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Original Research Article

Efficacy of Muscle Energy Technique and Codman's Exercises in Adhesive Capsulitis

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ABSTRACT

Background: To date, no study has directly compared the Muscle Energy Technique and Codman's exercises in managing the symptoms. Moreover, this is the most overlooked aspect of treatment in Indian physiotherapy clinics. Our study determined the efficacy of the Muscle Energy Technique compared with Codman's Exercises in adhesive capsulitis, helping to develop a better structured and optimized therapeutic strategy.

Study Setting: Physiotherapy OPD, Dasmesh College of Physiotherapy, Faridkot.

Methodology: Sixty patients, aged 40-60 years, were randomly assigned to three equal groups for the study. Group A participants received treatment consisting of a Hot Pack for 10 minutes, followed by the Muscle Energy Technique. Group B participants received treatment comprising a hot pack for ten minutes, followed by Codman's Exercises. Group C participants received only a hot pack. Assessments were conducted on the first day and repeated after 4 weeks of the intervention/control study.

Outcome Measures: Two standardized outcome tools were used: the Visual Analogue Scale (VAS) and the Shoulder Pain and Disability Index (SPADI) questionnaire.

Results: Relevant Statistical analyses were conducted using SPSS 21 software to verify the findings. All groups showed improvement; however, Group A demonstrated the most significant reduction in Pain and Stiffness. In contrast, Group C showed the minimum improvement in all measured parameters.

Conclusion: The findings indicate that combining hot pack therapy with the muscle energy technique may serve as an effective clinical intervention for adhesive Capsulitis. Thus, the muscle energy technique should be used as a cardinal approach for an effective treatment of Adhesive Capsulitis.

KEY WORDS: Pain, Stiffness, Adhesive Capsulitis (AC) or Frozen Shoulder, Visual Analogue Scale (VAS), Shoulder Pain and Disability Index (SPADI), Glenohumeral Joint, Muscle Energy Technique (MET), Codman's Exercises, Hot Pack, Range of Motion (ROM).

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BACKGROUND

A chronic inflammatory process involving the capsule, causing thickening and contracture, which secondarily develops attachment to the surface of the humeral head, is known as adhesive capsulitis [1]. The unpleasant progressive decline in both voluntary and assisted glenohumeral motion is characteristic of adhesive capsulitis [2,3]. Although this illness is self-limiting and may resolve within 2 to 3 years, approximately 40% of patients may experience manifestations that persist beyond a three-year duration [4,5].

Adhesive capsulitis (AC) affects approximately 3 to 5% of individuals in the general population, with prevalence increasing to up to 20% among those with diabetes. With an incidence of 10–36%, adhesive capsulitis is frequently linked to

diabetes mellitus [6]. Females are more frequently affected than males, and the non-dominant shoulder is typically more involved in such cases [7]. The pain typically worsens at night, and the range of motion (ROM) over the shoulder is restricted, chiefly the external rotation and abduction [8,9].

Adhesive capsulitis is classified into two forms: idiopathic (primary) and secondary. The main form occurs spontaneously and without apparent reason, mainly due to prolonged inflammatory processes and the proliferation of specific cells that may be coupled to an unusual immune response [10,11]. Trauma, surgery, or associated challenges, such as diabetes, immune system disorders, or heart-related conditions, can all cause secondary adhesive capsulitis [12]. Adhesive capsulitis typically progresses through four distinct clinical stages [13,14].

Stage I (painful stage): less than three months; hypertrophic synovitis; considerable discomfort and decreased mobility.

Stage II (Freezing stage): 3–9 months; collagen deposition is haphazard and causes excruciating discomfort.

Stage III (Frozen stage): 10–14 months; thick collagenous tissue; predominant rigidity.

Stage IV (thawing stage): 14–24 months; little discomfort; steady progress.

Typical physiotherapy techniques for treating adhesive capsulitis include Hot packs, Muscle Energy Techniques (MET), and Codman's (pendulum) exercises.

