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A Comparative Study on the Effect of Scapular Proprioceptive Neuromuscular Facilitation and Maitland Glenohumeral Mobilization Versus Scapular Mobilization and Maitland Glenohumeral Mobilization in Adhesive Capsulitis

Yashodhara S Joshi[1], Shridhar S[2], Manju Jayaram[3] , Sharath U.R[4]

[1]MPT, Kempegowda Institute of Physiotherapy, KIMS & RC, K.R.Road, V.V.Puram, Bangalore- 560004.
[2]Assistant Professor, Kempegowda Institute of Physiotherapy, KIMS & RC, K.R.Road, V.V.Puram, Bangalore- 560004.
[3]Associate Professor, Department of Orthopaedics, Kempegowda Institute of Medical Sciences, K.R.Road, V.V.Puram, Bangalore- 560004.
[4]Assistant Professor, Kempegowda Institute of Physiotherapy, K.R.Road, V.V.Puram, Bangalore- 560004.

Corresponding Author: Yashodhara S Joshi

ABSTRACT

Background and Objective: Adhesive capsulitis is an idiopathic disorder characterized by fibrosis, reduced volume of the glenoid capsule, and progressive pain with loss of range of motion (ROM) in the shoulder joint, which can lead to serious disability. The comparative study was done to determine the effectiveness of scapular Proprioceptive Neuromuscular Facilitation (PNF) and Maitland glenohumeral mobilization versus scapular mobilization and Maitland glenohumeral mobilization in subjects with adhesive capsulitis.
Method: 60 subjects with adhesive capsulitis based on inclusion and exclusion criteria were divided into Group-A and Group-B. Group-A subjects received scapular PNF and Maitland glenohumeral mobilization whereas Group-B subjects received scapular mobilization and Maitland glenohumeral mobilization. The outcome measures used were Visual Analog Scale (VAS), Universal goniometer for ROM, Lateral Scapular Slide Test (LSST), and Shoulder Pain and Disability Index (SPADI) and were measured pre-treatment, and at the 9th session of treatment. The duration of the treatment was for three weeks, thrice a week.
Results: Subjects showed statistically significant differences in the pre and post values of VAS, ROM, LSST, and SPADI in both, Group-A and Group-B (p=<0.05). Post-treatment values of VAS, ROM except for shoulder extension, LSST, and SPADI in Group-A showed more improvement than the post-treatment values of VAS, ROM, LSST, and SPADI in Group-B.
Conclusion: Scapular PNF and Maitland glenohumeral mobilization was more effective in improving pain, flexion, abduction, internal and external rotation ROM, LSST, and SPADI in adhesive capsulitis subjects (p=<0.05).

Keywords: adhesive capsulitis, Maitland glenohumeral mobilization, scapular mobilization, scapular PNF, SPADI, LSST.

INRODUCTION

Shoulder pain is a very frequent and common musculoskeletal disorder. The prevalence of shoulder pain between adults of age 30 to 70 years is 22.9% in Northern India.[1] Amongst shoulder pain; adhesive capsulitis is one of the most common and disabling orthopaedic disorders.[2]

Adhesive capsulitis is an idiopathic condition which is characterized by fibrosis,

decreased volume of the glenoid capsule, and progressive pain with loss of passive as well as active range of motion (ROM).[3] Codman was the first who coined the term "frozen shoulder". Neviaser then called it adhesive capsulitis.[4] It usually occurs between the ages of 40 and 60 years and the incidence is more in females than in males.[5]

As with many other glenohumeral joint pathologies, complaints of poorly localized shoulder pain with focal tenderness adjacent to the deltoid insertion and occasional pain that radiates to the elbow are usual. This pain is usually aggravated by shoulder movement and alleviated by rest. Pain may become extreme at night and disrupt sleep. Activities of daily living get difficult, particularly those that require reaching behind the back, overhead, or across the body. Patients have increasing difficulty finding comfortable arm positions, as symptoms progress. The strength of the muscles around the shoulder joint may be reduced, particularly of the glenohumeral internal rotators and flexors.[6] And for the shoulder; Cyriax proposed that external rotation would be more restricted than abduction, which would be more restricted than internal rotation.[7]

