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EFFECT OF MOTOR CONTROL RETRAINING OF SCAPULAR STABILIZERS VERSUS MULLIGAN MOBILISATION WITH MOVEMENT IN SHOULDER IMPINGEMENT SYNDROME

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ABSTRACT

Background: Shoulder Impingement is one of the most common causes of shoulder pain in adults. Scapular muscle imbalances results in impaired scapular orientation with altered scapular kinematics and altered glenohumeral rhythm.

Purpose of study: To study the effect of motor control retraining of scapular stabilizers versus mulligan mobilisation with movement in shoulder impingement patients.

Methodology: 60 patients with positive Hawkins, kinetic medial rotation and/or Neer impingement test were taken for the study as subjects. They were then divided into two groups of 30 each- Group A and Group B. Both the groups were assessed and reassessed for(i) pain status using VAS (Visual Analogue Scale) both at rest and on internal rotation, (ii)Shoulder Flexion, Extension, Shoulder Abduction, Adduction, Internal and External Rotation Range Of Motion (ROM), (iii)Functional Scale SPADI(Shoulder Pain and Disability Index) pre and post the intervention. Group A received motor control retraining of scapular stabilizers whereas group B received Mulligan's mobilization with movement for 6 weeks (3 times in a week). Both the groups received conventional physiotherapy. Data analysis was done using Wilcoxon sign ranked test for intragroup comparison and Manwhitney test for intergroup comparison.

Results: The results showed statistically significant improvement in shoulder pain, ROM and shoulder function in motor control retraining as compared to mulligan mobilisation with movement.

Conclusion: Motor control retraining of scapular stabilizers is more effective treatment technique as compared to mulligan mobilisation with movement in shoulder impingement.

KEYWORDS: Shoulder Impingement, Mulligan's Mobilisation with Movement, motor control retraining of scapular stabilizers, VAS, SPADI.

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INTRODUCTION

Shoulder impingement represents mechanical compression of the rotator cuff tendons and subacromial bursa against the anteroinferior undersurface of the acromion and coracoacromial ligament especially during elevation of

Several kinematic changes are present in people with symptoms of impingement which results in further decrease in the available supraspinatus muscle outlet or suprahumeral space [4,5]. This reduction in suprahumeral space is caused by the movements that bring the greater tuberosity in closer contact with the coracoacromial arch [6]. These movements include excessive superior or anterior translation of the humeral head on the glenoid fossa, inadequate lateral (external rotation) of the humerus and decrease in the normal scapular upward rotation and posterior tipping on the thorax, which occurs during humeral elevation. These kinematic changes all have been purported to occur in patients with symptoms of impingement [7]. These altered kinematics in scapular motion is linked with altered muscle firing patterns in shoulder impingement syndrome [7-9]. In healthy subjects, it was found that fatigue of the axioscapular muscles can result in a destabilized scapula during humeral elevation. Myoelectric signs of fatigue in the upper and lower trapezius and serratus anterior corresponded in a 50% decrement in peak force generating capacity.

The scapular stabilizers are susceptible to fatigue, resulting in altered scapulothoracic kinematics. Due to these altered kinematics associated with altered muscle firing patterns, motor control alterations occur. Motor control alterations have been proposed as a cause of these muscles activity changes. These motor control changes may include delayed activation of the muscle such that it fails to be recruited on time and or fails to maintain its required level of activation throughout the range of motion. Conversely, excess activation of the muscles may occur. Improper muscle control is characterized by changes in the muscle activation levels. It has been observed that, there is low activity of serratus anterior, high activity of upper trapezius [10] and there is lack of co-ordination between the different parts i.e; upper, middle and lower trapezius [11].

This inadequatemuscle control is believed to contribute to a reduction of amplitude in posterior tilting and lateral rotation of the scapula during arm elevation [10,12]. Lower activity of the infraspinatus and subscapularis [13] as well as inadequate coactivation of the scapulo-humeralmuscles [14] have also been reported. This abnormal muscle control is most likely associated with a reduction of the subacromial space [15,16] leading to impingement.

Physical therapy has been found to be effective in reducing pain and disability in patients with shoulder impingement syndrome. Effective interventions include therapeutic exercises focusing on strengthening the rotator cuff and scapular stabilizing musculature [17,18], stretching to decrease capsule tightness [19], scapular taping techniques [20] and patient education of proper posture [21]. Studies suggest that incorporation of joint mobilization to treat shoulder impingement results in superior outcomes compared with therapeutic exercises alone[22-27].

Mulligan mobilization with movement (MWM) is used for treating shoulder impingement syndrome patients as it has immediate pain relief and improved range of motion [22-24].

Motor control retraining of scapular stabilizers helps to maintain normal scapular posture and proper length tension relationship of scapular muscles, as it gets altered and results in impairments in shoulder impingement syndrome [25].

A manual therapy approach in treating shoulder dysfunction is the Mulligans concept of mobilization with movement (MWM) [26,27].

The goal of performing MWM is immediate and sustained improvement in joint pain and mobility. Mulligans technique involves application of an accessory mobilization to a peripheral joint by the physical therapist, while the patient simultaneously generate painfree active movement. Mulligans theory is that injured joint or chronic state of malalignment is present within the joint and technique may assist in properly aligning the joint tracking mechanism [26,27].

The direction of the applied forces (translation or rotation) is typically perpendicular to the plane of movement or impaired action and in some instances it is parallel to the treatment plane [26,28]. Kinematic studies of patients with impingement have demonstrated abnormal or excessive superior or anterior translation of the humeral head in the glenoid fossa [6,7]. Along with decreased posterior tipping, external rotation and upward rotation of scapula. Also there is excessive translation of the humeral head along the glenoid fossa, which results in pain and functional impairments [29,30]. It has been suggested that the application of posterolateral glide MWM to head of humerus correct this positional fault, correcting the humeral head position improving scapular posture, resulting in proper orientation of glenoid fossa which allow optimal painfree motion to occur [29].

