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Effect of reverse distraction technique versus post-isometric relaxation technique on shoulder flexion, abduction, external rotation range of motion, pain and disability in patients with diabetic adhesive capsulitis at the end of 4 weeks: A comparative study

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Abstract

Purpose: This Study was conducted to compare the effect of Reverse Distraction Technique and Post Isometric Relaxation on Shoulder Flexion, Abduction and External rotation Range of Motion (ROM), Pain and Disability in patients with Diabetic Adhesive Capsulitis at the end of 4 weeks.

Background: Adhesive Capsulitis is characterized by painful, progressive and disabling loss of Active & Passive ROM of Glenohumeral joint in multiple planes. Adhesive Capsulitis in Diabetes Mellitus (DM) may be attributed to increase in connective tissue stiffness and may be linked to non-enzymatic oxidative reaction of glucose and collagen causing formation of advanced glycation end products (AGE), resulting in changes in the biomechanical properties of tendon and capsule. The prevalence of Adhesive capsulitis in Diabetic patient is high. Reverse distraction technique involves distraction of scapula with Glenohumeral joint at various angles of ROM to stretch the contracted peri-articular structures. Post Isometric Relaxation (PIR) is the effect of increase in muscle relaxation and the decrease in muscle tone, after a brief period of sub maximal isometric contraction of the same muscle leading to pain relief and improved function.

Objective: To find the individual effect and Compare the effects of Reverse Distraction technique and Post Isometric Relaxation on Shoulder Flexion, Abduction External rotation ROM, Pain and Disability in patients with Diabetic Adhesive Capsulitis.

Method: 40 subjects within the age group of 40-60 years from in and around OPD & hospitals of Pune city were included in the study. Study design was Comparative study and Study duration was 6 months.

Procedure: Subjects were selected based on inclusion and exclusion criteria and divided into 2 groups, A and B by Random Allocation with Chit Method. Group A - Reversed Distraction technique with conventional exercises and Group B - Post-Isometric Relaxation with conventional exercises for 4 weeks with 3 session/week.

Outcome Measure: ROM using Goniometer, Pain using Visual Analogue Scale and Disability using SPADI score.

Results: Intergroup analysis was done using unpaired t-test which showed significant improvement in Group B in relieving pain ($p < 0.001$), improving flexion and abduction ($p < 0.005$) and reducing disability ($p < 0.001$) whereas for external rotation it was not statistically significant ($p = 0.577$)

Conclusion: This study concluded that Post Isometric Relaxation Technique was more effective than Reverse Distraction Technique in improving Shoulder Flexion, Abduction ROM, reducing pain and decreasing Disability, whereas it was equally effective as Reverse Distraction Technique in improving External Rotation ROM.

Keywords: Adhesive capsulitis, reverse distraction, post-isometric relaxation, diabetes, SPADI

1. Introduction

Glenohumeral joint is a Ball and socket type of Synovial joint with 3 degree of freedom- Flexion, Extension, Abduction, Adduction, Internal rotation External rotation. The articulation is composed of large head of Humerus distally and smaller glenoid fossa of Scapula proximally. Glenohumeral joint is surrounded by large loose capsule, taut superiorly and slack inferiorly in resting position. Glenohumeral joint has sacrificed articular congruency to serve mobility needs of hand and is subsequently susceptible to derangement, instability and degenerative changes [1].

Adhesive Capsulitis is a condition characterized by painful, progressive and disabling loss of Active Range of Motion & Passive Range of Motion of Glenohumeral joint in multiple planes. Adhesive capsulitis is one of the most common conditions in musculoskeletal problems with an incidence of 2 to 5% in general population. Prevalence among the age group of 40 to 70 years of age [2]. Idiopathic (primary) adhesive capsulitis occurs spontaneously without a specific precipitating event. Primary adhesive capsulitis results from an inflammatory response with fibro elastic proliferation, which may actually be an abnormal response from the immune system. Secondary Adhesive Capsulitis occurs after a shoulder injury or surgery or may be associated with another condition such as Diabetes, Rotator cuff injury, Cerebrovascular accident or Cardiovascular disease [3]. Diabetes mellitus (DM) is a metabolic, disorder characterized by high blood glucose levels over a period of time leading to various complications. Prevalence of Adhesive Capsulitis in Diabetes Mellitus patients is 13.4%. Studies suggested that this high prevalence of Adhesive Capsulitis in DM may be attributed to increase in connective tissue stiffness in DM may be linked to non-enzymatic oxidative reaction between glucose and collagen resulting in the formation of advanced glycation end products (AGE). These end products result in changes in the microstructural organization of collagen fibre. Alterations in the ultrastructure of collagen may thus result in changes in the biomechanical properties of tendon and capsule [4]. AGE are accompanied by increased free radical activity that contributes towards the bimolecular damage in diabetes [5]. Clinical presentation involves insidious onset. Pain, occasionally radiating till elbow, aggravated by movement, reduced ROM in capsular pattern (External Rotation > Abduction > Flexion > Internal Rotation), difficulty in Activities of Daily Living. (Overhead activities, behind reach, across the body activities), Altered Scapulohumeral Rhythm and Shoulder strength may be impaired [6]. Stages of Adhesive Capsulitis include four stages with first stage as Painful or Preadhesive stage. lasting from 0 to 3 months with symptoms of mild shoulder pain and reduced GHJ motion. Stage two is Freezing stage lasting from 3 to 9 months with symptoms of pain during movement and profound loss of GH ROM. Stage three is Frozen stage lasting from 9 to 15 months with symptoms of pain that tends to plateau or diminish and there is marked loss of GHJ ROM. Stage four is Thawing stage lasting from 15 to 24 months where symptoms of pain, GHJ motion and function improves. Painless stiffness and progressive improvement in ROM but never restored to Normal ROM [6]. Vermeulan *et al.* used Reverse Distraction on GHJ at various angles of Abduction and Flexion with purpose of stretching the contracted peri-articular structures in patients with Adhesive Capsulitis. Stenvers stated that the Glenohumeral joint capsule can be stretched by fixing the Scapula and moving the Humerus OR by fixing the Humerus and moving the Scapula. In terms of biomechanics, it was suggested that during the movement of the Humerus with respect to the Scapula, the Scapula is eventually fixed, but in an unnatural position. Furthermore, movement of the Humerus causes pain. Because of this pain, it is not possible to exert force on the Glenohumeral joint capsule. For this reason, movement of the Humerus with respect to the fixed Scapula, as implemented in traditional gliding techniques, is not an effective

