11 | 37 ± 10 | 0.08 |

*Statistically significant ($p < 0.05$)

Table 4 shows the improvement in shoulder range of motion at 6 months following treatment. The PRP group demonstrated significantly greater gains in shoulder abduction (48° ± 12° vs. 34° ± 10°; p = 0.01) and external rotation (19° ± 6° vs. 11° ± 5°; p = 0.02) compared to the corticosteroid group. Improvement in forward flexion was higher in the PRP group but did not reach statistical significance (p = 0.08).

**Table 5. Ultrasound Findings at 6-Month Follow-Up**

| Ultrasound Parameter | PRP Group (n = 30) | Corticosteroid Group (n = 30) | *p*-value |
|---|---|---|---|
| Improved tendon echotexture, n (%) | 19 (63.3%) | 10 (33.3%) | **0.03*** |
| Reduced hypo echogenicity, n (%) | 17 (56.7%) | 9 (30.0%) | **0.04*** |
| Tendon thickness change (mm) | 0.3 ± 0.2 | 0.2 ± 0.3 | 0.41 |

*Statistically significant ($p < 0.05$)

Table 5 presents the tendon healing outcomes assessed by ultrasound at 6 months. The PRP group showed significantly higher rates of improved tendon echotexture (63.3% vs. 33.3%; p = 0.03) and reduced hypo echogenicity (56.7% vs. 30.0%; p = 0.04) compared to the corticosteroid group, indicating better tendon quality and healing. There was no significant difference in tendon thickness change between the groups (p = 0.41).

**Table 6. Adverse Effects Following Injection**

| Adverse Event | PRP Group (n = 30) | Corticosteroid Group (n = 30) | *p*-value |
|---|---|---|---|
| Mild post-injection pain | 6 (20.0%) | 3 (10.0%) | 0.28 |
| Local swelling | 3 (10.0%) | 1 (3.3%) | 0.30 |
| Infection or severe complication | 0 (0%) | 0 (0%) | — |

No significant differences were observed *Statistically significant ($p < 0.05$)

Table 6 summarizes the safety profile of the two interventions. Mild post-injection pain and local swelling were reported in a few patients in both groups, with no statistically significant differences (post-injection pain: 20% vs. 10%, p = 0.28; swelling: 10% vs. 3.3%, p = 0.30). No infections or severe complications occurred in either group.

# DISCUSSION

The baseline demographic and clinical characteristics of participants in both the PRP and corticosteroid groups were comparable and consistent with previously published randomized trials on shoulder tendinopathy. In the present study, the mean age of participants was 46.5 ± 9.1 years in the PRP group and 47.2 ± 8.8 years in the corticosteroid group, with males comprising 56.7% and 60.0% of each group, respectively. The proportion of cases involving the dominant arm was

similar between groups (46.7% vs 43.3%), and the mean duration of symptoms was 7.8 ± 2.4 months in the PRP group and 8.1 ± 2.6 months in the corticosteroid group. Baseline pain intensity, assessed using the Visual Analog Scale (VAS), was moderately severe in both groups (7.2 ± 0.8 vs 7.1 ± 0.7), while baseline functional status, evaluated by the American Shoulder and Elbow Surgeons (ASES) score, indicated moderate functional limitation (48.2 ± 6.4 vs 47.6 ± 5.9). These findings are consistent with prior studies [12,13] reporting similar demographic distributions, pain severity, and functional impairment among middle-aged patients with shoulder tendinopathy. The overall homogeneity of baseline parameters in the present cohort strengthens the internal validity of subsequent intergroup comparisons regarding treatment efficacy.