Using hydrocollator units maintained at temperatures between 70°C and 75°C, hot packs are applied to promote pain alleviation, muscle relaxation, and improved blood flow [15,16]. Muscle Energy Technique (MET), a form of manual therapy, involves the patient actively contracting muscles against resistance to reduce hypertonicity and restore normal length [17,18]. Codman's exercises utilize gravity to facilitate joint distraction and early shoulder mobilization, incorporating movements such as flexion, extension, abduction, adduction, and circumduction [19,20].

Outcome tools used included SPADI for functional disability and VAS for pain intensity assessment. SPADI evaluates the shoulder pain and functional limitations, with a 10-point change considered clinically meaningful [21]. The Visual Analogue Scale (VAS) is a widely accepted tool in clinical settings for measuring the subjective intensity of pain [22].

Aim of this study was

1. To find the effectiveness of Hot pack (HP) combined with (MET) Muscle Energy Technique in individuals diagnosed with Adhesive Capsulitis affecting the Glenohumeral (GH) joint.

2. To find the effectiveness of Hot Pack (HP) combined with Codman's Exercises in individuals diagnosed with Adhesive Capsulitis affecting the Glenohumeral (GH) joint.

3. To assess and contrast the outcomes of the Muscle Energy Technique combined with Hot Pack versus Codman's Exercises paired with Hot Pack in individuals diagnosed with Adhesive Capsulitis affecting the Glenohumeral (GH) joint.

METHODOLOGY

This research was carried out at Dasmesh College of Physiotherapy (Faridkot). This study involved a total sample size of 60 participants, distributed equally among three groups of 20. A Simple Random sampling method was used. The study population consists of individuals with Adhesive Capsulitis who exhibited shoulder pain and stiffness. SPADI measured Shoulder Stiffness. The SPADI score assesses shoulder pain and functional limitations. A reduction of ten points in this score reliably indicates an improvement in the patient's shoulder condition, while an increase of ten points reflects a clinical deterioration. The level of pain experienced by participants was measured using a Visual Analogue Scale (VAS) whose range was from 0 (no pain) to 10 (maximum pain perceived). The Visual Analogue Scale (VAS) is a widely accepted tool used in clinical settings to assess the intensity of pain perceived by individuals. This evaluation was conducted on day 1, before the treatment, and on day 20, after the treatment. The data were entered into Microsoft Excel, and the Mean and standard deviation (SD) were calculated. Statistical significance was determined using the ANOVA test.

The study included male and female participants between the ages of 40 and 60 years who presented with a history of shoulder pain and were clinically diagnosed with stage-2 adhesive capsulitis. Eligible participants were required to report an average shoulder pain intensity greater than 4 on the Numeric Pain Rating Scale (NPRS) and demonstrate restricted shoulder range of motion, specifically external rotation at or below 60 degrees and abduction at or below 30 degrees. Pain was often aggravated by overhead tasks and prolonged activities of daily living. Individuals were excluded if they had any shoulder girdle motor deficit due to neurological disorders such as stroke or Parkinson's disease, post-fracture stiffness, cervical spondylosis with referred shoulder pain, a history of malignancy, diabetes mellitus, rotator cuff tears or other shoulder ligament injuries, traumatic shoulder stiffness, or a history of upper limb surgery. Additional exclusion criteria included a diagnosis of osteoporosis, cognitive impairment, psychiatric or behavioral disorders that could interfere with participation, as well as any conditions that might compromise patient collaboration or the validity of study outcomes.

Procedure: Upon obtaining informed consent, 60 participants diagnosed with Adhesive Capsulitis were assigned into three groups through a Simple Random Sampling Method: Group A (Muscle Energy Technique), Group B (Codman's or Pendulum Exercises), and Group C (Control group using only Hot Pack).

Each group consisted of 20 participants, with equal allocation to Groups A, B, and C.

