



EFFECTIVENESS OF ULTRASOUND-GUIDED PLATELET-RICH PLASMA INJECTION IN COMPARISON WITH CORTICOSTEROID INJECTION ON IMPROVING PAIN AND FUNCTION AMONG THE ATHLETES WITH PARTIAL SUPRASPINATUS TEAR OF SHOULDER: A RANDOMIZED CONTROL TRIAL

Sports Science

Dr Laimujam Sobhasini Devi	Post Graduate Student Department of Sports Medicine, Regional Institute of Medical Sciences, Imphal, Manipur, India.
Dr Yumnam Ningthemba Singh	Assistant Professor Department of Sports Medicine, Regional Institute of Medical Sciences, Imphal, Manipur, India.
Dr Pheiroijam Bhupes	Assistant Professor Department of Sports Medicine, Regional Institute of Medical Sciences, Imphal, Manipur, India.
Dr Akoijam Joy Singh*	Nodal Officer, Professor and i/c Head Department of Sports Medicine, Regional Institute of Medical Sciences, Imphal, Manipur, India. *Corresponding Author
Dr Yumnam Nandabir Singh	Professor Department of Sports Medicine, Regional Institute of Medical Sciences, Imphal, Manipur, India.
Dr Kongkham Purnimala	Senior resident Department of Sports Medicine, Regional Institute of Medical Sciences, Imphal, Manipur, India.
Dr Lisham Ranjankumar Singh	Senior resident Department of Sports Medicine, Regional Institute of Medical Sciences, Imphal, Manipur, India.
Dr Sagolsem Adarsh Singh	Post Graduate Student Department of Sports Medicine, Regional Institute of Medical Sciences, Imphal, Manipur, India.

ABSTRACT

Background: Supraspinatus tear is one of the most common causes of shoulder pain in athletes. PRP may have enhancing effect on healing of partial supraspinatus tear. Thus, the purpose of this study is to determine the role of PRP on partial supraspinatus tear. **Methods:** A RCT was done among the athletes with partial tear of supraspinatus who visited Department of Sports Medicine, RIMS, Imphal during October 2020 – January 2022. Patients with MRI diagnosed partial tear of supraspinatus (N=60) randomized into PRP injection plus rehabilitation, (n=30) and corticosteroid injection plus rehabilitation, (n=30) groups. The outcomes were compared using Shoulder Pain and Disability Index (SPADI) for function and Visual analogue scale for pain at baseline, 1st month, 3rd month and 6th month respectively. **Results:** There was no statistically significant difference in mean changes of SPADI ($p=0.679$) and VAS ($p=0.126$) from baseline to 1st month between groups. At the end of 3rd month and 6th month there was statistically significant difference in both mean changes of SPADI ($p=0.001$); ($p=0.000$) and VAS ($p=0.001$); ($p=0.000$) respectively with PRP group having more improvement. **Conclusion:** Ultrasound guided PRP injection along with standard rehabilitation program might be a treatment choice for partial supraspinatus tear.

KEYWORDS

Suprapinatus, PRP, Corticosteroid, SPADI, VAS, USG guided

Introduction:

The shoulder joint is one of the most complex joints and most mobile joints of the human body, this mobility contributes to the high incidence of injury and degenerative pathology of the joint.¹ Rotator cuff tears are among the most common causes of chronic shoulder pain and disability, with the supraspinatus partial thickness tendon tears constituting more than 50% of cases presenting with shoulder pain.^{2,3}

The supraspinatus is a relatively small muscle of the upper back that runs from the supraspinous fossa i.e. superior portion of the scapula to the greater tubercle of the humerus. Injury to supraspinatus is commonly seen in people who engage in overhead activities like throwing a ball, or swimming and also during rotation of the arm at the shoulder joint.¹ Because of poor vascularization, the tendons have a limited ability to regenerate. This failure to heal is considered a principal cause of chronic shoulder pain and hinders successful outcomes from both nonoperative and surgical treatment.⁴

Diagnosis is made based on clinical suspicion with supporting radiographic evidence. The preferred imaging method is magnetic resonance imaging (MRI) and Ultrasonography (USG).⁵

If activities that aggravate a rotator cuff tear continue despite increasing pain, further damage may occur. A rotator cuff tear can get larger over time. The goal of any treatment is to reduce pain and restore function. Nonsurgical treatment options may include rest, activity modification, non-steroidal anti-inflammatory drugs (NSAIDs),

strengthening exercises, physical therapy and different types of injections.⁶

Surgical treatment is generally indicated in patients with conservative treatment failure after three to six months and in younger patients with traumatic tears.^{3,7} Surgical interventions include repairs of torn and degenerate tears. Surgical repair frequently fails due to many factors.³ The chief advantage of nonsurgical treatment is the avoidance of surgical risks including infection, post-operative stiffness, lengthy recovery time, and anaesthesia complications.⁵ Despite its frequent occurrence, the best treatment is still inconclusive. There is no consensus regarding the treatment of partial-thickness tears of the supraspinatus.⁸

