

MOBILIZATION WITH MOVEMENT AND KINESIOTAPING COMPARED WITH A SUPERVISED EXERCISE PROGRAM FOR PAINFUL SHOULDER: RESULTS OF A CLINICAL TRIAL

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ABSTRACT

Objective: The purpose of this study was to compare the efficacy of Mobilization with Movement (MWM) and kinesiotaping (KT) techniques with a supervised exercise program in participants with shoulder pain. **Methods:** Twenty subjects with shoulder pain were included if subjects were diagnosed by the referring physician with either rotator cuff lesion with impingement syndrome or impingement shoulder syndrome. Participants were randomly assigned to 1 of 2 groups after clinical and radiologic assessment: group 1 was treated with MWM and KT techniques, whereas group 2 was treated with a supervised exercise program. The main outcome measures were active pain-free shoulder abduction and flexion tested on days 0, 5, and 10. **Results:** Improvement in active pain-free shoulder range of motion was significantly higher in the group treated with MWM and KT. Repeated-measures analysis of variance indicated significant effects of treatment, time, and treatment × time interaction. **Conclusion:** This study suggests that MWM and KT may be an effective and useful treatment in range of motion augmentation of subjects with rotator cuff lesion and impingement syndrome or impingement shoulder syndrome. (J Manipulative Physiol Ther 2012;35:454-463)

Key Indexing Terms: *Musculoskeletal Manipulations; Athletic Tape; Shoulder Impingement Syndrome; Range of Motion Articular*

Shoulder pain is a frequent musculoskeletal problem, with prevalence ranging from 7% to 36%.^{1,2} The most common cause of shoulder pain is secondary to subacromial impingement and often involves lesions to the rotator cuff, long head of the biceps, or may be due to subacromial bursitis, glenohumeral, and acromioclavicular osteoarthritis.^{1,3} Diagnostic procedures should differentiate these conditions, including nonshoulder pathology that also results in shoulder pain such as cervical spine pathology, neuromuscular disorders, and infiltrative pulmonary lesions.

The major symptoms include pain over the shoulder area (frequently irradiating along the ipsilateral arm), restricted range of shoulder motion (ROM), and impeded activities of daily living. Without proper treatment, symptoms can last several months or longer and are prone to chronicity.⁴

Conservative treatment of the shoulder impingement syndrome consists of a wide range of procedures such as exercise therapy; infiltration of corticosteroid; and/or local anesthetic, prolotherapy, ice/heat therapy, kinesiotaping (KT), electrotherapy, acupuncture, various types of manual therapy based on massage, manipulation, and joint mobilization procedures. Increasing number of references is engaged in researching chiropractic management techniques of the shoulder impingement syndrome.⁵⁻⁷

These procedures are aimed at reducing pain and restoring a full range of pain-free shoulder movement. Effects of the conservative therapy in terms of reducing pain, improving ROM, and overall function may depend on the underlying cause of shoulder pain and on the types of therapies applied. Nevertheless, substantial prolongation of symptoms despite the application of various therapy modalities has inspired research to look for evidence on their effect.

The concept of Mobilization with Movement (MWM), developed by Brian Mulligan,⁸⁻¹⁴ is a manual therapy technique in which the therapist manually sustains a specifically oriented glide to a painful joint, while a patient actively performs movement in the same joint. If the active

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movement performed is pain free, the orientation of the glide will be considered adequate. The principles for this type of joint mobilization are based on analyzing and correcting any minor positional fault in the joint, which according to the MWM theory¹⁴ occurs due to various soft and/or bony tissue lesions in/around the joint. Positional faults in a painful shoulder have been documented by several kinematic studies: small but significant changes in anterior-posterior translations of the humerus, registered during elevation in the scapular plane in persons with impingement syndrome.^{15,16} Harryman et al¹⁷ have demonstrated, in fresh cadavers, that tightening of the posterior portion of the humeral joint capsule (here produced experimentally, but otherwise often associated with impingement syndrome) increased the anterior translation of humeral head on flexion and cross-body movement causing it to occur earlier in the arc of motion compared with the intact glenohumeral joint. Operative tightening of the posterior part of the capsule also resulted in significant superior translation with flexion of the glenohumeral joint.¹⁷ Imaging studies have confirmed positional faults in a sprained ankle¹⁸ and in a case study of injured first metacarpophalangeal joint.¹⁹ The MWM treatment aims to realign these disturbed relations in a joint via manually applied specifically oriented glide to recreate conditions for the smooth, painless active movement in the joint.^{9,20} The principles of MWM include accessory glide, physiologic movement, pain-free or pain alteration, immediate or instantaneous effect, and overpressure.⁹ It is considered that further improvement in pain reduction can be achieved through the application of pain-free passive overpressure at the end of ROM during the MWM procedure.^{9,20} The glide applied in a shoulder pain MWM treatment is oriented in a posterior or posterolateral direction. In a fresh cadaveric shoulder specimen study of the humeral translation during MWM, Kai-Yu et al²¹ showed that the timing and degree of posterior and lateral translation during shoulder abduction were different when the MWM procedure was applied, suggesting that MWM could effectively prevent humeral head from superior and anterior translation in subacromial impingement syndrome. Potential analgesic mechanisms of the method have been studied widely.^{11,19,22-25}

