International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

Effectiveness of Muscle Energy Technique and Passive Stretching on Posterior Shoulder Tightness in Cricket Bowlers - A Randomized Clinical Trial

Khushboo Bathia[1], Charu Eapen[2], Zulfeequer CP.[3]

[1, 2, 3]Department of Physiotherapy, Kasturba Medical College, Mangalore

Abstract: ***Introduction: Repeated overhead motions during bowling leads to microtrauma and development of fibrotic scar tissue in posterior capsule which leads to tightness and alteration of GH joint ROM i.e. increase in GH external rotation and GH internal rotation deficit (GIRD). Method: Thirty four collegiate cricket bowlers with GIRD>10 ^{0} were assessed for GH Internal rotation, external rotation and horizontal adduction with Baseline bubble inclinometer TM and randomized into two group. Stretching group received 30 seconds of stretch and MET Group received 7 seconds of isometric contraction followed by 30 seconds of stretch. Analysis was done between groups by repeated measures ANOVA and within group by unpaired student t test. Results: Comparison between groups showed statistically significant difference for internal rotation ROM. While within group comparison showed high statistically significant difference post 1st week and 2nd week in both the groups for horizontal adduction and internal rotation range of motion. Conclusion: Both MET and passive cross body adduction stretch for GHJ horizontal abductors for multiple sessions over 1 week and 2 weeks results in greater post treatment GHJ horizontal adduction and internal rotation ROM in asymptomatic collegiate cricket bowlers***

Keywords: MET, GIRD, Passive stretching

1. Introduction

The shoulder plays a vital role in many athletic activities. Overhead motions repetitively place the shoulder in vulnerable positions possibly leading to injuries.[1,2] During bowling in cricket, glenohumeral (GH) joint reaches extremes of motion, velocity and forces.[3] It was suggested that posterior shoulder stiffness results from repetitive microtrauma which leads to the development of fibrotic scar tissue of the posterior capsule.[2] This leads to posterior shoulder tightness and alteration of GH joint ROM i.e. increase in external rotation and decrease in internal rotation in overhead athletes.[4] Glenohumeral internal rotation deficit (GIRD) has been attributed to two factors: retroversion of humerus (osseous) and posterior shoulder tightness (soft tissue).[5,6,7,8] GIRD can be considered to be "the loss in degrees of glenohumeral internal rotation of the dominant shoulder compared with the nondominant shoulder".[5,6,8,9]

The amount of total humeral rotational motion in the throwing shoulder is equal to the non-dominant shoulder.[5,6] Thus the function of throwing shoulder is not affected as every degree of external rotation gained is equal to the amount of internal rotation lost[3] and it can be due to an adaptive increase in retroversion of humerus which leads to increase in GH joint external rotation[4,12] and is physiological.[5] Studies have proven that GIRD more than 25 degrees has been associated with injuries in the throwing shoulder. Thus stating a need of preventive and corrective interventions to restore GH joint internal rotation ROM.[1,3,4] Different stretching procedures used for improving the ROM are ballistic stretch,[13] contract relax stretching,[13,14] hold-relax[15] and static stretching[15,16] and MET[4,17].

Stretching of posterior shoulder plays an important role in restoring flexibility[4] and was commonly used to treat internal rotation ROM loss due to muscular and capsular limitations[11] by positively influencing reflex activity in order to bring about increased muscle-tendon unit length[12]. Specific techniques for stretching posterior shoulder include towel stretch, sleeper's stretch, cross body adduction stretch,[11] door way stretch. Among them cross body adduction stretch has been found to be more effective in athletes.[11,19]

Muscle energy technique has been used to increase the flexibility,[4] and ROM of a restricted joint.[17] The basic principle is post-isometric relaxation.[20] Many theories have proposed explaining its effect : reflex activated during isometric contraction of muscles produces a stretch on the golgi tendon organs and a reflex relaxation of muscle occurs,[17] increased stretch tolerance is also suggested as a possible mechanism responsible for increased ROM.[17]

It has also been proven that a single application of MET for GH joint horizontal abductors in baseball pitchers resulted in increased GH joint horizontal adduction and internal rotation.[4] In another study it was proved that a single application of MET did not produce change in biomechanical tissue property[17] and does not deform tissues enough to produce a permanent change (i.e., a plastic deformation in the musculotendinous unit),[21] so multiple sessions of MET needed to be used. The purpose of this study was to compare the effects of MET applied to the GHJ horizontal abductors and passive cross body adduction stretch over multiple sessions on improving GHJ horizontal adduction and GHJ internal rotation ROM in asymptomatic cricket bowlers with GIRD.