A subacromial corticosteroid injection is an option used widely for patients with inadequate responses to nonoperative procedures, although clinical evidence of its efficacy is conflicting. A local corticosteroid injection counteracts the inflammatory and immune cascades, so it is beneficial in the early phase of the disease.⁴ Most studies have shown pain relief and functional improvement from a corticosteroid injection in the short term but no clear benefit in the long term.⁴ Inflammatory cytokines including tumor necrosis factor α , interleukin 1 β , and interleukin 6 are released from the ruptured rotator cuff and these cytokines can be repressed by steroid.⁶ The results of this study may shed light on the ability of corticosteroid injection to provide a window of opportunity to optimize rehabilitation following rotator cuff injury.⁹

Due to the relative avascular nature of tendons, the regenerative potential is limited.¹⁰ Hence, orthobiologics such as platelet-rich plasma (PRP), platelet-poor plasma and autologous processed serum could be an option for the treatment of this pathology.⁷

Platelet rich plasma (PRP) is an autologous blood product that has supra-physiologic levels of growth factors like platelet-derived growth factor (PDGF) which stimulates cell mitosis and vascular endothelial growth factor (VEGF) that helps multiplying of endothelial cell and transforming growth factor (TGF) which enhances collagen synthesis and cytokines that have the potential to expedite the tendon healing process.¹¹ There is some clinical evidence that application of autologous platelets may help to revascularize the area of injury, to promote tendon healing and to improve pain and functional outcomes in supraspinatus pathologies. PRP injection to the injured site provides it with healing growth factors that are difficult to reach due to poor blood supply and ultimately augment the body's natural healing process.^{1,3,4,12}

A good rehabilitation program should include: range of motion exercises, stretching and strengthening of the rotator cuff muscles, balancing of muscular tone of the rotator cuff muscles, scapular stabilization and control as well as eccentric strength exercises of the rotator cuff. Eccentric strengthening is utilizing muscle contraction while the muscle is lengthening and has been shown to promote tendon healing and decrease pain in patients with chronic rotator cuff tendinopathy.¹¹ Ultrasonic guidance injection can be a valid tool to perform a procedure with a proper selection of injection site, to increase the efficacy and reduce complications of blind injection.¹²

The indications of corticosteroid and PRP injections are controversial and a complete agreement has not been reached so far by the various authors studying these methods. Despite the advances in conservative treatment, cases of tears or tendinosis are still difficult to treat successfully in the long term.⁷ Therefore, in our study, we would like to compare the effectiveness of ultrasound guide PRP injection and corticosteroid injection in improvement of pain and function among the athletes with MRI diagnosed partial tear of supraspinatus.

Materials and method:

A randomized controlled trial was done among athletes with partial supraspinatus tear who visited Department of Sports Medicine, RIMS, Imphal during October 2020 – January 2022. Patients with shoulder pain were clinically examined and sent for MRI. A partial supraspinatus tear was defined as tendon disruption that did not involve the entire thickness of the tendon, might be including bursal, articular and intrasubstance tears.

Inclusion criteria: Patient of age between 18 to 40 years, with history of shoulder pain less than 3 months duration, patient with MRI diagnosed partial supraspinatus tear.

Exclusion criteria: Frozen shoulder, or severe shoulder arthritis, sub-acromial impingement due to a bony cause, prior shoulder joint operation, patients with history of shoulder dislocation, patients who received corticosteroid injection within last 12 weeks, history of platelet dysfunction syndromes, malignancy, thrombocytopenia (less than 150000/microliter).

A sample size of 60 was calculated using formula

$$N = (Z\alpha + Z\beta)^2 (S1^2 + S2^2) / (m1 - m2)^2$$

According to a study conducted by Serya et al. considering 80% power, and 5% level of significance and 10% for drop outs to counter attrition bias.¹⁴

Outcome measures:

Pain and functional activities measured by the Shoulder Pain and Disability Index (SPADI), and Visual analogue scale for pain.

Patient who met inclusion and exclusion criteria and gave consent for participation in the study were randomized (N=60) into PRP injection plus rehabilitation, (n=30) and Corticosteroid injection plus rehabilitation group, (n=30) groups by block randomization technique. After taking informed consent, all subjects were evaluated for Shoulder Pain and Disability Index (SPADI) score and VAS at baseline before starting any intervention. And after starting the interventions, at the end of 1st month, 3rd month and 6th month, patients were evaluated with SPADI score and VAS.