mobilization method. Movement of the Scapula with respect to the Humerus is a better mobilization method because it stretches the capsule directly and is painless [7].

Post Isometric Relaxation (PIR) is a technique is a form of Muscle Energy Technique developed by Karel Lewitt, Post Isometric Relaxation (PIR) is the effect of increase in muscle relaxation and the decrease in muscle tone in a single or group of muscles, after a brief period of sub maximal isometric contraction of the same muscle. PIR works on the concept of Autogenic Inhibition. The mechanism behind increase in ROM by PIR is that muscle contraction against equal counterforce triggers the Golgi Tendon Organ. The afferent nerve impulse from the Golgi tendon organ enters the dorsal root of the spinal cord and meets with an inhibitory motor neuron. This stops the discharge of the efferent motor neurons impulse and therefore prevents further contraction, the muscle tone decreases, which in turn results in the agonist relaxing and lengthening, so there increase in the ROM [8].

2. AIM

To compare the effect of Reverse Distraction Technique and Post Isometric Relaxation technique on Shoulder Flexion, Abduction and External rotation range of motion, Pain and Disability in patients with Diabetic Adhesive Capsulitis at the end of 4 weeks.

3. Objectives

To study the effect of Reverse Distraction technique on Shoulder Flexion, Abduction External rotation range of motion, Pain and Disability in patients with Diabetic Adhesive capsulitis at the end of 4 weeks.

To study the effect of Post Isometric Relaxation technique in improving Shoulder Flexion, Abduction and External rotation range of motion, Pain and Disability in patients with Diabetic Adhesive Capsulitis at the end of 4 weeks.

To compare the effects of reverse distraction technique and Post Isometric relaxation technique on Shoulder Flexion, Abduction and External rotation range of motion, Pain and Disability in patients with Diabetic Adhesive Capsulitis at the end of 4 weeks.

4. Hypothesis

Null hypothesis (H₀)

There is no significant difference in effect of Reverse Distraction Technique and Post Isometric Relaxation on Shoulder Flexion, Abduction and External rotation range of motion, Pain and Disability in patients with Diabetic Adhesive Capsulitis at the end of 4 weeks.

Alternate hypothesis

H1 (A): Reversed distraction Technique is more effective than PIR in improving Shoulder Abduction range of motion in patients with Diabetic Adhesive Capsulitis at the end of 4 weeks.

H1 (B): Reversed distraction Technique is more effective than PIR in improving Shoulder Flexion range of motion in patients with Diabetic Adhesive Capsulitis at the end of 4 weeks.

H1(C): Reversed distraction Technique is more effective than PIR in improving Shoulder External rotation range of motion in patients with Diabetic Adhesive Capsulitis at the end of 4 weeks.

- H1 (D):** Reversed distraction technique is more effective than PIR in improving Shoulder Pain in patients with Diabetic Adhesive capsulitis at the end of 4 weeks.
- H1 (E):** Reverse Distraction technique is more effective than PIR in improving Shoulder Disability in patients with Diabetic Adhesive Capsulitis at the end of 4 weeks.
- H2 (A):** PIR technique is more effective than Reverse Distraction Technique in improving Shoulder Abduction range of motion in patients with Diabetic Adhesive Capsulitis at the end of 4 weeks.
- H2 (B):** PIR technique is more effective than Reverse Distraction Technique in improving Shoulder Flexion range of motion in patients with Diabetic Adhesive Capsulitis at the end of 4 weeks.
- H2 (C):** PIR technique is more effective than Reverse Distraction Technique in improving Shoulder External rotation range of motion in patients with Diabetic Adhesive Capsulitis at the end of 4 weeks.
- H2(D):** PIR technique is more effective than Reverse Distraction Technique in improving Shoulder Pain in patients with Diabetic Adhesive Capsulitis at the end of 4 weeks.
- H2 (E):** PIR technique is more effective than Reverse Distraction Technique in improving Shoulder Disability in patients with Diabetic Adhesive Capsulitis at the end of 4 weeks

5. Methodology

Study Design: Comparative Study

Study Type: Pre and Post Comparative Study

Sample size: 40

Sampling method: Convenient sampling

Study population: Diabetic patients with stage 2 and 3 of Adhesive capsulitis: Age 40-60 yrs.