2. Review of Literature

Methods

Participants

Thirty four collegiate cricket bowlers with GIRD>10° [9] were included in the study. Exclusion criteria was history of shoulder surgery, dominant side upper extremity injury in the

last six months,[2] shoulder symptoms requiring medical treatment in the last one year, shoulder pain at the time of study[7] and cricketers not involved in any other sport. Sample size was determined by considering 95% confidence interval and 80% power.

Instrumentation

Baseline bubble inclinometer™ was used in the study to measure GH ROM with shoulder in 90° of abduction.[4] We used a rigid, non-elastic adjustable belt for stabilization of the scapula.

Procedure

The study protocol was approved by the Scientific Committee and Time Bound Research Ethics Committee of the Kasturba Medical College, Mangalore. Concerned authorities and athletes were approached and the procedure of the study was explained to them. Written informed consent was taken from all the athletes who participated in the study. During the initial evaluation session, the athletes were interviewed and the baseline outcomes of posterior shoulder tightness and glenohumeral joint horizontal adduction, internal and external rotation ROM were obtained.

1) Glenohumeral internal rotational ROM

Athlete was supine, with the shoulder abducted 90° and the elbow flexed 90°. The inclinometer was placed on the dorsal surface of the forearm. The forearm was vertical to start while the glenohumeral joint was passively internally rotated. Scapula was stabilized with a belt tied around athlete's chest while the examiner monitored compensatory movement at the end of internal rotation. When the scapula starts to protract, the measurement was taken by the examiner to differentiate glenohumeral internal rotation from composite shoulder internal rotation.[1,9]

2) Glenohumeral external rotation ROM

Athlete was supine with the shoulder abducted in 90° and the elbow flexed 90°. A towel was to be placed posterior to the humerus to ensure a neutral horizontal position. The forearm was then placed vertical while the examiner passively externally rotated the humerus with the hand at the athlete's wrist. The scapula was stabilized with the belt around athlete's chest. End range of glenohumeral external rotation was identified when resistance to any further motion was encountered, sometimes attempts to overcome the resistance causes a posterior tilt or retraction of the scapula. Measurements were made with the arm at end range, with the inclinometer on the ventral forearm surface by the examiner.[1,9]