Adhesive capsulitis classically progresses through a series of stages that correspond to arthroscopic and histologic findings.[8] In this study, subjects falling under the freezing stage were considered as it is characterized by more intense and persistent pain even at rest and a more profound ROM loss.[9] There is some loss of the axillary fold, which is suggestive of early adhesion formation and capsular contracture.[8] And in the freezing phase, the patient often compensates for diminished glenohumeral motion by increased scapulothoracic motion, veiling the limitations in motion.[10] This stage is typically seen between 3 and 9 months.[9]

The mobility of the shoulder complex involves combined movements of different joints, especially of the scapulothoracic and glenohumeral joints, which need to be coordinated to perform full arm elevation.[11] Scapulohumeral rhythm of an asymptomatic shoulder is 2:1.[12] Whereas the scapulohumeral rhythm of the symptomatic shoulder is inversely proportional to the severity of shoulder ROM limitation, which suggests a compensatory pattern in adhesive capsulitis. The decreased scapulothoracic joint motion is also known to affect the synergistic rhythm between the scapulothoracic and glenohumeral joints, which may further contribute directly to abnormal glenohumeral joint motion. Thus without the contributions of the scapulothoracic joint motion, passive and active ROM of shoulder flexion and abduction are diminished by at least one third.[13]

Presently, no standard medical, surgical, or physiotherapy regimen is universally accepted as the most effective treatment for rebuilding motion in patients with shoulder adhesive capsulitis; however, employing physiotherapy as the first line of treatment for shoulder pain has been proposed.[14] A variety of physiotherapy modalities could be used like heat or ice applications, ultrasound, interferential therapy, laser and transcutaneous electrical nerve stimulation.[15] The paraffin wax bath is frequently used as an effective remedy to improve circulation and promote relaxation. It has been concluded that paraffin wax bath combined with exercise improves mobility, decreases stiffness, and increases elasticity.[16] Joint mobilization and passive stretching have been recommended to restore joint extensibility of shoulder capsule and tight soft tissues.[17] Maitland's oscillations which are applied at grade I and II may have an inhibitory effect on the perception of agonizing stimuli by continuously stimulating the mechanoreceptors that block nociceptive pathways at the spinal cord or brain stem levels. Grades III and IV are primarily used as stretching maneuvers whereas, grades I and II are the non-stretch motions which

help the synovial fluid to improve nutrition to the cartilage.[9]

It has been observed that, even though scapular abnormalities were assessed in patients with adhesive capsulitis, physiotherapy treatment regimens were focused on pain relief and improvement in the ROM. Scapular exercises were not included in the programs even though the scapula plays various roles in facilitating optimal shoulder function.[15] And in adhesive capsulitis, since there is an involvement of both, the scapulothoracic, as well as the glenohumeral joint, it becomes important to tackle both these joints in the rehabilitation program.[2,11] Thus, in the present study the researcher applied the techniques of scapular Proprioceptive Neuromuscular Facilitation (PNF) and scapular mobilization to combat this issue. Joint mobilization using PNF techniques has a positive effect on pain, muscle strength, and ROM.[15] Scapular PNF incorporates functional or diagonal patterns (anterior elevation – posterior depression and posterior elevation – anterior depression) for performing the exercises and can be used to stretch or strengthen the muscles selectively. These techniques help the muscles to relearn the normal timing of recruitment and the amount of activation to sustain the balance between different groups of muscles.[18]

Scapular mobilization involves the manual application of a sustained mobilization by a therapist to a scapulothoracic joint and is considered to provide positive effects on the ROM of the shoulder joint.[19]

The main objective of this comparative study was to compare *the effect of scapular PNF and Maitland glenohumeral mobilization versus* scapular mobilization and Maitland *glenohumeral mobilization,* where paraffin wax bath was administered for both the groups.

