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**SHOULDER FLEXIBILITY IN COLOR GUARD PLAYER  
FOLLOWING POSTERIOR SHOULDER STRETCHING AND  
MUSCLE ENERGY TECHNIQUE**

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**ABSTRACT**

**Background:** Color guard players often exhibited loss of glenohumeral joint range of motion (ROM) in internal rotation which has been associated with shoulder pathology. Current stretching protocols aimed at improving flexibility of the posterior shoulder have resulted in different outcomes and previous studies have not been discussed color guard players for the subject.

**Aims:** This study was to determine the differences effects between non assisted posterior shoulder stretching (NAPSS) and muscle energy technique (MET) to increase internal rotation ROM of glenohumeral joint of the color guard marching band.

**Methods:** This study is experimental pre test and post test two group design, the subjects are 18 color guard players. The subjects were divided into 2 groups that 9 subjects in group I treated NAPSS and 9 subjects in group II treated MET. The treatment was given for 5 times per week in 2 weeks. This study used goniometer for measuring internal rotation ROM. Saphiro Wilk test for the normality test. Paired sample T-test to determine increasing of internal rotation ROM for group I and group II. Independent sample T-test to determine the differences effect between group I and group II.

**Result:** The result of paired sample T-test is  $p=0.001$  ( $p < 0.05$ ) in group I and  $p=0.001$  ( $p < 0.05$ ) in group II which exhibited that there is an effect the treatment of both posterior shoulder stretching and muscle energy technique to increase internal rotation ROM. The result of Independent sample T-test is  $p=0.084$  ( $p > 0.05$ ) indicated that there is no different effect between posterior shoulder stretching and muscle energy technique.

**Conclusion:** NAPSS and MET were capable of significantly increasing internal rotation ROM of glenohumeral joint and no different effects between the methods. Both methods can be used as stretching program before marching band exercise.

**Keywords:** Posterior Shoulder Stretching, Muscle Energy Technique, Goniometer, Range of Motion, Color Guard Marching Band.

**INTRODUCTION**

Overhead throwing is a highly dynamic movement requiring a balance of strength and flexibility, as well as coordination of all body segments for optimal performance [1,2]. Glenohumeral joint attains extreme ranges of motion (ROM) [2], velocities [2] and forces [1] throughout the throwing motion. Glenohumeral joint internal rotation reaches peak angular velocities of nearly 7000°/s [2], and deceleration during the follow-through occurs at 500 000°/s [3], creating a large force for the posterior shoulder to counteract as the humerus continues to internally rotate [4]. It is hypothesized that these substantial speeds and forces occurring at the posterior shoulder result in altered glenohumeral joint ROM and posterior shoulder tightness in throwing athletes [5].

Color guard player produced high force for throw equipments like flag, saber, stick, and rifle. As a result of the high forces experienced at the upper extremity joints, physical examinations of athletes who use overhead throwing consistently demonstrates unilateral soft tissue adaptations, such as increased external rotation range of motion, decreased internal rotation ROM in their throwing arms [2]. Tightness of posterior shoulder structures and decreased internal rotation ROM has been linked to nonspecific shoulder pain [6], subacromial impingement [7, 8], superior labrum anterior to posterior lesions [7,9], pathologic internal impingement [10], and ulnar collateral ligament insufficiency [11] due to its altering effect on glenohumeral arthrokinematics [7,12,13] and scapulothoracic kinematics [14].

One of the most effective methods to increase internal rotation ROM is stretching or technique. Nowadays, different stretching methods are used to increase ROM, for internal rotation ROM of glenohumeral joint can used non assisted posterior shoulder stretching (NAPSS) and muscle energy technique (MET). NAPSS and MET have been discussed on previous researches, but the subjects on those research are baseball players. The research about posterior shoulder tightness in color guard players is not yet found. So, in this study effectiveness of NAPSS and MET to increase internal rotation ROM in the color guard marching band player have been examined. Because on the future, physical therapist can participate in marching band world, especially for ergonomic and treatment.

## **METHODS**

Fifteen female and three male of color guard players from five Universities in Yogyakarta participated in this study. Group I (8 females & 1 male) treated NAPSS and group II (7 females & 2 males) treated MET. Subjects completed a questionnaire with regard to their age, height, gender, duration become color guard player, exercise duration, the difficulty of throwing, and internal rotation ROM of glenohumeral joint was measured. Color guard players aged 15-24 years who had limitation internal rotation ROM less than 70° in their dominant arm were included, whilst those who had history of trauma, fracture, subluxation, dislocation, or surgery in the shoulder were excluded. Goniometer was used to measure internal rotation ROM of glenohumeral joint.

