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Comparative study between suprascapular nerve block versus platelet rich plasma in the treatment of adhesive capsulitis of shoulder joint

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Abstract
Introduction: Adhesive capsulitis of shoulder is a condition characterised by painful restriction of active and passive glenohumeral range of motion in at least two directions most notably shoulder abduction and external rotation. [1] Therapeutic options for the management of adhesive capsulitis are NSAIDs, intra-articular steroid injections, Suprascapular nerve block (SSNB), platelet rich plasma Injection (PRP), manipulation under general anaesthesia or arthroscopic capsular release. SSNB is an old and effective method for the treatment of adhesive capsulitis. Recently USG guided nerve blocks have been found to be safer and more efficacious compared to blind, landmark guided nerve blocks. PRP is newer modality of treatment in regenerative medicine to enhance the healing process in adhesive capsulitis.
AIM: To evaluate & compare the outcome of adhesive capsulitis after either injection of PRP or SSNB.
Materials and Methods: Patients with Adhesive capsulitis either received single injection of SSNB (n=45) (40 mg methylprednisolone + 5ml 2% lignocaine) or PRP (n=45) after randomization. All participants were also advised to perform a home based 10 minute exercise therapy after injection. The outcome were measured by using Constant and Murley shoulder score. Participants were evaluated at 0 (post-procedure), 3rd day,1 and 6 month. One way ANOVA-F has been used to compare between groups.
Results: PRP showed significant difference in improvement than SSNB. No major adverse effect were seen in both groups.
Conclusion: Both treatment modalities are effective with better result in PRP group than SSNB in long term follow-ups.

Keywords: Fractures of the Calcaneum, PRP group

Introduction
Adhesive capsulitis is the condition which is characterised by painful and restriction of active & passive glenohumeral range of motion more than 20% in at least two directions. The aetiology of the adhesive capsulitis is still unknown [1].
In 1945, adhesive capsulitis term was given by Julius Neviaser. He described histological examination of bursa and capsule of shoulder joint of ten cases. Varying degree of inflammation were seen in bursa. In sub-synovial layers fibrosis and degeneration of the collagen and deposition of calcium were found [2].
McAlister *et al*. in 2016, Adhesive capsulitis can be primary or secondary. Primary type can occur spontaneously without any specific trauma or inciting event. The cause of primary is idiopathic. Causes of secondary adhesive capsulitis are periarticular fracture, dislocation of the shoulder joint or the sequel of other articular trauma around shoulder [3].
Suprascapular nerve, a mixed nerve, originates from upper trunk of brachial plexus. Just proximal to the suprascapular notch, the SSN gives off the sensory branches, which travels with it through the notch before proceeding laterally to innervate the acromioclavicular joint and its associated bursa and the coracoclavicular and coracohumeral ligaments.
The suprascapular nerve supplies sensory fibres to about 70% of the shoulder joint including the superior and posterosuperior regions of the shoulder joint, capsule and acromioclavicular joint. Nerve blockage increases patient's pain tolerability.

Adam *et al*. reported average improvement in abduction of 86.92 degree, and external rotation of 32.3 degree. He further reported significant improvement in pain and achieved almost normal day to day activity after suprascapular nerve block in adhesive capsulitis [4].

Venkat *et al*. reported that the patients who underwent ultrasound guided nerve block had more significant pain relief and the effect was more longer than the patients who had nerve block by traditional blind technique [5].

In 2016 Aslani *et al*. on PRP for adhesive capsulitis stated that adhesive capsulitis is a disorder of restriction of movement due to adhesion by fibrosis in the shoulder capsule. PRP releases growth factors, increases stem cells, thus produce collagen, which enhances the healing of capsule of shoulder joint. In this study, they found there was 60% improvement in pain, 70% improvement in functional outcome where flexion improved from 70 degree to 150 degree, abduction improved from 75 degree to 135 degree and external rotation improved from 25 degree to 50 degree. He also reported 70% satisfaction score after treatment with PRP in patients suffering with adhesive capsulitis [6].

Many studies have been done for SSNB in the management of adhesive capsulitis since past two decades, but there are very few studies regarding the efficacy of PRP for the management of adhesive capsulitis. In this view, purpose of the study was to compare the efficacy of the newer modality with the old modality of management for adhesive capsulitis.

Materials and Methods

Patients who had pain and stiffness in one or both the shoulders for at least 4 weeks, restricted active and passive range of motion at the glenohumeral joint, age of ≥ 40 and ≤60 years, and who gave voluntary consent for participation were included in the study.

Patients with chronic shoulder pain due to other causes like nerve damage or neurologic disorders, any skin problems including trauma and infection over the affected shoulder, h/o fracture around the shoulder joint, patient following shoulder surgery, uncontrolled diabetes were excluded from the study.

