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Full Length Research Article

TO COMPARE THE EFFECTS OF THE THREE MANUAL TECHNIQUES IN PATIENT WITH SHOULDER IMPINGEMENT SYNDROME

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ABSTRACT

Objective: To compare the effects of the three manual techniques in patient with shoulder impingement syndrome.
Research design: Pre test and post test structured, comparative study design.
Participants: 30 subjects were taken from outpatient physiotherapy department of SVNIRTAR and sub-centers.
Outcome measures: Pain intensity by VAS, shoulder range of motion and shoulder pain and disability index.
Results and conclusion: The results of the study suggest that all the intervention presented in the study ie, Maitland cervicothoracic mobilization, Maitland glenohumeral mobilization, posterior shoulder stretching are equally effective to reduce pain, disability and increase ROM when given with common strengthening exercises in individuals with shoulder impingement syndrome

INTRODUCTION

Shoulder pain with a sub-sequent restriction of movements is a common problem in both the sporting and working population. This reduced range of motion in shoulder joint leads to reduction of ADLs of the patient e.g. reaching, throwing, lifting, etc. Shoulder impingement syndrome, the most common diagnosis of shoulder dysfunction, is often described as shoulder pain exacerbated by overhead activities (Bang and Deyle, 2014; Cools *et al.,* 2012; Michael *et al.,* 2000). Neer first introduced the concept of rotator cuff impingement in 1972 and hypothesized that the rotator cuff is impinged upon by the anterior one third of the acromion, the coracoacromial ligament and the acromioclavicular joint rather than by merely the lateral aspect of the acromion. He also suggested that the part of the rotator cuff that is impinged upon is at the insertion of the supraspinatus tendon on the greater tuberosity (the impingement zone) (Neer, 1977). Primary shoulder impingement occurs when the rotator cuff tendons, long head of the biceps tendon, glenohumeral joint capsule, and/or subacromial bursa become impinged between the humeral head and anterior acromion. Primary impingement may be due to intrinsic factors: rotator cuff weakness, chronic inflammation of the rotator cuff tendons and/or subacromial bursa, rotator cuff degenerative tendinopathy, subacromial crowding, and posterior capsular tightness leading to abnormal anterior/superior translation of the humeral head due to weakness of the humeral head depressors. It may also be due to extrinsic factors: possession of a curved or hooked acromion, acromial spurs, or postural dysfunction. Secondary shoulder impingement is defined as a relative decrease in the subacromial space due to glenohumeral joint instability or abnormal scapulothoracic kinematics. Commonly seen in athletes engaging in overhead throwing activities, secondary impingement occurs when the rotator cuff becomes impinged on the posterior-superior edge of the glenoid rim when the arm is placed in end-range abduction and external rotation. This positioning becomes pathologic during excessive external rotation, anterior capsular instability, scapular muscle imbalances, and/or upon repetitive overload of the rotator cuff musculature (Neer, 1977; Neer, 1983). Neer described the classical three stages of impingement (Neer, 1983). Stage I with edema and hemorrhage of the bursa and cuff is typical in persons under twenty-five years old. Stage II involves irreversible changes, such as fibrosis and tendinitis of the

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rotator cuff, and typically occurs in patients who are twenty-five to forty years old. Stage III is marked by partial or complete tears of the rotator cuff and usually is seen in patients over forty years of age. Later, Neer divided impingement into outlet and non-outlet lesions. Outlet impingement occurs when the coracoacromial arch encroaches on the supraspinatus outlet and non-outlet secondarily to thickening or hypertrophy of the bursa or the rotator cuff tendons (Chang, 2004). Neer 1983, Rockwood and Lyons 1993 states that pain is the most common symptom of the shoulder impingement syndrome (Neer 1983; Rockwood and Lyons, 1993). Calvert in 1997 stated that night pain is typical, and daytime pain is related to overhead activities also he said that pain that originates from pathology in the subacromial region tends to be difficult to localize, is usually felt in the deltoid region and often radiates to the arm as far as the elbow. (Calvert, 1997) Bigliani and Levine; 1997 found that pain usually elicited between 70 and 120 degrees of abduction (Bigliani and Levine, 1997). This sector is called the 'painful arc' (Bang and Deyle, 2014; Cools *et al.,* 2012).

Clinical Signs that may assist in differentiating the stages of impingement lesions have been described by Neer and by Hawkins and Abrams. Pain, muscle weakness, restricted ranges of motion and soft tissue crepitus are generally present (Neer 1983). A positive impingement sign is present in primary impingement syndrome. The impingement sign, as described by Neer, is elicited by performing passive shoulder flexion while preventing upward scapular rotation, which leads to encroachment of the greater tuberosity against the acromion. Hawkins and Abrams describe a similar impingement sign in which the shoulder is flexed to approximately 90° and is forcibly internally rotate to produce a similar effect. Pain elicited with these signs may indicate impingement (Chang, 2004). Nicole suggested that there is a deficit in range of motion (ROM) that may exist in patients with shoulder impingement. Altered glenohumeral joint mobility and flexibility have been attributed to adaptive structural changes to the joint, resulting from the extreme demands of overhead activity. These adaptive changes have been defined as glenohumeral internal rotation deficit (GIRD). These include deficits in internal rotation and cross-chest adduction ranges due to tightness of the posterior capsule. Tightness of the posterior portion of the glenohumeral joint capsule has been proposed to contribute to impingement syndrome by causing abnormal superior translation of the humeral head. This has been shown by operative tightening of the posterior capsule. Harryman *et al* found that operative tightening of the posterior capsule led to increased anterior and posterior translation of the humeral head during shoulder flexion and cross-chest adduction (Harshbarger *et al.,* 2013).

