ORIGINAL ARTICLE

Role of Ultrasound Guided Platelet Rich Plasma Therapy for Isolated Supraspinatus Tendinopathy

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Abstract

Background: Rotator cuff (RC) injuries are not so uncommon a cause of disability among the population. The RC stabilizes the shoulder, a highly unstable joint owing to great mobility. Supraspinatus (SS) is one of the RC tendons undergoing damage ranging from mild tendinosis to complete tear due to degeneration, trauma, or other causes. Supraspinatus tears (STs) have been classically treated conservatively with physical and pharmacotherapy and later on with the help of surgical repair. Non-surgical treatment with biologics like platelet-rich plasma (PRP) therapy has been tried with positive results but with limited data. We aim to identify the role of PRP therapy in patients with symptomatic supraspinatus tendinopathy (STP) for improving the range of motion as well as reducing the pain and physical disability.

Methods: This study was done on fifty symptomatic STP patients who failed medical and physical therapy for at least three months. The improvement in the pain score following two sittings of PRP therapy was evaluated with numerical rating scale (NRS). The improvement of the function of shoulder joint movements for daily activities was assessed with the modified University of California-Los Angeles (UCLA) shoulder score. Moreover, NRS, tear size (TS, assessed with ultrasound), Constant Shoulder Score (CSS), and modified UCLA shoulder score were recorded at baseline, and subsequently at 1-month, 3-months, and 6-months following the second sitting of the PRP therapy.

Results: At baseline, the CSS was 36.42±5.12, and was 61.58±6.35, 81.22±6.23, and 87±3.9 at 1-month, 3-months, and 6-months follow-up, respectively. The NRS was 8.18±0.96 before the procedure and 4.26±0.8, 2.02±0.62, 1.84±0.51 at 1-month, 3-months, and 6-months follow-up, respectively. The mean TS pre-procedure was 3.12±0.89, and a significant decrease in TS was seen at 1-month (2.87±0.88), 3-months (2.44±0.79), and 6-months (2.17±0.76). Modified UCLA score was 16.86±3.49 at baseline which improved to 24.66±3.17 at 1-month, 31.64±2.69 at 3-months, and 32.5±1.67 at 6-months.

Conclusion: PRP results in healing of the torn SS tendon. It also reduces pain score, improve range of motion and quality of life of the patients.

Keywords: Rotator Cuff, Tendinopathy, Platelet Rich Plasma, Supraspinatus Tear

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Introduction

The rotator cuff (RC) comprises of four tendons, including supraspinatus (SS), infraspinatus, subscapularis, and teres minor. Collectively, these tendons provide stability and mobility to the shoulder by pressing the head of the humerus towards the glenoid cavity, and functioning as dynamic stabilizers. With their origin from the scapula and insertion on the superior part of the head of the humerus, they enhance both stability and movement of the joint. SS and subscapularis are responsible for arm abduction from initial 0-15 degrees and internal rotation of the shoulder, respectively, while infraspinatus and teres minor are responsible for external rotation of the shoulder[1]. SS originates from the back of the scapula, above the scapular spine, and inserts on the greater humeral tuberosity, partially merging with the infraspinatus tendon. Amongst all four RC tendons, the SS is most susceptible to injuries ranging from minor (acute RC tendinitis) to advanced/chronic injuries (RC tendinopathy and tear). Supraspinatus tendinopathy (STP) develops when the healing capacity of the tendon is less than the excessive mechanical load.

Multiple factors play important role in STP, classified as intrinsic and extrinsic factors. The former include age, sports injuries, trauma, hand-dominance, improper position, genetic predisposition, hypercholesteremia, vascular changes, as well as degeneration and repetitive eccentric forces play a major role in STP[2]. Degenerative injury is progressive and becomes the most important pathology with age playing a significant role. Around 30% and 60% of adults aged above 60 and 80 years, respectively, develop tear[3]. While, the latter lead to alteration in the biomechanics of the tendon leading to STP due to the anatomical and mechanical nature of the tendon, with subacromial impingement resulting from angle and shape of acromion process as well as the presence of acromioclavicular spurs being the most important[4]. Moreover, the changes in scapular kinematics[5] and posterior capsule tightness[6] are other important causes.