MATERIAL AND METHODS

The study was a hospital center-based comparative follow up from day 1 to week 3 and was approved by the institutional ethical committee (Ref no. KIPT/31/19-20). Samples of the study comprised of 60 adhesive capsulitis patients at Kempegowda Institute of Medical Sciences, aged between 40 to 60 years selected by convenient sampling method. The 60 adhesive capsulitis subjects were divided into two groups having 30 samples in each group, Group-A subjects were given scapular PNF and Maitland glenohumeral mobilization whereas Group-B subjects were given scapular mobilization and Maitland *glenohumeral mobilization.*

The study samples were selected based on inclusion and exclusion criteria.

Inclusion criteria:

1. Case diagnosed with adhesive capsulitis, both primary and secondary origin.
2. Freezing stage of adhesive capsulitis.
3. Capsular restriction of movement.
4. Unilateral adhesive capsulitis.
5. Both males and females of the age group 40 to 60 years.
6. Active shoulder abduction range of 90 degrees for performing lateral scapular slide test.

Exclusion criteria:

1. History of shoulder surgery or manipulation under anesthesia, local corticosteroid injection administration to the affected shoulder within the last 3 months,
2. Neurological deficit affecting the shoulder functioning during daily activities,
3. Pathology of the shoulder joint other than adhesive capsulitis.
4. Pain or disorder of the cervical spine, elbow, wrist or hand.
5. Cancer.
6. Patients diagnosed with diabetes mellitus.

The study was conducted and outcome measures, Visual Analog Scale (VAS), passive and active ROM of shoulder flexion, extension, abduction, internal and external rotation using universal goniometer, Lateral Scapular Slide Test (LSST), and Shoulder Pain and Disability

Index (SPADI) were collected on day 1 and at the end of 3rd week (9th session).

Lateral Scapular Slide Test (LSST) was used to assess scapular dyskinesis and its asymmetry under varying loads. It was in accordance with the method invented by Kibler, where three test positions i.e. at rest, and at 45 and 90 degrees of abduction are used. If the difference of the distance between the inferior aspect of the inferior angle of the scapula and the closest spinous process in the same horizontal plane which is measured bilaterally with a tape is 1.5 cm or more in any of the three positions it is considered a positive result of the LSST.[3]

The Shoulder Pain and Disability Index (SPADI) is a self-report questionnaire developed to measure the pain and disability in patients with shoulder pathology. It is only one of the many joint-specific self-report forms that focus on the shoulder joint.[20]

The patients of group A and B received the wrapping method of wax therapy for 8-10 min with a temperature maintained at 40°- 45° Celsius before the exercise. Wax therapy was applied in and around the shoulder.[21] And after that, the exercise protocol was performed.

For Group-A, scapular PNF was applied in two diagonals, anterior elevation and posterior depression and posterior elevation and anterior depression. The rhythmic initiation facilitation technique was applied in all patterns.[22] 20 repetitions of each diagonal pattern were performed, and the rest interval between the repetitions was 20 seconds.[3]

This was followed by Maitland glenohumeral caudal glide, caudal glide progression, and glenohumeral posteroanterior glide. Passive oscillatory movements were performed at the rate of 2-3 glides per second for 30 seconds for each glide. 5 such sets were given.[4] These techniques were applied thrice a week for three weeks (9 sessions).

For Group-B, scapular mobilization was given, which consisted of applying superior and inferior gliding, rotations, and distraction to the scapula of the affected shoulder. 10 sets of 10 repetitions were applied with a rest interval of 30 seconds between sets.[23]

And this was followed by the above-mentioned Maitland glenohumeral caudal glide, caudal glide progression, and glenohumeral posteroanterior glide. These techniques were also applied thrice a week for three weeks (9 sessions).

STATISTICAL ANALYSIS

Data was analyzed using the statistical package SPSS19.0 (SPSS Inc., Chicago, IL) and level of significance was set at p=<0.05. Chi square test was used to find out the association between categorical variables. Paired t test was used within the group and independent t test was used between the groups to find out the statistical significance. One-way ANOVA followed by Tukey's HSD post hoc test for the within group comparison for more than two intervals.