KT is an increasingly popular method for preventing and/or treating sports injuries. Applying stretching tapes within KT has been introduced widely by Kase et al²⁶ who proposed several benefits of the method: KT provides positional stimulus through the skin, aligns fascial tissues, creates more space by lifting fascia and soft tissue above the area of pain/inflammation, provides sensory stimulation to assist or limit motion, and assists in the removal of edema by directing exudates toward the lymph duct. KT can be applied to any joint or musculoskeletal region. Results on proprioception, stability, and reducing pain in various kinds of musculoskeletal painful conditions and in different age groups have been reported.²⁷⁻³¹ Thelen et al³¹ show that

KT of painful shoulder may be helpful in improving pain-free abduction immediately after taping when applied according to the protocol for rotator cuff tendonitis/impingement as suggested by Kase et al, but they also state that utilization of KT for decreasing pain intensity or disability for young patients with this pathology is not supported. It is believed that KT may be helpful in the reduction of poststroke shoulder pain, soft tissue inflammation, muscle weakness, and postural malalignment by improving the position of the glenohumeral joint. It may provide the proprioceptive feedback for achieving a proper body alignment.²⁸ KT has been found to be more effective than the local modalities (ultrasound, transcutaneous electrical nerve stimulation, exercise, and hot pack) in the first week of treatment and was similarly effective in the second week.³² KT may be an alternative option in the treatment of shoulder impingement syndrome especially when an immediate effect is needed.³²

The aim of this study was to determine whether MWM and KT give different results at the initial phase of the rehabilitation process when compared with a supervised exercises program in participants with shoulder pain who were diagnosed with rotator cuff lesion or/and impingement shoulder syndrome.

METHODS

Participants

In this double-blind randomized cross-sectional study, we followed the rehabilitation process of 20 participants, aged 34 to 79 years, who were diagnosed with rotator cuff lesion and/or impingement shoulder syndrome by the referring physician. Their main complaints were shoulder pain and painful, restricted ROM in the shoulder that compromised the activities of daily living. All the participants were treated during 2008 at the Clinic for Rehabilitation "Dr Miroslav Zotovic" in Belgrade, Serbia. Ethical clearance for the procedure in this study was obtained from the Review Board for Science and Research of the Clinic for Rehabilitation "Dr Miroslav Zotovic," Belgrade. Before the research was conducted, all the participants have given their signed and informed consent. This trial was registered with the Australian New Zealand Clinical Trials Registry ACTRN12611000359932.

The exclusion criteria were shoulder girdle fractures and dislocation, shoulder surgery in the last 12 months, physician diagnosis of adhesive capsulitis, full thickness rotator cuff tear, cervicobrachial pain due to cervical spine pathology, neuromuscular disorders in upper extremities, and use of corticosteroid and/or nonsteroid anti-inflammatory therapy within 10 days before the first day of measuring ROM. No subject could identify any acute, clearly defined traumatic event that provoked pain and restricted shoulder motion. All subjects were evaluated

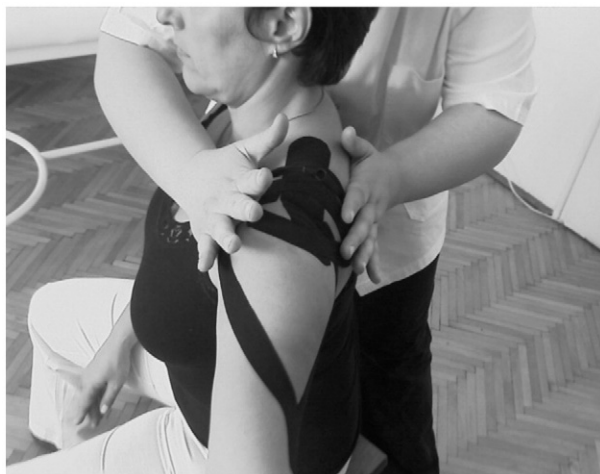


Fig 1. *MWM. We have applied posterolateral glide to humeral head as an accessory glide needed to correct positional fault.*

