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Original Research Article

Immediate Effect of Grade III / IV Maitland Mobilization Techniques Versus Scapular Proprioceptive Neuromuscular Facilitation and Glenohumeral Mobilization in Adhesive Capsulitis: A Randomized Controlled Trial

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ABSTRACT

Objective: Aim of the study was to determine immediate effect on pain, ROM, scapular dyskinesia and functional disability in adhesive capsulitis (AC) either after grade III/IV Maitland mobilization or scapular PNF and GH mobilization.
Methods: A RCT of 60 participants with AC, aged 40-65 years, ranged 3-9 months. They were divided into viz. Experimental group which received grade III/IV Maitland mobilization and Active Control group which received scapular PNF and GH mobilization. Both groups received TENS and moist heat before treatment session. Data was measured using Visual Analog Scale, Disabilities of the Arm, Shoulder and Hand questionnaire; GH ROM, Lateral Scapular Slide Test pre-treatment and immediately at 1 week treatment follow up.
Results: Both groups showed statistically significant difference in post intervention and post 1 week follow-up within the group except for internal and external rotation ROM in Active Control group. Post 1 week follow-up between groups analysis showed that there was statistically significant difference in internal rotation ROM (p<0.041) in Active Control group.
Conclusion: Scapular mobilization with Maitland GH mobilization and scapular PNF with Maitland GH mobilization are both effective in improving pain, functional disability, ROM and scapular dyskinesia in patients with AC but the effect size is small.

Keywords: *Adhesive capsulitis; Maitland mobilization; Moist heat; Proprioceptive neuromuscular facilitation; Transcutaneous electrical stimulation*

INTRODUCTION

The term "adhesive capsulitis" (AC) or "frozen shoulder" refers to a usual shoulder condition which is characterized by global restriction in the range of motion (ROM) of shoulder in a capsular pattern. Capsular pattern in the shoulder is characterized by limitation of passive external rotation and abduction (Cyriax, 1982). The prevalence of AC is approximately 3% in general population (Edwald, 2011) and 36% in diabetic patients (Vishnu et al., 2020). In women, the prevalence is 10.1% and men it is 8.2% (Walker-Bone et al., 2004). It most commonly affects women aged 40-70 years compared to men (Edwald, 2011). Also, positive HLA-B27 and prolonged immobilization of the glenohumeral joint are risk factors (Le et al., 2017).

A hallmark of adhesive capsulitis is the contracture of the glenohumeral capsule. Findings include, loss of the capsular synovial layer, presence of adhesions to the axillary fold, anatomical neck of the humerus and overall capsular volume reduction. AC is chiefly an inflammatory process that eventually leads to fibrotic changes (Le et al., 2017). In this study, participants falling under the freezing stage were considered, as it is characterized by intense pain even at rest and ROM limitation. This stage is typically seen between 3 and 9 months (Kisner & Colby, 2012).

Scapulohumeral rhythm in a healthy shoulder is 2:1 (Neumann, 2009; Levangie PK, Norkin, 2012). The scapulohumeral rhythm of the symptomatic AC shoulder is inversely proportional to the shoulder range of motion limitation severity, which may suggest a compensatory pattern in AC. This affects the coordinated rhythm which is present between the scapulothoracic and glenohumeral joints, which may further lead to abnormal glenohumeral joint motion (Oatis, 2009; Brotzman & Manske, 2011).

In AC, there are complaints of poorly localized shoulder pain with focal tenderness adjacent to the deltoid insertion and may radiate to the Laboratory studies do not contribute to the diagnosis of AC. Radiography of shoulder should be done to rule out any other pathologies. Magnetic resonance imaging may be required if another pathology is suspected based on the history and examination (Wong & Tan, 2010).