The shoulder MWM may be a useful manual therapy technique to apply to participants with a painful limitation of shoulder elevation in order to predominantly gain an initial improvement in range of motion and pain pressure threshold. It has been postulated that mechanisms responsible for manual therapy treatment effects (eg as an increase in range of motion and pain pressure threshold) may feasibly involve changes in the joint, muscle, pain and motor control systems [23,29,30]. Only two studies have been published supporting benefits of performing shoulder MWM in treating dysfunction [31,32]. One case study using MWM, a patient with shoulder impingement reported a decrease in pain, improvement in function and improvement in shoulder abduction active range of motion [31].

Roy et al, reported that intervention based on motor control theory for SIS patients changed the quality of the activity of the shoulder bones and the muscles and it improved the abnormal movement and instability of the glenohumeral and scapulothoracic motion and the sternoclavicular joint. This motor control theory (exercise control theory) have been prescribed for musculoskeletal patients. According to this theory, abnormal movement by damage or disease reorganizes the cerebral cortex, finally leading to changes in the brain and the altered brain is reorganized by performing correct exercise strategy. Based on this, normal movement can be achieved without inflammation and pain of the subacromial tissue..From the kinetical aspect, this result showed an improved ability to control movement and importance of exercise control as an intervention for SIS patients [25]. Retraining motor programming, or the neural control in panjabis model is dependent on motor learning. Motor learning involves learning new strategies for sensing as well as moving, arising from complex of perception – cognition- action processes. Motor learning can be enhanced by the use of mental imagery, tactile, verbal, visual, taping, weightbearing, movement oriented cues – different cues are effective with different people. Initially, facilitation is undertaken in an optimal position for the relevant muscle, usually midrange [32,33]. Roy et al reported that a combination of motor control and muscle strengthening exercise decreased pain and improved function. However, this research had a single subject design and the authors noted need for a control group in further study. Since these reviews, recent evidence has demonstrated that motor control and strengthening exercises can improve function in shoulder impingement patients; but the evidence is limited to a small sample single-subject study design. Realigning the scapula can change muscle recruitment patterns in patients with neck pain, but this has yet to be shown in shoulder pain [25].

Peripheral musculoskeletal impairments can be associated with cortical reorganization, and movement retraining using the principles of motor learning can change motor control in athletes and improve function in lower back pain patients [34]. As there is paucity of literature, because only single subject designs are being performed hence there is a need to conduct study to find the effect of motor retraining of scapular stabilizers and MWM in shoulder impingement syndrome patients and to compare between them.

MATERIALS AND METHODOLOGY

Approval for study was taken from committee for Academic Research Ethics. Written informed consent was taken from patients.

Inclusion Criteria: Subjects of both gender of age 30 and above with unilateral shoulder pain with impingement syndrome with positive signs of following 3: 1. pain on anterolateral aspect of shoulder. 2. pain on kinetic medial rotation test. 3. pain on Neer impingement test 4.pain on Hawkin kennedy test, impingement syndrome test 5. pain on empty can test 6. pain on impaired scapular posture, rounded shoulder (plinth - acromion distance of one inch or more).

Exclusion Criteria: Subjects with 1.Shoulder conditions like adhesive capsulitis, instability, labral tears, rotator cuff injuries 2.Any traumatic (fracture), infective, neoplastic condition affecting shoulder joint 3.Any cervical pathological condition Type 3 impingement syndrome(tear or tendon rupture, spurs or osteophytes on acromion.

Visual Analogue Scale (VAS) was used to record subjects pain at rest, on internal rotation, on reaching back. Assessment of shoulder range of motion for flexion, abduction, internal rotation and external rotation was done using universal goniometer in supine position. Scapulohumeral rhythm was assessed in standing during flexion and abduction. Shoulder function was assessed using shoulder pain and disability index.

Total 60 subjects satisfying the inclusion criteria were randomly divided into two groups by computer assisted randomization.

Group A – Motor control retraining of scapular stabilizers and

Group B – Mulligan mobilization with movement.

Group A : Motor control retraining of scapular stabilizers who received training of middle trapezius, lower trapezius, and serratus anterior.

1. Middle trapezius: 51

Patient in prone lying position with the shoulders horizontally abducted with external rotation i.e, thumb up position. Frequency of exercise – 2 sets of 10 repetitions with 10 seconds hold.

2. Lower trapezius: 51 Patient in prone lying with shoulders diagonally overhead or flexed to 120degrees. Or patient in prone lying shoulders 90 degrees abducted with external rotation andelbow flexed 90 degrees. Frequency of exercise – 2 sets of 10 repetitions with 10 seconds hold.

3. Serratus anterior (wall push):

Patient standing facing the wall with shoulders flexed to 90 degrees with elbows extended so that scapulae are in abducted position and patient is asked to move the scapula outwards and rotate the scapula upwardly with the therapist facilitating with tactile and verbal cues by palpating the medial border of scapulae for activation of serratus anterior muscle.

Frequency of exercise – 2 sets of 10 repetitions with 10 seconds hold

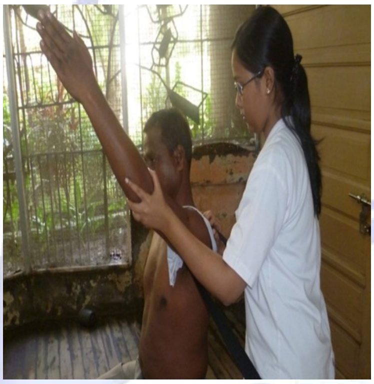
Group B: Patients received

Mulligan mobilization with movement [31]

1. Flexion: Patient in sitting position on chair. Therapist standing behind the patients involved shoulder in a posterolateral direction with the mobilization belt placed on the head of the humerus with one hand of therapist stabilizing the scapula. Posterolateral glide is given and the patient is asked to actively flex the shoulder with the maintenance of the glide.

Starting Position for flexion

End Position for flexion



2. Abduction: Patient position same as above, posterolateral glide is given with the mobilization belt over the head of humerus with one hand of therapist stabilizing the scapula and patient is asked to actively abduct the shoulder.

Frequency – minimum 3 repetitions depending on the stage of tissue healing and then progressing to 3 sets of 10 repetitions with 30 seconds interval between 2 sets (for both flexion and abduction).