PRP injection plus rehabilitation group:

PRP was prepared using the double spin method. 25ml whole blood was drawn under proper aseptic and antiseptic precautions and put in 3 vials containing acid citrate dextrose anticoagulant. The three vials were centrifuged at 2400 revolutions per minute for 10 minutes. The clear supernatant fluid was taken out using a 20-gauge spinal needle and put in plain vials and centrifuged again at 3600 rpm for 15 minutes. The lower 1/3rd was PRP and the upper 2/3rd was platelet-poor plasma (PPP). 4 ml of PRP was procured by removing the PPP.

The patient was seated, and the shoulder was placed in crass position. Sterile skin preparation was done. 2ml of PRP was given in the sub-acromial bursa and 2 ml of PRP was given inside the torn region of supraspinatus under ultrasound guidance in in-plane technique.

In the corticosteroid group, 1ml of triamcinolone acetonide 40mg and 1ml of lidocaine (2%) was injected into the subacromial bursa under ultrasound guidance.

After the injections, patients were asked to withdraw from using any non-steroidal anti-inflammatory drugs (NSAID). Patients were instructed to take rest on the affected shoulder for the next 2 days. Acetaminophen and cold therapy were allowed for pain control.

Both the groups followed a functional rehabilitation program including range of motion exercises, stretching and strengthening of the rotator cuff muscles, balancing of the muscular tone of the rotator cuff muscles, scapular stabilization and control as well as eccentric strength exercises of the rotator cuff muscles.

Informed Consent and Ethics Approval:

All the participants were informed about the nature of the study and those who agreed to participate were asked to sign the informed consent form. Participants were assured that they could withdraw from the study at any time. The study was approved by Institutional Ethics Committee.

Statistical Analysis:

Data were entered and analyzed by using SPSS version 21. The baseline characteristics between the PRP plus rehabilitation group and corticosteroid injection plus rehabilitation group were studied by chi-square test for categorical variables and independent t-test was used for continuous variables. For descriptive statistics, mean and standard deviation were used. For outcome measures, the mean changes from baseline to 1st month, 3rd month and 6th month follow-up for each group were compared by repeated measure ANOVA test followed by post hoc analysis (Bonferroni). For comparison between the groups, independent t-test was used. p-value < 0.05 was taken as significant.

Result:

The baseline characteristics of the patients in the control and intervention group were not statistically significant (Table 1). Outcome measures at baseline were not statistically significant (Table 1). There was significant improvement seen within the group comparison from baseline to 1st month, 3rd month but no significant improvement within the group comparison from 3rd month to 6th month in both SPADI and VAS in corticosteroid plus rehabilitation group however significant improvement is seen in all the follow-ups in PRP plus corticosteroid group (Table 2). At the end of 1st month, there was no statistically significant difference between the groups in both mean changes of SPADI (p=0.679) and VAS (p=0.126) from baseline. At the end of 3rd month, there was statistically significant difference in both mean changes of SPADI (p=0.001) and VAS (p=0.001) from baseline with more improvement in PRP plus rehabilitation group. At the end of 6th month, there was also statistically significant difference in both mean changes of SPADI (p=0.000) and VAS (p=0.000) from baseline with more improvement in PRP plus rehabilitation group (Table 3).

Table 1: Comparison of baseline characteristics between the groups, (N=60)

Baseline Characteristics	PRP + Rehabilitation (n=30) (Mean±SD)	Corticosteroid+Rehabilitation(n=30) (Mean±SD)	p-value*
Age in completed years			0.500*
18-25	13(43.3%)	12(40.0%)	
26-40	17(56.7%)	18(60.0%)	

Gender			0.604*
Male	15(50.0%)	12(40.0%)	
Female	15(50.0%)	18(60.0%)	
Type_of_Sports			0.960*
Cricket	12(40.0%)	13(43.3%)	
Badminton	7(23.3%)	9(30.0%)	
Boxing	3(10.0%)	2(6.7%)	
Tennis	3(10.0%)	3(10.0%)	
Swimming	3(10.0%)	2(6.7%)	
Judo	2(4.26.7%)	1(3.3%)	
Duration(weeks)	5.17±3.19	4.8±3.43	0.670*
VAS	8.513 ± 0.729	8.650 ± 0.669	0.500#
SPADI	76.17 ± 2.62	75.70 ± 3.07	0.530#

*chi-square test #Independent t-test

p-value < 0.05 is taken as significant

Table 2: Within the group comparison of outcome measures in both groups

Outcome measures	Study Groups	Baseline	1 st month	3 th month	6 th month
VAS	PRP + Rehabilitation	8.25±0.41	5.67±0.43	3.26±0.39	2.21±0.44
	p value*		0.00	0.00	0.00
	Corticosteroid + Rehabilitation	8.37±0.35	5.600.41	3.92±0.40	3.81±0.42
	p value*		0.00	0.00	0.086
SPADI	PRP + Rehabilitation	75.70±3.07	55.97±2.84	35.93±3.36	26.73±3.45
	p value*		0.00	0.00	0.00
	Corticosteroid + Rehabilitation	76.17±2.62	56.83±2.75	41.43±3.10	40.46±2.99
	p value*		0.00	0.00	0.056

*Repeated measures ANOVA

p-value < 0.05 is taken as significant

Table 3: Comparison of mean changes of SPADI score and VAS between the two groups from baseline to 1st month, 3rd month and 6th month follow up, (N=60).

