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## Effect of scapular proprioceptive neuromuscular facilitation on pain and disability in patients with adhesive capsulitis

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### Abstract

**Introduction:** Prevalence rate of adhesive capsulitis in the general population is 2-5% and 10-20% in diabetics. Patients with adhesive capsulitis have a painful restriction of both active and passive glen humeral joint motion in all planes, or a global loss of glen humeral joint motion.

**Aims:** To determine the effect of scapular proprioceptive neuromuscular facilitation and conventional physiotherapy on pain and disability in patients with stage II adhesive capsulitis.

**Methodology:** It is an Experimental study including, Population of 40-60yrs of age with adhesive capsulitis. Subjects were allocated into two group by chit method. Group A: Scapular proprioceptive neuromuscular facilitation<sup>38</sup> + Conventional treatment and Group B: Conventional treatment. At 0 week and after the 6 weeks intervention period, all patients were evaluated for Pain using VAS and Disability using SPADI.

**Result:** Statistical analysis was done using SPSS version 15 software. Paired t-test was used to analyze the pre and post intervention differences within each group and independent t-test was used for between groups comparison. Confidence interval was kept 95% and the level of significance for all statistical data was set  $\alpha = 0.05$ .

**Conclusion:** Application of Scapular Proprioceptive Neuromuscular Facilitation along with conventional physiotherapy exercises can be considered beneficial in reducing pain and disability in patient with adhesive capsulitis.

**Keywords:** Adhesive capsulitis, PNF, disability

### Introduction

Prevalence rate of adhesive capsulitis in the general population is 2-5% and 10-20% in diabetics<sup>[1]</sup>. An increased incidence of frozen shoulder has been noticed in patients with hyperthyroidism and hypertriglyceridemia<sup>[2]</sup>. The incidence of adhesive capsulitis is slightly higher in women than in men (70% of patients are women). This condition most frequently affects persons aged 40-60 years and rarely occurs in persons younger than 40 years age. Frozen shoulder might affect both shoulders in up to 16% of patients; however, a relapse is uncommon.

Adhesive capsulitis (AC) is an idiopathic disease characterized by fibrosis, decreased volume of the glenoid capsule, and progressive pain with loss of range of motion (ROM)<sup>[4, 5]</sup>. Joint dysfunction in "frozen shoulders" is often caused by adherence of the anteroinferior aspect of the joint capsule to the humeral head<sup>[6]</sup>. It has three phases: the painful stage, the frozen stage, and the thawing stage. Stage 1) The painful stage is characterized by the gradual onset of diffuse shoulder pain that usually lasts one to two months; Stage 2) The frozen stage is characterized by progressive loss of motion that lasts several months to a year or longer. This stage also exhibits decreased capsular volume, which can be visualized with MRI, for differential diagnosis; Stage 3) The thawing stage, the final stage, is characterized by gradual improvement of range of motion over several months to years. ROM deficits may continue to be unresolved for more than 3-5 years following the onset of adhesive capsulitis<sup>[7]</sup>.

Management includes physical modalities, analgesics, activity modification, ROM exercises, scapular stability exercises and extraarticular corticosteroid injections<sup>[10]</sup>. Procedures such as capsular hydro dilatation, manipulation under anaesthesia, and arthroscopic lysis of adhesions

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are reserved for shoulders resistant to more conservative methods [11-14]. The goals of exercise programs consisting of range of motion, strengthening and stretching exercises, proprioceptive neuromuscular facilitation (PNF), and mobilizing techniques are to relieve pain resulting from capsular contracture and improve glen humeral range of motion [15-19]. Abnormal changes in the position of the scapula at different angles of the shoulder indicate a disturbance of the scapulohumeral rhythm, and these changes adversely affect the functions of the upper extremity. Shoulder pathologies, such as adhesive capsulitis and subacromial impingement, can lead to changes in the position of the scapula [20, 21]. Even though scapular alterations have been assessed in patients with frozen shoulder, treatment programs were focused on pain relief and improvement in range of motion. Scapular exercises were not included in the programs even though the scapula plays several roles in facilitating optimal shoulder function [22].

Proprioceptive neuromuscular facilitation is a treatment concept with four theoretical mechanisms, referred to as autogenic inhibition, reciprocal inhibition, stress relaxation, and the gate control theory, that enhance range of motion and muscle activation [23, 24]. Proprioceptive neuromuscular facilitation has been reported to be effective in relieving pain and improving functional abilities. Proprioceptive neuromuscular facilitation methods, particularly those involving reciprocal activation of the agonist and antagonist to the desired motion, provide the greatest potential for muscle functioning [25, 27].

