Comparison of Muscle energy technique versus sleeper stretch in improving range of motion and strength of glenohumeral internal rotator, in college-level female racquet sport players with glenohumeral internal rotation deficit (GIRD).

Subhra Basu[1], Priyanka Amit Kumar[2,] Manjunatha H[3]

Associate Professor[1], Assistant Professor[2], Professor[3]
East Point College of Physiotherapy, Virgo Nagar post, Avallahalli, Bengaluru, Karnataka, India
Affiliated to Rajiv Gandhi University of Health Sciences, Karnataka. India.

ABSTRACT

OBJECTIVE - To compare muscle energy technique with sleeper Stretch in increasing range of motion and strength of Glenohumeral internal rotator (GIRD), in racquet players with Glenohumeral internal rotation deficit.

STUDY DESIGN - Comparative study, randomized, single-blind study.

PARTICIPANTS - 40 female players measured with GIRD <10 ^{0} were selected and randomized into two groups.

INTERVENTION- Group A were treated using the Muscle Energy technique and group B were treated using sleeper stretch 5 days a week for 2 weeks.

MAIN OUTCOME MEASURES - Both the Groups were assessed prior to and after the treatment session for any changes in Range of Motion and strength before and after 2 weeks of training.

RESULTS - By using the independent 't-test, both the groups were compared with the average of Pre & Post-treatment values for ROM, and strength, it became apparent that values did not differ significantly between the two study groups (P > 0.05).

CONCLUSION - When a comparison was made between the groups, it was found that both MET & Sleeper Stretch were equally effective in increasing internal range of motion and strength of glenohumeral internal rotator in racquet players with glenohumeral internal rotation deficit (GIRD).

CONTRIBUTION TO THE STUDY:

- **Female racquet players are well appreciated with this prognosis to real-time activity and sports.**
- **It has been found that unused range of motion should be encouraged to strengthen especially in young female athletes.**
- **Recruiting female racquet players from the institutional level was acceptable and feasible.**
- **Interviewers are permitting that there were no associated side effects observed.**

KEYWORDS: Racquet sport, strength, shoulder joint, females.

INTRODUCTION

Shoulder joint is a multi-axial ball and socket joint with three degrees of freedom. In racquet sports, it undergoes extremes of motion, velocity, and forces with repeated overhead motion which leads to change in the mechanics of the shoulder joint. The extensive ROM at the shoulder joint allows the athlete to engage in a multitude of sporting activities. Racquet sport is the most popular sport played worldwide. It is a non-contact sport played using a racket to hit the shuttlecock across the net which requires jumps, lunges, quick changes of direction, and rapid arm movements from a wide variety of body positions[1]. The prevalence of shoulder pain on the dominant side is 52% in racquet players and 36.9% of injuries most often occur in shoulder[2]. Overhead athletes commonly exhibit greater GHJ external rotation ROM at 90° of abduction of the dominant arm as compared to the non-dominant arm [3]. In racquet sport, overhead is the most important stroke which is approximately 44.6% (17% clear, 13.8% smash, and 13.8% drop). Wilk KE et al (2011) reported that the angular velocities during overhead sport are all within a small range, thus the physiological demands on the shoulder of these sports are very similar[4,5]. The total arc of motion does not differ bilaterally, suggesting a corresponding decrease in GHJ internal rotation ROM. GHJ internal rotation ROM loss at 90° of abduction in the dominant shoulder is referred to as glenohumeral internal rotation deficit (GIRD). GIRD is calculated as the difference in the maximum humeral internal rotation angle between the dominant (throwing) and non-dominant (non-throwing) limbs.[6] A deficit of 10-17 degrees of internal rotation is common in the dominant arm of racquet players who have not suffered any shoulder injury. GIRD greater than 25° has been associated with injuries and pathological changes in the throwing shoulder [7, 8]. Stretching of posterior shoulder muscles plays an important role in restoring flexibility and is commonly used to treat internal rotation ROM loss due to muscular and capsular limitations by positively influencing reflex activity to increase muscle-tendon unit length. The sleeper stretch is a range of motion exercise for the shoulder to improve shoulder internal rotation.[8, 9, 10]This stretches the posterior capsule of the glenohumeral joint as well as the posterior shoulder muscles. Researchers have described that sleeper stretch is accomplished by lying on the side to be stretched. The side-lying position enables stabilization of the scapula against the upper body and the treatment surface, thereby enabling more isolation of the posterior glenohumeral joint [11,12]. Another technique used to treat GIRD is Muscle Energy Technique (MET). MET is a manual therapy intervention that can be used to stretch or lengthen muscles and fascia that lack flexibility [12,13]. In MET, the patient creates a force by activating the targeted musculotendinous unit against a

