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Original Research Article

Effect of Muscle Energy Technique on Glenohumeral Internal Rotation Deficit and Functional Outcomes in Over Head Athletes - A Pre-Post Experimental Study

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ABSTRACT

Background: Overhead athletes present with posterior shoulder tightness and decreased internal rotation because of osseous and soft tissue adaptations. Muscle Energy Technique has been successfully used in lengthening the soft tissues and improves range of motion. No studies have explored the effectiveness of muscle energy technique on Glenohumeral Internal Rotation Deficit in overhead athletes.
Objective: To find out the effect of muscle energy technique on improving Glenohumeral Internal Rotation Deficit and functional outcomes in overhead athletes.
Methodology: This study was carried out with 40 patients who had Glenohumeral internal rotation deficit. Group A (n = 20) had received muscle energy technique. Group B (n = 20) underwent stretching program. All patients received two treatment sessions per week for four weeks. Glenohumeral internal range of motion was evaluated by goniometer and functional outcomes were evaluated by using Shoulder pain and disability index (SPADI), which were recorded at base line and at the end of four weeks.
Results: Both muscle energy technique and the stretching program were found to be significantly effective in increase Glenohumeral internal range of motion and also reduce the disability and improve functional outcomes. In the experimental group the SPADI was reduced from 61.75 to 57.60 which was statistically significant (p value 0.001) and the IROM was improved from 55.30 to 59.05 which was statistically significant (p value 0.0001). In the control group the SPADI was reduced from 62.45 to 60.50 which was statistically significant (p value 0.007) and the IROM was improved from 55.65 to 57.50 which was statistically significant (p value 0.005)
Conclusion: The results of this study demonstrate that the muscle energy technique and stretching program may be the treatment choice for therapist in managing Glenohumeral internal rotation deficit.

Key words:- Glenohumeral internal rotation deficit, Over head athletes, Muscle energy technique, Stretching program, Shoulder pain and disability index.

INTRODUCTION

The glenohumeral joint is inherently unstable and stability is provided predominantly by the ligaments, capsule and muscular structures and by relative position of glenoid and the arm through all motions. [1] There is a relationship between scapulothoracic muscle imbalance and shoulder pain. [1-4] These imbalance results in scapular instability, potentially increases the risk of shoulder problems. Overhead activities such as throwing, volley ball and tennis place the athletes at considerable risk of overuse injuries. [5] Athletes involved in repetitive overhead activities place unique demands on shoulder girdle. [6] Probably

overhead athletes present with increase in external rotation and decrease in internal rotation. These alterations can exist as a result of alterations to bones due to the stress placed on humeral head from rapid decrease in velocity results in humeral retroversion and mainly posterior capsule thickening due to passive stiffness known as thixotropy. [7] Most throwers exhibit significant laxity of Glenohumeral joint which permits excessive range of motion is referred as throwers laxity. [8] An athlete presenting with more than 20 degrees of internal rotation difference in between both shoulders is considered as glenohumeral internal rotation deficit (GIRD). [9] It appears to be an adaptation to overhead activities that might begin in early days of athlete's career and it can result in several pathological conditions. Goniometric measurement both active and passive is most commonly used technique to assess the glenohumeral internal rotation deficit.

Several studies have postulated that posterior capsular tightness alters glenohumeral kinematics and leading to possible pathologic changes such as internal impingement and superior labrum anterior posterior tears. [10]

The change in ROM as a result of humeral torsion is difficult to modify, changes to soft tissue inflexibility can be modified through an implementation of a routine stretching, [11,12] The posterior capsule stretching program is found to be effective in increasing internal rotation [13] range of motion and another stretching program termed as self-sleeper stretch and cross arm stretch are found to be effective in increasing both internal rotation and adduction range of motion of the shoulder joint. [14] Posterior capsule stretching is performed with aid of clinician. In addition most of stretches are in supine and side lying position on a treatment table. A clinician assisted stretch performed on treatment table has the advantage of scapular stabilization during stretches. However the disadvantages of these stretches are that athletes cannot perform the stretches independently and cannot perform on field as part of warm-up or cool-down routine. With a slight modification to clinician assisted stretches, posterior shoulder stretches can be perform independently with the use of treatment table. Specifically these stretches can perform while standing also. As there is acute improvement in Glenohumeral internal range of motion from these non-assisted shoulder stretches, athletes can perform posterior shoulder stretching more effectively rapidly and frequently. [15]

