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Review Article

Physiotherapy Section

Effectiveness of Mulligans Mobilisation with Movement on Shoulder Dysfunction: A Systematic Review

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ABSTRACT

Introduction: Shoulder dysfunction is common musculoskeletal disorder. This is due to repeated wear and tear of structures around the shoulder joint causing the malpositioning of shoulder. The Mulligan Mobilisation with Movement (MWM) has shown good results in treating the shoulder dysfunction.

Aim: To systemically review the available literature of MWM is effective in improving pain, Range Of Motion (ROM) and functioning in patients with shoulder dysfunction.

Materials and Methods: Five electronic databases like MEDLINE, PUBMED, Cochrane (CENTRAL), PEDro, and Google Scholar were searched up from March 2019 to September 2019 for randomised control trails of MWM in shoulder dysfunction subjects. The key words used were mobilisation with movement, mulligan's mobilisation with movement, shoulder dysfunction. Eligibility criteria were Randomised Control Trials (RCT) with 6 out of 12 Cochrane review group for risk of bias assessment published in English language.

Results: Nine out of ten studies showed significant changes in mulligan's MWM group than the general treatment, active ROM exercises, sham's technique, stretching's strengthening and stabilisation exercises, end range and mid-range mobilisations, electrotherapeutic modalities and only one showed no significant difference between the two groups but improvements in the pain, ROM, strength and functioning of the subjects with shoulder dysfunction.

Conclusion: On overall study of mulligan's MWM treatment in shoulder dysfunction it has very good improvements on outcome measures such as ROM, pain, strength and functional ability. Further more studies are required for knowing the individual effects of mulligan's MWM and its short term, long term effects.

Keywords: Manual therapy for shoulder, Mobilisation for shoulder pain, Painful shoulder, Shoulder impingement syndrome

INTRODUCTION

The shoulder girdle consists of four articulations, namely the glenohumeral, acromioclavicular, sternoclavicular, and scapulothoracic. Complex movements of these articulations are coordinated by shoulder girdle musculature. Apart from the initial 30 degree, full shoulder abduction in the coronal plane is effected by simultaneous motion of both the glenohumeral joint and scapular rotation in 2:1. Normal scapular motion is controlled by 17 muscles that receive innervations from 12 peripheral nerves. Most of the functional activies such as cleaning, dressing and carrying food are done with the help of upper extremities etc., [1].

In a study, conducted among 1069 subject's participated 22.9% (245) subjects reported with shoulder pain. It is more among the middle age people between 41-50 years of age. In these, 58.78% subjects had a chronic shoulder pain and taking treatment [2].

The normal shoulder stabilising mechanisms are compromised commonly in altered normal structural alignment of the bony constituents of the shoulder girdle, and rotator cuff muscles weakness. The increased tone of the rotator cuff muscles results in increased tensile forces to the joint capsule with which the rotator cuff tendons blend. The increased stress to the capsule stimulates an increase in the collagen production, which leads to a gradual loss of extensibility of the capsule which leads to capsular fibrosis. The weakness of the scapular muscles allows the scapula to assume a downward rotation common in hemiplegic following stroke. In these patients rotator cuff muscle activity may also be reduced and the arm is predisposed to inferior subluxation because of the loss of active and passive stabilising components [3].

Secondarily, pathologically due to degeneration or repeated activities there will be micro trauma to muscular, capsular and ligamentous tissue which is common. The muscle that form support for anterior capsule are subscapularis, pectoralis major, lattissimus dorsi and teres major are weak, fatigue/injured. Anterior capsule become stretched so the humeral head subluxes anteriorly, with anterior subluxation the posterior capsule become tight. This contributes to anterior displacement of the humeral head. The lack of strength and endurance of the anterior wall, tight posterior cuff of glenohumeral joint leads to the instability of humeral head. The subluxation leads to impingement finally to rotator cuff tear [3]. All these causes the malpositioning of the glenohumeral component of the shoulder joint. This pathogenesis of shoulder dysfunction was impaired shoulder movements with glenohumeral capsule adhesions and contracted soft tissues. Cyriax JH and Cyriax PJ suggested that capsular lesions would result in a limitation of movement in capsular pattern [4].

