Research Paper: Effect of One Session Static Stretching of the Shoulder Muscles on the Performance of Throwing at Wheelchair User Athletes

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ABSTRACT

Purpose: In recent years, many people show interest to Paralympics competition because it is dedicated to athletes with disabilities. In order to affect the throwing, static stretching can be applied on the two muscles, i.e. pectoralis major and latissimus dorsi that play an important role in the arm acceleration phase. Normally, before sport activities, static stretching is applied. Stretching increases the flexibility that is effective in the throwing. The important point is the effect of this type of stretching on the throwing function, which is a combination of muscular strength, range of motion and productive torque. This study is going to examine this issue.

Methods: In this study, 45 disabled male athletes (15 discus throwers, 15 shot put throwers, and 15 javelin throwers) participated. Before stretching, each athlete did 3 throws, then a static stretching session consisting of 5 sets of 30 seconds stretching followed by 30 seconds of rest between each set, was performed. One minute after the stretching, the athletes did throwing 3 more times. Static type of stretching is performed on pectoralis major and latissimus dorsi muscles.

Results: Based on study results, no significant change was observed in the amount of throw before and after the stretching (Discus: P=0.47, Shot put: P=0.46, Javelin: P=0.14).

Conclusion: Considering data analysis, one session of static stretching of pectoralis major and latissimus dorsi muscles does not create a significant change in the magnitude of throw in disabled athletes engaged in discus, shot put, and javelin throw.

1. Introduction

Practice and exercise are very important for people with disabilities because of their limited physical activities. Moreover, the opportunity to participate in paralympic competitions has grown tremendously over the past decades [1-4]. To compete in paralympic games, classes have been defined by the International Paralympic Committee with their own inclusion and exclusion criteria. Classes in which the athletes perform the throw in sitting position include F31-34 and F51-58. F31-34 group

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comprise athletes with hypertonia, ataxia and athetosis, and their classification is based on determining their spasticity according to Ashworth scale. F51-58 group are athletes with limbs inefficiency, severe motor limitations, lack of muscle strength in some limbs, and lower limbs asymmetry. Their classification is based on the injured segment of the spinal cord [5] or its equivalent inability to control different muscle groups [6].

Generally, throwing can be divided into six different phases which include wind up, stride, arm-cocking, arm acceleration, arm deceleration, and follow-through. By examining the different phases of throw during throwing exercises, the internal rotation of the glenohumeral joint has drawn much attention because of its effect on the propulsion force of the throw. This rotation results from the activity of latissimus dorsi and pectoralis major muscles in the arm acceleration phase. The external rotation of the glenohumeral joint is a key component of the arm cocking phase, which is associated with the transverse abduction and scapular retraction [7, 8].

Static stretching to increase muscle temperature followed by increased muscle conduction is a major component of warming up before any exercise [9, 10]. This type of stretching is a method whereby the muscle is taken to the extreme of its motion range and held in that position for a certain period of time [11]. The best length of time would be 30 seconds continuous stretch [12, 13]. Acute static stretching effect on the muscle can be divided into viscoelastic and neuromuscular effects. Viscoelastic changes can include creep, stress relaxation and hysteresis [14, 15].

Neuromuscular changes can reduce Hoffman reflex (H-reflex) during and after stretching, while stretching does not affect the activity of gamma motor neurons and discharge of muscle spindle. Reducing the magnitude of H-reflex after stretching can be the presynaptic changes, such as a decrease in the activity of Ia afferent nerves, and postsynaptic changes such as Golgi Tendon Organ (GTO) autogenic inhibition, recurrent inhibition of the Renshaw loop, or postsynaptic inhibition of afferents of the joints and the skin [15]. In other words, when a slow passive stretch is applied to the muscle, very little contraction happens in response to this stretch that decreases the sensitivity of the motor neuron. In fact, stretching reduces muscle strength [14].