	Mean changes from base line		
Mean differences VAS score	PRP + Rehabilitation (n=30) (Mean ± SD)	Corticosteroid+Rehabilitation (n=30) (Mean ± SD)	p-value*
1 st month	2.58±0.49	2.76±0.43	0.126
3 rd month	4.99±0.52	4.45±0.39	0.001
6 th month	6.04±0.69	4.55±0.38	0.000
Mean differences SPADI score	PRP + Rehabilitation (n=30) (Mean ± SD)	Corticosteroid+Rehabilitation (n=30) (Mean ± SD)	p-value*
1 st month	19.73±4.16	19.33±3.23	0.679
3 rd month	39.76±4.08	34.73±3.70	0.001
6 th month	48.96±4.40	35.73±3.67	0.000

*Independent t test

p-value < 0.05 is taken as significant

Discussion:

In our study, we gave injection PRP inside the torn region of the supraspinatus and in the sub-acromial bursa under ultrasound guidance which is followed by functional rehabilitation program and in the control group, we gave corticosteroid injection in the sub-acromial bursa under ultrasound guidance and the same rehabilitation program was received. At 1st month follow-up, there was no significant difference seen between the two groups. There were significantly better improvements seen in the PRP plus rehabilitation group in 3rd and 6th month follow-up in comparison with the corticosteroid plus rehabilitation group.

The results from the current study showed that both PRP and a corticosteroid had beneficial effects for the treatment of partial supraspinatus tears. However, the corticosteroid effects plateau after 3 months, with no significant change between the 3rd and 6th month

assessments in the corticosteroid plus rehabilitation group. Cortisone is widely used to treat patients with shoulder pain, and there is no doubt about its positive effect on pain, especially in the short term.^{15,16} Several systematic reviews have found the effectiveness of corticosteroids in the treatment of shoulder disorders.^{17,18,19} The use of corticosteroids should be carefully evaluated given the high risk of muscle weakness, tendon rupture and collagen collapse.⁷ There have been several case reports of tendon rupture following the administration of corticosteroid injections, particularly in the Achilles, biceps brachii and supraspinatus. Given all of the potential side effects and proven low efficacy of corticosteroid injections, patients and providers are looking for better options. With the proven in vitro studies confirming PRPs efficacy to promote healing it would seem as if PRP would be a superior option to corticosteroids for rotator cuff tendinopathy.¹¹

PRP is a method recently developed due to the discovery of growth factors released by platelets, which have been shown to be effective in tissue repair.⁷ PRP provide a minimally invasive non-operative treatment for partial tears of rotator cuff muscles and can be considered a less expensive alternative to surgery with reduced potential for operative side effects and adverse events.¹³ Healing process starts with platelet aggregation and clot formation and forms a scaffold, which acts as a temporary matrix for cell growth and differentiation. Platelets actively secrete pre-synthesized growth factors (GF) and synthesize more GFs for several days during their life span. PRP injection to the injured site provides it with healing growth factors that are difficult to reach due to poor blood supply.¹⁴ Application of these agents was shown to promote tendon cell proliferation, collagen synthesis and vascularization in vitro and in vivo.^{20,21}

This shows that PRP provides both short-term as well as long-term improvement in both pain and function and athletes were able to perform activities and progress functional rehabilitation program without any limitations thus they had improvement in function and could achieve a faster return to sports activities

This study helps to establish PRP injection as the preferred treatment for partial supraspinatus tears. With the proven poor efficacy of corticosteroid injections and the potential risks involved, PRP seems to be a safe option with better results compared to steroids and a good alternative to sub-acromial cortisone injections, especially in patients with contraindication to cortisone.

Limitation of the study:

The study could have been more reproducible if done with a bigger sample size and longer follow-ups.

Conclusion:

Platelet rich plasma is a less invasive procedure compared to surgical treatment. With the proven poor efficacy of corticosteroid injections and the potential risks involved, PRP seems to be a safe option with results that are better to steroids. Injection of PRP under ultrasound guidance gives the injection at exact location and probably gives better outcomes. PRP injection provides faster improvement which allowed the athletes for sooner return to sports activities. Therefore, we believe PRP injection should be considered the treatment of choice for patients with partial supraspinatus tear.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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