Study setting: In and around OPD & hospitals of Pune

Study duration: Minimum 6 months

Treatment duration: 4 weeks (3 treatment session per week)

6. Criteria

Inclusion criteria

1. Diagnosed case of Unilateral Adhesive Capsulitis ^[9].
2. Stage 2 and 3 of Adhesive Capsulitis ^[9].
3. Limitation in Shoulder ROM: Flexion (<180), Abduction (<180) and External rotation (<50)
4. Age: 40 – 60 years ^[2].
5. Male and Female ^[3].
6. VAS score between 3 to 7 (mild to moderate) ^[10].
7. Type 2 Diabetes Mellitus

Exclusion criteria

1. VAS value > 7
2. History of surgery of the affected Shoulder ^[9].
3. Fractures in and around Shoulder.
4. Neurological disorders leading to altered muscle activity ^[11].
5. Systemic arthritic conditions of the shoulder (Rheumatoid arthritis, osteoporosis or malignancies in the shoulder region) ^[12].
6. Disorders of the Cervical spine ^[9].

7. Corticosteroids injections in the affected Shoulder in preceding 6 weeks ^[12].
8. Skin lesions or bruises around the Shoulder ^[12].
9. Shoulder injuries such as Rotator cuff tear.

7. Materials and Tools

Pen

Paper

Plinth

Consent form

Universal Goniometer

Hot moist pack

Towel

Shoulder Pain and Disability Index scale (SPADI)

8. Outcome Measures

Visual Analogue Scale: (ICC=0.71-0.99) ^[10].

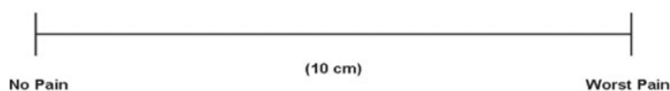
VAS is considered by some as one of the best measures of pain Intensity

VAS is a self reported measure consisting of a vertical or horizontal line with extreme anchors of “no pain” to “extreme pain”

This line represents a continuum of pain intensity and is most often 10cm in length.

The patient is asked to mark their perceived level of pain on the line.

The therapist scores the instrument by measuring the distance on millimeter from from the ‘no pain’ anchor to the mark, which the patient identified as their level of pain.



Goniometer: Reliability – 0.94 – 0.98 (for assessment of range of motion) ^[13].

Goniometric measurements are highly reliable provided measurements are conducted by the same therapist. Shoulder Abduction, Flexion and External rotation range will be taken by a Universal Goniometer.

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 Acromion 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.

Stabilization: Scapula to prevent upward rotation and elevation.

Testing motion: Abduct the shoulder by moving the Humerus lateral away from the subjects trunk maintaining upper extremity in lateral rotation and neutral flexion and extension.

Shoulder Flexion

Proximal arm: Aligned parallel to the mid-axillary 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.

Stabilization: Scapular stabilization to prevent upward rotation, posterior tilting and elevation of Scapula.

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

Shoulder External Rotation

Proximal arm: Either perpendicular or parallel to the floor

Distal arm: Align with ulna, using Olecranon process and Ulnar styloid process as reference

Fulcrum: over the Olecranon process

Subject position: Supine, arm being tested in 90 degrees of Shoulder abduction, 0 degrees of Supination and Pronation so that palm of hand faces the feet

Stabilization: At the distal end of Humerus to keep the Shoulder in 90 degree of Abduction

Testing Motion: Rotate the Shoulder laterally by moving the forearm posteriorly, bringing dorsal surface of hand towards the floor^[1].

Shoulder Pain and Disability Index (SPADI)

Reliability- 0.89, Validity – 0.90 (for assessment of disability)^[14].

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 pain score: / 50 x 100 = %

Total disability score: / 80 x 100 = %

Total Spadi score: / 130 x 100 = %

9. Procedure

The presentation of synopsis was done and then approval and Clearance from the ethical committee was taken from P.E.S. MODERN COLLEGE OF PHYSIOTHERAPY, SHIVAJINAGAR PUNE -05. Subjects were explained about the study procedure.

Consent were taken from the patients who were willing to participate in the study.

Subjects were selected according to the inclusion and exclusion criteria.

Subjects were divided into 2 group by Random Allocation with Chit Method.

Pre-intervention, outcome measures for range of motion using Goniometer, pain using VAS and Disability using SPADI score of the shoulder joint was taken.

Group A: receives reversed distraction technique along with conventional exercises for 4 weeks.

Group B: receives Post Isometric Relaxation along with conventional exercises for 4 weeks.

Post-intervention outcome measures was taken again.

Group A: reverse distraction technique

Patient position: Side - lying. Patient lies on unaffected side at the edge of the plinth.

Therapist position: In front of 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, flexion and external rotation with the lower hand mobilizing the scapula in medial and downward direction.

No. of repetitions: 10 (shoulder abduction) 10 (shoulder flexion) 10 (Shoulder External rotation)

No. of sessions per week: 3 per week for 4 weeks (40 min per session)^[2].

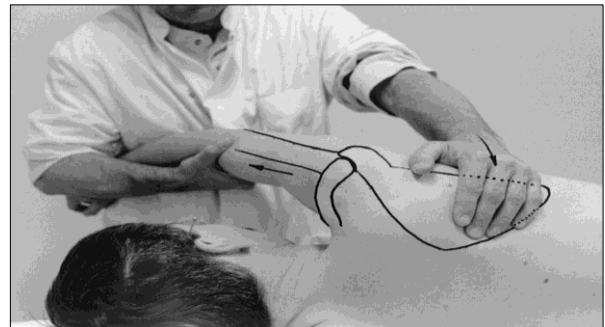


Fig 1: Reverse Distraction Technique

Group B: Post Isometric Relaxation

Post –isometric relaxation method of the muscle energy techniques was used to lengthen a shortened muscle and increase joint mobility. The joint is taken to its restricted range within the pain limits. 5-10seconds hold time is used with 5 repetitions/set, 3 sets/session, 1 session/day 20% to 30% of Strength of the patient is used^[15].

