

ORIGINAL ARTICLE

Comparison of High-grade Maitland Mobilization and Post Isometric Relaxation (PIR) Muscle Energy Technique on pain, range of motion, and functional status in patients with Adhesive Capsulitis

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Aim: To compare the effect of post isometric relaxation (PIR) muscle energy technique and high-grade Maitland mobilization technique on pain, glenohumeral joint abduction and external rotation, and functional activities in the subject of frozen shoulder.

Study design: Randomized control trial

Methods: A total of 60 patients were initially assessed for eligibility and 52 were included in the study after taking written consent. Patients were divided into two groups; Group A was treated with post isometric relaxation (PIR) technique and group B with Maitland grade (IV) mobilization for 4 weeks. Pain with a Numeric Pain rating scale, Glenohumeral joint abduction and external range of motion with a goniometer and shoulder function with shoulder pain and disability index were evaluated.

Results: Both groups were similar at baseline ($p > 0.05$) and within-group comparison has shown that there was a significant improvement in all variables in both groups as $p < 0.05$, but between-group comparison has shown that post-isometric relaxation (PIR) was more effective in reducing pain, improving range of motion and functional status and the mean difference between both groups for pain was 1.96, for shoulder abduction was 24.88, for external rotation was 10.42 and for SPADI was 23.27 with $p < 0.05$ for all, showing that post isometric relaxation (PIR) muscle energy technique is superior to the Maitland grade IV mobilization technique in improving pain, Glenohumeral joint range, and shoulder function.

Conclusion: Both Post isometric relaxation (PIR) and Maitland Mobilization are effective but post isometric relaxation (PIR) muscle energy technique is superior to the Maitland grade IV mobilization technique in improving pain, Glenohumeral joint range, and shoulder function.

Keywords: Adhesive capsulitis, Maitland mobilization technique, Muscle energy technique, Shoulder pain and disability

INTRODUCTION

Adhesive capsulitis (frozen shoulder), a painful disorder caused by capsular inflammation that results in fibrosis and rigidity of the glenohumeral joint capsule, is characterized by a progressive loss of both active and passive glenohumeral movements¹. Frozen shoulder can be primary (also known as idiopathic) if there is no underlying cause of disease or it can be secondary. The term "secondary frozen shoulder" is associated with injury, trauma, cardiovascular diseases, hemiparesis, or diabetes².

Hannifin described the frozen shoulder in IV stages. Stage I: Pre-adhesive stage, during which there is little to no restriction on glenohumeral motion and the joint lining (synovium) is inflamed. Adhesive synovitis with proliferative synovitis and scarring of the underlying capsule are symptoms of stage II (the freezing stage). Stage III (Frozen stage), which is characterized by severe rigidity brought on by capsule scarring and axillary fold loss. Stage IV, or the "thawing stage," is a chronic stage characterized by fully developed adhesions and a severe range of motion restriction. Stages II and III are challenging in which ROM is severely limited³.

Several predisposing factors are known to produce secondary adhesive capsulitis. These secondary factors have been categorized in several review articles. According to its nature, factors are further divided into systemic, intrinsic, and extrinsic factors. Intrinsic causes include acromioclavicular arthritis, diseases of the rotator cuff, biceps tendinitis, and calcific tendinitis, whereas systemic causes include diabetes, thyroid disease, and hypoadrenalism. Cardiopulmonary issues, cervical disc issues, stroke, Parkinson's disease, and humeral fracture are examples of extrinsic causes⁴. Through trauma and surgery, risk of being affected is increased⁵. Most important risk factors for frozen shoulder are diabetes and thyroid disease⁶.

In Pakistan, precise prevalence of frozen shoulder is unknown but in general its 2-5%⁷. A high prevalence of adhesive capsulitis which exists in diabetic patients and an equal prevalence of diabetes mellitus is present in patients with frozen shoulder⁸.

The goals of frozen shoulder treatment are to reduce pain, preserve range of motion, and improve function⁹. Strengthening exercises, stretches, electrotherapy modalities, and mobilization are all components of physiotherapy treatment¹⁰. Grade IV is a small amplitude of force that is applied against the tissue resistance. Grade III and IV are used to produce the stretching to relieve the joint stiffness¹¹. End range mobilizations at glenohumeral joint are proven to be effective in increasing range of motion¹².