Pappas *et al*. were the first to suggest that posterior shoulder stiffness results from repetitive microtrauma leading to the development of fibrotic scar tissue of the posterior capsule. Currently, the exact cause and underlying mechanism of posterior glenohumeral joint stiffness remains a matter of debate. Posterior capsule contracture, as well as posterior cuff muscle inflexibility and osseous adaptations, are described to clarify the decreased internal rotation range of motion (ROM). Posterior shoulder stiffness has been suggested to be a causative or perpetuating factor in shoulder impingement and labral pathology. Abnormal humeral head translations, caused by selective tightening of the posterior-inferior capsule, may decrease the width of the subacromial space, thus causing subacromial impingement. Other studies suggest a posterior and superior translation of the humeral head during cocking (i.e. the phase in throwing where the glenohumeral joint is placed into maximal external rotation and horizontal abduction) with a tight posterior capsule, possibly leading to an encroachment of the rotator cuff tendons against the postero-superior rim of the glenoid. As a result, posterior capsule stiffness possibly increases the risk for internal (postero-superior) as well as subacromial impingement in the overhead (Cools *et al.,* 2012). Michael and Bang found the effectiveness in reducing pain and disability in patients with shoulder impingement. Effective interventions include therapeutic exercises focusing on strengthening the rotator cuff and scapular stabilizing musculature, stretching to decrease capsular tightness, scapular taping techniques, and patient education of proper posture, along with laser therapy, ultrasound therapy, phonophoresis and exercise therapy. Passive joint mobilization is considered to be an effective treatment protocol for enhancing ROM in the patients with shoulder impingement syndrome (Michael *et al.,* 2000). Gail D. Deyle suggested that the incorporation of joint mobilizations to treat shoulder impingement results in superior outcomes compared with therapeutic exercise alone. Some researchers propose that a mobilization force can be selectively directed to a specific area of the capsule to restore capsular extensibility (Michael *et al.,* 2000).

Douglas E. Conroy, Karen W. Hayes found that individuals with shoulder impingement often have a tight posterior capsule resulting in altered glenohumeral arthrokinematics and a decrease in glenohumeral internal rotation range of motion (ROM). Thus, performing translational mobilization techniques (using accessory movements have been described to increase internal rotation ROM) maitland grade 1 and 2 are used to reduce pain and grade 3 and 4 are used to improve ROM. There was a significant improvement with passive shoulder abduction in patient with impingement syndrome who received passive joint mobilization grade III or IV mobilizations aimed at restoring posterior capsule mobility in subjects with shoulder impingement may result in increased active ROM and decreased impingement symptoms, whereas all grades of mobilizations (I-IV) may result in pain reduction. Thus, High-grade (grade III and IV in the Maitland classification) end-range dorsal glide mobilizations have been suggested to influence the posterior capsule of the glenohumeral joint. Little scientific evidence is available regarding the effectiveness of these techniques (Bang and Deyle, 2000; Conroy and Hayes, 2014). Wainer *et al* has given the concept of regional interdependence which suggests that seemingly unrelated impairments in a remote anatomical region may contribute to or be associated with the patient's primary complaints. This concept of examining and treating impairment away from the primary source of pain is gaining popularity in the orthopaedic manual therapy. Patients with primary complaint of shoulder pain often have impairments of the shoulder girdle, including cervicothoracic spine and adjacent ribs and these impairments can negatively affect patient's outcome. Sober *et al* found that more than 40% of the patient's with shoulder complaints had impairments of the cervicothoracic spine and adjacent ribs. Lynda McClatchie showed the effectiveness of cervico thoracic mobilization in shoulder dysfunctions (McClatchie *et al.,* 2008). In 2008, Crosbie *et al.,* (2008) found synchronous interactions between humeral, scapular and thoracic segments. They documented that scapular upward rotation is significantly greater on the non-dominant side than the dominant in all planes of movement and in both unilateral and bilateral arm movement. Unilateral and bilateral arm movements produce different ranges and patterns of spinal motion and ranges of scapular external rotation. Thus, the functional disorders in the cervical spine and the higher thoracic spine are not extrinsic causes of shoulder complaints. It is advisable to include cervicothoracic spine in the clinical assessment of shoulder girdle and in the treatment of patients with shoulder complaints (McClatchie *et al.,* 2008). Based on the findings of these specific adaptations in the overhead activity and the possible association with the development of impingement symptoms and labral injury, stretching has been recommended in the prevention, as well as rehabilitation, of chronic shoulder pain .In general, two unique intervention techniques of stretching are described in literature to increase glenohumeral internal rotation ROM. In the angular stretching techniques, internal rotation (e.g. the 'sleeper-stretch') or horizontal adduction (e.g. the 'cross-body stretch') movements are passively performed, by the therapist, or by the patient. Little scientific evidence is available regarding the effectiveness of these techniques, nor the possible influence of these stretching protocols on impingement symptoms (McClatchie *et al.,* 2008; Poser and Casonato, 2008; Angela *et al.,* 2010).