Kevin E[1] recommended 4 phases of rehabilitation in overhead athletes in which the exercises is of more aggressive and stress on shoulder is gradually increases,

1) Phase 1- Acute phase of rehabilitation:

It includes local therapeutic modalities such as ice, ultrasound and electrical stimulation to decrease pain and inflammation and also flexibility and stretching program for posterior shoulder muscles and also rotator cuff strengthening and scapular muscle strengthening and also proprioception training

2) Phase 2-Strengthening phase:

It includes isotonic strengthening program to improve flexibility and facilitate neuromuscular control to restore muscle balance and also throwers ten program and also rhythmic stabilization drills and also initiate core strengthening also

3) Phase 3-Advanced strengthening phase:

Enhances power and endurance and it consists of plyometric and endurance drills

4) Phase 4- consists of all above exercises which returns to their normal activity.

Kinesio taping increases the scapular kinematics and strength of lower trapezius muscle which thereby increases the activity of players. [16]

Muscle energy technique is a manual therapy intervention that can be used to stretch or lengthen the muscles and fascia that lack flexibility. [17] It requires the patient to create a force by activating the

targeted musculotendinous unit against a precisely directed counter force applied by clinician followed by relaxation and passive stretch applied by clinician. It claimed to be effective for a variety of purposes including lengthening a shortened muscles, increase range of motion (ROM), as well as lymphatic or venous pump to aid drainage of fluid or blood16. One application of MET may consists of 3 to 5 contractions held for 5 sec each, with a stretch following each contraction that ranges from 3 to 5 sec to 30 to 60 sec. [18]

Muscle energy technique has been relatively unexplored with only a few published studies supporting its use for cervical, [19] lumbar, [20] and thoracic motion [21] restrictions and also use of met in lower extremity [22] conditions. There is literature showing the effectiveness of 4-week program of muscle energy technique in baseball players who had posterior shoulder tightness, also many studies showed that posterior shoulder stretching increases internal range of motion in overhead athletes. There are no previous studies that related to effects of MET in improving GIRD. As overhead athletes present with posterior shoulder tightness and decrease in internal rotation because of the osseous and soft tissue adaptations, there is lack of literature regarding improvement in Glenohumeral internal rotation deficit using muscle energy technique in overhead athletes. Therefore, there exists a need to find out the effectiveness of MET on Glenohumeral internal rotation deficit in overhead athletes.

MATERIALS & METHODS

An Experimental study was conducted among 40 overhead athletes, who were taken from Sports Authority of India (Karnataka, Bangalore) based on the inclusion and exclusion criteria. Informed consent was taken from the subjects prior to study and proper assessment was done.

Inclusion criteria:

- Overhead athletes who are having GIRD of 20 degrees and above
- Age group: 17-30 years
- Both male and female

Exclusion criteria:

- Any previous shoulder injury
- Post-surgical cases
- Shoulder instability

Outcomes measures:

- Goniometry
- Shoulder pain and disability index(SPADI)

Materials used:

- Couch
- SPADI
- Universal Goniometer
- Paper
- Pen

Exercise protocol:

The subjects were randomly divided into an experimental group (EG) and a control group (CG). Experimental Group received Muscle Energy Technique. The Control Group performed a self-stretching.

- **Experimental Group:** The subjects in this group were received Muscle energy technique. This was performed in supine lying position on the couch with the shoulder and elbow should be in 90 degrees of flexion and lateral border of scapula stabilized by the therapist. The therapist keeps the subject shoulder in adduction in first barrier of motion. Then instruct the subject to perform isometric contraction for 5 sec in direction of horizontal abduction against an opposing force applied by the therapist. Then the therapist instructs the subject to relax for 5 sec. Again the technique was repeated in the new movement barrier. The technique was repeated for total 3 repetitions. [15]
- **Group B:** In this group the subjects were performed posterior shoulder stretch which was a kind of self-stretch. It was performed in side standing position with 90 degrees flexion of both shoulder and elbow against wall to stabilize the scapula against the wall. Then the therapist was instructed the

subject to move the shoulder into internal rotation by using contra lateral hand and hold it for 30 sec and repeat it for 3 times with 30 sec rest between each contraction.

