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COMPARATIVE STUDY ON THE EFFECTIVENESS OF MUSCLE ENERGY TECHNIQUE AND ACTIVE RELEASE TECHNIQUE ON THE GLENOHUMERAL INTERNAL ROTATION DEFICIT (GIRD) IN YOUNG THROWING ATHLETES

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Abstract:
Background: Glenohumeral internal rotation deficit (GIRD) is one of the most common causes of impairments in overhead throwing athletes due to high intense and repeated throwing activities. The purpose of this study is to compare the effects of Muscle energy technique and Active release technique in overhead throwing athletes with Glenohumeral internal rotation deficits. **Materials and Methods:** A total of 42 athletes with age group 18-25 were selected for the study and a simple random lottery method was used to divide the sample into three groups; Group A (n=14) received muscle energy technique and conventional therapy, Group B (n=14) received active release technique and conventional therapy, Group C (n=14) received only conventional therapy. Measurements of shoulder internal rotation ROM (by Goniometer) and SPADI (shoulder pain and disability index) were assessed pre- and post-treatment after 4 weeks. **Results:** The results showed that Group A shows a significant difference in shoulder internal rotation ROM with a p-value <0.05 than Group B and C, but there was no significant difference was found between all the groups in the SPADI score with p-value >0.600. **Conclusion:** The study concluded that the muscle energy technique is more effective than the active release technique in improving shoulder internal rotation ROM, but both techniques have equally effective in improving shoulder function among athletes with GIRD.

Keywords: overhead athletes; glenohumeral internal rotation deficits; muscle energy technique; active release technique

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1. Introduction

Shoulder pain affects 18-26% of adults at some point in their lives, according to demographic studies, making it one of the most frequent regional pain syndromes[1]. The cause of shoulder pain in India has been reported as one of the major work-related musculoskeletal symptoms, the prevalence of shoulder pain is claimed to affect 2% urban population and 7.4% rural population[2]. As sports continue to gain popularity around the world, the "sports industry" has become increasingly competitive and profitable for athletes, with many aspiring to the highest levels of professionalism[3]. Throwing is a complex set of actions that combines rotational and translational motion, reaching angular velocities up to 7000 deg/sec[4]. There are six distinct phases to the throwing motion such as wind-up, early cocking, late cocking, acceleration, deceleration, and follow-through phase, each of which typically lasts less than two seconds[5].

Due to the enormous loads and forces the shoulder encounters throughout the various throwing phases, overhead sports pose a significant risk of injury. Laxity, instability, glenohumeral internal rotation deficit (GIRD), rotator cuff strength imbalance, scapular dyskinesis, SLAP lesion, and impingement are all prevalent shoulder pathologies in overhead throwers[6,7]. Among all injuries, Glenohumeral internal rotation deficit (GIRD) is one of the most common risk factors for shoulder injuries[8]. The occurrence of Glenohumeral internal rotation deficit (GIRD) was already identified in several athletes, such as baseball, volleyball, basketball, softball, handball, cricket, tennis and badminton players[9,10].

Glenohumeral Internal Rotation Deficit (GIRD) is defined as "*the loss in degrees of Glenohumeral Internal Rotation of the dominant shoulder compared with the non-dominant shoulder*"[11]. There are various causes which lead to Glenohumeral internal rotation deficit (GIRD) such as posterior capsular thickening, rotator cuff stiffness, humeral retroversion and abnormal scapular positioning[12]. The repetitive throwing motion causes adaptive changes to bone and soft tissue, which lead to the development of GIRD in overhead athletes[13,14]. Repeated microtrauma during the stages of late cocking and follow-through of the throwing motion, the postero-inferior region of the glenohumeral capsule contracts and thickens, which results in GIRD[13,15,16].

Muscle energy is a class of soft tissue osteopathic manipulation methods that incorporate precisely directed and controlled, subject initiated, isometric and/ or isotonic contractions, designed to improve musculoskeletal function and reduce pain[17]. Muscle energy technique (MET) is a primer remedy intervention that can be used to stretch or lengthen muscles and fascia that lacks flexibility. This leads to improves postural alignment and restriction of proper common biomechanics and functional movement[18,19]. Active release technique (ART) is the combination of point-specific manual pressure with precise patient movement. ART is used to find the specific tissues that are confined, and physically work on the soft tissues back to their normal texture, tension, and length by using various hand positions and soft tissue manipulation methods[20].

The primary responsibility of the therapist is to appropriately screen the athlete and treat the GIRD in accordance with the athlete. Some studies suggested that Muscle energy techniques (MET) are effective in treating patients with Glenohumeral internal rotation deficits (GIRD). However, there is a paucity of literature related to the effects of muscle energy technique and active release technique on treatment options for GIRD. Hence the need arises to study the effectiveness of both MET and ART on GIRD individuals. Once the effects of both MET and ART on the GIRD population have been identified, therapists may treat the ailment with ease using these manual approaches, which has superior results than using conventionally different stretching techniques on the GIRD population.