Recruited patients underwent software (Open Epi Random Program) generated randomization into two study groups.

Group-1: Suprascapular nerve block (group-S).

Group-2: Plate Rich Plasma injection (group-P).

Technique of Suprascapular nerve block (SSNB)

Patient in sitting position with hand on opposite shoulder. Patient attached to a monitor, the ultrasound machine is placed anterior to the patient allowing an unobstructed view of the ultrasound screen by the operator. The skin was sterilized with antiseptic solution and a sterile dressing applied to the probe surface. A linear transducer (L38x, 6-13 MHz, broadband linear array; Sonsite M-turbo Inc, Bothell, WA) is placed just cephalad and parallel to scapular spine. First, identify the scapular spine as a hyperechoic linear structure that, unlike the pleura, does not move with normal respiration. Moving the probe laterally and cephalad, the SSN is identified as a 2- to 3-mm hyperechoic structure 3 to 4 cm deep to the skin beneath the transverse scapular ligament in the scapular notch.

2 ml 2% lignocaine is injected for local anaesthesia. A 50-mm short bevel needle is then advanced in-plane with ultrasound guidance in a medial to lateral approach toward the scapular notch. When the needle tip is adjacent to the nerve and underneath the transverse suprascapular ligament, 9 ml of 2% lignocaine and 1 ml (40 mg) of depot methyl prednisolone in 3 mL increments with intermittent aspiration used for suprascapular nerve block. A successful injection is confirmed by cephalad displacement of the transverse scapular ligament.

Technique of suprascapular nerve block (SSNB): Patient in sitting position with hand on opposite shoulder. Patient attached to a monitor, the ultrasound machine is placed anterior to the patient allowing an unobstructed view of the ultrasound screen by the operator. The skin was sterilized with antiseptic solution and a sterile dressing applied to the probe surface. A linear transducer (L38x, 6-13 MHz, broadband linear array; Sonsite M-turbo Inc, Bothell, WA) is placed just cephalad and parallel to scapular spine. First, identify the scapular spine as a hyperechoic linear structure that, unlike the pleura, does not move with normal respiration. Moving the probe laterally and cephalad, the SSN is identified as a 2- to 3-mm hyperechoic structure 3 to 4 cm deep to the skin beneath the transverse scapular ligament in the scapular notch.

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Fig 1: Method of SSNB

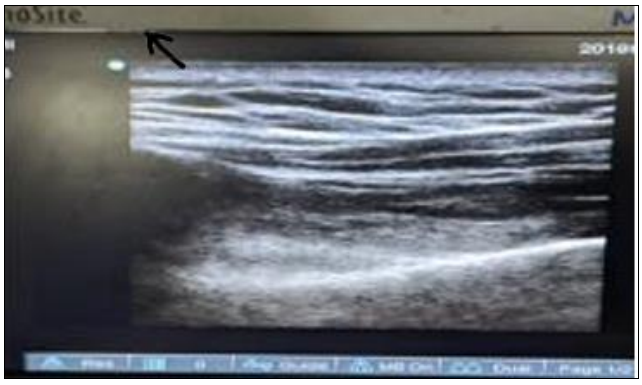


Fig 2: Suprascapular notch under USG

Technique of PRP preparation & administration: 35 ml of blood was drawn from the peripheral vein of the same patient. The blood was collected in CPDA (citrate phosphate dextrose

adenine) containing blood bag with the ratio of 1.4 ml anticoagulant to 10 ml of Whole blood. Then we transfered the blood in 3 test tubes, each contain 10ml of blood. All the 3 tubes were kept in laminar flow for preventing cross-contamination. We also did a quantitative count of platelet in patient's Whole blood. The tubes were kept at room temperature (20- 25 degree centigrade) for half an hour for settling the Red blood cells. Centrifugation was performed using a spin of 2200 rpm for 3 mins and supernatant PRP was transferred to another tube. Centrifugation done for 2nd time using heavy spin at 2000 x g (2.0 RCF) for 10 mins. The platelet poor plasma was separated from the settled PRP which then was transferred to satellite tube. We did the quantitative estimation of the pooled platelet's in blood product. The prepared PRP were taken to OPD in sterile tube and used within 1 hour of preparation. An average of 4 ml of PRP was prepared from the 30 ml of blood which contains an average 7.5 lakhs of platelets. 2 to 3 cm inferior and 1cm medial to the posterolateral corner of the acromion process and directed anteriorly in the direction of the coracoid process and needle position was confirmed under c-Arm. PRP is injected into the joint.

Fig 3: Landmark of PRP injection

Constant and Murley Shoulder assessment Score were recorded (Using standard orthopaedics goniometer and spring balance) immediately after the procedure, on day 3, after 1 month 6 months.

