Review Article

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The Impact of Mulligan Movement with Mobilization Technique (MWM) and Muscle Energy Technique (MET) on Adhesive Capsulitis of the Shoulder

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Abstract

Background: Adhesive Capsulitis most commonly referred to as "Frozen Shoulder" is an insidious painful condition with progressive and gradual restriction of all planes of movement in the glenohumeral joint. The principles of treatment of adhesive capsulitis are to relieve pain, maintain Range of Motion and restore function. The purpose of this study is to find out the efficacy of Mulligan Movement with Mobilization Technique compared to Muscle Energy Technique in decreasing pain and increasing ROM in patients with idiopathic shoulder adhesive capsulitis.

Objectives: To Compare the effect of Mulligan Movement with mobilization technique and MET in adhesive capsulitis patients.

Methods: 30 subjects of both sex groups aged between 40-60 years diagnosed with adhesive capsulitis of the shoulder. They were randomly assigned into two groups with 15 subjects each. Group A received Mulligan Movement with mobilization technique and ultrasound and Group B received MET and ultrasound. Both groups received the treatment protocol five days a week for four weeks. Pre and post-evaluation of pain was done by using the VAS scale, range of motion by the Universal Goniometer and functional disability by using the Shoulder Pain and Disability Index (SPADI).

Result: The Adhesive capsulitis patients treated with Mulligan Movement with mobilization technique and muscle energy technique along with ultrasound reported an equal improvement in pain relief and ROM values, especially in abduction and external rotation, and also reduced the disabilities of the shoulder. Hence, it can be concluded that both MWM and MET are equally effective in the treatment of adhesive capsulitis.

Conclusion: It was concluded that Mulligan Movement with mobilization technique (MWM) and Muscle Energy Technique (MET) are equally effective in reducing pain and improving shoulder functional ability in subjects with Adhesive capsulitis.

Keywords: Adhesive capsulitis; MET; Mulligan Movement with mobilization technique, Range of motion, Pain.

INTRODUCTION

The prevalence of adhesive capsulitis is around 2-5% and in India it was reported that the incidence is around 17.7% in diabetic and 7% in nondiabetic population. Women are more prone to get adhesive capsulitis than men in age groups between 40-60 year. In 6-17% of patients the other shoulder becomes affected, usually within 5 years. Adhesive capsulitis or frozen shoulder, is a

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musculoskeletal disorder.[23] Mostly with unknown aetiology. It is characterized by pain and restriction in the shoulder movement in a capsular pattern. The capsular pattern in the shoulder is characterized by most limitation of passive lateral rotation and abduction.[4]

Simon-Emmanuel Duplay describe the pathology of adhesive capsulitis and which he called 'scapulohumeral periarthritis in 1934'. Codman coined the term frozen shoulder in 1945, as "a condition difficult to define, difficult to treat, and difficult to explain from the point of view of pathology." Neviaser was the first to use the term adhesive capsulitis.[6,7] Neisser (1983) introduced the concept of adhesive capsulitis when he discovered that the capsule was tight, thickened and stuck to the humerus in such a manner that it could be peeled off like' adhesive plaster from the skin.[8]

Adhesive capsulitis presentation is classified into different stages. The first one is pain stage. As the symptoms progress, pain worsens and both active and passive range of motion becomes more restricted. The frozen stage lasts from 4 to 12 months. The third stage begins when a range of 3 motion begins to improve. This third stage is termed the thawing stage. This stage lasts more than 12 months.

Mulligan Movement with mobilization technique was introduced by Brian Mulligan in 1999, and the technique incorporated Kaltonborne principles of mobilization.[1] MWM combined sustained manual application of gliding forces to joint intending to reposition bone positional faults with concurrent physiological (osteo kinematics) motion of the joints. Either performed actively by the subject or passively by the therapist.[11]

MET is a non-invasive technique and it was introduced by Dr. Farad Mitchell.[1] The technique is a manual technique that targets the soft tissues. (Although it makes a major contribution towards joint mobilization. The MET or active muscular relaxation technique is beneficial for a variety of purposes such as lengthening a shortened muscle, as a lymphatic or venous process to aid the drainage of fluid or blood and increase the range of movements.[12]

There were only a few studies were done to evaluate and find out the effect of the Mulligan Movement with mobilization technique and MET in adhesive capsulitis of the shoulder. Hence, this study is to compare the effect of MWM and MET on adhesive capsulitis on reduction in pain and disability and improvement in ROM.