3) Glenohumeral horizontal adduction ROM

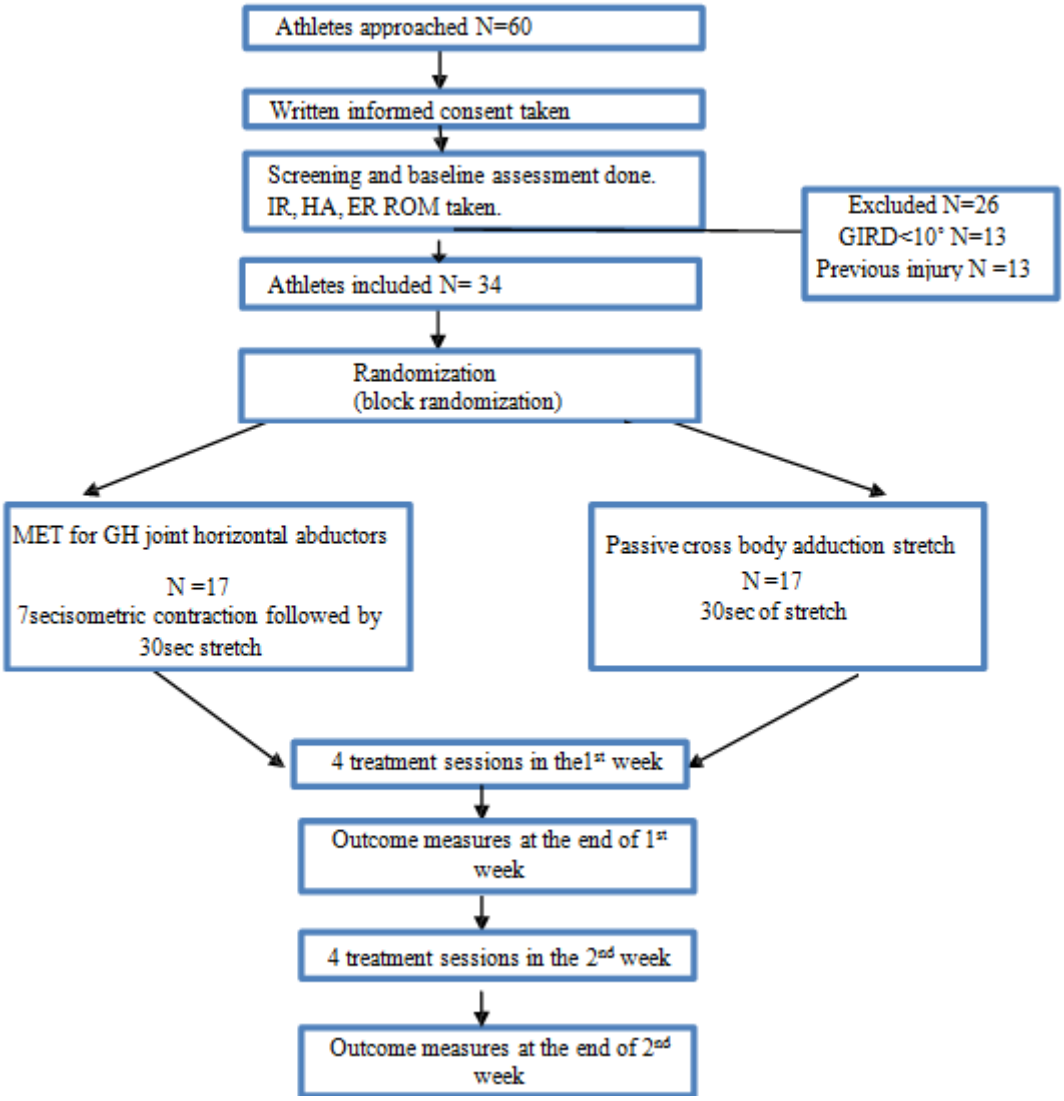
Athlete was supine, with both shoulders flat against the plinth. The test shoulder was placed in 90° of abduction, and elbow in 90° of flexion. The scapula was fixed with a belt tied around athlete's chest to maintain the starting position of the scapula. Athlete's proximal forearm was grasped and then the humerus was passively horizontally adducted. When the first tissue resistance reached, inclinometer was aligned along the ventral midline of the humerus for measurement. The angle of the axis of the humerus with respect to 0° horizontal adduction (plane perpendicular to examination table), as determined by the inclinometer was measured by the examiner, which was used to assess the total amount of GH joint horizontal adduction ROM.[22]

Athletes included in the study were then randomized by block randomization into 2 groups. Three blocks of 5 athletes each and 1 block of 2 athletes were taken.

In MET for GH joint horizontal abductors the intervention was given as follows - athlete were in supine position on the plinth. The lateral border of the scapula was stabilized, and with the elbow flexed, athlete's shoulder was horizontally adducted to the first barrier of motion. The athlete was instructed to perform a 7-second isometric contraction at approximately 25% of maximal effort in the direction of horizontal abduction, against an opposing force provided by the examiner at the distal humerus. Following which examiner applied a 30-second active assisted stretch. The

athlete was instructed to relax, and a new movement barrier was then engaged. This was performed for a total of 3 repetitions and 4 such sessions were done in a week for 2 weeks.

3. Methodological Flow Chart



In Passive cross body adduction stretch the intervention was given as follows - athlete were in supine on the plinth, the humerus was brought into 90 degrees of flexion and elbow in 90 degrees of flexion with neutral rotation at the GH joint. The scapula was manually stabilized at the acromion and humerus was passively brought into adduction till the level of discomfort.

Stretch was maintained for 30 seconds, repeated 3 times in each session and 4 such sessions were undertaken in a week for 2 weeks. Athletes were reassessed for outcome measures at the end of 1st week and 2nd week.

