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Comparison of Mulligan Mobilization with Movement and End-Range Mobilization Following Maitland Techniques in Patients with Frozen Shoulder in Improving Range of Motion

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Abstract:** this Quasi experimental study was aimed to compare the outcomes of end range joint mobilizations (ER M) following Maitland technique with mobilization with movement (MWM) for treating frozen shoulder to increase range of motion and to find the most effective management technique for treating other patients with frozen shoulder patients. 100 patients were taken in which comparison of two interventions on a single condition i.e. frozen shoulder, was done, over the period of two months for improving ROM. Paired Sample t-test performed. All the subjects was interviewed and evaluated for inclusion and they signed the consent form then they was asked to pick up a card for entitlement randomly in each of two groups i.e. either group A or B and was included in the study. The results showed strong statistical significant correlation between range of movement in shoulder extension before and after two months of treatment. In both experimental groups, shoulder flexion and abduction range of movements increased but improvement was not significant statistically i.e. respectively p-value=0.348 and p-value=0.367. Mean value for shoulder internal rotation were same in both experimental comparative groups. Regarding pain measurements, VAS Mean scores were found statistically insignificant when analyzed before and after intervention. This supported their usefulness in improving quality of life due to frozen shoulder. This may contribute in improved public health in country where cost is a critical factor having long term physiotherapy treatment. There found no statistically significant difference in both approaches in improving range of motion and pain.

Keywords: Mulligan, Maitland, Adhesive Capsulitis, Frozen Shoulder, Mobilization with movement, Range of motion.

1. Introduction

1.1 Overview

Frozen shoulder is a musculoskeletal disorder in which the capsule of joint, surrounding connective tissue becomes stiff, inflamed and shortened. This condition is also called adhesive capsulitis. It grows gradually from restriction of shoulder range of movements to severe stiffness and chronic pain (1, 2).

Between the articular surfaces, there grows abnormal tissue that cause restriction of joint motion. In addition to this, there may be lack of synovial fluid that provide lubrication to shoulder joint during intra-articular movements i.e. humeral head and glenoid cavity of scapula(3).

On the basis of degree of joint space restriction between joint capsule and glenoid cavity, frozen shoulder is differentiated with regard to complication, pain level and stiffness degree. Diabetes Mellitus, stroke, cerebrovascular accident, lung diseases, arthritis, rheumatic diseases, spinal disc pathologies and cardiac problems are all risk factors of frozen shoulder. Age is other indicator. Condition develops usually in people more than that of age 40 years(4, 5).

According to Cyriax, limitation in shoulder joint develops according to capsular pattern i.e. external rotation limited more then abduction then internal rotation and then flexion(6).

Other scientists Vermillion and his colleagues stated any anatomical abnormalities such as axillary recess can also reduce movement. However, normal flexibility and extensibility of shoulder joint can be attained by soft tissue mobilization of surrounding regions, and Maitland's joint mobilization techniques. More specifically, mid-range and end-range joint mobilization techniques, and mobilization with movement can be the techniques to relieve symptoms of frozen shoulder including stiffness and pain(7, 8).

The treatment of musculoskeletal joint dysfunction may require a physiotherapist to use manual therapy. Physical therapist treat joint dysfunction by manual therapy such as mobilization with movement developed by Brian Mulligan(9, 10). The mobilization with movement technique require several parameters for prescription as outlined in figure 1. It is done with both therapist patient participation i.e. passive glide is done by physiotherapist at peripheral joint meanwhile patient performs pain free physiologic movement. The hallmark of mobilization with movement technique is pain should be decreased after the application of technique(11, 12).

The Maitland concept is defined by International Maitland Teachers Association (IMTA) as a process of examination

followed by assessment and then treatment of neuromuscular disorder by manipulation techniques(13).

Therefore, the purpose of the study was to compare the outcomes of three of these mobilization techniques i.e. End Range Mobilization (ERM), Mid-Range Mobilization (MRM) and mobilization with movement (MWM) for managing frozen shoulder syndrome (FSS)(14).

FSS, ERM and MWM were more effective than MRM alone in enhancing range and functional mobility of shoulder. Scapulothoracic rhythm and its mobility improved after 3 week mobilization with movement(15-18).

Mobilization techniques seems to have intensive role in adhesive capsulitis treatment, however, there is further need to conduct controlled trial figuring out effectiveness of end range mobilization techniques in frozen shoulder syndrome. There are many research reports advocating good effects of mobilization with movement techniques. The most reported effect is immediate reduction in pain and improved shoulder function. The dramatic effects, however, raise questions about mechanism of action of these techniques. Current literature review answers these questions and also further proves the claim of effectiveness of mobilization with movement techniques(19, 20).