Need of the Study

There is lack of information on the effect of MET and Mulligan Movement with mobilization technique, the purpose of the present study is to compare the effect of MET and Mulligan Movement with mobilization technique.

Objectives

- To find out the effect of Mulligan Movement with mobilization technique in adhesive capsulitis of shoulder.
- To find out the effect of MET in shoulder adhesive capsulitis.
- Comparing the effect of Mulligan Movement with mobilization technique and MET in adhesive capsulitis patients.
- To analyze the pain and functional status of the shoulder using the SPADI scale in subjects undergoing MWM and met.

Hypothesis

Alternative hypothesis

There will be a significant difference in the effect and outcomes of the Mulligan Movement with mobilization technique and MET in shoulder adhesive capsulitis.

Null hypothesis

There will be no significant difference in the effect and outcomes of Mulligan Movement with mobilization technique and MET in adhesive capsulitis of the shoulder.

REVIEW OF LITERATURE

Ujjwal I yeole et al (2017): It is a randomized control trial study of the effectiveness of movement with mobilization in adhesive capsulitis of shoulder. The patients (n=30) where divided into 2 groups, 4 group A (n=15) undergoing MWM and group B (n=15) undergoing supervised exercise for 1 week. And the outcome measures are ROM, SPADI and pain using Numerical pain Rating Scale (NPRS). The study concluded that, MWM showed good improvement in shoulder.[6]

Narayan, Anupama et al (2014): It is an experimental study, to find out the efficiency of MET and functional movent of shoulder in adhesive capsulitis. They were divided into control group treated with convectional physical treatment. And other with MET. Used SPADI as outcome measure. Both groups showed significant difference and

improvement after treatment. So MET is very much effective in adhesive capsulitis.[7]

Gokhan D oner et al (2012): Conducted a study to evaluate mulligans technique in adhesive capsulitis patients. Group A (n=20) treated with conventional methods and stretching exercise. group B (n=20) treated with conventional and Mulligan technique. The outcomes are measured by vas scale, SPADI, ROM. The result showed that both are effective with Mulligan more effective.[13]

Deepali Rathod et al (2019): conducted a comparative study, with 40 patients to compare the effectiveness of Kaltenborn Mobilization verses Mulligan Mobilization in Frozen shoulder. Group A (n=20) with Kaltenborn mobilization and Group B (n=20) with mulligan mobilization. The outcomes are measured by VAS scale, Range and SPADI questionnaire. The results concluded that Mulligan mobilization is more effective than Kaltenborn mobilization.[14]

Hafiz Sheroz Arshad (2013): The experimental study was to find out the effectiveness of Maitland technique with mobilization and movement in frozen shoulder patients (n=100). After 2 months the results show no satisfactory significant difference in outcome measures and concluded that both approaches are good.[15]

Dhara Santosh Agnihotri et al (July-2016): This study was conducted for 6 months and treatment was given for 4 weeks with two groups including MET with regular treatment and other group only with conventional treatment. In case of control range of motion showed significant improvement.[16]

Stephanie D. Moore et al (2011): It is focuse on effects of technique by using muscle energy on posterior shoulder tightness. Basketball players (n=61) where grouped. A single application of a MET for the GHJ horizontal abductors provide immediate improvements in both ROM in asymptomatic collegiate baseball players. Application of MET for the horizontal abductors may be useful to gain ROM in overhead athletes.[17]

Edrish Saifee contractor: It was aimed to find the spencer MET on shoulder pain. The study concluded that Spencer MET is more effective increasing functional ability as compared to conventional treatment.[18]

B. Chakradhar Reddy et al (2014): It is a randomised control study to compare the effects of MET with conventional therapy in shoulder capsulitis. The participants are randomly allocated into 2 groups of 15 each. Which included conventional therapy (n=15) and MET along with conventional therapy (n=15). And used VAS, shoulder ROM and DASH score as outcome measures. Hence it is concluded that both treatments are equally effective in reducing pain, improving ROM and fuction.[19]

