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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.

INTRODUCTION

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,
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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.\(^5\)

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.\(^11\) Scapulothoracic rhythm of an asymptomatic shoulder is 2:1.\(^12\) Whereas the scapulothoracic 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
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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>
<thead>
<tr>
<th>Table 1: Visual Analog Scale (VAS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS</td>
</tr>
<tr>
<td>PRE SCORE (in cm)</td>
</tr>
<tr>
<td>POST SCORE (in cm)</td>
</tr>
<tr>
<td>(p) value (within group)- paired t test</td>
</tr>
<tr>
<td>% CHANGE</td>
</tr>
</tbody>
</table>

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
Statistically significant changes were also seen between the groups (p<0.05) apart from 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 2: Glenohumeral Joint Range Of Motion (ROM)

<table>
<thead>
<tr>
<th></th>
<th>PASSIVE ROM (in degrees)</th>
<th>P VALUE (Independent t test)</th>
<th>ACTIVE ROM (in degrees)</th>
<th>P VALUE (Independent t test)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GROUP-A</td>
<td>GROUP-B</td>
<td>GROUP-A</td>
<td>GROUP-B</td>
</tr>
<tr>
<td>FLEXION ROM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRE SCORE</td>
<td>130.16±17.61</td>
<td>137.53±16.84</td>
<td>0.10</td>
<td>124.8±18.75</td>
</tr>
<tr>
<td>POST SCORE</td>
<td>139.96±9.62</td>
<td>154.2±11.27</td>
<td>0.03*</td>
<td>154.93±10.07</td>
</tr>
<tr>
<td>P value (within group)-paired t test</td>
<td>0.0001*</td>
<td>0.0001*</td>
<td>0.0001*</td>
<td>0.0001*</td>
</tr>
<tr>
<td>%CHANGE</td>
<td>22.8%</td>
<td>12.1%</td>
<td>24.1%</td>
<td>12.2%</td>
</tr>
<tr>
<td>EXTENSION ROM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRE SCORE</td>
<td>28.76±4.48</td>
<td>29.3±3.33</td>
<td>0.59</td>
<td>26.53±5.15</td>
</tr>
<tr>
<td>POST SCORE</td>
<td>32.6±5.02</td>
<td>31.6±2.79</td>
<td>0.35</td>
<td>31.2±4.79</td>
</tr>
<tr>
<td>P value (within group)-paired t test</td>
<td>0.002*</td>
<td>0.004*</td>
<td>0.006*</td>
<td>0.0001*</td>
</tr>
<tr>
<td>%CHANGE</td>
<td>13.35%</td>
<td>7.9%</td>
<td>17.6%</td>
<td>12.8%</td>
</tr>
<tr>
<td>ABDUCTION ROM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRE SCORE</td>
<td>111.1±13.94</td>
<td>115.8±14.15</td>
<td>0.18</td>
<td>104.93±15.67</td>
</tr>
<tr>
<td>POST SCORE</td>
<td>144.73±8.70</td>
<td>137.7±4.02</td>
<td>0.02*</td>
<td>140.5±4.92</td>
</tr>
<tr>
<td>P value (within group)-paired t test</td>
<td>0.0001*</td>
<td>0.0001*</td>
<td>0.0001*</td>
<td>0.0001*</td>
</tr>
<tr>
<td>%CHANGE</td>
<td>30.38%</td>
<td>18.8%</td>
<td>33.9%</td>
<td>23.3%</td>
</tr>
<tr>
<td>INTERNAL ROTATION ROM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRE SCORE</td>
<td>46.8±9.61</td>
<td>48.9±9.01</td>
<td>0.38</td>
<td>42.2±9.79</td>
</tr>
<tr>
<td>POST SCORE</td>
<td>63.4±8.11</td>
<td>59.1±8.11</td>
<td>0.04*</td>
<td>59.96±8.22</td>
</tr>
<tr>
<td>P value (within group)-paired t test</td>
<td>0.0001*</td>
<td>0.0001*</td>
<td>0.0001*</td>
<td>0.0001*</td>
</tr>
<tr>
<td>%CHANGE</td>
<td>35.4%</td>
<td>20.8%</td>
<td>42.1%</td>
<td>23.1%</td>
</tr>
<tr>
<td>EXTERNAL ROTATION ROM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRE SCORE</td>
<td>36.1±7.98</td>
<td>38.2±7.28</td>
<td>0.28</td>
<td>31.96±8.58</td>
</tr>
<tr>
<td>POST SCORE</td>
<td>54.3±8±6.60</td>
<td>50.1±6.48</td>
<td>0.03*</td>
<td>50.83±8.83</td>
</tr>
<tr>
<td>P value (within group)-paired t test</td>
<td>0.0001*</td>
<td>0.0001*</td>
<td>0.0001*</td>
<td>0.0001*</td>
</tr>
<tr>
<td>%CHANGE</td>
<td>50.5%</td>
<td>31.2%</td>
<td>59.2%</td>
<td>36.7%</td>
</tr>
</tbody>
</table>

Table 3: Lateral Scapular Slide Test (LSST)

<table>
<thead>
<tr>
<th></th>
<th>WITHIN GROUP</th>
<th>BETWEEN GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GROUP-A</td>
<td>GROUP-B</td>
</tr>
<tr>
<td></td>
<td>LSST-PRE (in cm)</td>
<td>LSST-POST (in cm)</td>
</tr>
<tr>
<td></td>
<td>REST</td>
<td>45 ABD</td>
</tr>
<tr>
<td>MEAN ±SD (in cm)</td>
<td>0.48±0.17</td>
<td>0.95±0.23</td>
</tr>
<tr>
<td>P VALUE/ANOVA</td>
<td>0.0001*</td>
<td>0.0001*</td>
</tr>
<tr>
<td>CHANGE</td>
<td>12.5%</td>
<td>10.1%</td>
</tr>
</tbody>
</table>
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>
<thead>
<tr>
<th>SPADI</th>
<th>GROUP-A</th>
<th>GROUP-B</th>
<th>P VALUE (INDEPENDENT T TEST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRE SCORE</td>
<td>61.91±11.94</td>
<td>56.07±14.12</td>
<td>0.08</td>
</tr>
<tr>
<td>POST SCORE</td>
<td>30.88±6.89</td>
<td>38.08±12.39</td>
<td>0.004*</td>
</tr>
<tr>
<td>%CHANGE</td>
<td>53.07%</td>
<td>32.8%</td>
<td></td>
</tr>
</tbody>
</table>

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<sup>0</sup> and 45<sup>0</sup> 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
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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
5. Wong PL, Tan HC. A review on frozen shoulder. Singapore medical journal. 2010 Sep 1;51(9):694.
Yashodhara S Joshi et al. 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


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