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Efficacy of Muscle Energy Technique Versus Conventional Treatment on Pain, Range of motion, Functional Disability and Quality of Sleep in Patients with Idiopathic Adhesive Capsulitis

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Abstract-

Background: *A common musculoskeletal disorder is defined as a condition in which inflammation of the joint capsule that preserves the glenohumeral joint which will give rise to pain, stiffness, along with tightness during movement of glenohumeral joint.*

Aim: *To evaluate the efficacy of Muscle Energy Technique (MET) along with conventional treatment and conventional treatment alone on pain, range of motion (ROM), functional disability and quality of sleep in adhesive capsulitis patients.*

Materials and Methods: *26 participants were included. Patients were segregated into 2 groups Group A and Group B. Both male and females were included of 40-60 years of age, 2nd and 3rd stage of idiopathic adhesive capsulitis, unilateral shoulder condition, having painful stiff shoulder for at least 3 months. Group A received MET along with conventional treatment and Group B received conventional treatment. Pre intervention measurements was taken on day 1 before treatment and post intervention measurements was taken on day 21 after treatment for pain, ROM, functional disability and quality of sleep. The study protocol has been endorsed by the Institutional Ethics Committee of Saket College of Physiotherapy, Chandimandir, Panchkula. The study is registered under Clinical Trials Registry- India with Registration No. CTRI/2024/02/062932.*

Result: *T-test was used for within group analysis and for between group analysis was done. Non parametric test were used. There is a significant reduction in pain, augment in shoulder ROM, reduces functional disability and improves quality of sleep. (P<0.05)*

Conclusion: *This study concludes that the two treatment method MET along with conventional and conventional treatment alone was effective. However MET along with conventional treatment was shown better result for reducing pain, augmenting ROM, reducing functional disability and improving quality of sleep.*

Keywords: *Conventional treatment, Idiopathic adhesive capsulitis, Muscle energy technique*

INTRODUCTION-

Adhesive capsulitis is a common musculoskeletal disorder [1]. Based on the finding in 1945 it was Neviaser who coined the term adhesive capsulitis and also has been known by other names as periarthritis of shoulder proposed by Duplay, periarthritis scapulae by Charnely and the term frozen shoulder coined by Codman [2].

The shoulder joint is extremely a complex joint in a human body as a number of articulations are necessary to place the humerus in space. Shoulder is ball and socket variety joint with a greatest remarkable range of motion (ROM) which is essential for many daily living activities and sports. When associated with pain, inclusive decline in both active and passive shoulder ROM because of the development of adhesions to the glenohumeral joint capsule and is referred as adhesive capsulitis [1].

It is defined as a condition in which inflammation of the joint capsule that preserves the glenohumeral joint give rise to pain, stiffness, along with tightness during shoulder movement [3]. It is characterized as a painful disabling condition in which adherence of axillary recess and also biceps tendon,

thickening of the synovial capsule, destruction of axillary fold secondary to adhesion which will give rise to subtle and gradual loss of both active and passive ROM of glenohumeral joint [4].

The prevalence of adhesive capsulitis is 2-5% in general population affecting individuals within the age group 40-60 years [3]. Females (45.70%) are highly prevalent than males (20.07%). In diabetic and non-diabetic population dominant side is more common (80%) [5]. Individuals carrying repetitive activities at this age usually spends most of the time being working therefore increases the chances of chronic trauma and in time causes symptoms of adhesive capsulitis [3].

The pathogenesis of adhesive capsulitis is not clear but it has been proposed that adhesive joint capsule, axillary recess and contracted soft tissues around the joint, are the hallmark which impairs the shoulder movements [6]. Primary and secondary frozen shoulder has sustained inflammation and fibrosis leading to elevated level of cytokines including interleukin (IL) - 1a, IL- 1b. Type I and Type III collagen are released when there is excessive accumulation of fibroblast via inflammatory healing.