Sreenivasu kotagiri et al (2019): It is a comparative research on MET and mobilization to improve the ROM in frozen shoulder. Subjects were randomly selected and assigned into 2 groups a performed, Group A (n=30) with MET and Group B (n=30) with Maitland technique. The overall study proved that MET is beneficial in improving Pain and decreasing the disability level. On comparing the pretest and post-test measurements are done with VAS and SPADI.[20]

Einar Kristian Tevita et al (2008): To investigate the responsiveness and by comparing of Standardized response means (SRM) and reliable change proportion (RCP) with ROM. Results for test retest reproductivity indicate a small detectable difference. The study supports the use of SPADI as a good outcome measure.[21]

Kathryan E. Roach et al (1991): It is a study to prove the use of SPADI in clinical and research level. Test -retest reliability and internal consistency of the SPADI total and subscale score were highly negatively correlated with ROM. So, the SPADI detected changes in clinical status over short time intervals. The SPADI should prove useful for both clinical and research purposes.[22]

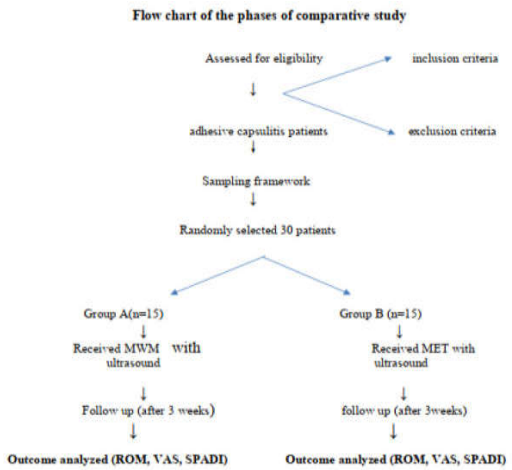
Jerosch-Herold c et al (2017): This is multicentre longitudinal cohort study. To compare the 2-hand questionnaire (SPADI and DASH) measuring similar outcomes and to select one that is sufficiently responsive. After the physical therapy treatments, the outcomes are collected from the patients (n=600). The result shows that both were equally effective outcome.[23]

Morey J. Kolber et al (2012): They conducted study about mobility(flexion, adduction, IR and ER) measurements using a digital inclinometer and goniometer In 30 asymptomatic participants with 95% acceptance measurements.[24]

METHODOLOGY

Sample Size: 30 subjects with Adhesive capsulitis of the shoulder

Resarch Design: Experimental design study.



Sample Technique: Simple Random sampling Technique

Study Setting: Physiotherapy department, Aparampar Swami Physiotherapy college, Nanded.

Study Duration: 4 Weeks.

Selection Criteria

Inclusion criteria:

- Adhesive capsulitis with limited ROM of shoulder
- Both Male and female subjects included
- Between the age group of 45-60 years

Exclusion criteria:

- Osteoporosis
- Any surgical procedure of shoulder joint
- Peripheral nerve injury
- Any Other Neurological Diseases
- Rheumatoid arthritis
- Osteoarthritis
- Infective conditions such as septic arthritis, and osteomyelitis
- Tendon calcification
- Fracture of the shoulder complex
- Malignancies in the shoulder region
- Subjects who are not willing to participate

Study Materials:

- Universal full-circle Goniometer
- Treatment table
- Stabilizing belts
- Soft pad
- Couch
- Stool
- Towel

Procedure

Total 30 subjects were assigned for the research. The subjects were made clear about the study and consent will be taken. These 30 subjects were divided into two groups. Group A (Total 15) were treated with MWM and ultrasound therapy. Group B (Total 15) were treated muscle energy technique and ultrasound therapy.[8]

Mulligan movement with mobilization (MWM)

Flexion and Abduction: Patient sitting with therapist posterolateral to him/her. Therapist places the Mulligan belt across the humeral head and to his waist. Leaning backward, or with the hands he applies a posterolateral glide to the shoulder joint and then asks the patient to perform the painful/restricted movement of shoulder flexion or abduction, which would be pain free now.