RESULTS

In the present study, the mean age of Group-A was 51.56 years and that of Group-B was 50.63 years. The standard deviation was 6.17 and 6.67 of Group-A and Group-B respectively. And the groups were comparable, as it did not report any statistical significance, since the p-value was 0.42 (p=>0.05).

Group-A consisted of 53.3% of males and 46.7% of females and Group-B consisted of 56.6% of males and 43.4% of females.

Table 1: Visual Analog Scale (VAS)

	VAS		P VALUE (Independent t test)
	GROUP-A	GROUP-B	
PRE SCORE (in cm)	6.87±1.18	6.37±1.36	0.11
POST SCORE (in cm)	3.28±0.93	4.25±1.38	0.002*
P value (within group)-paired t test	0.0001*	0.0001*	
%CHANGE	52.2%	33.28%	

Table 1 represents pre and post VAS scores of both the groups. Statistically significant changes were seen within both the groups (p<=0.05). Statistically significant changes were also seen between

the groups (p<=0.05). And, the percentages of pre-post differences observed for the VAS scale were 52.2% vs. 33.28% in Group-A and Group-B respectively. So the outcome of Group-A for reducing pain was found to be better than Group-B.

Table 2: Glenohumeral Joint Range Of Motion (ROM)

	PASSIVE ROM (in degrees)		P VALUE (Independent t test)	ACTIVE ROM (in degrees)		P VALUE (Independent t test)
	GROUP-A	GROUP-B		GROUP-A	GROUP- B	
FLEXION ROM						
PRE SCORE	130.16±17.61	137.53±16.84	0.10	124.8±18.75	132.96±17.32	0.08
POST SCORE	159.96±9.62	154.2±11.27	0.03*	154.93±10.07	148.93±12.02	0.03*
P value (within group)-paired t test	0.0001*	0.0001*		0.0001*	0.0001*	
%CHANGE	22.89%	12.1%		24.1%	12.2%	
EXTENSION ROM						
PRE SCORE	28.76±4.48	29.3±3.33	0.59	26.53±5.15	27.33±3.43	0.47
POST SCORE	32.6±5.02	31.63±2.79	0.35	31.2±4.79	30.83±2.97	0.71
P value (within group)-paired t test	0.002*	0.004*		0.0006*	0.0001*	
%CHANGE	13.35%	7.9%		17.6%	12.8%	
ABDUCTION ROM						
PRE SCORE	111±13.94	115.86±14.15	0.18	104.93±15.67	108.63±15.92	0.36
POST SCORE	144.73±8.70	137.7±9.02	0.02*	140.53±9.20	133.93±9.50	0.008*
P value (within group)-paired t test	0.0001*	0.0001*		0.0001*	0.0001*	
%CHANGE	30.38%	18.8%		33.9%	23.3%	
INTERNAL ROTATION ROM						
PRE SCORE	46.8±9.61	48.96±9.01	0.38	42.2±9.79	44.86±9.76	0.25
POST SCORE	63.4±8.11	59.13±8.11	0.04*	59.96±8.22	55.2±8.50	0.03*
P value (within group)-paired t test	0.0001*	0.0001*		0.0001*	0.0001*	
%CHANGE	35.4%	20.8%		42.1%	23.1%	
EXTERNAL ROTATION ROM						
PRE SCORE	36.1±7.98	38.2±7.28	0.28	31.96±8.58	34.23±7.95	0.28
POST SCORE	54.36±8.60	50.13±6.48	0.03*	50.83±8.83	46.8±6.51	0.04*
P value (within group)-paired t test	0.0001*	0.0001*		0.0001*	0.0001*	
%CHANGE	50.5%	31.2%		59.2%	36.7%	

Table 2 represents the pre and post passive and active ROM values for flexion, extension, abduction, internal rotation, and external rotation of the glenohumeral joint for Group-A and Group-B. Statistically significant changes were seen within both the groups (p<=0.05) for all the ROM. Statistically significant changes were also seen between the groups (p<=0.05) apart for the extension ROM. Since Group-A showed a greater percentage of change than Group-B, we can infer that Group-A showed better improvement in ROM of the glenohumeral joint than Group-B except for the extension ROM.

