International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

A Study to Compare the Effects of Proprioceptive Neuromuscular Facilitation Technique and Glenohumeral Capsular Stretching on Shoulder Pain and Disability Among Patients with Adhesive Capsulitis"

Dr Samriti Sharma[1], Dr Harleen Kaur[2], Dr Palak Arora[3], Dr Manpreet Kaur[4]

[1]Master's of Physiotherapy, Orthopedics Department, D.A.V Institute of Physiotherapy and Rehabilitation, Jalandhar, Punjab, India.
[2,3,4]Assistant professor, (MPT Orthopedics) D.A.V Institute of Physiotherapy and Rehabilitation, Jalandhar, Punjab, India.

Abstract

Background: Adhesive Capsulitis is a painful condition in which there is progressive fibrosis and contracture of the glenohumeral joint, which results in restriction of both active and passive range of motion in all planes of glenohumeral joint. External rotation and abduction are more restricted due to capsular pattern involvement Aim: The study aims to compare the effects of proprioceptive neuromuscular facilitation technique and glenohumeral capsular stretching on pain and disability in individuals affected by adhesive capsulitis. Methodology: Total duration of the study will be one and a half year. A minimum of 45 subjects will be selected for the study between the age group of 40 to 60 years. The subjects will be divided into 3 groups with each group having 15 subjects. Group A (Control group) subjects will be treated with moist hot pack, Interferential therapy (4 pole, vector 45 for 15 minutes). ultrasound (1 Mhz at 1w/cm') and conventional exercises (Codman exercises, Wall Ladder and Shoulder Pulley) Group B (Experimental group): subjects will be treated with moist hot pack, Interferential therapy, Continuous Ultrasound and Proprioceptive Neuromuscular Facilitation Technique (Rhythmic Initiation). Group C (Experimental Group) Subjects will be treated with moist hot pack, Interferential therapy, Ultrasound and Glenohumeral Capsular Stretching. Total 12 sessions of physiotherapy treatment will be given to the subjects for three weeks i.e 6 sessions in each week. The data will be recorded on Day1(pre intervention), Day 6th (post intervention) and Day 12th (post intervention). Result: Stastistical study revealed that by the 12th day all the three groups (A,B and C) showed significant improvement in reducing pain and disability. Conclusion: The present study concludes that the Glenohumeral capsular stretching was more effective in reducing pain and disability than Proprioceptive Neuromuscular Facilitation technique in individuals with adhesive capsulitis.

Keywords: Adhesive Capsulitis, Proprioceptive Neuromuscular Facilitation Technique, Glenohumeral Capsular Stretching.

1. Introduction

Adhesive capsulitis is defined by increasing fibrosis and rigidity of the joint capsule along pain, which leads to a gradual loss of active and passive range of motion in all glenohumeral joint planes, primarily the external rotation because of the involvement of the capsular pattern.[1,2] The exact cause remains unclear though, it is linked with factors like inflammation, fibrosis and result in thickening , tightening of the joint capsule that surrounds the shoulder[3] Simon-Emmanuel Duplay coined the name "scapulohumeral periarthritis" in 1872 to characterize the condition, describing it as a painful state that differs from arthritis with overall radiological preservation of the joint. Later, in 1934, Codman used the phrase "frozen shoulder" to categorise a condition where sleeping on the afflicted side is difficult due to a subtle beginning of discomfort at the deltoid insertion.[4,5]The initial appearance of FS may be spontaneous with no identifiable justification, or it may be associated with systemic or local diseases. The glenohumeral capsule contracture is the distinctive characteristic of adhesive capsulitis. The axillary adhering to the humeral neck and to itself, the capsule's synovial layer disappearing, and a general reduction in capsular volume are some other pathological findings. The rotator interval, a structure crucial for the stability of the glenohumeral joint, is swollen and fibrotic, and this condition is linked to adhesive capsulitis.[6] Neviaser et all and Haniff et all outlined the four stages of adhesive capsulitis progression based on an arthroscopy and physical evaluation of the symptomatic joints. Stages 1: The first stage is marked by a slow onset of pain, usually related to the deltoid insertion, that gets worse with movement and is commonly felt during rest. Patients may express discomfort at night and difficulty falling asleep on the afflicted side. Typically, symptoms subside within three months. Stage 2 The "freezing stage" is another name for stage 2, which is characterized by progressive capsular contracture and acute synovitis. chronic discomfort that could worsen, particularly at night. Internal and exterior rotation, abduction, and forward flexion are all restricted movements. Stage 3: The patient's primary complaint at this stage of maturation is severe stiffness. Another name for this stage is the frozen stage. There may be persistent soreness toward the conclusion of range of motion and sometimes at night. Stage 4: The thawing stage is another name for the stage that is sometimes referred to as the chronic stage. There is not much pain, and mobility might become better over time.1 According to estimates, between 3% and 5% of the general population have adhesive capsulitis, while the range is as low as 0.5% and as high as 10%.7 Women make up around 70% of patients who arrive with frozen shoulder, while men are more likely to have a longer recovery and more disability8 and the condition mostly affects those between 40 and 70 years old. Before the age of 40, it is uncommon.9,10 The literature is confusing because to the lack of a consistent terminology for frozen shoulder. Primary frozen shoulder was initially classified as idiopathic by Lundberg64, whereas subsequent frozen shoulder was classified as posttraumatic. Significant histological changes occur in the capsule, which differ greatly from those brought on by immobility or degeneration brought on by an unknown stimulation. Nevertheless, not a single crucial stimulus has been identified, primary frozen shoulder may be caused by a confluence of host and extrinsic factors. Some examples of extrinsic influences include trauma, immobility, certain illnesses, and poor body mechanics.[11] Primary frozen shoulder: The hallmark of primary adhesive capsulitis is capsule fibrosis, which causes a painful, progressive loss of shoulder range of motion in both the active and passive directions12 No significant trauma is necessary for primary adhesive capsulitis to occur, and it is frequently linked to diabetes mellitus

