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# Effect of Reverse Distraction technique and Scapular Mobilization on Shoulder Flexion and Abduction Range of Motion, Pain and Disability in Primary Adhesive Capsulitis- A Comparative Study

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**Abstract**

**Objective:** The objective of this study was to compare the effect of Reverse Distraction technique and Scapular Mobilization on Shoulder flexion and abduction range of motion, pain and disability in patients with primary adhesive capsulitis at the end of 4 weeks.

**Subject and Methods:** 40 subjects with Stage 2 primary adhesive capsulitis were divided into two equal groups using random allocation. The study included both males and females in the age group of 40 to 55 years. The Reverse distraction group (Group A) was given Reverse distraction technique along with conventional exercises. The Scapular Mobilization group (Group B) was given Scapular Mobilization along with conventional exercises. Both the groups received treatment for a duration of 4 weeks (3 sessions/week). Outcome measures for active range of motion, pain and disability were Range of motion (Universal goniometer), Numerical Pain Rating Scale(NPRS) and Shoulder pain and disability index (SPADI) respectively which were taken pre intervention and after duration of the study ended.

**Result:** In Group A, the Sh Flex ROM improved from 90.05°±3.52° to 135.53°±3.89° and Sh Abd ROM improved from 82.47° ± 5.21° to 124.84 °±4.54°. In Group B, Sh Flex ROM improved from 86.84°±4.33° to 115.74°±4.62° and Sh Abd ROM improved from 79.10°±3.81° TO 112.74°±4.40°.

In Group A, the NPRS score reduced from 5.78 ±0.63 to 2.84± 0.60 and the total SPADI score reduced from 61.306±4.004% to 43.891±3.676%.

In Group B, the NPRS score reduced from 6.263±0.7335 to 3.316±0.6710 and the total SPADI score reduced from 63.07±5.62% to53.06 ±5.11%.

**Conclusion:** The Reverse distraction technique was more effective in improving Shoulder flexion and abduction range of motion and reducing disability. Both the techniques were equally effective in reducing pain.

**Keywords:** reverse distraction, scapular mobilization, stage 2 adhesive capsulitis, pain, ROM

## 1. Introduction

Adhesive capsulitis is one of the most common musculoskeletal problem in orthopedics with an incidence of 2- 5 % in general population [2]. Adhesive capsulitis is caused due to inflammation consistent with multiregional synovitis of the glenohumeral capsule causing the capsule to contract and hold the humeral head against the glenoid fossa tightly [3]. A pouch of the glenohumeral capsule evolving from the inferior rim of the glenoid cavity to inferior part of the humeral head is called the axillary recess. Capsular adhesions of the axillary recess hinder normal expansion during abduction causing diminished active and passive mobility of the shoulder [4]. Patients with adhesive capsulitis thus, have a painful restriction of both active and passive movements of glenohumeral joint in all planes: a global loss of function [5].

Adhesive capsulitis can be divided into 2 types: Primary and Secondary adhesive capsulitis. Primary adhesive capsulitis is idiopathic and is not associated with a systemic condition or history of injury [6]. Secondary adhesive capsulitis is defined by a relationship between a disease or pathology such patients with diabetes mellitus, thyroid, cervical disc disease, distal extremity fracture, or self-imposed immobilization, proximal humeral or scapular fracture [7].

The stages of adhesive capsulitis are [8]:

- **Stage 1**: characterized by a gradual onset of pain typically referred to the deltoid insertion. It is achy at rest and sharper with movement. Night pain is common, and patients frequently report an inability to sleep on the affected side. Duration of symptoms is generally less than 3 months.
- **Stage 2**: characterized by acute synovitis and progressive capsular contracture, which is also called the freezing stage. Pain persists and may be more severe, particularly at night. Motion is restricted in forward external rotation (most) followed by abduction, internal rotation and forward flexion (least). Duration: 3 to 9 months.
- **Stage 3**: also called the frozen stage. the predominant complaint of the patient is significant stiffness. Pain may still be present at the end of range of motion and occasionally at night. Physical examination reveals a sense of mechanical block or tethering at the ends of motion. Duration: 9-15 months.
- **Stage 4**: the chronic stage has also been termed the thawing stage. Pain is minimal, and a gradual

improvement in motion can occur. Duration: 15 – 24 months.