The muscle energy technique (MET) which is used to stretch or lengthen the muscle and fascia that lack flexibility, is another manual therapy intervention. In MET, the patient must exert force by contracting the targeted muscle against the therapist's counterforce before relaxing and receiving a passive stretch from the therapist. Three to five contractions can be included in one MET application, each contraction is hold for 5 seconds and each contraction is followed by a stretch that ranges from 3 - 5 seconds to 30-60 seconds¹³. This technique can be used for any joint with restricted ROM. One of the indications for using this technique is to normalize the joint range of motion¹⁴.

There is lack of comprehensive evidence of physiotherapy interventions in adhesive capsulitis patients. So, the objective of this study is to measure the influence of high-grade mobilization technique and post isometric relaxation (PIR) muscle energy technique in patients with adhesive capsulitis. Because the method of treatment is inexpensive, findings of this study could be beneficial in revision of the clinical protocols to manage the patients of adhesive capsulitis.

METHODOLOGY

A single-blinded, parallel group Randomized control trial (RCT) was conducted in the physiotherapy department of Mayo hospital, Lahore from May 2021 to October 2021. Data was collected from Mayo Hospital and Kanaan Physiotherapy and spine clinic, Lahore. Ethical approval was obtained from the Review Board Committee (Ref no. PT/2021/REC/1RB/22). Before involving the patients in the study, informed consent was obtained. Sample size was determined using Gpower 3.1.9.4 and sample of 46 patients was

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estimated by using 5% level of significance, 95% power of test , effect size $d= 1.08$, with $mean \pm S.D$ for Maitland group was 23.53 ± 6.96 and for Maitland group was 31.14 ± 7.08^{15} , but sample of 52 patients, 26 in each group were taken, with estimation of 15 % attrition rate. Sample was collected through convenience sampling technique and patients were allocated randomly through lottery method in to two groups. Patients were blinded to the treatment, muscle energy technique was used on Group A, and Maitland mobilizations were used in Group B.

Patients from the age 35-60 years, men and women with idiopathic adhesive capsulitis were included, as well as those with at least a 50% reduction in the range of motion (ROM) of the glenohumeral joint in abduction, external rotation, and internal rotation when compared to the unaffected side. Patients with peripheral nerve injury, rheumatoid arthritis, osteoarthritis, malignancies and rotator cuff pathologies were excluded from the study.

As a conventional treatment, hot pack at shoulder joint for 10 minutes was applied in supine lying position and 2 sets of 10 repetitions of shoulder isometrics were performed in sitting position in both groups. In Muscle energy technique group, post isometric relaxation (PIR) was applied in sitting position for shoulder abductors and external rotators with 1 set of 3 to 5 repetitions and each repetition was maintained for 7 to 10 seconds. Patient had been asked to do the isometric contraction with force not more than 20% of total muscle strength, against the resistance at the maximum range of motion available and after 3 to 5 isometrics contractions patient is asked to relax the muscle and arm is moved in the new available range of abduction or external rotation.

In Maitland mobilization group patient was in sitting position and therapist was in walk standing position cradling the patients arm around the shaft of humerus and maintaining a lateral humeral distraction. After finding the actual resting position of glenohumeral joint, 1 set of 3 to 5 repetitions of grade IV oscillatory caudal and then anterior glide mobilization was given for 10 seconds for each glide. Patients in both groups received 3 sessions per week and total duration of treatment was 4 weeks.

The outcomes were assessed at baseline and after four weeks of treatment through Numeric pain rating scale (NPRS) for pain, goniometer for range of motion measurement, and Shoulder pain and disability index (SPADI) scale for functional assessment. The numeric pain rating scale (NPRS) is an 11 point scale ranging from 0 to 10, and a higher score indicates that the pain is more intense. The pain scale goes from 0 (no pain) to 10 (worst possible pain). The Numeric pain rating has strong test-retest reliability with ICC= 0.74 in patients with shoulder pain¹⁶. SPADI is also a reliable and consistent tool with ICC= 0.65 and cronbach's alpha > 0.95¹⁷.