precisely directed counterforce applied by the therapist. Relaxation and a passive stretch is applied by the therapist immediately as the patient relaxes. One application of MET consist of 3 to 5 contractions, held for 5 seconds each, with a stretch followed by a contraction that ranges from 3 to 5 seconds to 30 to 60 seconds., [14] Literature has established the efficacy of sleeper stretch and Muscle Energy Technique independently over the routinely used.[14,15] However, this study was done to compare MET versus sleeper stretch on improving shoulder range of motion and strength in female racquet sport players with GIRD.

MATERIALS AND METHODS

A comparative study Design was conducted on human subjects. The ethical clearance was obtained from the ethical committee of the institution as per the ethical guidelines of biomedical research on human subjects. 40 female racquet players with GIRD>10^0, aged between 16 to 30 years were selected from the East Point group of institutions in Bangalore and were enrolled in the study. All the participants were randomly divided into two groups, Group A and Group B. Subjects having recent shoulder injury and fracture, dominant side upper extremity injury in the last six months, shoulder symptoms requiring medical treatment in the last one year, shoulder pain, and GIRD more than $10^{0,}$ were excluded from the study. All the participants were clearly instructed about the purpose and procedure of the study. Baseline ROM of glenohumeral internal rotation was measured with a universal goniometer by placing the subject supine on a treatment table. The dominant shoulder was kept initially at 90 degrees of abduction and 90 degrees of elbow flexion, with the arms perpendicular to the ground while the scapula was stabilized by placing a towel roll below the shoulder. The fulcrum of the goniometer was kept at the olecranon process of the ulna, the stationary arm perpendicular to the ground, and the moving arm was parallel to the longitudinal axis of the ulna pointing towards the styloid process. The shoulder was then, passively internally rotated with one hand, and the ROM measurement was taken at the first point of resistance, using a universal goniometer.[6,7] (fig -2).

The strength of glenohumeral internal rotators was taken by positioning the subject prone on the treatment table, with the shoulder at 90 degrees of abduction. A leather wrist strap was positioned 15 cm distal to the olecranon process and was attached to a strain gauge, via, a chain. The subjects were asked to perform maximum voluntary isometric internal rotation contraction in the neutral position. The contraction was sustained for five seconds. The value of the force generated during maximum isometric shoulder internal rotation contraction was recorded in the strain gauge [16, 17] (Fig- 3). Baseline measurements were taken on 1st week and at the end of 2nd week. Group A received Muscle energy technique (MET) & Group B received Sleeper Stretch. The subjects of Group A were positioned supine on the treatment table with the shoulder and elbow, at 90 degrees of abduction and flexion. The shoulder was stabilized by the therapist 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 is reached. The subjects were instructed to perform a 5-second isometric contraction of approximately 25% maximal effort in the direction of external rotation, against an opposing force provided at the distal forearm. Following the contraction, the subjects internally rotated the arm towards the ground as a 30-second active assisted stretch was applied. The subjects were instructed to relax, and a new movement barrier was engaged. This protocol was performed for a total of 3 repetitions. [18] (Fig- 4)

The sleeper stretch to group B was applied in the following way. The subject's shoulder and elbow were positioned into 90 degrees of flexion with the lateral border of the scapula positioned firmly against the treatment table. The therapist internally rotated the subject's shoulder by grasping the distal forearm and moving the arm towards the treatment table. The pressure was held constant at the end range of motion for 30 seconds and was repeated twice with 30 seconds rest between stretching episodes [18] (fig-5).