Statistical analysis

1 Statistical analysis carried out using statistical packages for SPSS 23 for Windows (SPSS Inc., Chicago, IL, USA).
2 One way ANOVA-F has been used to compare between post- procedure (day-0), day 3, 1 month and 6 month.
3 Two sided p values will be considered as statistically significant at $p<0.05$.

Results

A total of 90 subjects (45 in each group) were evaluated in this study by using Constant and Murley Shoulder Score. After both the procedure patients were advised to do home based physiotherapy for 10 mins thrice daily.

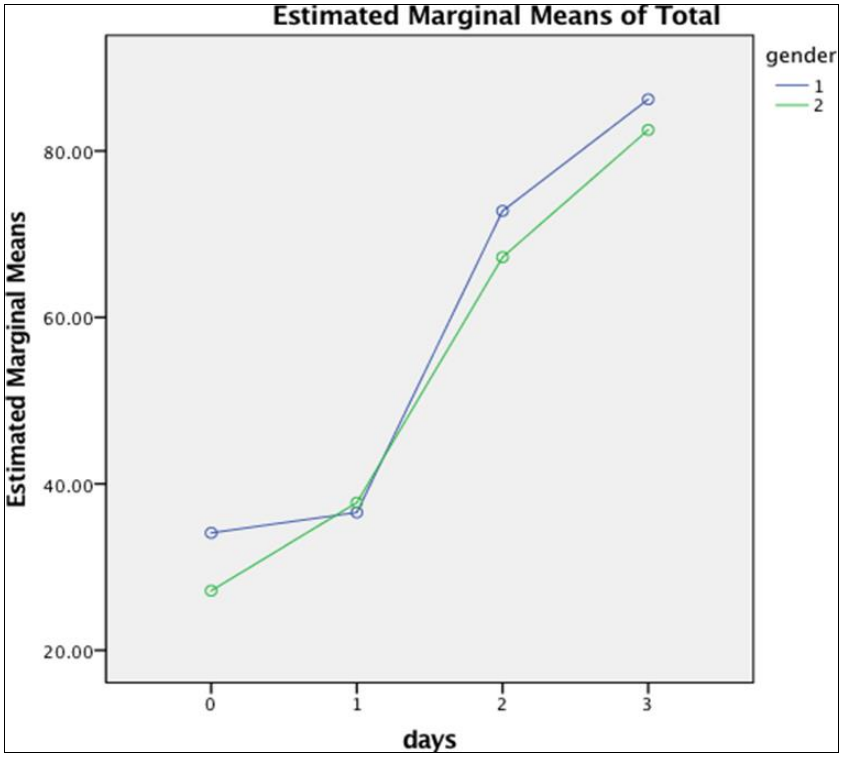
Table 1: Post procedure observation-Constant and murley shoulder score

	Day-0	3RD Day	1 Month	6 Month
1.Pain-				
.none-15 .mild-10 .moderate- 5 .severe-0				
2.Activity-				
.ability to work: 0-4 .ability to recreational activity: 0-4 .ability to sleep: 0-4				
3.Arm position-				
.up to waist-2 .up to xiphoid-4 .up to neck-6 .up to top of head-8 .above head-10				
4. Strength of abduction(pounds) -25 points(1/lb*) [1 lb=0.454 kg]				
5.Forward flexion-				
>150-10 121-150 -8 91-120-6 61-90-4 31-60-2 0-30-0				
6.Abduction-				
>150-10 121-150-8 91-120-6 61-90-4 31-60-2 0-30-0				

7.External rotation-				
Head behind head-elbow forward- 2 Head behind head-elbow back - 2 Head on top of head- elbow forward-2 Head on top of head- elbow back- 2 Full elevation- 2				
8.Internal rotation-				
Inter scapular region-10 Inferior tip of scapula-8 12th rib-6 Lumbo sacral junction-4 Buttock-2 Lateral thigh-0				

Table 2: Effect of gender in improvement of both the groups.

ANOVA						
		Sum of Squares	**Degree of Freedom**	**Mean Square**	**F**	**Sig.**
Day 0	Gender	1066.17	1	1066.17	8.297	0.005
	Error	11308.34	88	128.50		
	Total	12374.50	89			
Day 3	Gender	30.82	1	30.82	0.125	0.724
	Error	21621.28	88	245.70		
	Total	21652.10	89			
1M	Gender	683.09	1	683.09	5.680	0.019
	Error	10583.54	88	120.27		
	Total	11266.62	89			
6M	Gender	298.59	1	298.59	2.230	0.139
	Error	11781.07	88	133.88		
	Total	12079.66	89			