Anatomical location of SS is an important determining factor, and the most common tear site is around 15 mm posterior to the biceps tendon[1]. Articular surface tears are around 3-times more frequent owing to its complex structure involving ligament, tendon, and capsule compared to the involvement of only tendon on the bursal surface[7].

Ellman[8] graded the tear, based on the size and location, as grade I, II, and III with involvement of <3mm (<25% tendon thickness, [TT]), 3–6mm (25–50% TT), >6mm (>50% TT), respectively.

There are various factors contributing to the healing of partial tears and risk factors, including age, symptoms, location, and TS, contribute to the healing or worsening of the tear. This study aimed to identify the factors contributing to the tendon healing, and evaluated the role of PRP in assessing the improvement in pain and functional component of the tendon.

The PRP, an autologous concentration of platelets in a small volume of plasma, has 2-10 folds higher platelet concentration than the normal levels observed in a healthy individual. It acts by activating cells that can heal themselves or fasten the healing process resulting in the resolution of damaged tissues. As the tendons lack rich blood supply and the degenerated ruptured tendon is devoid of the nutrients necessary for repair, auto-regeneration is difficult. This process is fastened by the PRP which supplies the growth factors and a necessary internal environment for the tendon to heal quickly[9]. Several studies have concluded favorable outcome with PRP in healing chronic STP[10-13].

The primary objective of the study was to identify the improvement in the pain score following two sittings of PRP therapy in patients with symptomatic STP. While, the secondary objective was to assess the improvement in shoulder joint function for daily activities.

Methods

A total of 70 patients, over a period of 8 months (January to August 2021), were diagnosed with symptomatic isolated partial supraspinatus tear (STs) and screened for eligibility. Of 70 patients, 50 agreed to be regular for follow-up over 6-months and thus, were enrolled in the study. The study included adult patients, of either sex, and diagnosed with symptomatic STP, confirmed on musculoskeletal ultrasound, who failed medical and physical therapy over a period

of at least 3-months. While, the patients with full-thickness RC tear (>50% involvement); coexisting tendinopathy of subscapularis, teres minor, and infraspinatus tendons; prior surgery of the injured shoulder; history of administration of steroid injection in the past 3-months in the affected shoulder; and patients not willing for follow-up were excluded.

Diagnostic ultrasound was performed on all patients while they were seated in a modified Crass position. In this position, the shoulder was extended, adducted, and internally rotated, with the elbow flexed, the palm facing outward, and the fingers pointing towards the opposite scapula. The internal rotation positions the SS as an anterior structure, while the extension moves it anteriorly from beneath the acromion, enabling the visualization of its maximal length. The examination was conducted along both the transverse and longitudinal axes. All RC tendons were visualized. The SS muscle was examined, and parameters were recorded, including thickness of the SS tendon, identification and location of any tears, TS, and presence or absence of cortical irregularity as well as bursitis (Fig I). Only patients with isolated STs were included.

The study was performed at Epione – Center for Pain Relief and Beyond, Hyderabad, India. The patients were enrolled after taking written informed consent. Following enrolment, the patients were explained about the study procedure, prerequisite, intra-operative procedure, complications, and failure of the efficacy of the procedure. Pre-procedure, complete blood count, platelet count, and function were analyzed. All the patients were advised to stop intake of NSAIDs and statins one week before and one week after the procedure.

On the day of the PRP therapy administration, the patients were explained the procedure, and written informed consent was obtained. Moreover, Numerical Rating Scale (NRS) score and Constant Shoulder Score (CSS) were recorded. Under all aseptic precautions, blood (18 ml) was collected from the antecubital vein in 20 ml syringe with 2 ml anticoagulant. Blood was transferred into a commercially available kit for double centrifugation using a REMI machine. The first soft spin and second spin or the hard spin were done at 2800 RPM for 7 minutes and 3200 RPM for 10 minutes, respectively. Following first spin, the RBCs settled in the lower chamber and the two chambers were locked, while after second spin the supernatant platelet-poor plasma was discarded, and 2 ml PRP pellets remained as the sediment, which were extracted using a 16G needle and kept in sterile area. Once the PRP was prepared, the patient was shifted to the operation theatre.