Considering post-stretch viscoelastic and neuromuscular changes, it can be concluded that stretching reduces muscle stiffness or increases muscle flexibility and relative decrease in muscle strength [16, 17]. Furthermore, because the angular velocity of the throw is directly related to the magnitude of the external rotation of the glenohumeral joint of the abducted arm at the end of the arm-cocking phase, the throw depends on the extent of the motion range of the external rotation [16]. A very important objective of stretching before exercise is to improve the muscle performance by increasing the range of motion and reducing the resistance to stretching which allows for a freer movement during sports activities. This mode of exercise allows the athlete to perform better, especially for athletes who need a range of motion and in fact a greater torque of the joints [17-20].

Although many studies have pointed out the ineffectiveness of static stretching on body function and even the negative effects of stretching on the muscle, the important issue is the components needed for an effective throw, which requires flexibility [21, 22]. Indeed more flexibility results in larger torque in the shoulder during the throw [23, 24]. Considering the different results on the effect of static stretching on the distance of the throw, further study in this field seems necessary. The immediate impact of static stretching on the throw in athletes with disabilities has not been studied yet. This study can be helpful in determining whether the use of static stretching in these athletes before the throw can increase the magnitude of the throw and gain higher rankings in competitions.

According to various studies on the effects of different stretches on the body, this study is the first of its kind to investigate the acute effect of static stretch on the shoulder muscles of disabled athletes in the track and field sports. The objective of this study is to determine the immediate effect of static stretch of pectoralis major and latissimus dorsi muscles on the magnitude of the throw in athletes with disability engaged in discus, shot put, and javelin throw.

2. Materials and Methods

The present study is a quasi-experimental type of the pre-post intervention. The study population were disabled athletes in the javelin, discus, and shot put throw at the sports complex of Sports Federation of the Islamic Republic of Iran and the Sports Federation for the Disabled. In this study, the sampling method was the non-probability and accessible sampling method. Grouping was based on three disciplines of discus, shot put, and javelin throw, and each group included 15 athletes.

The study inclusion criteria included athletes with disabilities engaged in shot put, discus, and javelin throw

according to the International Paralympic Committee (IPC) classification, lack of sports injury in the shoulder during the past three months, lack of history of shoulder operation, age range of 14 to 40 years, lack of stretch therapy during the last three months by a therapist or coach (other than exercises for warm-up). The exclusion criteria included injury to the athlete during the throw, injury during the performance of this study, and a report of pain and discomfort by the athlete following stretching or throwing.

For data collection, first a questionnaire about each athlete's personal information was given to them. Then, the level of classification of the athlete was determined according to the IPC definition [6]. To assess the magnitude of the throw, the athlete was initially advised to avoid doing the stretching by himself. Then, before carrying out the stretching by the therapist, the athletes performed three throws with their maximum power, and the length of each throw was measured. After each throw, the athlete took one minute rest. Then the second and third throws were performed with rest periods between them.

The average distance of three throws was recorded, then 5 sets of static stretching of the pectoralis major and latissimus dorsi muscles were performed. Duration of stretching was 30 seconds each time with a rest period of 30 seconds between each stretching. After a minute passed, the athletes carried out 3 other throws with maximum power, and the one-minute rest between each throw was observed. Finally, the mean length of the three throws was calculated. For stretching the latissimus dorsi muscle, the patient is placed in a crook lying position and the therapist is placed on the side of the arm on which he intends to do the stretching exercise.

The athlete flexes his shoulder while the therapist holds athlete's scapula with his hand to prevent excessive scapular abduction. When stretching was applied, traction was also given to the humerus bone [25]. To stretch the pectoralis major muscle, the patient is lying supine on the bed, places his hand under his head and the therapist is beside the patient's head and pushes the patient's elbow gently towards the bed to stretch the pectoralis major muscle. Stretching was of the static type and maintained for 30 seconds. If the elbow collided with the bed or the patient did not feel the stretching, the therapist would place roller foam under the patient's scapula so that he would feel the stretch [26, 27].

This study assesses the throw performance, so it does not need other measurements such as the shoulder movement range and muscle strength of the pectoralis major and latissimus dorsi. Because the throws were different in terms of kinesiology and the throwing device and therefore different records were registered for each discipline, their integration into one group eliminated the normality of the data. In this case we should use non-parametric tests that were less significant. In this study, the paired t test was used to compare the mean throwing distances before and after the stretching. All statistical tests were performed in SPSS V. 22. $P \leq 0.05$ represents the significance of the difference between the means.

