

# Comparative Study on Mulligan Movement with Mobilisation versus Proprioceptive Neuromuscular Facilitation in Adhesive Capsulitis of Shoulder

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**Abstract:** Adhesive Capsulitis is one of the most common causes of shoulder pain & disability. Although it is self-limiting and gradually resolves within 3 years, the course of the disease can extend resulting in greater emotional & economic distress. **Aim:** To compare the effectiveness of Mulligan Movement with Mobilization & Proprioceptive Neuromuscular Facilitation in reducing pain, disability & improving ROM in Adhesive capsulitis of the shoulder. **Method:** A total of 40 subjects were allocated into Group A (Mulligan MWM) & Group B (PNF Hold-relax). Subjects were evaluated for pain on Numeric Pain rating scale (NPRS), Range of motion & function on Shoulder Pain and Disability Index (SPADI) at baseline & post-intervention, at the end of 3 weeks. **Result:** Pre-Post within group comparisons showed significant improvement in pain, ROM & shoulder function in both the groups. Between group, comparisons showed more improvement in pain & shoulder function in Mulligan group as compared to PNF group. No statistically significant difference was found between Group A & B in improving shoulder ROM. **Conclusion:** The study shows that both Mulligan MWM & PNF Hold-relax are effective in reducing pain, disability & improving ROM in Adhesive capsulitis of the shoulder. Mulligan MWM was more effective in reducing pain & improving shoulder function.

**Keywords:** Mulligan, Movement with Mobilization, Proprioceptive Neuromuscular Facilitaion, Hold-relax, Adhesive Capsulitis

## 1. Introduction

Adhesive Capsulitis is one of the most common causes of shoulder pain and disability. It is a condition of uncertain aetiology characterized by a progressive loss of both active and passive shoulder motion.<sup>2</sup> Annual incidence of adhesive capsulitis is 2-4% in the general population and up to 30% in people with diabetes. Adhesive capsulitis is also reported to be more in women, especially between the ages of 40 to 60 years.<sup>2</sup> A variety of treatments have been recommended for Adhesive Capsulitis and studies have demonstrated successful results but the best treatment has been the subject of extensive investigation. The types of treatment have included oral corticosteroids, Anti-inflammatory drugs, local corticosteroids injection, physical therapy exercises and modalities, manipulation under anesthesia, arthrographic distension and arthroscopic release.<sup>16,17</sup> Ideally, the treatment of frozen shoulder should be tailored to the stage of the disease but the general aim is to reduce pain and inflammation and increase the shoulder Range of motion.<sup>15</sup> Generally the treatment regimens include a trial of conservative therapy, followed by more invasive procedures for recalcitrant cases. Therapeutic exercises and mobilization are strongly recommended for reducing pain, improving range of motion (ROM) and function in patients with stages 2 and 3 of frozen shoulder.<sup>18</sup>

Mobilization and Manipulation techniques have been advocated for the restoration of a pain-free state and normal use of the upper extremity.<sup>16</sup> The Mulligan concept of Mobilizations with movement (MWM) is a specific therapeutic intervention designed to couple accessory mobilization with physiological motion. The technique combines a sustained passive joint glide while the patient actively moves the joint (or motion segment) and the application of overpressure at the end of the available range is necessary for lasting improvement.<sup>19</sup> The manual force, or mobilization, is theoretically intended to cause repositioning of bone positional faults. The intent of MWM is to restore pain-free motion at joints that have a painful limitation of range of movement.<sup>20</sup> It has been shown that Mulligan's technique can produce concurrent hypoalgesic effects during and following its application, as well as altering sympathetic nervous system function.<sup>19</sup>

Proprioceptive Neuromuscular Facilitation (PNF) stretching techniques are commonly used to enhance both active and passive range of motion to optimize motor performance and rehabilitation. It is positioned in the literature as the most effective stretching technique when the aim is to increase the passive range of motion.<sup>21</sup> It is effective in relieving pain and improving functional abilities.<sup>22</sup> Hold Relax involves resisted isometric contraction of the antagonistic muscles (shortened muscles) followed by relaxation. The goal is to promote functional movement through facilitation, inhibition, strengthening, and relaxation of muscle groups.<sup>23</sup>

## 2. Objective

To compare the effectiveness of Mulligan Movement with Mobilization (MWM) & Proprioceptive Neuromuscular Facilitation (PNF) Hold-relax in reducing pain, disability and improving ROM in patients with Adhesive Capsulitis of the shoulder.