Fig: Subject receiving Muscle Energy Technique

Fig: Subject performing Stretching

Before starting the intervention the subjects were assessed with Goniometer and Shoulder Pain and Disability Index (Pre-measurement). After 4 weeks of completion of intervention, subjects were again assessed with Goniometer and Shoulder Pain and Disability Index (Post-measurement) and the data was analyzed.

As this study involved human subjects, the ethical clearance was obtained from the ethical committee of Padmashree Institute of Physiotherapy, Nagarbhavi, Bangalore as per the ethical guidelines for Biomedical Research on Human subjects, 2001 ICMR, New Delhi.

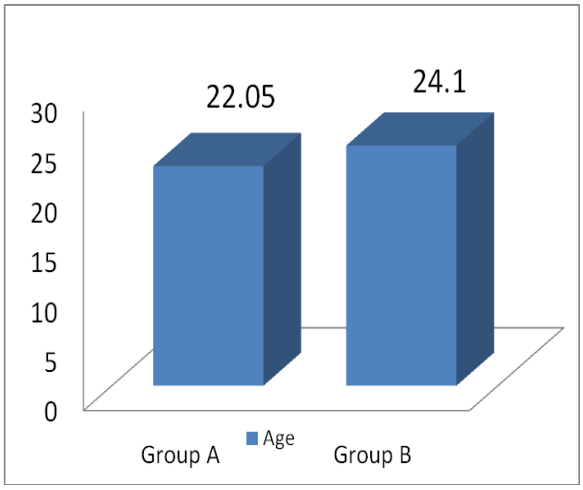
Data analysis

Data analysis was performed using SPSS (version 17) for windows. Alpha value was set as 0.05. Paired t-test was used to compare pre and post test ROM in both the groups. Wilcoxon's test was used to compare the pre and post SPADI in both the groups. Unpaired t-test was used to compare the post test ROM in between groups. Mann Whitney-U test was used to compare the post test SPADI in between groups.

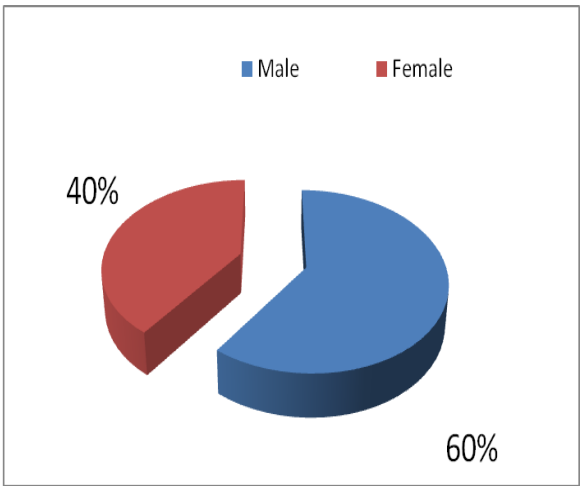
RESULTS

Table 1: Baseline Data for Demographic Variables

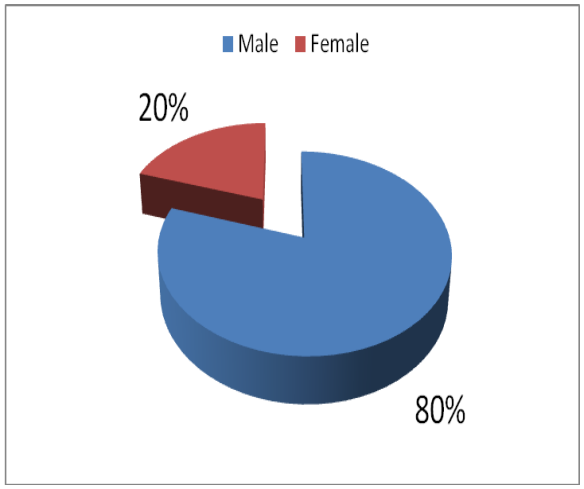
Variable	Experimental	Control	p-value
Age	22.05±2.89	24.10±3.08	<0.036
Gender (M/F)	12/8	16/4	>0.168



