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Effectiveness of Subscapularis Training Versus Serratus Anterior Training on Improving Performance in Overhead Throwing Athletes

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ABSTRACT

Background: The overhead throwing motion is an intricate, highly coordinated musculoskeletal sequence placing multi-directional and supra physiological forces on the shoulder. The repetitive and highly demanding action results in adaptive structural changes allowing the athlete to effectively perform the overhead athletic motions; however, this is often at the expense of the normal kinematics of the gleno humeral joint.

Objective: This experimental study was aimed to find out the effect of Subscapularis Training Versus Serratus Anterior Training on Improving Performance in overhead throwing athletes.

Methods: Before the collection of data, subjects were explained about the purpose of the study. The investigators have given a detailed orientation about the various test procedures. Such as FTPI to measure the throwing accuracy and Medicine ball throw test to measure the throwing distance. The consent and full co-operation of each participant was sought after complete explanation of condition and demonstration of the procedures involved in the study.

Results: Paired t-test was used for within group analysis. Independent t test followed by post analysis was employed for between group comparisons. When comparing mean values of group, A and B, Group A subjects trained by subscapularis training showed more difference in throwing distance than group B.

Conclusion: This study concludes that the results from the present study are very encouraging and demonstrate the benefits of subscapularis training in improving throwing distance as compared serratus anterior training. Thus, subscapularis training can be incorporated into training programs of overhead throwing athlete for enhancing their performance levels.

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Introduction

The overhead throwing motion is an intricate, highly coordinated musculoskeletal sequence placing multi-directional and supra physiological forces on the shoulder. The repetitive and highly demanding action results in adaptive structural changes allowing the athlete to effectively perform the overhead athletic motions; however, this is often at the expense of the normal kinematics of the gleno humeral joint. Abnormal kinematics coupled with altered motion could result in a variety of pathologic changes and injuries at the shoulder including; scapular dyskinesia, gleno humeral internal rotation deficit (GIRD), superior labral anterior posterior (SLAP) tears, and rotator cuff tears.1–9 Because of the con-tinued prevalence of injury in this athletic population, it is important to understand the biomechanics of throwing, how to physically evaluate and work-up these athletes, and sub-sequently determine the best treatment options.

Shoulder injury is commonly managed in musculoskeletal and sports medicine clinical settings. The shoulder is the most common location for the throwing-related injury. In the United States, there are more than 2.1 million participants in high school American football, baseball, softball, and volleyball who are at risk for sport-related shoulder injury. During 2005 to 2012, there was a shoulder injury rate in high school athletics of 2.15 per 10,000athlete exposures. At the NCAA level, there are currently over 140,000men and women that participate in overhead throwing sports at the division I, II, and III levels, including baseball, softball, and volleyball. In collegiate baseball, a 16-yr study revealed 1623 shoulder injuries of which 59.5% were associated with throwing and 73% were attributed to pitching. Interestingly, if comparing pitchers versus position players in high school baseball and softball, one study revealed that the incidence of injury for pitchers was 37.3%versus 15.3%forposition players. A subset of track and field athletes participate in four throwing sports: javelin, discuss, hammer, and shot put (84). Cricket is enjoyed by nearly two million participants in England, Wales, and Australia and is the most popular sport in India.

Shoulder instability encompasses a spectrum of disease ranging from subluxation to frank dis location. While a large number of instability events occur following trauma, repetitive attenuation of the capsuloligamentous structures about the shoulder also can lead to instability. Overhead athletes are more likely to experience subluxation type events duet repetitive microtrauma. During subluxation, the humeral head translates beyond normal physiological limits, but maintains contact with the glenoid, often resulting in translation to, but not beyond the glenoid rim. While subluxation is often overlooked, it can be problematic, especially in overhead athletes. In 2007, Owens et al. reported that subluxation may comprise up to 85% of instability events. Additionally, in this series of patients, all of whom were U.S. military cadets, 41% of instability events were noncontact in nature, most commonly due to missed punches in boxing (15). Shoulder subluxation and dislocation can be associated with several injuries, which are considered to be pathognomonic for instability. During an anterior shoulder dislocation, injury typically occurs to the anterior inferior labroligamentous, which also is known as a Bankart lesionThe subscapularis is the largest and most powerful muscle of the rotator cuff. Occupyingthevast majority of the subscapular fossa, it is the only internal rotator of the rotator cuff. The subscapularis innervation is classically taught as a dual innervation of 1 upper subscapular and1 lower subscapular nerve arising from the posterior cord of the brachial plexus. However, there is a large amount of research that suggests there is significant variance in the innervation of the muscle from multiple upper subscapular nerves to multiple lower subscapular nerves arising from various portions of the plexus. Although one of the main functions of the subscapularis is to internally rotate the humerus, there is substantial evidence that displays its importance in glenohumeral stability as well. The insertion of the subscapularis is both tendinous as well as muscular. The more superior tendinous portion inserts on the lesser tuberosity while the more muscular portion inserts inferior to the less tuberosity. The medial to lateral spread of the insertion is quite variable ranging from only on the lesser tuberosity to merging with fibers from the supraspinatus.