2. Material and Methods

2.1 Participants

The study was conducted at Alva's College of Physiotherapy, Moodbidri, Dakshina Kannada, Karnataka, India. The sample size was calculated by using G*power 3 program with a power of 80%, effect size of 0.8, and error probability of 0.05. The selection criteria of the study were 1) only male athletes between 18-25 years of age 2) athletes who were involved in overhead sports such as cricket, volleyball, and badminton 3) athletes with GIRD > 15°. The exclusion criteria included 1) individuals with post-surgical case 2) individuals with dominant shoulder instability 3) individuals with a dominant shoulder injury. A total of 42 overhead-throwing males having GIRD were included in the study and divided into 3 groups. Group A received MET and conventional therapy (CT), Group B received ART and CT and Group C received CT only. The lottery method was used for random allocation.

2.2 Ethical Approval

Ethical approval for the study was obtained from the Institutional Ethical Committee Review Board of Alva's College of Physiotherapy, Moodbidri, Dakshina Kannada, Karnataka, India.

2.3 Outcome Measures

Shoulder internal rotation range of motion and SPADI (shoulder pain and disability index) were performed at baseline and post-test following 4 weeks of intervention.

2.4 Procedures

Participants were assessed and those who presented with GIRD were identified. Individuals who fulfilled the inclusion criteria were interviewed for their consent to participate in this study and written consent was obtained from athletes. The study purpose and protocol were explained to all the participants. Their age, and height was recorded for demographic statistics. Baseline range of motion and SPADI were assessed.

2.5 Application of Muscle Energy Technique

The subject was positioned supine on the treatment table with the shoulder and elbow, at 90° of abduction and flexion respectively. The shoulder was stabilized at the acromion process with one hand, and the other hand was used to passively move the arm into internal rotation until the first barrier of motion was reached. The subject was then instructed to perform a 5- second isometric contraction of approximately 25% maximal efforts in the direction of external rotation, against an opposing force provided at the distal forearm. Following the contraction, the subject was instructed to internally rotate the arm toward the ground as a 30-second active assisted stretch was applied. The subject was instructed to relax, and a new movement barrier was then engaged. This protocol was performed for a total of 3 repetitions.

Figure 1: Application of Muscle Energy Technique

2.6 Application of Active Release Technique

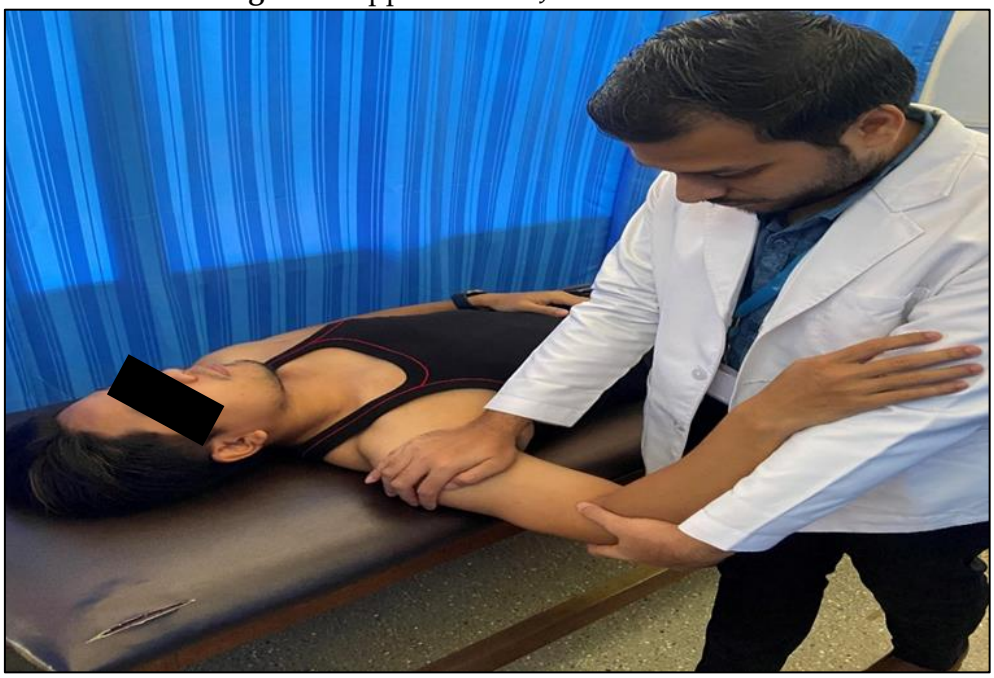
The patient was prone lying and the arm was taken from the adducted (elbow next to the side) position to the fully abducted (full reach above the head) and internally rotated position. Tension was given for 10 seconds on the external rotators muscle (infraspinatus) and asked the patient to return to starting position as per ART protocol. This cycle was repeated for 5 times.