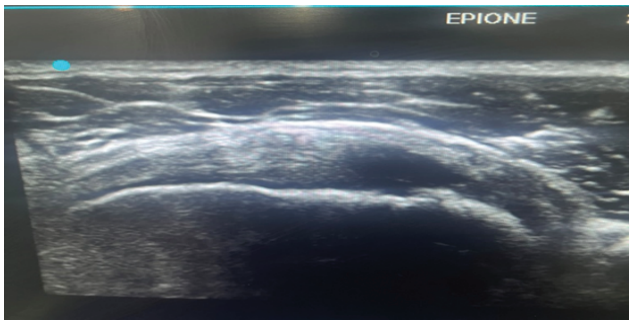

Fig I: The intertendinous tear

Intravenous catheter (22G) in the opposite hand was secured, and routine monitoring for NIBP, HR, SPO2, and ECG were secured. The patient was placed in the supine position and the symptomatic side hand was put in a modified crass position. The shoulder was cleaned with betadine and draped with a sterile towel. Using the ultrasound, the area was anesthetized using 1% lignocaine and then 2 ml of PRP was injected into the SS tendon (Figure 2) at the tear site in the transverse plane. The second sitting of PRP therapy was given similarly after two weeks. The patients were followed-up at 1-month, 3-months, and 6-months after the second sitting of PRP therapy. The parameters analysed were NRS, CSS, modified University of California-Los Angeles (UCLA) shoulder score, and TS.

A detailed history was taken in all the patients followed by thorough general and musculoskeletal examination, with a particular focus on the shoulder and cervical spine, along with a neurological examination to identify potential referred pain. A shoulder test was conducted to diagnose SS pathology and to exclude pain associated with other shoulder conditions. Various differential diagnoses, including superior labral anterior posterior or other labral tears, biceps tendinitis, cervical radiculopathy, acromioclavicular osteoarthritis, and calcific tendinitis, were considered and ruled out. Ultrasound examination (Esaote SL1543) was performed by a senior radiolo-

gist (15 years of experience) with a linear probe

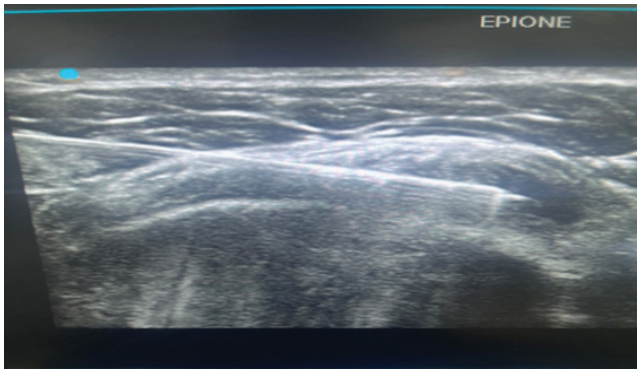

Fig II: Needle at the site of the tear

frequency of 3-13 MHz.

Outcome measure

NRS score: It assesses pain intensity in adults. It is a 11-point scoring system, ranging from 0 to 10, with 0 and 10 representing no pain and worst imaginable pain, respectively.[14]

CSS: It includes subjective and objective evaluation irrespective of the underlying condition, making it useful across a range of disorders. It ranges from 0 to 100-points, the objective components (range of motion includes shoulder strength, internal and external rotation, and lateral and forward elevation) can receive maximum of 65 points and the subjective 35 points (15 points for pain and 20 for arm position and ability to perform routine daily activities). A scores of <11, 11-20, 21-30, and >30 points are excellent, good, fair, and poor, respectively.[15]

UCLAS score: A tool to evaluate the functional outcome of the shoulder following treatments, which measures pain, function, active forward flexion, strength of forward flexion, and patient satisfaction, with a maximum score of 35 points. Scores exceeding 27 are considered good or excellent, while those below 27 are deemed poor.[16]

Results

The study included 50 patients with a mean age of 39.8 years (range: 28 – 70 years). There were 23 (46%) females and 27 (54%) males. Of 50 patients, 33 (66%) had right sided affection, while 17 (34%) had left-sided affected. TS was more than 3 cm in 14 (28%) patients and less than or equal to 3 cm in 36 (72%) patients. The duration of injury was more than 3 months in all the patients with 11 (22%) patients having symptoms more than 9 months and 39 (78%) patients having symptoms of less than 9 months. Majority of the patients had tear in articular surface (n=26, 52%) followed by bursal surface (16%, 32%) and intertendinous tear (n=8, 16%). The demographic and clinical profile is mentioned in Table I.