In order to assess internal rotation ROM, subjects were placed in side lying position. Side lying measurements of shoulder internal rotation PROM were obtained with the subject lying on the involved side, in a position in which the acromion processes were aligned perpendicular to the plinth by visual estimate. The shoulder was flexed to 90° with 0° rotation and the elbow was flexed to 90°. No manual stabilization of the scapula was required, but the rater visually ensured that the subject kept the acromion processes perpendicular to the table. The rater passively internally rotated the humerus while maintaining 90° shoulder and elbow flexion. The rater located the goniometer such that the fulcrum was placed over the olecranon process, the stationary arm was aligned with the plinth edge, and the movable arm aligned with the subject's ulnar styloid process [15]. The procedure was repeated thrice.



Figure 1. ROM measurement by goniometer

Subjects were randomly divided to two groups. Each subjects received ten session of specific treatment. The treatment was given for 5 times per week in 2 weeks

***Non assisted posterior shoulder stretching***

Subjects were given treatment horizontal cross arm stretch and standing sleeper stretch at 45°. Horizontal cross-arm stretch, the subjects stood with the involved side and lateral border of their scapula against a wall. The dominant shoulder was flexed to 90° and passively horizontally adducted by the subjects to end range using the contralateral arm.<sup>8</sup> Proper stabilization of the scapula was ensured by having the subjects lean against the wall using his body weight, preventing the scapula from following the humerus across the body [16].

Standing sleeper stretch at 45°, the subject stood with the involved side against the wall and flexed to 45° with elbow in 90° of flexion. The subject leaned against the wall applying pressure to the lateral border of the scapula while the head and neck remained in a neutral position, looking straight ahead. The scapula remained pressed against the wall while the subject used the contralateral hand to rotate the dominant shoulder into internal rotation [17].



Figure 2. Performance of a standing sleeper stretch at 45°

Post-stretch ROM measurements were performed immediately following the completion of the last set of stretch (within 1 to 2 minutes) [17].

### ***Muscle energy technique***

A single application of MET was applied to the glenohumeral joint external rotators. The subject was in a supine position on the examination table. With the humerus supported and the subject's shoulder and elbow in 90° of abduction and flexion, respectively, the examiner passively moved the humerus 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 effort in the direction of external rotation, against an opposing force provided by the examiner 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 by the examiner. This protocol was performed for a total of 3 repetitions [5].

The Saphiro-Wilk test was used to determine the normal distribution of the data. Data were analyzed using paired sample *t*-test for pre and post test in both groups and independent sample *t*-test was used to compare increasing internal rotation ROM of glenohumeral joint between two groups. The data were analyzed using SPSS 17.

## **RESULTS**

Anthropometric characteristic of the study subjects are shown in Table 1. Females in group I is more than group II. Height of players in group I and group II, the different of both were not significant. For color guard duration, MET had higher mean that means old player in MET group is more than NAPSS group. Exercise duration from two groups is significant difference, MET group is

longer for exercise than NAPSS group, and the last is the difficulty of throwing, color guard player who feel difficult of throwing in NAPSS group is more than MET group.

Table 2 represents the results of internal rotation ROM of glenohumeral joint for both groups. The improvements of internal rotation ROM were 21° and 28.8° for NAPSS and MET groups.

Table 1. Anthropometric characteristics of 18 subjects

Characteristic		NAPSS group (N=9)	MET group (N=9)
		Mean ± SD	Mean ± SD
Gender	15 F> 3 M	1,89 ± 0,33	1,78 ± 0,44
Height	149-175 cm	160,22 ± 6,94	161,78 ± 8,26
CG duration	4-84 months	19,78 ± 14,64	26,33 ± 24,72
Exc duration	8-160 hours/month	58,67 ± 45,78	83,56 ± 45,80
The difficulty of throwing	No>Yes	1,44 ± 0,53	1,78 ± 0,44

Furthermore, there was no significant difference between NAPSS and MET to increase internal rotation ROM of glenohumeral joint.

