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Effectiveness of Muscle Energy Technique on Pain, Range of Motion, Proprioception, Muscle Strength & QOL in Diabetic Frozen Shoulder Conditions

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ABSTRACT

Introduction: The term "frozen shoulder" was first introduced by Codman in 1934. He described a painful shoulder condition of insidious onset that was associated with stiffness and difficulty sleeping on the affected side. Codman also identified the marked reduction in forward elevation and external rotation that are the hallmarks of the disease (Richard Dias *et al*, 2005).

Aims and Objectives: To evaluate the effectiveness of Muscle Energy Techniques along with conventional Therapy on Pain, ROM, Muscle Strength, Proprioception, Disability, Anxiety & Depression, quality of life and Mindfulness in patients with diabetic frozen shoulder.

Methodology: 31 Patients were treated with Muscle Energy Technique (MET), Stabilization Exercise and Moist Heat Therapy. All the patients were selected after informed consent. These patients were interviewed by direct method. The patients were assessed in 0 (zero) week and reassessed in 4 (four) weeks and 8 (eight) weeks of treatment programme. Every 0 week 4 weeks and 8 weeks of treatment programme, pain, ROM, shoulder strength, shoulder Proprioception & disability were recorded. These treatment protocols will be given five days per week for eight weeks.

Conclusion: Our study concluded that Muscle Energy Technique (MET), Stabilization Exercise and Moist Heat Therapy (MHT) in Patients with Diabetic Frozen Shoulder showed significant improvement in pain, Range of motion muscular strength and joint position sense in 4th weeks & 8th weeks of treatment programme.

Keywords: Diabetic Frozen Shoulder; Muscle Energy Technique (MET); Stabilization Exercise; Moist Heat Therapy; Digital Inclinometer; Force Gauge & NPRS.

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INTRODUCTION

The term "frozen shoulder" was first introduced by Codman in 1934. He described a painful shoulder condition of insidious onset that was associated with stiffness and difficulty sleeping on the affected side. Codman also identified the marked reduction in forward elevation and external rotation that are the hallmarks of the disease. Long

before Codman, in 1872, the same condition had already been labelled "periarthritis" by Duplay. In 1945, Naviesar coined the term "adhesive capsulitis" (Richard Dias *et al*, 2005).

Diabetic frozen shoulder is characterized by pain and severe limited active and passive range of motion of the glenohumeral joint, particularly external rotation. Diabetes is frozen shoulder is due to the effects on collagen in the shoulder, which holds the bones together in a joint. Collagen gets triggered by the presence of high blood sugars. Interestingly, collagen gets sticky when sugar molecules become attached, leading to restricted movements and shoulder starting to stiffen (Cintia Garcilazo *et al*, 2010) (Fig. 1).

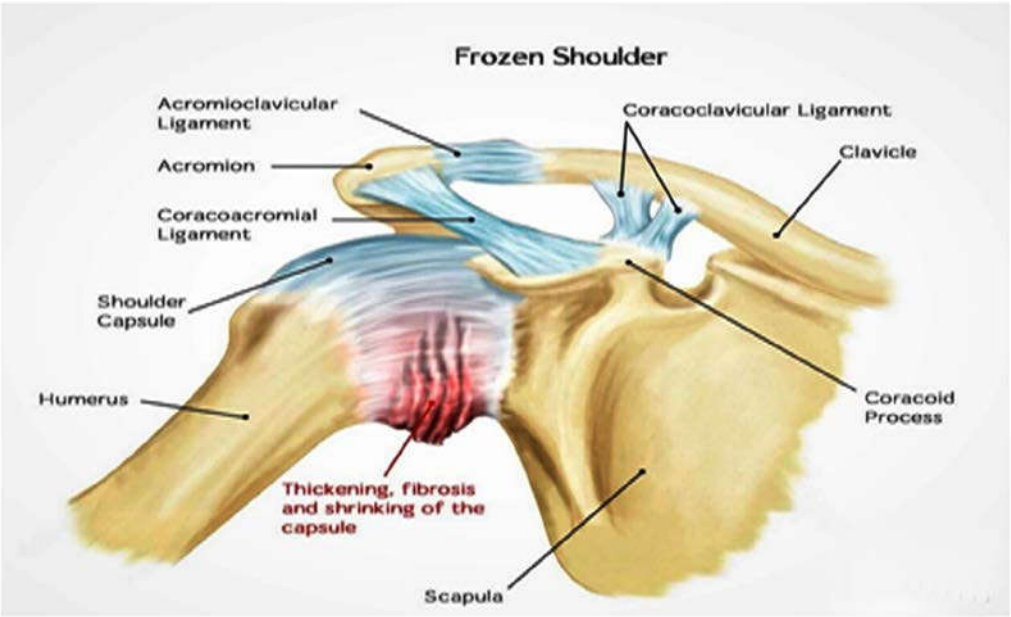


Fig. 1: Frozen Shoulder

The prevalence of adhesive capsulitis in patients with diabetes in India was reported to be 11%-29.61%, in Saudia Arabia 6.7%, in Iran 13.30%, in Finland 14%, in UK around 10.8%. Whereas other studies identified around 20% Australians, 38.6% Americans, 27% Indians and around 40% British reported diabetes in patients with adhesive capsulitis (Rita Rastogi, *et al.* 2014).

The etiology of periarthritis of the shoulder, however, is not clearly understood. Amongst the factors suggested are trauma myocardial infarction hemiplegia, pulmonary tuberculosis, thyrotoxicosis, cerebral tumor, and epilepsy. In this paper, an association of periarthritis of the shoulder with diabetes mellitus is described. The incidence of this condition in diabetic patients is compared with that in non-diabetic medical patients seen during the same period of time (G. C. Lloyd-Roberts, *et al*. 1959; J. F. Bridgman, *et al*. 1972).