Table 3: Lateral Scapular Slide Test (LSST)

WITHIN GROUP													
		GROUP-A						**GROUP-B**					
		LSST-PRE (in cm)			LSST-POST (in cm)			LSST-PRE (in cm)			LSST-POST (in cm)		
		REST	45 ABD	90 ABD	REST	45 ABD	90 ABD	REST	45 ABD	90 ABD	REST	45 ABD	90 ABD
	MEAN ±SD (in cm)	0.48±0.17	0.953 ±0.23	1.466± 0.217	0.30± 0.12	0.71± 0.24	1.22± 0.21	0.54± 0.14	1.05± 0.23	1.54± 0.19	0.39± 0.13	0.89 ±0.25	1.37 ±0.20
	PVALUE(ANOVA)	0.0001*			0.0001*			0.0001*			0.0001*		

BETWEEN GROUP						
	LSST-PRE			**LSST-POST**		
	REST	45ABD	90 ABD	REST	45ABD	90 ABD
GROUP A	0.48±0.17	0.953±0.23	1.466±0.217	0.30±0.12	0.71±0.24	1.22±0.21
GROUP B	0.54±0.14	1.05±0.23	1.54±0.19	0.39±0.13	0.89±0.25	1.37±0.20
P-VALUE (INDEPENDENT T TEST)	0.14	0.09	0.12	0.007*	0.006*	0.006*
CHANGE %	12.5%	10.1%	5.1%	30%	25.3%	12.2%

Table 3 represents the statistically significant changes in the pre and post values of the LSST scores in all the 3 positions in Group-A and Group-B ($p<=0.05$). Since Group-A showed a greater percentage of change than Group-B, we can infer that Group-A showed better results than Group-B.

Table 4: Shoulder Pain and Disability Index (SPADI)

	SPADI		P VALUE (Independent t test)
	GROUP-A	GROUP-B	
PRE SCORE	61.91±11.94	56.07±14.12	0.08
POST SCORE	30.88±6.89	38.08±12.39	0.004*
P value (within group)-paired t test	0.0001*	0.0001*	
%CHANGE	53.07%	32.8%	

Table 4 represents pre and post SPADI scores of both groups. Statistically significant changes were seen within both the groups ($p<=0.05$). Statistically significant changes were also seen between the groups ($p<=0.05$). And, the percentages of pre-post differences observed for SPADI were 53.07% vs. 32.8% in Group-A and Group-B respectively. So the outcome of Group-A for reducing pain and disability was found to be better than Group-B.

DISCUSSION

The present study was conducted to compare the effects of paraffin wax bath, Maitland glenohumeral mobilization, and scapular PNF with the effects of paraffin wax bath, Maitland glenohumeral mobilization, and scapular mobilization to reduce pain, improve shoulder ROM, scapular dyskinesis, and disability, if any, in subjects with adhesive capsulitis. Evidence from various literatures demonstrates the importance of mobilization and scapular PNF for improving the shoulder ROM and decreasing the pain in case of adhesive capsulitis.

As we know, pain is one of the major symptoms of adhesive capsulitis. Thus, Visual Analog Scale (VAS) was used as an outcome measure for pain. When comparing Group-A and Group-B, the subjects of Group-A showed better improvement in terms of decreasing the VAS pain score.

It is known that thermotherapy is a popular adjunct to mobilization. A paraffin wax bath is generally used to improve circulation and to promote relaxation. The genesis of pain is usually multi-factorial which may include a buildup of a toxic metabolite, muscle spasm, inflammation, and psychological factors.[24] The biophysical effects of temperature elevation of body tissue to a therapeutic level between 40^0 and 45^0 C, include improved local blood flow and metabolism, superficial vasodilation, mild inflammation, higher pain threshold, diminished muscle spindle firing rate, and increased extensibility of connective tissue.[25] Thermotherapy is usually soothing and psychologically relaxing, thereby positively modifying the emotional response to pain and further reducing painful muscle spasm.[24]