The first procedure which is used in people with musculoskeletal dysfunction of the shoulder is Physiotherapy. There are manual therapy in conjunction with stretching and strengthening exercises, and electrotherapeutic treatment. Few studies have shown the benefits for manual therapy in terms of reducing pain and improving shoulder mobility, improvements in function and quality of life [5]. Different studies have demonstrated that exercise alone is enough to manage chronic shoulder dysfunction in addition to MWM [6-12].

Mulligan B considered that a minor positional fault occurs following injury or strain resulting in movement restriction and pain. By repositioning these minor faults by correctional mobilisations which are not visible in X-ray and also not palpable may help in restoring the pain free movement in the affected joint. By repeating this mobilisations several times we may bring the long lasting improvements in the functioning of that joint. He considered that this theory holds because when you just mobilise the joint in the same direction many times without the movement, and then check the active range, there is no change. Another reason that seems to

confirm the position hypothesis is that the MWM take place and will only work in one direction. Added to this is that when successful in restoring flexion the same correction will also restore extension if it lost? A further point is that when the correct MWM is repeated several times, the joint's option to say on track seems to return [13].

Need of this study was to prove the MWM on shoulder dysfunction is useful to decrease the pain, improve the ROM of shoulder and functional abilities of the patients.

MATERIALS AND METHODS

Search Strategy

Researcher has done the electronic search with no boundations of dates from March 2019 to September 2019 using the following databases: MEDLINE and PUBMED, Cochrane (CENTRAL) PEDro, and Google Scholar. The search terms were adapted for the particular databases and included "mobilisation with movement" OR MWM OR Mulligan OR "Mulligan mobilisation" OR "manual therapy" AND mobilisation on shoulder joint. Eligibility criteria were randomised control trails with 6 out of 12 Cochrane review group of risk of bias assessment published in English language [14]. Only RCTS were included in present review as it has highest level of evidence and it is more suitable to study the outcome of any intervention [15]. Case studies, crossover studies and cadaver studies were not included.

Participants

Participants who were suffering from shoulder dysfunction of any age and since any duration were included in present review. Post-surgical participants, patients who have already taken corticosteroid injections were excluded.

Interventions and Comparison

Studies including Mulligan's MWM performed on shoulder joints alone or combined with other interventions were included. The MWM intervention had to be compared with shams techniques, manual therapy, mobilisations and also with various modalities used in physiotherapy treatments. Eligible studies could additionally included other comparison physiotherapy interventions.

Outcome Measures

Any particular results or outcomes were not considered in inclusion criteria. Physical measures, functional measures of pain were included.

Data Extraction

Key data of each study was extracted in a data extraction form described by Wright RW et al., and Furlan AD et al., [16,17]. Study characteristics, participant characteristics, interventions, comparison of interventions, outcome measures and results were included in the data extraction.