The patho-physiology of idiopathic adhesive capsulitis is poorly understood. Most authors have reported various degrees of inflammatory changes in the synovial membrane. Adhesions between the shoulder capsule and the humeral head have been noted by some, but not all, authors. The optimum management of adhesive capsulitis has been the subject of great debate, particularly since the condition tends to resolve spontaneously over months to years (Simon Carette, *et al*. 2003).

Dr. Fred Mitchell Sr. developed the muscle energy technique. It is a non-invasive treatment that can be used to extend or stretch stiff muscles and fascia. MET primarily targets soft tissues, but it also significantly contributes to joint mobilisation, which enhances extensibility of muscle and increases range of motion of joints through a mechanism known as "enhanced tolerance to stretch." (Geetha Mounika Rayuduet *et al*. 2018).

The Numerical Pain Rating Scale (NPRS) is a subjective measure in which individuals rate their pain on an eleven point numerical scale. The scale is composed of 0 (no pain at all) to 10 (worst imaginable pain). It has been shown that a composite scoring system including best, worse, and current level of pain over the last 24 hours was sufficient to pick up changes in pain intensity with

maximal reliability (Jensen, *et al.* 1999).

Range of motion (or ROM), is the linear or angular distance that a moving object may normally travel while properly attached to another. It is also called range of travel (or ROT). Range of motion refers to the distance and direction a joint can move between the flexed position and the extended position. (Wikipedia Range of motion, 2021).

A digital force gauge is a load cell (this is often combined with software and a display). A load cell is an electronic device that is used to convert a force into an electrical signal. Through a mechanical arrangement, the force being sensed deforms a strain gauge. The strain gauge converts the deformation (strain) to electrical signals. The software and electronics of the force gauge convert the voltage of the load cell into a force value that is displayed on the instrument. Test units of force measurements are most commonly newtons or pounds (Wikipedia Force gauge, 2020).

AIMS AND OBJECTIVES

To evaluate the effectiveness of Muscle Energy Techniques along with conventional Therapy on Pain, ROM, Muscle Strength, Proprioception, Disability, Anxiety & Depression, quality of life and Mindfulness in patients with diabetic frozen shoulder.

Hypothesis

Alternate Hypothesis

There will be significant differences of Muscle Energy Techniques along with conventional on Pain, ROM, Proprioception and muscle strength in patients with diabetic frozen shoulder.

Null Hypothesis

There will be not significant differences of Muscle Energy Techniques along with conventional on Pain, ROM, Proprioception and muscle strength in patients with diabetic frozen shoulder.

METHODOLOGY

Approval from the Synopsis Approval Committee (SAC) of SGRR University and Institutional Ethics Committee of Shri Guru Ram Rai Institute of Medical & Health Sciences, Patel Nagar, Dehradun was sought. The confidence level–95% and confidence interval-5% used to calculate sample size. In this study, Dehradun census (Uttrakhand) population (679,370 in 2018) was included (Census and Sample Survey, Dehradun 2018) (C. R. Kothari, 2004; Census and Sample Survey, Dehradun 2018).

In this study simple random sampling technique was used. These subjects were solicited from the Shri Mahant Indiresh Hospital, Department of Physiotherapy, Patel Nagar, Dehradun (Uttarakhand) and selected according to inclusion and exclusion criteria.

Inclusion Criteria: Patients which were diagnosed to suffer from Diabetic Frozen Shoulder, Patients with limited Range of motion of shoulder abduction, external rotation and flexion, All the patients (both males and females) between ages 40 to 70 years, All the subjects must have frozen shoulder for at least last 15 days, Affected shoulder must have not more than 90 degrees of flexion & abduction and 50% decreased external rotation & internal rotation as compared to normal side/ normal ROM values.

Exclusion Criteria: Subjects with Rotator cuff tears and other shoulder ligament injuries, History of any arthritis related to shoulder, RA shoulder secondary to fracture, dislocation, Reflex sympathetic dystrophy and neurological disorder, Malignancy, All the patients having any cervical or thoracic problem. If present must be treated first before including in the study, All the objects having any intra articular injection in the glenohumeral joint during last three months, Patients with fractured scapula, Any history of surgery on that shoulder and patients with tendon calcification, Patients with cervical rib, Diagnosed severely osteoporotic, Diagnosed Rheumatoid Arthritis, Diagnosed Osteoarthritis, Prolonged immobilization and Neurological/Hemiplegics. Those patients were also excluded from the study whose ROM; Flexion was more than 90°, Abduction more than 90°, Lateral rotation and medial rotation more than 50%. Outcome Measures Numeric Pain Rating Scale (NPRS), Digital Inclinometer, Force Gauge and Proprioception Measurement. (Table 1)

Table 1: Outcome Measures

Variables	Measurements
Pain	Numeric pain rating scale
Range of motion	Insize digital inclinometer
Muscle strength	Lutron force gauge
Shoulder proprioception	Joint position sense measurement

PROCEDURE

All the patients were selected after informed

consent. These patients were interviewed by direct method. The patients were assessed in 0 (zero) week and reassessed in 4 (four) weeks and 8 (eight) weeks of treatment programme. Every 0 week 4 weeks and 8 weeks of treatment programme, pain, ROM, shoulder strength, shoulder Proprioception & disability were recorded. These treatment protocols will be given five days per week for eight weeks. 31 Patients were treated with Muscle Energy Technique (MET), Stabilization Exercise and Moist Heat Therapy.

Application Muscle Energy Techniques (MET) for Rotator cuff Muscle:

MET Treatment of Supraspinatus (Abduction O TO 15°):

Assessment for Shortness of Supraspinatus:

The therapist stands behind the seated patient, with one hand stabilizing the shoulder on the side to be assessed while the other hand reaches in front of the patient to support the flexed elbow and forearm. The patient's upper arm is adducted to its easy barrier and the patient then attempts to abduct the arm.

If pain is noted in the posterior shoulder region during this attempt this is diagnostic of supra spinatus dysfunction and, by implication because it is a postural muscle, of shortness.

Assessment for Supraspinatus Weakness

The patient sits or stands with arm abducted 15°, elbow extended. The therapist stabilizes the shoulder with one hand while the other hand offers a resistance contact which if forceful would adduct the arm. The patient attempts to resist this, and the degree of effort required to overcome the patient's resistance is graded as weak or strong.