Patients with adhesive capsulitis present with the involved shoulder in a protective manner. The scapula of the affected side is usually elevated, laterally rotated and abducted secondary to compensatory scapular motion. There is reversal of scapulohumeral rhythm or compensatory elevation strategy which indicates that the scapula moves more than the humerus. The patient cannot produce a smooth coordinated movement but hikes the shoulder complex entirely [9]. Abnormal scapular biomechanics that occur as a result of the pathology lead to abnormal scapular patterns and reduce shoulder mobility [10].
Treatment includes NSAIDS during active phases of treatment. Standard physical therapy includes modalities, passive manual techniques and soft tissue mobilization exercises. In physiotherapy exercise programs, mobilization techniques are an important part of the protocol.

**The reverse distraction technique** used by Vermulean *et al*. on different angles of flexion and abduction at end ranges with a purpose of stretching contracted tissues. In biomechanical terms, scapular stabilization with respect to humerus is inadequate during motion of humerus with respect to the scapula. Also, the humeral movement causes pain due to which there is difficulty in exerting force on the glenohumeral capsule. In reverse distraction technique, no force is exerted to counteract the rotation of scapula as it is held in place by the joint capsule. During movement of scapula with respect to the humerus, only glenohumeral joint is involved and the joint capsule is stretched without causing pain, which makes this technique better and less painful clinically. The reverse distraction technique is thus, based on the principle that the glenohumeral and scapulothoracic joints are in a closed chain. If the glenohumeral mobilization increases shoulder mobility and normalizes the scapulohumeral rhythm, then the reverse distraction technique should improve shoulder movements as it is directed towards gliding the scapula in medial and downward rotations with humerus distracted at varying angles of abduction and flexion [11].

**Scapular mobilization** used by Manas Kumar *et al.* inferred that scapular mobilization, a passive, skilled manual therapy which involves scapular mobilization in 4 directions. (superior glide, inferior glide, upward and downward rotation).These patterns were used as decreases in scapular upward rotation, posterior tilt, superior tilt, and external rotation have been identifed as patterns of dysfunction in patients with impingement syndrome and frozen shoulder syndrome. Scapular mobilization helped to normalize the altered scapulohumeral rhythm improving shoulder extensibility. It acts on the inferior shoulder capsule by breaking up adhesions. It also produces tissue stretch which leads to desensitization of stretch induced pain rearranging connective tissue, extracellular matrix and collagenous tissues thereby improving glenohumeral active and passive range of motion [12]. Thus, the aim of the study is to compare the effectiveness of reversed distraction technique and Scapular mobilization in improving range of shoulder abduction and flexion, reducing pain and disability in adhesive capsulitis.

## 2. Materials and Methods

### 2.1 Selection of Subjects

40 subjects with clinically diagnosed unilateral stage 2 primary adhesive capsulitis were included in the study. Both males and females were included in the study within the age group of 40 – 55 years. Subjects with a passive limitation in shoulder abduction and flexion range of motion (< 50% of the unaffected side) [5] were included. Subjects with NPRS value ≥ 7, history of surgery of the affected shoulder5, Osteoarthritis in the affected shoulder6Neurological disorders leading to altered muscle activity, Systemic arthritic conditions of the shoulder (Rheumatoid arthritis, osteoporosis or malignancies in the shoulder region), Injections with corticosteroids in the affected shoulder in preceding 6 weeks 9and diabetic patients4 were excluded from the study.
The selected subjects were divided into two equal groups (Group A and B) of 20 subjects each using random allocation (chit method). The Reverse distraction technique was given to Group A. Scapular mobilization was given to Group Both the groups received conventional exercises.