Evidences suggest that inclusion of manipulative interventions (both thrust and non-thrust techniques) indeed may be helpful in treatment of individual with shoulder pain. The current literature supports the use of therapeutic exercise to strengthen the rotator cuff and scapular muscles and to stretch the posterior structures. Therapeutic exercises appear to be more effective when combined with joint mobilization technique focused on upper quarter. Although therapeutic exercise has been shown to be effective in treating shoulder impingement symptoms, very few studies have evaluated the effectiveness of incorporating glenohumeral joint mobilizations. There are studies to support effects of either Maitland mobilization or cervico-thoracic mobilization or stretching techniques on improving shoulder pain and ROM but no published study have been found which compares the effect of stretching the posterior structures, Maitland mobilization in shoulder and mobilization of asymptomatic cervical spine for the same and still there is a need in that respect. So, the purpose of this study is to compare the effects of three physical therapy interventions comprising of stretching the posterior structures, mobilization of cervical spine and Maitland shoulder mobilization on ROM, pain and function in patients with shoulder impingement syndrome.

MATERIALS AND METHODS

Design: Experimental, Pre test - Post test comparative analysis design with random group assignment.

Subjects: A total of 30 subjects (14 men and 16 women) age; 29 ± 6.033 were randomly taken who fulfilled the inclusion and exclusion criteria from the outpatient physiotherapy department of swami vivekanand national institute of rehabilitation training and research and sub centers.

Inclusion Criteria: The patient needs to meet at least three or five of the following criteria:

Complains of anterior or lateral shoulder pain or shoulder pain in C5-6 dermatome, reduced range of motion at shoulder joint, tenderness to palpation of rotator cuff tendons, painful arc of shoulder abduction between 40–120 degrees, pain with active arm elevation, positive Hawkin's – Kennedy Test ie, reproduction of pain when the shoulder was passively placed in 90° of forward flexion and internally rotated to end range, positive Neer impingement test ie reproduction of pain when the examiner passively flexed the humerus to end range with overpressure, positive Jobe's sign, reproduction of pain and lack of force production with isometric elevation in the scapular plane in internal rotation (empty can), resisted painful or weak shoulder abduction, resisted painful or weak shoulder internal rotation, resisted painful or weak shoulder external rotation, adequate understanding of the language to participate in a subjective examination and to answer questionnaires, provide informed consent and were able to attend the clinics for treatment and assessments, co-operative subjects, not receiving any drugs other than stable doses of analgesics or NSAIDS.

Exclusion criteria

Pregnant or nursing women, systemic or neurological disease, corticosteroid injections 3 months prior to treatment, previous physical therapy or chiropractic care for their shoulder, shoulder surgery, glenohumeral dislocation, frozen shoulder, acromioclavicular joint arthritis, full-thickness rotator cuff tear, bicipital tendonitis, inflammatory rheumatoid arthritis, inflammatory arthropathy/osteoarthritis, shoulder instability, primary scapulothoracic dysfunction, radiating pain from cervical spine or elbow joint, cervical pain with arm elevation, other like radiographic evidence of calcific periarthritis or radiographic evidence of degenerative changes, workmen's compensation claim/litigation, severity and irritability of symptoms, other severe disabiling health problems.

Procedure

A total of 30 subjects (14 men and 16 women) were randomly taken with shoulder pain (age; 29 ± 6.033) who fulfilled the inclusion and exclusion criteria from the outpatient physiotherapy department of SVNIRTAR and sub centers. Detailed assessment was done and consent form was taken. They were then randomly assigned one of the 3 groups;

- Group I with total 10 subjects (4 males and 6 females) received Maitland cervico thoracic spine mobilization with strengthening exercises.
- Group II with total 10 subjects (4 males and 6 females) received Shoulder maitland mobilization with strengthening exercises.
- Group III with total 10 subjects (6 males and 4 females) received Posterior shoulder structures stretching and strengthening exercises.

Strengthening exercises were performed by using colour – code exercise bands in seven level of resistance. Treatment was given 5 days a week for 3 weeks.

Data Collection

Measurements for all the dependent variable Dependent variables **-**Pain intensity measured by Visual Analogue Scale, Shoulder Range of motion by 180 degree goniometer. And Shoulder Pain And Disability Index (SPADI) - a functional ability questionnaire in each subjects were taken before the treatment started for all the subjects (pre-test) and after 3 weeks completion (post-test) following ceasation of treatmen.t.