and co-morbid illnesses including rheumatoid arthritis and thyroid disorders, which increase the risk.[7,13,] Secondary frozen shoulder: secondary AC encompasses a variety of disorders that result in shoulder stiffness, including calcific tendinopathy (CT), rotator cuff tears (RCT),glenohumeral or acromion-clavicular arthritis, and prior shoulder surgery or trauma.[14] During the examination, the stage of adhesive capsulitis will determine the severity of the disease's symptoms and physical manifestations. Typically, patients complain of poorly localized shoulder discomfort that occasionally radiates to the elbow and focal soreness at the deltoid insertion[15] A medical history and a physical examination are the most popular ways to diagnose frozen shoulder. The term "functional limitation of both active and passive shoulder mobility" refers to adhesive capsulitis (AC). According to the American Shoulder and Elbow Surgeons, "for which radiographs of the glenohumeral joint are basically unremarkable aside from the potential occurrence of osteopenia or calcific tendonitis." Patients usually start with shoulder pain and subsequently report having trouble moving around. External rotation is usually the initial mobility restriction observed, and one of the main diagnostic signs of AC is the constricting of the coracohumeral ligament.[16] Characteristic findings of AC include loss of axillary recess, obliteration of subcoracoid fat (subcoracoid triangle sign), and thickening of the coraco-humeral ligament and joint capsule in the rotator interval on magnetic resonance imaging (MRI) and MR arthrography[17] Adhesive capsulitis is treated with a variety of conservative and surgical techniques. Conservative therapy approaches include non-steroidal anti-inflammatory drugs (NSAIDs), oral anti-inflammatory medications, hydrodilation, physical therapy, occupational therapy, electrotherapy, cryotherapy, shoulder injections of corticosteroids or hyaluronate, or any combination of these treatments. Open capsular release, arthroscopic capsular release, and manipulation under anesthesia (MUA) are surgical options for treating adhesive capsulitis18.Physical therapy, also referred to as physiotherapy, is a subfield of physical medicine and rehabilitation that treats impairments and enhances mobility, function, and quality of life through examination, diagnosis, prognosis, and physical intervention. For many shoulder disorders, such as frozen shoulder, physiotherapy is the initial line of treatment [19] Transcutaneous electrical nerve stimulation (TENS), ultrasound (US), short wave diathermy, interferential treatment (IFT), heat application, infrared therapy, and light amplification stimulated by LASER, or electrical radiation. The workouts in the program include dynamic scapular movements, proprioceptive neuromuscular facilitation (PNF) methods, strengthening, and stretching[20,21,22.] PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION: PNF has demonstrated benefits for ROM, muscular strength, and discomfort. Herman Kabat first proposed PNF, a method for eliciting the motor response that Knott and Vass subsequently refined. By facilitating, inhibiting, strengthening, and relaxing muscle groups, PNF treatments help to enhance functional movement. To further engage weak muscles and increase mobility or stability, a variety of approaches can be used when performing a PNF pattern. There are several fundamental strengthening methods: Repeated contraction, rhythmic stabilization, slow reversal, slow reversal hold, contract-relax, and hold-relax. Rhythmic initiation: The capacity to initiate is encouraged through the use of rhythmic initiation. The therapist repeatedly moves the patient's limb passively over the range of the desired movement pattern once the patient has voluntarily relaxed opportunities to help the patient become used to the pattern's movement. Practice with aided or active movements (without resistance) helps the patient develop a movement pattern.23Capsular stretching: Adhesive Capsulitis is also characterised by the loss of the synovial layer of the capsule, adhesions of the axillary to itself and to the anatomical neck of the humerus which leads to decrease in capsular volume.[4] The muscle stretching is 13usually helps to enhance the range of motion. The synovial gland is encouraged to produce a liquid lubricant that facilitates the articulating joints to glide past one another when capsular