Fibroblasts are usually responsible for capsular contraction when they transform into smooth muscle phenotype 2 (myofibroblasts) [7]. External rotation and abduction are usually affected movements of the shoulder joint and is restricted by coracohumeral ligament which is generally contracted. In resting position arm is usually held in adduction and medial rotation whereas scapula in upward direction, and rotated externally [8], [9], [10]. Frozen shoulder is categorized as primary and secondary frozen shoulder. Primary frozen shoulder is also called idiopathic (unknown reason) frozen shoulder. The etiology is unclear without any history of trauma [11]. Secondary frozen shoulder (known disorders) is divided into systemic, extrinsic and intrinsic frozen shoulder. Systemic is more common in diabetes mellitus, hyperthyroidism, hypothyroidism, hypoadrenalism patients is because of underlying systemic connective tissue disease processes [12].

Adhesive capsulitis is classified into 3 stages: Stage 1: painful or freezing stage, it lasts for 36 weeks. Pain, discomfort which typically occurs at night and ranges of shoulder begins to restrict at this stage. Stage 2: transitional or frozen stage, it lasts for 4 to 12 months. Pain may decrease but stiffness persists and progressive restriction in all ranges of shoulder joint. Stage 3: it lasts from for 12 to 42 months and is known as thawing stage, improvement in shoulder ROM which slowly decreases stiffness [13].

Common risk factors of adhesive capsulitis are with increasing age, most common in females, diabetes mellitus, thyroid dysfunction, hypercholesterolemia, and hypertension. Therefore Adhesive capsulitis is highly prevalent in both males and females with diabetes mellitus [14].

Shoulder joint capsule adhesions are reversible in acute stage, whereas regaining of ROM is minimal in chronic stage. By the time patients affected with unilateral shoulder pain experience disability in activity of daily living and further progression leads to compensatory movements of trunk and shoulder girdle [15].

Adhesive capsulitis individuals having difficulty in functional activities of daily living leading to limitation of social activities [16], and it also signifies that melatonin level which ranges high during, night and early morning, further triggers inflammatory response which acts as mediator aggravate pain, yields joint stiffness specially during the freezing stage which results in exceptional decrease in sleep with expanded night time arouse and the patient was not able to lie on affected side, thus compromised with mood, musculoskeletal pain, quality of life, and overall well-being. Sleep is an integral part of life for everyone. Below standard quality of sleep influences the normal circadian rhythm [17]. As per literature searched we could not found any interventional study on adhesive capsulitis in which quality of sleep was taken care of. In this study we focused to evaluate the quality of sleep in adhesive capsulitis patients while using Pittsburg sleep quality index (PSQI) questionnaire and will try to fill this gap of knowledge.

MATERIAL AND METHODOLOGY

This study is pre-post experimental study design. In this study, participants were assessed on the basis of inclusion and exclusion criteria for the participation and written informed consent was taken. Demographic details of the participants were taken. The study was ethically endorsed by the Institutional Ethics Committee of Saket College of Physiotherapy, Chandimandir, Panchkula. CTRI registration no for the study is CTRI/2024/02/062932. The sample size was 26 for the study (n= 13 in each group) which was calculated by formula [18] $n= N (Z_\beta + Z\alpha_{/2})^2 / ES^2$

Where N = Number of groups (N =2, since there are two groups), Z_β = Desired power (Typically 0.84 for 80 percent power), $Z\alpha_{/2}$ = Measure of statistical significance (Typically 1.96 at 95% confidence interval), ES^2 = Effect size (Cohen's standard effect size 1.1) Convenient sampling method was used. The sample was collected from college rehabilitation centre Saket College of Physiotherapy, Panchkula; Mother Teresa Saket Orthopedic Hospital, Panchkula and Civil Hospital, Panchkula.

Inclusion Criteria: Both male and female were included of 40-60years of age [1], 2nd and 3rd stage of idiopathic adhesive capsulitis [14], [20], capsular pattern restriction [19], unilateral involvement [1], stiff and painful shoulder at least for 3 months [2].

Exclusion criteria: Severe trauma related to painful stiff shoulder[20], fracture of the shoulder complex[21], rotator cuff tendinitis [21], presence of neurological disorders of upper extremity[21], previous surgery of the shoulder [21], diabetes [22].

NPRS Scale [23]- For pain intensity NPRS was used. This scale was numbered from 0 to 10, where 0 represents no pain, 5 with moderate pain and 10 with the most severe pain.