Both groups received ultrasound therapy, Muscle energy technique for shortened pectoralis minor muscle, rotator cuff exercises, active range of motion exercise for flexion and abduction.

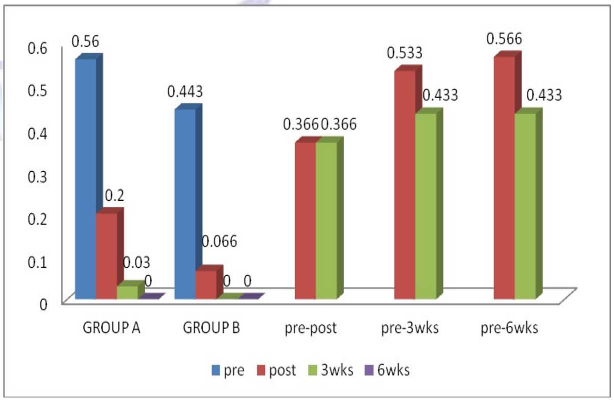
Outcome measures were assessed on1st day pre and post treatment, after 9 sessions (3 weeks) and 18 sessions (6 weeks)

RESULTS

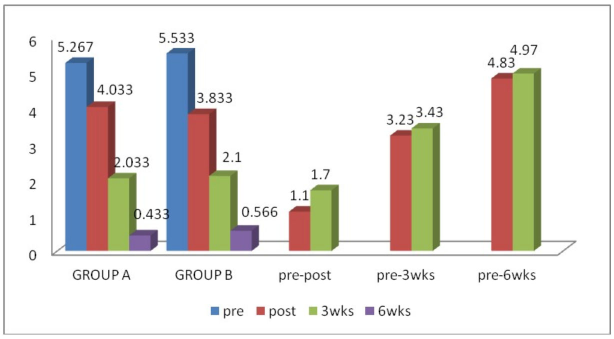
Statistical Analysis: The data was analyzed using SPSS software version 16.0. There was no statistical difference between the groups at baseline. The data was assessed for normality test Kolmogorov-Smirnov test. Pain passed normality test in both groups A and B. Thus paired t test was used for intragroup comparison and unpaired t test for intergroup comparison of mean. Wilcoxon test (intragroup comparison of median) was used for range of motion and shoulder pain and disability index as it did not pass the normality test. The P value less than 0.05 was statistically taken as significant.

Pain on VAS at rest, internal rotation and hand to back activity on treatment, pre – post, pre – 3 weeks, pre – 6weeks was statistically significantly reduced in group A and group B with P value (<0.00). But, intergroup comparison pre– post, pre – 3weeks, pre – 6weeks reduction in pain was not statistically significant with p values (pain at rest) = 0.99, 0.60, 0.50 respectively. Pain on internal rotation pre–post statistically significantly reduced in group B with P value (<0.00). pre – 3weeks, pre – 6weeks reduction in pain was not statically significant with p values= 0.17, 0.55 respectively. Pain on hand reaching back intergroup comparison pre–post statistically significantly reduced in group B with P value (<0.00). pre – 3weeks, pre – 6weeks reduction in pain was not statistically significant with p values= 0.81, 0.31 respectively.

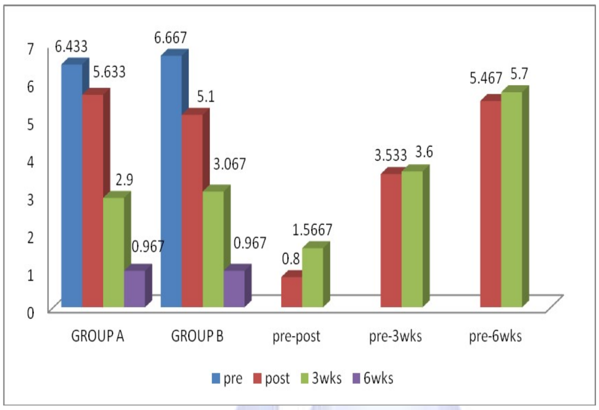
COMPARISON OF CHANGES IN MEAN SCORE ON PAIN ON VAS AT REST BETWEEN GROUPS A AND B.



COMPARISON OF CHANGES IN MEAN SCORE ON PAIN ON VAS ON INTERNAL ROTATION BETWEEN GROUPS A AND B.



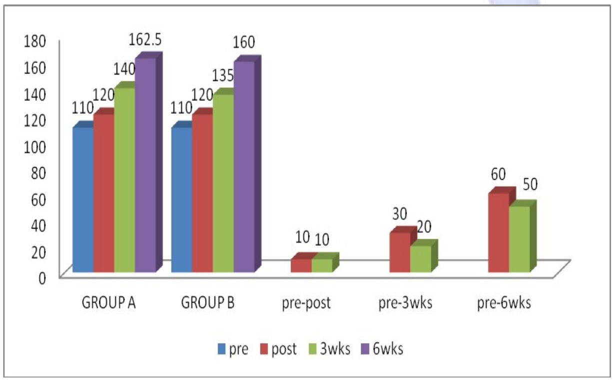
COMPARISON OF CHANGES IN MEAN SCORE ON PAIN ON VAS ON HAND TO BACK BETWEEN GROUPS A AND B



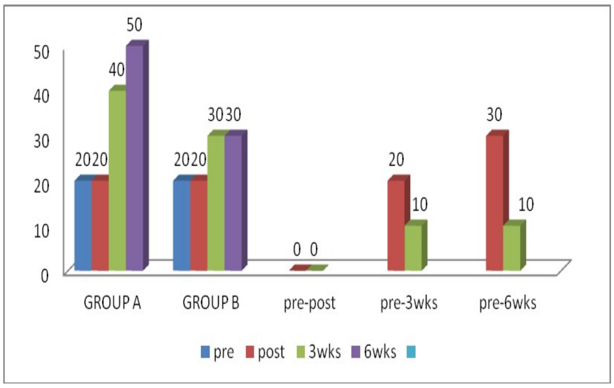
Range of motion for flexion on treatment, pre – post, pre – 3weeks, pre – 6weeks was statistically significantly improved in group A and group B with P value(<0.00).Intergroup comparison pre–post improvement was not stastistically significant pvalue(0.10), whereas improvement pre-3wks, pre-6wks was more in group A as compared to group B pvalue(<0.00).