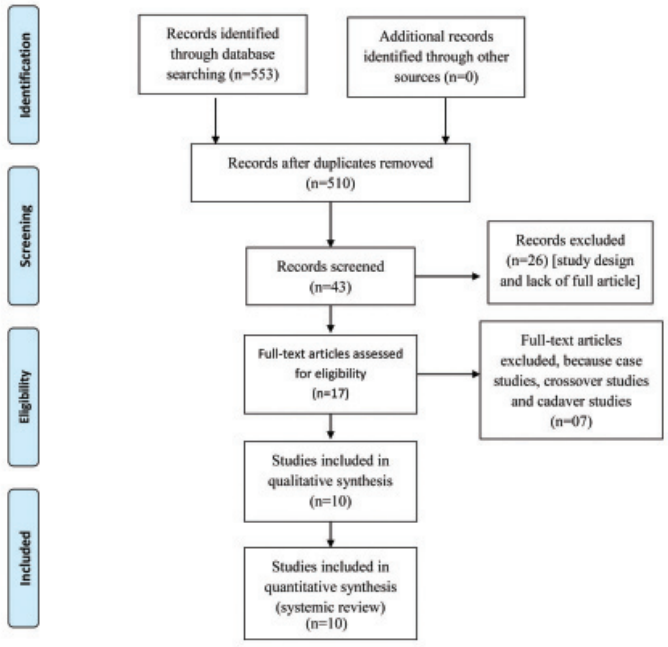
RESULTS

Study Selection

The electronic search was performed in March 2019 to September 2019. The results of the search of the different databases were 553. The search of the five databases and the secondary searches identified 43 relevant records after removal of duplicates. After a screening of the titles and abstracts, all studies were assessed in full text against the inclusion criteria. A total of 26 studies were excluded because of study design and lack of full article. At the end of the study selection process, 10 RCT studies were included in this systematic review and seven other case studies, crossover studies and cadaver studies were excluded. [Table/Fig-1] shows the flow chart of the search result and study selection.

Risk of Bias Assessment

Cochrane Back Review Group which consists of 12 item criteria was applied to determine the risk of bias of the eligible studies. Low



[Table/Fig-1]: PRISMA 2009 flow diagram.

risk of bias were scored as yes, high risk as no or unclear. This tool provides a maximum score of 12 points and a study which scores six out of twelve or more was defined as a study with a low risk of bias and they were only taken in this study [14]. This systematic review is following the PRISMA-guidelines [18]. All the studies are well explained in [Table/Fig-2] [19-28].

Study Characteristics

The salient features of each study is explained in [Table/Fig-3]. The studies included in total 303 participants with sample sizes ranging from 20 to 44. The included studies investigated the effects of MWM performed on shoulder joint Rotator cuff syndrome [19], Shoulder Impingement Syndrome (SIS) [20-23], shoulder dysfunction [24], shoulder pain [25], adhesive capsulitis [26], shoulder limited ROM [27], frozen shoulder [28].

The studies which were included compared MWM with several different comparison interventions such as conventional therapy, Codman's exercises, eccentric exercises, stretching, tens, cold packs, hot packs, kinesiotapting, End Range Mobilisations (ERM), Mid Range Mobilisations (MRM), mobilisations, placebo effects and shams techniques.

Outcome Measures

Visual Analog Scale (VAS), Shoulder Pain And Disability Index (SPADI), the Disabilities of the Arm, Shoulder and Hand (DASH), ROM, Hand Held Dynamometer (HHD), Numerical Pain Rating Scale (NPRS), flexilevel scale of shoulder function (FLEX-SF), short form -36, Pain Pressure Threshold (PPT), shoulder kinematics, pressure pain algometry, constant score and Shoulder Disability Questionnaire (SD-Q) in various studies.

Effect of the Intervention

The overall effectiveness of MWM is presented in [Table/Fig-3] and the following paragraphs will summarise the clinical effectiveness of MWM on various shoulder pathologies [19-28].

Yang JL., had conducted randomised multiple treatment trial among 28 frozen shoulder subjects. For group-1 MRM (0-3 wk), ERM (3-6 wk), MRM (6-9 wk) and MWM (9-12 wk). For group-2 MRM (0-3 wk), MWM (3-6 wk), MRM (6-9 wk) and ERM (9-12 wk). The results have shown that statistically significant improvements were found in end range mobilisations and MWM. But the MWM corrected scapulohumeral rhythm then end range mobilisation [28].

S. No.	Author (Year of Publication)	Random isation	Concealed allocation	Patient blinding	Care provider blinding	Out-come assessor blinding	Accept-able drop-out rate	Participants analysed in the allocated group	Free of selective outcome reporting	Groups similiar at baseline	Co-inter-ventions avoided or similar	Acceptable compliance	Similar timing of outcome assessment	Total (0-12)
1.	Menek B et al., (2018) [19]	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	Y	9
2.	Guimarães JF et al., (2016) [20]	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	10
3.	Neelapala YR et al., (2016) [24]	Y	Y	Y	N	Y	Y	Y	Y	N	N	Y	Y	9
4.	Delgado-gil JA et al., (2015) [22]	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	11
5.	Satpute KH et al., (2015) [21]	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	11
6.	Teys P et al., (2013) [25]	Y	N	Y	N	Y	Y	Y	Y	N	N	Y	Y	8
7.	Doner G et al., (2013) [26]	Y	Y	U	N	N	Y	Y	Y	Y	Y	Y	Y	9
8.	Kachingwe AF et al., (2008) [23]	Y	Y	Y	N	N	Y	Y	Y	N	N	Y	Y	8
9.	Teys P et al., (2008) [27]	Y	Y	Y	N	Y	Y	Y	Y	U	N	Y	Y	9
10.	Yang JL et al., (2007) [28]	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	9
		10	9	8	0	6	10	10	10	5	5	10	10	