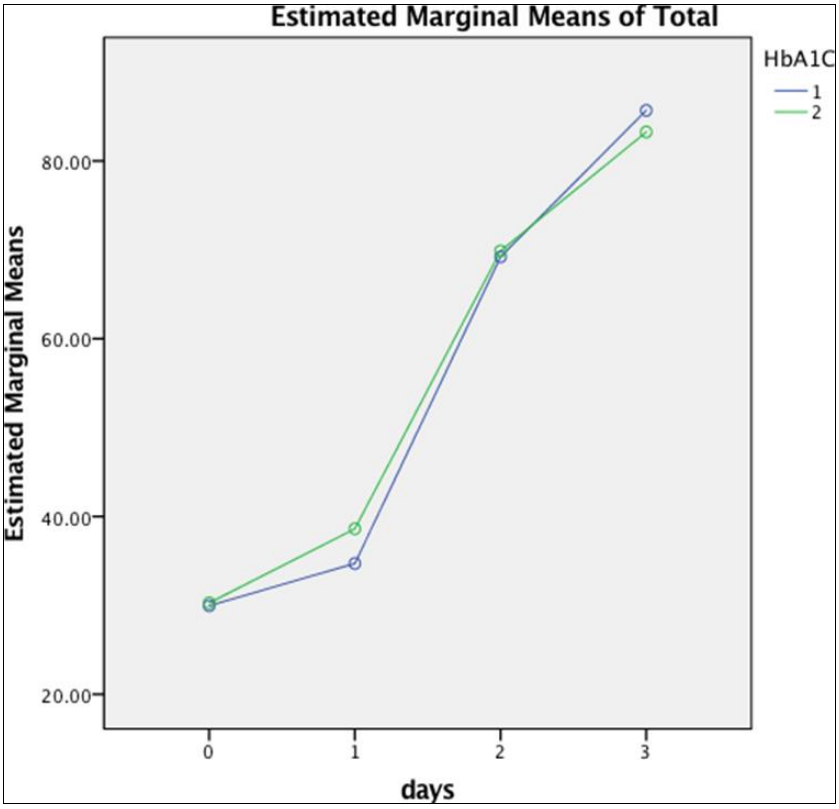
Graph 1: Correlation of Gender with outcome (gender-1= male, 2= female)

On X-axis 0 indicates day-0, 1 for day-3, 2 for 1 month & 3 for 6th month follow-up. On day-0 there is significant difference in score. On day-3 F-scores improve but difference is not significant as compare between males and females. On 1 month follow-up both male & female show improvement and the improvement was significant. On 6th month improvement is more in male.

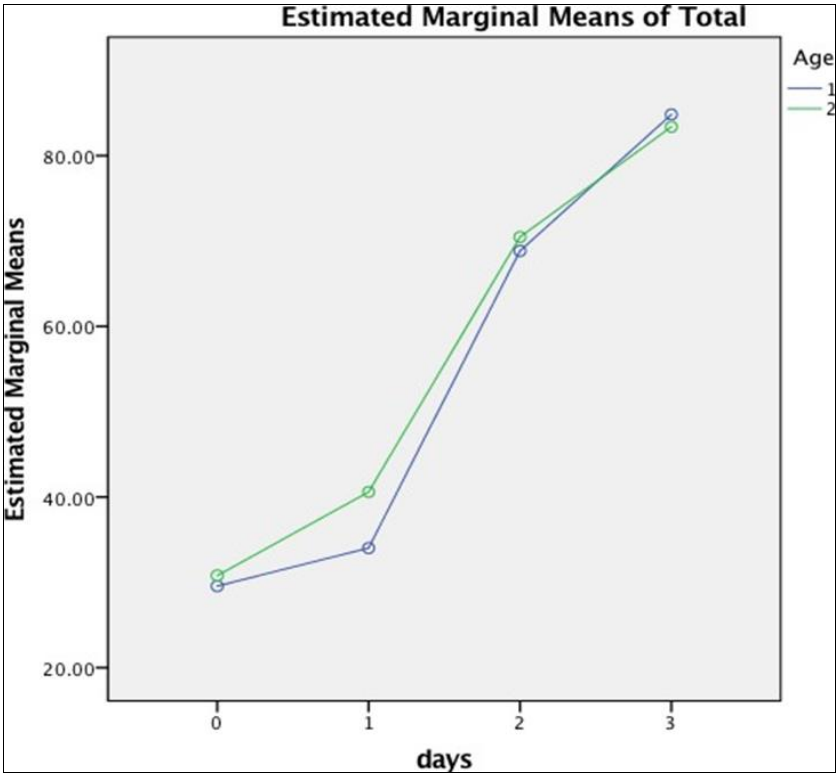
Table 3: Effect of diabetes in improvement of both the groups.