Also, in accordance with a similar study by Kumar A et al (2012), mobilization reduces pain due to neurophysiologic effects on the stimulation of peripheral mechanoreceptors and the inhibition of nociceptors. As a result of this, there is the activation of apical spinal neurons, which produces presynaptic inhibition of nociceptive afferent activity. It causes a reversal of ischemia, edema, and inflammation cycle and reduces joint effusion, and relieves pain by reducing the pressure over the nerve endings.[4] Also, Group-A showed better improvement in VAS than Group-B. This result was in accordance with a similar study by Mishra N and colleagues (2019), which stated that PNF has been proven to produce analgesic effects through the pain gate control mechanism. The entry and the transmission of pain signals are inhibited by pressure and proprioceptive inputs (produced by the PNF techniques), that reach the spinal level. A similar mechanism has been explained in a study conducted by Hindle KB.[26]

As noted above, there is a restriction of movement in the capsular pattern. This being one of the methods to clinically diagnose adhesive capsulitis, it is important to measure the ROM of the glenohumeral joint using a universal goniometer. And since the intra-tester and the inter-tester reliabilities of ROM measurements done by the universal goniometer are accepted worldwide, it serves as an ideal tool.[27] As seen in table-2, Group-A showed better improvement in the passive and active ROM of flexion, abduction, internal and external rotation, but not extension, although within-group improvements were seen in the extension ROM in both the groups.

In the present study, the Maitland mobilization techniques were common for both groups. These techniques recuperate the normal extensibility of the shoulder capsule and stretch the tightened soft tissues to bring about favorable effects. Mobilization glide selected to increase external rotation and extension ROM was posteroanterior glide and to increase abduction, caudal glide and caudal glide progression were selected.[9] These glides increase the capsular extensibility and lengthen the soft tissues that inhibit joint play movement at the joint. This increased capsular extensibility may have permitted increased ROM at the glenohumeral joint. These techniques have also thought to increase the proprioceptive and kinesthetic sensation in the joint thus enabling the individuals to perform activities in the newly gained ROM. This result supports the findings of a study performed by Abhay K et al (2012).[4]

In addition to this, Scapular mobilization was performed on the subjects of Group-B, which showed significant changes in the pre and post ROM values. These patterns were chosen because of decreases in the abnormal biomechanics of scapular upward rotation, superior tilt, posterior tilt, and external rotation. Scapular mobilization can break adhesions and release these muscles and thus increase scapular motion, which reduces pain, increases ROM and shoulder function. And since glenohumeral and scapulothoracic joints are considered to be in a closed kinetic chain, improvement in scapular motions should improve the glenohumeral motions. This outcome is consistent with the previous study of Pragassame S and colleagues (2019).[28]

However, Group-A, where scapular PNF was performed demonstrated better results in terms of ROM. This could be a result of two probable mechanisms. Shimura and Kasai (2012) advocated for the factors such as a decrease in response time and increment in the excitability to be responsible for post interventional increase in ROM while Hindle et al (2012) proposed the mechanisms such as a decline in the excitability of Golgi tendon organ and induction of relaxation of muscles to lie behind the process of ROM improvement. An alternative mechanism explained for the increase in ROM relies on the firing of the Golgi tendon organ to cause reflexive muscle relaxation.[18] Also, the rhythmic initiation technique which is applied in scapular PNF normalizes the motion, teaches the motion to the subject, aids the subject to relax, and improves coordination.[26]

Scapular dyskinesis usually accompanies adhesive capsulitis. Thus, the researcher used LSST to measure and find out if any scapular dyskinesis was present. The subjects of Group-A showed better improvement in terms of decreasing the LSST scores than the subjects of Group-B. This outcome of the study is in accordance with a similar study done by Prasanna KJ and colleagues (2017).[29]

In the present study, the researcher had selected SPADI to measure pain and disability in these adhesive capsulitis subjects. When comparing between Group-A and Group-B, the subjects of Group-A showed better improvement in terms of decreasing the SPADI Scores. The reduction in the disability would be attributed to the reduction in pain and also the increase in the ROM, thus enabling the individuals to

participate in the activities of daily living due to the above-mentioned mechanisms.