Internal Rotation: Patient in a sitting position. For loss of left internal rotation, stand facing patient's left side and vice versa. Place your right thumb in the bend of his flexed right elbow. His hand should be as far behind his back as possible. Now, place the web between your finger and thumb of your right hand in the patient's axilla. Now glide the head of the humerus down in the glenoid fossa using your right thumb while stabilizing up and inwards. While this distraction is taking place have the patient internally rotate his shoulder, while you abduct his upper arm using your abdomen. The procedure was performed 3 sets of 10 repetitions with 30 sec rest between sets. The treatment procedure was performed 5 days in a week for 4 weeks.[4]

Muscle Energy Technique (MET)

The subject is in a side-lying position for application of the method for shoulder flexion, abduction and the supine position for shoulder internal and external rotation. The therapist stands by the side of the subject. The therapist performs the movement. When the first physiological barrier is reached, the subject is asked to oppose the movement utilizing no more than 20% of available strength, building up force slowly. This effort is firmly resisted, and after 7-10 seconds the subject is instructed to cease the effort simultaneously with the therapist gradually. After complete relaxation, the shoulder is moved to the next restriction bar. The MET was given for 5 repetitions per set for 3 sets and the treatment procedure performed 5 days in a week for 4 weeks.

All the subjects of both groups are treated with ultrasound for pain relief. The subjects wore loose fitting clothes or minimal clothing for easy mobilization of the shoulder. Outcome measures: Before the treatment, pre-test evaluation and post-intervention post-test evaluation was conducted for both the groups. The intensity of pain by vas scale and range of motion of shoulder by universal goniometer and functional disability with Shoulder Pain and Disability Index.[9]

DATA ANALYSIS

The patients were fully informed about the treatment procedure and written consent was taken. 30 subjects were selected and were divided into 2 groups in randomized manner and each group consisted of 15 subjects and group A received MET and group B received MWM. Both groups received ultrasound and taken treatment for 5 days /week in total of 4 weeks. Outcome measures were VAS, SPADY, MMT and ROM. VAS was used to measure shoulder pain and SPADY was used for disability evaluation, MMT is used to check muscle power of shoulder. Improvements were observed pre and post treatment for both group by using outcome measures separately.

Statistical Tool

- **Arithmetic mean = $\sum x/N$**

  Where,

  X = arithmetic mean

  $\sum x$ = sum of variables

  N = total number of variables

RESULTS

Table 1: Mean of Demographic data for age and sex

Parameter	Group A (MWM)	Group B (MET)
Age	48	50
Sex(m/f)	7/8	6/9

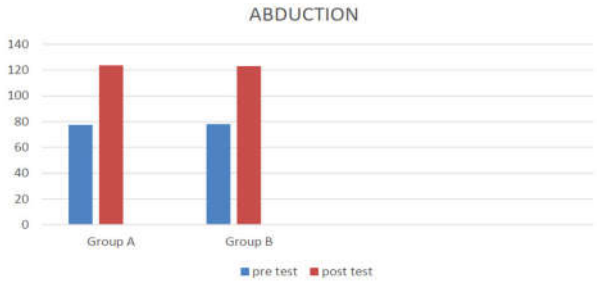
Intra-group analysis of outcome measures

Table 2: This table shows the mean of ROM of Shoulder Abduction

Group	Pretest ROM	Post-test ROM
	Mean	Mean
Group A	77.6	123.6
Group B	78	123.13

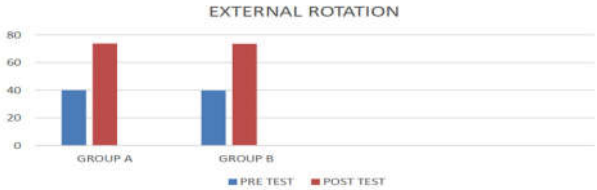
Table 3: This table shows the mean of ROM of Shoulder External Rotation

Group	Pre-test ROM	Post-test ROM
	Mean	Mean
Group A	40	73.73
Group B	39.93	73.53



Graph 1: Evaluation of abduction in Group A and Group B

This graph shows the intra group evaluation of Shoulder abduction by comparing the mean values of pretest and posttest values of both groups. Group A pretest was 77.6 and post-test 123.6. In Group B pretest and posttest values was 78 and posttest values are 123.13. Which indicate there was a significant difference in the pretest and post values and shows equal improvement in shoulder Abduction.