ROM [24] - All ranges of shoulder was measured while using digital goniometer (in degrees).

Shoulder Pain and Disability Index (SPADI) Questionnaire [25]

SPADI set of questions contains one component of pain and other component of functional activity. There are 5 questions related to pain and there are 8 questions related to functional activities that are related to individual having difficulty in activity of daily living. For pain: 0=no pain and 10= worst pain ever. For functional activities: 0 = no difficulty during daily activities and 10 = it is so difficult that it requires support.

Pittsburg Sleep Quality Assessment [26]

19 self-report questions were included in the PSQI, each having an ordinal class ranging from 0 to 3, where 0 represents no problem while sleeping and 3 with poor quality of sleep.

Group A (MET) - Hot Pack [20]

The patient was positioned in supine. Before the intervention, a hot pack was wrapped in a towel and placed on the affected shoulder for 10–15 minutes.

MET for reduced shoulder flexion: The patient was in a supine position, and the therapist stood on the testing side. The scapula and clavicle were stabilized with the therapist's upper hand, while the other hand grasped the patient's forearm. The therapist then passively moved the shoulder into flexion and instructed the patient to draw the elbow toward the floor using no more than 20% of available strength. This effort was maintained for 7–10 seconds, after which the patient was asked to relax and exhale. The therapist then moved the shoulder further into flexion.

MET for Reduced Shoulder Abduction:

The patient was positioned in supine lying, and the therapist stood on the testing side. The scapula and clavicle were stabilized with the therapist's upper hand, while the other hand grasped the patient's forearm. The therapist then passively guided the shoulder into abduction and asked the patient to draw the elbow toward the floor using no more than 20% of available strength. This contraction was sustained for 7–10 seconds, after which the patient was instructed to relax while exhaling. The therapist then gently increased the range of abduction.

MET for Reduced Shoulder External Rotation:

The patient was positioned in supine lying, and the therapist stood on the affected side. The scapula and clavicle were stabilized with the therapist's upper hand, while the other hand grasped the patient's forearm. The arm was abducted to 90°, with the elbow flexed to 90° and the forearm positioned in external rotation, the fist facing upward, and the entire arm resting at the motion barrier. The therapist applied minimal resistance for 7–10 seconds while the patient attempted to raise the forearm slightly. With gentle support, the therapist then guided the arm further into external rotation and held the stretch for 30 seconds. Each MET was performed for 5 repetitions per set, with 5 sets per session [20].

Conventional treatment-

Capsular stretch [27]

For Anterior capsule: Position of patient on side with the impacted arm to the top and the arm was guided backward into extension while maintaining this stretch for 30 seconds.

For Posterior capsule

Patient position was lying on back. The therapist takes the impacted arm in the direction of upgrading in excessive elevation. Maintain this counterforce at patient sternum to stop extension of spine and hold this for 30 seconds.

For Inferior capsule

The patient was positioned in supine lying, and the therapist moved the testing arm into extreme elevation, maintaining the position for 30 seconds while counterbalancing the patient's sternum to prevent spinal extension. For a global capsular stretch, 3 repetitions were performed with a 30-second hold each.

Codman's pendular exercises [20]

Patient was in standing with spine flexed at the buttocks about 90 degrees or may lie in prone lying. The arms were freely swinged downward in between 60 and 90 degrees of elevation and swinging freely into one direction to another. All shoulder flexion, extension, abduction, adduction and circumduction motions were performed. (5 repetitions per set, 3 sets per session)

Finger ladder exercises [20]

Patient position was in standing facing the ladder which is suspended on a wall. At a low level the affected hand is placed on the ladder by the patient. Then slowly there was an upward climb on the ladder until reached to top and then slowly coming down to starting position.

(5 repetitions per set, 3set per session)

Active and passive shoulder flexion in supine lying
Active and passive shoulder abduction in supine lying
Active and passive shoulder medial rotation in supine lying

Active and passive shoulder lateral rotation in supine lying

Self-stretching exercises [28]

For improving flexion and horizontal adduction: Patient was positioned in sitting. Therapist asks the patient to adduct the shoulder horizontally by placing the arm over chest and then applying sustained overpressure to the adducted arm by pulling the arm towards the chest, without rotating trunk.