The relative strength is judged and the method discussed by Norris (1999) should be used to increase strength (isotonic eccentric contraction performed slowly).

MET Treatment of Supraspinatus

The therapist stands behind the seated patient, with one hand stabilizing the shoulder on the side to be treated while the other hand reaches in front of the patient to support the flexed elbow and forearm. The patient's upper arm is adducted to its easy barrier and the patient then attempts to abduct the arm using 20% of strength against therapist resistance. During this procedure, the patient inhales the air. After a 10 second isometric contraction, the patient exhales the air. The arm is taken gently towards its new resistance barrier into greater adduction, with the patient's assistance. Repeat several times, holding each painless stretch for not less than 20 seconds (Leon Chaitow, *et al*. 2006) (Fig. 2).

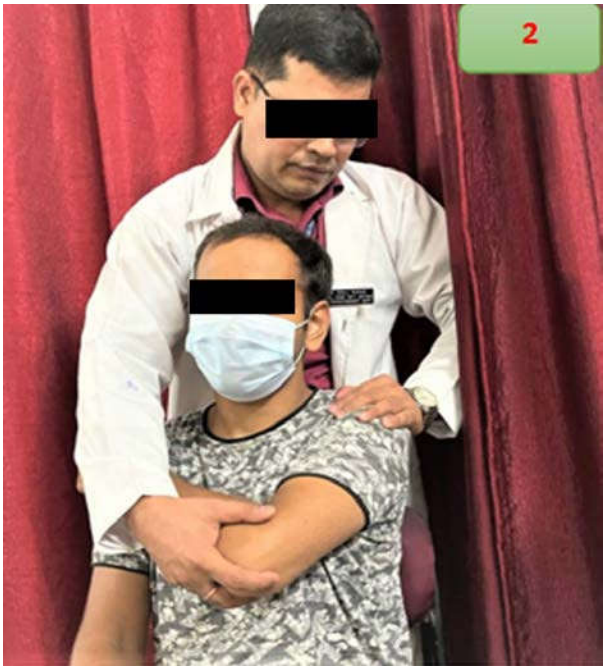


Fig. 2: MET treatment of supraspinatus

MET of Infraspinatus (External Rotator)

Infraspinatus Shortness test

1. The patient is asked to reach upwards, backwards and across to touch the upper border of the opposite scapula, so producing external rotation of the humeral head. If this effort is painful Infraspinatus shortness should be suspected.
2. The patient supine, upper arm at right angles to the trunk, elbow flexed so that lower arm is parallel with the trunk, pointing caudad with the palm downwards. This brings the arm into internal rotation and places Infraspinatus at stretch. The therapist ensures that the shoulder remains in contact with the table during this assessment by means of light compression.

If Infraspinatus is short, the lower arm will not be capable of resting parallel with the floor, obliging it to point somewhat towards the ceiling.

Assessment for Infraspinatus weakness

The patient is seated. The therapist stands

behind. The patient's arms are flexed at the elbows and held to the side, and the practitioner provides isometric resistance to external rotation of the lower arms (externally rotating them and also the humerus at the shoulder). If this effort is painful, an indication of probable Infraspinatus shortening exists. The relative strength is also judged. If weak, the method discussed by Norris (1999) (see Ch. 3) should be used to increase strength (isotonic eccentric contraction performed slowly). Force should always be built slowly and not suddenly.

MET Treatment of Infraspinatus:

The patient was positioned in supine lying on the examination table and shoulder abducted to 90 degree and elbow flexed to 90 degree respectively. The therapist will be passively internal rotated the shoulder until the first barrier of movement is reached. Then the patient will be asked to perform a 5 second isometric hold at 25% of his/ her maximal voluntary contraction in the direction of external rotation, against an opposing force provided by the examiner at the distal forearm. During this procedure, the patient inhales the air. After a 05 second isometric contraction, the patient exhales the air. Following the contraction the patient will be instructed to relax and the therapist took the shoulder to new internal rotation range and the stretch was applied for 30 seconds and the same method is performed again (Leon Chaitow, *et al.* 2006; Geetha Mounika Rayudu, *et al*. 2018; Stephanie D. Moore, *et al.* 2011) (Fig. 3).

Fig. 3: MET treatment of Infraspinatus

MET of Subscapularis (Internal Rotator & Adductors)

Subscapularis Shortness Test:

The patient was lying supine with the arm abducted to 90°, the elbow flexed to 90°, and the forearm in external rotation, palm upwards. The whole arm was resting at the restriction barrier, with gravity as its counter weight. If subscapularis is short the forearm was unable to rest easily parallel with the floor but was somewhat elevated.

Care is needed to prevent the anterior shoulder becoming elevated in this position (moving towards the ceiling) and so giving a false normal picture.

Assessment for Subscapularis weakness:

The patient was lying prone with humerus abducted to 90° and elbow flexed to 90°. The shoulder was in internal rotation so that the forearm is parallel with the trunk, palm towards ceiling. The therapist stabilized the scapula with one hand and with the other applies pressure to the patient's wrist and forearm as though taking the humerus towards external rotation, while the patient resists. The relative strength was judged and the method discussed by Norris (1999) should use to increase strength (isotonic eccentric contraction performed slowly).

MET Treatment of Subscapularis (Internal Rotation)

The patient was positioned supine on the treatment table with the shoulder and elbow, at 90 degree of abduction, flexion and the forearm in external rotation, palm upwards. The shoulder was stabilized at the acromion process with one hand, and the other hand will be used to passively move the arm into internal rotation until the first barrier of motion was reached. The patient was then instructed to perform a 7-10 second isometric contraction of approximately 25% maximal effort in the direction of external rotation, against an opposing force provided at the distal forearm. During this procedure, the patient inhales the air. After a 7-10 second isometric contraction, the patient exhales the air. Following the contraction, the patient will be instructed to internally rotate the arm toward the ground as a 30 second active assisted stretch will be applied. The patient was instructed to relax, and a new movement barrier was then engaged. This protocol was performed for a total of 3 repetitions. (Stephanie D. Moore *et al* 2011). This lengthens the external rotators thus

increasing the internal rotation range of motion (Leon Chaitow, *et al.* 2006; Sonakshi Sehgal, *et al.* 2016; Stephanie D. Moore, *et al.* 2011).