Table 2. Effect of non assisted posterior shoulder stretching and muscle energy technique to increase internal rotation range of motion of glenohumeral joint

Internal rotation ROM	NAPSS		MET	
	Range (°)	Mean ± SD	Range (°)	Mean ± SD
Pre	30-52	42,78 ± 7,26	30-61	47,44 ± 11,02
Post	50-95	63,78 ± 14,21	45-95	76,33 ± 14,73

## DISCUSSION

This study presents that gender, height, color guard duration, exercise duration, and the difficult of throwing is influence increasing internal rotation ROM of glenohumeral joint of color guard marching band on NAPSS and MET. In this study, female players had greater improvement internal rotation ROM than male. Research by Schneider (18) proves that female is more flexible than male on active straight leg raise and shoulder mobility.

Color guard players who had height greater than 160 cm had greater improvement internal rotation ROM than color guard players who had height less than 160 cm, this is because color guard player who had height less than 160 cm result higher force to throwing equipment. This study is relevant with previous study where wall painter who paint higher wall result higher force than short and medium wall [19].

Player who becomes color guard player less than 3 years is greater for improvement internal rotation ROM than color guard that play more than 3 years, this study is reverse with another work where baseball player who did longer stretching program, internal rotation deficit will be smaller [20]. This is presume because different exercise program between baseball player and color guard player, activity of color guard player like spin and throwing equipment is longer than stretching program.

Exercise duration every color guard player was different, color guard players who exercise greater than 8 hours per month had greater improvement than color guard player who exercise less

than 8 hours per month. Lintner has assessed characteristic ROM professional baseball player who did stretching program everyday and reported athlete who did a stretching program more than 3 years had internal rotation ROM greater than athlete who did stretching program less than 3 years [20].

Color guard players that feel difficult of throwing have been 4 until 12 months become color guard. Criteria the difficulty of throwing is player couldn't throw equipment like other players, for the example player could throw two rounds of rifle and for the other players could throw three rounds rifle with same technique. From the interview, players will be fatigue after exercise on the target like decrease of power when throwing equipment and spasm when spin too much and too fast. According to Jonsson, prolonged static elevated arm tasks at 10% maximum voluntary contraction (MVC) is adequate because muscular fatigue [21], in repetitive arm loading like throwing by color guard player result MVC greater than 10% that cause fatigue muscle.

Several research have evaluated that overhead throwing athletes exhibit decrease in glenohumeral joint in the dominant arm than dominant arm [2]. Loss of internal rotation ROM has been associated with glenohumeral internal rotation deficit (GIRD).

Burkhart *et al* [8] on clinical observation indicated that sleeper stretch can increase glenohumeral joint internal rotation ROM in patients with symptomatic GIRD within 2 weeks of use. Oyama found new techniques of sleeper stretch for athlete with stand position, from that research increasing horizontal cross-arm and sleeper stretch at 45° is greater than group means and could increase internal rotation ROM [17]

Moore demonstrated MET for glenohumeral joint external rotators in baseball player with dosage 5 contractions held for 5 seconds each, with a stretch following each contraction that ranges 30 seconds [5]. Five times per week didn't improve posterior shoulder flexibility. But, in our research with same dosage, MET for glenohumeral joint external rotators in color guard player improved significant internal rotation ROM. However, Moore examined on male players, and this study examined majority on female players.

If we can see from the result, NAPSS and MET can be performed on color guard players. NAPSS can be performed on the field and can be used as home program. MET didn't improve posterior shoulder flexibility on baseball players that their gender were males [5]. Therefore, in the future MET is better used on female players. In this research, MET couldn't be performed if there is no clinician that help player, but on the future in the field clinician can be replaced by other player, so this technique can be used as stretching program before exercise. One limitation in this study is color guard players did non assisted posterior shoulder stretching by themselves, researcher just monitored them via communication network and check list. So, in the next research need more control for NAPSS groups.

## **CONCLUSION**

The present study demonstrated that the two methods of NAPSS and MET significantly improves internal rotation ROM of glenohumeral joint. But, there is no significant difference effect between NAPSS and MET for increasing internal rotation ROM. Recommendation for marching band team, NAPSS and MET can be performed on color guard players as stretching program before marching band exercise and NAPSS technique can be used as home program. The finding of this study may help future research to compare stretching methods with different parameters.