Data analysis: Using SPSS version 23 data was managed and analyzed. Quantitative variables like age were used in the form of mean and standard deviation (mean \pm S.D). While the qualitative variables like gender, socioeconomic status and behaviour of pain were presented in the form of percentages and frequencies. The

normality of the data was evaluated using the Shapiro-Wilk test. The difference within and between the groups was compared using the paired t test and the independent t test, respectively.

RESULTS

SPSS for Windows software version 26 was used to analyze the data. Statistical significance was set at $p \leq 0.05$. Sixty subjects were initially assessed and fifty-two were selected based on the sample selection criteria. Twenty-six subjects were allocated randomly to either Group A or B. Two subjects from muscle energy technique group and three from Maitland mobilization dropped out. The missing data resulting from loss of follow-up were handled by intending to treat analysis using the last observation carried forward (LOCF) technique. On the basis of mean, standard deviation, and frequency (%), as shown in table 1, the demographic baseline values for the two groups were comparable.

Table 1: Baseline characteristics of the participant

Characteristics	Randomized (n=52)	
	(MET) (PIR) group (n=26)	MM (IV) group (n=26)
Age (yr.) Mean \pm SD	49.84 \pm 10.04	46.73 \pm 9.96
Gender		
Male	6 (23.1%)	11 (42.3%)
Female	20 (76.9%)	15 (57.7%)
Behavior of pain		
Localized	22 (84.6%)	19 (73.1%)
Radiating	4 (15.4%)	7 (26.9%)

Pre and post treatment comparison of shoulder abduction and external rotation range of motion, numerical pain rating scale (NPRS) and SPADI score within both groups has shown that within both groups, a statistically significant difference was detected as $p < 0.05$ for all variables in both groups as mentioned in table 2, showing that in patients with adhesive capsulitis, both approaches are helpful in lowering pain, enhancing joint range of motion and enhancing functional status. Comparison of Numeric pain rating scale (NPRS), shoulder abduction and external rotation range of motion and SPADI score at baseline between both groups has shown that variables were similar and comparable (p -value > 0.05) as mentioned in Table 3.

Comparison of NPRS, Shoulder range of motion and functional status between both groups has shown that mean pain after four weeks of treatment in MET group was 2.38 ± 0.49 , mean shoulder abduction was 132.96 ± 10.56 , mean external rotation was 45.61 ± 9.85 and mean SPADI score was 65.61 ± 4.16 and in Maitland mobilization group mean pain was 4.34 ± 1.41 , mean shoulder abduction was 108 ± 24.94 , mean external rotation was 35.19 ± 19.44 and mean SPADI score was 88.89 ± 14.98 showing that post isometric relaxation muscle energy technique is more efficient in lowering pain, enhancing range of motion and functional status in adhesive capsulitis patients as shown in table 3.

Table 1: Comparison of pain, range of motion and functional status within MET and High-Grade Maitland IV mobilization group at baseline and after 4 weeks of treatment.

Outcomes	Week 0		Week 4		Difference within groups Week 4 minus Week 0	
	MET (PIR) n=26 mean (SD)	MM (IV) group n=26 mean (SD)	MET (PIR) n=26 mean (SD)	MM (IV) group n=26 mean (SD)	MET (PIR) Mean difference (SD), p-value	MM (IV) Mean difference (SD), p-value
NPRS	6.73 (1.18)	6.60 (1.34)	2.38 (0.49)	4.34 (1.41)	4.35 (0.69) $p < 0.05$	2.26 (1.70) $p < 0.05$
ROM (Abduction)	93.84 (27.92)	103.07 (24.94)	132.96 (10.56)	108.07 (24.94)	39.12 (26.48) $p < 0.05$	5.00 (0.40) $p < 0.05$
ROM (External Rotation)	27.88 (18.98)	30.38 (19.79)	45.61 (9.85)	35.19 (19.44)	17.73 (11.89) $p < 0.05$	4.80 (0.74) $p < 0.05$
SPADI	95.51 (15.55)	91.42 (14.92)	65.61 (4.16)	88.89 (14.98)	29.89 (14.54) $p < 0.05$	2.53 (0.60) $p < 0.05$

Table 2: Comparison of pain, range of motion and functional status between MET and High-Grade Maitland IV mobilization group at baseline and after the 4 weeks of treatment and mean difference (95% CI) between groups