The serratus anterior punch, scaption, dynamic hug, knee push-up plus, and pushup plus exercises consistently elicited serratus anterior muscle activity greater than 20% maximal voluntary contraction. The exercises that maintained an upwardly rotated scapula while accentuating scapular protraction, such as the push-up plus and the newly designed dynamic hug, elicited the greatest electromyographic activity from the serratus anterior muscle. Normal shoulder motion results from a complex interplay of the scapulohumeral, acromioclavicular, sternoclavicular, and scapula thoracic articulations. The coordination of these articulations provides the shoulder with an ample range of motion necessary for overhead sporting activities. Proper positioning of the humerus in the glenoid cavity, known as scapulohumeral rhythm,6 is critical to the proper function of the gleno humeral joint during overhead motion. A disturbance in normal scapulohumeral rhythm may cause inappropriate positioning of the glenoid relative to the humeral head, resulting in injury. One of the primary muscles responsible for maintaining normal rhythm and shoulder motion is the serratus anterior., Lack of strength or endurance in this muscle allows the scapula to rest in a downwardly rotated position, causing the inferior border to become more prominent (scapular winging). Scapular winging may precipitate or contribute to persistent symptoms in patients with orthopedic shoulder abnormalities. Thus, the injured shoulder with subsequent immobilization or disuse may benefit from a rehabilitation program that reconditions the serratus anterior muscle.

Aim and Objectives

Aim

- ❖ To find out the effect of Subscapularis Training Versus Serratus Anterior Training on Improving Performance in overhead throwing athletes

Objectives

- ❖ To find the effect of Subscapularis Training on Improving Performance in overhead throwing athletes
- ❖ To find out the effect of Serratus Anterior Training on Improving Performance in overhead throwing athletes
- ❖ To compare the effect of Subscapularis Training Versus Serratus Anterior Training on Improving Performance in overhead throwing athletes

Materials and Methodology

Study Design

Pre and Post Experimental study design

Study Setting

Out Patient Department, Thanthai Roever College of Physiotherapy, Preambular, Tamil Nadu, India.

Study Duration

12 months.

Materials Required

- ✓ Inch tape
- ✓ Wooden block
- ✓ Stopwatch
- ✓ Pen
- ✓ paper
- ✓ Thera Band (Blue colour)
- ✓ Swiss ball
- ✓ Stepper
- ✓ Mat
- ✓ Medicine ball (2lb, 6lb)
- ✓ Trampoline.
- ✓ Pen
- ✓ Papper

Sample Size

40 Over head throwing athletes were divided into 2 groups - Group A [20 subjects] and Group B [20 subjects]

Sampling Technique

Convenient Sampling

Criteria for Selection

Inclusion Criteria

- ❖ athletes who are runners
- ❖ Age between 20-26 years
- ❖ Only male athlete
- ❖ Overhead throwing players
- ❖ Subjects being engaged in sports that require athlete's arm to be above shoulder
- ❖ height on a repetitive basis during throwing.
- ❖ Duration of sporting activities for 2 years with at least 6 months a year and a frequency of minimum 40 minutes thrice a week.

Exclusion Criteria

- ❖ stress fracture
- ❖ deep vein thrombosis

- compartment syndrome
- distal nerve pain
- trauma
- paranesthesia
- surgery
- Previous shoulder injury
- upper limb disorders
- Cervical, thoracic conditions and rint

Outcome Measures
Medicine Ball Throw Test
Functional Throwing Performance Index

Procedure
Before the collection of data, subjects were explained about the purpose of the study. The investigators have given a detailed orientation about the various test procedures. Such as FTPI to measure the throwing accuracy and Medicine ball throw test to measure the throwing distance. The consent and full co-operation of each participant was sought after complete explanation of condition and demonstration of the procedures involved in the study.