clinically, by radiography and ultrasound imaging of the painful shoulder. Clinical assessment included the following: assessment of posture and trophic in the scapular and shoulder region; cervical ROM; test for cervical nerve root affection (Spurling test); active shoulder ROM; passive shoulder ROM; assessment of scapulohumeral rhythm; tests to rule in/out rotator cuff tear: empty can test for the supraspinatus muscle, tests for infraspinatus muscle and teres minor muscle, and lift-off test for subscapular muscle^{33,34}; test to rule in/out shoulder impingement: Neer³⁵ and Hawkins Kennedy,³⁶ test for evaluation of the biceps brachii tendon (Speed test),³⁴ and manual muscle testing of shoulder girdle muscles' strength. Radiographic evaluations consisted of routine anteroposterior and axillary shoulder radiographs. Ultrasound imaging of the shoulder was performed with a linear array 11-MHz transducer of the Toshiba Nemio 30 apparatus (SSA-550A-20) (Otawara-shi, Tochigi-ken, Japan). We examined cortical bone contours, long head biceps tendon, bicipital groove, and rotator cuff tendons. We searched for effusion and bursas and explored the humeroscapular joint, acromioclavicular joint, and glenohumeral groove. We used von Haslebeck criteria for diagnosis of rotator cuff tendon rupture.³⁷ After assessment, participants were randomly allocated to 1 of 2 intervention groups: group 1 was treated by MWM and KT treatment, and group 2, by a supervised exercise program.

Procedure

After clinical and radiologic assessment (radiographic and ultrasound imaging of the painful shoulder), shoulder ROM measurements for each participant were then completed. Active pain-free flexion and abduction were measured, and these initial measurements were marked as flexion of day 0 and abduction of day 0, respectively. Participants were randomly allocated to group 1 or group 2. To ensure balance

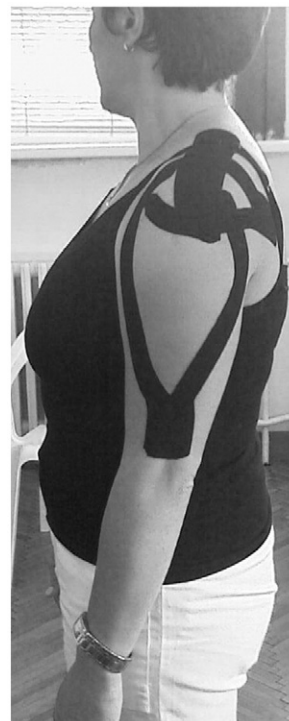


Fig 2. *KT was applied as a standardized shoulder application.*

between the 2 groups, we used a minimization process as a form of restricted randomization. Minimization was run by Minim version 1.5, a minimization program for allocating patients to treatments in clinical trials, written by Stephen Evans, Simon Day, and Patrick Royston, from the Department of Clinical Epidemiology, London Hospital Medical College, which can be downloaded from the Internet (<http://www-users.york.ac.uk/~mb55/guide/minim.htm>).³⁸ Group 1 received MWM and KT treatment, whereas group 2 received the supervised exercises program. The range of active pain-free flexion and abduction in the painful shoulder was measured again on days 5 and 10 of treatment.

To avoid bias, a clinical and ultrasound examination was carried out by the first author. Outcome measures were measured by the second author, who also remained blind to the group assignment. The third author, a physiotherapist and certified MWM and KT practitioner with experience in orthopedic rehabilitation of more than 15 years, was responsible for both groups' treatments. This third author was blind to the group assignment and also to the ROM measured on days 0, 5, and 10. She was also instructed not to discuss with the subject if his/her treatment was any different from the usual program applied to the painful shoulder.

Outcome Measures (Dependent Variables)

Outcome measures were taken by the second author who was blinded to the allotted treatment. Outcome measures (dependent variables) were pain-free active abduction and

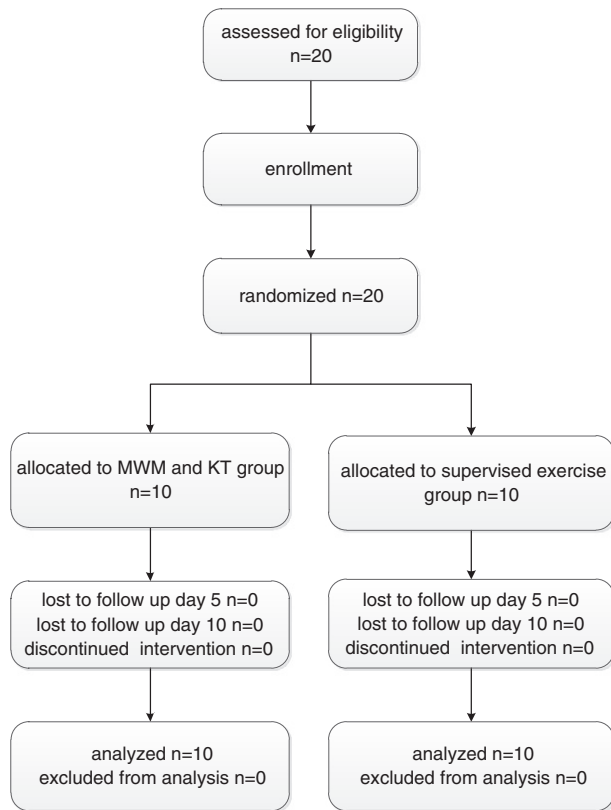


Fig 3. Flow diagram showing the progress of participants at each stage of the study.