For improving lateral rotation: Patient was positioned in standing and facing a door frame with the wrist against the edge of the frame, 90 degrees flexed elbow. While placing arm against the side or it can be in slight abduction. Therapist asks the patient to turn away from fixed hand on the door frame and holds it for 10 seconds.

For improving medial rotation: Patient was positioned in high sitting and from the back grasps the towel using both hands. The patient grasps the towel from behind the neck through affected side and tries to pull the towel from unaffected arm which was behind the lower back and holding it for 10 seconds.

For improving abduction: patient was positioned next to the side of the couch in sitting positioned while forearm in supination. Therapist asks the patient to slide the arm across the couch and head was put down towards the arm and thorax moves away from the couch holding it for 10seconds. The above said self stretching exercises were repeated 10 times for each movement with a rest period in between and with 10 seconds hold.

Figure 1 showing MET for shoulder flexion

Figure 2 showing MET for shoulder abduction

Figure 3 showing MET for external rotation

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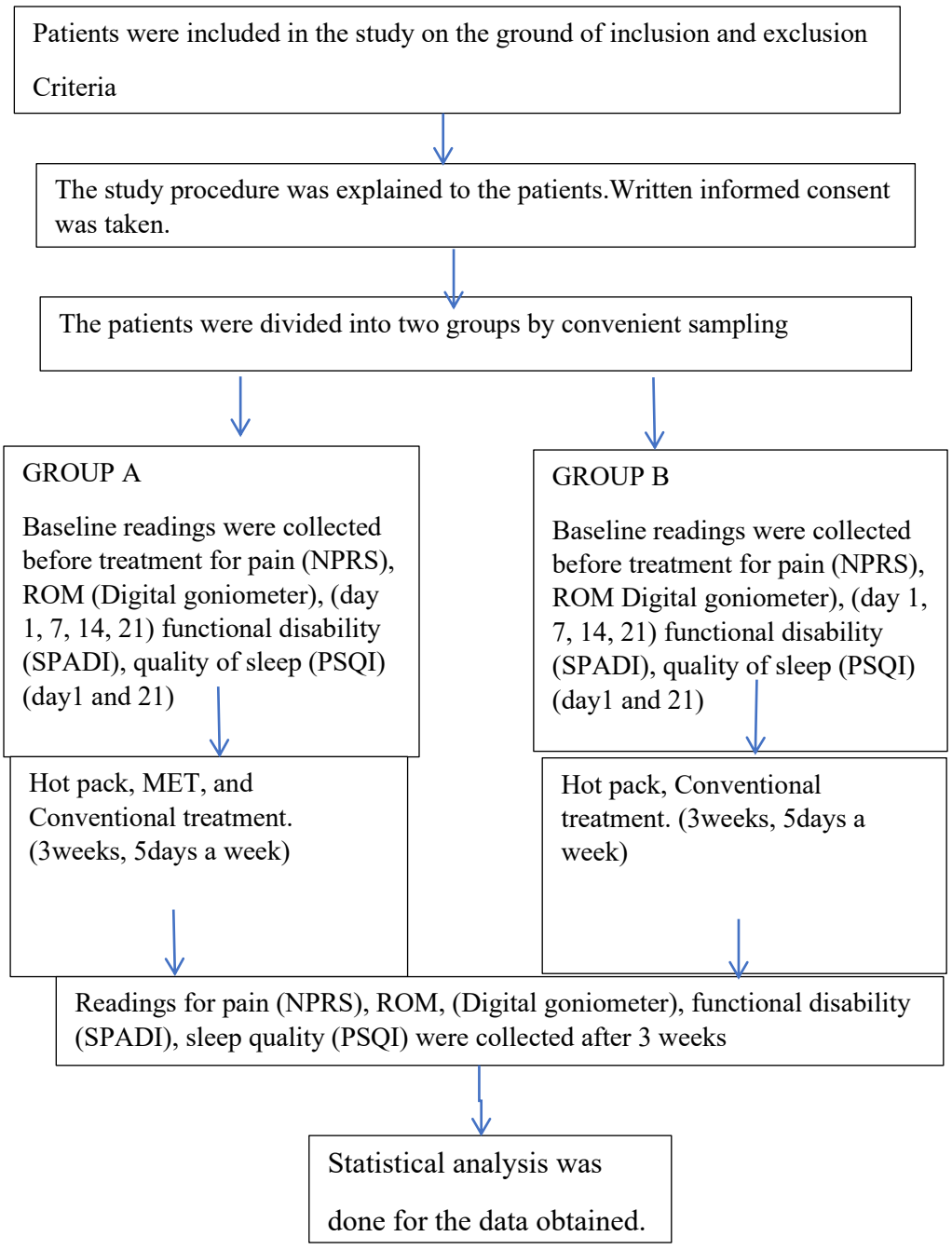
FLOW CHART OF THE STUDY