joints stretched. The process is referred as capsular stretching. It also increases the intraarticular pressure and helps in the tight articular surface separation.[24]

2. Subjects & Methodology2.1 Study Design: Quasi-experimental study comparative in nature. Convenient sampling was done. The study was performed in the OPD of D.A. V Institute of Physiotherapy and Rehabilitation, Jalandhar. The duration of study was one and half years. A total of 45 subjects (male and female) were enrolled for the study and divided into three groups- group A, group B and group C. Group A was Control group, Group B and Group C were Experimental groups (1 and 2). Minimum of 15 subjects were allocated in each group.

2.2 Procedure

The subjects were screened as per the inclusion and exclusion criteria. Inclusion criteria: Subjects with stage 2 and stage 3 adhesive capsulitis exhibiting capsular restrictions of movements. Exclusion criteria: Subjects with a history of recurrent shoulder dislocation, subluxation, or ligament injury, as well as those with neurological deficits affecting shoulder function.After explaining the need and procedure of the study, written informed consent were obtained from all subjects and were assessed for pain level with Visual Analogue Scale (VAS) and functional disability with Shoulder Pain And Disability Index (SPADI). A total of 45 subjects were conveniently allocated into 3 groups- Group A were control group, Group B and Group C were experimental group. A minimum 15 subjects were assigned to each group. Group A (control group) subjects were treated with moist pack, Interferential therapy, Ultrasound and conventional exercises (Codman exercises, shoulder pulley and wall ladder). Group B (experimental group) subjects were treated with moist heat pack, Interferential therapy, Ultrasound and proprioceptive neuromuscular facilitation technique. Group C (experimental group) subjects were be treated with moist heat pack, Interferential therapy, Ultrasound and Glenohumeral Capsular Stretching. A total of 12 treatment sessions were given to each group, 6 sessions per week for 2 weeks.

2.3 Control Group

Codman's pendulum exercises – Standing with the trunk flexed at the hips to 90 degrees. The hand hanged loosely downwards in a position between 60 and 90 degrees of flexion or scaption. A pendulum or swinging motion.

- Pulley exercises – Flexion, Extension, Abduction and External rotation were done.
- Finger Ladder exercises

The 15 repetitions were given for each exercise

Figure 1 Showing wall ladder for shoulder flexion

Figure 2 Showing wall ladder for shoulder abduction

Figure 3 showing codman's exercise

2.4 Experimental group 1 (Proprioceptive Neuromuscular Facilitation Technique)

Proprioceptive Neuromuscular Facilitation Technique were performed. Scapular Proprioceptive Neuromuscular Facilitation technique (anterior elevation and posterior depression and posterior elevation and antero-depression.) 20 repetitions with 20 second hold.

Proprioceptive Neuromuscular Facilitation technique (D2 Flexion Extension) were performed.20 repetitions with 20 second hold.