Figure 2: Application of Active Release Technique

2.7 Application of Joint Mobilization

The subject in supine lying at the edge of the couch, so the table provided scapular stabilization. The participant's shoulder was abducted to 90° and internally rotated to the first barrier. Then examiner gave ten repetitions of grade III posterior oscillations to the humeral head parallel to the glenoid treatment plane. This procedure was repeated for 3 sets.

Figure 3: Application of Joint Mobilization



2.8 Application of Sleeper Stretch

The subject lies on the affected side with the shoulder stacked underneath and a pillow was used under the subject's head. The shoulder was abducted to 90° and moved his hand in the direction of internal rotation up to the first barrier felt. Hold this position for 30 sec and repeated this procedure three times.

Figure 4: Application of Sleeper Stretch

2.9 Statistical Analysis

Data analysis was done by using SPSS version 23 for Windows. Descriptive statistics were calculated for each group. The paired t-test was used to test the significance within the group for SPADI and shoulder internal rotation ROM for all three groups. One-way ANOVA was used to test the significance of SPADI and shoulder internal rotation ROM between the groups. Post hoc (Turkey's test) was used for multiple comparisons between the groups.

3. Results

The baseline data were homogeneous with respect to gender, age, height, hand dominance, and sports participation between all three groups $p>0.05$ as reported in Table 1. A total of 42 male overhead athletes were included in the study and were divided into three groups (n=14). The mean age of athletes in group A was 20.857±2.507, group B was 20.643±1.598 and group C was 20.857±1.562. In the present study out of 42 athletes, there were 41 athletes with right arm dominant and 1 athlete was left dominant. A total of 17 cricket bowlers, 12 volleyball players and 13 badminton players were included in the study, out of which 24 athletes were having <5 years of practice whereas 18 athletes were having ≥5 years of practice. Hence baseline similarity of participants in all three groups was assured.

Table 1: Demographic distribution

Groups	Age	Height	Dominant side		Sports			Year of practice	
			Right	Left	Cricket	Volley ball	Badminton	< 5 years	≥5 years
Group A	20.857 ± 2.507	171.429 ± 7.832	14	0	06	04	04	07	07
Group B	20.643 ± 1.598	171.071 ± 5.581	13	01	05	05	04	08	06
Group C	20.857 ± 1.562	169.143 ± 4.330	14	0	06	03	05	09	05
p-value / Total	0.945	0.570	42		42			42	

The results showed that there were significant differences in pre- and post-scores in outcome parameters within all three groups calculated by paired t-test ($p<0.05$) as reported in Table 2. One-way ANOVA was used to calculate pre- and post-significance between the group and it showed that there was a significant difference between all three groups in improving GH internal rotation ROM ($p<0.05$), but there was no significant difference between the groups for SPADI scores ($p>0.05$), which is described in Table 2. Post hoc (Turkey's test) was used for multiple comparisons between the groups. As described in Table 3, it showed that there was a significant difference in ROM in MET group compared with ART and conventional group ($p<0.05$) however there was no significant difference between all three groups in SPADI score ($p>0.05$).

Table 2: Comparison within and between all three groups

			Group A	Group B	Group C
Within the group comparison	ROM	Pre test	59.071 ±3.626	60.143 ± 6.062	59.786 ± 3.262
		Post test	68.429 ± 3.180	65.643 ± 4.830	64.857 ± 3.348
		p-value	0.000	0.000	0.000
	SPADI	Pre test	29.175± 4.775	28.571 ± 3.517	28.956 ± 3.998
		Post test	22.142 ± 4.193	22.269 ± 3.850	23.516 ± 3.789
		p-value	0.000	0.000	0.000
Between the group comparison	ROM	Pre test	59.071±3.626	60.143±6.062	59.786±3.262
		Post test	68.429±3.180	65.643±4.830	64.857±3.348
		p-value	0.047		
	SPADI	Pre test	29.175± 4.775	28.571 ± 3.517	28.956 ± 3.998
		Post test	22.142 ± 4.193	22.269 ± 3.850	23.516 ± 3.789
		p-value	0.600		

Table 3: Post hoc test of shoulder internal rotation ROM and SPADI for multiple comparisons between the groups

Groups	Comparing Groups	Internal rotation ROM		SPADI	
		Mean Difference	p-value	Mean Difference	p-value
Group A	Group B	2.786	0.049	0.127	0.996
	Group C	3.571	0.049	1.374	0.631
Group B	Group C	0.786	0.853	1.247	0.683

4. Discussion

The present study was conducted to compare the effectiveness of muscle energy technique and active release technique on the glenohumeral internal rotation deficits (GIRD) in young overhead-throwing male athletes between 18 to 25 years of age.