The treatment of AC may be either operative or non-operative. Non-operative treatment includes pharmacological therapy, corticosteroid intra-articular injection, sodium hyaluronate intra-articular injection and physiotherapy (Le et al., 2017; Kelley et al., 2013; Balci et al., 2016; Nitz, 1986; Mitra, 2006; Cameron, 2013; Tepperman & Devlin, 1986; Adler et al., 2008; Alghadir et al., 2018). IN a study, it was found that 6 weeks end range mobilization and scapular mobilization was more effective than passive stretching exercises (Maarouf et al., 2021). A study done over 3 weeks treatment with scapular PNF and Maitland glenohumeral mobilization versus scapular and glenohumeral mobilization in adhesive capsulitis that scapular PNF and Maitland GH mobilization was more effective (Joshi et al., 2020).

Among the various studies it has been found that Maitland mobilization is more effective. Data suggest that scapular PNF also aids in improving the symptoms. Also, there is no study which has been done to prove which treatment is effective in adhesive capsulitis. The aim of the study was to determine the immediate effect of grade III or IV Maitland mobilization techniques versus scapular proprioceptive neuromuscular facilitation and glenohumeral mobilization in adhesive capsulitis.

MATERIALS & METHODS

Design: The study was double-blinded parallel randomized controlled with 1:1 allocation ratio trial between June 2021 and October 2022. The study was approved by the Institutional Ethical Committee (REF/2022/04/053168). The study was registered under Clinical Trial Registry – India with the registration number CTRI/2022/04/041985 based on Declaration of Helsinki.

Participants, Therapist, Centre: 60 AC participants recruited from outpatient department of Physiotherapy, Goa Medical College and Hospital, Bambolim-Goa, India allocated with block randomization of size four using web-based randomization service. Random allocation sequence was generated by the Statistician. Physiotherapist enrolled and assigned the participants to interventions. The statistician and participants were blinded after assignment to interventions. The 60 AC participants were randomly allocated to experimental group (n = 30) and active control group (n = 30).

A total of 60 participants were screened and included in the study (Figure 1). All participants gave informed consent prior to intervention. In both the groups, the total duration of intervention was immediate on the day of assessment and follow-up was done after 7 days post intervention.

The study samples were selected based on inclusion and exclusion criteria as follows:

Inclusion criteria:

- 40-65 years (Kelley et al., 2013)
- All genders (Kelley et al., 2013)
- Diagnosed with adhesive capsulitis with 3-9 months (Kisner & Colby, 2012)
- Capsular restriction of movement (Yatheendra et al., 2015)
- Visiting Goa Medical College
- June 2021 – October 2022

Exclusion criteria:

- Shoulder surgery (Yang et al., 2007)
- Corticosteroid injection (Maarouf et al., 2021)
- Shoulder impingement (Kisner & Colby, 2012)
- Trauma to shoulder or scapula (Maarouf et al., 2021)
- Hypermobile joints (Kisner & Colby, 2012)
- Neurological disorders (Balci et al., 2016)
- Migration (Johnson et al., 2007)

Intervention

Experimental group received TENS (Physiogear, New Delhi, India): 100 Hz for 20 minutes and moist heat for 20 minutes for warming up.

Intervention	Sets	Repetitions	Grade	Rest time	Technique
Maitland end-range GH mobilization	3	10-15	III/IV	10 secs	Scaption plane
Scapular mobilization	3	10-15	III/IV	10 secs	Distraction, Superior & inferior glides Upward & downward rotation

Maitland end-range glenohumeral mobilization:

Participant lying supine with the involved arm positioned in scaption plane. Therapist standing facing the top of the treatment table. One hand placed at the proximal humerus and the other at the elbow joint to provide grade I distraction. Maitland grade III or IV was given in the end range.

Figure 2. Maitland end-range glenohumeral mobilization

Scapular mobilization:

It consist of applying superior and inferior gliding, upward and downward rotations to the involved scapula in a side lying position facing the therapist. The participant's arm draped over the therapist inferior arm and allowed to hang so that the muscles are relaxed. The therapist's one hand placed across the acromion process to control the motion and the fingers of the other hand scooping under the medial border and inferior angle of scapula. Mobilizing force applied to the scapula in the superior, inferior, upward and downward rotations by lifting the inferior angle or by pushing on the acromion process.