Restriction of Flexion

Position: side lying

Procedure: Therapist stands in front of the patient. Right hand is placed over the top of the patients shoulder (superior part of scapula) to palpate the motion. Left hand and forearm supports the patients flexed right elbow. The patient's humerus is flexed at the gleno-humeral joint in the sagittal plane to initiate the point of resistance.

The patient is asked to extend the shoulder against the counterforce and held for 5 seconds. The patient is asked to gently cease the directive force. (Relax Voluntarily)

Rest time of 2 seconds for the tissues to relax is given and then taken up the slack to the new point of initial resistance.



Fig 2: PIR for Shoulder Flexion

Restriction of Abduction

Position: Side lying.

Procedure: Therapist stands in front of the patient. Right hand is placed over the top of the patients shoulder (superior part of scapula) to palpate the motion. The patient's flexed right elbow is supported with the therapist left hand and arm abducted to initial resistance.

The patient is asked to press the shoulder towards the body (adduct) against equal counterforce at the elbow. Forces are maintained long enough to sense the patient's contractile force for 5 seconds. The patient is asked to gently cease the directive force.

Rest time of 2 seconds for the tissues to relax is given and then taken up the slack to the new point of initial resistance.



Fig 3: PIR for Shoulder Abduction

Restriction of External rotation

Position: side lying

Procedure: Therapist stands behind the patient. Therapist left hand is placed superior to the patient's Glenohumeral joint. Therapist right forearm is placed medial to the patients flexed right forearm and the therapist right hand supporting the patients right hand and wrist. The elbow is held close to the patient's body. The patients arm is externally rotated to an initial resistance. The patient is asked to internally rotate the arm by pressing the right hand against the equal counterforce of the therapist right hand. The patient's right elbow is used as the pivot joint. Forces are maintained long enough to sense the patient's contractile force for 5 seconds. The patient is asked to gently cease the directive force. (Relax voluntarily). Rest time of 2 seconds for the tissues to relax is given and then taken up the slack to the new point of initial resistance ^[3].



Fig 4: PIR for Shoulder External Rotation

Conventional Exercises

Conventional exercises were given to both groups as follows [2]:

All the exercises were performed in 3 sets of 10 to 12 repetitions each.

Hot moist packs applied to the affected Shoulder joint for 10 to 15 min prior to mobilization.

Codman's exercises: Patient is in supine or 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 therapist move the trunk slightly back and forth. Motions of Flexion, Extension, Abduction, Adduction and Circumduction can be done.

Finger Ladder Exercise: Finger is taken overhead in Flexion and Abduction.

Wand Exercises: ROM exercises with help of a stick or wand is performed for Flexion Extension, Abduction Adduction, Internal rotation External rotation.

Active assisted shoulder range of motion exercises

1.) Shoulder External Rotation: Patient position: Standing or sitting.

Procedure: The patient's arms are at the sides, and elbows are flexed to 90°. Rotation of the arms is done by moving wand from side to side across trunk while maintain Elbows at the side.

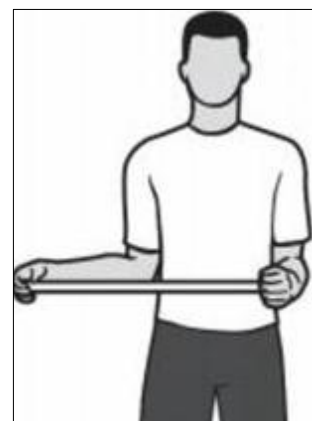


Fig 5: Shoulder External Rotation

2.) Shoulder Internal Rotation: Patient position: Standing or sitting.

Procedure: Patient is instructed to hold a towel with the affected arm behind the back and use the unaffected arm to pull the affected arm up the back.



Fig 6: Shoulder Internal Rotation

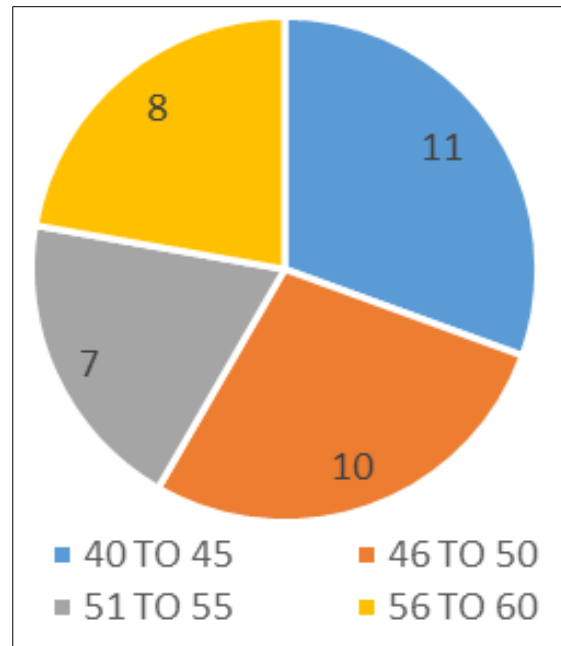


Fig 8: Age wise distribution

10. Data analysis

Improvement in the range of motion and reduction in pain and disability were analyzed using Universal Goniometer (to measure Range of motion in degrees), Visual Analogue Scale (VAS) and Shoulder Pain and Disability Index (SPADI) respectively.