The MET to shoulder was given for 5 repetitions per set for 3 sets and the treatment procedure performed 3 sessions in a week for 8 weeks (Leon Chaitow, *et al.* 2006; Geetha Mounika Rayudu *et al.* 2018) (Fig. 4).

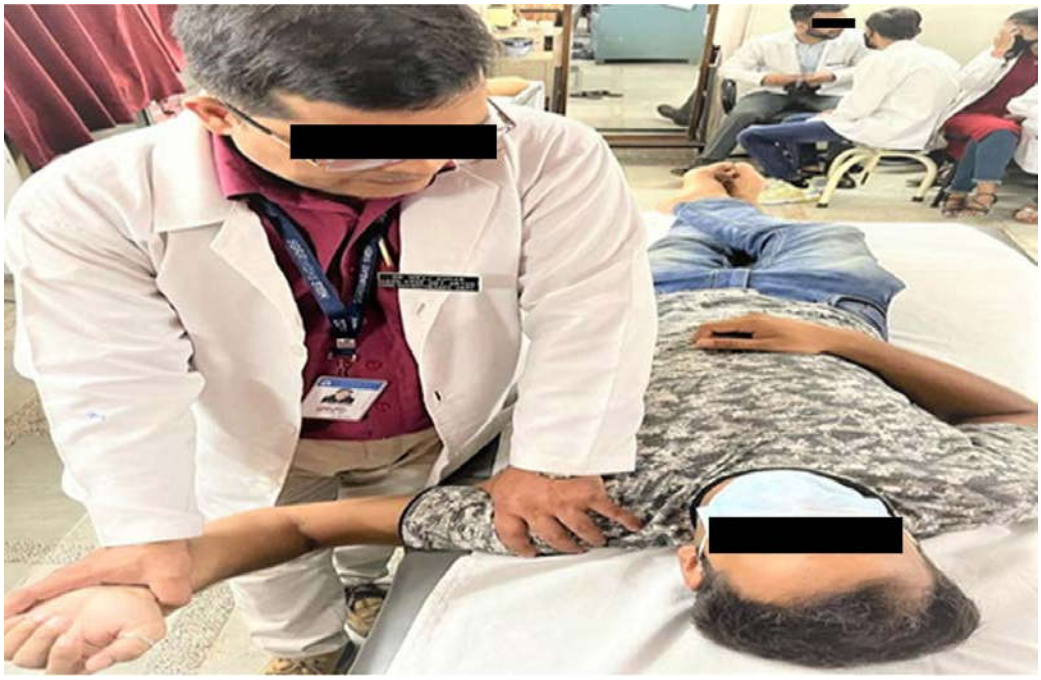


Fig. 4: MET treatment of subscapularis (Internal Rotation)

SHOULDER STABILIZATION EXERCISE

After manual therapy intervention, the exercises were incorporated for the training of shoulder flexors, abductors and external and internal group muscle.

Shoulder Stabilization Exercise for Abductors (Supraspinatus and Middle Deltoid)

1. **Shoulder Stabilization Exercise for Supraspinatus**

Patient will be sitting position. The patient pushing out against the wall. Initially the manoeuvres are done with the shoulder in less than 0 to 10° of abduction (Fig. 5).

2. **Shoulder Stabilization Exercise for Deltoid**

Patient will be sitting position. The patient pushing out against the therapist hand. Initially the manoeuvres are done with the shoulder in above than 90° of abduction (S.B. Brotzman *et al*. 1996; T. M. S kirven, *et al.* 2011) (Fig. 6).

Fig. 5: Shoulder Stabilization Exercise for Supraspinatus

Fig. 6: Shoulder Stabilization Exercise for Supraspinatus and Deltoid (5 & 6).

3. **Shoulder Stabilization Exercise for External Rotators (Infraspinatus, Teres Minor, Posterior Deltoid).**

Patient will be stand with the involved side of his body against a wall or therapist hand. Bend your elbow to 90° and told the patient performed external rotation against the wall. The patient arm should not move (S.B. Brotzman *et al.* 1996; Shoulder Strengthening Exercises 2010).

4. **Shoulder Stabilization Exercise for Internal Rotators (Subscapularis and anterior deltoid)**

Patient will be stand with the involved side of his body against a wall. Bend your elbow to 90° and told the patient performed internal rotation against therapist hand. The patient arm should not move (S.B. Brotzman 1996; American Academy of Orthopaedic Surgeons 2017; T. M. S kirven, *et al.* 2011).

5. **Shoulder Stabilization Exercise for scapular muscles.**

- ***Patient Position and Procedure:*** standing with shoulder flexed 90° and hand supported against a wall. The patient is try to touch the wall by upper trunk.

Progression: have the patient quadruped position with both hands on a stable surface, so that one extremity bears the body weight and stabilizes against the shifting load to increase Serratus activity and lower trapezius activity respectively.

- ***Scapular Elevation/Depression:*** Place your top hand superiorly and the other hand inferiorly around the scapula to provide manual resistance.
- ***Scapular Protraction/Retraction:*** Place your top hand along the medial border and the other around the coracoid process to provide resistance.
- ***Scapular Upward and Downward Rotation:*** Place one hand around inferior angle and the other hand around the acromian and coracoid process to provide resistance (C. Kisner, *et al*. 2018).

The exercise will be performed 8 to 15 repetitions for 3 sets only 5 times/week for 8 weeks. It is performed with 5 to 10 second hold in each repetition a break of 1 min after each set (S.B. Brotzman, *et al.* 1996; Ju-hyun Lee, *et al.* 2018).