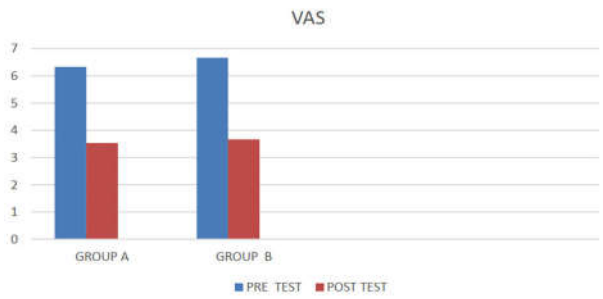


Graph 2: Evaluation of external rotation in Group A and Group B

This graph shows the intra group evaluation of shoulder external rotation by comparing the mean values of pretest and posttest values of both groups. Group A pretest was 40 and posttest 73.73. In Group B pretest and posttest values was 39.93 and posttest values are 73.53. Which indicate there was a significant difference in the pretest and post values and shows equal improvement in shoulder External rotation.

Table 4: This table is showing the values of VAS reduction from pretest and post test

	Pre-test	Post-test
Group A	6.33	3.53
Group B	6.666	3.666

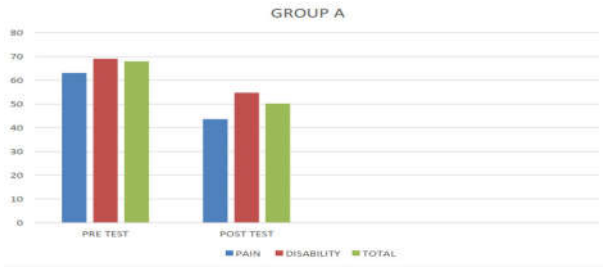


Graph 3: Evaluation of VAS score in Group A and Group B

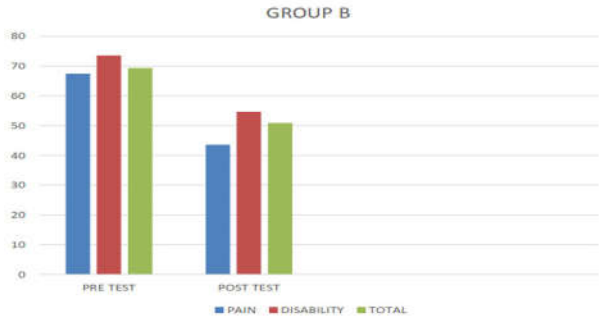
This graph 3 shows the intra group evaluation of VAS By comparing the mean value of pre and post–test values. In Group A with mean in pre-test was 6.33 and post–test was 3.53, and Group B with mean in pre-test was 6.66 and post-test was 3.66. Which indicate there was significant difference between pre-test and post–test values in both Groups.

Table 5: This table shows the mean of pretest and posttest of Spadi Scale

	Group A			Group B		
	Pain (%)	Disability (%)	Total (%)	Pain (%)	Disability (%)	Total (%)
Pre-test	63.06	69.05	67.91	67.46	73.5	69.38
Post-test	43.6	54.75	50.18	43.6	54.58	50.91



Graph 4: Evaluation of spady in Group A



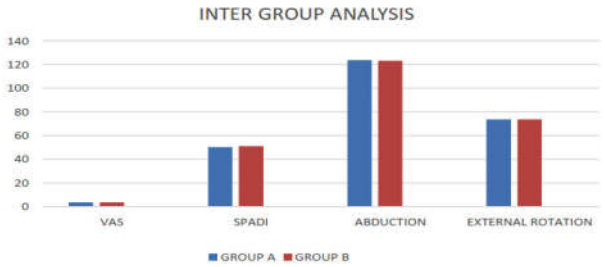
Graph 5: Evaluation of spady in Group B

Graph 4 and 5: In Group A and Group B shows reduction of pain and disability subscale score which was calculated by using SPADI showed a significant reduction in the pain threshold and disability after treatment.

Inter-group evaluation of outcome measure

Table 6: This table shows the inter group evaluation of outcome measures of post treatment

Outcomes	Vas	Spadi	Rom	
Abduction	**External rotation**			
Group A	3.53	50.18	123.6	73.73
Group B	3.66	50.91	123.16	73.53



Graph 6: Evaluation of posttest outcomes measures in Group A and Group B

Graph 6: The graph showed that both were equally improved after the treatment. On comparing the posttest outcome measures of both Group A and B. It showed pain relief and improvement in their Range of motion, especially Abduction and External Rotation of shoulder, and reduced the shoulder disability.