Figure 3. Scapular mobilization

Figure 4. Scapular distraction

For scapular distraction, the participant in side lying position and the therapist places ulnar finger under the medial scapular border and distract the scapula away from the thorax.

Active control group received TENS: 100 Hz for 20 minutes and moist heat for 20 minutes.

Intervention	Sets	Repetitions	Grade	Rest time	Pattern	Technique
Scapular PNF	-	20	-	20 secs	Anterior elevation & posterior depression	Hold -relax
Maitland GH mobilization	5	30 secs	III or IV	10 secs	Caudal glide Caudal-glide progression Postero-anterior glide	

Scapular proprioceptive neuromuscular facilitation:

1. **Anterior elevation:** Participant in side lying position with the therapist standing behind the participant facing towards the participant’s head. The therapist’s one hand placed on the anterior aspect of the glenohumeral joint and over the acromion process with the fingers cupped and the other hand placed on top of it for support. The scapula was pulled down and back towards the lower thoracic spine with the inferior angle of the scapula rotated towards the spine. The participants were commanded to shrug the shoulder up toward the nose. Resistance was applied to the inferior angle of scapula in the direction of the spine. The end position of scapula was upward and forward with the acromion process close to the patient’s nose. This position was held for 5-8 seconds.

Figure 5. Scapular PNF - Anterior elevation

2. **Posterior depression:** Participant in side lying position with the therapist standing behind the participant facing towards the participant’s head. The therapist’s heel of the hand placed along the vertebral border of the scapula with other hand over it for support. The scapula was pushed upward and forward with the inferior angle of the scapula moved away from the vertebral border of the spine. The participant was commanded to push the shoulder blade down towards the therapist. Resistance was applied to the inferior angle of scapula in the direction away from the vertebral border of the spine. The end position of the scapula was depression and retraction. This position was held for 5-8 seconds.

Figure 6. Scapular PNF - Posterior depression

Maitland glenohumeral mobilization:

1. **Caudal glide:** Participant lying supine with the arm in resting position. Therapist standing at the involved side places one hand in the axilla to provide distraction and web space of the other hand placed just distal to the acromion process of the scapula. Mobilizing force was applied in the inferior direction.

Figure 7. Maitland glenohumeral mobilization – Caudal glide

2. **Caudal glide progression:** Participant lying supine with the arm abducted to the end of its available range. Therapist standing at the involved side. The therapist stabilized the arm against the trunk and provided distraction and the web space of the other hand placed just distal to the acromion process of the scapula. Mobilizing force was applied in the inferior direction.

Figure 8. Maitland glenohumeral mobilization – Caudal glide progression

3. **Postero-anterior glide:** Participant in prone with the arm resting over the edge of the treatment table. Acromion stabilized on a padding. The therapist standing facing the top of the treatment table with one hand held the arm against the thigh and provided grade I distraction and the other hand placed just distal to the posterior angle of the acromion process of the scapula. Mobilizing force was applied to the humeral head in the anterior and slightly medial direction.

Figure 9. Maitland glenohumeral mobilization – Postero-anterior glide

Outcome Measures

Brief demographic data were obtained from the participants before the assessment. The outcome measures were recorded pre-, post and 1 week post intervention.

1. Visual Analog Scale (VAS) was used for assessing the level of pain. It is an 11 - point scale, beginning at 0 and ending at 10 and with the reliability of 0.97. Criterion validity has not been evaluated (absence of gold standard for pain measurement).
2. Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire is a self – report questionnaire which contains 30-items used to assess physical function (21-items), pain symptoms (5-items) and emotional and social function (4-items). With the score ranging from 0 – 100, reliability ranging between 0.77-0.98 and validity >0.70.
3. Lateral Scapular Slide Test (LSST) was used to assess dyskinesis of scapula. It was based on the method invented by Kibler, where it measures distance between inferior angle of scapula and the closest thoracic spinous process in 1) neutral position, 2) hands resting on hips with thumbs posterior and 3) 90° shoulder abduction, full internal rotation and full radio-ulnar supination. If the difference of distance measured bilaterally was 1.5 cm or more with tape in any of the three positions it was considered a positive result. With reliability and validity for 1st and 2nd positions were 0.87-0.95 and 0.78-0.92 respectively and 3rd position was 0.70-0.82 and 0.62-0.81 respectively.
4. Glenohumeral Range of Motion was done using half circle goniometer to