Graph 1:-Baseline data for demographic variable-Age



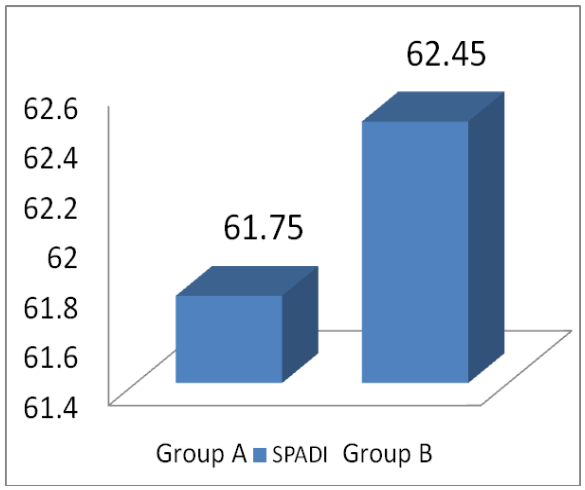
Graph 2:- Baseline data for demographic variable – Gender (Group A)



Baseline data for demographic variable – Gender (Group B)

Table II: Descriptive statistics for the outcome variables

Variable	Experimental	Control	p-value
SPADI	61.75±15.08	62.45±21.34	>0.904
IROM	55.30±9.42	55.65±12.63	>0.921

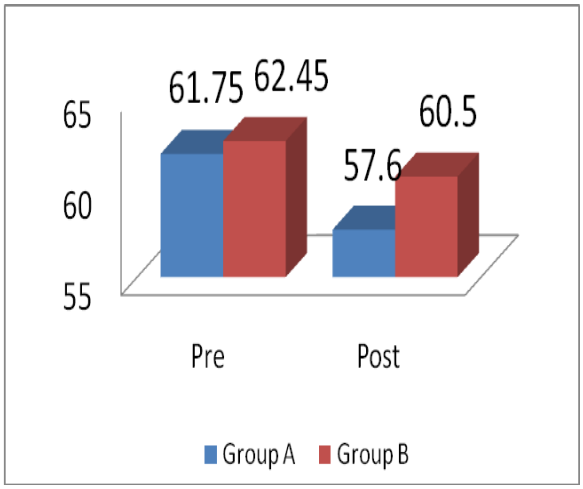


Graph 3: Baseline data for outcome variables

Table III: Pre-Post Difference with in the groups

Variable	Pre	Post	p-value
SPADI	61.75±15.08	57.60±16.25	<0.001
IROM	55.30±9.42	59.05±8.44	<0.0001

In the exp group the pre SPADI score reduced from 61.75 with sd of 15.08 to post SPADI score of 57.60 with sd of 16.25 which was statistically significant (p value .001). In the exp group the pre IROM score improved from 55.30 with sd of 9.42 to post score of 59.05 with sd of 8.44 which was statistically significant (p value .0001)

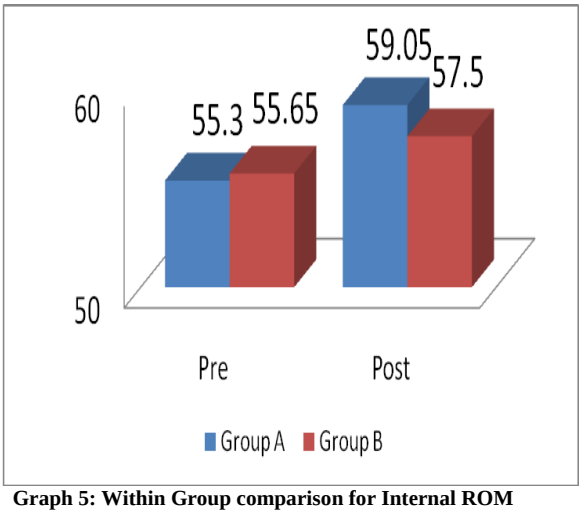


Graph 4: Within Group comparison for SPADI

Table IV: Within Group comparison for control group

Variable	Pre	Post	p-value
SPADI	62.45±21.34	60.50±22.10	<0.007
IROM	55.65±12.63	57.50±12.41	<0.005