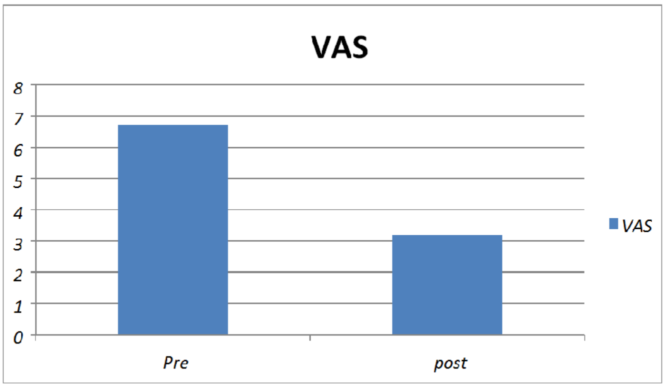
Data Analysis

Statistical analysis was performed using SPSS version 16.0 The dependent variables were analyzed using repeated measures ANOVA. There was one between factor (group) with three levels (Groups – Maitland cervicothoracic mobilization, Maitland glenohumeral mobilization, Posterior capsule stretching) and one within factor (time – pre and post). All pair wise post -hoc comparisons were analyzed using a 0.05 level of significance.

RESULTS

PAIN –VAS

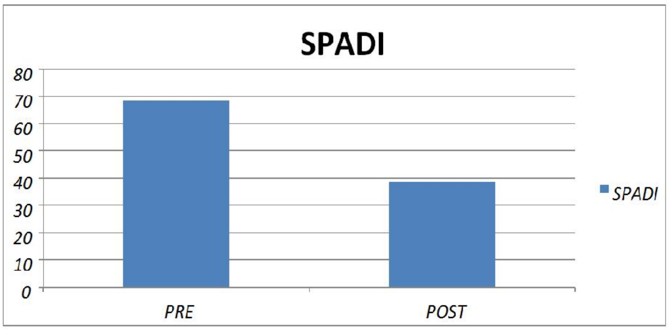
Graph 1 illustrates that there was improvement in VAS score in groups receiving cervicothoracic mobilization (group - 1), posterior capsule stretching (group -2) and maitland mobilization (group - 3) from the pre treatment measurements to post treatment measurements for a period of 3 weeks. The result showing that, there was main effects for the time i.e, F(1,28 ,0.05) = 156.539, P=0.00 and main effects for time × group did not attain significant level i.e, F (1,28,0.05) = 2.717, P = 0.123, also the main effect for the group did not attain significant level i.e, F (1,28 , 0.05) = 1.517 ,P= 0.736 , which is between the group effect.



Graph 1.

SPADI

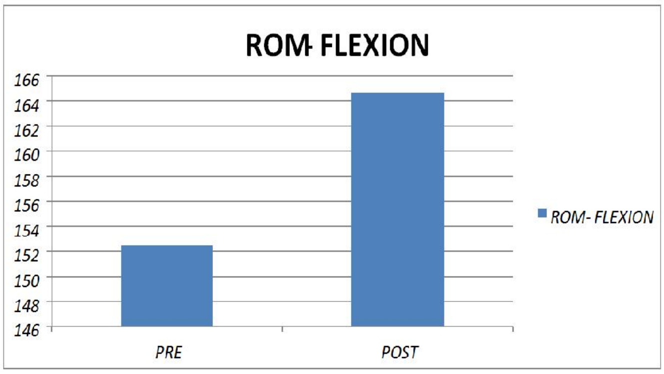
Graph 2 illustrates that there was improvement in pain and disability in groups receiving cervicothoracic mobilization (group - 1), posterior capsule stretching (group -2) and maitland mobilization (group - 3) from the pre treatment measurements to post treatment measurements for a period of 3 weeks. The result showing that, there was main effects for the time i.e, F(1,28 ,0.05) = 59.351, P=0.00 and main effects for time × group did not attain significant level i.e, F (1,28,0.05) = 1.804 , P = 0.184 , also the main effect of group did not attain significant level for the group interaction i.e, F (1,28, 0.05) = 2.654, P= 0.089 , which is between the group effect .



Graph 2.

Range of motion flexion

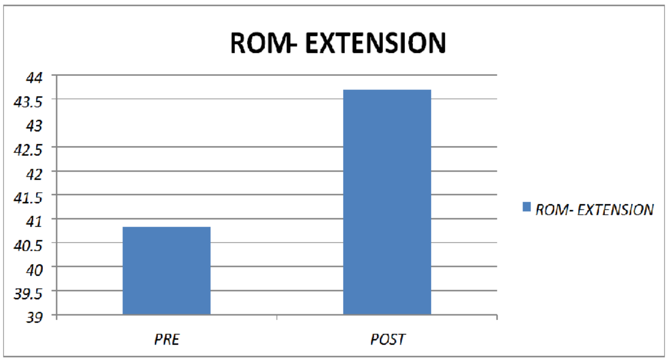
Graph 3 illustrates that there was improvement in flexion range of motion in groups receiving cervicothoracic mobilization (group - 1), posterior capsule stretching (group - 2) and maitland mobilization (group - 3) from the pre treatment measurements to post treatment measurements for a period of 3 weeks. The result showing that, there was main effects for the time i.e, F(1,28 ,0.05) = 114.108 , P=0.00 and main effects for time × group did not attain significant level i.e, F (1,28,0.05) = 0.616, P = 0.548 , also the main effect of group did not attain significant level for the group interaction i.e, F (1,28 , 0.05) = 0 .139, P= 0.871 , which is between the group effect .