### Significance of the Study

Re-establishment of normal shoulder function and restoring normal scapular muscle activation patterns by scapular proprioceptive neuromuscular facilitation in our view, can lead to successful rehabilitation program. Till date less studies are found see the effect of scapular proprioceptive neuromuscular facilitation on pain and disability in adhesive capsulitis patients. The result of the study would implicate a better exercise program for the adhesive capsulitis patients.

### Objectives of the Study

To determine and compare, the effect of scapular proprioceptive neuromuscular facilitation and conventional physiotherapy on pain and disability in patients with stage II adhesive capsulitis.

### Hypothesis

#### Null Hypothesis [H<sub>0</sub>]

There is no significant difference in effect of scapular proprioceptive neuromuscular facilitation and conventional physiotherapy in reducing pain and disability in patient with adhesive capsulitis.

#### Alternative Hypothesis H<sub>1</sub>

There is significant difference in effect of scapular proprioceptive neuromuscular facilitation and conventional physiotherapy in reducing pain and disability in patient with adhesive capsulitis.

### Methodology

It was Experimental study with Population including 40-60yrs of age with adhesive capsulitis Sample Size was 30, calculated with G POWER, 3.19.2 version with effect size 1.1,  $\alpha=0.05$ , power 0.80. the Sampling technique :was Purposive sampling. Allocation of groups was done randomly

by chit method. Study Setting: was S.P.B. Physiotherapy college, surat and Source of data included different clinical O.P.D.s of surat. Inclusion criteria: Age 40- 60 yrs [28, 29, 30], shoulder ROM restriction, Difficulties in two or more of the following: flexion, abduction, external rotation, and/or hands behind the body presenting limitation of more than 30 degrees in active ranges of motion, compared to the normal side with regard to range of motion [31, 32].and Shoulder pain more than 3 months. Following were Excluded: patients having History of trauma or accidental injuries [33, 34], Neurological involvement (stroke, Parkinsonism, radiating pain to arm) [33-35], History of surgery on particular shoulder [34]. Other pathological conditions involving the shoulder (rotator cuff tear, tendinitis, etc.) and Pain or disorders of the cervical spine, elbow, wrist, or hand.

### Outcome measure

Were Pain measured using Visual Analogue Scale (VAS) [36] and Disability measured using Shoulder Pain And Disability Index (SPADI) Gujarati version [37]

### Procedure

Patients were screened on the basis of inclusion and exclusion criteria. The purpose of the study was explained and a written informed consent and demographic detail were obtained from all subjects. Subjects were allocated into two group by chit method. At 0 week and after the 6 weeks intervention period, all patients were evaluated for Pain measured using VAS and Disability measured using SPADI. Description of group are as follows:

**Group A:** Scapular proprioceptive neuromuscular facilitation [38] + Conventional treatment

**Group B:** Conventional treatment

**Group A:** Exercise include Scapular Proprioceptive Neuromuscular Facilitation (PNF) [27, 38] +conventional exercise Scapular proprioceptive neuromuscular facilitation (PNF).

### Include

Anterior elevation and Posterior depression Posterior elevation and Anterior depression with 20 repetitions.

Patients position was sidelying, on the unaffected side while the therapist stood in the line of desired motion. Firstly, the therapist gave preparatory instructions. In the beginning of the pattern, the therapist would pull the scapula to the elongated position and then give instructions for the desired movement. Rhythmic initiation and repeated contractions facilitation techniques applied in all patterns.

Each exercise was performed for three sets of 20 repetition, three times per-week for 6 weeks.<sup>39</sup>Total duration of treatment was 30 minutes (scapular proprioceptive neuromuscular facilitation (PNF) 15 minute conventional 35 minute). The subjects were allowed to rest whenever they feel fatigue during exercise.

Group B: was given Conventional treatment which included Pendulum (Codman's) Exercises (shoulder flexion, abduction, circumduction) [40, 41]. Wand exercise (shoulder flexion, abduction extension, internal rotation) [38]. Capsular stretching (anterior, posterior, inferior capsule) [42] Hot pack for 20 min [39] Each exercise were performed for three sets of 10 repetition, three times per- week for 6 weeks.<sup>39</sup>Total duration of treatment were 35 minutes.