Figure 4 D2 flexion

Figure 5 D2 extension

Figure 6 Scapular PNF

2.5 Experimental group 2 (Glenohumeral Capsular Stetching)

Glenohumeral Capsular Stretching were performed for (30 seconds) with 3 repetitions foreach(anterior, posterior,inferior)

Figure 7 posterior capsular stretching

Figure 8 anterior capsular stretching

Figure 9 inferior capsular stretching

3. Results:

The aim of this study was to compare the effect of Proprioceptive neuromuscular facilitation Technique and glenohumeral capsular stretching on pain and disability among patients with adhesive capsulitis.The statistical analysis was performed using SPSS software version 18.0*. Level of significance 0.05* was used to determine the analytical importance. Both within the group and between the group analysis was done to analyze dependent variables measurement using visual analogue scale, Score of shoulder pain and disability index (SPADI) for Shoulder disability. Repeated ANOVA test was done for intra group analysis and one way ANOVA and post hoc analysis by Turkey's were used for the inter group analysis. On comparing the mean values between Group A, Group B and Group C in VAS score and SPADI score there was a statistically significant difference in the post treatment values. When comparing the mean values across group A, group B and group C, the group C demonstrates more significant improvement in reducing pain, shoulder disability

Table 1 Analysis for change in VAS scores of group A, B and C

.	VAS								
ANOVA	1ST			6TH			12TH		
	Group A	Group B	Group C	Group A	Group B	Group C	Group A	Group B	Group C
Mean	7.93	7.80	7.73	6.47	5.87	5.67	5.33	4.07	3.73
S.D.	0.799	1.014	0.884	0.743	0.915	0.724	0.816	1.100	0.704
Number	15	15	15	15	15	15	15	15	15
Maximum	9	9	9	8	7	7	7	6	5
Minimum	7	6	6	5	4	5	4	2	3
Range	2	3	3	3	3	2	3	4	2
F test	0.191			4.075			13.522		
Table Value at 0.05	3.220			3.220			3.220		
P value	0.827			0.024			<0.001		
Result	Not Significant			Significant			Significant		
Tukey's method for Pairwise		A			A			A	

comparison									
Mean Difference & Result>	B	0.14NSig	B	B	0.61NSig	B	B	1.27Sig	B
	C	0.2NSig	0.07NSig	C	0.8Sig	0.2NSig	C	1.6Sig	0.34NSig

At baseline (1st day), there was no notable difference was observed in in VAS scores among the three groups ($p = 0.827$), indicating similar levels of pain. On the 6th day, a significant difference emerged ($p = 0.024$), with Group C showing greater improvement than Group A. By the 12th day, the difference became highly significant ($p < 0.001$), with Group C reporting the lowest pain levels, followed by Group B, and Group A showing the least improvement.

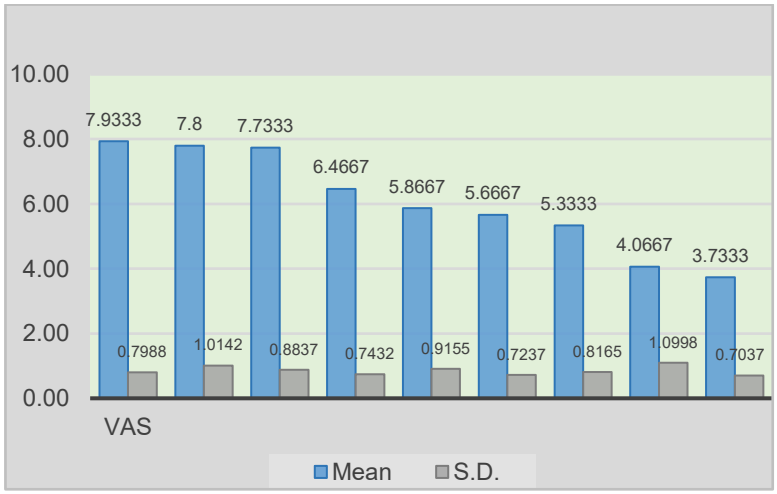

Figure 10 Analysis for change in VAS score for Group A, B and C

Table 2 Analysis for change in SPADI scores of group A, B and C

.	SPADI								
ANOVA	1ST			6TH			12TH		
	Group A	Group B	Group C	Group A	Group B	Group C	Group A	Group B	Group C
Mean	73.18	71.18	74.13	64.81	57.74	59.32	57.58	46.93	46.45
S.D.	4.511	5.364	4.273	3.840	6.589	5.171	4.520	6.467	5.620
Number	15	15	15	15	15	15	15	15	15