### 2.2 Outcome Measures

- **Range of motion**: Measurement tool – Universal Goniometer Reliability – 0.94 – 0.98 [15]
- **Shoulder abduction**:

Proximal arm: Aligned parallel to the mid line of the anterior aspect of sternum
Distal arm: Aligned with the anterior midline of the humerus.
Fulcrum: Anterior aspect of acromian process
Subject position: Supine, with the shoulder in lateral rotation and 0° of flexion and extension so that the palm of the hand faces anteriorly. Elbow should be extended.
Testing motion: Abduct the shoulder by moving the humerus lateral away from the subjects trunk maintaining upper extremity in lateral roatation and neutral flexion and extension.

**Shoulder flexion**
Proximal arm: Aligned parallel to the midaxillary line of the thorax.
Distal arm: Aligned with the lateral midline of the humerus.
Fulcrum: Over the lateral aspect of the greater tubercle.
Subject position: Supine, with shoulder positioned in 0° of abduction, adduction and rotation. Elbow should be extended with palm of the hand facing the body.
Testing motion: Flex the shoulder by lifting the humerus off the examining table, bringing the hand up over the subject's head maintain the extremity in neutral abduction and adduction.

**Numerical Pain Rating Scale (NPRS)** –assessment of pain Reliability – 0.95 – 0.96. Validity – 0.86 – 0.95 [13]
The NPRS is a segmented numeric version of the visual analog scale (VAS) in which a respondent selects a whole number (0–10 integers) that best reflects the intensity of their pain (21). intensity of their pain (21). The common format is a horizontal bar or line (23). The NPRS is anchored by terms describing pain severity extremes. The pain NPRS is a single 11 – point numeric scale. An 11-point numeric scale (NRS 11) with 0 (no pain) and 11 (worst imaginable pain)

**Shoulder Pain and Disability Index (SPADI)- Reliability- 0.89, Validity – 0.90 (for assessment of disability)**
The Shoulder Pain and Disability Index (SPADI) is a self-administered questionnaire that consists of two dimensions, one for pain and the other for functional activities. The pain dimension consists of five questions regarding the severity of an individual's pain. Functional activities are assessed with eight questions designed to measure the degree of difficulty an individual has with various activities of daily living that require upper-extremity use.
Total Spadi score: / 130 x 100 = %

### 2.3 Procedure

**GROUP A**

**Reverse distraction technique** [11]
Patient position: Side - lying. Patient lies on unaffected side at the edge of the plinth.
Therapist position: Facing the patient.
Upper hand of the therapist is placed on the patient's humeral head just below the acromion. The patient's arm rests in the therapist's arm.
Lower hand of the therapist is placed on the lateral border of the scapula.
Technique: The upper hand applies glenohumeral distraction at varying levels of shoulder abduction and flexion with the lower hand mobilizing the scapula in medial and downward direction.
No. of repetitions: 10 (shoulder abduction)
10 (shoulder flexion)
No. of sessions per week: 3 per week for 4 weeks (40 min per session).

**GROUP B**

**Scapular mobilization** [17]

- Patient position: Side lying. Patient lies on unaffected side aligned with the bed's edge and head supported on a pillow.
- Therapist position: Facing the patient.
- Hand placement: Therapist places the index finger of one hand under the medial border of scapula of the affected side, the other hand grasping the superior border of the scapula.
- Technique:
  1. Superior and Inferior glide: Scapula is moved superiorly and inferiorly maintaining the hand placement.
  2. Upward and downward rotation: Scapula is rotated in upward and downward maintaining the hand placement.
  3. Scapular distraction: Therapist places ulnar fingers under the medial border of the scapula and distracts the scapula from the thorax.
- No. of repetitions – 10 repetitions.
- No. of sessions per week – 3 per week for 4 weeks (40 min per session).