The data was entered in Excel spread sheet, tabulated and subjected to Statistical Analysis.

Data entered was analyzed with the help of Primer of Biostatistics Version 7.0

Table 1: Gender wise distribution of demographic data

GENDER	NO.
MALE	19
FEMALE	17

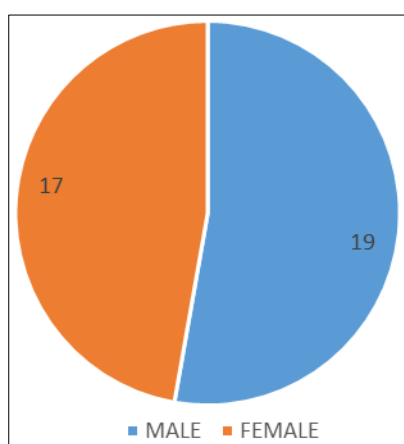


Fig 7: Gender Wise Distribution

Table 2: Age Wise Distribution

AGE	NO.
40-45	11
46-50	10
51-55	7
56-60	8

Table 3: Dominance wise distribution

DOMINANCE	NO
DOMINANT SIDE AFFECTED	13
NON DOMINANT SIDE AFFECTED	23

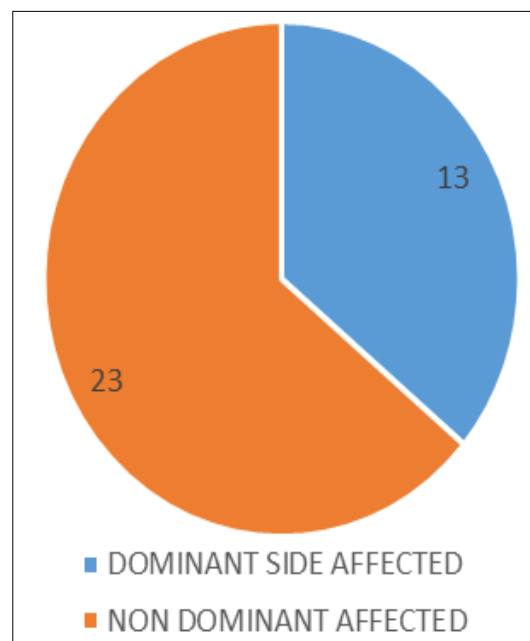


Fig 9: Dominance wise distribution

11. Statistical Analysis

Data analysis was done for Group A and Group B using outcome measures using Visual Analogue Scale (VAS) Universal Goniometer (measure Range of motion in degrees), and Shoulder Pain and Disability Index (SPADI) respectively.

Pre and post data analysis for VAS, Range of motion (shoulder flexion, abduction and External Rotation) and SPADI for Group A and Group B was done by paired t test. Group A and Group B Inter Group Analysis was done using Unpaired t test.

Table 4: Shoulder Rom Group A and Group B (Intra Group)

ROM	PRE (MEAN/SD)	POST (MEAN/SD)	tVALUE	pVALUE	RESULTS
FLEXION A	131.8±20.29	151.4±19.3	-16.538	<0.0001	Highly Significant
FLEXION B	126.6±24.39	154.3±16.02	-10.254	<0.0001	Highly Significant
ABDUCTION A	127.5±21.2	147.2±19.09	-12.551	<0.0001	Highly Significant
ABDUCTION B	122.6±22.31	149.9±17.54	-13.712	<0.0001	Highly Significant
EXTERNAL ROTATION A	32.39±4.816	44.11±4.31	-15.300	<0.0001	Highly Significant
EXTERNAL ROTATION B	34.28±5.245	46.56±4.817	-19.804	<0.0001	Highly Significant

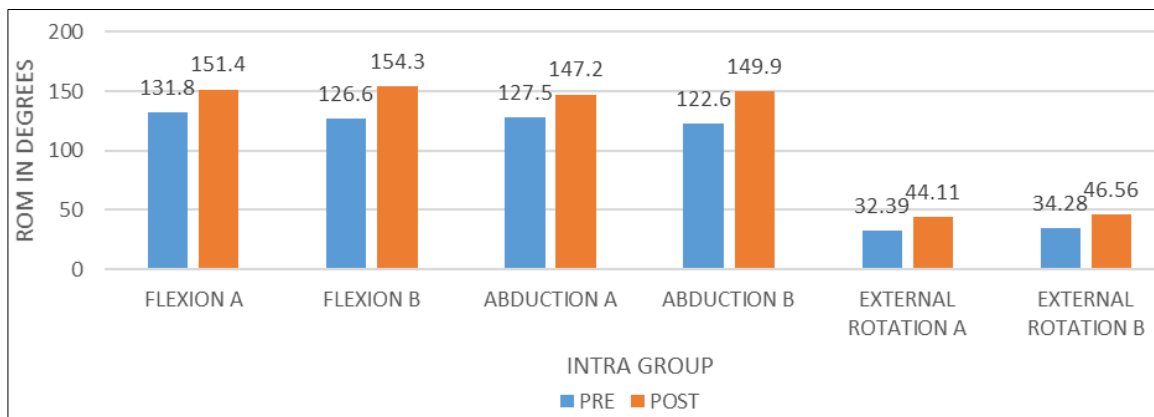


Fig 10: Mean Shoulder Rom

Table 5: VAS Group A and Group B (Intra Group)