Graph 3.

Range of motion – Extension

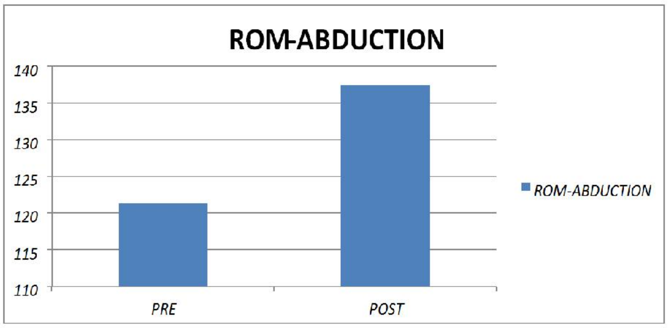
Graph 4 (Appendix- VIII) illustrates that there was improvement in extension range of motion in groups receiving cervicothoracic mobilization (group - 1), posterior capsule stretching (group -2) and maitland mobilization (group - 3) from the pre treatment measurements to post treatment measurements for a period of 3 weeks. The result showing that, there was main effects for the time i.e, F(1,28 ,0.05) = 241.058, P=0.00 and main effects for time × group did not attain significant level i.e, F (1,28,0.05) = 0.810, P = 0.455, also the main effect of group did not attain significant level for the group interaction i.e, F (1,28 , 0.05) = 0 .034, P= 0.966, which is between the group effect.



Graph 4.

Range of motion – Abduction

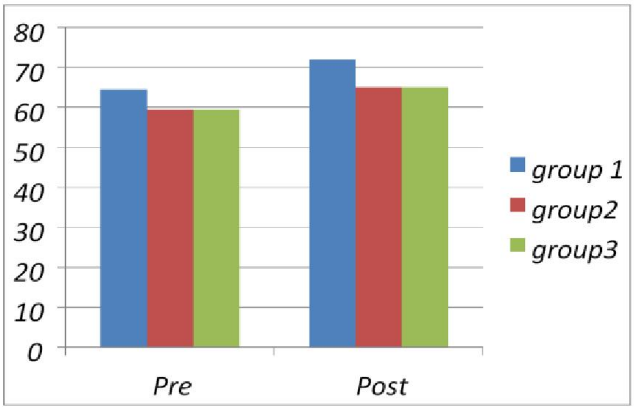
Graph 5 (Appendix- VIII) illustrates that there was improvement in abduction range of motion in groups receiving cervicothoracic mobilization (group - 1), posterior capsule stretching (group -2) and maitland mobilization(group - 3) from the pre treatment measurements to post treatment measurements for a period of 3 weeks. The result showing that, there was main effects for the time i.e ,F(1,28 ,0.05) = 88.587, P=0.00 and main effects for time × group did not attain significant level i.e, F (1,28,0.05) = 0.049 , P = 0.952, also there was main effects for the group interaction i.e, F (1,28, 0.05) = 4.141, P= 0.027 , which is between the group effect.



Graph 5.

Range of motion – External rotation

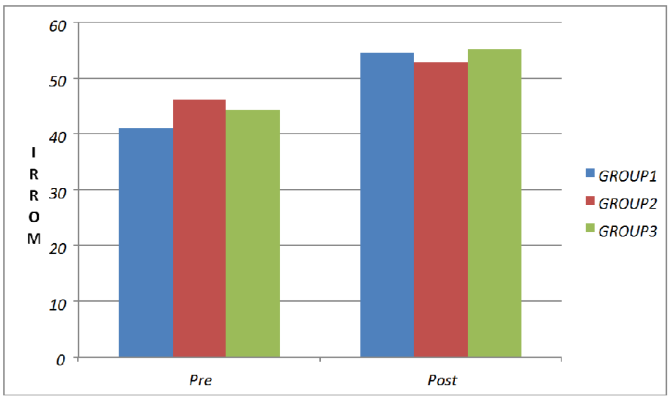
Graph 6 illustrates that there was improvement in external rotation range of motion in groups receiving cervicothoracic mobilization (group - 1), posterior capsule stretching (group - 2) and maitland mobilization(group - 3) from the pre treatment measurements to post treatment measurements for a period of 3 weeks. The result showing that , there was main effects for the time i.e ,F(1,28 ,0.05) = 105.860, P=0.00 and main effects for time × group did not attain significant level i.e, F (1,28,0.05) = 1.093 , P = 0.350 , also the main effect for group did not attain significant level for the group interaction i.e, F (1,28 , 0.05) = 1.423, P= 0.259 , which is between the group effect.



Graph 6.