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Day 0	HbA1C	1.95	1	1.95	0.014	0.907
	Error	12372.56	88	140.60		
	Total	12374.50	89			
Day 3	HbA1C	313.98	1	313.98	1.295	0.258
	Error	21338.12	88	242.48		

	Total	21652.10	89			
1M	HbA1C	9.00	1	9.00	0.070	0.791
	Error	11257.62	88	127.93		
	Total	11266.62	89			
6M	HbA1C	121.66	1	121.66	0.895	0.347
	Error	11958.00	88	135.89		
	Total	12079.66	89			



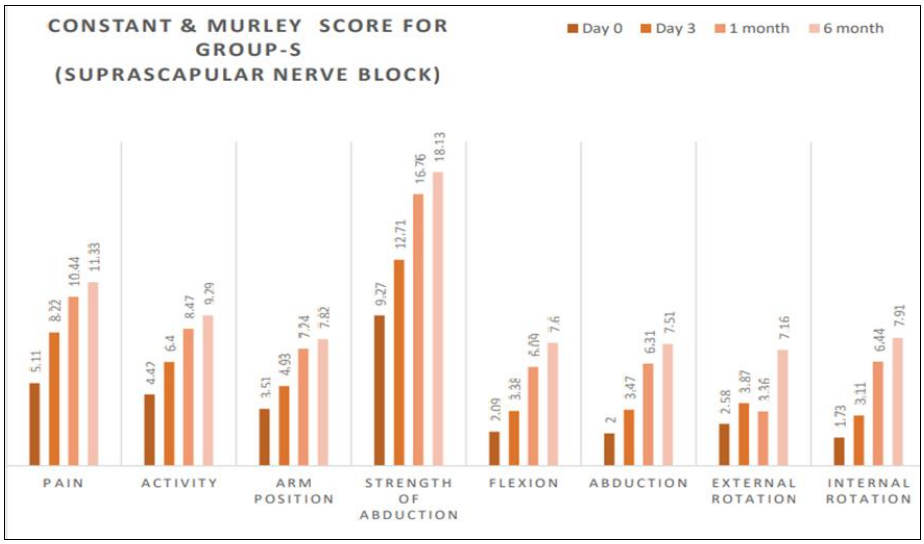
Graph 2: Correlation of diabetes with outcome (In Y axis: 1= non-diabetic, 2= diabetic) It shows diabetes and non-diabetes has similar improvement.



Graph 3: Effect of age in improvement. (in Y axis:1= 41 to 50 years, 2= 51 to 60) Age groups has no significant difference in the outcome.

Table 4: Effect of age in improvement.

ANOVA						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Day 0	Age	34.04	1	34.04	0.243	0.623
	Error	12340.46	88	140.23		
	Total	12374.50	89			
Day 3	Age	970.49	1	970.49	4.129	0.045
	Error	20681.62	88	235.02		
	Total	21652.10	89			
1M	Age	59.71	1	59.71	0.469	0.495
	Error	11206.91	88	127.35		
	Total	11266.62	89			
6M	Age	46.62	1	46.62	0.341	0.561
	Error	12033.04	88	136.74		
	Total	12079.66	89			



Graph 4: Improvement of constant score in Group

Day-0 in group-S

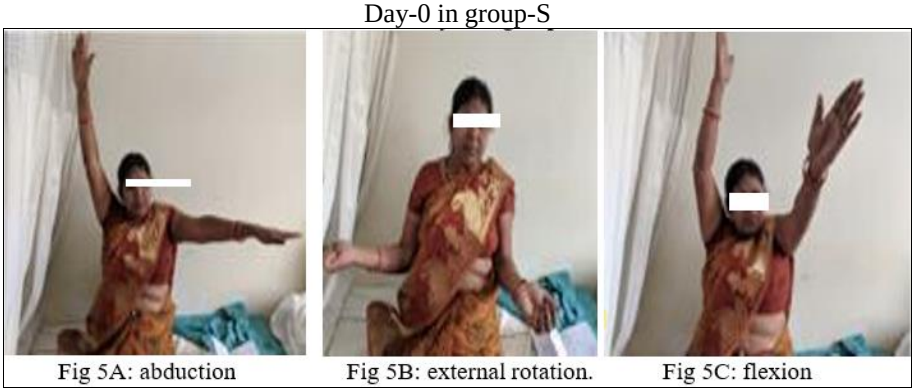
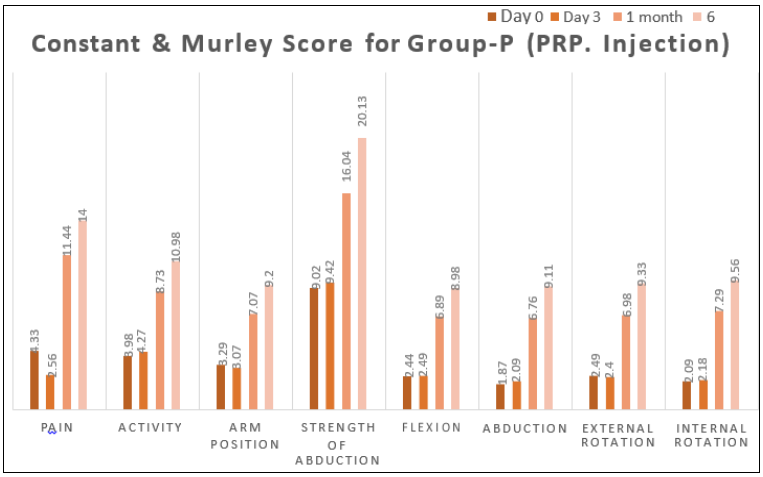