flexion of the shoulder, expressed in degrees. The ROM was measured using the universal goniometer. Standardized goniometric measurements have been shown to have good intrarater reliability and validity.³⁹ The subject was positioned as for clinical assessment. The starting position of the shoulder was 0° glenohumeral joint abduction, 90° elbow flexion, and neutral supination/pronation forearm position. The fulcrum of the goniometer or its axis was always placed over stationary bony landmark, such as acromion. The subject moved the affected extremity to the end of a pain-free active range of shoulder flexion and abduction. The flexion angle was formed by aligning the moving arm of the goniometer with the lateral epicondyle and the midline of the humerus, whereas a stationary arm remained in its starting position, aligned with the lateral midline of the thorax. The abduction angle was formed by aligning the moving arm of the goniometer with the medial epicondyle and midline of the humerus, and the stationary arm remained still, parallel to the sternum.⁴⁰

Techniques (Treatments, Independent Variables)

MWM Technique. The physiotherapist, who was not involved in taking outcome measures, performed the treatment in both groups. Treatment for group 1 consisted of MWM and KT. During the MWM treatment, the participant was seated, and the therapist was positioned on the opposite side of

Table 1. Baseline demographics, clinical and ultrasound findings, and pretreatment (day 0) mean values (SD) for outcome variables

	Group 1	Group 2	P
Age in years	51.80 (5.3)	54.10 (6.8)	>.05 ^a
Sex (male:female)	4:6	3:7	1.000 ^b
Arm dominance	6 D and 4 ND	5D and 5 ND	1.000 ^b
Pain duration in months	4.7 (0.6)	4.8 (0.9)	>.05 ^a
Hypotrophy	4	5	.315 ^b
Empty can test positive	10	10	–
Hawkins Kennedy’s test positive	10	10	–
Neer’s test positive	10	10	–
Speed’s test positive	4	4	–
Rotator cuff tendinopathy	9	8	.4209 ^b
Partial rotator cuff tendon tears	6	6	–
Effusion around tendon of long head of M biceps brachii	3	4	–
SASD bursitis	4	5	–
Flexion 0 day in degrees	53 (28.48)	69 (14.63)	.151 ^a
Abduction 0 day in degrees	53 (21)	46 (14.28)	.419 ^a

D, dominant arm; ND, nondominant arm; SASD, subacromial subdeltoid.

^a Student *t* test.

^b Fisher exact probability test.

participant’s painful shoulder. The therapist applied the thenar of one hand on the anterior aspect of the participant’s humeral head and the other hand on his/her scapula. The hand on the humeral head performed a posterolateral glide, while the other hand stabilized the scapula. During this maneuver, the participant was encouraged to perform active shoulder movement to the point of the first onset of pain. Prescription details of MWM for experimental group were as follows: 10 repetitions in 3 sets daily, 30-second rest periods between sets; 10 sessions with 24 hours between sessions. We followed the MWM principle of reduction or elimination of pain. We have not specified the exact amount of posterolateral pressure applied, but we allowed up to 4 attempts to determine which amount was the best to eliminate the pain during the active movement in the shoulder (Fig 1).

KT Technique. Participants from group 1 received KT after the initial, 0 day measurements of shoulder ROM were taken. Before therapeutic KT was applied on the painful shoulder, the participant was first checked for allergy to the tape. It was done by applying a small (1 × 1 cm²) patch of tape on the volar side of contralateral forearm while looking for redness or other skin changes in 15 minutes. After the initial measurement and allergy testing, KT was applied. On day 5, tapes were taken off, ROM measurements were taken, and then KT was reapplied. The tapes were taken off definitively on day 10, just before the day 10 measurements of ROM were taken.

We used a standard 5-cm black Kinesio Tex tape for all the participants in the group 1. Taping procedure followed this order: supraspinatus muscle, deltoid muscle, and glenohumeral joint. The first strip of tape was torn down just above the anchor point where Y strip was formed. The anchor point of the strip was taped to the projection of insertion of the supraspinatus muscle on the greater