Range of motion for altered glenohumeral rhythm angle in flexion on treatment, pre – post, pre – 3weeks, pre – 6weeks was stastistically significantly improved in group A and with P value(<0.00). In group B, improved range of motion for altered glenohumeral rhythm angle in flexion on treatment pre– post was not statistically significant p value(0.25), pre–3 weeks, pre–6weeks was statistically significantly improved in group B with P value(<0.00). Intergroup comparison pre–post improvement was not statistically significant p value(0.06), whereas improvement pre-3wks, pre-6wks was more in group A as compared to group B which was statistically significant p value(<0.00).

COMPARISON OF CHANGES IN MEDIAN SCORE ON FLEXION BETWEEN GROUPS A AND B



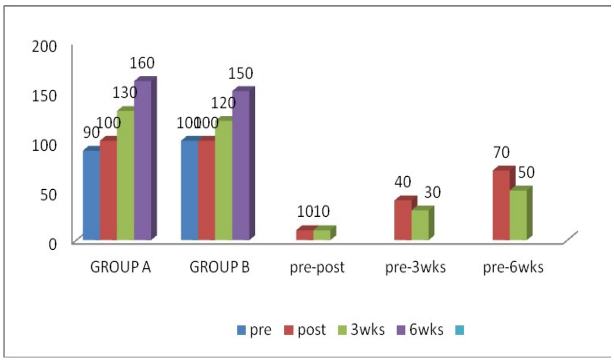
COMPARISON OF CHANGES IN MEDIAN SCORE ON FLEXION ALTERED GLENOHUMERAL RHYTHM ANGLE BETWEEN GROUPS A AND B



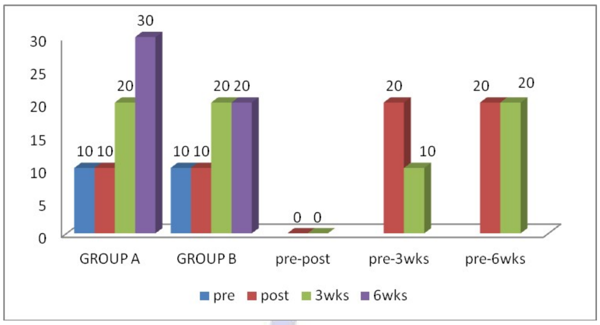
Range of motion for abduction on treatment, pre – post, pre – 3weeks, pre – 6weeks was statistically significantly improved in group A and group B with P value(<0.00). Inter group comparison pre–post improvement was not stastistically significant p value(0.35), whereas improvement pre-3wks, pre-6wks was more in group A as compared to group B which was statistically significant with p value(<0.00).

Range of motion for altered glenohumeral rhythm in abduction on treatment, pre – post, pre – 3weeks, pre – 6weeks was statistically significantly improved in group A with P value(<0.00). In group B, improved range of motion for altered glenohumeral rhythm in abduction on treatment pre– post was not statistically significant with p value(0.5), pre – 3weeks, pre – 6weeks was statistically significantly improved in group B with P value(<0.00). Intergroup comparison pre–post improvement was not statistically significant p value(0.35), whereas improvement pre-3wks, pre-6wks was more in group A as compared to group B which was statistically significant with p value(<0.00).

COMPARISON OF CHANGES IN MEDIAN SCORE ON ABDUCTION BETWEEN GROUPS A AND B

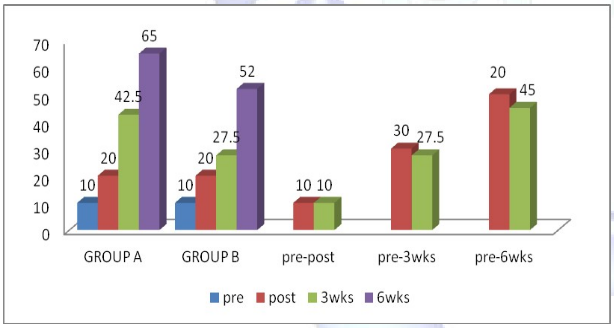


COMPARISON OF CHANGES IN MEDIAN SCORE ON ABDUCTION ALTERED GLENOHUMERAL RHYTHM BETWEEN GROUPS A AND B



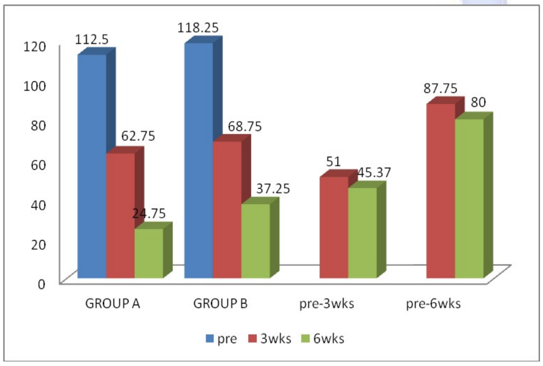
Range of motion for internal rotation on treatment, pre – post, pre – 3weeks, pre – 6weeks was statistically significantly improved in group A and group B with P value(<0.00). Inter group comparison pre–post improvement was not statistically significant p value(0.10), whereas improvement pre-3wks, pre-6wks was more in group A as compared to group B which was statistically significant with p value(<0.00).

COMPARISON OF CHANGES IN MEDIAN SCORE ON INTERNAL ROTATION BETWEEN GROUPS A AND B



Total score in SPADI on treatment, pre – 3weeks, pre – 6weeks was statistically significantly improved in group A and group B with P value(<0.00). Intergroup comparison, improvement pre-3wks, pre-6wks was more in group A as compared to group B which was statistically significant with p value(<0.00).

COMPARISON OF CHANGES IN MEDIAN TOTAL SCORE ON SPADI BETWEEN GROUPS A AND B.