Range of motion – Internal rotation

Graph 7 illustrates that there was improvement in internal rotation range of motion in groups receiving cervicothoracic mobilization (group - 1), posterior capsule stretching (group - 2) and maitland mobilization (group - 3) from the pre treatment measurements to post treatment measurements for a period of 3 weeks. The result showing that , there was main effects for the time i.e, F(1,28 ,0.05) = 100.872 , P=0.00 and main effects for time × group i.e, F (1,28,0.05) = 3.541 , P = 0.043 , which shows that there is statistically significant of P value within the group but the main effect of group did not attain significant level for the group interaction i.e, F (1,28 , 0.05) = 0 .059, P= 0.942 , which is between the group effect. Turkey's Post Hoc analysis shows that each of the three groups improved significantly from pre to post. At the end of three weeks groups were significantly different from each other. Although there were statistically significance between the group difference. The difference between (1-3) degree which is not clinically significant.



Graph 7.

DISCUSSION

The overall results of present study showed significant improvement in pain , range of motion and disability index in all the groups at the end of three weeks of the intervention. However, at the end of three weeks, there was no significant difference between the three groups in pain, range of motion and disability index.

PAIN – VAS and SPADI PAIN

In present study it was found that there was significant reduction in VAS and SPADI pain in all the groups at the end of the study. However there was no significant difference between the three groups. The reason could be attributed to the common exercise protocol. Exercises include prone horizontal abduction at 100 degree abduction with ER, full can/scaption, Gerber lift off against resistance, ER and IR, flexion and abduction with theraband and along with that a variety of weight bearing upper extremity exercises such as pushups, push up plus, standing scapular dynamic hug-forward scapular punch and rowing type exercises (Escamilla *et al.,* 2009; Uhl *et al.,* 2003; Digiovine *et al.,* 1992; Escamilla *et al.,* 1998). The rotator cuff strengthening exercises proposed by Kuhn was scaption performed with the thumb up. Clinically, this exercise called as the full-can (thumb-up) exercise. Yanai *et al* showed impingement forces on the rotator cuff tendons under the coracoacromial ligament were lesser with the full-can exercise (Fleming *et al.,* 2010). Supraspinatus compress, abducts and provides external rotation torque at glenohumeral joint (Escamilla *et al.,* 2009). At lower scaption angles supraspinatus activity increases to provide humeral head compression within glenoid fossa to counter the humeral head superior translation from the deltoids. Due to decreasing moment arm with abduction the supraspinatus is more effective during scaption at smaller abduction angles but also it generates abductor torque at larger abduction angles thereby reducing the risk of impingement in the present study.

Kuhn in his study in impingement patients showed scaption exercise lead to a decreased pain and improved ROM. (Kuhn, 2009) Theraband internal rotation - external rotation with the arm by the side. Infraspinatus and teres minor comprise the posterior cuff and provides glenohumeral compression , ER , and abduction and resist superior and anterior humeral head translation by exerting an posterioinferior force under coracoacromial arch during overhead movements thus minimizing subacromial impingement in the present study. Prone Horizontal abduction at 100 degree abduction with ER: Here teres minor activity is much higher. Teres minor comprise the posterior cuff, which provides glenohumeral compression, ER , and abduction and resist superior and anterior humeral head translation by exerting an posterioinferior force under coracoacromial arch during overhead movements thus minimizing subacromial impingement in the present study. Bang M, Deyle along with conroy *et al* showed in study in impingement patients that these all exercises significantly reduced the pain and improved ROM. (Pappas *et al.,* 1985). Gerber lift off against resistance: An isolated activation of subscapularis by minimizing teres minor, supraspinatus, infraspinatus . It is performed by lifting the dorsum of the hand off the mid-lumbar spine (against resistance). It avoids subacromial impingement position associated with IR at 90 degree abduction. Seated pushups, push-up plus, knee push up plus, dynamic hug, exercise for training of Serratus Anterior and that the plus-phase (protraction at the end of the movement) is of extreme importance in activating sufficient levels of SA activity. Study by Dvir and Berme along with Johnson *et al* found that Serratus Anterior has the largest moment arm for production of scapular upward rotation torque and SA line of action is also such that it can contribute to scapula posterior tilting (Dvir and Berme, 1978; Johnson *et al.,* 1994). Thus overall possible mechanisms from all the exercises listed above in this study which are responsible for pain reduction by exercise therapy includes stimulation of mechanoreceptors, production of beta-endorphins, reduce muscular imbalance, improve blood circulation, increase extensibility of soft tissues and reduce fatigue. Mechanism by which cervicothoracic mobilization group reduced pain:

A significant decrease in the radius of the arc of pain with shoulder movement was noted in post-mobilization. It was proposed by Schneider (1989) that the restriction in shoulder movement was likely not capsular but perhaps due to cervical somatic structures referring pain to the shoulder region and initiating spasm in shoulder musculature. It was also suggested that the improvement in shoulder movements following cervical mobilization may have had a neurological basis by positively affecting a nerve root impingement also the thoracic mobilization affect shoulder range as the literature postulated that would appear that mobilization influences both pain inhibition and muscle inhibition which consequently improves rehabilitation potential. Mobilization appears to produce a hypoalgesic effect either segment ally or centrally. It may also alter mechanoreceptor activity which decreases neural inhibition to allow restoration of muscle strength. Cleland *et al*. demonstrated peak strength improvements in the lowertrapezius muscles immediately following thoracic mobilization and in a subsequent study he reported that mobilization also results in immediate analgesic effect. Another clinical rationale for the use of cervicothoracic spinal mobilization on SIS patients in present study was based upon regional interdependence (Wainner *et al.,* 2001), or the theory that dysfunction of one body part imparts dysfunction upon another (Vicenzino *et al.,* 2001, 1998; Wainner *et al.,* 2001, 2007). Bullock *et al* have showed the effects of thoracic posture on shoulder pain.