In the control group the pre SPADI score reduced from 62.45 with sd of 21.34 to post SPADI score of 60.50 with sd of 22.107 which was statistically significant(p value .007). In the exp group the pre IROM score improved from 55.65 with sd of 12.63 to post score of 57.50 with sd of12.41 which was statistically significant (p value .005)



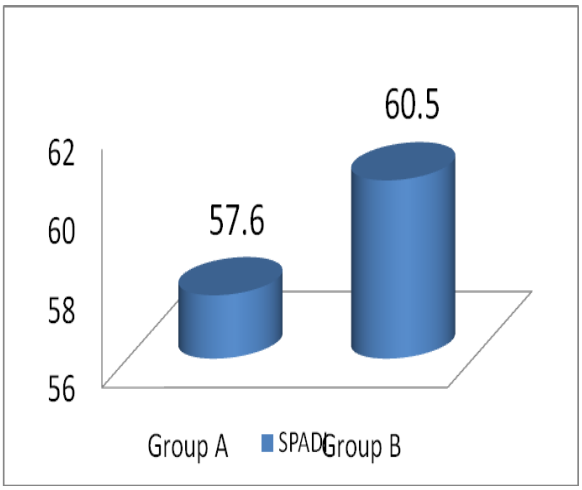
Graph 5: Within Group comparison for Internal ROM

Table V: Mean gain in improvement for Between groups

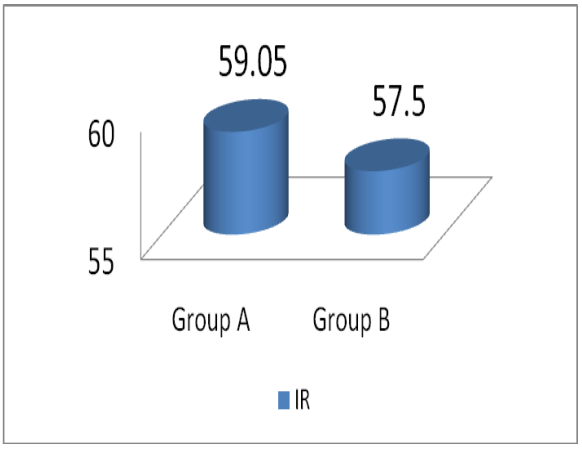
Variable	Experimental	Control	p-value
SPADI	57.60±16.25	60.50±22.10	>0.640
IROM	59.05±8.44	57.50±12.41	>0.647

However when comparing between group the mean reduction in SPADI score for exp group was 57.60 with sd of 16.25 and in the control group score was 60.50

with sd of 22.10 which was not statistically significant (p value more than .640) for the exp group the mean gain in improvement for IROM was 59.05 with sd of 8.44 and in the control group mean gain improvement was 57.50 with sd of 12.41 which was not statistically significant(p value more than 0.647).



Graph 6: Pre-post difference in between groups for SPADI



Graph 7: Pre-post difference in between groups for IROM

DISCUSSION

Objective of the study was to find out the effectiveness of muscle energy technique on improving Glenohumeral Internal Rotation Deficit and functional outcomes in overhead athletes.

The baseline demographic data for age were homogenous between groups in which group A had mean age of 22.05 and group B had mean age of 24.10. The baseline demographic data for gender were heterogeneous in which 12 males and 8 females were taken in Group A and 16 males and 4 females were taken in group B. All the patients in both the groups were able to complete the study. The baseline data for outcome were homogenous between groups with mean SPADI score of 61.75 in Group A and 57.60 in Group B. The mean Internal ROM score was 55.30 in Group A and 59.05 in Group B.

The SPADI score in Group A was reduced from pre intervention 61.75 to 57.60 which was statistically significant ($p<0.001$). This was supported by Noelle M. Selkow et al (2009), discussed the effectiveness of muscle energy technique in reducing pain and disability and they said that the small decrease in worst pain over past 24 hours may have been due to a decrease in neurophysiological pain, thus decreasing the level of pain perceived by the patient and they hypothesized that during patient interaction, manual contact with patient may have resulted in alleviation of pain, through neurophysiological mechanism of applied movement. So the effect was associated with clinical touch of pain. [23]