**Statistical Analysis**

Statistical analysis was done using SPSS version 15 software. Shapiro-WILK test was applied to check the normality of data. All quantitative data of this study follow the normality ( $p>0.05$ ). Baseline characteristics were compared to check homogeneity between intervention groups. Independent t-test was used for all the demographics and outcome measures. Paired t-test was used to analyze the pre and post intervention differences within each group and independent t-test was used for between groups comparison. Confidence interval was kept

95% and the level of significance for all statistical data was set  $\alpha =0.05$ .

**Result**

Study included 30 patients. There was no significance difference between the groups at baseline. Paired t-test showed both group are significantly improved ( $p<0.0001$ ) Unpaired t-test showed scapular Proprioceptive neuromuscular facilitation (PNF) was significantly more effective than conventional physiotherapy exercise ( $p<0.0001$ )

**Table 1:** Baseline characteristics of patients

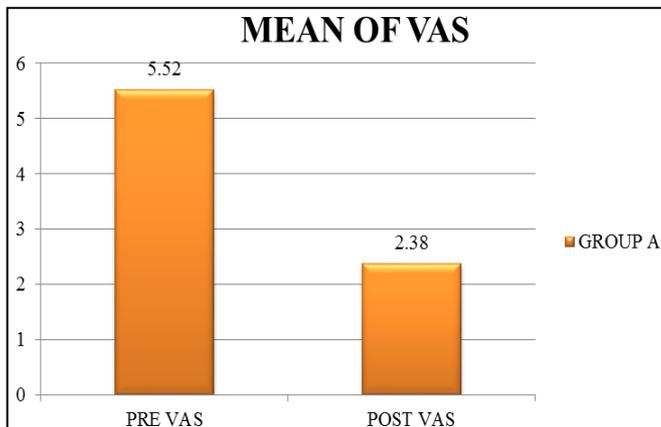
Characteristics	Group a Mean±SD	Group b Mean±SD	P-value
Age (Year)	49.4±6.4120	49.66±5.9601	0.907
BMI (Kg/m <sup>2</sup> )	22.12±1.2257	22.29±1.2832	0.724
PRE VAS (Cm)	5.52±0.3473	5.48±0.3342	0.711
PRE SPADI	53.30±1.9949	53.52±1.9700	0.766

**Table 2:** Gender distribution of patients in group A and group B

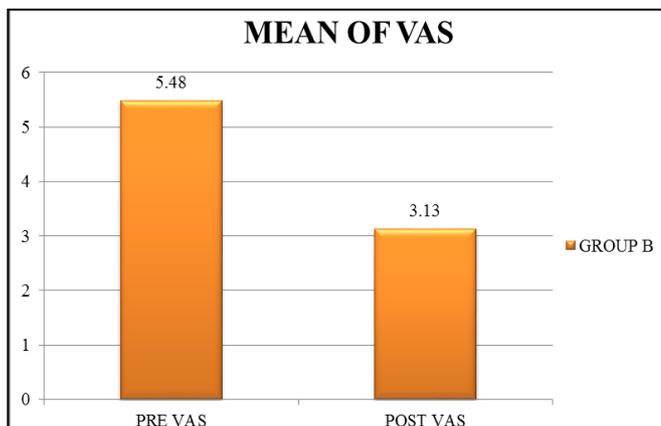
Gender	Group A	Group B
Female	9	7
Male	6	8
Total	15	15

**Table 3:** Intra-Group Comparison of Mean of VAS score before and after 6 weeks of intervention using paired t-test in Group A and Group B

Group	Pre Mean±SD	Post Mean±SD	P-value
Group A	5.52±0.3473	2.38±0.2956	0.000
Group B	5.48±0.3342	3.13±0.2329	0.000



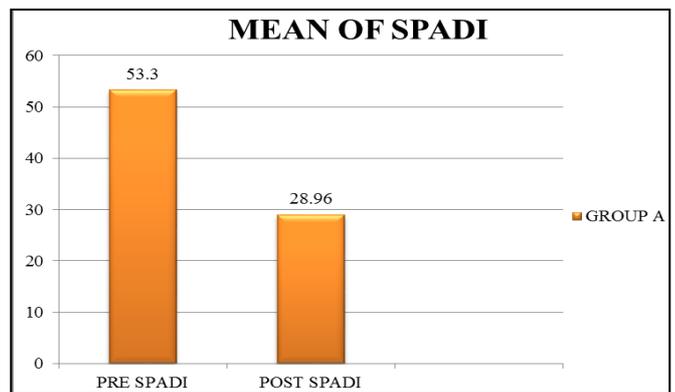
**Graph 1:** Mean of VAS score before and after 6 weeks of intervention in group A