VAS	PRE (MEAN /SD)	POST (MEAN/SD)	T VALUE	P VALUE	RESULTS
GROUP A	5.506±1.07	4.167±0.97	13.700	<0.0001	Highly Significant
GROUP B	5.794±0.88	2.911±0.96	12.132	<0.0001	Highly Significant

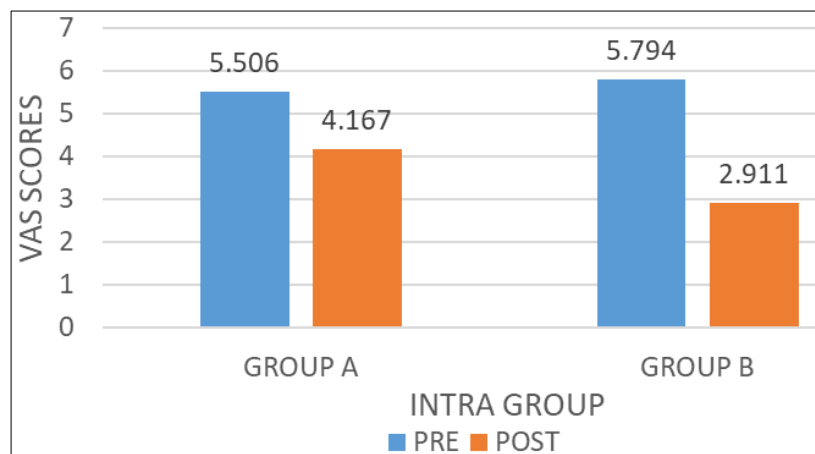


Fig 11: Mean

Table 6: Spadi Group A And Group B(Intra Group)

SPADI	PRE (MEAN/SD)	POST (MEAN/SD)	tVALUE	pVALUE	RESULTS
GROUP A	62.23±9.378	45.59±8.406	19.731	<0.0001	Highly Significant
GROUP B	62.68±14.76	32.22±12.04	13.510	<0.0001	Highly Significant

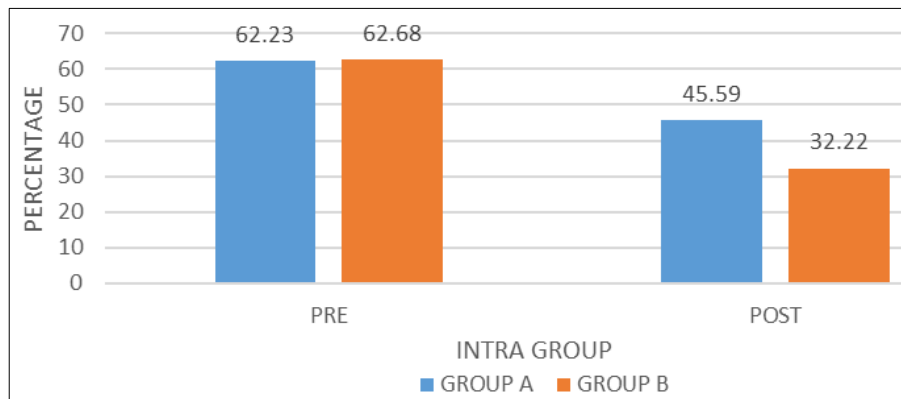


Fig 12: Mean Spadi scores

Inter Group Analysis

Table 7: Vas Group A V/S Group B

Outcome Measure	Group A (Mean/SD)	Group B (Mean/SD)	T Value	P Value	Results
VAS	1.339 ±0.4146	2.883±1.008	-6.010	<0.0001	Highly Significant

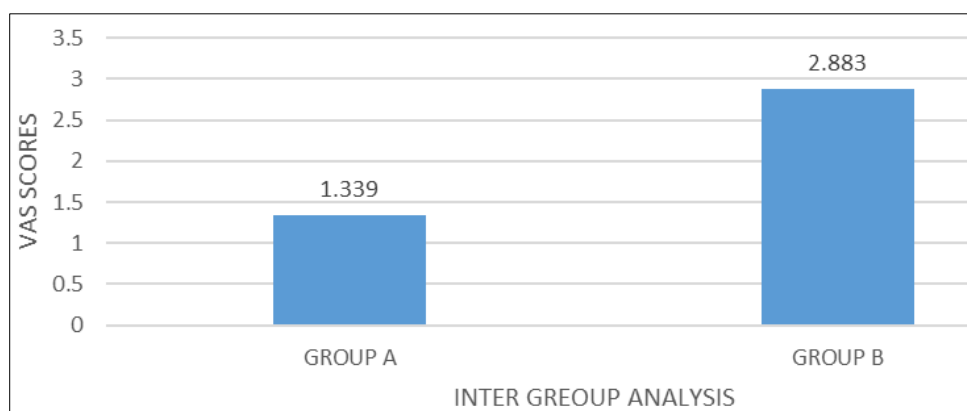


Fig 13: Mean Pain Scores

Table 8: Shoulder Rom Group A V/S Group B

OUTCOM E MEASUR	GROUP A (Mean/SD)	GROUP B (Mean/SD)	T VALUE	P VALUE	RESULTS
FLEXION	19.61±5.031	28.06±11.22	-2.913	<0.005	Significant
ABDUCTI ON	9.72±6.667	27.33±8.458	-2.998	<0.005	Significant
EXT ROT	11.72±3.25	12.28±2.63	-0.564	<0.577	Not Significant