Pain levels and shoulder functionality were evaluated in all participants using the Visual Analogue Scale (VAS) and Shoulder Pain and Disability Index (SPADI) on Day 1 prior to the intervention.

Intervention in Experimental Group A: The Glenohumeral Joint was treated with heat packs for ten minutes while the subjects remained supine position. Then followed by the Muscle Energy Technique.

MET for Restricted External Rotation of the Glenohumeral Joint while the patient is in a supine position. After the elbow and shoulder patients have reached 90 degrees, the external rotation (ER) of the shoulder should be gradually introduced. At the position of the very first indication of resistance to movement, the patient was instructed to push further towards the direction of the examiner at the distal forearm. After 10 seconds of contraction, the patient was instructed to stop the contractions in tandem with the therapist, gradually. Three sets of five repetitions were administered after four seconds of further bending to the next limitation barrier.

The patient was then placed in the side-lying position while receiving **MET for the Glenohumeral Joint for Restricted Abduction.** The therapist stands beside the patient, cups the patient's shoulder with one hand, firmly compressing the clavicle and scapula to the thorax, and then slowly abducts the shoulder in the direction of the patient's head with the other hand. When the patient first showed signs of resistance to movement, they were instructed to push further in the direction of abduction, utilizing no more than 20% of their strength. After 10 seconds, they were told to stop their efforts while the therapist watched gradually. Following four seconds of relaxation, the therapist steadily increased force by moving the arm to take the shoulder into greater abduction to the next restriction barrier. Three sets of five repetitions were given [23,24].

Intervention in Experimental Group B: Selected subjects were also given hot packs for 10 minutes in the supine position for the Glenohumeral Joint. This was followed by Codman's exercises in the standing position, which involved five repetitions of 30 seconds. The therapist stands beside a table with one hand on your unaffected shoulder and the other on the table, with feet slightly wider than shoulder width.

The affected arm was allowed to hang freely while the participant bent forward at the waist to approximately 90 degrees, encouraging shoulder movement by gravity.

Patients were instructed to perform adduction, abduction, and to flex and extend their arms. The patients were instructed to move their hands in circumduction once they were at ease with these motions, with caution not to engage their shoulder muscles to generate movement. Keep the circle small, less than 8 inches.

Each session lasted 30 seconds and was carried out five times weekly. Every prescribed movement was done ten times in each session [25].

Intervention in Control Group C: The selected subjects were given a Hot Pack, which was intended to demonstrate the extent of improvement achieved with just a hot pack.

All three groups' outcome measures were re-evaluated post-treatment, that is, after the 4th week in all three groups. After comparing the pretreatment (day 1) measurements with the post-treatment (4th week) readings, the relevant data analysis was completed.

STATISTICAL ANALYSIS AND RESULTS

Paired t-tests were applied to the groups using SPSS 21 software to signify the findings. Every group demonstrated some level of progress across the different factors examined in the study; however, their level of improvement varied significantly between the experimental and control groups. An Unpaired t-test sample was used to analyze statistical differences between the treatment groups.

The calculated VAS score between Groups A and B was -8.634; this finding was statistically very strong, with a p-value less than 0.001. A statistically meaningful reduction in pain was observed among the groups that were compared. Similarly, the comparison between Groups A and C produced a t-value of -11.336, indicating a significant difference, and the t-value for Group B as compared to Group C was -3.006; both the results were statistically significant with p-values less than 0.001 and 0.005, respectively. This suggests that Group A was the most effective in reducing pain, followed by Group B, with Group C showing the least improvement.

In SPADI scores, the comparison between Group A and Group B showed a t-value of -9.391, while between Group A and Group C, it was -11.968. A significant difference was also noted between Group B and Group C, with a t-value of -2. 854. All values were statistically significant, with p-values less than 0.001 and 0.007, respectively, indicating that Group A showed the most important improvement in shoulder function and reduction in disability, followed by groups B and C.