DISCUSSION

Motor control retraining group receiving scapular stabilizers showed statistically significant improvement in shoulder range of motion and function assessed using shoulder pain and disability index (SPADI).as compared to group B which receive mulligan's posterolateral glide with active movement of flexion and abduction. However there was statistically significant improvement in in pain on VAS immediate post session day 1 in group B as compared to group A. But at the end of 6 weeks between groups comparison did not show any statistically significant difference in reduction of pain, thus suggesting that, reduction in pain was similar for both the groups.

Kinematic studies of patients having shoulder impingement syndrome have demonstrated altered scapular posture with change in the orientation of the glenoid fossa. During humeral elevation there is decrease in normal scapular upward rotation, decrease posterior tilting on the thorax and excessive winging of scapula. Also, there is excessive superior or anterior translation of the humeral head on the glenoid fossa, inadequate lateral (external rotation) of the Humerus [7,8]. All of these results in pain and functional impairments [30]. These altered kinematics are associated with motor control changes which includes delayed activation of the muscle such that it fails to be recruited on time and or fails to maintain its required level of activation throughout the range of motion in middle trapezius, lower trapezius and serratus anterior. Conversely, excess activation of the muscles may occur which is seen in upper trapezius, levator scapulae.

Hence, improper muscle control is characterized by change in the muscle activation levels. It has been observed that, there is low activity of serratus anterior, high activity of upper trapezius [10] and there is lack of co-ordination between the different parts i.e. upper, middle and lower trapezius [11]. This inadequate muscle control is believed to contribute to a reduction of amplitude in posterior tilting and lateral rotation of the scapula during arm elevation [10,12] which changes the orientation of the glenoid fossa along with superior and anterior translation of humeral head with respect to glenoid (Sahrman SA 2002) and is considered to be the potential mechanism for subacromial impingement resulting in decreased range of motion and pain during elevation.

Subjects participated in this study also demonstrated altered scapular posture which was assessed with visual inspection. Out of 60 patients with SIS, 87% patients (n=52) showed prominence of the scapular inferior angle with respect to thorax and superior angle suggests anterior tilting. With 83% patients (n=50) demonstrated entire medial scapular border prominent relative to the thorax indicating excessive internal rotation of scapula. With all patients showed downward rotation i.e; 73% patients (n=44) which was measured by line joining root of spine of scapula to acromion, showed horizontalscapula spine inclination and 26% (n=16) showed scapula spine in a inferolateral inclination, where normally scapula spine is in superolateral direction.

Also 55% patients (n=33), presented with scapular elevation with medial scapular spine and inferior scapular angle superior to the T3-4 and T7–9 spinous processes, respectively [35]. This results in muscle length imbalances in serratus anterior, middle trapezius, lower trapezius and pectoralis minor as mentioned above.

Acromion to plinth distance was measured (mean value pre treatment was 6.3cm) which suggests shortening of pectoralis minor (Sahrman) resulting in anterior tilting of scapula [36]. Also as reported in literature, subjects had altered movement patterns during arm elevation in frontal plane i.e. during abduction and in sagittal plane i.e. during flexion. It has been shown that the persons with SIS used a different motor strategy during reaching tasks in the frontal plane. Specifically, these persons used more trunk rotation and clavicular elevation, and finished reaching with the trunk more rotated, clavicle more elevated and shoulder in a more anterior plane of elevation. The explanation for these results is that such movement strategies may be used to protect the impaired shoulder following superior displacement of the humeral head during arm elevation. By using more trunk rotation, persons with SIS elevate their arm in a manner that prevents them from going into the frontal plane where the subacromial space is minimal along with abnormal eccentric control while lowering the arm. This results support our findings of movement dysfunction as the patients presented with anterior tilting, elevation, decreased upward rotation and decreased external rotation (winging) of scapula. It has also been suggested that during arm elevation there is inability to dissociate trunk movements from scapular movements (kibler). It was observed in this study, that during full elevation, flexion was accompanied with trunk extension.

These movement dysfunctions were observed and measured by altered glenohumeral angle during flexion by palpating inferior angle and the medial border which suggested anterior tilting and winging of scapula respectively. During abduction, scapular retraction due to lack of scapular muscle control, inability to laterally rotate the humerus in frontal plane resulting abduction in scapular plane due to pain, decreased upward rotation of scapula and lateral trunk flexion to opposite side.

In this study, all the patients with SIS demonstrated decreased range of motion with altered glenohumeral pattern pre treatment group A median values, Flexion – 110 with altered glenohumeral rhythm angle - 20, Abduction – 90 with altered glenohumeral rhythm angle – 10, Internal rotation – 10, External rotation – 50. Pre treatment group B median values, Flexion – 110 with altered glenohumeral rhythm angle - 20, Abduction – 100 with altered glenohumeral rhythm angle – 10, Internal rotation – 10, External rotation – 55.

hese movement dysfunction have been observed in musculoskeletal disorders and these peripheral impairments results in altered cortical representation. Hence, motor control theory (exercise control theory) have been prescribed for musculoskeletal patients. According to this theory, abnormal movement by damage or disease reorganizes the cerebral cortex, finally leading to changes in the brain and the altered brain is reorganized by performing correct exercise strategy. Based on this, normal movement can be achieved without inflammation and pain of the subacromial tissue [25]. Hence, exercises focusing on improving the dynamic control of the shoulder can significantly improve symptoms of impingement, making specific reference to serratus anterior and lower trapezius. Hence, motor control retraining becomes the integral treatment technique. The goal of motor control rehabilitation is to gain awareness of, and the ability to, activate the deep stabilizers of the region prior to activation of the, usually, more superficial torque producing muscles and to maintain that activation during activity. This involves motor programme retraining which includes facilitation by verbal, visual cues, tactile feedback, movement facilitated by imagery for the refined, controlled activation of the deep stabilizing force couples [37]. The improvement in range of motion in group A could be attributed to the motor control retraining of scapular stabilizers which works on the principle of specificity of muscle function [38,33].

According to Doyon and Benali, the first steps of learning are characterized by improvement in performance occurring within a single session. Still, the skills are not consolidated and multiple training sessions are needed before their consolidation. Present results support this view with short-term positive changes, but minimal retention 24 hours after. One session, therefore, was not enough to bring permanent changes in motor strategies [39].