Specifically the relationship of postural corrections in the thoracic spine and its effects of decreasing pain and increasing shoulder motion (Bullock *et al.,* 2005). There has also been research that has shown a relationship between scapular positional dysfunction and shoulder pathology (Kibler, 1998). Norlader *et al* (1997) in their study reported that reduced relative mobility at C7-T1 and T1-T2 significant predict neckshoulder pain and the hand weakness. The strongest relationship between segment mobility and symptoms was found in C7-T1 than T1-T2. Thus , limitation in shoulder motion, pain while motion and function could be linked to restricted cervicothoracic spine motion which was restored after gaining spinal mobility with cervicothoracic (i.e, C7-T1) central PA mobilization (Norlander *et al.,* 1997). Lynda *et al* (2008) in their study showed that the immediate effects of cervical lateral glide mobilizations on pain intensity and shoulder abduction painful arc in subjects with shoulder pain. Results revealed the shoulder abduction painful arc and shoulder pain intensity were significantly decreased (Conroy and Hayes, 2014). Micheal D. Bang, Gail D. Ddeyle (2000) reported that the group receiving mobilization techniques aimed at the shoulder , shoulder girdle, cervical spine and/or upper thoracic spine had a statistically significant increase in function as assessed with questionnaire (Pappas *et al.,* 1985).

Mechanism of Glenohumeral mobilization

The posterior glenohumeral capsule has been implicated and stretching of the posterior capsule produces a reduction in shoulder pain. The small changes in reduction of pain immediately following one episode of stretching could be attributed to creep and hysteresis in the posterior capsule in present study. The difference in pain between groups might be explained through the neurophysiologic pain reduction phenomenon associated with graded movement. Neuromodulation of pain is reportedly achieved when stimulation of type I and II afferent articular mechanoreceptors reflexogenically reduces tone or the awareness of pain. Thereby in present study reduced the pain by glenohumeral mobilization (Bang and Deyle, 2000). Cool *et al* found significant decrease on a self-reported visual analogue scale for pain in patients receiving joint mobilization and stretching protocols and found improved patientreported function and pain in symptomatic patients, as well as prevention of symptoms in asymptomatic patients with posterior shoulder tightness (Cools *et al.,* 2012).

Range of motion

In present study it was found that there was significant improvement in ROM seen in all the groups at the end of the study. However there was no significant difference between the groups. Mechanisms by which Maitland cervicothoracic mobilization improved ROM can be attributed to its mechanical and neurophysiological effects (Zusman, 1986). In the mechanical effects It was found that there occurs a permanent or temporary change in length of connective tissues structure such as joint capsule, ligaments and muscle. It seems unlikely that any observed changes in mobility associated with mobilization are due to permanent changes in the length of connective tissues. Threlkeld (1992) suggests that the forces used in mobilization are not great enough to result in microfailure of tissues and more likely to cause temporary length changes due to creep which is reversible over time. Another possibility of increased ROM found in present study may be due to the neuro physiological mechanisms that have also been postulated to account for changes in mobility observed in response to application of PA forces. One of the reasons may be modulation of afferent input such that perception of pain is diminished (Zusman 1986). Improvement in range of motion in present study may be due to neurophysiologic reduction in pain and associated muscle guarding, mechanical reduction in edema, improved rotator cuff and shoulder girdle strength, or improved extensibility of the shoulder musculotendinous and capsuloligamentous structures.

Another factor that may attribute to ROM by mobilization theoretically could be particularly in the mid-ranges of humeral elevation, where improved opposite direction humeral head glide should act to reduce the propensity of impingement of the subacromial contents by virtue of which capsular stretching can also be accomplished through indirect means of physiologic stretching. The exercise regimen designed for both groups in this study included physiologic stretching exercises that not only stretched the musculotendinous structures but also indirectly stretched the various portions of the glenohumeral capsule. In this population of subjects, perhaps the degree of capsular tightness was such that physiologic stretching was adequate enough to improve range. On the other hand, because mobilization was rendered with the joint in the mid-range, there may not have been adequate stretch to the capsule. Perhaps mobilization delivered at or near end range would have a more noticeable effect on mobility of the joint. The mid-range position appeared to be appropriate for the use of mobilization to alleviate pain but may not have been appropriate to improve mobility (Bang *et al.,* 2000; Kromer *et al.,* 2009). Micheal D. Bang, Gail D. Ddeyle (2000) in their study reported similar results which favours the results of my study that the group receiving mobilization techniques aimed at the shoulder , shoulder girdle, cervical spine and or upper thoracic spine had a statistically significant increase in AROM (Pappas *et al.,* 1985). Michener incorporated grade IV posterior glenohumeral joint mobilizations and found significant improvements to IR range of motion. Two of studies reported an increase in IR, ranging from 13°6 to 19°, after joint mobilizations. Patients with glenohumeral internal rotation deficit decreased approximately 26° over the course of treatment, indicating that posterior mobilizations performed in both the scapular plane and with the shoulder in 90° of horizontal abduction and 90° of IR were beneficial (Bang and Deyle, 2004).