## 3. Methodology

- Source of data: Hospital and Clinical setup.
- Study design: Experimental study; Non-Randomised control trial.
- Sample technique: Non-Probability sampling
- Sample size: 40 subjects (Group A: 20, Group B: 20)
- Duration of study: 1 year
- Duration of intervention: 3 weeks (4 days per week)
- Criteria for selection:

### Inclusion criteria:

- Age: 40-70 years (both male and female).
- Patients in Stage 2 (Frozen stage) of Adhesive capsulitis.
- Unilateral involvement for more than 3 months.
- Restriction in shoulder ROM  $\geq 25\%$  in at least two of the following range: Shoulder Flexion, Abduction, Internal rotation or External rotation.

### Exclusion criteria

- Bilateral shoulder involvement.
- History of trauma (Shoulder dislocation, fracture, rotator cuff injury) or surgery (Shoulder arthroscopy, surgical release of capsule, ORIF) in and around the shoulder joint.

- Patients with signs of cervical radiculopathy.
- Patients with any neurological disorder.

The proposed title and the procedure of the study were approved by ethical committee members. The subjects were assessed and those who were found to meet the inclusion and exclusion criteria were selected for the study. The subjects were explained the purpose of the study and the treatment procedure, thereafter their written consent was taken for enrolment in the study. A total of 40 subjects meeting the selection criteria were chosen and divided into two groups. Group A was given Mulligan Movement with mobilization along with conventional therapy and Group B was given Proprioceptive Neuromuscular Facilitation technique along with conventional therapy. The patients were evaluated for pain using Numeric Pain Rating Scale (NPRS), Shoulder function using Shoulder Pain and Disability Index and Shoulder ROM using Universal Goniometer at the baseline and post-intervention at the end of 3 weeks.

The patients were treated for 3 weeks (4 days a week; 12 sessions).

- Mulligan Mobilization with Movement (MWM) was given in 3 sets of 6 repetitions in one session for 4 days a week for 3 weeks.
- The PNF Hold-relax technique was given in 2 sets of 8 repetitions during one session, with each repetition maintained for 5-8 seconds followed by 10 seconds relaxation for 4 days a week for 3 weeks.
- The common treatment given to both the groups:

### Short wave diathermy

Active assisted wand, ladder, pulley, shoulder wheel exercises.

Codman's pendulum exercises

Available range strengthening

Capsular stretch

Group A: Mulligan Movement with Mobilisation	Group B: Proprioceptive Neuromuscular Facilitation Hold-Relax
<ul style="list-style-type: none"> <li>- MWM for Shoulder Distraction</li> <li>- MWM for Shoulder Internal &amp; External Rotation</li> <li>- MWM for Shoulder Flexion</li> <li>- MWM With Traction for Abduction</li> <li>- MWM for Shoulder Internal rotation</li> </ul>	<ul style="list-style-type: none"> <li>- PNF Hold-relax for Shoulder Flexion</li> <li>- PNF Hold-relax for Shoulder Abduction</li> <li>- PNF Hold-relax for Internal rotation</li> <li>- PNF Hold-relax for External rotation</li> <li>- PNF Hold-relax for D2 flexion (Flexion- Abduction-External Rotation)</li> </ul>



MWM for Shoulder Flexion



Hand placement for Shoulder distraction



PNF Hold-relax for Shoulder flexion

#### 4. Results

The statistical analysis of data was done using SPSS 20. Before applying statistical tests, data were screened for normal distribution. All the outcome measures (NPRS, Shoulder ROM, and SPADI) were analyzed at baseline and post-intervention at the end of 3 weeks using appropriate statistical test. Level of significance was kept at 5%. Changes in outcome measures were analyzed within group and between groups. Non-Parametric tests were applied for within group and between group analysis.

Pre-Post within group comparisons for pain using Numeric Pain Rating Scale (NPRS), Shoulder Range of motion using Universal goniometer and Shoulder function using Shoulder Pain and Disability Index (SPADI) were analyzed using WILCOXON SIGNED RANK TEST for both Group A (Mulligan MWM) and Group B (PNF technique).

MANN WHITNEY U TEST was used for between group comparisons: Group A (Mulligan MWM) and Group B (PNF technique).

There were 3 patients who dropped out from the study due to unknown reasons, 1 from Group A (Mulligan MWM) and 2 from Group B (PNF group). The statistical analysis was done for 37 patients, excluding the dropouts.