Maximum	81.5	81.5	79.2	70.76	66.2	68.5	64.6	56.15	58.5
Minimum	66.2	61.83	66.2	58.46	46.9	50.8	48.46	34.61	35.4
Range	15.3	19.67	13	12.3	19.3	17.7	16.14	21.54	23.1
F test	1.513			7.303			19.007		
Table Value at 0.05	3.220			3.220			3.220		
P value	0.232			0.002			<0.001		
Result	Not Significant			Significant			Significant		
Tukey's method for Pairwise comparison		A			A			A	
Mean Difference & Result>	B	2NSig	B	B	7.08Sig	B	B	10.66Sig	B
	C	0.96NSig	2.95NSig	C	5.5Sig	1.58NSig	C	11.14Sig	0.49NSig

At the baseline (1st day), there was no significant difference in SPADI scores among Groups A, B, and C ($p = 0.232$), suggesting all groups had similar levels of shoulder disability. However, by the 6th day, a significant difference was observed ($p = 0.002$), with Group B showing better improvement than Group A, and Group C also showing favourable outcomes compared to Group A. By the 12th day, the differences became highly significant ($p < 0.001$), with Group B and Group C demonstrating substantially greater improvement in SPADI scores than Group A. Notably, Group C had the lowest SPADI scores, indicating the greatest reduction in shoulder pain and disability.

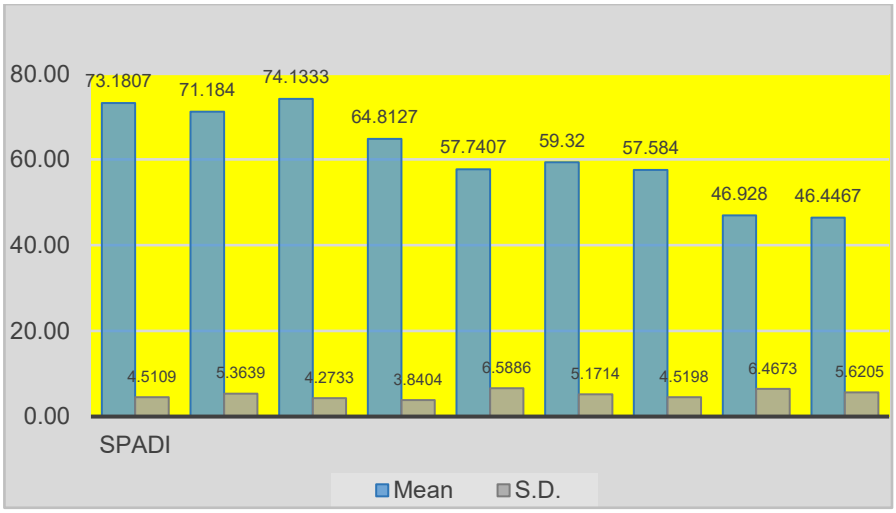

Figure 11 Analysis for change in SPADI score for Group A, B and C

4. Discussion

The purpose of this study was to compare the effect of Proprioceptive neuromuscular facilitation Technique and glenohumeral capsular stretching on pain and disability among patients with adhesive capsulitis. Selviani L, Okilanda A, Resmana R, Arisman (2023)[25] did a study to show the effects of codman pendulum exercises and scapular mobilization to reduce pain in frozen shoulder. The study done by Sharma D, Assistant professor, UIHS, CSJM University, Kanpur Chandra Shekhar Kumar, Assistant professor, UIHS, CSJM University,[26] Kanpur concluded that pain is reduced and range of motion is improved by Interferential therapy in Adhesive Capsulitis. Soni VP, Shukla Unmesh Dr Y,[27]did a study to see the effect of PNF on pain, ROM and quality of life in adhesive capsulitis. The result of the study concluded that group B who received PNF technique shows statistically significant improvement on pain, and quality of life as compared to group A who received conventional treatment. Manohar B, Subramanian SS, et all (2023)[28] conducted a study similar study. The result of the study concluded that capsular stretching significantly improved pain and quality of life. According to Izumi et al. (2008), capsular stretching exercises aid in improving intra-articular pressure and expanding the space between certain shoulder regions. The shoulder joint capsule experiences the highest level of passive tension during passive stretching, which lowers the capsule's adhesion (Iida et al., 2021). Shoulder tightness can be alleviated over time by stretching across the joint's constricted soft tissues (Lukasiewicz et al., 1999).[21]

5. Future scope:

The long term follow ups of the subjects can be done and the study can be conducted for longer duration with samples size .

6. Conclusion: Thus, it can be concluded that glenohumeral capsular stretching is more effective than proprioceptive neuromuscular facilitation in reducing pain and functional disability as indicated by significant difference in between group comparison of SPADI and VAS.

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