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## REFERENCES

- [1] Fleisig GS, Andrews JR, Dillman CJ, Escamilla RF. Kinetics of baseball pitching with implications about injury mechanisms. *Am J Sports Med.* 1995;23:233-239.
- [2] Dillman CJ, Fleisig GS, Andrews JR. Biomechanics of pitching with emphasis upon shoulder kinematics. *J Orthop Sports Phys Ther.* 1993;18:402-408.
- [3] Bandy WD, Irion JM. The effect of time on static stretch on the flexibility of the hamstring muscles. *Phys Ther.* 1994;74:845-852.
- [4] Pappas AM, Zawacki RM, Sullivan TJ. Biomechanics of baseball pitching. A preliminary report. *Am J Sports Med.* 1985;13:216-222.
- [5] Moore, S.D., Laudner, K.G., McLoda, T.A. dan Shaffer, M.A... The Immediate Effects of Muscle Energy Technique on Posterior Shoulder Tightness: A Randomized Controlled Trial. *Journal of Orthopaedic & Sports Physical Therapy*, 2011. 41(6), pp.400-407.
- [6] Giles K, Musa I. A survey of glenohumeral joint rotational range and non-specific shoulder pain in elite cricketers. *Phys Ther Sport.* 2008;9:109-116.
- [7] Harryman DT 2nd, Sidles JA, Clark JM, McQuade KJ, Gibb TD, Matsen FA 3rd. Translation of the humeral head on the glenoid with passive glenohumeral motion. *J Bone Joint Surg Am.* 1990;72:1334-1343
- [8] Burkhart SS, Morgan CD, Kibler WB. The disabled throwing shoulder: spectrum of pathology, Part I: *Pathoanatomy and biomechanics.* *Arthroscopy.* 2003;19:404-420
- [9] Morgan CD, Burkhart SS, Palmeri M, Gillespie M. Type II SLAP lesions: Three subtypes and their relationships to superior instability and rotator cuff tears. *Arthroscopy.* 1998;14:553-565
- [10] Myers JB, Laudner KG, Pasquale MR, Bradley JP, Lephart SM. Glenohumeral range of motion deficits and posterior shoulder tightness in throwers with pathologic internal impingement. *Am J Sports Med.* 2006;34:385-391
- [11] Dines JS, Frank JB, Akerman M, Yocum LA. Glenohumeral internal rotation deficits in baseball players with ulnar collateral ligament insufficiency. *Am J Sports Med.* 2009;37:566-570.
- [12] Grossman MG, Tibone JE, McGarry MH, Schneider DJ, Veneziani S, Lee TQ. A cadaveric model of the throwing shoulder: A possible etiology of superior labrum anterior-to-posterior lesions. *J Bone Joint Surg Am.* 2005;87:824-831
- [13] Warner JJ, Allen AA, Marks PH, Wong P. Arthroscopic release of postoperative capsular contracture of the shoulder. *J Bone Joint Surg Am.* 1997;79:1151-1158.
- [14] Borich MR, Bright JM, Lorello DJ, Cieminski CJ, Buisman T, Ludewig PM. Scapular angular positioning at end range internal rotation in cases of glenohumeral internal rotation deficit. *J Orthop Sports Phys Ther.* 2006;36:926-934.
- [15] Lunden, Jason B. Muffenbier, Mike. Giveans, M Rusell. Cieminski, Cort J. Reliability of Shoulder Internal Rotation Passive Range of Motion Measurements in the Supine Versus Sidelying Position. *Journal of Orthopaedic & Sports Physical Therapy.* 2010;vol 40, number 9, p.589
- [16] Williams D. Posterior capsule stretching. *Strength and Conditioning.* 1998(4):11-12.
- [17] Oyama, Sakiki., Georger, Candice., Georger, Benjamin M., Lephart, Scott M., dan Myers, Joseph B. Effects of Non-Assisted Posterior Shoulder Stretches on Shoulder Range of Motion Among Collegiate Baseball Pitcher. *Ath Train Sport Health Care.* 2010;2(4), pp.163-107.
- [18] Schneiders A.G., Davidsson, Asa., Horman, Elvira., dan Sullivan S.J. Original Research: Functional Movement Screen™ Normative Values in a Young, Active Population. *The International Journal of Sports Physical Therapy.* 2011;vol 6, number 2, p.75
- [19] Rosati, P.M., Chopp J.N., dan Dickerson, C.R. Investigating Shoulder Muscle Loading and Exerted Forces during Wall Painting Tasks: Influence of Gender Work Height and Paint Tool Design. *Applied Ergonomics.* 2014.;vol 45 p.1133-1139
- [20] Lintner, D., Mayol, M., Uzodinma, O., Jones, R. dan Labossiere, D. Glenohumeral Internal Rotation Deficits in Professional Pitchers Enrolled in an Internal Rotation Stretching Program. *The American Journal of Sports Medicine.* 2007;35(4), pp.617-621.
- [21] Jonsson, B. The static load component in muscle work. 1988. *Eur. J. Appl. Physiol.* 57, 305e310.