**Conventional exercises** [11, 18]
Conventional exercises were given to both groups as follows. All the exercises were performed in 3 sets of 15 repetitions each.
Hot moist packs applied to the affected shoulder joint for 10 to 15 min prior to 0mobilization.

**Codman's exercises**: Patient is in standing position with trunk flexed at the hips about 90 degrees. The affected arm hangs loosely downward in a position between 60 and 90 degree of elevation. A pendulum or swinging motion of the arm is initiated by having the patient move the trunk slightly back and forth. Motions of flexion, extension, abduction, adduction and circumduction can be done.

**Active assisted range of motion exercises for shoulder.**
**Capsular stretching:** Anterior, Posterior, Inferior capsular stretches performed. (3 repetitions with 15 sec hold for each repetition)

### 3. Statistical analysis

Statistical analysis within the group (Intragroup analysis) was done using paired 't' test for range of motion and SPADI. Intragroup analysis for NPRS was done using Wilcoxon rank test.
Statistical analysis was done using: Intergroup analysis for Range of motion and SPADI was done using Unpaired 't' test SPADI to compare effectiveness between the two groups.
Intergroup analysis for NPRS was done using Mann Whitney U test.

### 4. Findings

**4.1 Intragroup Analysis: 1. Range of Motion (Shoulder Flexion and Abduction) Group A**

**Table 1**

| Shoulder Flexion Rom | p <0.0001 (considered extremely significant) | Shoulder abduction Rom | p <0.0001 (considered extremely significant) |
|---|---|---|---|
| p value | | p value | |
| t value | t = 38.35 | t vale | t= 37.45 |

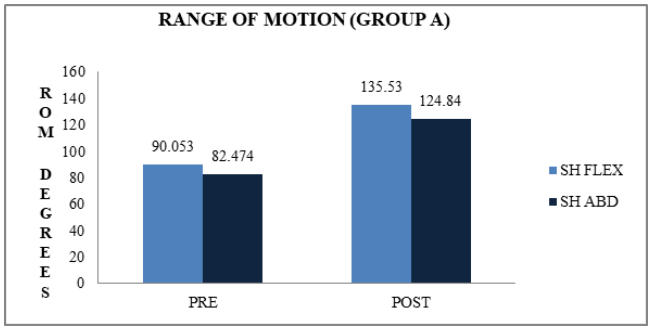


**Fig 1**

**2. Intragroup NPRS: Group A**
p<0.0001 (considered extremely significant)

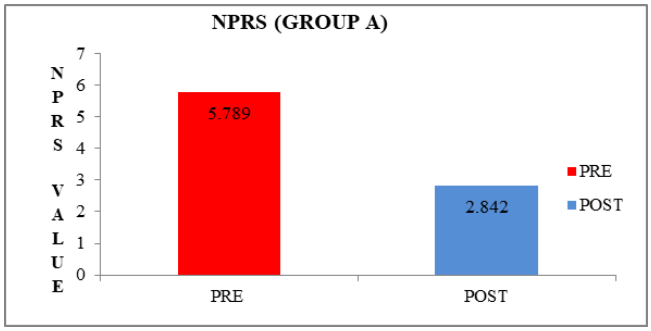


**Fig 2**

### 3. Intragroup SPADI: Group A

**Table 2**

| SPADI | |
|---|---|
| p value | p<0.0001(considered extremely significant) |
| t value | t=21.835 |