STUDY LIMITATIONS:

1. The study was carried out on small sample size.
2. The frequency of male and female subjects was not equally distributed that limits the study.
3. No control group was taken.
4. The study was of a shorter duration.
5. Adhesive capsulitis is a self-limiting disease so the actual improvement throughout the treatment in this study could not be evaluated.
6. Proper strengthening program was not followed after mobilization sessions due to lack of time.

FURTHER RECOMMENDATIONS:

1. Inclusion of more objective measures for the study.
2. Geriatric population can be considered.
3. Since the present study was done in subjects falling under the freezing stage, the frozen and thawing stage can be considered.
4. A separate study on how this protocol can affect the diabetic population diagnosed with adhesive capsulitis.

CONCLUSION

The study concludes that scapular PNF with Maitland glenohumeral mobilization and scapular mobilization with Maitland glenohumeral mobilization are both effective in improving pain, flexion, extension, abduction, internal and external ROM of the glenohumeral joint, scapular dyskinesis, and disability in the subjects of adhesive capsulitis. However, scapular PNF with Maitland glenohumeral mobilization is a better technique thus more effective than, scapular mobilization with Maitland glenohumeral mobilization for improving pain, scapular dyskinesis, disability, and ROM except for extension in subjects with adhesive capsulitis.

Thus, re-establishment of normal shoulder function and restoring normal scapular muscle activation patterns by the addition of scapular proprioceptive neuromuscular facilitation in our view can lead to a successful rehabilitation program and may broaden the options for rehabilitation program planning. The result of this study would implicate a better exercise program for adhesive capsulitis patients.

REFERENCES

1. Bhawna, Multani NK, Kundu ZS. Prevalence Of Shoulder Pain Among Adults In Northern India. Asian Journal of Health and Medical Research (AJHMR). 2016, Volume 2, Issue 2, June, Page No.18-22.
2. Sarkari E, Dhakshinamoorthy P, Multani NK. Comparison of caudal and antero-posterior glide mobilisation for the improvement of abduction range of motion. Journal of Exercise Science and Physiotherapy. 2006;2:59.
3. Balci NC, Yuruk ZO, Zeybek A, Gulsen M, Tekindal MA. Acute effect of scapular proprioceptive neuromuscular facilitation (PNF) techniques and classic exercises in adhesive capsulitis: a randomized controlled trial. Journal of physical therapy science. 2016;28(4):1219-27.
4. Kumar A, Kumar S, Aggarwal A, Kumar R, Das PG. Effectiveness of Maitland Techniques in idiopathic shoulder adhesive capsulitis. ISRN Rehabilitation. 2012 Oct 24;2012.
5. Wong PL, Tan HC. A review on frozen shoulder. Singapore medical journal. 2010 Sep 1;51(9):694.
6. S. Brent Brotzman's Clinical Orthopaedic Rehabilitation- An Evidence Based Approach, 3rd Edition. 2011. 3: Shoulder Injuries; pg no. 114.
7. Rundquist PJ, Anderson DD, Guanche CA, Ludewig PM. Shoulder kinematics in subjects with frozen shoulder. Archives of physical medicine and rehabilitation. 2003 Oct 1;84(10):1473-9.
8. Le HV, Lee SJ, Nazarian A, Rodriguez EK. Adhesive capsulitis of the shoulder: review of pathophysiology and current clinical treatments. Shoulder & Elbow, 2017; 9(2):75–84.