STATISTICAL ANALYSIS

SPSS software version 22 was used to analyze the data, and appropriate statistical test were used. The variables observed were age, gender, affected hand, ROM of shoulder, SPADI and PSQI. The characteristics of data will be presented through tables. Normality of data was evaluated by Kolmogorov- Smirnov test.

Homogenity of data was analyzed using levene's tests. Descriptive statistics was used for this research study to calculate mean and standard deviation (SD). T-test was used for between group analysis and for within group analysis. Non parametric test (Mann-whitney and Wilcoxon Signed Rank test) were used for between group analyses.

40 years was the minimum age and maximum was 60 years of age. Showing comparison of age for both the groups. Unpaired t test was used. Before the intervention the mean pain intensity was 7.38 and 7.54 in group A and B respectively.

For all active shoulder ROM digital goniometer were used.

With group analysis shows significant difference in all ranges of shoulder movements on 7, 14 and 21 day in both groups.

Within group analysis of shoulder flexion revealed significant difference in group A "p" value are on day 7 (.001**), day 14 (.001**) and on day 21 (.001**) and the mean score before treatment was (76.15), on day 7 (94.62), on day 14 (109.62) and on day 21(124.85).

Within group analysis of shoulder flexion revealed significant difference in group B "p" value are on day 7 (.001**) , day 14 (.001**) and on day 21 (.001**) and the mean score before treatment was (76.54), on day 7 (84.62) , on day 14 (91.15) and on day 21(98.62).

Within group analysis of shoulder extension revealed significant difference in group A "p" value are on day 7 (.001**), day 14 (.002**) and on day 21 (.002**) and the mean score before treatment was (28.46), on day 7 (34.23), on day 14 (38.85) and on day 21 (41.31).

Within group analysis of shoulder extension revealed significant difference in group B "p" value are on day 7 (.001**) , day 14 (.001**) and on day 21 (.002**) and the mean score before treatment was (27.08), on day 7 (31.77) , on day 14 (35.15) and on day 21 (37.31).

Within group analysis of shoulder abduction revealed significant difference in group A "p" value are on day 7 (.001**) , day 14 (.001**) and on day 21 (.001**) and the mean score before treatment was (48.46), on day 7 (63.85) , on day 14 (80.38) and on day 21 (102.69).

Within group analysis of shoulder abduction revealed significant difference in group B "p" value are on day 7 (<.001**) , day 14 (.001**) and on day 21 (.001**) and the mean score before treatment was (40.77), on day 7 (46.15) , on day 14 (52.15) and on day 21 (58.54).

Within group analysis revealed significant difference for shoulder external rotation in group A "p" value are on day 7 (<.001**), day 14 (<.001**) and on day 21 (<.001**) and the mean score before treatment was (18.69), on day 7 (23.92), on day 14 (30.08) and on day 21 (35.31).

Within group analysis revealed significant difference for shoulder external rotation in group B "p" value are on day 7 (.001**) , day 14 (.001**) and on day 21 (.001**) and the mean score before treatment was (19.23), on day 7 (25.08) , on day 14 (31.23) and on day 21 (36.08).