measure shoulder flexion, extension, abduction, adduction, external rotation and internal rotation. With the reliability ranging from 0.87-0.99 and validity of >0.85.

STATISTICAL ANALYSIS

Sample size was determined using a randomized controlled trial (Joshi et al., 2020). It was based upon the ability to detect a 1.3 cm difference in improvement in VAS. A sample size of 22 participants per group would have been required to achieve 80% power to detect difference of 1.3 cm between the 2 groups with mean of 3.28 and 4.25 and 1.155 standard deviation at a 5% significance level. $Z\alpha$ at 95% was considered as 1.96 and $Z\beta$ was 0.842. 10% was allowed as loss to follow-up and aimed to recruit 60 participants per group.
Data was analyzed using Statistical Package for Social Sciences software version 22.0. Mean and standard deviation were calculated for all the demographic data and outcome measures. Chi-square test was used for determining the association between categorical variables. Student t-test for dependent sample was used to compare the mean of VAS, DASH questionnaire, Glenohumeral ROM and LSST within groups. Student t-test for independent sample was used to compare the VAS, DASH, LSST and GHROM between groups. Bonferroni post hoc analysis was used to determine the effectiveness of treatment. Cohen's d was used to measure the effect size where 0.2 indicates small, 0.5 indicates medium and 0.8 indicates large effect size. The level of significance was set at p-value $\leq$ 0.05 with 95% confidence interval.

RESULT

Sixty participants were selected and allocated equally (n=30) into experimental and active control group as per the inclusion criteria. Participants moved through the trial outlined in Figure 1. Descriptive demographic analysis of characters such as age and gender were measured in both the groups at baseline and presented as mean and standard deviation. The Chi square test showed no significant difference (P>0.05) between these characters in the groups which indicate study homogeneity (Table 1).

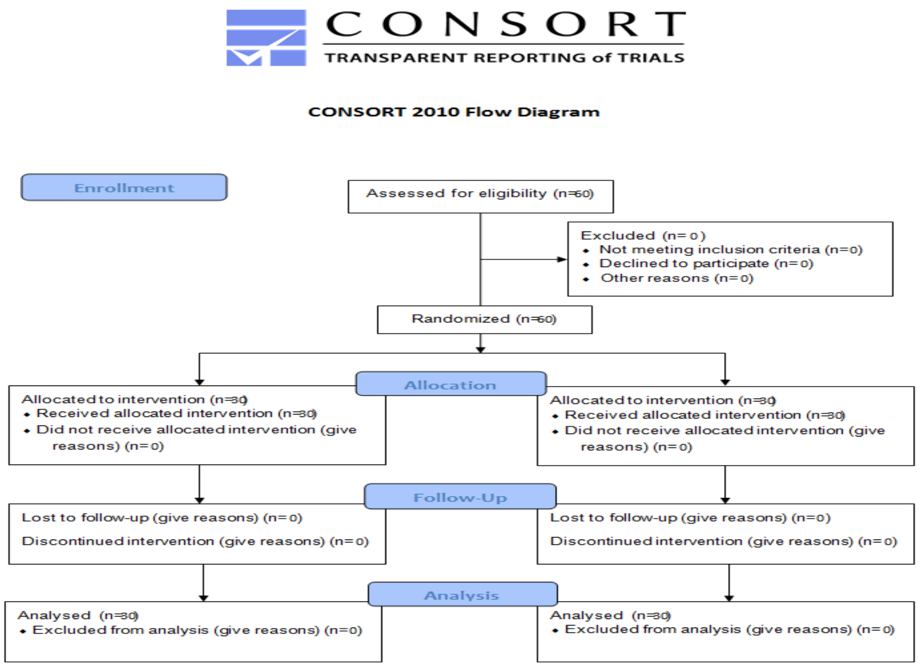

Figure 1. CONSORT 2010 Flow Diagram

Table 1. Demographic characteristics of participants

Characteristics		Experimental group (n=30)	Active control group (n=30)	p - value
Age (years)		56.9 (6.9)	58.2 (6.6)	0.482
Gender	Male	15	15	
	Female	15	15	