3. Results

To examine the effect of static stretching on the extent of the throw of disabled athletes, the mean throws were compared before and after the stretching (Table 1). This study included 45 athletes aged 14-35 years old (average age: 22 y). The average distance of the discus throw before stretching was 22.85 m and after the stretch 22.56 m. Based on the paired t test results, the difference was not statistically significant (P=0.473). Also, the mean distance of the shot put throw before stretching was 10.67 m and after stretching it was 10.69 m, with no statistically significant difference (P=0.468) . Finally, the mean

Table 1. Comparing the mean of the throw before and after the stretching in the discus throw

Discipline	Throw	Mean	No.	SD	SEM	T Statistic	P
Discus	Before stretching	22.58	15	9.93	2.56	0.738	0.473
	After stretching	22.56	15	9.91	2.56		
Shot put	Before stretching	10.67	15	1.69	0.43726	-0.746	0.468
	After stretching	10.69	15	1.68	0.43634		
Javelin	Before stretching	21.71	15	8.16	2.10935	-1.562	0.141
	After stretching	21.85	15	8.23	2.12733		

Abbreviations: SD: Standard Deviation; SEM: Standard Error of the Mean

PHYSICAL TREATMENTS

distance of javelin throw before stretching was 21.71 m and after stretching it was 21.85 m, with no statistically significant difference (P=0.141).

4. Discussion

The objective of this study was to investigate the effect of static stretching on the magnitude of the throw in athletes with disability. Results of this study showed that static stretching of pectoralis major and latissimus dorsi muscles before the throw does not increase the magnitude of the throw in these athletes.

Static stretching is the integral part of the body's warm-up exercises in athletes. The overall goal of body warm-up and stretching is to prevent sports' injuries, on which all studies agree. However, stretching has other effects on the body's muscles, the most prominent one is increased flexibility. This higher flexibility can increase the range of the joint, which ends in higher angular velocity of the joint in quick motion sports activities (such as the throwing) [21, 22]. If the study athletes had a significant motion limitation, the performed stretching protocol could increase the motion range of the shoulder joint and their magnitude of the throw would improve.

However, since the study athletes had no movement limitations, the stretching may not be effective in improving their throw. Before each throw, throwers do a lot of eccentric contraction and active stretch of the throwing muscles and then perform the act of throwing; however, the stretching method in the present study is not exactly the same as that of the initial stretching done by the thrower without the intervention of the therapist. Thus if the stretching method be performed exactly to the athlete's own discretion, the results may be different. Findings of this study, due to the non-significance of the data, are neutral for using the stretching before the throw. Studies by Gonzalez Rave et al. [28] and O'Conner et al. [11] have shown positive effects of static stretching.

We must keep in mind that most studies have focused on the effect of stretching on the neuromuscular function of the lower limbs. Evidently, the stretching had different effects on the lower limbs as compared with the upper limbs, and according to Hamilton et al. [29], this difference in results of stretching on the lower and upper limbs is related to joints stability and muscle size due to the effect of the number of GTO and spindle-shaped bodies. The results of this study showed that one session of static stretching does not have much effect on the magnitude of throw in track and field disciplines, and its results were consistent with a number of previous studies [26, 30-34].

The small numbers of professional throw athletes with disabilities and the difficulty to access them and providing the conditions for conducting the stages of research were among the limitations of this study. In future studies, it is recommended that instead of passive stretching, the effect of active stretching and eccentric contractions of the throwing muscles by the thrower be investigated.

According to the results, one session of shoulder muscle stretching did not have a significant effect in the magnitude of the discus, shot put, and javelin throw in athletes with disability in each field of sport separately. This study did not confirm the hypothesis that static stretching increases the magnitude of the throw in athletes with disability engaged in discus, shot put, and javelin throw. Therefore, according to this study, performing the static stretching in the throw sports that require high angular velocities has no effect on the performance of the throw.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles were considered in this article. The participants were informed about the purpose of the research and its implementation stages; They were also assured about the confidentiality of their information; Moreover, They were allowed to leave the study whenever they wish, and if desired, the results of the research would be available to them.

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Conflict of interest

The authors declared no conflict of interest.

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