From these findings, it's clear that Group A was the most effective in reducing pain and enhancing shoulder movement, with Group B showing moderate gains, and Group C showing the least progress.

Table 1: Post-treatment mean of Group A, Group B, and Group C for Vas Analogue Scale (VAS).

S.No.	Age Group	N	Vas Analogue Scale	
			Mean	Standard Deviation
1	Group A	20	2.2	0.767
2	Group B	20	4.55	0.944
3	Group C	20	5.5	1.051

Table 2: An Analysis of variance (ANOVA) was conducted on the mean Vas Analogue Scale(VAS) scores for Groups A, B & C. The calculated F-ratio of 300.87 exceeds the critical F-value at the 1% significance level, indicating a statistically significant difference among the means of Group A, Group B, and Group C for the Vas Analogue Scale (VAS).

ANOVA	df	Sum of Squares	Mean Square	F-ratio
Between Groups	2	515.85	257.925	300.87
Within Groups	57	48.89	0.8577	
Total	59	564.74		

Table 3: Post-treatment mean of Group A, Group B, and Group C for Shoulder Pain and Disability Index (SPADI).

S.No.	Age Group	N	SPADI	
			Mean	Standard Deviation
1	Group A	20	24.1	6.919
2	Group B	20	46.4	8.055
3	Group C	20	54	8.772

Table 4: An Analysis of variance (ANOVA) was conducted on the mean Shoulder Pain and Disability Index (SPADI) scores for Groups A, B & C. The calculated F-ratio of 76.34, which surpasses the 1% critical value, confirms significant differences among these groups regarding SPADI scores.

ANOVA	df	Sum of Squares	Mean Square	F-ratio
Between Groups	2	9660.4	4830.2	76.34
Within Groups	57	3605.1	63.25	
Total	59	13265.5		

DISCUSSION

Adhesive capsulitis is distinguished by Pain and a limited range of motion (ROM). Internal rotation and horizontal adduction are particularly limited due to tightness in the posterior shoulder structures. The Muscle Energy Technique (MET) applied to shoulder abductors can significantly improve external rotation and horizontal adduction ranges. Moore (2011) observed an increase in range of motion in Athletes. Although the study was limited to healthy collegiate baseball

players, the mechanisms at play, post-isometric relaxation (PIR), prove valuable in complex cases like adhesive capsulitis by relieving tightness and enhancing mobility. By addressing capsular tightening and improving mobility, the study supports the inclusion of MET in physiotherapy for adhesive capsulitis, thereby maximizing functional results [26].

Bicer A, Ankarali H. (2010) assessed the reliability and convergent validity of the SPADI in a research involving 101 female patients with shoulder discomfort. Every patient completed both the Health Assessment Questionnaire (HAQ) and SPADI. Patients' shoulder joints were actively manipulated while the Visual Analogue Scale (VAS) was used to measure their level of pain. The assessment tool demonstrated strong test-retest reliability and internal consistency. Cronbach's alpha was used to evaluate internal consistency in this study. The validity and reliability of SPADI in assessing shoulder pain in Turkish women were established through correlational analysis between the SPADI score and VAS and HAQ scores [27].

Deepak Kumar Mallick et al. 2023. The study investigated how MET enhances mobility and alleviates symptoms in individuals with frozen shoulder. It aimed to evaluate MET's therapeutic potential for improving joint range and reducing pain. The findings demonstrated significant improvements in the range of motion, specifically in shoulder flexion, abduction, and rotation, as well as a reduction in pain intensity as measured by the VAS score. Findings suggest MET is particularly effective when introduced during early rehabilitation. The findings support the use of MET to enhance mobility and alleviate symptoms in patients diagnosed with frozen shoulder [28].