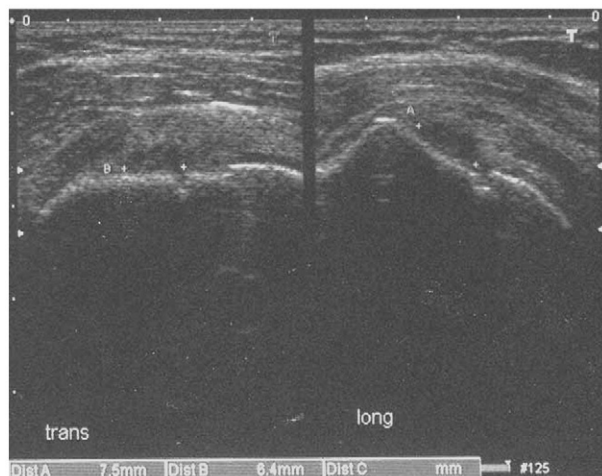


Fig 4. Partial rupture of the supraspinatus muscle tendon. Ultrasound image.

tubercle, and then the whole strip was taped along the supraspinatus muscle along the spine of the scapula to the muscle's origin, with paper-off tension and with approximately 20% to 25% stretch. Deltoid muscle was taped using Y strip as well, which was applied from anchor site, 3 cm below deltoid insertion to its origin, with paper-off tension. The front tail of Y strip was taped along the anterior edge of the deltoid, and the back tail was applied along the posterior edge of the deltoid muscle. Finally, glenohumeral joint was taped using an I strip, which was applied from a coracoid process following laterally, below the acromion, and around the posterior deltoid edge (Fig 2).

Supervised Exercises Program. Group 2 received the usual initial exercise program for impingement syndrome. It consisted of pendulum exercises and pain-limited, active ROM exercises of shoulder elevation, depression, flexion, abduction, rotations, and strengthening exercises. Strengthening exercises were isometric in nature, working on the external shoulder rotators, internal rotators, biceps, deltoid, and scapular stabilizers (rhomboids, trapezius, serratus anterior, latissimusdorsi, and pectoralis major). Prescription details of supervised exercise program for group 2 were as follows: 10 repetitions in 1 set daily, 30-second rest periods between sets of different types of exercises; 10 sessions with 24 hours between sessions. The participants were instructed to perform all the exercises to the first onset of pain.

Data Analysis

STATISTICA 8 software (StatSoft, Inc, Tulsa, OK) was used for the statistical analysis. The Fisher exact probability test and the Student *t* test were conducted to determine whether the 2 groups differed on the demographic (age and sex) and day 0 (pretreatment) characteristics: pain occurrence in dominant/nondominant arm, duration of pain, clinical and ultrasound findings, and day 0 active pain free

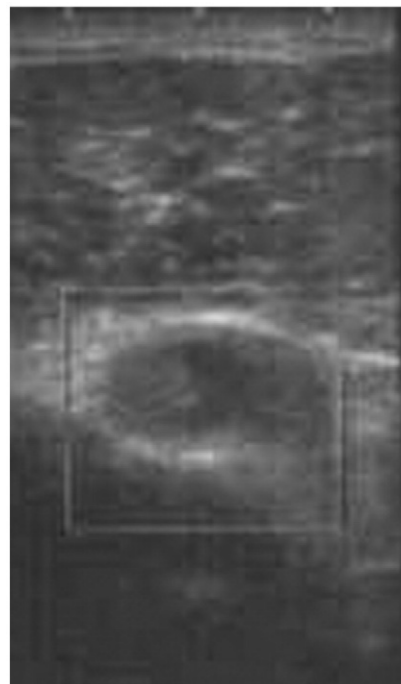


Fig 5. Effusion around tendon of long head of *M biceps brachii*. Ultrasound image.

shoulder flexion and abduction (outcome, dependent variables). Repeated-measures analysis of variance (ANOVA) was conducted for dependent variables, flexion and abduction on days 0, 5, and 10 (time) as the within-subject variable, and the 2 groups (treatments) as the between-subject variables. Differences were considered statistically significant when $P < .05$.

RESULTS

All subjects went through each phase of the study (flow diagram showing the progress of subjects at each stage of the clinical trial) (Fig 3).

Baseline demographics and descriptive statistics (pretreatment frequencies and pretreatment mean values [SD]) for outcome variables of each group are represented in Table 1. No significant differences between the 2 groups' age, sex, duration of shoulder pain, pain occurrence in dominant/nondominant arm, and clinical findings were found (Table 1).

The mean age in the groups were 51 years, 80 ± 5.3 years, in group 1 and 54 years, 10 ± 6.8 years, in group 2 ($t = 0.843$; $P > .05$). Both sexes were equally present in the 2 groups (Fisher exact, $P = 1.000$). Mean duration of pain was 4.7 ± 0.6 months in group 1 and 4.8 ± 0.9 months in group 2 ($t = 0.09$; $P > .05$). Pain occurred equally in dominant and nondominant arm in both groups (Fisher exact, $P = 1.000$) (Table 1).