$p < 0.05$ – Statistically significant

Table 2 represents pre, post treatment and post 1 week VAS scores, DASH, shoulder ROM and LSST of experimental group. Using paired t-test, there were statistically significant changes were seen within the experimental group ($p<0.05$).

Table 2. Within group comparison of outcome measures in experimental group

Outcome Measures	Baseline	Post intervention	Post 1 week follow-up	Mean difference (95% CI) Baseline – Post intervention	Mean difference (95% CI) Baseline – Post 1 week follow-up	p – value Baseline and Post intervention	p – value Baseline and Post 1 week
VAS (cm)	7 (6.9) (6.3 to 7.5)	4 (2) (3.1 to 4.7)	5 (2.1) (4.0 to 5.6)	-3.0 (-5.6 to -0.4)	-2.0 (-4.6 to -0.6)	0.000	0.000
DASH	54.6 (15.8) (50.6 to 58.7)	-	39.3 (11.9) (36.6 to 42.9)	-	-15.3 (-22.4 to -8.2)	-	0.000
Flexion (°)	125.3 (24.9) (116.0 to 134.0)	150.6 (19.4) (143.3 to 157.8)	138.2 (24) (129.1 to 147.1)	25.3 (14 to 36.6)	12.9 (0.5 to 25.3)	0.000	0.000
Abduction (°)	85.1 (16.9) (78.7 to 91.4)	108.5 (21.6) (100.4 to 116.5)	94.6 (22.2) (86.3 to 102.8)	23.4 (13.6 to 33.2)	9.5 (-0.5 to 19.5)	0.000	0.000
Internal rotation (°)	48.6 (14.6) (43.1 to 54.0)	61.7 (10.3) (57.9 to 65.5)	54.7 (11.9) (50.1 to 59.0)	13.1 (6.7 to 19.5)	6.1 (-0.6 to 12.8)	0.000	0.000
External rotation (°)	35.5 (19.6) (28.1 to 42.8)	51.9 (21) (44.0 to 59.7)	42.2 (21.9) (34.0 to 50.3)	16.4 (6.1 to 26.7)	6.7 (-3.8 to 17.2)	0.000	0.000
LSST Rest (°)	0.3 (0.6) (0.0 to 0.5)	0.1 (0.4) (-0.0 to 0.3)	0.1 (0.4) (-0.3 to 0.2)	-0.2 (-0.5 to 0.0)	-0.2 (-0.5 to 0.0)	0.019	0.016
LSST 45°	0.5 (0.7) (0.1 to 0.7)	0.2 (0.4) (0.0 to 0.3)	0.1 (0.4) (-0.3 to 0.2)	-0.3 (-0.6 to 0.0)	-0.4 (-0.7 to -0.1)	0.024	0.012
LSST 90°	0.9 (0.8) (0.6 to 1.2)	0.4 (0.6) (0.1 to 0.6)	0.5 (0.7) (0.2 to 0.8)	-0.5 (-0.9 to -0.1)	-0.4 (-0.8 to 0.0)	0.000	0.010

$p < 0.05$ – Statistically significant

VAS – Visual Analog Scale, DASH – Disabilities of Arm, Shoulder and Hand, LSST – Lateral Scapular Slide Test

Table 3 represents pre, post intervention and post 1 week VAS scores, DASH, shoulder ROM except internal rotation and external rotation and LSST of active control group. Using paired t-test, there were statistically significant changes were seen within the group (p<=0.05).