Data Analysis

All statistical analysis was done by using Statistical Package for Social Sciences (SPSS)
version 16.0. The level of significance of <0.05 was considered to be statistically significant with
95% confidence interval. Intention to treat analysis was done by last observation carry forward method, where missing observations for participants who withdrew were replaced with their last observed value. Analysis was done between groups by Repeated measures ANOVA and with group by unpaired student t test.

4. Results

Participant characteristics

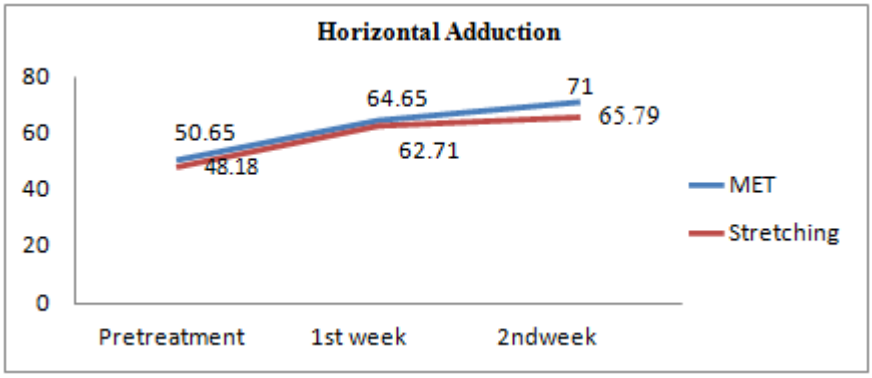
	MET for GHJ horizontal abductors Mean ± SD	Passive cross body adduction stretch Mean ± SD
Age (yr)	22.47(±3.84)	21.29(± 3.98)
BMI (kg/m^2)	23.44(± 2.84)	22.00(± 3.00)
GIRD (˚)	17.53(± 6.63)	18.29(± 6.98)
Years of bowling (n)	9.82	7.35
Dominance (Right, Left)	15,2	14,3
Fast, medium pace, spinners (n)	7,8,2	7,5,5

Comparison within group

Horizontal adduction

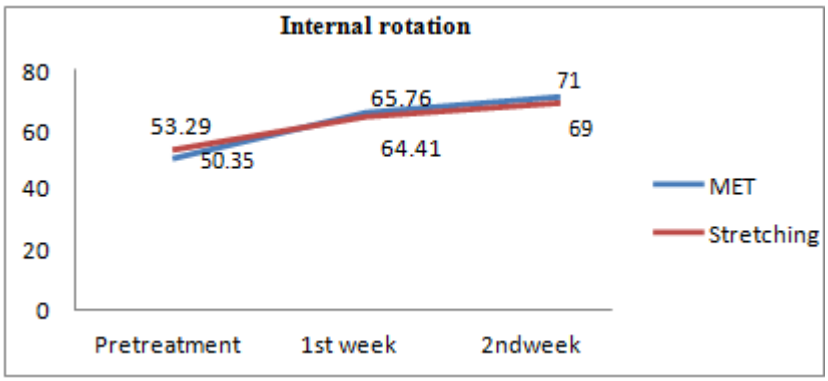
Between MET and stretching groups there was no statistically significant difference in the mean values of GHJ horizontal adduction pre treatment (p = 0.46), post 1 week (p = 0.49) and post 2 weeks (p = 0.06).The trend of increase in horizontal adduction in both the groups at 1st week and at 2nd week is shown in the figure below.