Outcome	Group	Mean Difference ± SD	Z Value	P Value
NPRS (AT REST)	Group A	1.94 ± 0.77	-0.918	0.359
	Group B	1.77 ± 0.64		
NPRS (ON ACTIVITY)	Group A	3.57 ± 0.90	-3.385	0.001
	Group B	2.55 ± 0.61		
SPADI	Group A	31.78 ± 4.45	-4.328	0.000
	Group B	23.38 ± 3.71		
Shoulder ROM Flexion	Group A	15.10 ± 3.72	-1.005	0.315
	Group B	13.94 ± 5.04		
Shoulder ROM Abduction	Group A	15.42 ± 6.14	-0.781	0.435
	Group B	14.16 ± 4.82		

Shoulder ROM External rotation	Group A	10.31 ± 3.65	-0.278	0.781
	Group B	10.22 ± 4.16		
Shoulder ROM Internal rotation	Group A	12.52 ± 4.12	-1.077	0.282
	Group B	11.11 ± 3.86		

#### Interpretation:

- The result indicates no statistically significant difference in improving pain at rest between Group A and Group B in patients with Adhesive Capsulitis of shoulder. There is a significant difference in improving pain during activity evaluated on NPRS between Group A and Group B. Improvement is more in Group A compared to Group B.
- There is a statistically significant difference in improvement of Shoulder function evaluated on Shoulder pain and disability index (SPADI) between Group A and Group B in patients with Adhesive Capsulitis of shoulder. Improvement is more in Group A compared to Group B.
- The results indicated no statistically significant difference in improvement of Shoulder Flexion, Abduction, External and Internal Rotation between Group A and Group B in patients with Adhesive Capsulitis of shoulder.

## 5. Discussion

In the present study, when pre-post intervention values were analysed for pain, Shoulder range of motion and function, the results were highly significant ( $P < 0.01$ ) in both Group A and Group B, suggesting that both Mulligan MWM and PNF is effective in improving pain, shoulder ROM and function.

Mulligan's technique has been shown previously to result favorably in terms of pain, ROM and function in various studies. **Satpute K et al., 2022** in systematic review revealed that MWM in isolation or in addition to exercise therapy and/or electrotherapy is superior in improving pain, ROM, and disability in patients with shoulder dysfunction when compared with either exercise therapy and electrotherapy alone or other type of manual therapy. **Ragav S et al., 2019** concluded the effect of Mulligan MWM technique in reducing pain and improving end range of motion in patients with Adhesive Capsulitis of Shoulder Joint. **B. Chakradhar Reddy et al., 2015** concluded that Mulligan's MWM is more effective in treatment of Adhesive Capsulitis than conventional therapy.<sup>8</sup> **Gokhan Doner et al., 2013** concluded that Mulligan's technique led to better improvements in terms of pain, range of motion, shoulder scores, patient and physiotherapist satisfaction.<sup>16</sup>

Researchers have proved the effectiveness of Proprioceptive Neuromuscular Facilitation technique in improving pain, ROM and shoulder function in patients with Adhesive Capsulitis. **Tedla JS et al., 2019** concluded that PNF group is superior than conventional physical therapy in decreasing pain, increasing external rotation, abduction ROM and improving function. **Eda AKBAS et al., 2015** concluded that PNF provides a significant contribution to night pain and range of flexion and abduction movements in patients with Adhesive capsulitis.<sup>27</sup> **Harshit Mehta et al., 2013** concluded that PNF Stretching appears to be more effective in improving glenohumeral joint mobility and reducing disability as compared to Self Stretching.<sup>28</sup>

Intergroup comparisons showed no significant difference in improvement in pain at rest, as evaluated on NPRS between Group A and Group B. However there was a significant difference in improvement in pain during activity. Improvement of pain was more in Group A (Mulligan MWM) compared to Group B (PNF). Clinically, Mulligan MWM was more effective in reducing pain as compared to PNF hold-relax. Mobilization reduces pain due to neurophysiologic effects on the stimulation of peripheral mechanoreceptors and the inhibition of nociceptors. The activation of apical spinal neurons as a result of peripheral mechanoreceptor by the joint mobilization produces presynaptic inhibition of nociceptive afferent activity.<sup>25</sup> Mulligan's technique can produce concurrent hypoalgesic effects during and following its application, as well as altering sympathetic nervous system function.<sup>16</sup> **Paungmali et al., 2003** have previously demonstrated the hypoalgesic effect and concurrent sympathoexcitation by Mulligan's technique for lateral epicondylalgia.<sup>43</sup> In addition **Teys et al., 2006** stated that clinically meaningful improvements in both ROM and pressure pain threshold occur immediately after the application of Mulligan's technique in the pain-limited shoulder.<sup>44</sup> In MWM, manual force in the form of a joint glide, is applied to a motion segment and sustained while a previously impaired action (e.g. painful reduced movement, painful muscle contraction) is performed. The technique is indicated if, during its application, the technique enables the impaired joint to move freely without pain or impediment.<sup>45</sup> This combination of the glide by the therapist and the active movement performed by the patient may be responsible for the rapid recovery of pain-free movement.<sup>2</sup> It has been proposed that the MWM treatment technique produces its effects by correcting positional faults of joints that occur following injuries or strains.<sup>45</sup>