Table 3. Within group comparison of outcome measures in active control group

Outcome Measures	Baseline	Post intervention	Post 1 week follow-up	Mean difference (95% CI) Baseline – Post intervention	Mean difference (95% CI) Baseline – Post 1 week follow-up	p – value Baseline and Post intervention	p – value Baseline and Post 1 week follow-up
VAS (cm)	7.7 (1.9) (7.0 to 8.4)	4.3 (2.1) (3.4 to 5.0)	4.7 (2) (3.9 to 5.5)	-3.4 (-4.2 to -2.6)	-2.9 (-3.7 to -2.2)	0.000	0.000
DASH	54.7 (15.5) (50.6 to 58.7)	-	40.2 (12.5) (36.6 to 42.9)	-	-14.5 (-21.6 to -7.4)	-	0.000
Flexion (°)	135.8 (18.70 (128.8 to 142.8)	155.8 (15.9) (149.8 to 161.7)	143.2 (17.6) (136.6 to 149.8)	20 (11.2 to 28.8)	7.4 (-1.8 to 16.6)	0.000	0.005
Abduction (°)	85.3 (22.3) (76.9 to 93.5)	108.4 (22.6) (99.9 to 116.7)	95.4 (19.5) (88.1 to 102.6)	23.1 (11.7 to 34.5)	10.1 (-0.5 to 20.7)	0.000	0.000
Internal rotation (°)	55.8 (13.3) (50.7 to 60.7)	68.1 (6.7) (65.6 to 70.6)	57.9 (11.4) (53.6 to 62.1)	12.3 (7 to 17.6)	2.1 (-4.2 to 8.4)	0.000	0.243*
External rotation (°)	42.3 (15.9) (36.3 to 48.2)	56.2 (15) (50.5 to 61.7)	43.9 (4) (38.6 to 49.1)	13.9 (6.1 to 21.7)	1.6 (-4.3 to 7.5)	0.000	0.124*
LSST Rest (°)	0.4 (0.7) (0.1 to 0.6)	0.2 (0.5) (-0.6 to 0.4)	0.2 (0.6) (-0.0 to 0.4)	-0.2 (-0.5 to 0.1)	-0.2 (-0.5 to 0.1)	0.026	0.037
LSST 45°	0.5 (0.8) (0.1 to 0.8)	0.3 (0.6) (0.0 to 0.5)	0.3 (0.7) (0.0 to 0.5)	-0.2 (-0.6 to 0.2)	0 (-0.3 to 0.3)	0.043	0.028
LSST 90°	0.9 (0.8) (0.5 to 1.2)	0.2 (0.3) (0.0 to 0.3)	0.4 (0.6) (0.0 to 0.6)	-0.7 (-1 to -0.4)	-0.5 (-0.9 to 0.1)	0.000	0.002

p < 0.05 – Statistically significant
***p > 0.05 – No statistically significant**
VAS – Visual Analog Scale, DASH – Disabilities of Arm, Shoulder and Hand, LSST – Lateral Scapular Slide Test

Using unpaired t-test, there was no significant difference between the post 1 week treatment means of VAS scores, DASH, shoulder ROM (flexion, abduction and external rotation) and LSST. However, there was significant difference between the post 1 week treatment means of shoulder internal rotation (Table 4) (Figure 10).

Table 4. Between group comparison of outcome measures in experimental and active control group