Nicholson (1985) in his study found the effects of passive mobilisation and active exercise in patients with painful restricted shoulders. Twenty patients with painful glenohumeral restrictions were randomly allocated to receive mobilisation and active exercise or active exercise alone for four weeks. The mean reduction in pain for the experimental group was – 5.1 out of 10 (SD 4.6) compared with –2.9 (SD 4.4) for the control group which resulted in a non-significant difference of –2.2 (95% CI –6.4 to 2.0). Only passive abduction range of motion increased significantly more in the mobilization group than in the control group. [35] Mechanisms by which Posterior capsule stretching improved ROM can be attributed to an increase in glenohumeral internal rotation. The small changes in GIRD reported immediately following one episode of stretching could be attributed to creep and hysteresis in the posterior capsule (Cools *et al.,* 2012). The results of present study are consistent with those produced by other authors:

Cools *et al.* (2012) who demonstrated that stretching of the posterior shoulder improves shoulder internal rotation ROM associated with impingement symptoms (Cools *et al.*, 2012)

Laudner *et al* and Tyler *et al* demonstrated that the clinician-assisted sleeper-stretches resulted in significant acute increase in glenohumeral internal rotation ROM and posterior shoulder motion. Indeed only an increase of 3.1 degree was found immediately after two repetitions of 30 seconds of stretching, performed by therapist (Tyler *et al.,* 2010).

Lintner *et al* showed that professional pitchers who underwent an internal rotation stretching programme for more than 3 years had a significant more internal rotation ROM (+20 degree) compared to pitchers enrolled in a stretching programme for less than 3 years (Lintner *et al.,* 2007).

SPADI- Disability index (SPADI)

It is a self-adminisred questionaire that consists of two dimensions, one for pain and other for functional activities. The pain dimensions consists of 5 questions regarding the severity and individual's pain. Functional activities are assessed with eight questions designed to measure the degree of difficulty in individual has with various ADLs that requires upper extremity use. In present study there was significant reduction in SPADI in all the groups at the end of the study. However there was no significant difference between the three groups. The Reason for improvement in all the groups in this study may be due to that functional limitations are assumed to be related to increased mobility and decreased pain associated with the condition. Improved mobility and pain would, therefore, be expected to lead to functional improvement. Also considering the amount of activity performed in this study immediately prior to the post-treatment measurements. As an example, two of the subjects who reported more pain at the end of the study admitted that in actuality, one to two days before their posttreatment session, their shoulders had felt "so good" that they had performed activities they had been unable to do before being involved in the study (cleaning out a garage and cleaning out closets). Thus, although their participation in the study resulted in a substantial reduction in their shoulder pain, this diminution in pain permitted them to perform high-function activities that they had previously been unable to perform and led to an increase in their shoulder pain immediately prior to the post-treatment assessment session. This may be one reason why improvement as assessed with the SPADI may be more indicative of overall functional improvement as it is evaluated by the individual as a general or average over the previous few days (Guru *et al.,* 2015). The results of present study are consistent with those produced by other authors:-

Jean-Se'bastein Roy *et al.,* (2009) evaluated the effect of an intervention including shoulder control and strengthening exercises on shoulder function in persons with impingement syndrome. All subjects showed significant improvement in the SPADI at the end of the study. A disappearance of a painful arc of motion in flexion and abduction (n=6), an increase in isometric peak torque in lateral rotation (n=3) and abduction (n=2) and changes in the scapular kinematics, mainly in the sagittal plane were observed (Roy *et al.,* 2009). Lynda *et al.,* (2008) examine the immediate effects of cervical lateral glide mobilizations on pain intensity and shoulder abduction painful arc in subjects with shoulder pain. Results revealed the shoulder abduction painful arc and shoulder pain intensity were significantly decreased. The results of study suggest that any immediate change in shoulder pain or active shoulder ROM following cervical mobilizations indicate that treatment directed towards asymptomatic cervical spine may expedite recovery. [13]

Werner *et al.,* (2002) compared the effects of a standardized self training versus standard physiotherapist – supervised exercises in the non-operative treatment of shoulder impingement syndrome. They concluded that strengthening of the centering muscles around the humeral head leads to good results in the operative treatment of subacromial impingement.

Conclusion

The results of the study suggest that all the intervention presented in the study ie, maitland cervicothoracic mobilization ,maitland glenohumeral mobilization, posterior shoulder stretching are equally effective to reduce pain , disability and increase ROM when given with common strengthening exercises in individuals with shoulder impingement syndrome.

Limitations

Small sample size, no control group, no follow up was taken and duration of the study was short.

Recommendation

- Large sample size can be taken.
- A group with only exercise programme can be taken.

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