Fig 5A: abduction Fig 5B: external rotation. Fig 5C: flexion

6 months in group-S

Fig 6A: Abduction Fig 6B: External rotation. Fig 6C: Flexion



Graph 5: Improvement of total constant score in Group-P.

Day 0 in Group-P

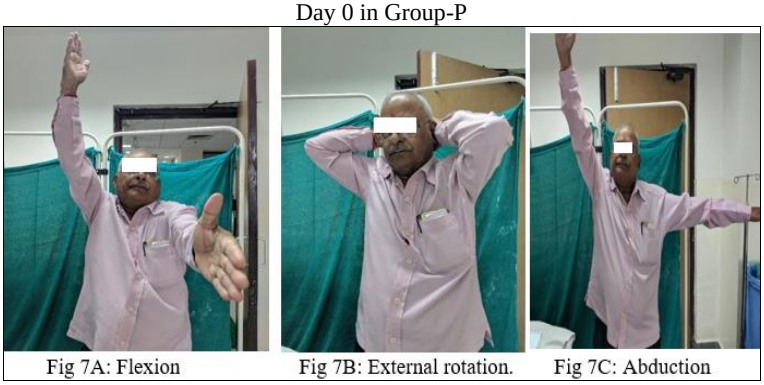


Fig 7A: Flexion Fig 7B: External rotation. Fig 7C: Abduction

6 month in Group-P

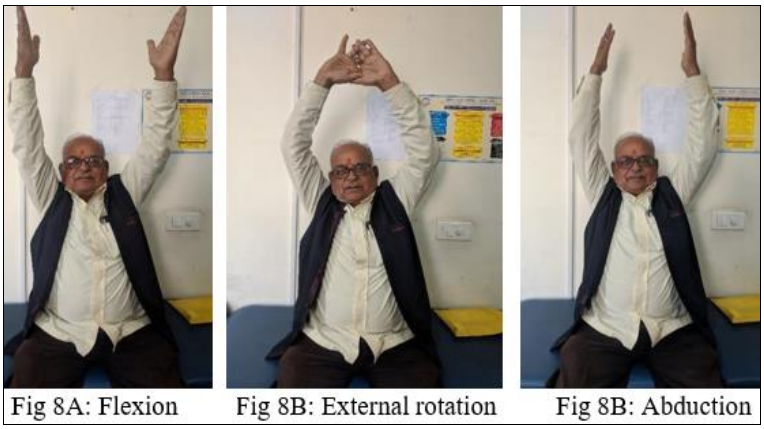


Fig 8A: Flexion Fig 8B: External rotation Fig 8B: Abduction

In group-S improvement is significant from day-0 to day-3 & 1 month. But at 6 month the improvement is not significant correlated with day-0.

Graph-4 shows pain improvement was 73%, activity improvement 75%, arm position by 78%, abduction by 75.1%, external rotation by 71.6%, range of motion improved by average of 75.5%.

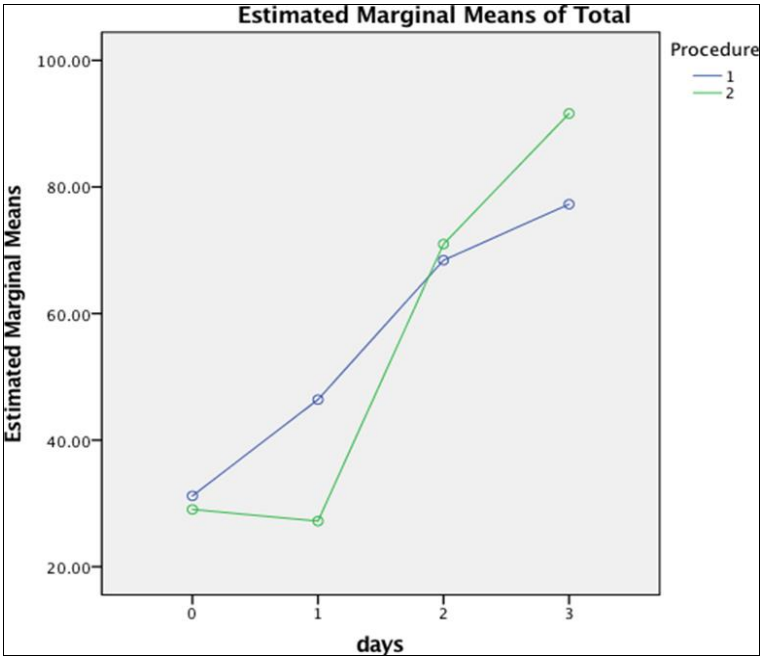
In group-P when compared the improvement of day-3 with day-0, the improvement is moderate. Similar improvements are there in other follow-up also. Procedure-P is showing moderate improvement from day-0 to 6 month. It is showing the gradual and steady improvement in Group-P.