Outcome Measures	Experimental group	Active control group	Mean difference (95%CI)	p – value	Cohen's d
VAS (cm)	5 (2.1) (4.0 to 5.6)	4.7 (2) (3.9 to 5.5)	-0.3 (-1.1 to 0.5)	0.465	0.0
DASH	39.3 (11.9) (36.6 to 42.9)	40.2 (12.5) (36.6 to 42.9)	-0.9 (-7.0 to 5.2)	0.875	0.0
Flexion (°)	138.2 (24) (129.1 to 147.1)	143.2 (17.6) (136.6 to 149.8)	-6.9 (-16.7 to 2.8)	0.163	0.2
Abduction (°)	94.6 (22.2) (86.3 to 102.8)	95.4 (19.5) (88.1 to 102.6)	-0.2 (-10.5 to 9.9)	0.959	0.0
Internal rotation (°)	54.67 (11.9) (50.1 to 59.0)	57.9 (11.4) (53.6 to 62.1)	-5.6 (-11.0 to -0.2)	0.041*b	0.2
External rotation (°)	42.2 (21.9) (34.0 to 50.3)	43.9 (4) (38.6 to 49.1)	-4.2 (-13.3 to 4.7)	0.346	0.0
LSST Rest (°)	0.1 (0.4) (-0.3 to 0.2)	0.2 (0.6) (-0.0 to 0.4)	-0.0 (-0.3 to 0.2)	0.583	0.1
LSST 45°	0.1 (0.4) (-0.3 to 0.2)	0.3 (0.7) (0.0 to 0.5)	-0.1 (-0.4 to 0.1)	0.495	0.3
LSST 90°	0.5 (0.7) (0.2 to 0.8)	0.4 (0.6) (0.0 to 0.6)	-0.1 (-0.1 to 0.4)	0.386	0.6

***p < 0.05 – Statistically significant**

p > 0.05 – No statistically significant

b. Adjustment for multiple comparisons: Bonferroni.

VAS – Visual Analog Scale, DASH – Disabilities of Arm, Shoulder and Hand, LSST – Lateral Scapular Slide Test

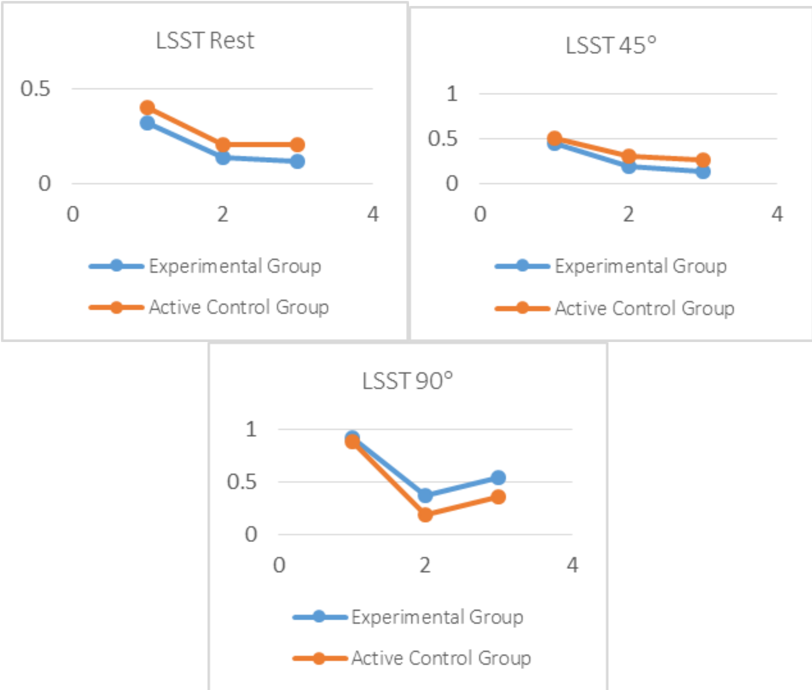

Figure 10. Baseline, post intervention and post 1 week follow-up Visual Analog Scale, Disabilities of Arm, Shoulder and Hand questionnaire; Shoulder ROM (flexion, abduction, internal rotation and external rotation) and LSST at rest, 45° and 90°.

DISCUSSION

The present study was conducted to determine the immediate effects of grade III or IV Maitland glenohumeral and scapular mobilization with scapular PNF and glenohumeral mobilization. The results showed that there was immediate and statistically significant improvement in pain intensity, functional disability, shoulder ROM and scapular dyskinesia was seen in experimental and active control group.