Within group analysis of shoulder internal rotation revealed significant difference in group B "p" value are on day 7 (.001**) , day 14 (.001**) and on day 21 (.001**) and the mean score before treatment was (14.31), on day 7 (18.46) , on day 14 (21.69) and on day 21 (24.54).

The results also specified that within group changes in group A and B were significant on day 21 and shows significant reduction in functional disability from day1 to day 21. The post treatment values of mean score (21.00) in group A which was lower than group B mean score (40.85).

Both groups A and B show significant recovery with a p-value (.001). The results also specified that within group changes in group A and B were significant on day 21 and shows significant improvement in sleep quality from day1 to day 21. The post treatment values of mean score (5.54) in group A were lower than group B mean score (7.00)

Table 1 representing groups along with mean

Groups (n=13)	Mean	SD	P-value	T-value
A	48.76	5.80	0.395	0.867
B	50.76	5.96		

Table 2 representing NPRS and Shoulder ROM

Groups	Pain		**Day1**	**Day7**	**Day14**	**Day21**	**Z-value**	**P-value**
A	NPRS	**Mean**	**7.38**	**6.00**	**4.46**	**3.23**	**-3.418**	**.001***
		SD	.961	1.080	1.127	1.235		
B	NPRS	Mean	7.54	6.46	5.46	4.54	-3.464	.001**
		SD	1.198	1.330	1.330	1.330		
	ROM		**Day1**	**Day7**	**Day14**	**Day21**	**t-value**	**P-value**
A	Shoulder flexion	Mean	76.15	94.62	109.62	124.85	-6.954	.001*
		SD	18.947	17.376	16.389	19.608		
B	Shoulder flexion	Mean	76.54	84.62	91.15	98.62	-8.074	.001*
		SD	32.812	34.36	35.009	34.746		
A	Shoulder extension	Mean	28.46	34.23	38.85	41.31	-2.264	.024
		SD	7.742	6.723	5.460	4.151		
B	Shoulder extension	Mean	27.08	31.77	35.15	37.31	-2.333	.020
		SD	7.376	6.379	6.012	4.837		
A	Shoulder abduction	Mean	48.46	63.85	80.38	102.69	-3.190	.001

		SD	16.506	18.161	19.944	25.545		
B	Shoulder abduction	Mean	40.77	46.15	52.15	58.54	-3.353	.001
		SD	17.181	16.727	16.567	17.352		
A	Shoulder external rotation	Mean	18.69	23.92	30.08	35.31	-7.579	<.001
		SD	4.626	5.965	6.601	6.183		
B	Shoulder external rotation	Mean	13.62	17.69	21.00	24.23	-6.882	<.001
		SD	4.331	4.608	5.148	4.675		
A	Shoulder internal rotation	Mean	19.23	25.08	31.23	36.08	-3.240	.001
		SD	4.935	7.488	6.942	6.739		
B	Shoulder internal rotation	Mean	14.31	18.46	21.69	24.54	-3.108	.002
		SD	5.407	5.425	5.893	5.060		

Table 3 representing SPADI and PSQ

			Day1	Day21	T-value	P-value
A	SPADI	Mean	67.23	21.00	15.332	<.001
		SD	5.73	8.18		
B	SPADI	Mean	75.15	40.85	16.351	<.001**
		SD	9.48	11.69		
A	PSQI	Mean	12.46	5.54	-3.194	.001**
		SD	1.561	1.854		
B	PSQI	Mean	12.69	7.00	-3.194	.001**
		SD	1.032	1.780		

DISCUSSION

The study aimed to see the effectiveness of two treatment MET along with conventional treatment and conventional treatment alone on pain, ROM, functional quality, and quality of sleep in adhesive capsulitis patients. The outcome measures were pain measured by NPRS, ROM measured by digital goniometer, functional disability by a set SPADI, and quality of sleep measured with the help of PSQI. Before the intervention the mean pain intensity was 7.38 and 7.54 in group A and B respectively.

These findings implies that there were no significant difference in pain intensity before the intervention for both the groups, this also further indicates that both groups experience similar level of pain at the baseline. After the intervention the pain intensity shows a significant difference on day 7, day 14 and day 21 in both the groups.