Another review article provides the insight of literature review of clinical efficacy and underlying mechanism of action of this mobilization with movement approach.

While in another article all the pain science theories and involved action mechanism of these techniques have been summarized and concluded, meanwhile keeping the limitation and directions provided by these studies in consideration(21). Another trial found comparing the effects of gong's mobilization and mobilization with movement techniques for improving pain and function of shoulder affected with capsulitis. This study concluded both techniques equally effective, combined with conventional therapies(22).

In 2009 a study was done to see the Effects of Maitland joint mobilizations and therapeutic exercises for the management of frozen shoulder. The purpose of this study was to see the outcome of shoulder range of movement, pain status, and function limitation. A patient with phase three frozen shoulder was treated with active exercise (phase B) and exercises plus passive joint mobilization (phase C). Two type of "accessory" glenohumeral mobi(23)lization, antero-posterior mobilizations in flexion and longitudinal caudal in shoulder abduction, were done in phase C. The outcomes of techniques were measured by Split Middle Technique and visual observations. The SPADI score showed a reduction in phase A and an increase in phase B1, C1, and B2. Although all of the movements of shoulder exhibit improvement in both protocols, but more increase in ROM was seen with joint mobilization and an exercise program used in combination. Exercise plus Maitland joint mobilization are a cost-effective treatment. The decrease in shoulder range of motion, pain status, and function was seen in stage A suggests more advantage of an early physical therapy treatment intervention(7, 8, 24).

Pain in frozen shoulder is usually dull or aching in nature. It also aggravates when movement is attempted, or with a sudden jerk. A physiotherapist may suspect that the patient has frozen shoulder if a physical examination of the patient reveals limited shoulder ROM. Frozen shoulder is diagnosis if limits to the active ROM(range of motion are the same or almost the same)as the limits to the passive ROM (range of motion). An MRI may confirm the diagnosis, but in practice this is rarely recommended.

In frozen shoulder the normal protocol for treatment in physical therapy is use of therapeutic modalities to reduce pain and active and passive ROM exercises to improve and maintain ROM of shoulder joint and to gain muscles strength(18, 20).

Stretching of joint capsule is the major objective in treatment of frozen shoulder with physical therapy exercises. Almost all of exercises devised for frozen shoulder focus on stretching the shoulder joint capsule(25).

In this regard, joint mobilization techniques have specialty increasing range of movement. These techniques can help achieve full range of motion. These are combined sometimes with graded stretching techniques. These combinations improve range quickly focusing on capsular stretch(26).

As for pain is concerned, frozen shoulder exercises make an important part of symptom relief, as these exercises increase both flexibility and extensibility of shoulder capsule. Which ultimately leads to relieve of pain. The most thinkened part of joint capsule is anterioinferior part and point of attachment of joint capsule to neck of humerus. These all factors in combination increase range of motion(27).

Adhesive capsulitis occurs mostly unilateral and its mostly self-limiting condition, which automatically recovers within two to three years. However, according to some researchers it is said that about 40 percent of objects have symptoms and limitation of range of motion which persists even after 3 to 4 years, and approximately fifteen percent got long term or permanent type disability if they were not get treated(28).

Non steroidal anti-inflammatory drugs are effective in both medicine and surgery for pain reduction and inflammation control, however, they are not effective in increasing range of movement and enhancing muscle strength. Among other choices for relieving symptoms, critisone injections and manipulation under general anesthesia are the options.

Manual therapy is one of the good options for the treatment of musculoskeletal problems. mobilization with movement (MWM) is one of these manual therapy techniques, which is a type of joint mobilizations techniques developed by Brian Mulligan. this techniques is also called as a Mulligan mobilization or a manipulative technique. The MWM technique consists of asset of mandatory parameters for prescription. A normal physiological movement, which is pain provoking, is performed actively or passively along with application of accessory glide at peripheral joint. A key feature to MWM is that pain should always be decreased or eliminated after the application.

The international Maitland Teachers Association (IMTA) defines the Maitland concept as a process of examination, assessment, and treatment of neuromusculoskeletal disorder by manipulative physiotherapy.