But, the internal rotation and external rotation in active control group showed no significant improvement. However, both interventions were equally effective in improving pain intensity, functional disability, shoulder ROM and scapular dyskinesia as no statistically significant changes were observed between the groups. There are no other published studies on the immediate effect on frozen shoulder.

There was significant improvement in scapular mobilization and end range mobilization than passive stretching exercises in improving shoulder flexion and abduction ROM; pain severity and functional disability (Maarouf et al., 2021). There was no significant difference in internal rotation and external rotation ROM. They did not measure the scapular dyskinesia. But this study found that there was no significant improvement between the groups.

Capsular stabilization exercises along with high grade mobilization techniques is effective in decreasing pain, increasing shoulder ROM and to improve functional disability on DASH in frozen shoulder (Yatheendra kumar et al., 2015). They did not assess internal rotation ROM and gave shoulder flexion and abduction ROM results.

Maitland glenohumeral mobilization and scapular PNF was more effective in improving pain, shoulder ROM, SPADI and LSST in adhesive capsulitis patients (Joshi et al., 2020). This study did not find consistent results as it was done to determine the immediate effect.

There was significant improvement observed post intervention in both the groups. Maitland mobilization technique increases the extensibility of shoulder joint capsule and stretches the tightened soft tissues and increases the synovial fluid to the shoulder joint (Kisner & Colby, 2012). These patterns were selected as there is limitation of scapular upward rotation, posterior tilt and external rotation (Oatis, 2009). Using scapular mobilization, there was break down of the adhesion and release of muscles thus increasing the shoulder motion and reducing pain (Kisner & Colby, 2012).

As there is restriction of shoulder movement in capsular pattern which has been documented, to increase shoulder abduction caudal glide and caudal glide progression and to increase external rotation postero-anterior glide was selected. Grade III or IV are used as stretching maneuvers (Oatis, 2009).

Hold relax scapular PNF was used as it resists isometrically contracted shortened muscles followed by relaxation. This technique is used to increase ROM and to decrease pain (Adler et al., 2008). LSST showed improvement in both groups but there wasn't significant difference which was observed in both groups.

During moderate irritability modalities such as heat and electrical stimulation for pain modulation can be used. Along with this, joint mobilization by progressing the amplitude and duration on procedures into tissue resistance can also be used (Kelley MJ et al., 2013). Their study also supports that using neuromuscular education to improve normal scapulohumeral movements to perform reaching activities.

DASH score was not significant between groups. But within the group there was statistically significant improvement noted. Also, the minimal clinically important difference was seen within the groups. Thus, improving the functional disability.

The experimental group has shown better results than that of the active control group. This could be because the fact that mobilization aids in the alignment of the collagen, improving the balance of glycosaminoglycans and water content within the tissue, improving tensile properties, encouraging collagen turnover and decreasing the formation of adhesions. Thus, increasing the ROM, pain and decreasing dyskinesia. Whereas, using mobilization and scapular PNF to increase the ROM depending on the firing of the GTO to cause reflexive relaxation. PNF may be an effective technique to increase ROM if used for long time.

Few participants reported that there was soreness next day and few complained that there was increased pain on the same day following treatment. Also, gave positive response by pain reduction and increasing the slight ROM for almost two days. For some it remained for 4 days and the process was reversed on the fifth day. Strength of this study is that the frequency of male and female participants was equally distributed.

There are few limitations as no control group was taken, the study was of a shorter duration assessing post 1 week improvement following 1 session of intervention and strengthening program was not followed after mobilization session as no home protocol was given. Also, there were no changes seen in outcome measures post 1 week, adherence to the treatment was not assessed and fixed ROM was not taken in the inclusion criteria.

CONCLUSION

The study concluded that scapular mobilization with Maitland glenohumeral mobilization and scapular PNF with Maitland glenohumeral mobilization are both effective in improving pain, functional disability, glenohumeral joint ROM and scapular dyskinesis in post treatment in patients with adhesive capsulitis but won't have effect post 1 week. Also, the effect size is small.

Declaration by Authors

Ethical Approval: Approved

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