DISCUSSION

While analysing the both groups, it showed equal improvement in outcome measures VAS and SPADI. The ROM in shoulder shows significant improvement and the pain and disabilities of shoulder also reduced after the treatment period.

In Group A (MWM and ultrasound), Due to physiological changes of muscles & tendons lead to changes in shoulder. The biomechanical effect of MWM may include breaking up of adhesions in specific parts of the capsular tissue.[4]

In (Group B) MET is a soft tissue manipulation method that incorporates precisely directed and controlled, patient initiated, isometric and isotonic contraction. The effect of MET is to improve function by stimulation of Golgi tendon organ that results in direct inhibition of agonist's muscles and reflexive inhibition at the antagonistic muscles allowing the joint to be moved further into the restricted ROM.[25]

According to Manmit kaur A. Gill et al (2018): It consists of group A with conventional therapy along with MET and group B conventional therapy only. And used ROM, VAS, SPADI,

Maan Whitney. Utest and Wilcoxon signed rank tests as outcome measures, the results shows, Conventional physiotherapy and MET along with conventional, both are individually effective in relieving pain.[26]

In this study ROM values, SPADI and VAS score were recorded to the subjects on first day prior to treatment and at the last day. Mean VAS score calculated for Group A pre-test was 6.33 and in post-test was 3.53. Mean score for Group B in pre-test 6.66 and in post-test 3.66. In Group A, there was 28% reduction in mean VAS score and in Group B, there was 30% reduction in VAS score. Only 2% difference is seen in intergroup analysis, so both techniques have equal effect in reducing pain.

SPADI values calculated for Group A in pre-test was 67.91% and post-test was 50.18% and in Group B, pre-test was 69.38%and post-test were 50.91%. They had a significant difference in the pre-test and post-test values at the last. In group A shows 17.73% sand Group B shows 19.73%. With this value we can say both techniques are equally effective in reduction of pain and disabilities in adhesive capsulitis patients.

In this study ROM values of the pre-test values of Group A was 77.6 and 40 and Group B was 78 and 39.93 and post-test values of Group A was 123.6 and 73.73 and Group B was 73.53. Here also showed that two groups improved their ROM after the treatment.

With this outcome measures we can conclude that. The MET and MWM are equally effective in patients and both shows more over equal changes in the outcome measures after the treatment period. Both techniques reduce the pain and disability of shoulder and improved the ROM of shoulder. Here is a study concluded with same conclusion.

The study reported by Geetha Mounika Raududa and Nithyal Kumar Alagingi (2018): The comparative study by using SPADI and VAS as outcome measures. It was concluded that MWM and MET are equally effective.[1]

CONCLUSION

The Adhesive capsulitis patients treated with MWM and MET along with Ultrasound reported an equal improvement in pain relief and in ROM values, especially in abduction and external rotation, and also reduced the disabilities of shoulder. Hence, it can be concluded that both Mulligan Movement with mobilization technique and MET are equally effective.[17]

Limitations: The sample size on the study was small, larger sample size was not taken, Gender variations were not considered.

Recommentations: The Sample size can be used more, greater duration can be used, gender variations can be included, muscle strength can be evaluating.

REFERENCES

1. Geetha Mounika Rayudu et al: Efficiency of Mulligan Mobilization technique verses MET on functional ability in subjects with adhesive capsulitis.
2. Yuvarani Gopinath, Santhosh Krithika Sreenivasan, Senthil Nathan Celambakkam Veeraraghavan, Rajalaxmi Viswanathan, Mohan Kumar Govindaraj: Effectiveness of Gong'S mobilization verses MET on pain and functional ability of shoulder in phaseii adhesive capsulitis.
3. Jain TK. Sharma NK: The effectiveness of physiotherapeutic intervention in treatment of frozen shoulder /adhesive capsulitis: a systemic review.
4. Umair Ur Rehman, Syed Shakil Ur Rehman, Fozia Sibtain. Effectiveness of Mobilization with Movement with and without Therapeutic Ultrasound in Rehabilitation of Idiopathic Adhesive Capsulitis.
5. Hai V. Le, Stella Jaleel, Ara Nazarian, Edward K. Rodriguez: Adhesive capsulitis of the shoulder: review of pathophysiology and current clinical treatment.
6. Ujjwal L Yeole: effectiveness of movement with mobilization in adhesive capsulitis of shoulder; randomized controlled trial.
7. Narayan, Anupama, Jagga, Vinay: Efficacy of MET on treatment ability of shoulder in adhesive capsulitis.
8. Phillip W. McClure PT, PhD2, Martin J. Kelley, PT, DPT, OCS, Brain G. Leggin PT, DPT, OCS: Frozen shoulder: evidence and a proposed model guiding rehabilitation.
9. Andrea J. Johnson, DPTS cl, Joseph J. Godges, DPT, Grenith J. Zimmerman, PhD, Leroy L. Ounanian, MD: The effects of anterior verses posterior glide joint mobilization on external rotation range of motion in patients with shoulder adhesive capsulitis.
10. Robert C. Monske, Daniel Prohaska: Diagnostic