Moist Hot Pack (MHT)

The subject will be asked to lie down in a supine position and the shoulder is placed in the neutral position. The hot pack (standard size which had been stored in a hydro collator tank of 74.5-80 °C). Moist heat pack will be wrapped in towel with three to four folds over the affected shoulder. The pack was left in place for 10 to 15 minutes (Dhara N. Panchal, *et al.* 2015; Kumar Neeraj, *et al.* 2016) (Fig. 7).

Fig. 7: Application of Moist Heat Therapy in Shoulder joint

RESULTS

Total 31 patients were included in the study by simple random sampling method. The data were analyzed using the statistical software SPSS 15 version. The result was analyzed by Repeated Measure ANOVA for within group in 0 week, 4 week & 8 week of treatment. Pain was measured by NPRS, Range of Motion was measured by Digital

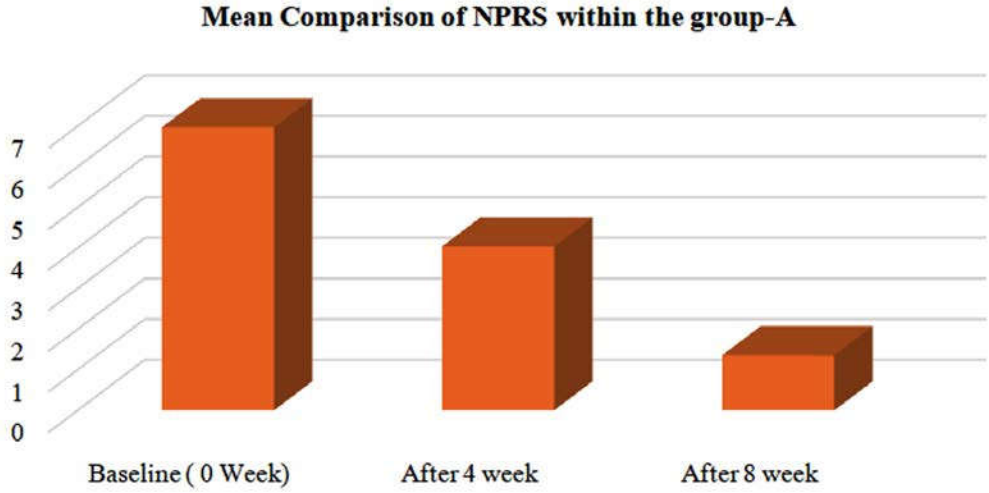
Inclinometer, Shoulder Proprioception was also measured by Digital Inclinometer, Muscle strength was measured by Force Gauge and Quality of Life was measured by WHOQOL.

Measurement of Numeric Pain rating scale within the Group-A:

Analysis of the Numeric pain rating scale within groups was done usingrepeated measure ANOVA test. The differences in NPRS scores from Baseline (0 Week), 4 week & 8 week for Group Ashowed highly significant reduction of pain (p-Value 0.001). (Table 2 & Graph 1).

Table 2: Mean Comparison within Group A of NPR Susing repeated measure ANOVA

Duration	Mean ±SD	F-Value	p- Value
Baseline (0 Week)	6.9677±.98265		
After 4 week	4.0323 ±1.13970	549.750	0.001
After 8 week	1.3548 ±.75491		



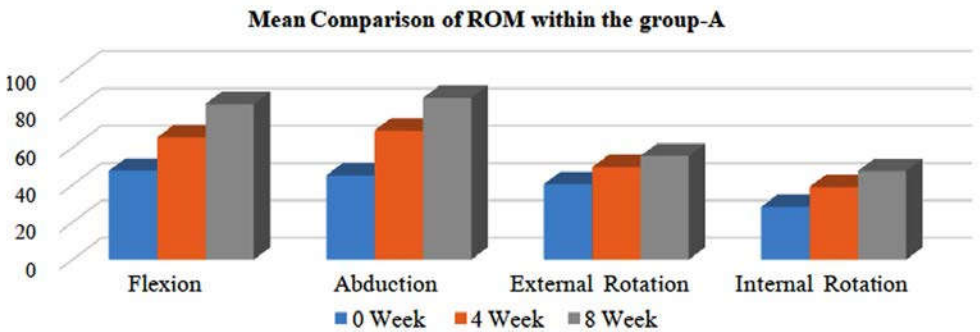
Graph 1: Comparison of Mean NPRS Score within Group A by repeated measure ANOVA

Measurement of Range of Motion scale within the Group-A:

Analysis of the difference in the ROM within groups repeated measure ANOVA test was used. The differences in Flexion, Abduction, External Rotation and Internal Rotation ROM at Baseline (0 Week), 4 week & 8 week for Group C showed highly significant improvement (p-Value 0.001) (Table 3 & Graph 2).

Table 3: Mean Comparison within Group A of RO Musing repeated measure ANOVA

Range of Motion (ROM)	0 Week (Mean ± SD)	4 Week (Mean ± SD)	8 Week (Mean ± SD)	F - Value	p-Value
Flexion	47.4935 ±6.39244	65.4129 ±12.88854	83.3548 ±15.31533	156.075	0.001
Abduction	45.0613±9.10980	69.0968 ±12.32430	86.5323 ±13.36940	128.972	0.001
External Rotation	40.3161 ±3.95416	49.3935 ±5.72503	55.4032 ±5.06883	159.724	0.001
Internal Rotation	28.2097 ±3.73830	38.8484 ±3.41163	47.3806 ±3.45344	622.456	0.001