Clinically identified impairments included decreased shoulder ROM active, positive tests for rotator cuff lesions

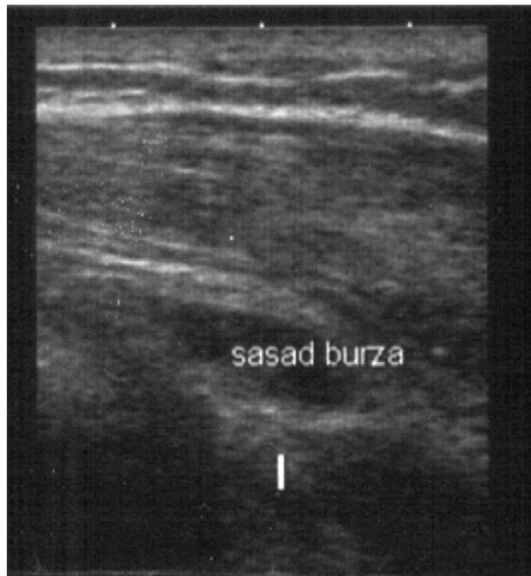


Fig 6. Subacromial subdeltoid bursitis. Ultrasound image.

and impingement syndrome, rotator cuff, and scapular mobilizers weakness (Table 1). Outcome for manual muscle testing for rotator cuff and scapular stabilizers was inconclusive due to pain. Alternatively, we could have administered local anesthetic or corticosteroid injection for obtaining more objective results on muscle strength, but this would not respect exclusion criteria. Outcome for posture of the scapular and shoulder region: in neutral position (shoulder abduction 0°), no winging of scapula nor asymmetry of the scapular position was found. Asymmetry of the scapular position at 45°, 90°, and 120° shoulder abduction was not obtainable for all subjects, due to restricted ROM. Slight hypotrophy of shoulder region was found in 9 cases: 4 in group 1 and 5 in group 2 (Fisher exact, $P = .315$) (Table 1). These were all the subjects whose duration of pain was 5 months or more. Empty can test, Hawkins Kennedy's test, and Neer's test was found positive in all subjects (Table 1). Test for subscapular tendon lesion was inconclusive due to painful shoulder internal rotation. Speed's test was found positive in 8 subjects: 4 in group 1 and 4 in group 2 (Table 1). No signs of cervical nerve root affection were found. X-ray results were normal in all the subjects (no bone lesions, joint subluxation/luxation, or calcification was found). Ultrasound findings (Table 1) in both groups were related to the impingement syndrome: tendinopathy (tendinosis) and partial rupture of the supraspinatus muscle tendon (Fig 4), effusion around long head biceps tendon (Fig 5), and subacromial subdeltoid bursa (Fig. 6). Because there were frequencies less than 5 (Table 1), we regrouped ultrasound findings into 2 categories and applied Fisher exact P . There was no statistically significant difference in ultrasound findings between the 2 groups (Fisher exact, $P = .4209$).

Table 2. Average ROM (SD) for outcome variables on days 0, 5, and 10 for both groups

Average ROM in degrees	Group 1	Group 2
Flexion day 0	53 (28.48)	69 (14.63)
Flexion day 5	105 (41.10)	72 (17.35)
Flexion day 10	166 (20.59)	86 (21.89)
Abduction day 0	53 (21)	46 (14.28)
Abduction day 5	112 (46.49)	47.5 (15.21)
Abduction day 10	170 (17.89)	60.5 (15.72)

Table 3. Repeated-measures ANOVA for flexion in time as within-subjects variable and treatment as between-subject variable

Flexion	F	P	Partial η^2	Observed power ($\alpha = .05$)
Treatment	10.76	.004	0.374	0.873
Time	59.16	.000	0.766	1.000
Treatment \times time	32.01	.000	0.640	1.000

There was no statistically significant difference in ROM between the 2 groups at the beginning of the rehabilitation (day 0, Table 1) (for flexion, mean flexion range for group 1 was $53 \pm 28.48^\circ$, mean flexion range for group 2 was $69 \pm 14.63^\circ$; $t = -1.499$, $P = .1511$; for abduction, mean abduction range for group 1 was $53 \pm 21^\circ$, mean abduction range for group 2 was $46 \pm 14.28^\circ$, $t = 0.827$; $P = .419$).

The average range of movement in time (days 0, 5, and 10) for both groups is presented in Table 2 and graph forms (Figs 7 and 8).

Repeated-measures ANOVA showed a significant treatment \times time interaction effect for both flexion and abduction: for flexion, $F_{2,36} = 32.012$, $P = .000$, partial $\eta^2 = 0.640$, observed power ($\alpha = .05$) = 1.000; for abduction, $F_{2,36} = 5.34$, $P = .009$, partial $\eta^2 = 0.229$, observed power ($\alpha = .05$) = 0.808 (Tables 3 and 4). The effect of treatment as between-subjects variable was also found to be significantly different (for flexion, $F_{1,18} = 10.760$, $P = .004$, partial $\eta^2 = 0.374$, observed power [$\alpha = .05$] = 0.873; for abduction, $F_{1,18} = 43.022$, $P = .000$, partial $\eta^2 = 0.705$, observed power [$\alpha = .05$] = 0.999). The effect of time as within-subject variable was also found to be statistically significant (for flexion, $F_{2,36} = 59.158$, $P = .000$, partial $\eta^2 = 0.766$, observed power [$\alpha = .05$] = 1.000; for abduction, $F_{2,36} = 59.610$, $P = .000$, partial $\eta^2 = 0.768$, observed power [$\alpha = .05$] = 1.000) (Tables 3 and 4).