According to Gary Fryer (2011), MET may influence pain mechanism and promote hypoalgesia. The specific mechanisms are not known, but may involve central and peripheral modulatory mechanisms, such as activation of muscle and joint receptors that involve centrally mediated pathways, like the periaqueductal grey (PAG) in the midbrain, or non-opioid serotonergic and noradrenergic descending inhibitory pathways. Studies have shown sympathoexcitation and localized activation of the lateral and dorsolateral PAG from induced or voluntary muscle contraction, and activation of non- opioid descending inhibitory pathways from peripheral joint mobilization. Additionally, MET may increase fluid drainage and augment hypoalgesia. He concluded that MET application may reduce pro-inflammatory cytokines and desensitize peripheral nociceptors. [24]

According to Leon Chaitow, these results may be due to the mechanism

include neurological and tissue factors, such as stimulation of low threshold mechanoreceptors on centrally mediated pain inhibitory mechanisms and on neuronal populations in the dorsal horn with possible gating effects and also the effect of rhythmic contraction of muscle on interstitial and tissue fluid flow which all reduces the pain and there by leads to reduction in disability. [25] According to Hamilton et al (2007), MET was effective in reducing pain and improve functional activity and the effect was due to stimulation of joint proprioceptors, via the production of joint movement and the stretching of joint capsule, may be capable of reducing pain by inhibiting the smaller diameter nociceptive neuronal input at the spinal cord leads to alter the perception of pain which leads to decrease in disability. [26]

In Group A the internal range of motion was improved from pre intervention of 55.03 to 59.05 which was statistically significant. This was in accordance with study done by Ballentyne et al, (2003) suggested that the muscle energy technique leads to improve muscle flexibility there by improve in ROM by a mechanism called post-isometric relaxation and they hypothesised that as the isometric contraction of muscle leads to activation of golgi tendons that leads to reflex relaxation of the muscle there by flexibility of muscle increases. [27] According to John Gibbons (2011), evaluated the effects of muscle energy technique in improving Range of motion and he hypothesised that the effects are mainly due to two distinct physiological processes, which are of PIR/RI in which PIR of agonist contraction and RI of antagonists contraction. They stated that when an isometric contraction is sustained, neurological feedback through the spinal cord to the muscle itself results in PIR. But during IR, the reduction in tone relies on the physiological inhibiting effect on antagonists. [28]

In Group B the SAPDI score was reduced from pre intervention 62.45 to 60.50 which was statistically significant. This was in accordance with Stephen S. Burkhart et al (2003), the posterior shoulder stretch was effective in reducing pain by application of posterior shoulder stretch through the separation of the anatomical structures that causes impingement pain. The posterior shoulder stretch leads to separation of posterior glenoid and humerus there by reduces the pain and disability. [5] This was also supported by a study done by Kibler WB et al (1998), found the effectiveness of posterior shoulder stretch in reducing pain through the elongation of posterior shoulder structures there by reduces disability. [4]

In Group B the internal ROM was improved from pre intervention of 55.65 to 57.50. This was supported by a study done by Sakki Oyama et al (2010), hypothesized the effect of posterior shoulder stretch in collegiate baseball players and there was an improvement in internal ROM was noted by improving shoulder flexibility through the elongation of posterior shoulder structures. [16] According to Philip Mcclure et al (2007), posterior shoulder stretch was effective in improving shoulder internal ROM in baseball players through stabilizing the scapula, as isolation of the stretch occurs in posterior shoulder region. Therefore, the effect occurred in both contractile tissue and the capsule. The elongation of these two structures leads to improvement in ROM. According to Kevin G.Launder et al (2008), posterior shoulder was effective in improving the restricted ROM in overhead athletes by lengthening the soft tissue. [14]

Results did not show any statistical significant between group A and group B. In group A the mean SPADI score was 57.60 and in group B the mean SPADI score was 60.50 which was not statistically significant. The mean internal ROM in group A was 59.05 and in group B 57.50 which was not statistically significant. This could be due to Muscle energy technique and the posterior shoulder stretching both elongates the posterior shoulder structures. There by both leads to lengthening of contractile tissue and

as well as capsule. So the effectiveness was same in both techniques. Hence the study accepts the null hypothesis- "There will be no significant effect of MET in improving GIRD and functional outcomes in overhead athletes".

CONCLUSION

There is no significant effect of MET in improving Glenohumeral Internal Rotation Deficit and functional outcomes in overhead athletes.

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