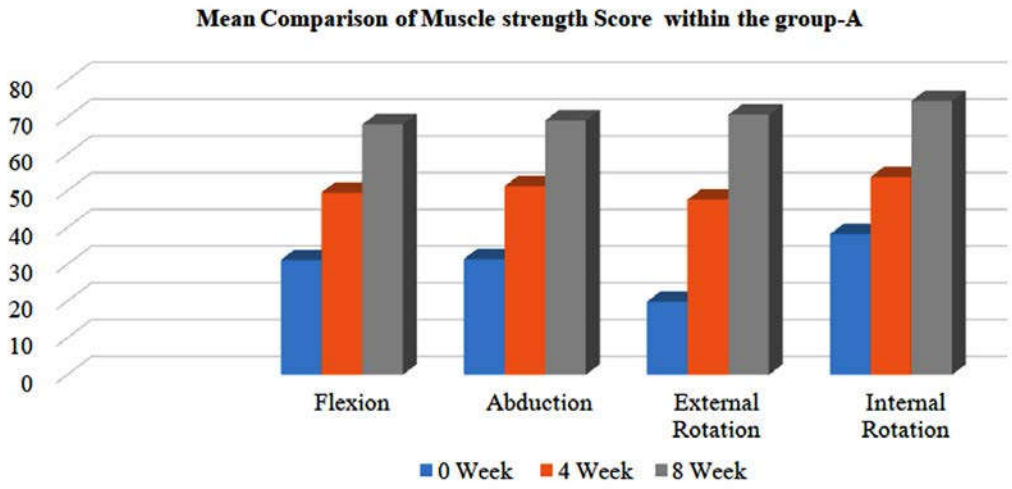
Graph 2: Comparison of Mean ROM within Group A by repeated measure ANOVA

Measurement of Measurement of Shoulder Strength within the Group-A:

Analysis of the difference in the Shoulder Muscle Strength within groups repeated measure ANOVA test was used. The differences in Flexion, Abduction, External Rotation and Internal Rotation Muscle Strength at Baseline (0 Week), 4 week & 8 week for Group A showed highly significant improvement (p-Value 0.001) (Table 4 & Graph 3).

Table 4: Mean Comparison within Group A of Shoulder Muscle Strength using repeated measure ANOVA

Strength Measurement	0 Week	4 Week	8 Week	F - Value	p-Value
	(Mean ±SD)	(Mean ±SD)	(Mean ±SD)		
Flexion	31.2077 ±10.69094	49.5223 ±7.31794	68.0210 ±8.95250	405.385	0.001
Abduction	31.4639 ±11.35258	51.2626 ±7.95710	69.1332 ±7.20782	319.822	0.001
External Rotation	19.8348 ±7.33526	47.5829 ±7.21948	70.6694 ±6.71968	958.858	0.001
Internal Rotation	38.1948 ±9.05161	53.7561 ±4.89439	74.4300 ±6.38854	337.739	0.001



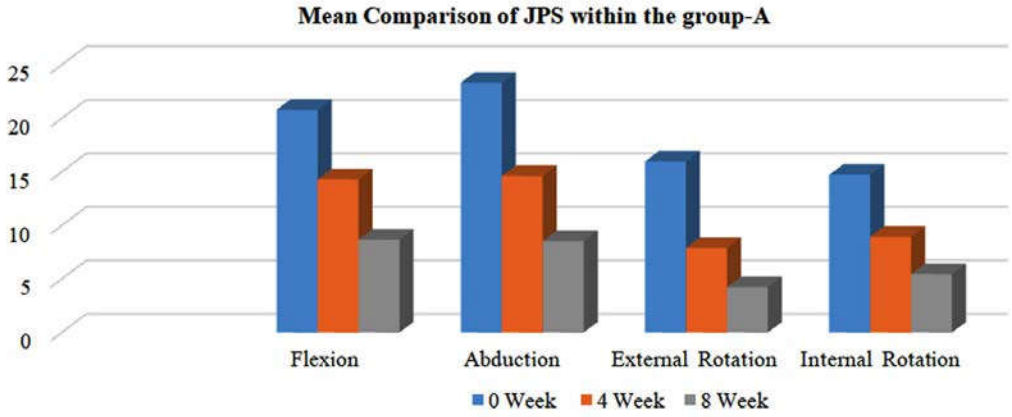
Graph 3: Comparison of Mean Muscle strength Score within Group A by repeated measure ANOVA

Measurement of Joint Position Sense Score within the Group-A

To analyze the difference in the Shoulder JPS within groups repeated measure ANOVA test was used. The differences in Flexion, Abduction, External Rotation andInternal Rotation JPS at Baseline (0 Week), 4 week & 8 week for Group Ashowed highly significant improvement of joint position sense and decrease error of shoulder joint (p-Value 0.001) (Table 5 & Graph 4).

Table 5: Mean Comparison within Group A of JPS using repeated measure ANOVA

Joint Position Sense	0 Week	4 Week	8 Week	F - Value	p-Value
	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)		
Flexion	20.8000 ±4.95775	14.3000 ±3.44564	8.6667 ±2.98656	156.723	0.001
Abduction	23.3226 ±3.53447	14.6129 ±3.90451	8.5161±.3.07540	293.189	0.001
External Rotation	15.9677 ±2.94939	7.9032 ±2.21141	4.2258 ±1.96146	282.470	0.001
Internal Rotation	14.7097 ±3.23722	8.9355 ±2.64494	5.4516 ±2.32148	201.632	0.001



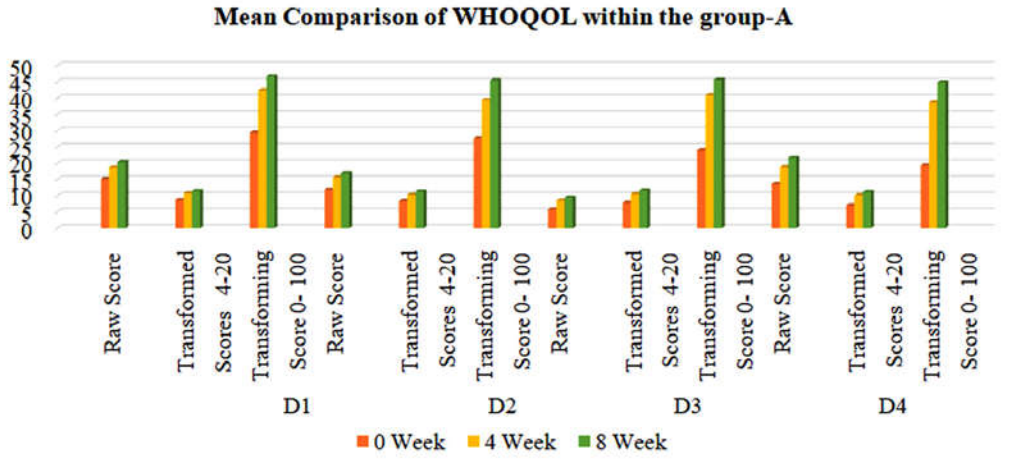
Graph 4: Comparison of Mean JPS Score within Group A by repeated measure ANOVA