Graph-5 shows pain improvement was 93.3%, activity improvement 91.5%, arm position by 92%, abduction by 91.1%, external rotation by 93.3%, range of motion improved by average of 92.45%.

Table 5: Comparison between group-S vs group-P on different days separately.

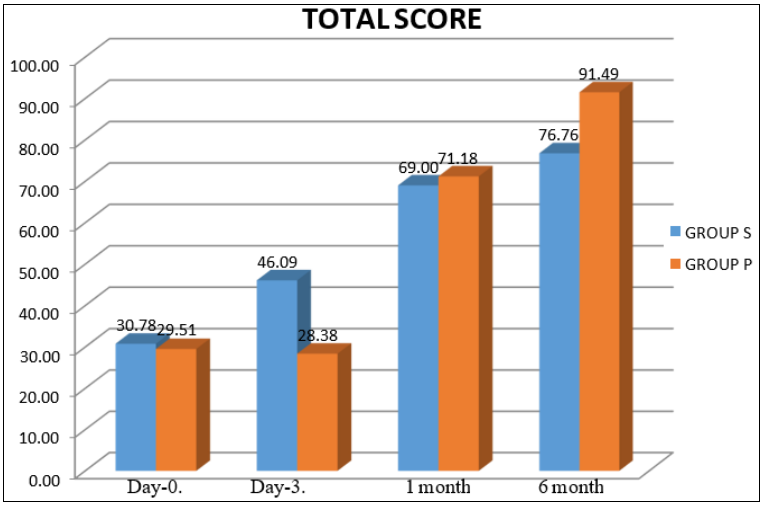
ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Day 0	Procedure	103.32	1	103.32	0.74	0.392
	Error	12271.18	88	139.45		
	Total	12374.50	89			
Day 3	Procedure	8273.67	1	8273.67	54.42	0.000
	Error	13378.44	88	152.03		
	Total	21652.10	89			
1M	Procedure	146.16	1	146.16	1.16	0.285

	Error	11120.47	88	126.37		
	Total	11266.62	89			
6M	Procedure	4609.97	1	4609.97	54.31	0.000
	Error	7469.68	88	84.88		
	Total	12079.66	89			



Graph 6: Comparison of 2 groups on different days

In this graphical presentation on X-axis 1 indicates Group-S & 2 indicates Group-P. On Y- axis 0 indicates day-0, 1 indicates day-3, 2 indicates 1 month & 3 is for 6th month follow-up. On day-0 (day of procedure) both the groups show similar result. On day-3 S-group shows improvement but P-group shows the result same as with day-0. Again on 1-month both S & P groups have same improvement. On 6th month P-group shows significant improvement but S- group also shows improvement but not significant compared to day-3 and 1-month follow-up.



Graph 7: Comparison between two groups on total constant score

Discussion

Adhesive capsulitis (Frozen shoulder) is the condition which is characterised by painful and restriction of active and passive shoulder joint (glenohumeral) range of motion more than 20% in at least two directions. Most notable restriction of shoulder movement are abduction and external rotation.

In our study we included only idiopathic adhesive capsulitis. The patient, who had no improvement by physiotherapy, we included them in study. In initial investigation if patient's blood sugar level was found more than reference level (FBS >126mg/dl & PPBS>200mg/dl), we advised patients for HbA1c test. If HbA1c was found >7, then Endocrine consultation was sought for treatment of diabetes. When diabetes was controlled (HbA1c <7), the patients were included in study for intervention, and they were asked to continue antidiabetics as advised by Endocrinologist. In our evaluation we compared outcome between two groups and compared the incidence related to gender, age group, diabetes etc. and their impact on outcome.

Sheridan MA *et al*. showed there is 70% incidence rate of adhesive capsulitis among female, whereas incidence of adhesive capsulitis among female in our study is 56.6% with

M:F is 1:1.3. According to Griggs SM *et al*. male gender showed worse outcome in final evaluation. But in our study there is no significant difference in outcome in all four follow-up. There is no impact of gender in final outcome of result in both interventional groups.