Retraining motor programming, or the neural control in Panjabi's (1992) model, is dependent on motor learning [40]. Motor learning has been defined as "a set of internal processes associated with practice or experience leading to relatively permanent changes in the capability of skilled behaviour [41]. It involves learning new strategies for sensing as well as moving, arising from a complex of perception— cognition—action processes [42]. According to Fitts & Posner, the first phase of learning is the cognitive stage. It is during this stage that the use of extrinsic feedback is thought to be the most effective since it brings awareness to movement deficits. Hence, in this study; the focus was to improve activation of the middle trapezius, lower trapezius and serratus anterior whichare the scapular stabilizers.

Thus, retraining of scapular stabilizers improved the kinematics resulting in posterior tilting, upward and external rotation of the scapula. This in turn corrects the orientation of the glenoid fossa i.e; improved scapular posture which is reflected with statistical significant improvement in acromion to plinth distance with median value groupA(pre-post-0.3, pre-3 wks-1.3, pre-6wks-2.45) than group B(pre-post-0.2, pre-3wks-1, pre-6wks-1.9) with pvalue<0.0001(S.)and thus increasing the subacromial space and decreasing the impingement of subacromial structures during elevation (flexion).

Improvement in range of motion of shoulder external rotation range of motion group A (pre-post-5, pre-3wks-20, pre-6wks-30) than group B(pre-post-5, pre-3wks-15, pre-6wks-20) with p value<0.0001(S.) which is associated with in improved abduction range of motion median values group A (pre-post-10, pre-3wks-40, pre-6wks-70) than group B(pre-post-10, pre-3wks-30, pre-6wks-50) with p value<0.0001(S.), glenohumeral altered abduction rhythm angle group A(pre-post-0, pre-3wks-20, pre-6wks-20) than group B(pre-post-0, pre-3wks-10, pre-6wks-20) with p value<0.0001(S.), Also improvement in internal rotation range of motion group A (pre-post-10, pre-3wks-30, pre-6wks-50) than group B(pre-post-10, pre-3wks-27.5, pre-6 wks-45) with p value<0.0001(S.)which is associated with improved flexion in group A median values{(pre-post10, pre-3wks-30, pre-6wks -60) as compared to group B(pre-post -10, pre-3 wks- 20, pre-6wks -50) with p-value<0.001(S.)}, altered glenohumeral angle during flexion with median values(pre-post-0, pre-3wks-20, pre-6wks-30) than group B(pre-post-0, pre-3wks-10, pre-6wks-10) with p value<0.0001(S.).

Motor control retraining involves neurophysiological and biomechanical changes, with significant changes seen in muscle recruitment patterns which optimize scapular kinematics during humeral movements [43].

Improvement in group B receiving MWM can be attributed to correction of the positional fault, as mentioned above. Mulligan originally postulated a positional fault cause of this occurs secondary to injury and lead to changes in the shape of articular surfaces, thickness of cartilage, orientation of fibres of ligament or direction of pull of muscles and tendons (Mulligan 2004, Wilson 2001).

As MWM involves a posterolateral glide to the head of humerus which corrects this positional fault and allow optimum pain free motion to occur [26]. Biomechanical analysis of the MWM's posterolateral glide causes correction correction of the positional fault i.e; anteriorly translated humeral head in glenoid fossa, with active flexion and abduction movement thereby centering the humeral head in glenoid fossa. This correction of the scapular posture, may have improved activation of the scapulothoracic and glenohumeral muscles. This active component would stimulate the muscle spindles and Golgi tendon organs which in turn would convey the CNS information regarding muscle length and rate of change in length and tension developed during contraction respectively [40].

The joint mechanoreceptors (type I, II and III) would be stimulated via the posterolateral glide MWM technique which would convey to central nervous system information regarding rate and direction of joint movement [40]. One case study using MWM, a patient with shoulder impingement reported a decrease in pain, improvement in function and improvement in shoulder abduction active range of motion [31]. Our results highlighted the effect of motor control retraining of scapular stabilizers (group A) resulted in improved shoulder function assessed by SPADI with reduction of pain score group A (pre-3 wks-28, pre-6wks-44) than group B(pre-3wks-26, pre-6wks-41) with pvalue<0.0001(S.) Disability score group A(pre-3wks-23.125, pre-6wks-40.62) than group B(pre-3wks-21.25, pre-6wks-39.25) with p value<0.0001(S.),and total SPADI score group A(pre-3wks-49.5, pre-6wks-85.87) than group B(pre-3wks-45.37, pre-6wks-80) with p value<0.0001(S.) Analysis of SPADI score showed that the components most commonly affected in pain score were reaching something on high shelf, touching the back of your neck.

In disability score the most common components affected were washing your back, placing object on high shelf, removing something from back pocket and carrying a heavy object of 10 pounds. As these activities requires elevation and internal rotation which is in accord to our results of decrease in range of motion (flexion, abduction and internal rotation) and pain on VAS scores while reaching back and pain on internal rotation. These decreased ranges of motion and pain occurs secondary to altered scapular posture and improper muscle control in SIS. Hence, in group A due to activation of scapular stabilizers there was improvement in the scapular posture and thereby by improving glenoid fossa orientation, increase in the subacromial space and clearance of the greater tubercle under the coracoacromial arch resulted in pain free improved range of motion and hence, earlier pain free movements with better function than group B which involved passive correction of the positional fault along with active movement. As most patients, range of motion is the main factor which limits the ADL activities.

Our results shows, significant improvement in pain immediate post session day 1 VAS. However, there was no statistical significant improvement in both the groups at the end of 6 weeks.

The possible explanation for pain relief after MWM technique can be attributed to the following concepts of MWM

Pain Gate Mechanism: Stimulation of large diameter low threshold mechanoreceptors by MWM may produce inhibition at the spinal cord level by "pain gate mechanism" [44,45].