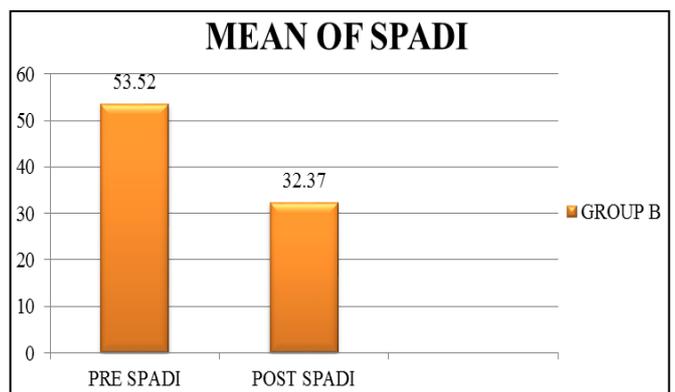
**Graph 2:** Mean of VAS score before and after 6 weeks of intervention in group B

**Table 4:** Intra-Group Comparison of Mean of SPADI score before and after 6 weeks of intervention using paired t-test in Group A and Group B.

Outcome	Pre Mean±SD	Post Mean±SD	P-value
Group A	53.30±1.9949	28.96±0.9787	0.000
Group B	53.52±1.9700	32.37±1.5636	0.000



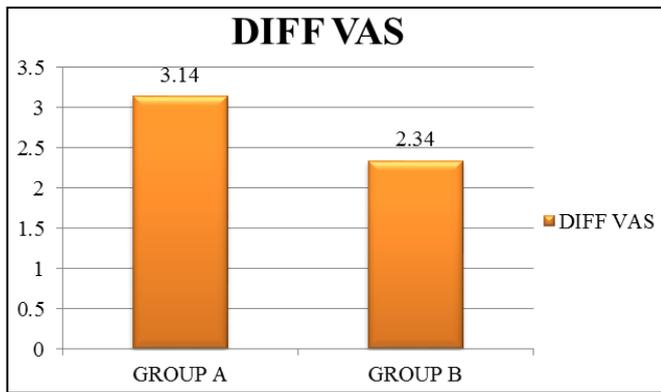
**Graph 3:** Mean of SPADI score before and after 6 weeks of intervention in group A



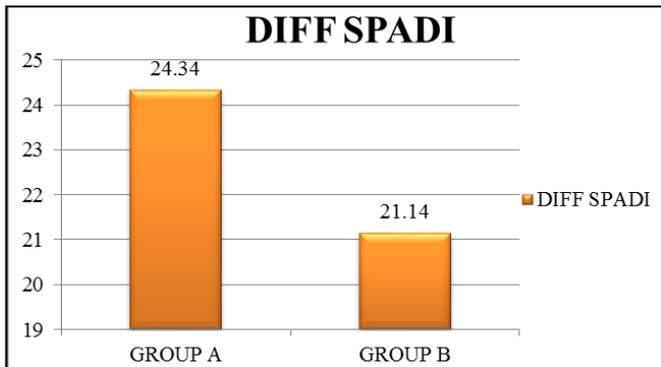
**Graph 4:** Mean of SPADI score before and after 6 weeks of intervention in group B

**Table 5:** Inter group comparison of mean of VAS and SPADI of two groups using independent t- test

Variable	Group A	Group B	P-Value
	Pre-Post Diff MEAN±SD	Pre-Post DIFF MEAN±SD	
Vas	3.14±0.3270	2.34±0.3356	0.000
Spadi	24.34±2.0637	21.14±1.1027	0.000



**Graph 5:** Mean diff of VAS score in group A and group B



**Graph 6:** Mean diff of SPADI score in group A and group B

## Discussion

The purpose of the present study was to investigate the effect of a 6-weeks scapular PNF and conventional treatment on pain and disability in patients with adhesive capsulitis.

Result of the present study indicate that both the exercises are effective in reduction of pain and disability after 6 weeks of intervention but when compared between groups it shows that scapular PNF shows more improvement compare to conventional treatment.

Within group analysis of group A (Scapular PNF) shows significant reduction in pain at a significance level of  $p < 0.000$ . The mechanism behind this finding could be PNF has been proven to produce analgesic effects through gate control mechanism [22]. Pressure and proprioceptive inputs (produced by the PNF techniques) make it to the spinal level and inhibit the entry and transmission of pain signals. Similar mechanism have been explained in study conducted by Hindle KB [22].