and management of adhesive capsulitis.

11. Gaurav Mahaska, Nidhi Kala, Prerna Patil: Immediate effect of mulligan's mobilization with movement in frozen shoulder: A case report.
12. Gokhan Doner, PT, MSc, Zeynep Guven, MD, Ayce Atalay, MD and Reyhan Celiker MD: Evaluation of Mulligan 'S technique for adhesive capsulitis of the shoulder.
13. Deepthi Rathod, Gokhale Priyanka, Anagha Palkar: Comparative study of Kaltonborn Mobilization verses Mulligan mobilization in patients with Frozen shoulder.
14. Hafiz Sheraz Arshad, Imtiaz Hussain Shah, Rashid Haffez Nasir (2015): Comparison of Mulligan Mobilization with Movement and End Range Mobilization Following Maitland Techniques in Patients with Frozen Shoulder in Improving Range of Motion.
15. Edrish Saifee Contractor, Dhara Santosh Agnihotri, Ronak Mukeshbhai Patel: Effect of Muscle Energy Technique on Range of Motion in Cases of Patients with Adhesive Capsulitis.
16. Stephanie D. Moore, MS ATC, Kevin G. Launder, PhD, ATC, Todd A. Mcloda, PhD, ATC, Michael A. Shaffer, PT, ATC, OCS The Immediate Effects of Muscle Energy Technique on Posterior Shoulder Tightness: A Randomized Controlled.
17. Edrish Saifee Contractor, Dhara Santosh Agnihotri, Ronak Mukeshbhai Patel: Effect of Muscle Energy Technique on Range of Motion in Cases of Patients with Adhesive Capsulitis.
18. B. Chakradhar Reddy, Santosh Metgud.: A randomized controlled trial to compare the effect of Muscle Energy Technique with Conventional Therapy in stage ii adhesive capsulitis
19. Sreenivasu Kotagiri, Neeti Mathur, Vadana, Gayathri Balakavi, Anup Kumar Songa: The Effectiveness of Muscle Energy Technique and Mobilization to Improve the Shoulder Range of Motion in Frozen Shoulder
20. Einar Kristian Tveitaa, Ole Marius Ekeberg, Niels Gunnar Juel And Eril Bautz: Responsiveness of the shoulder pain and disability index in patients with adhesive capsulitis
21. Kathryn E. Rouch, Elly Budiman-Muk, Norwarat Songsiridej, and Yongsuk Lertratanakul (1991) Development of a Shoulder Pain and Disability Index
22. Chester R, Jerosch-Herold C, Lewis J, Shepstone L.The SPADI and QuickDASH Are Similarly Responsive in Patients Undergoing Physical Therapy for Shoulder Pain
23. Morey J. Kolber, PT, Phd, OCS, Cert MDT, CSCS[1] And William J. Hanney, DPT, Phd, ATC, CSCS2 the reliability and concurrent validity of shoulder mobility measurements using a digital inclinometer and goniometer: a technical report.
24. Manmitkaur A Gill, Bhavika P Gohel, Sandhya K Singal: Effect of Muscle Energy Technique on Pain and Function in Adhesive Capsulitis -An Interventional Study (MET) treatment technique for AC
25. Nithya Jaiswal, J. Saketa, Hannah Rajsekhar (2019): efficacy of Energy techniques muscle as an adjunct with Mulligan's mobilization in adhesive capsulitis of shoulder.