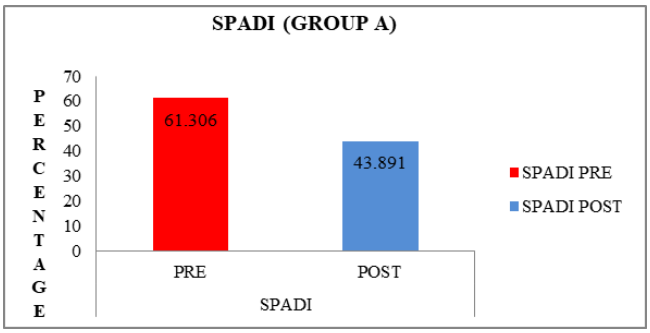


**Fig 3**

### 4. Intragroup Range of Motion (Shoulder Flexion and Abduction): Group B

**Table 3**

| Shoulder flexion rom | p <0.0001 (considered extremely significant) | Shoulder abduction Rom | p <0.0001 (considered extremely significant) |
|---|---|---|---|
| p value | | p value | |
| t value | t = 34.36 | t vale | t= 33.41 |

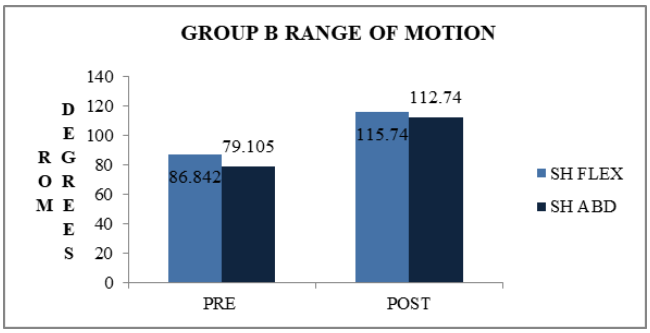


**Fig 4**

### 5. Intragroup NPRS: Group B

p<0.0001 (considered extremely significant)

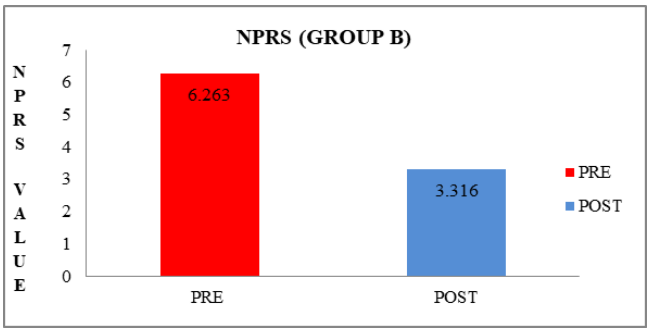


**Fig 5**

### 6. Intragroup SPADI: Group B

**Table 4**

| SPADI | |
|---|---|
| p value | p<0.0001 (considered extremely significant) |
| t value | t=24.77 |

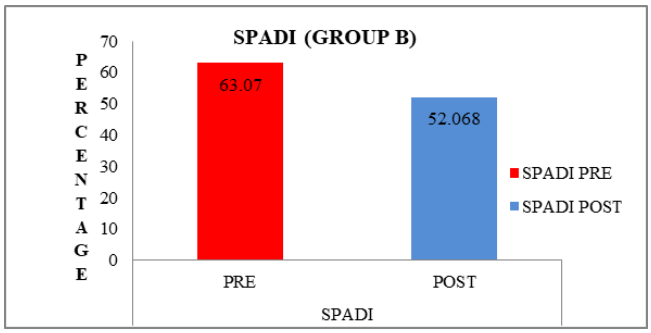


**Fig 6**

### 4.2 Intergroup Analysis
### 1. Range of Motion (Shoulder Flexion and Abduction)

**Table 5**

| Shoulder flexion rom | p <0.0001 (considered extremely significant) | Shoulder abduction Rom | p <0.0001 (considered extremely significant) |
|---|---|---|---|
| p value | | p value | |
| t value | t = 14.26 | t value | t= 8.26 |