[Table/Fig-2]: Risk of bias assessed using 12 item criteria recommended by the Cochrane Back Review Group [19-28]. Y: Yes; N: No; U: unidentified.

S. No.	Study	Participants	Study design	Pathology	Intervention	Outcome measures	Protocol	Results
1	Menek B et al., (2018) [19]	30	RCT	Rotator cuff syndrome	Conventional physiotherapy protocol+MWM	VAS DASH ROM SHORT FORM -36	Codman exercises, finger stairs, shoulder handwheel and shoulder capsule stretching exercises. Flexion, abduction extension, external and internal rotation stretching in the direction of the shoulder was applied. Stretching exercises five repetitions in each direction and hold 20 seconds. Also, strengthening exercises with theraband. Shoulder flexion strengthening exercises with theraband were used with three sets of 10 repetitions with one minute of rest interval between each set. The both groups are treated with TENS for 20 minutes and ultrasound for 6 minutes. Control group: Experimental group The MWM technique lasted around 20 minutes, in 3 sequences of 10 repetitions with a rest interval of 30 seconds between each sequence	MWM is more effective than general treatment
2	Guimarães JF et al., (2016) [20]	27	RCT	SIS	MWM Shams technique	ROM HHD SPADI DASH	GROUP-1 MWM-4 sessions Sham's -4 sessions GROUP-2 Sham's-4 sessions MWM-4 sessions	No significance between two groups
3.	Neelapala YR et al., (2016) [24]	31	RCT	Shoulder dysfunction	AROM Ex's MWM	VAS HHD-SUR, ERS, IRS	Control Group-AROM Ex's Experimental Group- AOM Ex's +MWM	MWM was effective in reducing pain and increased external rotation but no significance in IRS and SUR
4	Delgado-gil JA et al., (2015) [22]	21	RCT	SIS	MWM/Sham's	NPRS ROM	Sham'S/MWM four Session /Week For two Weeks	MWM is significantly better out comes for pain during shoulder flexion, maximal flexion and external rotation
5	Satpute KH et al., (2015) [21]	44	RCT	SIS	Moist heat HBB MWM Strengthening Ex's and isometric Ex's Home Ex's	HBB ROM-IR VAS SPADI	Group-A Moist Heat +HBB MWM+HOME Ex's Group-B Moist Heat +Resistance Ex's And Isometric Ex's+Home Ex's	MWM is more significant than Ex's group
6.	Teys P et al., (2013) [25].	25		Shoulder pain	MWM AND MWM With Kinesio Taping	ROM PPT VAS	MWM for one group and MWM with kinesio taping for another group	MWM with kinesiotaping is significantly improved the ROM
7	Doner G et al., (2013) [26].	40	RCT	Adhesive Capsulitis	Hot pack TENS Passive stretching Exercises MWM	VAS PROM AROM Constant Score SD Q	Group-1 hot pack TENS and passive stretching exercises Group-2 hot pack, TENS and MWM	Significantly group-2 has greater improvements