Fryer G. et al. (2011) concludes that the significant improvement in group A because of the applying MET. There is a depletion in proinflammatory cytokines and also desensitizes the peripheral nociceptors. The affected blood flow and lymphatic flow rates may lead to rhythmic muscle contraction and implies changes in the interstitial pressure thus increasing in the transcapillary blood flow [29].

Hot pack shows significant improvement in both groups can be because of central effect of non-noxious skin warming which helps in preparing the joint for treatment and increasing blood flow and extensibility by reducing muscle guarding [30].

Williams & Wilkins L. (2010) suggested that the detection of prolonged change in tension in the golgi tendon organs. This claims that an augment in impulses which travels from the muscle spindle to the posterior horn cell (PHC) of the spinal cord and anterior horn cell (AHC) also pass on an augment in motor impulses to the muscle fibres, therefore give rise to preservative tension which hold against the to stretch. The golgi tendon organs senses the increased tension which was further maintained for few seconds. Extended muscle stretch will augment overall stretching potential because of the conservative relaxation of the golgi tendon organ which reverses the preventative contraction. The spinal cord gives neurological feedback to the muscle after a sustained which further claims that Post isometric relaxation (PIR), found a reduction in tone of the contracted muscle [31].

Chaitow S. et al. (2023) quoted that for primary treatment muscle stretching is the basic procedure. Around the restricted or tight joint muscles loosens which further calms, comforts, the joint. This also shows that MET intervention to the targeted muscle results in increased myoelectric activity [32].

Decreased pain and augmented shoulder ROM implies improvement in functional activity of patients thereby reducing SPADI score.

The rationale behind this technique is to bring on the rheological changes in synovial fluid, and thereby increasing the interchange of fluid between the synovial tissue and in cartilage matrix, which further changes the synovial fluid. This promotes the supply of nutrition, and also helps to take steps towards healing, however upgrades shoulder functions in both the groups [33].

Naryana et al. said that there is a significant changes due to MET that relaxes and improves biomechanics and also concludes that MET was very effective for improving function of shoulder joint and also shows better SPADI when compared to the groups meanwhile only treated with conventional treatment [34].

The results of this study were supported by Ian Johnson (2002) evidence that there is a reduction in pain, augment ROM, and improve disability in elderly patients by post-isometric muscle relaxation [35].

Adhesive capsulitis patients have higher score in connection with persistent sleep efficiency, disrupted sleep PSQI subcategories and overall score of PSQI in correspondence to healthy ones [36]. Thus poor

sleep quality has a remarkable effect on normal circardian rhythm. Eventually nocturnal pain and sleep disturbances is common in adhesive capsulitis patients. Disturbed sleep is related to the elevated levels of proinflammatory and pain relate to cytokines [36]. This is further said by Ha et al. that during night and early morning melatonin rises which activates the inflammatory response and acts as mediator, further provokes pain complaint during night [17].

Further it was quoted by Bhagade et al. in correlation study on 60 patients of adhesive capsulitis that sleep disturbances is connected to pain, activities of daily living, and overall well being. It is also related to the physical problems, spirit, tiredness, bodyache, and social functioning [16]. Temperature regulation is an important aspect for the maintenance of the core body temperature. Modulation in core body brought about by active exercises or passively by warm bath, blankets. Further core body temperature responds to circadian rhythm. Later on enhances the mental health, and restores the body [37]. Horne et al found the positive relationship between the sleep and exercises [38]. All of these factors elucidate that the importance of relieving pain improves the quality of sleep in patients who have adhesive capsulitis.

CONCLUSION

The study shows that the two treatment method MET along with conventional and conventional treatment alone were effective. However MET along with conventional treatment was shown better result in decreasing pain, improving ROM, improving functional disability and quality of sleep.

LIMITATIONS

1. A relatively small sample size.

2. Treatment time could be more.

RECOMMENDATIONS FOR FUTURE RESEARCH

1. Studies may include larger sample size.

CONFLICT OF INTEREST-None

FINANCIAL SUPPORT: Nil

PRACTICAL IMPLICATIONS: We can use MET along with conventional treatment in our day to day practice to reduce pain, augment ROM, improving activity of daily living and quality of sleep.

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