Fig 1- Materials used to measure the baseline ROM and strength of internal rotation.

Fig 2- Measurement of internal rotation on the dominant shoulder of group A subject.

Fig- 3: Measurement of isometric strength of internal rotator of the dominant hand of the subject.

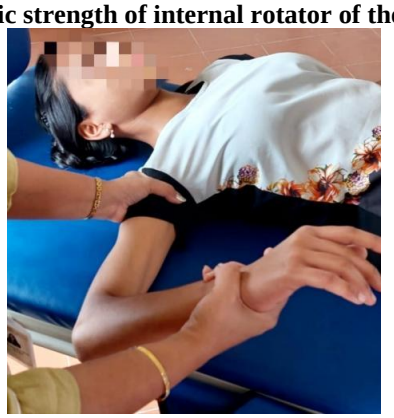


Fig-4: Application of MET on the dominant hand of group A subject.

Fig-5: Application of Sleeper stretch on the dominant hand on group B subject.

STATISTICAL ANALYSIS:

The data on quantitative characteristics were presented as Mean ± Standard Deviation (SD) across two study groups. The data on qualitative characteristics were presented as n (% of cases). The statistical significance of the difference of mean quantitative characteristics between two study groups (inter-group comparisons) was tested using an unpaired t-test after confirming the underlying normality assumption. The statistical significance of difference of pre-treatment and post-treatment quantitative characteristics in each study group (intra-group comparisons) was tested using paired t-test, after confirming the underlying normality assumption of pre-and post-treatment difference of parameters. The entire data was entered and cleaned in MS Excel before it was statistically analyzed in SPSS. The entire data was analyzed statistically using Statistical Package for Social Sciences (SPSS ver 22, Inc. Chicago, USA) for MS Windows.

RESULTS:

All the results are shown in tabular as well as graphical format to visualize the statistically significant difference more clearly. The p values less than 0.05 are considered to be statistically significant. All the hypothesis was formulated using two-tailed alternatives against each null hypothesis.

Table-1. Mean, Variance & Standard Deviation Values of the Ages in Group A & Group B

Groups	No	MEAN	VARIANCE	SD
Group A	20	22.25	9.040	3.007
Group B	20	22.3	6.642	2.577

TOTAL	40	22.28	7.450	2.764

40 players meeting the inclusion criteria with a Mean age 22.28 years, SD= 2.764 were selected for the study. In group A mean age: 22.25 years, SD= 3.007. And in Group B mean age: 22.3 years, SD=2.577

Table- 2: Intragroup comparison of Internal ROM of GHJ in Groups A & B

Parameter	**Follow-up**	**Group A (n=20) MET**	**Group B (n=20) Sleeper Stretch**
Internal ROM of GHJ	**Pre R_x**	51.45 ± 5.80	51.15 ± 6.47
	Post R_x	70.55 ± 6.40	69.65 ± 6.43
T value	**Pre R_x v/s Post R_x**	45.90	41.64
P value	**Pre R_x v/s Post R_x**	< 0.0001	< 0.0001

In group A, the average internal ROM of GHJ is significantly improved after the application of MET ($P < 0.0001$). In Group B, the average internal ROM of GHJ is significantly improved after the application of Sleeper Stretch ($P < 0.0001$).

Table – 3: Intergroup comparison of Internal ROM of GHJ between Group A & Group B

Parameter	**Follow - up**	**Group A (n=20) MET**	**Group B (n=20) Sleeper Stretch**	**T value**	**P-value**
Internal ROM of GHJ	**Difference between Pre & Post R_x**	19.10 ± 1.86	18.60 ± 2.01	0.82	0.4195

The average Pre & Post R_x value of internal ROM of GHJ did not differ significantly between the two study groups ($P > 0.05$).