One study was conducted to compare the use of three (3) mobilization techniques: 1, end-range mobilization (ERM), 2, mid-range mobilization (MRM), and 3, mobilization with movement (MWM)—for the treatment of subjects with frozen shoulder syndrome (FSS). ERM and MWM were found to be more effective than MRM in increasing range of motion and functional activity level. scapulohumeral rhythm of FSS and Movement strategies was also improved after 3 weeks of MWM.

To find out the combined effect of end range mobilization (ERM) and mobilization with movement (MWM) in patients with frozen shoulder another study was conducted. A total sample size of 30 patients were taken (male =16; female=14) and they were further divided into 3 groups respectively (Group A=ERM; Group B=MWM; Group C=ERM+MWM). Each group consist of 10 patients. Patients were divided in following scheme (Group A & B male=6, female=4; Group C male= 4, female= 6). The results of the this study proposed that the mean values of Range of Motion (both active & passive) and Shoulder Pain Disability Index scores after treatment in all the 3 groups was improved. It was also found that group C showed more improvement in range of motion & pain level as compared to group A & B. so combined manual therapy technique i.e. ERM+MWM should be incorporated in the treatment protocol of adhesive capsulitis patients to get improved results in the ROM & pain level.

Jewell et al. in 2005 had conducted a research to see whether physiotherapy interventions give significant short-term improvement in four measures of physical health, pain level, and functional level for subjects who were diagnosed with frozen shoulder. Data was obtained from 2,370 subjects who had gone through outpatient physiotherapy. None of the subjects got a 50% or more improvement. The outcomes are same with results from RCT's that showed the efficacy of passive joint mobilizations and exercise for subjects with frozen shoulder. Ultrasonic, therapeutic massage application, iontophoresis, and phonophoresis reduce the likelihood of getting favorable results that suggests that their use should not be promoted(29, 30).

A latest study published in 2012 in Central India to compare the outcomes of three treatment methods for frozen shoulder. In that randomized control trial almost 72 subjects were recruited for applying treatments and were assigned to 3 equal groups: i.e. Group I, M, and P then were treated by manipulations under anesthesia (M), periarticular injection (I) and by physical therapy (P) respectively then outcomes at the end were then compared. However the outcomes of different treatment methods is comparable, but groups I and M gave better outcomes than group P(31).

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The treatment of musculoskeletal joint dysfunction may require a physiotherapist to use manual therapy. Physical therapist treat joint dysfunction by manual therapy such as mobilization with movement developed by Brian Mulligan. It's also called Mulligan Mobilization or manipulative technique(32).

The mobilization with movement technique require several parameters for prescription as outlined in figure 1. It is done with both therapist patient participation i.e. passive glide is done by physiotherapist at peripheral joint meanwhile patient performs pain free physiologic movement. The hallmark of mobilization with movement technique is pain should be decreased after the application of technique(33).

The Maitland concept is defined by International Maitland Teachers Association (IMTA) as a process of examination followed by assessment and then treatment of neuromuscular disorder by manipulation techniques(34-36). Mobilization techniques seems to have intensive role in adhesive capsulitis treatment, however, there is further need to conduct controlled trial figuring out effectiveness of end range mobilization techniques in frozen shoulder syndrome(37-39).

There are many research reports advocating good effects of mobilization with movement techniques. The most reported effect is immediate reduction in pain and improved shoulder function. The dramatic effects, however, raise questions about mechanism of action of these techniques. Current literature review answers these questions and also further proves the claim of effectiveness of mobilization with movement techniques(40, 41).

Another review article provides the insight of literature review of clinical efficacy and underlying mechanism of action of this mobilization with movement approach. While in another article all the pain science theories and involved action mechanism of these techniques have been summarized and concluded, meanwhile keeping the limitation and directions provided by these studies in consideration(37, 42).

Another trial found comparing the effects of gong's mobilization and mobilization with movement techniques for improving pain and function of shoulder affected with capsulitis. This study concluded both techniques equally effective, combined with conventional therapies.

There are strong evidences of mulligan's mobilization with movement (MWM) technique for peripheral joint mobilization. Patterns of application of MWM are variable and are not well defined. This study was done to critically

analyze evidences regarding MWM prescription on peripheral joints. A defined algorithm has been structures for the integration in clinical practice. Future researches use more health methodologies for the measurement of MWM prescription parameters.

1.2 Objectives

The objective of the study was to compare the effectiveness of end range joint mobilization techniques and Maitland Technique as compared to Mobilization with Movement Techniques. In both of above groups, the conventional intervention of physiotherapy was given to both groups.