9. Carolyn Kisner, Lynn Allen Colby. Therapeutic Exercise: Foundation and Technique, 6th Edition. India: Jaypee Brothers Medical Publishers (P) Ltd; 2012.
10. Milgrom C, Novack V, Weil Y, Jaber S, Radeva-Petrova DR, Finestone A. Risk factors for idiopathic frozen shoulder. The Israel Medical Association Journal. 2008 May 1;10(5):361.
11. Surenkok O, Aytar A, Baltaci G. Acute effects of scapular mobilization in shoulder dysfunction: a double-blind randomized placebo-controlled trial. Journal of Sport Rehabilitation. 2009 Nov;18(4):493-501.
12. Donald A. Neumann. Kinesiology of The Musculoskeletal System- Foundations for the Physical Rehabilitation. 2009. 5: Shoulder Complex; pg no. 114
13. Oatis CA. Kinesiology: The Mechanics And Pathomechanics Of Human Movement. 2nd edition. Philadelphia: Baltimore: Lippincott Williams & Wilkins; 2009. 8: Structure And Function Of The Bones And Joints Of The Shoulder Complex.
14. Loew M, Heichel TO, Lehner B. Intraarticular Lesions in Primary Frozen Shoulder after Manipulation under General Anesthesia. J Shoulder Elbow Surg, 2005; 14: 16-21.
15. Balci NC, Yuruk ZO, Zeybek A, Gulsen M, Tekindal MA. Acute effect of scapular proprioceptive neuromuscular facilitation (PNF) techniques and classic exercises in adhesive capsulitis: a randomized controlled trial. Journal of physical therapy science. 2016;28(4):1219-27
16. Sibtain F, Khan A, Shakil-ur-Rehman S. Efficacy of paraffin wax bath with and without joint mobilization techniques in rehabilitation of post-traumatic stiff hand. Pakistan journal of medical sciences. 2013 Apr;29(2):647.
17. Düzgün I, Baltaci G, Atay OA. Manual therapy is an effective treatment for frozen shoulder in diabetics: an observational study. Eklem Hastalik Cerrahisi. 2012 Jan 1;23(2):94-9.
18. Joshi D, Chitra J. Effect of scapular proprioceptive neuromuscular facilitation on shoulder pain, range of motion, and upper extremity function in hemiplegic patients: A randomized controlled trial. Indian Journal of Health Sciences and Biomedical Research (KLEU). 2017 Sep 1;10(3):276.
19. Duzgun I, Turgut E, Eraslan L, Elbasan B, Oskay D, Atay OA. Which method for frozen shoulder mobilization: manual posterior capsule stretching or scapular mobilization?. Journal of musculoskeletal & neuronal interactions. 2019;19(3):311.
20. MacDermid JC, Solomon P, Prkachin K. The Shoulder Pain and Disability Index demonstrates factor, construct and longitudinal validity. BMC musculoskeletal disorders. 2006Dec; 7(1): 12.
21. Dr. Mayur Das et al. 2017. "Effectiveness of subscapularis soft tissue mobilization versus proprioceptive neuromuscular facilitation on glenohumeral external rotation in periarthritis shoulder", International Journal of Current Research, 9, (12), 63484-63489.
22. Adler, Beckers, Buck. PNF in practice: An Illustrated Guide, 4th edition: Springer; 2013.
23. Yang JL, Jan MH, Chang CW, Lin JJ. Effectiveness of the end-range mobilization and scapular mobilization approach in a subgroup of subjects with frozen shoulder syndrome: a randomized control trial. Manual therapy. 2012 Feb 1;17(1):47-52.
24. Tepperman PS, Devlin M. The therapeutic use of local heat and cold. Canadian Family Physician. 1986 May;32:1110.
25. Minor MA, Sanford MK. Physical interventions in the management of pain in arthritis an overview for research and practice. Arthritis & Rheumatism: Official Journal of the American College of Rheumatology. 1993 Dec;6(4):197-206.
26. Mishra N, Mishra A, Charaniya P. Effect of scapular proprioceptive neuromuscular facilitation on pain and disability in patients with adhesive capsulitis.
27. Riddle DL, Rothstein JM, Lamb RL. Goniometric reliability in a clinical setting: shoulder measurements. Physical therapy. 1987 May 1;67(5):668-73.

28. PRAGASSAME S, KURUP VM, KIFAYATHUNNISA A. Effectiveness of Scapular Mobilisation in the Management of Patients with Frozen Shoulder-A Randomised Control Trial. Journal of Clinical & Diagnostic Research. 2019 Aug 1;13(8).
29. Prasanna KJ, Rajeswari R, Vpr S. Effectiveness of scapular proprioceptive neuromuscular facilitation (pnf) techniques in adhesive capsulitis of the Shoulder Joint. J Physiother Res. 2017;1(2):9.

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