'Mobilisation induced analgesia' or reestablishing a normal level of proprioceptive stimulation: According to a literature review with reference to Maitland and Mulligan paradigms in the mobilization of a joint, it has been suggested that the rationale behind Mulligan's techniques is that joints have evolved in a manner that facilitates free but controlled movement whilst minimizing compressive forces generated by movement. This balance is maintained by normal proprioceptive feedback. Strain or injury may cause alteration of the balance and positioning of structures in and around the joint and the mechanoreceptors may also over react to sudden stretching of connective tissue and continue to fire for longer than the protective mechanism warrants. The alteration in the muscle tone then alters joint tracking resulting in pain or restriction of movement, that in turn transmits proprioceptive stimulate to the already excited central nervous system thereby perpetuating its own malfunction.

An agitated central nervous system may cause soft tissue pain even after the tissues have recovered from strain. It is postulated that these techniques "sedate an agitated, facilitated nervous system, particularly the dorsal horn, by bombarding it with the painless normality it has always been patterned to receive. Normal afferent discharge provokes a reciprocal normal efferent discharge to the structures controlling joint movement". Manual therapy may thus re-establish a normal lower level of proprioceptive stimulation or 'mobilisation induced analgesia'[46]. Symapthoexcitation by MWM might increase the shoulder blood flux improving the vascularity of the hypovascular zone present within the inner tendon surface [47].

Increase in vascularity: Manual therapy is thought to bring about sympathoexcitation response at the treatment site. This leads increase cutaneous blood flux (vasodilatation) which may lead to pain relief [47].

However, the pain relief in group A could be attributed to correction of the scapular posture, resulting in increase in the subacromial space, hence reducing the impingement of the subacromial structures and thereby reducing pain during arm elevation. Effect of Ultrasound, rotator cuff retraining, and home exercise program in both the groups: The reduction in pain may also be attributed to the nonthermal effect (acoustic streaming, cavitation, micromassage) caused by pulsed ultrasound are thought to promote healing [48]. Rotator cuff retraining primarily causes the compression and thereby centering the humeral head in the glenoid fossa.

CONCLUSION

Motor control retraining is more effective treatment technique as compared to Mulligans MWM in Shoulder impingement syndrome

Clinical Implications: Motor control retraining of scapular stabilizers should be an integral treatment technique with or without MWM in shoulder impingement syndrome.

Limitations: 1. Electromyographic studies of the muscles during the kinematics was not done pre and post treatment for assessing the difference in the activation patterns in the muscles. 2. Video analysis of the the movement patterns was not done pre-post treatment.

Scope for future research: Electromyographic activation patterns can be assessed during these treatment techniques.

Conflicts of interest: None

REFERENCES

[1]. Neer CS II. Anterior acromioplasty for chronic impingement in the shoulder: a preliminary report. J Bone Joint Surg Am. 1972;54A:41-50.

[2]. van der Windt, D.A., Koes, W., de Jong, A., Bouter, L.M. Shoulder disorders in general practice: incidence, patient characteristics and management. Ann. Rheum. Dis. 1995;54:959-964.

[3]. Lori A. Michener u, Philip W. McClure. Anatomical and biomechanical mechanisms of subacromial impingement syndrome, Clinical Biomechanics 2003;8:369-379.

[4]. Budoff, J.E., Nirschl, R.P., Guidi, J. Debridement of panial thickness tears of the rotator cuff without acromioplasty. Longterm follow-up and review of the literature. Journal of bone and joint surgery. 1998 May;80(5):733-48.

[5]. Fu FH, Harner CD, Klein AH. Shoulder impingement syndrome: a critical review. Clin Orthop. 1991;269:162–173.

[6]. Kuhn JE. Exercise in the treatment of rotator cuff impingement: a systematic review and a synthesized evidence-based rehabilitation protocol. Journal of shoulder and elbow surgery. 2009 Jan 1;18(1):138-60.

[7]. Kamkar A, Irrgang JJ, Whitney SL. Nonoperative management secondary shoulder impingement syndrome. J Orthop Sports Phys Ther 1993;17:212–224.

[8]. Paine RM, Voight M. The role of the scapula. J Orthop SPhys Ther. 1993;18:386–391.

[9]. Sahrman SA. Adult posturing. In: Kraus SL, ed. TMJ Disorder Management of the Craniomandibular Complex. New York, NY: Churchill Livingstone Inc; 1988;295–309.

[10]. Ludewig PM, Cook TM. Alterations in shoulder kinematics an associated muscle activity in people with symptoms of shoulder impingement. Physical Therapy 2000;80:276e91

[11]. Wadsworth DJ, Bullock-Saxton JE. Recruitment patterns of the scapular rotator muscles in freestyle swimmers with subacromial impingement. International Journal of Sports Medicine 1997;18.

[12]. Borstad JD, Ludewig PM. Comparison of scapular kinematics between elevation and lowering of the arm in the scapular plan Clinical Biomechanics (Bristol, Avon) 2002;17:650e9.

[13]. Reddy AS, Mohr KJ, Pink MM, Jobe FW. Electromyographic analysis of the deltoid and rotator cuff muscles in persons subacromial impingement. Journal of Shoulder and Elbow Surgery 2000;9:519e23.

[14]. Myers JB, Hwang JH, Pasquale MR, Rodosky MW, Ju YY, Lephart SM. Shoulder muscle coactivation alterations in with subacromial impingement. Medicine & Science in Sports & Exercise 2003;35(5):S346

[15]. Graichen H, Bonel H, Stammberger T, Haubner M, Rohrer H Englmeier KH, et al. Three-dimensional analysis of the width of the subacromial space in healthy subjects and patients with impingement syndrome. American Journal of Roentgenology 1999;172:1081e6.

[16]. He´bert LJ, Moffet H, Dionne CE, McFadyen BJ, Dufour M,Lirette R. Shoulder impingement syndrome: clinical and short-term predictors of disability. Archives of Physical Medicine and Rehabilitation 2003a;84:A7.

[17]. Ludewig PM, Borstad JD. Effects of a home exercise programme on shoulder pain and functional status in construction worker Occupational Environmental Medicine 2003;60:841e9.

[18]. Conroy DE, Hayes KW. The effect of joint mobilization as Component of comprehensive treatment for primary shoulder impingement syndrome. Journal of Orthopaedic & Spor Physical Therapy 1998;28:3e14.