DISCUSSION

Both groups experienced improvement in ROM of the painful shoulder after the 10-day period, although the treatment in time effect was found to be significantly different between the 2 groups, with greater effect in the MWM/KT group (group 1). MWM and KT seem to have a quicker effect on ROM of the painful shoulder than the

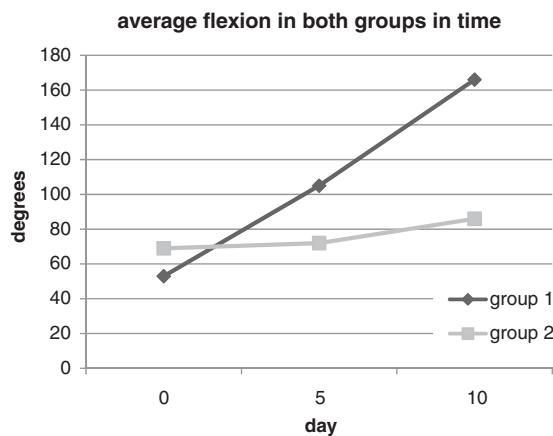


Fig 7. Average flexion in time (0, 5, and 10 days) for both groups. Dark line represents group 1; light line represents group 2.

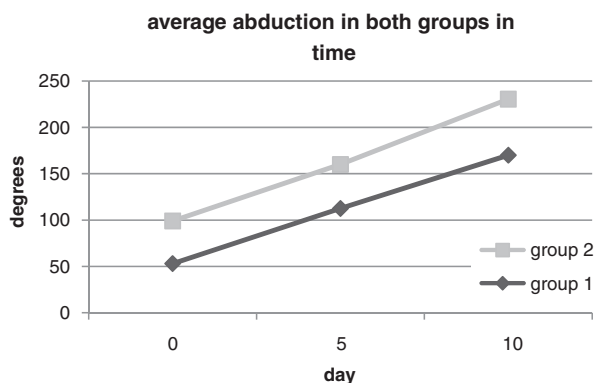


Fig 8. Average abduction in time (0, 5, and 10 days) for both groups. Dark line represent group 1; light line represent group 2.

supervised exercise program. Although there are several studies that deal with either MWM or KT in painful shoulder, none has ever dealt with MWM and KT at the same time. However, taping has been described as a form of therapy adjunctive to MWM treatment, with the helpful role of maintaining the effects of MWM treatment on some other joints, such as in case reports on ankle sprain⁴¹ or tennis elbow⁴² treatment. Mulligan⁹ states that the effects of MWM can be maintained further via taping and self-MWM, which may further enhance its potential long-lasting effects. It is stated⁴³ that taping can help maintain joint position and increase proprioceptive awareness. In cases of ankle sprain, taping applied to the fibula, while the therapist holds the anteroposterior glide, can complement the treatment effects.^{43,44} In addition, a home program of appropriate and correct movement patterns (program aimed at correcting muscle imbalance often found in painful shoulder, such as poor activation of the trapezius muscle) with the addition of taping can ensure a prolonged and

Table 4. Repeated-measures ANOVA for abduction in time as within-subjects variable and treatment as between-subject variable

Abduction	F	P	Partial η^2	Observed power ($\alpha = .05$)
Treatment	43.02	.000	0.705	0.99
Time	59.61	.000	0.768	1.000
Treatment \times time	36.36	.000	0.669	1.000