Measurement of World Health Organization Quality of Life within the Group-A

Analysis of the difference in the WHOQOL scores within groups repeated measure ANOVA test was used. The differences in D1, D2, D3 & D4 Raw Score, Trans formed Scores (4-20) and Trans formed Scores (0-100) at Baseline (0 Week), 4 week & 8 week for Group C showed highly significant improvement (p-Value 0.001) (Table 6 & Graph 5).

Table 6: Mean Comparison within Group A of WHOQO Lusing repeated measure ANOVA

	Outcome Measures	0 Week (Mean ± SD)	4 Week (Mean ± SD)	8 Week (Mean ± SD)	F – Value	p- Value
	Raw Score	15.1935±2.1824	18.7097±1.50982	20.4194±1.50054	146.963	0.001
D1	Transformed Scores 4-20	8.7097±1.24348	10.7419±.89322	11.4516±.88840	103.406	0.001
	Transforming Score 0-100	29.4516±7.94078	42.3871±5.49350	46.7097±5.33038	107.894	0.001
	Raw Score	11.8710±1.58623	15.6452±1.53945	16.9677±1.35361	136.049	0.001
D2	Transformed Scores 4-20	8.4194±2.48696	10.2903±1.07062	11.2903±.82436	22.236	0.001
	Transforming Score 0-100	27.7097±15.4255	39.4839±6.75214	45.4839±5.07852	22.321	0.001
	Raw Score	5.8065±.98045	8.5161±2.51490	9.4839±3.09700	40.38	0.001
D3	Transformed Scores 4-20	7.8387±1.06761	10.5484±1.65002	11.6452±2.42966	112.785	0.001
	Transforming Score 0-100	24.0000±6.49615	40.9032±10.3773	45.6774±17.92277	62.36	0.001
	Raw Score	13.6452±1.76160	18.8387±3.45540	21.6774±2.15077	128.227	0.001
D4	Transformed Scores 4-20	7.0645±.92864	10.1613±.77875	11.1290±1.05647	324.359	0.001
	Transforming Score 0-100	19.3871±5.57182	38.7419±5.02638	44.8710±6.61182	332.833	0.001



Graph 5: Comparison of Mean WHOQOL Score within Group A by repeated measure ANOVA

DISCUSSION

The aim of this review was to understand the efficacy of MET on pain, ROM. MS. JPS, Anxiety & Depression, Quality of Life and Mindfulness to understand the differences within MET protocols in DFS.

Pain:

Pain was measured by Numeric pain rating scale. To analyze the difference in the NPRS scale within groups repeated measure ANOVA test was used. The difference in NPRS scores from Baseline (0 Week), 4 week & 8 week for Group C (MET), P-value are 0.001. Our study showed statistical improvement in pain score ($P< 0.05$) at 4 week and 8 week of treatment. Muscle energy techniques originally developed by osteopaths are a class of soft tissue manipulation technique which generally involves précisely directed and controlled patient initiated isometric and/or isotonic contractions to improve musculoskel *et al* function or to reduce pain. (Chaitow L, 2006). MET exercises spread synovial fluid stimulate tonically depressed joint mechanoreceptors and reduced pain (Narayan, *et al*. 2014). Muscle energy technique is effective on functional ability of shoulder in Frozen shoulder (Narayana, *et al*. 2014). Stephanie D. Moore in 2011 showed that pain reduction by MET was due to centrally mediated pain in hibitory mechanism and neuronal mechanism in dorsal horn is by neurological and tissue factors such as stimulation of low threshold mechanoreceptors which leads to possible gating effects and effect of rhythmic muscular contraction on interstitial and tissue fluid flow (Stephanie D. Moore 2011). MET improve the circulation and lymphatic flow and reduce pain (Joshua A. Waxenbaum, *et al* 2020).

Range of Motion (ROM)

Range of Motion was measured by Digital Inclinometer. To analyze the difference in the Flexion, Abduction, External Rotation & Internal Rotation ROM within groups repeated measure ANOVA test was used. The difference in ROM scores from Baseline (0 Week), 4 week & 8 week for Group-C (MET), P-value are 0.001. Our study showed statistical improvement in ROM score in the Flexion, Abduction, External Rotation & Internal Rotation ROM ($P< 0.05$) at 4 week and 8 week of treatment. Ewan Thomas, *et al.* 2019 stated high intensity contraction of MET could produce post synaptic inhibitory mechanisms, resulting in lower excitation of the cortical and α-motor neurons, thereby modulating stretch perception and increase that ROM and increased stretch tolerance. Stephanie *et al* (2011) stated muscle energy technique for the glenohumeral joint given immediate improvement in GHJ horizontal adduction and internal rotation ROM in asymptomatic collegiate baseball players. The increased active range of motion following MET may be due to various factors like neural, viscoelastic and thixotropic properties. After application of MET, musculo tendinous junction acts in a viscoelastic manner and lead to the properties of creep and stress relaxation (Geetha Mounika Rayudu *et al*. 2018). MET is effective in increasing the ROM of the glenohumeral joint. According to Chaitow L, 2006 the physiological mechanisms behind the changes in muscle extensibility produced by MET are reflex relaxation, viscoelastic or muscle property change, and changes to stretch tolerance a change to tolerance to stretching is most supported by the scientific literature (lean Chaitow). These mechanisms bring about a change in muscle physiology and hence lead to increased ROM at the joint. (Sonakshi Sehgal, *et al.* 2016). According to Lean Chaitow the physiological mechanisms behind the changes in muscle extensibility produced by MET are reflex relaxation, viscoelastic or muscle property change, and changes to stretch tolerance a change to tolerance to stretching is most supported by the scientific literature (lean Chaitow). These mechanisms bring about a change in muscle physiology and hence lead to increased ROM at the joint. (Sonakshi Sehgal *et al*. 2016).