Table – 4: Intragroup comparison of Internal Rotator Strength of GHJ between Groups A & B

Parameter	**Follow-up**	**Group A (n=20) MET**	**Group B (n=20) Sleeper Stretch**
Internal Rotator Strength of GHJ	**Pre R_x**	2.27 ± 0.21	2.23 ± 0.20
	Post R_x	2.82 ± 0.22	2.71 ± 0.19

T value	**Pre R_x v/s Post R_x**	23.40	14.24
P value	**Pre R_x v/s Post R_x**	< 0.0001	< 0.0001

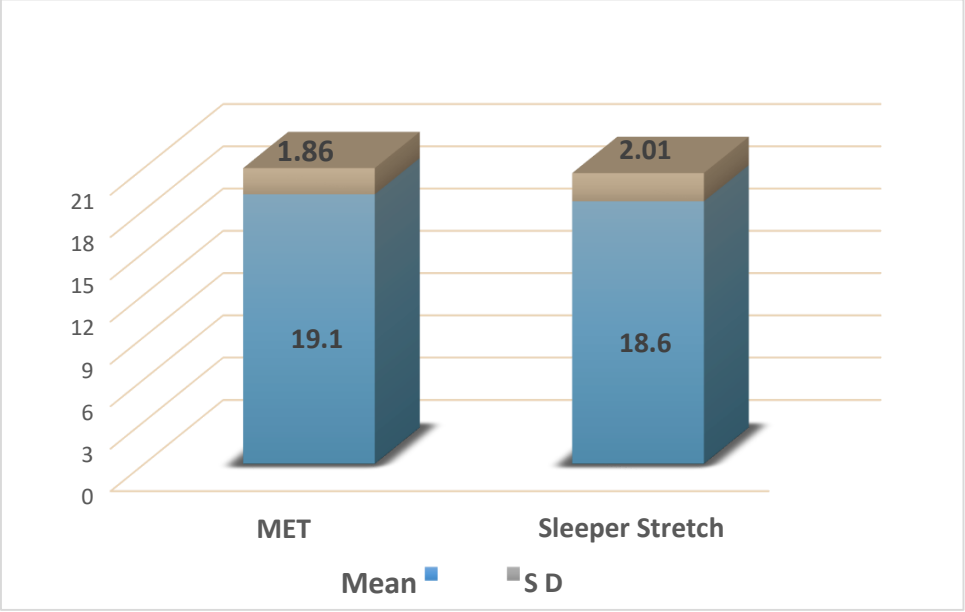
In group A, the average internal rotator strength of GHJ is significantly improved after the application of MET (P < 0.0001). In group B, the average internal rotator strength of GHJ is significantly improved after the application of Sleeper Stretch (P < 0.0001).

Table – 5: Intergroup comparison of Internal Rotator Strength of GHJ between Group A & Group B

Parameter	**Follow - up**	**Group A (n=20) MET**	**Group B (n=20) Sleeper Stretch**	**T value**	**P-value**
Internal Rotator Strength of GHJ	**Difference between Pre & Post Rx**	0.55 ± 0.11	0.48 ± 0.15	1.70	0.0967