[19]. D'Hespeel CG. Current concepts: Rehabili¬tation of patients with shoulder impingement and tight posterior capsule. Orthop Pract 2004;16:9–13.

[20]. Host HH. Scapular taping in the treatment of anterior shoulder impingement. Phys Ther 1995;75:803–812.

[21]. Borstad JD. Resting position variables at the shoulder: Evidence to support a posture-im¬pairment association. J Orthop Sports Phys Ther 2006;86:549–557.

[22]. Bang MD, Deyle GD. Comparison of super¬vised exercise with and without manual physical therapy for patients with shoulder impingement syndrome. J Orthop Sport s Phys Ther 2000;30:126–137.

[23]. Conroy DE, Hayes KW. The effect of joint mobilization as a component of comprehen¬sive treatment for primary shoulder im¬pingement syndrome. J Orthop Sports Phys Ther 1998;28:3.

[24]. Winters JC, Jorritsma W, Groenier KH, So¬bel JS, Meyboom-DeJong B, Arendzen HJ. Treatment of shoulder complaints in general practice: Long-term results of a random¬ized, single blind study comparing physio¬therapy, manipulation, and corticosteroid injection. Br Med J 1999;318:1395–1396.

[25]. Jean-Se´bastien Roy , He´ le'ne Moffet , Luc J. He´bert , Richard Lirette Effect of motor control and strengthening exercises function in persons with impingement syndrome: A single-subject study design. Manual Therapy 14 (2009) 180e188.

[26]. Mulligan B, Manual Therapy ''NAGS'', SNAGS'', ''MWMS'' etc, Plane view Services Ltd., 1999.

[27]. Exelby L. The Mulligan concept: its application in the management of spinal conditions. Manual Therapy 2002;7:64–70.

[28]. Carolyn Kisner and Lynn Allen Colby. Therapeutic Exercises: Foundations and Techniques. 5th edition. New Delhi: Ja Brothers; 2007. Chapter 4. pg 110

[29]. Hing W, Bigelow R, Bremner T. Mulligan's Mobilisation With Movement: A Systematic Review. The Journal of Manual & Manipulative Therapy,2009; 17(2): 39E -66E.

[30]. Matsen F, Fu F, Hawkins R. The shoulder: a balance of mobility and stability. Rosemont, IL: American Academy of Orthopaedic Surgeons; 1993

[31]. DeSantis L, Hasson SM. Use of mobilization with movement in the treatment of a patient with subacromial impingement: A case re¬port. J Man Manip Ther 2006;14:77–87.

[32]. Mulligan BR. The painful dysfunctional shoulder: A new treatment approach using "mobilisation with movement". New Zea-land J Physiother 2003;31:140–142.

[33]. Shumway-Cook A, Woollacott MJ 2001 Motor Control: Theory and Practical Applications. Lippincott Williams and Wilkins, Philadelphia

[34]. Henry Tsao , PhD , * Lieven A. Danneels , PhD , Smudging the Motor Brain in Young Adults With Recurrent Low Back Pain SPINE 2011 Volume 36, Number 21, pp 1721–1727.

[35]. Steven M.McPhail, Lars Nagelstad Dalland, Kaja Naess. Intratherapist Reliability in the Rating of Scapula Posture in Multiple Planes of Reference International Scholarly Research Network ISRN Rehabilitation Volume 2012.

[36]. Jeremy S Lewis and Rachel E Valentine , The pectoralis minor length test: a study of the intra-rater reliability and diagnostic accuracy in subjects with and without shoulder symptoms BMC Musculoskeletal Disorders 2007;8:6.

[37]. M.E. Magarey, M.A. Jones Dynamic evaluation and early management of altered motor control around the shoulder complex Manual Therapy 2003; 8(4): 195–206.

[38]. Kibler B. 1998a Shoulder rehabilitation: Principles and practice. Medicine and Science in Sports and Exercise S40–S50.

[39]. Jean sebastein Roy, Helene Moffet Bradford J McFadyen and Richard Lirette, Impact of movement training on upperlimb motor strategies in persons with shoulder impingement syndrome sports Medicine, Arthroscopy, Rehabilitation, Therapy & technology 2009;1:8.

[40]. Panjabi M. The stabilising system of the spine. Part II: Neutral zone and stability hypothesis. Journal of Spinal Disorders 1992;5:390–397.

[41]. Schmidt RA. Motor learning principles for physical therapy Contemporary management of motor control problems. Proceedings of the II Step Conference, APTA, Alexandria, VA 1991.

[42]. Shumway-Cook A, Woollacott MJ. Motor Control: Theory and Practical Applications. 201 Lippincott Williams and Wilkins, Philadelphia

[43]. Worsley P, Warner M, Mottram S, Gadola S, Veeger HE, Hermens H, Morrissey D, Little P, Cooper C, Carr A, Stokes M. Motor control retraining exercises for shoulder impingement: effects on function, muscle activation, and biomechanics in young adults. Journal of shoulder and elbow surgery. 2013 Apr 1;22(4):e11-9.

[44]. Sterling M, Jull G, Wright A. Cervical mobilisation: concurrent effects on pain, sympathetic nervous system activity and motor activity. Man Ther, 2001;6(2):72-81.

[45]. Forster A and Palastanga N. Clayton's Electrotherapy Theory and Practice. 9th edition. Bailliere Tindall; 2004; pg.102,199-201.

[46]. Noten S, Meeus M, Stassijns G, Van Glabbeek F, Verborgt O, Struyf F. Efficacy of different types of mobilization techniques in patients with primary adhesive capsulitis of the shoulder: a systematic review. Archives of physical medicine and rehabilitation. 2016 May 1;97(5):815-25.

[47]. Vicenzino B, Collins D, Benson H, Wright A. An investigation of the interrelationship between manipulative therapy-induced hypoalgesia and sympathoexcitation. Journal of Manipulative and Physiological Therapeutics 1998;21:448–53.

[48].Low JL, Reed A. Electrotherapy Explained: Principles and Practice. 3rd edition. Butterworth Heinemann; 2000. pg 185

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