1.3 Operational Definitions

1.3.1 ROM
it stands for Range of Motion exercise therapy

1.3.2 GONIOMETRY
It is an instrument use to measure range of motion. It has two arms. One arm fixed, other arm is moving. It has one dial for reading degree of motion and one axis around which other arms revolve. Axis is placed on joint line. The limb of which range of motion is to measure is placed along moving arm. Once the required range is achieved. Reading is done from dial that is indicated by the pointer of moving arm.

1.3.3 VAS
visual analogue scale is used to measure pain level. Patient is asked to point the number between 1 to 10 on a scale that best represents his pain intensity, bigger the number more severe the pain and vice versa.

1.3.4 ER
It stands for External Rotation of shoulder in standing

1.3.5 IR
It stands for internal rotation of shoulder in standing

1.3.6 AROM
it stands for active range of motion exercises of shoulder

1.3.7 PROM
It stands for passive range of motion exercises in standing

1.4 Materials and Methods

1.4.1 Study Design
It was a Quasi experimental study of 100 patients of frozen shoulder in which comparison of two different interventions i.e. end range joint mobilizations (ERM) following maitland technique with mobilization with movement (MWM) on a single condition i.e. frozen shoulder, was done, over the period of two months for improving ROM.

1.4.2 Setting
- Chaudhry Muhammad akram teaching & research hospital Lahore
- Rasheed Hospital Lahore

1.4.3 Study Population
Male and Female patients with Adhesive Capsulitis

1.4.4 Duration of Study
Was done, over the period of six months

1.5 Sample size

100 patients was equally divided into two groups of 50 each. The sample size was calculated by the following formula. the power of study equal to 90% and level of significance equal to 5%. The sample size was 50 in each group.

$n=([(Z_{(1-\beta)}+Z_{(1-\alpha/2)})]^2+(\delta_1^2+\delta_2^2))/[(\mu_{(1-)}\ \mu_2)]^2$

Desired Power of the study = β =90%
Desired Level of Significance = α = 5%
Mean ROM in abduction Difference = 151- 159 = -30=310
(Vermeulen et al., 2000)
Proposed Standard Deviation of Group A= δ¬1= 22
Proposed Standard Deviation of Group B= δ2= 24
Sample size in each group
n = 48.16

1.6 Sampling Technique

Convenience sampling

1.6.1 Eligibility
Inclusion Criteria
- All the patients (both males and females) with AROM/PROM less than or equal to 90 degrees between ages 50 to 70 years.
- Diabetic and hypertensive patients are included in this study if they meet the criteria of limited ranges and specified age.
- All the subjects must have frozen shoulder for at least last three months.
- Affected shoulder must have not more than 90 degrees of abduction and 50 % decreased external rotation as compared to normal side/normal ROM values.
- All the patients (M/F) between ages 50and 70years with no other serious pathology/red (as tumor, infection and any fracture or tear) flags are to be included in the study.

Exclusion Criteria
- All the patients having any cervical or thoracic problem. If present must be treated first before including in the study.
- All the objects having any intra articular injection in the glenohumeral joint during last three months.
- Patients with fractured scapula.
- Any history of surgery on that shoulder and patients with tendon calcification.
- Patients with cervical rib.
- Rotator cuff complete tear patients.
- All the patients with cervical and thoracic spine dysfunctions are first ruled out.

1.6.2 Data Collection
All the subjects was interviewed and evaluated for inclusion and they signed the consent form then they was asked to pick up a card for entitlement randomly in each of two groups.i.e either group A or B and was included in the study. Data was collected by convenience sampling and then all the objects was divided into 2 groups i.e. group A and group B.

Group A subjects was treated by U/S, TENS and end range joint mobilizations following maitland technique (twice/week) + home plan for exercises

Group B was U/S, TENS and mobilization with movement (twice/week) + home plan for exercises. Data was collected prospectively by using specially designed questionnaires.

1.6.3 Ethical consideration

This study has no barriers and it is ethical to do as the outcomes are expected to become positive and did not harm to the subjects/patients and results of this study did not intend to be used for the betterment of patients suffering from this global problem. Furthermore both treatments are non invasive and have no side effects so being already used for the management of frozen shoulder and have their own identity and efficacy so there are no barrier or ethical issue regarding implementation and generalizability of results. This was approved from Research Review Committee of Riphah International University.

1.7 Statistical Procedure

SPSS version 20 was used for analysis of data using paired t test. Data entry was done by using Microsoft excel and SPSS and data analysis done using SPSS. Firstly we measured the outcomes of Group A and Group B, and then we compared the outcomes of both groups to find the most effective choice of treatment by using paired sample t test.