8	Kachingwe AF et al., (2008) [23]	33	A Randomised controlled pilot study	SIS	Supervised Ex's SE+glenohumeral mobilisation SE+MWM Control group	VAS- NEER, HKT AROM SPADI	GROUP-1 Supervised Ex's-posterior capsule stretching, postural correction Ex's, posterior capsule strengthening and scapular stabilisation Ex's GROUP-2 SE+GHM GROUP-3 SE+MWM GROUP-4 Control group with no Ex's	MWM has higher change in AROM, VAS, NEER, HKT
9	Teys P et al., (2008) [27]	24	Double blinded Randomised plaebo controlled trial	Shoulder pain and limited ROM	MWM Sham control	ROM PPT Presure Pain Algometry	MWM+Sham MWM+Control Sham Control	MWM is significant
10	Yang JL et al., (2007) [28]	28	Randomised multiple treatment trial	Frozen shoulder	A-MRM B-ERM C-MWM	Flex-SF Shoulder Complex Kinematics with Fastrak Motion ROM-Abduction in Scapular Plane, Hand to Neck, Hand to Scapula	Group-1 ABAC Group-2 ACAB	Statistically significant improvements were found in ERM and MWM. Additionally, MWM corrected scapulohumeral rhythm significantly better than ERM did.

[Table/Fig-3]: Studies representing the overall effectiveness of MWM [19-28].
VAS: Visual analog scale; DASH: Disabilities of the arm; shoulder and hand; ROM: Range of motion; HHD: Hand held dynamometer; SPADI: Shoulder pain and disability index; SUR: Scapular upward rotation; IRS: Internal rotator strength; ERS: External rotator strength; NRS: Numerical pain rating scale; HBB: Hand behind back; IR:Internal rotation; PPT: Pain pressure threshold; PROM: Passive range of motion; AROM: Active range of motion; TENS: Transcutaneous electrical nerve stimulation; SIS: Shoulder impingement syndrome; NEER: Neers impingement test; HKT: Hakwins kennedy test; Ex: exercise; MRM: Mid Range Mobilisations; ERM: End Range Mobilisations; MWM: Mobilisation with Movement; SD Q: Shoulder Disability Questionnaire

Kachingwe AF et al., had conducted a randomised controlled pilot clinical trial on 33 SIS patients. Subjects were divided into four groups. For group-1 supervised exercises, group-2 supervised exercises and glenohumeral mobilisation, group-3 supervised exercises and mobilisation with movement and group-4 is a controled group home exercise by physician. They has shown that MWM has higher changes in Active range of motion (AROM), VAS, Neer, Hawkins-Kennedy test then supervised exercises, mobilisation and supervised exercises and control group [23].

Teys P et al., had doubled blinded randomised placebo controlled trial among 24 patients. All the patients were given any one of the MWM or shams technique or control group. Three sessions at same time with 24 hours of interval were given. The results showed significant improvements on ROM, PPT and pressure pain algometry in patients who are under MWM treatment [27].

Teys P et al., has studied one week time course of the effects of Mulligan's MWM and taping in painful shoulders of 25 subjects. The patients were allocated into 2 groups, group-1 received MWM. Group-2 is received MWM and taping. The results were MWM with tape significantly improved ROM over the one-week follow-up compared to MWM alone [25].

Doner G et al., evaluated the Mulligan's technique for adhesive capsulitis of the shoulder a randomised control trial of 40 patients. All the patients were allocated into two groups, group-1 has received hot pack, TENS and passive stretching exercises and group 2 has received hot pack, TENS and MWM as treatment protocols. The results of the study showed improvements which was significantly greater in subjects in group 2, who were treated with Mulligan's technique [26].

Delgado-Gil JA et al., has conducted a RCT among 21 subjects of SIS. The subjects were given MWM or shams technique as treatment protocol 10 minutes each session four days per week for two weeks. The results have shown MWM exhibited significantly better than patients who received the sham treatment [22].

Satpute KH et al., conducted a RCT to know the efficacy of hand behind back MWM for acute shoulder pain and movement impairment in the 44 patients with SIS. The subjects were divided into two groups, group-A has received moist heat, hand behind back MWM and home exercises, group-B has received moist heat resistance and isometric exercises and home exercises nine sessions for three weeks. The results were the MWM-with-exercise group showed significantly greater improvements than the exercise group [21].

Neelapala YR et al., has conducted a RCT among 31 patients with shoulder. The subject were divided into 2 groups, control group received AROM exercises and experimental group received AROM exercises and MWM as a treatment protocol. The results were MWM was effective in reducing pain and increasing external rotator strength [24].