automatic pattern correction, which all integrate well with MWM.⁴⁰ MWM was found to have immediate positive effects on both ROM and pain among subjects with painful limitation of shoulder movements.¹⁰ In a case report by DeSantis and Hasson,⁴⁵ dedicated toward exploring the response of the glenohumeral joint to MWM (in a subject with supraspinatus tendinopathy due to impingement and restricted active shoulder abduction up to 95°), it was found that the subject had reached full abduction ROM after 12 MWM sessions. It is stated that MWM may be an effective treatment intervention for patients with subacromial impingement.⁴⁵ Comparison of 3 manual therapy techniques with therapeutic exercise in the treatment of shoulder impingement showed that the MWM group had the highest percentage of change in active ROM.²² A systematic review of randomized controlled trials, conducted to determine the effectiveness of different manual techniques for the treatment of musculoskeletal disorders of the shoulder, showed that MWM may be useful for short-term outcomes on shoulder dysfunction.⁴⁶ Quite a number of studies on the MWM technique's effects on other joints have reported its effects on subjects with de Quervain tenosynovitis,⁴⁷ acute and chronic ankle sprain,^{41,48-50} elbow lateral epicondylalgia,^{12,24,25,51,52} and intervertebral joints of the lumbar spine in low back pain.⁵³ KT, applied to rotator cuff tendonitis/impingement syndrome, showed improvement in pain-free shoulder abduction, but without any other significant ROM and functional improvements.³¹ Thelen et al³¹ also conclude that utilization of KT for decreasing pain intensity or disability for young patients with suspected shoulder tendonitis/impingement is not supported. KT was also found to be effective for immediate functional outcome improvement in shoulder impingement syndrome.³² It is stated that KT may help to support joint-creating structures and reduce soft tissue inflammation and pain.²⁸ Through its effect on sensorimotor and proprioceptive systems, it can assist in postural trunk and scapula alignment and support weak rotator cuff and deltoid muscle in subluxated shoulder in hemiplegic patient.²⁸ KT was also found to be helpful in improving arm and hand motor function and providing needed stability of the shoulder and hand in acute pediatric rehabilitation setting.⁵⁴

Keeping in mind the original idea of the MWM technique, namely, correcting the positional fault in malaligned ergo painful joint, while also supporting any corrective effect that KT may have on joint alignment, our

idea was to apply both techniques simultaneously to perpetuate the same goal. Mechanisms of MWM action have been studied before. The positional fault hypothesis states that injuries lead to positional faults in the joint, which result in pain and limited ROM; hence, correction of the positional fault would consequently reduce pain and increase ROM. Evidence of radiographic positional faults in chronic ankle sprain supports this hypothesis.²³ A randomized controlled trial by Collins et al¹¹ showed significant immediate improvement of ankle dorsiflexion in 14 subacute ankle sprains after MWM application. On the other hand, a case study by Hsieh et al,¹⁹ using magnetic resonance imaging to evaluate position of the proximal phalanx of the injured thumb before and after MWM treatment, did not show long-term changes of the proximal phalanx positional fault despite long-term pain-relieving effects. Paungmali et al²⁴ found that hypoalgesic effects after MWM for chronic epicondylgia concurred with signs of sympatoexitation; they also found that these hypoalgesic effects seem to be of nonopioid origin.^{12,25} It is also suggested that improving function and reducing pain after MWM may be due to the promotion of active movement in this technique, which may engage additional proprioceptive tissues, such as the Golgi tendon organ activated by tendon stretch.²² Although there is no substantial evidence of any long-term effect on correcting the positional fault by MWM on painful shoulder, improvements in ROM have been shown.^{10,22,45,46} On the other hand, a beneficial role of an isolated KT application in painful shoulder due to impingement and rotator cuff injury generally showed immediately after application, although not in a long-term period.^{31,32} In our study, posterolateral supports of glenohumeral joint in MWM and KT were crucial procedural differences between groups 1 and 2. Mindful of the anterior translation of humeral head found in numerous studies on painful shoulder with impingement syndrome,¹⁵⁻¹⁷ the positional effect of MWM or MWM and KT seems to be of some importance for improving active ROM.

Limitations of the Study

Although our idea was to unite the corrective principles of both techniques and examine their effects on ROM in shoulder impingement syndrome, it would have been useful had we also an additional group with only MWM treatment. Having the additional group with only MWM treatment and also the additional control group (with no treatment) would allow us to isolate the effects of MWM and KT therapy and to judge if the improvement in active ROM in group 1 was due to synergistic effect of these 2 treatments or the result of one of them. Another limitation of this study was a small sample size. Larger sample size would improve the accuracy of the results and would probably allow us segmentation (younger vs older participants, among different pathologies in impingement syndrome, and so on). In addition, the effects of the MWM and KT were

followed during the initial 10-day period, and the time course of these effects is still unknown. Besides that, only active ROM was measured, but no measures of pain, disability, or function were followed.

Further research is planned with a larger sample size, an additional MWM-only-treated group, and an additional control (no treatment) group with more outcome measures related to the pain and functional outcome and with long-lasting effects of the methods, to be followed.

CONCLUSION

Our results suggest that MWM and KT may be useful therapy modalities in improving active ROM in painful shoulder.

Practical Applications

- MWM technique and KT are widely applied to different painful joint conditions.
- They can be applied in impingement shoulder syndrome at any time.
- MWM technique intends to realign subtly malpositioned relationships in shoulder joint and to practice active movement within these corrected circumstances. KT seems to have a helping role in maintaining these corrected relationships of the joint-creating structures.
- Initial effects in improving ROM and reducing pain in impingement shoulder syndrome are better comparing with supervised exercise program.

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