Study by Arkkila *et al*. on shoulder capsulitis associated with Diabetes reported that shoulder capsulitis is commonly associated with both type 1 and type 2 diabetes. The prevalence of adhesive capsulitis increases after age of 40 in type 1 diabetes and age of 50 in type 2 diabetes. Smoking increases prevalence of adhesive capsulitis in diabetes mellitus patients due to microvascular vasoconstriction. Long term diabetes also increases complication of adhesive capsulitis due to diabetic microvascular complication. Type 2 diabetes patients with poor glycaemic control Hba1c> 9 have more shoulder capsulitis than patients with better control. The prevalence of adhesive capsulitis in type 1 diabetes are around 10% and type 2 diabetes are much higher rate of 22%. Griggs SM *et al*. also stated diabetes has worse final outcome compare to non- diabetic. In contrast, our study shows 35.5% are diabetic among which older age groups has more incidence rate (38%) of being diagnosed as diabetes compared to younger age group (32%). But in our study, there is no impact of diabetes on final outcome i.e. both diabetic and non-diabetic showed non-significant difference in final outcome.

Adhesive Capsulitis can be treated conservatively with nonsteroidal anti-inflammatory drugs and physiotherapy. The interventional options available are intra-articular shoulder joint steroid injections, Suprascapular nerve block (SSNB), platelet rich plasma Injection (PRP). The surgical options are manipulation of shoulder to release of adhesion of capsule under general anaesthesia or arthroscopic capsular release. We did study on two less invasive line of management of adhesive capsulitis i.e. suprascapular nerve block (SSNB) & platelet rich plasma (PRP) and there comparison for outcome.

SSNB is an old modality of treatment with high efficacy as shown by many previous study. Adam *et al*. reported average improvement in abduction of 86.92 degree, and external rotation of 32 degree. He further reported significant improvement in pain and achieved almost normal day to day activity after suprascapular nerve block in adhesive capsulitis. According to Shanahan *et al*. there was significant improvement in the group receiving suprascapular nerve block than the control group. In our study pain improvement was 73%, activity improvement 75%, arm position by 78%, abduction by 75.1%, external rotation by 71.6%, range of motion improved by average of 75.5%. Group-S shows significant improvement from day-0 to day-3 &1 month, but at 6 month the improvement is not significant correlated with day-0.

Platelet rich plasma injection (PRP) is a newer modality of treatment for Adhesive capsulitis of shoulder. PRP has good anti-inflammatory affect, for which it is used in various field in orthopaedics for enhancement of tissue healing. Aslani *et al*. have reported 60% improvement in pain, 70% improvement in functional outcome where flexion improved from 70 degree to 150 degree, abduction improved from 75 degree to 135 degree and external rotation improved from 25 degree to 50 degree. He also reported 70% satisfaction score after treatment with platelet rich plasma injection in patients suffering with adhesive capsulitis. In our study pain improvement was 93.3%, activity improvement 91.5%, arm position by 92%, abduction by 91.1%, external rotation by 93.3%, range of motion improved by average of 92.45%. In group-P shows constant improvement from day-0 to 6 months. On day-3 group-P shows decreased than day-0 because of increased in intensity of pain which directly increase restriction of all movements of shoulder. This is due to the inflammatory cytokines released from the activated platelets. We observed this worsening of condition for 2-3 days of post injection. At this period, patients were unable to do home based exercise. We advised application of ice over the shoulder 3-4 times/day or referred to physiotherapy department for cryotherapy to decrease inflammation. When pain decreased after this inflammatory phase of PRP injection patients were asked to follow home based 10 min physiotherapy. Group-s doesn't show no such kind of result.

On 1-month both group show similar result. But on 6 months follow-up group-P is significantly better than group-S.

Two of our patients from group-S showed the same score on last follow-up as on day0 though they were showing gradual improvement on day-3 and 1 month follow-up.

We didn't find any major complication like infection, nerve palsy or pneumothorax in either of the interventional groups.

Our study showed that there was statistically significant better functional outcome in patients treated with either PRP or SSNB, however, PRP group showed significantly better result than SSNB group and the improvement is more constant than SSNB on prolonged follow-up.

Conclusion

We found diabetes and female gender are risk factors for adhesive capsulitis of shoulder joint but there are no difference in outcome when comparing with non diabetics or male gender. In our study group-S shows significant improvement at 6 month from day-0 in Constant- Murley score.

Group-P also showed significant improvement on 6 months as compared to day-0 in Constant-Murley score. When comparing the two interventional group, PRP injection showed significantly better result than SSNB in the management of adhesive capsulitis of shoulder.

Conflict of Interest

Not available

Financial Support

Not available

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