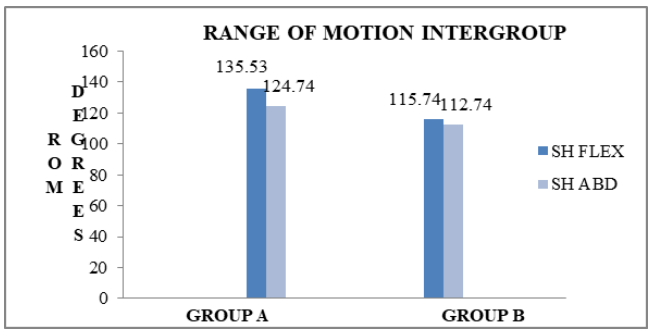


**Fig 7**

### 2. Intergroup Analysis For NPRS

p=0.0716 (considered not quite significant)

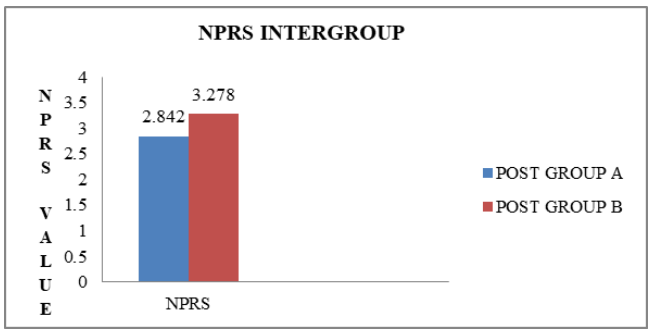


**Fig 8**

### 3. Intergroup Analysis for SPADI

**Table 6**

| SPADI | |
|---|---|
| **p value** | p<0.0001(considered extremely significant) |
| **t value** | t=6.32 |

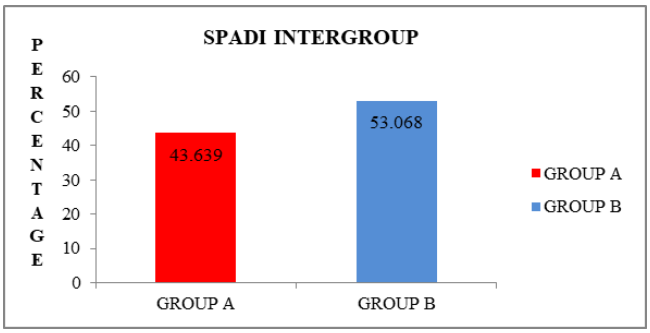


**Fig 9**

### 5. Result

- After statistical analysis was done, it was found that the Shoulder Flexion and Abduction range of motion post treatment in Group A (Mean±SD: 135.53±3.89 SF and 124.74±4.54 SA[1]) improved more than Group B (Mean±SD: 115.74±4.62 SF and 112.74±4.40 SA). p value<0.0001 considered extremely significant.
- The decrease in the total SPADI score in Group A (Mean±SD: 43.63±4.01) was statistically more significant than Group B (Mean±SD: 53.06±5.11) post treatment. p value<0.0001 considered extremely significant.
- The decrease in NPRS score showed no statistically significant difference when both the groups were compared post treatment. (Mean±SD: 2.84±0.60 – Group A and 3.31±0.67- Group B). p value=0.0716- considered not quite significant.

### 6. Discussion

Adhesive capsulitis is a chronic, progressive condition characterized by pain and a global loss of motion of the glenohumeral join. It is characterized by abnormal scapulohumeral rhythm, restriction of movement at the shoulder thus, affecting overall shoulder function. The present study was done to evaluate and compare the effectiveness of Reverse Distraction technique and Scapular mobilization on shoulder flexion and abduction range of motion, pain and disability in patients with Primary adhesive capsulitis. This study included 40 subjects in the age group 40 -55 years; the mean age being 47.89± 4.59 and 49.57± 4.07 years for Group A and Group B respectively. The number of female subjects were more than males and after the samples were assessed, the numbers of samples with the non-dominant arm affected were more than the dominant arm. Among the 40 subjects, 2 subjects left the study in the 1st week of the treatment duration. Thus, the data analysis was carried out for 38 subjects. Both the mobilization techniques were given along with conventional therapy which included hot water fermentation, Codman's exercises, capsular stretches and active assisted ROM exercises. The duration of the protocol was 4 weeks with treatment given for 3 days /week.