The mechanism of scapular PNF that may have reduced disability is that, increment in the excitability and decrease in response time to be responsible for post interventional increase in ROM [33], while Hindle *et al.* proposed the mechanisms such as reduction in the excitability of Golgi tendon organ and induction of relaxation of muscles to lie behind the process of ROM improvement [22]. Single session of scapular PNF has shown to be effective in improving the shoulder ROM flexion and abduction.<sup>36</sup> Although the techniques administered in above-quoted study were rhythmic initiation and repeated contractions, the pattern of the PNF was similar, i.e., anterior elevation and posterior depression. Another mechanism explained for the increase in ROM relies on the firing of the Golgi tendon organ to cause reflexive muscle relaxation [44].

Another mechanism that attributes to improve shoulder function is that proprioceptive neuromuscular facilitation technique is aimed at relaxing tense muscles and restricted

joints to make quick gains in ROM. Previous studies by Etnyre and Abraham *et al.* confirmed that joint ROM can be increased significantly by PNF stretching [45]. The study of Shimura and Kasai shows clearly that PNF pattern of exercise is benefit for initiating movements [43]. The rhythmic initiation technique applied in scapular PNF teaches the motion, helps the patient to relax, improves coordination, and normalizes the motion. The repeated contractions facilitation technique increases active range of motion and strength and guides the patient's motion towards the desired motion [38]. Thus, our study validates the use of PNF technique in improving quality of life and recovery from adhesive capsulitis.

Result of the present study are in concordance with previously mentioned study of K Jothi Prasanna *et al.* who, found that the addition of proprioceptive neuromuscular facilitation to conventional treatment brings significant improvement in shoulder function, scapular dyskinesis and functional activities in comparison to conventional treatment alone in participants with adhesive capsulitis [46].

In the present study, both the groups received similar conventional treatment which included codman's pendulum exercise, wand exercise, capsular stretching, and hot pack at shoulder for 20 minutes.

Mechanism of Codman's pendulum exercises in reducing disability is that the pendulum exercise uses the effects of gravity to distract the humerus from the glenoid fossa. They help to relieve pain through gentle traction and oscillation and provide movement of the synovial fluid. It also increased flow of nutrients into the joint space resulting in decrease in pain with an effect of distraction and oscillation [47].

The principal physiological mechanisms of hydrotherapy in reducing pain, is that it increases in blood flow and metabolism, and increased elasticity of connective tissue [48]. Increasing tissue temperature stimulates vasodilation and increases tissue blood flow [49, 50], which is thought to promote healing by increasing the supply of nutrients and oxygen to the site of injury [48, 51, 52]. The rate of local tissue metabolism is also increased by warming, which may further promote healing.<sup>50</sup> Heat-induced changes in the viscoelastic properties of collagenous tissues may underlie the demonstrated efficacy of heat therapy for improving range of movement [53, 54].

Between group analysis of both the groups (scapular proprioceptive neuromuscular facilitation and conventional physiotherapy) shows significant improvement, but mean value of group A shows more reduction in pain and disability compared to group B. Mean difference value of VAS in group A was  $(3.14 \pm 0.3270)$  and group B was  $(2.34 \pm 0.3356)$  and Mean difference value of SPADI in group A was  $(24.34 \pm 2.0637)$  and group B was  $(21.14 \pm 1.1027)$ . Hence it can be concluded, that there was more improvement in pain and functions in group A (scapular proprioceptive neuromuscular facilitation exercise) than the group B (Conventional physiotherapy).

**Limitations of the study:** include Lack of blinding, Small Sample size, only effect of two techniques of proprioceptive neuromuscular facilitation i.e. rhythmic initiation and repeated contraction facilitation technique were used in scapular proprioceptive neuromuscular facilitation.

**Recommendations for further study:** include Addition of upper limb PNF and Study can be done on large sample size

## Conclusion

The study concluded that subjects who underwent Scapular

Proprioceptive Neuromuscular Facilitation techniques along with Pendulum (Codman's) Exercises, Wand exercise, Capsular stretching, Hot pack showed improvement in pain and disability at the end of 6 weeks when compared to subjects with group B, who underwent Pendulum (Codman's) Exercises, Wand exercise, Capsular stretching, Hot pack for 20 min. Therefore, Application of Scapular Proprioceptive Neuromuscular Facilitation along with conventional physiotherapy exercises can be considered beneficial in reducing pain and disability in patient with adhesive capsulitis.

### Clinical Implication

Application of Scapular Proprioceptive Neuromuscular Facilitation (PNF) along with conventional physiotherapy exercises can be considered beneficial in reducing pain and disability in patient with adhesive capsulitis.

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