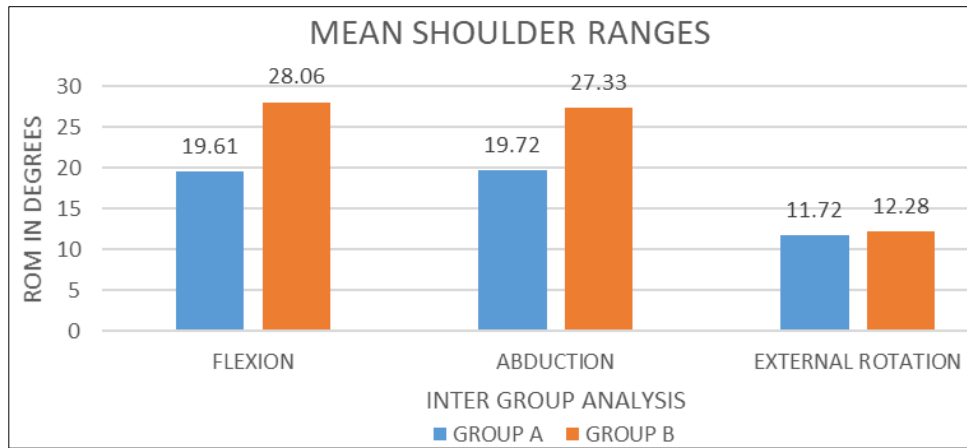


Fig 14: Spadi inter group

Table 9: Group A Vs Group B

OUTCOME MEASURE	GROUP A	GROUP B	T VALUE	P VALUE	RESULTS
SPADI	16.24±3.743	30.37±9.562	-5.839	<0.0001	Highly Significant

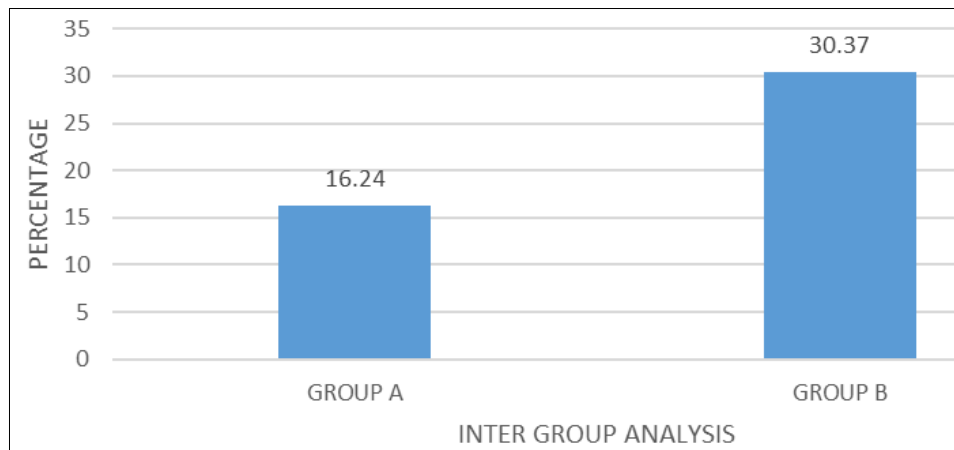


Fig 15: Mean Spadi Values

12. Results

The treatment techniques used in this study are Reverse Distraction Technique (Group A) and Post Isometric Relaxation (Group B) for patients with Diabetic Adhesive Capsulitis at the end of 4 weeks.

Vas scores

Mean values for Pain (VAS) between Group A and Group B was 1.339±0.4146 and 2.883±1.008 respectively (t = -6.010 and p = <0.0001 which is considered significant).

This Study revealed statistically significant difference in reducing pain scores between the two groups.

Range of Motion

Mean values for Shoulder Flexion Range of Motion between Group A was 19.61 ± 5.031 and for Group B was 28.06±11.22 respectively. (t = -2.913 and p = <0.0006 which is considered significant). Mean values for Shoulder Abduction Range of Motion between Group A was 19.72±6.667 and for Group B was 27.33± 8.458.(t = -2.998 and p = <0.005 which is considered as significant). Mean values for Shoulder External Rotation Range of Motion between Group A was 11.72± 3.25 and for Group B was

12.28 ± 2.63. (t = -0.564 and p = <0.577 which is considered as not significant).

The Study revealed Statistically significant difference in Improving Shoulder Flexion and Abduction ROM but very slight difference in improving External Rotation ROM though they were clinically significant.

SPADI

Mean values of SPADI Scores was 16.24± 3.743 for Group A and 30.37± 9.562 for Group B respectively. (t = -5.839 and p = <0.0001 which is considered significant).

The study revealed statistically significant difference in improving Disability in patients with Diabetic Adhesive Capsulitis.

13. Discussion

Adhesive capsulitis is one of the most common condition in musculoskeletal problems. It is a condition characterized by painful, progressive and disabling loss of AROM & PROM of GHJ in multiple planes. Diabetes mellitus (DM), is a metabolic, disorder characterized by high sugar levels in blood over a period of time leading to various Complications, Adhesive Capsulitis being one of them.