Table I: Demographic and clinical profile of patients

Characteristics		Value
Age		28-72 (median 39.8)
Gender	Male	27 (54%)
	Female	23 (46%)
Side	Right	33 (66%)
	Left	17 (34%)
Site of tear	Articular	26 (52%)
	Bursal	16 (32%)
	Intertendinous	8 (16%)
Duration of injury	3-9 months	39 (78%)
	>9 months	11 (22%)

Values are expressed as number and percentage

Table II shows the primary and secondary outcomes. It shows the mean scores at the start of the study (pre-procedure) and at 1-month, 3-months, and 6-months follow up. The pre-procedure CSS was 36.42±5.12, and 61.58±6.35, 81.22±6.23, and 87±3.9 at 1-month, 3-months, and 6-months, respectively. The pre-procedure NRS was 8.18±0.96, and 4.26±0.8, 2.02±0.62, and 1.84±0.51 at 1-month, 3-months, and 6-months, respectively. The mean TS pre-procedure was 3.12±0.89, and significant decrease in TS was seen at 1-month (2.87±0.88), 3-months (2.44±0.79), and 6-months (2.17±0.76). Moreover, there was a significant drop in modified UCLA score from pre-procedure value (16.86±3.49) to 24.66±3.17 at 1-month, 31.64±2.69 at 3-months, and 32.5±1.67 at 6-months.

Table II: Primary and secondary outcomes of the study

Characteristics	Pre-procedure	1 month	3 month	6 month	P value
CSS	36.42±5.12	61.58±6.35	81.22±6.23	87±3.9	<0.001
NRS	8.18±0.96	4.26±0.8	2.02±0.62	1.84±0.51	<0.001
Tear Thickness	3.12±0.89	2.87±0.88	2.44±0.79	2.17±0.76	<0.001
UCLAS	16.86±3.49	24.66±3.17	31.64±2.69	32.5±1.67	<0.001

Data are presented as mean± SD. P-value is achieved by repeated measure ANOVA test.

The CSS, NRS, Tear thickness and UCLAS score before and after PRP therapy was shown in **Fig III.**

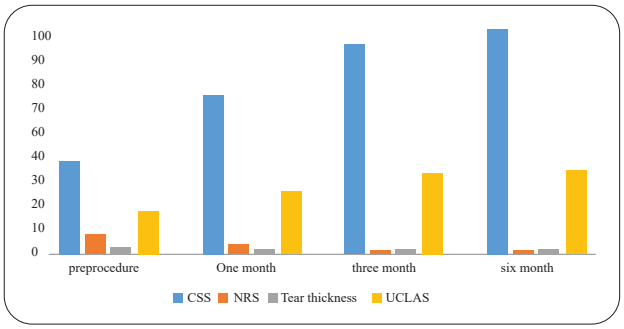

Fig III: CSS, NRS, Tear thickness and UCLAS score before and after PRP therapy

Discussion

The study aims to identify the role of PRP in healing ST and enhancing the functional movement of the shoulder joint. Our findings indicate that PRP is highly effective in treating ST, as evidenced by reductions in NRS scores, improvements in CSS, and tendon healing observed as a decrease in TS on ultrasound scans at 1-month, 3-months, and 6-month follow-ups. The study shows that while pain scores and functional components improved at 1- and 3-months, the most significant reduction in tendon TS was observed at 6 months. There were no reported adverse events, increased pain, or further impairment of function, demonstrating a positive impact on tendon healing.

Our study was backed by numerous other research efforts. Xiao Chen et al.[14] conducted a meta-analysis involving 37 studies with a total of 1,031 patients. Most of these studies focused on RC injuries (38.1%) and demonstrated that, overall, long-term data revealed significantly less pain in the PRP group than the control group.

In a study conducted by Randell et al.[15] involving 53 patients, it was reported that all patients experienced pain reduction and functional improvement without any adverse events when PRP was used to augment arthroscopy for RC repairs. This was evidenced by an improvement in the CSS 12 weeks post-repair, and the patients treated with autologous PRP experienced pain reduction in the initial postoperative months. The long-term data for patients with grade 1 and 2 tears demonstrates that PRP positively influences RC healing.