2. Results

2.1 Paired Samples Statistics (Group A)

Table 1: Paired Samples Statistics (Group A): Range of Motion

		Mean	N	Standard. Deviation	Standard. Error Mean
Pair 1	FLEXION	50.80	50	19.082	2.699
	flex after2months	152.92	50	13.659	1.932
Pair 2	EXT	10.78	50	4.700	.665
	EXT after2months	22.06	50	5.105	.722
Pair 3	ABDD	42.88	50	12.818	1.813
	ABDD after2months	153.50	50	15.884	2.246
Pair 4	In-Rot	10.82	50	3.963	.560
	I/R after2months	56.44	50	8.399	1.188
Pair 5	Ext-Rot	11.18	50	3.932	.556
	E/R after2months	50.80	50	11.220	1.587

2.2 Paired Samples Statistics (Group B)

Table 2: Paired Samples Statistics (Group B)

		Mean	N	Standard. Deviation	Standard. Error Mean
Pair 1	FLEXION	49.82	50	17.388	2.459
	FLEX after2months	155.50	50	12.667	1.791
Pair 2	EXT	10.72	50	4.730	.669
	EXT after2months	22.66	50	4.369	.618
Pair 3	ABDD	43.70	50	38.489	5.443
	ABDafter2months	155.40	50	11.377	1.609
Pair 4	In-Rot	10.72	50	4.046	.572
	I/R after2months	58.94	50	8.522	1.205
Pair 5	Ext-Rot	10.56	50	3.775	.534
	E/R after2months	54.40	50	8.785	1.242

2.3 Paired Samples Correlations (Group A)

Table 3: Paired Samples Correlations (Group A)

		N	Correlation	Sig.
Pair 1	FLEXION & flex after2months	50	.065	.653
Pair 2	EXT & EXT after2months	50	.412	.003
Pair 3	ABDD & ABDD after2months	50	.071	.623
Pair 4	In-Rot & I/R after2months	50	.099	.495
Pair 5	Ext-Rot & E/R after2months	50	.121	.401

* p-value significant at or less than 0.05.

2.4 Paired Samples Correlations (Group B)

Table 4: Paired Samples Correlations(Group B)

		N	Correlation	Sig.
Pair 1	FLEXION & FLEX after2months	50	.021	.885
Pair 2	EXT & EXT after2months	50	.399	.004
Pair 3	ABDD & ABDafter2months	50	.150	.298
Pair 4	In-Rot & I/R after2months	50	.179	.212
Pair 5	Ext-Rot & E/R after2months	50	.039	.789

2.5 Comparison of Group A and Group B

Table 5: Comparison of Group A and Group B

ROM Component		*Group A(mean increase in ROM)*	*Group B(mean increase in ROM)*
	FLEXION	102	105
	Extension	11	11
	Abduction	110	111
	Internal-Rotation	45	48
	External-Rotation	39	43

2.6 Comparison of ROM after Treatment in Degrees

Table 6: Comparison of ROM after treatment in degrees

	Group		N	Mean	Std. Deviation	t-test	p-value
Flexion		A	50	152.92	13.659	0.943	0.348
		B	50	155.40	12.610		
Extension		A	50	22.06	5.105	0.834	0.407
		B	50	22.86	4.472		
Abduction		A	50	153.50	15.884	0.906	0.367
		B	50	156.00	11.339		
In-Rotation		A	50	10.82	3.963	0.000	1.000
		B	50	10.82	3.963		
Ext-Rotation		A	50	11.18	3.932	0.682	0.497
		B	50	10.66	3.690		

3. Conclusion

The study concluded that end range mobilization following maitland are equally effective as that of mobilization with movement exercises. The study calculated the effectiveness of end range mobilization following maitland for increasing range of motion and improving pain. This supported their usefulness in improving quality of life due to shoulder dysfunction such as frozen shoulder. This may contribute in improved public health in country where cost is a critical factor having long term physiotherapy treatment.

There found no statistically significant difference in both approaches i.e. end range mobilization following maitland and mobilization with movement in improving range of

motion and pain. So basis of this, we can accept Null Hypothesis i.e. there is no difference in effectiveness of end range mobilization following maitland and mobilization with movement.

Also there found significant difference in improvement of pain through Visual Analogue Scale within group analysis, but there was no significant difference in intergroup analysis.

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