Variables	Randomized (n=52)			p-value
	MET (PIR) (n=26) Mean (SD)	MM (IV) (N=26) Mean (SD)	MET minus MM Mean (95%CI)	
Baseline				
NPRS	6.73 (1.18)	6.60 (1.34)	0.13 (0.38-1.08)	0.08
ROM(Abduction)	93.84 (27.86)	103.07 (24.94)	9.23(23.96-5.50)	0.62
ROM(External rotation)	27.88 (18.96)	30.38 (19.79)	2.50(13.30-8.30)	0.84
SPADI	95.51 (15.55)	91.42 (14.92)	4.09(4.39-12.58)	0.96
After 4 weeks				
NPRS	2.38 (0.49)	4.34 (1.41)	1.96 (2.55-1.37)	p <0.05
ROM(Abduction)	132.96 (10.56)	108.07 (24.94)	24.88 (15.03-34.73)	p <0.05
ROM(External rotation)	45.61 (9.85)	35.19 (19.44)	10.42 (1.83-19.01)	p <0.05
SPADI	65.61 (4.16)	88.89 (14.98)	23.27(29.40-17.15)	p <0.05

DISCUSSION

The purpose of this study was to compare the efficacy of Post isometric muscle energy technique and Maitland mobilization technique in patients of adhesive capsulitis. After 4 weeks of therapy, both groups showed improvements in their functional status, range of motion, and pain, but statistically significant differences were also discovered between the two groups' outcomes. Patients who received the Post isometric relaxation MET technique showed more improvement in pain, range of motion and functional status as compared to Maitland mobilization groups.

A study was conducted by Mohan Kumar and his colleagues to compare muscle energy technique with maitland mobilization technique and concluded that muscle energy approach worked better in enhancing shoulder functionality¹⁸ which correlated with results of the present study as mean value of SPADI score in MET group was 65.61±4.16 and in Maitland mobilization group was 88.89±14.89 and the underlying mechanism could be tissue elongation, which is probably what is enhancing ROM and function. Another study was conducted by Shikha and his colleagues to compare muscle energy technique with Maitland mobilization technique and concluded that muscle energy technique was more effective¹⁹.

Mutiple evidences also support the use of Maitland's mobilization in patients of frozen shoulder. A study conducted by Abhay Kumar et al. had reached the conclusion that in order to reduce discomfort, improve range of motion (ROM), and restore function to the shoulder joint in adhesive capsulitis, shoulder mobilization must be incorporated to the supervised exercise program.²⁰ Another study that evaluated the combined effects of Maitland's mobilization and muscular energy technique on patients with frozen shoulder came to the conclusion that the combined treatment is beneficial in lowering pain and enhancing range of motion and functional status²¹.

Neeti and his colleagues conducted a study to compare the effects of MET and Maitland's mobilization with comparatively larger sample size than the previous studies and results showed that the muscle energy technique was more efficient as compared to the Maitland Mobilization technique. The muscle energy technique group's pre-treatment SPADI score was 70%; after the therapy, it fell to 48%. Their functionality improved significantly by 22%. While in mobilization group mean score was 69% and decreased to 54% in post-treatment. Improvement in function was 14%. Analysis indicated that MET showed more remarkable improvements as compared to Maitland's mobilization technique²².

Results of the present study and previous literature supports that post isometric relaxation (PIR) of muscle energy technique is better than Maitland (grade IV) mobilization but there are few limitations of this study and it is recommended to conduct the future researches with bigger sample size and in multiple centers so that external validity could be enhanced. Further more long term follow ups and different treatment combinations rather than isolated techniques could be studied.

CONCLUSION

It is concluded that both Post isometric relaxation (PIR) muscle energy technique and Maitland's Mobilization technique are effective but post isometric relaxation (PIR) muscle energy technique is superior to Maitland grade IV mobilization technique in improving pain, Glenohumeral joint range and shoulder function.

Author's contribution: SN: conceptualization, methodology, writing the original draft, AZ: Supervision, formal analysis, MA, FMR and UH: data collection

Ethics approval: Ethical approval was obtained prior to conducting the study (Ref# PT/2021/REC/IRB/22). All participants gave written informed consent before data collection began.

Competing interests: None

Source(s) of support: None

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