Horizontal Adduction



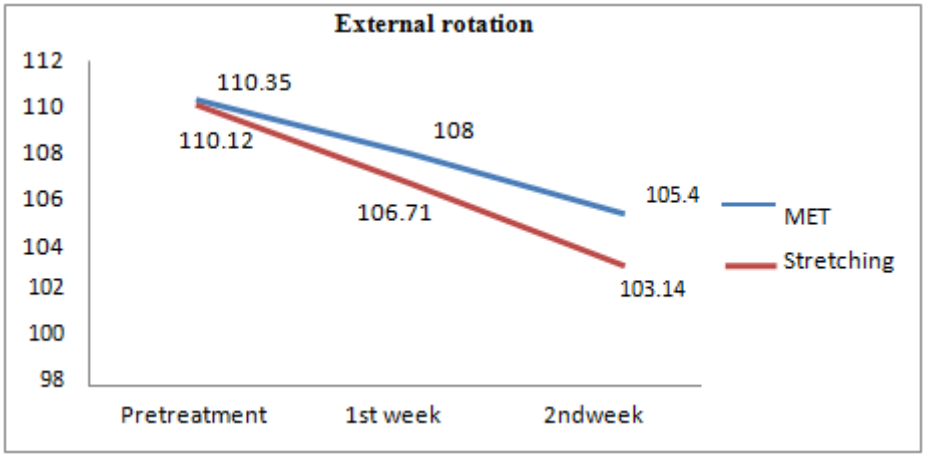
Internal rotation

Between MET and stretching groups there was no statistically significant difference in the mean values of GHJ internal rotation ROM pre treatment (p = 0.38), post 1st week (p = 0.62) and post 2 weeks (p = 0.49). The trend of increase in internal rotation in both the groups at 1st week and at 2nd week is shown in the figure below.



External rotation

Between MET and stretching groups there was no statistically significant difference in the mean values of GHJ external rotation ROM pre treatment (p = 0.95), post 1 week (p = 0.68) and post 2 weeks (p = 0.48). The trend of decrease in external rotation in both the groups at 1st week and at 2nd week is shown in the figure below.



Pre treatment to 1st week

	MET	Stretching	p	t
HA	-14.00	-14.53	.79	.27
IR	-15.41	-11.12	.08	-1.76
ER	2.35	3.41	.52	-.64

No statistically significant difference was noted in any of the variables between groups.

Pre treatment to 2nd week

	MET	Stretching	p	t
HA	-20.35	-17.61	.27	-1.12
IR	-20.65	-15.71	.05	-2.00
ER	4.95	6.97	.48	-.72

No statistically significant difference was noted in any of the variables except internal rotation which was nearly significant between groups.

Comparison within groups

Pre treatment to 1st week

ROM	MET				Stretching			
	Pre	4th	Diff	p	Pre	4th	Diff	p
HA	50.65 (±7.36)	64.65 (±6.31)	-14.00	.00*	48.18 (±10.26)	62.71 (±9.58)	-14.53	.00*
IR	50.35 (±11.67)	65.76 (±10.29)	-15.41	.00*	53.29 (±7.33)	64.41 (±4.30)	-11.19	.00*
ER	110.35 (±11.22)	108.00 (±8.41)	2.35	1.00	110.12 (±10.07)	106.71 (±9.46)	3.41	.87

High significant difference was noted post 1 week in both MET and stretching group in both horizontal adduction and internal rotation range of motion.

Pre treatment to 2nd week

ROM	MET				Stretching			
	Pre	8th	Diff	p	Pre	8th	Diff	p
HA	50.65 (±7.36)	71.00 (±5.25)	-20.35	.00*	48.18 (±10.26)	65.79 (±8.70)	-17.61	.00*
IR	50.35 (±11.67)	71.00 (±9.84)	-20.67	.00*	53.29 (±7.34)	69.00 (±4.36)	-15.71	.00*
ER	110.35 (±11.22)	105.40 (±9.05)	4.95	.46	110.12 (±10.07)	103.14 (±7.97)	6.97	.12

High significant difference was noted post 8 sessions in both MET and stretching group in both horizontal adduction and internal rotation range of motion.

5. Discussion

The purpose of the present study was to compare the effectiveness of Muscle energy technique and passive cross body adduction stretch for the dominant shoulder of cricket bowlers with glenohumeral internal rotation deficit. Outcome variables were ROM of internal rotation, external rotation and horizontal adduction taken pre intervention, at the end of 1st week (post 4 sessions) and at the end of 2nd week (post 8 sessions) . Internal rotation and horizontal adduction improved after MET for horizontal abductors and passive cross body adduction stretch, but there was no statistically significant difference between the two groups (p>0.05).

The baseline data were homogeneous with respect to age, BMI, GIRD, hand dominance, number of years of playing cricket or the technique of bowling in both the groups. In our study 60 cricket bowlers were screened for posterior shoulder tightness and 47 were found to have GIRD. In both MET and stretching groups the average GIRD was found to be 17˚.