Saltzman et al.[16] concluded that intra-operative PRP augmentation during arthroscopy for patients with RC tears leads to pain improvement and a shorter rehabilitation period. Using PRP to enhance RC repair resulted in lower re-tear rates, quicker return to daily activities, and pain reduction.

Ibrahim et al.[17] compared the effectiveness of PRP therapy with corticosteroid injections for managing 30 patients with RC tendinopathy. The authors found that both treatments were effective for RC tendinopathy. PRP, in particular, was found to be a safe and effective alternative to corticosteroid injections, promoting healing and reducing inflammation. The use of ultrasound guidance may enhance the treatment's efficacy.

Contrarily, Fu et al.[18] performed a meta-analysis of 11 studies that compared PRP or platelet-rich fibrin matrix (n=320) with control (n=318), and concluded that the standard difference in the functional scores was comparable between the groups, and thus the findings do not justify the use of PRP or platelet-rich fibrin matrix in patients with RC injuries.

In another meta-analysis, Hurley et al.[19] included [18] RCTs involving 1,147 patients. The findings significantly favored PRP over the control group for the CSS. However, PRF did not significantly reduce the rate of incomplete tendon healing for all tears. The available literature suggests that using PRP in RC repair leads to better healing rates, lower pain levels, and improved functional outcomes. Contrarily, PRF has shown no benefits in enhancing tendon healing rates or functional outcomes.

Charousset et al.[20] compared two groups of patients with RC tear and found that patients who received leukocyte-PRP and those who did not receive it were comparable in terms of UCLA score Simple Shoulder Test score, Constant score, and strength. Consequently, they concluded that the use of autologous leukocyte-PRP did not enhance tendon healing quality in patients with large or massive RC tears.

A study by Niazi et al.[21] involving 30 patients demonstrated a decrease in pain and disability scores. Despite this, radiological evaluations indicated no change in tendon thickness from baseline to the 12-week follow-up, though a notable reduction in tendon thickness was observed at 24 weeks. The researchers concluded that PRP therapy for patients

with STP is a safe, cost-effective, and viable alternative to traditional treatment methods.

In a study conducted by Agarwal et al.[22] involving 50 patients with partial RC tears, the use of PRP demonstrated significant improvements in pain scores at both the 6- and 12-months. Additionally, there was a notable reduction in the average Quick DASH score at 12-month. The final follow-up revealed that the majority of patients were able to resume their daily activities, suggesting that PRP holds promising potential.

PRP is an autologous formulation rich in growth factors, typically characterized as plasma with a platelet level exceeding the normal range of 150,000 per µ l to 300,000 per µl. PRP has been shown to enhance cell proliferation and stimulate the expression of collagen synthesis genes in tenocytes, with the addition of thrombin significantly boosting these effects.[23,24]

Numerous studies have supported the role of PRP in treating chronic musculoskeletal conditions. While some research indicates no functional improvement in the initial months, they also report an absence of side effects and complications. PRP is an outstanding autologous source of concentrated growth factors that could potentially speed-up healing, suggesting it may be beneficial for treating early RC tendon tears and shoulder pain syndromes.[25]

The study would also like to emphasize several key aspects that must be considered, such as the need for a standardized preparation protocol. Various factors, including timing, speed, technician-dependent reproducibility, and the number of centrifugation cycles, can influence the composition of final PRP produced. Variations in platelet concentration, PRP composition, and the activation method are among the factors that determine PRP's effectiveness.

Conclusion

Our study demonstrated a favourable outcome for use of PRP in supraspinatus tear with improvement in NRS, Constant score, range of motion, and quality of life. The 6 months follow-up showed that PRP was not associated with any side effects or complications and can be considered to be a safe and viable alternative option to conventional surgical treatment.

Declaration

Ethics approval

The study was approved by Institutional review board

Author contributions

Conception and development of the idea *SD, MC*
Writing *MC, CC*
Data analysis *MC, SP*
Data collection *MC, CC, SP*
Review and Editing *SD, MC*

Funding None

Conflict of interests None

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