Adhesive capsulitis or frozen shoulder syndrome manifests as pain and reduced motion due to joint capsule inflammation and fibrosis. Certain physiotherapy techniques, like scapular rhythm training and Codman's pendulum exercises, aim to improve agility while reducing pain. While both exercise regimens significantly reduced pain and increased external rotation range in women with frozen shoulder, scapular rhythm-based protocols have demonstrated greater pain relief compared to Codman's exercises in reducing pain (P=0.001) and improving glenohumeral external rotation (P=0.006), these outcomes are supported by findings from Sokhtehzari et al. (2022) confirming their effectiveness. The findings made clear how important it is to address scapulohumeral rhythm and the balance of the muscles surrounding the scapula, both of which are essential for the healing process. The efficacy of scapular rhythm training suggests that active treatment, as opposed to passive treatment, may produce better outcomes following mobilization when shoulder joint movements, both passive and active, are combined with physiotherapy techniques aimed at reestablishing the scapula's natural kinematics. Therefore, patients with adhesive capsulitis may benefit from a biomechanically sound and comprehensive rehabilitation approach if scapula-specific techniques are emphasized in therapy in addition to regular care [29].

In a 2021 study conducted by Raksha R. Jivani and colleagues, Spencer MET was compared with traditional mobilization for managing frozen shoulder symptoms. Outcomes were measured through improvements in mobility and reductions in disability. The research found that both therapeutic approaches led to significant improvements in all measured outcomes. However, the Spencer MET group showed superior results overall, except for shoulder extension and internal rotation, where outcomes were comparable. The researchers suggested that the active participation required during Spencer MET may contribute to its greater effectiveness, making it a more suitable approach for managing frozen shoulder in clinical settings [30].

In a 2018 interventional study conducted by Manmitkaur A. Gill and colleagues, the researchers, examined the effects of Muscle Energy Techniques (MET) on pain alleviation and functional enhancement in individuals with adhesive capsulitis. Participants were randomly distributed into two groups: a control group that only received standard physiotherapy, and an intervention group that received MET targeting shoulder flexion, abduction and external rotation in addition to conventional therapy. The findings revealed that although both groups exhibited significant improvements in pain levels (as measured by the Visual Analogue Scale) and

disability (assessed using the SPADI), the group receiving MET alongside physiotherapy demonstrated significantly greater gains in functional performance and rehabilitation outcomes, particularly as reflected in improved SPADI scores. These results suggest that Muscle Energy Technique (MET) may enhance joint mobility and functional capacity by promoting post-isometric relaxation and facilitating capsular movement. While both groups experienced a reduction in pain, the superior functional improvements observed in the MET group indicate that incorporating MET into physiotherapy routines could be particularly advantageous for managing adhesive capsulitis [31].

Kelley M et al. (2009) Heating pads can be applied before treatment begins and even during the course of treatment. Applying moist heat in conjunction with stretching is believed to reduce muscle stiffness, thereby improving muscle flexibility and joint range of motion. Heat therapy functions by alleviating pain, boosting circulation, and promoting the delivery of oxygen and nutrients to injured tissues. This is achieved through an increase in tissue temperature, which leads to vasodilation and improved elasticity of connective tissues, ultimately supporting the healing process [32].

CONCLUSION

It is concluded that all treatment methods, including the Muscle Energy Technique combined with hot packs, Codman's or Pendulum Exercises with hot packs, and the use of hot packs alone, exert a positive effect on reducing shoulder stiffness and pain. Furthermore, it is determined that the most effective treatment protocol is the Muscle Energy Technique with hot packs, which should be incorporated into shoulder rehabilitation programs.

ABBREVIATIONS

PIR- Post-Isometric Relaxation
MET- Muscle Energy Technique
ROM- Range of Motion
GH- Glenohumeral
HP- Hot Pack
VAS- Visual Analogue Scale
SPADI- Shoulder Pain And Disability Index
SD- Standard Deviation
ER- External Rotation
ANOVA- Analysis Of Variance
AC- Adhesive Capsulitis
HAQ-Health Assessment Questionnaire

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