The mechanism underlying the improvement in the ROM in MET group could be because of reflex muscle relaxation and tissue texture changes following MET. Muscle relaxation following isometric contraction is claimed to be mediated by the golgi tendon organ with its inhibitory influence on the α-motor neuron pool and by reciprocal inhibition from contraction of a muscle antagonists.[20,23] However, studies support increased tolerance to stretching (hypoalgesia), as the primary mechanism for increasing muscle length.[23]

Consistent with MET literature,[20] our results support the use of a 7-second isometric contraction, which has been found to be more effective in improving ROM. Previous study on MET failed to demonstrate a significant benefit in the use of a longer (20-second) isometric contraction when treating the upper cervical spine with MET.[24] Our protocol also involved the application of a post-isometric 30-second active assisted stretch. A 30-second static stretch of the hamstring muscles, performed 5 times per week over 6 weeks, has been shown to be more effective than a 15-second stretch,[25] or no stretch[25,26] and no more effective than a 60-second stretch. [25,26]

Passive cross body adduction stretch was also found to be effective on posterior shoulder tightness by increasing the GHJ internal rotation and horizontal adduction ROM. Statistically significant difference was noted post 1 week and post 2 weeks of intervention. The mechanism behind the change could be that stretching may adjust the positional sensitivity of the golgi tendon organs by affecting the series elastic component of the muscle which leads to a recoil of the stretched elastic components of the tissue to a new equilibrium state.[21] It is believed that 90% of all throwers with GIRD and posterior shoulder tightness will respond positively to a postero inferior capsular stretching program.[3]

Between group analysis showed internal rotation improved more in MET group then in stretching group post 1 week (MET = 15.4˚/Stretching = 11.1˚) and post 2 weeks (MET = 20˚/ Stretching = 15˚). The change exceeds the MDC for internal rotation (4˚). This change can be attributed to the 7 seconds of isometric contraction in the MET group which increased the stretch tolerance and caused reflex relaxation of the tissues. And as a result there was more improvements in internal rotation ROM. Between groups there was no statistically significant difference in internal rotation and horizontal adduction ROM but the results were clinically significant.

While most studies on stretching have concentrated on the immediate effect on the musculotendinous unit,[25,26] the lasting effects of stretching are important clinically because lasting effects may relate to optimizing function, injury prevention, and enhanced muscle performance. Only a small number of studies have evaluated the lasting effects of ROM (flexibility) gains after stretching.[27] It was likely that a single application of MET did not produce change in biomechanical tissue property[15] so multiple sessions of MET were used in the present study.

The results of the present study states that 1 week of MET or stretching causes improvement in internal rotation and horizontal adduction ROM and as the interventions were continued for the next week the improvements were further seen.

6. Conclusion

Our findings indicate that application of MET for the GHJ horizontal abductors and Passive cross body adduction stretch for multiple sessions over 1 week and 2 weeks results in greater post treatment GHJ horizontal adduction and internal rotation ROM in asymptomatic collegiate cricket bowlers**.** Also comparatively better effects were noted in the internal rotation ROM in MET group. These improvements in ROM may help in prevention of shoulder injuries associated with true GIRD and posterior shoulder tightness.[4]

7. Limitation

In this study the group of throwers was heterogeneous, composed of both elite and amateur players. We also did not examine the amount of humeral retroversion. Specific muscles of post shoulder not targeted. There could have been better results if there was stretch targeted to particular muscle. Also the duration for which the flexibility was maintained post intervention was not studied.

8. Future Research

The participants in the current study were healthy, asymptomatic overhead athletes. Further study is required to determine the effectiveness of MET application in individuals with symptoms that may be related to GIRD. Also studies to examine the duration of maintained flexibility gains following both single and multiple sessions of treatment with MET can be done.

9. Acknowledgement

I would like to thank Mr. Shyam Krishnan, Mr. Shashidharan Kotian and Mr. Mukesh Patel for their kind help in my thesis. Also I would like to thank all the athletes who willingly participated in the study.

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Author Profile

Khushboo Bathia is PG student , Department of Physiotherapy, Kasturba Medical College, Mangalore

Charu Eapen *s* Associate Professor (Senior Scale) Department of Physiotherapy, Kasturba Medical College, Mangalore

Zulfeequer CP is Assistant Professor, Department of Physiotherapy, Kasturba Medical College, Mangalore