Guimarães JF et al., conducted a RCT in 27 patient with SIS. The subject were divided into two groups, group-1 has received first of MWM for 4 session secondly sham's four sessions. Group-2 has received firstly sham's 4 session and secondly MWM 4 session. The results have shown that there is no significance between two groups [20].

Menek B et al., studied a RCT among 30 Rotator Cuff syndrome patients. The subjects were divided into two groups. the control group was received the conventional physiotherapy treatment such as stretching, cold pack, finger ladder exercises, codmanns pendular exercises and Mulligan group the MWM technique lasted around 20 minutes, in three sequences of 10 repetitions with a rest interval of 30 seconds between each sequence. Both groups were treated with TENS for 20 minutes, ultrasound for 6 minutes and 6 weeks exercise program. The results were statistically significant improvement was found in Mulligan group than control group [19].

DISCUSSION

Summary of Evidence

The RCT that included in the study were assessed with risk of bias assessment recommended by Cochrane back review group. In this two studies scored 11 out of 12, 1 scored 10 out of 12, 5 scored 9 out of 12, 2 scored 8 out of 12. According these scores, included studies are showing low risk of bias. The two researchers independently scored this assessment in order to prevent the bias.

These systematic review summaries the clinical effects of MWM performed to shoulder joint, and proved that MWM is an effective treatment intervention for managing subjects with shoulder dysfunction. The 9 out of 10 studies showed MWM is superior then the other treatment measure that are used [19,21-28]. Only one study said there were no significant changes between the groups but there was significant change in reducing pain, improving ROM and functional abilities before and after treatment in both the groups [20].

Menek B et al., concluded that MWM is more effective than general treatment on rotator cuff syndrome [19]. Guimarães JF et al., concluded that there was no significance between two groups [20]. Neelapala YR et al., proved MWM was effective in reducing pain and increased external rotation but no significance in Internal Rotator Strength (IRS) and Scapular Upward Rotation (SUR) [24]. Delgado-Gil JA et al., showed MWM has significantly better outcome for pain during shoulder flexion, maximal flexion and external rotation [22]. Satpute

KH et al., seen MWM group was more significant than exercise group [21]. Teys P et al., proved MWM with kinesiotaping is significantly improved the ROM [25]. Doner G et al., Group-2 hot pack, TENS and MWM significantly has greater improvements [26]. Kachingwe AF et al., showed that, MWM has higher change in AROM, VAS, Neers Impingement Test (NEER), Hakwins Kennedy Test (HKT) [23]. Teys P et al., proved, MWM was significant than shams or control groups [27]. Yang JL et al., showed statistically significant improvements were found in ERM and MWM. Additionally, MWM also improved the scapulohumeral rhythm significantly better than ERM [28].

The results in this review were equal with the previous systematic reviews reporting positive clinical effects of MWM of various peripheral joints [5,29]. This review presented further evidence for the clinical effectiveness of MWM on specifically shoulder dysfunction. It showed better evidences for MWM has best effects on pain ROM and functional abilities of patients. In this study, only the high quality RCT's were included for best systemic review.

Clinical Implications

This review provided evidence that MWM is a good treatment for managing shoulder dysfunction. However, the studies reported only the initial effects of intervention, so this couldn't be implicated in clinical practice because clinical treatment is often associated with a series of interventions.

Limitation(s)

The studies that included showed low risk of bias. The data collection was by both authors which has no chance of selection bias. This study has language bias because only English language articles were included. Meta-analysis could not be conducted because of having almost 10 outcome measures in which some of them were not able to compare because they were used in only one study.

CONCLUSION(S)

This systematic review revealed good quality evidence for the effects of MWM in improving ROM and function in subjects with shoulder dysfunction. MWM are superior to placebo and no intervention control, but not compared to corticosteroids and other physiotherapy interventions. It is said that MWM with kinesiotaping has best long term effects on pain functioning and ROM. There is also a need for more RCTs with parallel groups design to provide strong conclusion about the clinical effects of MWM.

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