To our knowledge, this will be the first study to evaluate the effects of the active release technique in overhead athletes with GIRD and also to compare the effects of the active release technique with the muscle energy technique among athletes with GIRD.

According to Enger M. et al. (2019), males are more prone to develop sports-related shoulder injuries than female athletes[21]. Hellem A. et al. (2019) concluded that injuries to the dominant arm are extremely common in the overhead throwing motion both in professional pitchers as well as younger players[22]. Studies have shown that the risk of shoulder injury among athletes is high between 19-29 years of age[21,22,23,24]. In the study of Bhatia K. et al. (2017) and Savasaviya K. et al. (2019) among symptomatic collegiate players they found out that there was a greater prevalence of GIRD in cricket bowlers and badminton players[10,25]. Hence the findings of this study can be correlated with previous studies.

The results of the study showed that the application of MET and ART increased the glenohumeral internal rotation ROM and decreased the SPADI scores in both groups after 4 weeks of intervention. However, MET gave better results compared with ART in increasing glenohumeral internal rotation ROM but both groups showed equal effectiveness in reducing SPADI score.

Group A athletes were treated with the muscle energy technique showed to improve ROM and decrease SPADI score significantly. According to Chaitow L., the physiological mechanisms behind the changes in muscle extensibility produced by MET are reflex relaxation, viscoelastic or muscle property change, and changes to stretch tolerance. These mechanisms bring about a change in muscle physiology by restoring normal length-tension relationships which are shortened and by strengthening the weakened muscles and reducing edema by pumping action for the lymphatic system, hence leading to increased ROM at the joint.[17,19,26.]

Sehgal S. et al. (2016) demonstrated that MET is an effective treatment for increasing the ROM and strength of internal rotation at the glenohumeral joint in asymptomatic overhead athletes[13]. Moore S. D. et al. (2011) examined the effects of a MET application on the shoulder external rotators and horizontal abductors in subjects with posterior shoulder tightness. The results of the study demonstrated that the application of MET creating significant improvements in horizontal adduction and internal rotation range of motion[14].

Group B athletes were treated with the active release technique and showed significant improvement in glenohumeral internal rotation ROM and reduced SPADI score. Due to mechanical stimulation, ART results in reactive hyperaemia and has analgesic effects. The cutaneous and muscular mechanoreceptors are stimulated

mechanically by digital pressure, which causes a physiological response that may have an impact on nociception and pain. By removing adhesions and regaining the soft tissue's integrity, ART treatment was effective. In research studies, this was accomplished by keeping the muscle in touch with the adhesion while it is shortened, and then lengthening the muscle along its fiber orientation to break up the adhesion[20,27].

Rajalaxmi V. et al. (2017), who conducted a study to analyse the immediate effects of ART in patients with adhesive capsulitis concluded that ART was highly effective in immediately reducing the pain and increasing the shoulder range of motion in adhesive capsulitis patients[26]. Paul J et al. (2021) concluded that the active release technique was more effective in improving pain, ROM and shoulder function among patients with shoulder impingement syndrome[28]. Mishra D. et al. (2018) found that the active release technique was highly effective in the alleviation of symptoms and associated disability in upper trapezius muscle spasm[27]. Khan S. et al. (2021), concluded that a single session of the active release technique was found highly effective in improving hamstring flexibility and range of motion[29].

In the study of Yatheendra Kumar G. et al. (2017), a significant difference was found in MET and ART groups in adhesive capsulitis patients. They concluded that ART gave better results in improving ROM, decreasing SPADI and VAS scores compared to MET and conventional group[30]. However, our results differ from the previous study, in this study, MET group showed a significant difference compared to ART and conventional group in improving ROM ($p < 0.05$) but there was no significant intergroup difference in SPADI score ($p > 0.05$) suggesting that both the techniques had similar effects on improving functional disability.

5. Recommendations

1) Future studies can be done in large sample size;
2) Other forms of overhead sports can be taken for interpreting the same;
3) Both gender of athletes can be included in future studies.

6. Conclusion

The study concluded that both the muscle energy technique and active release technique could be used as effective manual therapy for the management of GIRD populations. However, MET showed more effectiveness than the active release technique in improving shoulder internal rotation ROM, but both techniques have equally effective in improving shoulder function among athletes with GIRD. Hence the study suggested that the incorporation of MET along with conventional therapy may be considered when designing a rehabilitation program for athletes with GIRD.

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Conflict of Interest Statement
The authors declare no conflicts of interest.

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