Muscle Strength

Muscle Strength was measured by Lutron Force Gauge. To analyze the difference in the Flexion, Abduction, External Rotation & Internal Rotation Muscle Strength within groups repeated measure ANOVA test was used. The difference in Muscle Strength from Baseline (0 Week), 4 week & 8 week for Group C (MET), P-value are 0.001. Our study showed statistical improvement in Muscle Strength score in the Flexion, Abduction, External Rotation & Internal Rotation ($P< 0.05$) at 4 week and 8 week of treatment. MET lengthens and strengthens muscle by changing the viscoelastic property of the muscle, decreases local edema and reduces adhesions. (Ballantyne F, 2003). Roberts indicated the effects of MET as decreased pain, increased range of motion, decreased muscle tension and spasm, and increased strength. Another study by, Greenman (1989) depicts that Muscle Energy Technique helps

to regain the mobility of the hypomobile joints by restoring normal length tension relationships which are shortened and by strengthening the weakened muscles and reduce edema by pumping action for lymphatic system (B. Chakradhar Reddy, Santosh Metgud, 2014).

Joint Position Sense Score (JPS)

Joint Position Sense Score (JPS) was measured by Digital Inclinometer. To analyze the difference in the Flexion, Abduction, External Rotation & Internal Rotation JPS within groups repeated measure ANOVA test was used. The difference in JPS scores from Baseline (0 Week), 4 week & 8 week post intervention for Group C (MET), P-value are 0.001. Our study showed statistical improvement in JPS score in the Flexion, Abduction, External Rotation & Internal Rotation and decrease the error of JPS ($P< 0.05$) at 4 week and 8 week of treatment. MET may also have physiological effects & involve a variety of neurological and biomechanical mechanisms that altered proprioception, motor programming and changes in tissue fluid that decrease the error of JPS (Fryer G. *et al*, 2003).

Quality of Life

Quality of Life was measured by WHOQOL. To analyze the difference in the QOL within groups repeated measure ANOVA test was used. The difference in QOL scores from Baseline (0 Week), 4 week & 8 week for Group C (MET), P-value are 0.001. Our study showed statistical improvement in QOL score ($P< 0.05$) at 4 week and 8 week of treatment.

The term frozen shoulder refers to a common shoulder condition characterized by the global restriction in the shoulder range of motion in a capsular pattern. The capsular pattern in the shoulder is characterized by most limitation of passive lateral rotation and abduction. Neviaser called it adhesive capsulitis, as he, under arthroscopy, observed that the capsule looked thickened and adhered to underlying bone and could be peeled off from the bone (Rizwan Haider *et al*. 2014).

In our study we used numerical pain rating scale (NPRS) for measurement of pain in Diabetic Frozen Shoulder Patients. Childs J *et al* in 2005 did study on responsiveness of the Numeric Pain Rating Scale in Patients with Low Back Pain. The NPRS shows adequate responsiveness for use both in the clinical and research settings. They found out that a two points change in NPRS represented clinically and meaningful changes in pain levels, though there were not much statistically significant difference. (Childs J *et al*, 2005).

In this study we found that in MET there are significantly increase joint AROM of Shoulder Joint than control group. Range of motion is the capability of a joint to go through its complete spectrum of movements. Measurement of range of motion can be used to evaluate available motion, determine joint stability, and determine soft tissue elasticity as well as response to therapy over time. Sandra Hudson, (2009). In our study for measure the joint ROM of shoulder joint we used Digital Inclinometer. Digital inclinometer is used for measuring active shoulder (Morey J. Kolber, *et al*. 2012).

In this study we found that in MET there are significantly increase muscle strength of Shoulder Joint than control group. J. Sokk, H. Gapeyeva, *et al*. 2007 stated Frozen shoulder syndrome (FSS) is typically characterized by shoulder pain, a limited range of motion (ROM) and gradual loss of strength of the shoulder muscles. 4 week individualized rehabilitation on shoulder muscle function in patients with FSS. There are significant changes in shoulder muscle strength. (J. Sokk, H. Gapeyeva, *et al.* 2007).

In this study we found that in Muscle Energy Technique (MET), there are decrease of error of Shoulder Joint proprioception. Amanda L. Ager, *et al*. 2017 stated that shoulder Joint proprioception is essential for the optimization of shoulder neuromuscular control throughout the movement, yet continues to be a quantitative challenge today. Due to the lack of standardization of proprioception terminology and complexity of evaluation methods, it remains an area of psychometric contention. The purpose of this systematic review was to identify and summarize the current methods used for quantifying shoulder proprioception, specifically JPS and kinesthesia. Although shoulder proprioception impairment is very important to evaluate and treat during rehabilitation, the protocols currently being used have not been thoroughly psychometrically tested. A proprioceptive outcome that is being used in a clinic without known psychometric qualities can lead to erroneous clinical decisions and provide a false impression that an evidence based approach is being used (Amanda L. Ager, *et al*.2017).

In our study Muscle Energy Technique (MET), Stabilization Exercise and Moist Heat Therapy (MHT) showed greater improvement pain, range of motion, muscle strength decrease error of

shoulder joint proprioception. When we compared with Mean ± SD it was found that 0 week showed insignificant, 4 weeks showed significant and 8 weeks showed highly significant in diabetic frozen shoulder patients.

CONCLUSION

Our study concluded that Muscle Energy Technique (MET), Stabilization Exercise and Moist Heat Therapy (MHT) in Patients with Diabetic Frozen Shoulder showed significant improvement in pain, Range of motion, muscle strength and joint sense in 4th weeks & 8th weeks of treatment programme p values (<0.05).

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