This study showed a statistically significant difference in the improvement of Shoulder function, evaluated on Shoulder Pain and Disability Index between Group A and Group B, suggesting that Mulligan MWM was more effective in improving Shoulder function, owing to reduction in pain and disability.

There was no statistically significant difference in the improvement of Shoulder Flexion, Abduction, External and Internal rotation between Group A and B suggesting that both Mulligan MWM and PNF were equally effective in improving shoulder ROM. In the mulligan group, the improvement can be attributed to the corrective glide to achieve optimal alignment of the articular surfaces and its maintenance by appropriate recruitment of the muscles by the patient's active efforts. This goes well with the Mulligan concept of positional fault. The alteration of the shoulder biomechanics can be due to capsular tightness seen in Adhesive Capsulitis. This capsular tightness pulls the head of humerus towards glenoid fossa, thus altering humeral head excursion in the glenoid. This glenohumeral mechanism alteration leads to altered mechanics of the scapulothoracic and acromioclavicular joints which in turn leads positional faults in these joints also. Mobilizations have a definite effect on this altered biomechanics. The mechanical effect may include the breaking up of adhesion, realigning collagen or increasing fiber glide.<sup>24</sup>

Improvement in the PNF group is based on the mechanisms of Autogenic and reciprocal inhibition that have been accepted as the neurophysiological explanations for the superior ROM gains that PNF stretching achieves.<sup>47</sup> Isometric contractions (the hold phase) used immediately before the passive stretch (the relax phase) facilitates Autogenic inhibition. Autogenic Inhibition is a reflex relaxation that occurs in the same muscle where the Golgi tendon organ is stimulated.<sup>21</sup> The reduced efferent drive to the muscle by the way of autogenic inhibition is a factor believed to assist target muscle elongation. PNF stretching utilizing a shortening contraction of the opposing muscle, to place the target muscle on stretch, followed by static contraction of the target muscle, achieves greater gains in ROM and this effect is attributed to Reciprocal Inhibition.<sup>47</sup> PNF Technique is aimed at relaxing tense muscles and restricted joints to make quick gains in range of motion with the ultimate goal being to optimize motor performance and rehabilitation.<sup>29</sup>

This study shows that both Mulligan MWM and PNF technique are effective in reducing pain, improving shoulder ROM and shoulder function in subjects with Adhesive Capsulitis of shoulder.

The Minimal Clinical Important difference (MCID) for NPRS is 2.17, in patient receiving rehabilitation for 3-4 weeks. Based on MCID for NPRS, both Mulligan MWM and PNF were clinically effective in reducing pain in patient with Adhesive Capsulitis. Clinically, the improvement in pain was more in the Mulligan group as compared to PNF group. The Minimal Clinical Important difference (MCID) for SPADI is 18.1. Based on MCID for SPADI, the improvement in shoulder function was clinically significant in both Mulligan and PNF group. Mulligan MWM is more effective in reducing pain and improving shoulder function as compared to PNF.

## 6. Conclusion

Mulligan Mobilization with Movement and Proprioceptive Neuromuscular Facilitation technique are effective in reducing pain and disability, improving shoulder ROM and shoulder function. Mulligan MWM is more effective in reducing pain (NPRS on activity) and improving Shoulder function as compared to PNF group. There is no statistically significant difference in the improvement of Shoulder flexion, Abduction, External and Internal rotation between Mulligan MWM and PNF group.

### Clinical Implication:

Clinically, Mulligan MWM was found to be more effective in reducing pain and improving shoulder function as compared to PNF group. Clinically, both techniques were found equally effective in improving Shoulder ROM.

### Limitations of the study:

- Blinding was not done.
- There was no control group to compare the effectiveness of Mulligan MWM and PNF with conventional therapy.
- Sample size was small.
- Long term follow up is not taken.

### Recommendation for future study:

- The same study can be conducted with a larger sample size.
- Follow up can be extended to study the long term benefits of Mulligan Movement with Mobilization and Proprioceptive Neuromuscular Facilitation techniques.
- Further studies using both Mulligan MWM and PNF techniques in the same subjects to know the combined effects are also recommended.

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