The present study demonstrated that baseline pain scores (VAS) were comparable between the PRP and corticosteroid groups (7.2 ± 0.8 vs 7.1 ± 0.7; p = 0.64). At 6 weeks post-intervention, both groups showed improvement in pain intensity; however, the intergroup difference did not reach statistical significance (4.1 ± 0.9 vs 3.6 ± 1.0; p = 0.09). At 3 and 6 months of follow-up, patients receiving PRP exhibited significantly greater and more sustained pain reduction compared to those treated with corticosteroids (3 months: 2.3 ± 0.8 vs 3.5 ± 0.9, p = 0.01; 6 months: 1.9 ± 0.7 vs 3.1 ± 0.8, p < 0.001). These results align with prior evidence indicating that corticosteroid injections primarily confer short-term analgesic benefit, whereas PRP therapy offers superior and prolonged pain relief over mid- to long-term follow-up periods. [12,13]

The functional outcomes observed in this study are consistent with previously published data comparing Platelet-Rich Plasma (PRP) and corticosteroid injections in shoulder tendinopathy. At baseline, both groups exhibited comparable functional scores (ASES ≈ 48/100). At 6 weeks, both groups demonstrated early functional improvement without a statistically significant intergroup difference (65.4 vs 68.2; p = 0.27). Subsequently, the PRP group achieved significantly greater functional gains at 3 months (78.6 vs 70.3; p = 0.002) and 6 months (85.9 vs 75.2; p < 0.001). This pattern parallels findings from prior systematic reviews, which indicate that although both interventions enhance shoulder function, PRP provides superior and more sustained functional recovery in the mid- to long-term follow-up period (3–6 months) compared to corticosteroid therapy. [12,14]

In the present study, at 6 months of follow-up, patients in the PRP group demonstrated significantly greater improvements in shoulder abduction (48° ± 12° vs 34° ± 10°; p = 0.01) and external rotation (19° ± 6° vs 11° ± 5°; p = 0.02) compared with those receiving corticosteroid injections, whereas the improvement in forward flexion did not reach statistical significance (p = 0.08). These results are consistent with prior evidence indicating that PRP therapy yields superior mid-term enhancement in shoulder range of motion and functional recovery relative to corticosteroid treatment, particularly in parameters of abduction and external rotation. [12,13]

The present study demonstrated that at 6 months, the PRP group exhibited significantly greater evidence of tendon healing on ultrasonography, characterized by improved echotexture (63.3% vs 33.3%; p = 0.03) and reduced hypo echogenicity (56.7% vs 30.0%; p = 0.04), whereas the change in tendon thickness did not differ significantly between groups (0.3 ± 0.2 mm vs 0.2 ± 0.3 mm; p = 0.41). These findings are in concordance with earlier reports suggesting that PRP facilitates superior tendon structural regeneration compared to corticosteroid therapy in patients with rotator cuff tendinopathy. [12,15]

The safety profile of the interventions, summarized in Table 6, demonstrated mild post-injection pain (20% in the PRP group vs 10% in the corticosteroid group; p = 0.28) and local swelling (10% vs 3.3%; p = 0.30), with no cases of infection or serious complications in either group. These observations are consistent with prior studies comparing PRP and corticosteroid injections. A recent meta-analysis reported that most trials documented no serious adverse events with either treatment [16]. While corticosteroid therapy carries recognized risks such as tendon weakening and local tissue atrophy, these complications were infrequently observed in short-term injection studies [17]. Collectively, these findings support that both PRP and corticosteroid injections are generally safe for managing shoulder tendinopathy, with only minor, transient adverse effects and no significant differences between treatment groups.

# CONCLUSION

Ultrasound-guided platelet-rich plasma (PRP) injections provided superior mid-term outcomes compared to corticosteroids in chronic shoulder tendinopathy. PRP achieved greater and more sustained pain reduction, improved functional recovery (higher ASES scores), enhanced range of motion particularly in abduction and external rotation and demonstrated superior tendon healing on ultrasonography, reflecting true structural regeneration. Both treatments were safe, with only minor transient adverse effects. Overall, PRP represents an effective and well-tolerated regenerative therapy offering durable clinical and structural benefits over corticosteroid injections for long-term management of chronic shoulder tendinopathy.

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