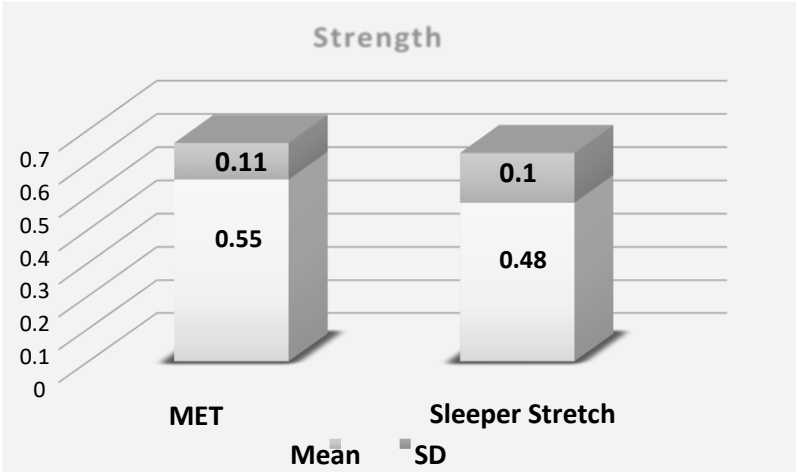
The average Pre & Post R_x value of internal rotator strength of GHJ did not differ significantly between the two study groups (P > 0.05)

Graph – 1: Difference of Mean and SD for pre and post-Rx internal ROM of GHJ in between Group A & Group B



The average Pre & Post R_x value of internal ROM of GHJ did not differ significantly between the two study groups (P > 0.05).

Graph – 2: Difference of Mean and SD for pre- and post-Rx strength of internal rotator of GHJ in-between group A & group B



The average Pre & Post R_x value of internal rotator strength of GHJ did not differ significantly between the two study groups ($P > 0.05$)

INTERPRETATION OF THE STATISTICAL RESULTS:

This comparative study was done with 40 players who were randomly allotted into two groups namely, Group A and Group B consisting of 20 players each, to determine the effectiveness of Muscle Energy Technique (MET) & Sleeper Stretch in increasing internal range of motion and strength of glenohumeral internal rotator, in female badminton players with GIRD. The parameters used were the scores obtained from ROM & Strength which were measured prior to and after the treatment session of 2 weeks in individuals of each group respectively. The data was analyzed using the dependent "t" test to find the significance of interventions used within the two Groups. Within the group, the dependent "t" test showed significance at $P < 0.05$ showing that both MET & sleeper stretch were effective in increasing ROM and strength of glenohumeral internal rotator, in players with GIRD respectively. When compared between the groups, the results were found to be insignificant with an independent "t" test at $P > 0.05$ which showed that both MET & sleeper stretch were equally effective increasing ROM and strength of glenohumeral internal rotator, in racquet sport players with GIRD.

DISCUSSION

The purpose of this study was to compare the effects of Muscle energy technique versus sleeper stretch in improving range of motion and strength of glenohumeral internal rotator, in female racquet sport players with GIRD, measured by goniometer and simple handheld dynamometer. This study was conducted on 40 players, group- A (who received MET) and group B (who received sleeper stretch) consisted of 20 in each group. The statistical analysis showed significant improvement in both groups A and group B. MET & sleeper stretch were equally effective in improving ROM and strength of glenohumeral internal rotator, in racquet sport players with GIRD. Moore SD et al (2011) stated in a similar kind of study that, the application of MET successfully improved GHJ posterior shoulder ROM in collegiate baseball players and may assist in the prevention and treatment of shoulder injuries associated with pathologic GIRD and posterior shoulder tightness.[20] The two aspects of MET are their ability to relax an overactive muscle and the ability to improve the stretch of a shortened muscle when connective tissue or viscoelastic changes have occurred. Two fundamental neurophysiological principles may account for the neuromuscular inhibition that occurs during the application of these techniques. The first is post isometric relaxation (PIR) which states that after a muscle is contracted, it is automatically in a relaxed state for a latent period. The second is reciprocal inhibition (RI) which states that when one muscle is contracted, its antagonist is automatically inhibited. MET has also been explored as a treatment targeting the soft tissue extensibility issues behind motion restrictions.[21,22]

The subjects who received Sleeper stretch also had significant improvement in their range of motion and strength as it targets the Infraspinatus and the Teres minor muscles, which are found in the rotator cuff, and isolate the soft tissues of posterior aspects of the shoulder.[23] Reuther KE et al in their study showed that overhead athletes with an internal rotation ROM deficit ($\geq 15^{o}$) benefit from performing posterior shoulder stretching daily. Sleeper stretches have been proven effective for increasing horizontal adduction and internal rotation[24]. The effectiveness of MET and sleeper stretch together in subjects with GIRD can be considered in further study.