When pre and post analysis was done within the Reverse distraction group (Group A) it showed that the technique was effective in improving Shoulder flexion and abduction range of motion, reduce pain and disability. The data analyzed by paired t testing within the group showed significant statistical difference in all the three outcome measures. Vemuelean *et al.* in their study state that Reverse distraction technique is an end range mobilization technique based on the closed chain theory which involves movement of the scapula relative to the humerus as opposed to traditional mobilization techniques. In patients with shoulder dysfunction like in adhesive capsulitis or rotator cuff injuries where there is an altered scapulohumeral rhythm, a compensatory elevation strategy develops where in the scapula moves more than the humerus and is laterally rotated and abducted to compensate for the deficit in the glenohumeral mobility. This technique involves a corrective position of scapula by moving it medially and in a downward position followed by distraction of the humerus at the end ranges of flexion and abduction. Moreover, stretching of the contracted periarticular tissues made the mobilization relatively painless as compared to conventional mobilization techniques.

Within the group B (Scapular mobilization group), pre and post analysis within the group done by paired t test also showed significant statistical difference post the intervention in improving Shoulder flexion and abduction, in reducing pain and disability. Scapular mobilization is a passive, skilled manual therapy applied at varying speeds and amplitudes. Scapular mobilization emphasizes on the movement of scapula without involving a humeral component. Scapular mobilization helps to break adhesions in the glenohumeral capsule and improves glenohumeral range of motion. It involved 4 glides- Superior and Inferior glide and Upward and downward rotation of scapula. These patterns were given as they improve the posterior tilting of the scapula on the thorax. Posterior tilting of scapula brings the anterior part of the acromion process up and back which minimizes reduction in the sub acromial space as the humerus elevates. Manas Kumar *et al.* in their state that Scapular mobilization is based on the closed chain kinetic theory that states that any movement occurring at the glenohumeral joint causes movement at the scapulothoracic joint. So in turn any movement at the scapulothoracic joint should affect the glenohumeral mobility.

The inter group analysis done using the unpaired t test showed that while both the techniques were individually effective in improving shoulder flexion and abduction range of motion, pain and disability, the Reverse distraction technique was more effective as compared to Scapular mobilization in improving shoulder flexion and abduction range of motion and disability according to the statistical analysis. The Reverse distraction group was better than scapular mobilization as it included a humeral component and also maintained a corrective position of scapula while distracting the humerus as opposed to glides given in scapular mobilization thus improving shoulder flexion and abduction range of motion and disability. Both the techniques were equally effective in reducing pain as statistical analysis showed no significant difference in the nprs value post intervention in both the groups. The reduction in pain can be attributed to the physiological effects of mobilization which can be divided into: 1. Neurophysiological effects: reduced transmission of

[1] SF, SA –Shoulder Flexion, Shoulder Abduction

nociceptive stimuli, stimulation of mechanoreceptors. 2. Mechanical effects: enhanced synovial fluid motion, maintain and improve nutrient exchange. Thus, both techniques were equally effective in reducing pain.

Reverse distraction technique and scapular mobilization are individually effective in improving shoulder flexion and abduction range of motion, reducing pain and disability in patients with primary adhesive capsulitis. Thus, the alternate hypothesis (H1 A,B and D) is accepted for improving shoulder flexion and abduction range and reducing disability while the null hypothesis can be accepted for reducing pain as both the techniques were found to be equally effective in reducing pain. The techniques can be given along with conventional physiotherapy in to improve glenohumeral mobility, reducing pain and disability in patients with adhesive capsulitis.

## 7. Conclusion

This study concludes that Reverse distraction technique is more effective than Scapular mobilization to improve shoulder flexion and abduction range of motion reduces disability and both techniques are equally effective to reduce pain in patients with primary adhesive capsulitis.

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