The objective of the present study was to evaluate and Compare the effects of Reverse Distraction Technique with Post Isometric Relaxation Technique on Pain (VAS), Shoulder Flexion, Abduction and External Rotation and Disability (SPADI) in patients with Diabetic Adhesive Capsulitis. No published study has compared these two techniques directly. Although some studies have evaluated the effectiveness of the individual technique along with other mobilization techniques. This study included 40 subjects in the age group of 40 to 60 years with mean age being 50.11 ± 6.009 For Group A and 48.33 ± 5.911 for Group B. The number of male subjects were more than female subjects in this study. The gender distribution in each Group was such that Group A consisted of 11 males and 7 females and Group B consisted of 8 males and 10 females. Both the Techniques were given with the Conventional Treatment which included hot fomentation, Codman's Exercise, and Active Assisted Range of Motion Exercise. 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) with paired t test which revealed significant reduction in pain, improving shoulder ROM and Disability. The reverse distraction technique, which was proposed by *Stenvers* and later used by *Vermeulen* stated in a study that the Glenohumeral joint capsule can be stretched by fixing the Scapula and moving the Humerus OR by fixing the Humerus and moving the Scapula. In terms of biomechanics, it was suggested that during the movement of the Humerus with respect to the Scapula, the Scapula is eventually fixed, but in an unnatural position. Furthermore, movement of the Humerus causes pain. Because of this pain, it is not possible to exert force on the Glenohumeral joint capsule. For this reason, movement of the Humerus with respect to the fixed Scapula, as implemented in traditional gliding techniques, is not an effective mobilization method. Movement of the Scapula with respect to the Humerus is a better mobilization method because it stretches the capsule directly, is painless and improves ROM [2]. In this study, active and passive abduction ROM in all three planes increased and pain reduced significantly, which supports the results of the studies conducted by *Johnson et al.*, *Vermeulen et al.*, and *Stenver*. This can be attributed to the following reasons:

Positional correction of the scapula occurs with reverse distraction, there is an increase in mobility at the glenohumeral joint.

Mechanical effects of mobilization on joint mobility: adhesions break up, realignment of collagen, or fiber gliding increase by specific movements that stress the capsular tissue.¹⁶ Moreover, the induced rheological changes in synovial fluid, increased exchange of fluid between synovial tissue and the cartilage matrix, and enhanced synovial fluid turnover are found to be affected by joint mobilization [17].

Due to this underlying mechanism, the technique showed significant results in improving ROM, relieving Pain and thus reducing Disability.

When Pre and Post analysis was done within the Post Isometric Relaxation group (Group B) using paired t test, it revealed significant statistical difference in reducing pain, improving shoulder Flexion, External Rotation and Abduction and reducing Disability. The possible mechanism to relieve pain include neurological and tissue factors, such as stimulation of low threshold mechanoreceptors on

centrally mediated pain inhibitory mechanism and on neuronal populations in the dorsal horn with possible gating effect. Low threshold mechanoreceptors from the joints and muscles project to the periaqueductal grey in the midbrain region. During isometric contraction, activation of muscle and joint mechanoreceptors occur. This leads to sympatho-excitation evoked by somatic efferent's and localized activation of PAG that plays a role in descending modulation of pain. Nociceptive inhibition then occurs at the dorsal horn of the spinal cord, as simultaneous gating takes place of nociceptive impulses in dorsal horn, due to mechanoreceptor stimulation [18]. The mechanism behind increase in ROM by PIR is that muscle contraction against equal counterforce triggers the Golgi Tendon Organ. The afferent nerve impulse from the Golgi tendon organ enters the dorsal root of the spinal cord and meets with an inhibitory motor neuron. This stops the discharge of the efferent motor neurons impulse and therefore prevents further contraction, the muscle tone decreases, which in turn results in the agonist relaxing and lengthening, so there increase in the ROM [18]. Due to this underlying mechanism, the technique showed significant results in improving ROM, relieving Pain and thus reducing Disability. This is also supported by the study of *Patil et al.* (2010). They took 40 subjects (21 males and 19 females) diagnosed with acute low back pain. Subjects were randomly assigned to two groups of 20 each. The control group received interferential therapy while interventional group received MET on quadratus lumborum combined with interferential therapy. MET on quadratus lumborum combined with IFT demonstrated a statistically significant difference ($p < 0.001$) showing decrease in disability and increase in spinal range of motion than IFT alone [19].

Inter Group analysis done using the Unpaired t test revealed that while both the technique along with Conventional treatment were individually effective in improving shoulder ROM, reducing pain and reducing Disability, the Post Isometric Relaxation technique (Group B) was more effective as compared to Reverse Distraction Technique (Group A) in Improving Shoulder Flexion and Abduction, relieving Pain and reducing Disability according to Statistical Analysis, whereas it was equally effective and revealed no significant difference according to statistical analysis in improving External rotation ROM, though it was clinically significant and evident. This may be attributed to the fact that External rotation ROM is the first to be affected according to the Capsular pattern of Glenohumeral joint and last to recover during the course of treatment period.

Post Isometric Relaxation Technique and Reverse distraction technique are individually effective in improving shoulder flexion and abduction range of motion, reducing pain and disability in patients with Diabetic Adhesive capsulitis. Both the techniques were equally effective in improving Shoulder External Rotation Range of Motion. The techniques can be given along with conventional physiotherapy to improve glenohumeral mobility, reducing pain and disability in patients with Adhesive Capsulitis.

14. Conclusion

This study concludes that Post Isometric Relaxation Technique (Group B) was more effective than Reverse Distraction Technique (Group A) in Improving Shoulder Flexion, Abduction ROM, Reducing pain and Decreasing Disability, whereas it was equally effective as Reverse

Distraction Technique in improving Shoulder External Rotation Range of Motion.

15. Limitations

The study was done using a small sample size.

16. Future Scope of The Study

The technique can be compared with other treatment techniques.

The study can include other types of Adhesive Capsulitis.

Technique can be given along with Home Protocol.

17. References

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