LIMITATIONS OF THE STUDY:

The study was limited to a group of 16 to 30 years only. The study can be done by taking a specific condition instead of a generalized joint pathology. The duration of the study was limited to only 2 weeks. A long-term follow-up should have been conducted to study the further effect of these techniques. A sample of only 40 subjects was obtained hence effect seen cannot be generalized. Individuals' learning ability, motivation, and the cognitive process act as confounding factors hence may have affected the results. A comparison could have been done between the basic technique and the modified techniques. The duration for which the flexibility was maintained post-intervention was not studied.

SUGGESTIONS & FURTHER RECOMMENDATIONS:

This study was done only for the internal rotator of GHJ, further studies can be carried out in a large group and to both the gender and to elder age to check if the same results hold. The effectiveness of MET and sleeper stretch together in subjects with GIRD can be considered in further study. Other measures like electromyography can be used to assess muscle strength. There could have been better results if the stretch was targeted a particular muscle.

CONCLUSION

Based on the outcome of the final inferential statistical analysis, it was concluded that both MET & Sleeper Stretch were equally effective in increasing internal range of motion and strength of glenohumeral internal rotator, in female racquets sports players with glenohumeral internal rotation deficit.

FUNDING:
This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
CONFLICT OF INTEREST: None
ACKNOWLEDGEMENT: Authors were expressing their sense of gratitude to people who helped and encouraged them for the guidance and completion of this study.

ETHICAL APPROVAL: Ethical approval was obtained from the institutional ethical committee before the conduct of the study and consent was obtained from all the participants after clear instructions about the procedure.

REFERENCE:

1. Marchena-Rodriguez A, Gijon-Nogueron G, Cabello-Manrique D, Ortega-Avila AB. Incidence of injuries among amateur badminton players: A cross-sectional study. Medicine. 2020 May;99(18).
2. Zhou X, Imai K, Liu X. Survey of Epidemiology and Mechanisms of Badminton Injury Using Medical Check-Up and Questionnaire of School Age Badminton Players. International Journal of Sport and Health Sciences. 2020 May 2;14(6):146-51.
3. Ng GY, Lam PC. A study of antagonist/agonist isokinetic work ratios of shoulder rotators in men who play badminton. Journal of Orthopaedic & Sports Physical Therapy. 2002 Aug;32(8):399-404.
4. Ng GY, Lam PC. A study of antagonist/agonist isokinetic work ratios of shoulder rotators in men who play badminton. Journal of Orthopaedic & Sports Physical Therapy. 2002 Aug;32(8):399-404.
5. Dabhokar A, Gazdar M, Dabholkar T, Chiddarwar V. Assessment of upper extremity stability, GIRD (Glenohumeral internal rotation deficit)/GERG (Glenohumeral external rotation gain) ratio and strength of internal rotators (IR) and external rotators (ER) in badminton players. International Journal of Physical Education, Sports and Health. 2018;5(2):137-42.
6. 7.Mullaney MJ, McHugh MP, Johnson CP, Tyler TF. Reliability of shoulder range of motion comparing a goniometer to a digital level. Physiotherapy theory and practice. 2010 Jul 1;26(5):327-33.
7. 8. Myers JB, Oyama S, Goerger BM, Rucinski TJ, Blackburn JT, Creighton RA. Influence of humeral torsion on interpretation of posterior shoulder tightness measures in overhead athletes. Clinical Journal of Sport Medicine. 2009 Sep 1;19(5):366-71.
8. 9. Wilk KE, Macrina LC, Fleisig GS. Correlation of Glenohumeral internal rotation deficit and total rotational motion to shoulder injuries in professional baseball pitchers. Am J Sports med 2011; 39:329-35.
9. 10. Laudner KG, Sipes RC, Wilson JT. The acute effects of sleeper stretches on shoulder range of motion. Journal of athletic training. 2008 Jul;43(4):359-63.
10. 11. Reuther KE, Larsen R, Kuhn PD, Kelly IV JD, Thomas SJ. Sleeper stretch accelerates recovery of glenohumeral internal rotation after pitching. Journal of shoulder and elbow surgery. 2016 Dec 1;25(12):1925-9.
11. 12. Desai R, Shah A, Palekar TJ, Khandare S, Joshi G. Effectiveness of sleeper stretch on internal rotation in individuals with shoulder adhesive capsulitis.
12. 13.Chary DS, Nagrale S, Golhar S. Immediate effects of muscle energy technique on pain and posterior shoulder tightness in badminton players: An experimental study.(2020)
13. 14. Bathia K, Eapen C, Zulfeequer CP. Effectiveness of Muscle Energy Technique and Passive Stretching on Posterior Shoulder Tightness in Cricket Bowlers-A Randomized Clinical Trial. International Journal of Science and Research (IJSR). 2016;5(8):354-60
14. 15. Reed ML, Begalle RL, Laudner KG. Acute effects of muscle energy technique and joint mobilization on shoulder tightness in youth throwing athletes: a randomized controlled trial. International journal of sports physical therapy. 2018 Dec;13(6):1024.
15. 16. Chen B, Liu L, Chen LB, Cao X, Han P, Wang C, Qi Q. Concurrent Validity and Reliability of a Handheld Dynamometer in Measuring Isometric Shoulder Rotational Strength. Journal of Sport Rehabilitation. 2021 Jan 19;30(6):965-8.
16. 17. Romero-Franco N, Fernández-Domínguez JC, Montaño-Munuera JA, Romero-Franco J, Jiménez-Reyes P. Validity and reliability of a low-cost dynamometer to assess maximal isometric strength of upper limb: Low cost dynamometry and isometric strength of upper limb. Journal of Sports Sciences. 2019 Aug 3;37(15):1787-93.
17. 18. Rabbani F, BV RS. A study to assess the effectiveness of muscle energy technique with sleeper stretch on posterior shoulder tightness in tennis players.
18. 19. Grow K. The Sleeper Stretch: Effects on Range of Motion and Injury in Baseball Players.
19. 20. Moore SD, Laudner KG, Mcloda TA, Shaffer MA. The immediate effects of muscle energy technique on posterior shoulder tightness: a randomized controlled trial. journal of orthopaedic & sports physical therapy. 2011 Jun;41(6):400-7.
20. 21. Reed ML, Begalle RL, Laudner KG. Acute effects of muscle energy technique and joint mobilization on shoulder tightness in youth throwing athletes: a randomized controlled trial. International journal of sports physical therapy. 2018 Dec;13(6):1024.
21. 22 Sehgal S, Sen S, Dhawan A. Effects of muscle energy technique in increasing range of motion and strength of glenohumeral internal rotator, in athletes with glenohumeral internal rotation deficit. Am J Sports Sci. 2016 Mar 28;4(2):43-8.
22. 23. Laudner KG, Sipes RC, Wilson JT. The acute effects of sleeper stretch on shoulder range of motion. Journal of athletic training. 2008 Jul;43(4):359-63.
23. 24. Reuther KE, Sheridan S, Thomas SJ. Differentiation of bony and soft-tissue adaptations of the shoulder in professional baseball pitchers. Journal of shoulder and elbow surgery. 2018 Aug 1;27(8):1491-6.
24. 25. Reddy BC, Metgud S. A randomized controlled trial to compare the effect of muscle energy technique with conventional therapy in stage ii adhesive capsulitis. Int J Physiotherapy Res. 2014;2(3):549-.