Group A: Subscapularis Training
Intermediate Phase

1. **Internal Rotation (90º of abduction)**
   Thera band still tied, arm abducted 90º, elbow flexed, Subject was asked to internally rotate the arm by pulling the band forward and return to starting position.
2. **Internal Rotation (90º of forward flexion)**
   Thera band still tied, arm forward flexed 90º, elbow flexed. Then internally rotate the arm by pulling the band forward and inward and return to starting position.
3. **Diagonal Internal Rotation**
   With elbow flexed 45º, shoulder abducted 90º.Then slowly horizontally flexed, adducted, internally rotated the humerus until the hand reached the anterior superior iliac spine opposite to resistance
4. **Rhythmic Stabilization**
   Subject in "Statue of Liberty position" and challenged to maintain this position against
   resistance while throwing and catching in the opposite hand.
5. **Extension from 90º to 0º**
   Subject in standing and grab thera band with arm flexed 90º, internally rotated then pulls the band downwards until hand reaches the thigh.

Advance Phase

1. **Ball Throw Rebound**
   With shoulder abducted 90º, elbow flexed 90º, holding medicine-ball of 2lb, then asked to bounce the ball by throwing it against the trampoline.
2. **Wall Dribble**
   Asked to stand by holding medicine-ball of 2lb in hand with shoulder abducted 90º, elbow flexed 90º, band was tied to shoulder height, then Subject dribbles the ball against the wall for10 to 12 counts
3. **Overhead Throw**
   Standing by facing wall and shoulders 90-90 position, subject throws the ball over head against
   the wall.
4. **Side Throw**
   Standing side of the wall, grabs the ball of 6lb and throws it against the wall in side way.
5. **TheraBand Diagonal Acceleration**
   Standing and grabs thera band with elbow flexed 45º, shoulder abducted 90º, quickly horizontally flexed, adducted, and internally rotated the humerus until the hand reached the anterior superior iliac spine opposite to the resistance.

Group B: Serratus Anterior Training
Intermediate Phase

1. **Diagonal PNF using TheraBand**
   The subject was asked to perform a diagonal PNF pattern (shoulder flexion, extension, and external rotation) toward the end of the subject's range of motion.
2. **Shoulder Abduction in the Plane of Scapula**
   The subject arm straight at the side, and ask to turn their palm so that it is facing forward, then to lift their arm out to the side in the scapular plane.
3. **Serratus Anterior Punch**
   With the thera band still tied to a fixed surface, turn away from the surface and the Subject hold the band and punches forward.
4. **Dynamic Hug**
   With the shoulder abducted at 60º, internally rotated at 45º, and elbow flexed at 45º then they were asked to horizontally flex their shoulder described by their hands (hugging action) till reaches maximum protraction, then return slowly to the starting position.
5. **Wall Slide**
   With the thera band tied, the forearm should remain parallel and in the form of the number 11. Subject protracts the shoulder blades by pushing the upper back away from the wall and sliding up and down against the wall.

Advance Phase

1. **Push-up Plus**
   From standard push-up position, continue to rise up by protracting scapula and return to starting position.
2. **Plyo Push-ups**
   Subjects were advised to lower their body until the chest almost touches the ground. When pushing up, then asked to clap their hands, then return to starting position.
3. **Medicine Ball Reverse Throw and Catch**
   Shoulder abducted to 100º and rotates externally, then asked to throw the medicine-ball
   reverse and catch
4. **Step Over**
   From high plank position and stepper is placed in front of the subject and asked to step up and down.
5. **Swiss Ball Walk Outs**
   From high plank position with legs supported on a Swiss ball, hands shoulder-width apart, chest near the ground, torso in straight line. The subject was asked to take a step walk forward for 5 to 7 steps and return to starting position.

Repeat all the exercise for 3 sets of 10 repetitions per set

Data Analysis
Table 1: The Table Shows, Mean Difference, Standard Deviation and Paired 't' Value Between Pre and Post-Test Scores of Throwing Distance Among Group A

Measurement	Mean	MeanDifference	Standard Deviation	Paired 't' Value
Pre-test	5.51	1.31	0.425	14.52*
Post-test	6.82			

* 0.005 Level of Significance

In group A for throwing distance the calculated paired ‘t’ value is 14.52 and ‘t’ table value is 2.861 at 0.005 level. Since the calculated ‘t’ value is more than ‘t’ table value above study shows that there is significant difference in throwing distance following sub scapularis training in overhead throwing athletes.

Graph 1: Shows the Pre-Test Mean, Post-Test Mean and Mean Difference of throwing Distance for Group A

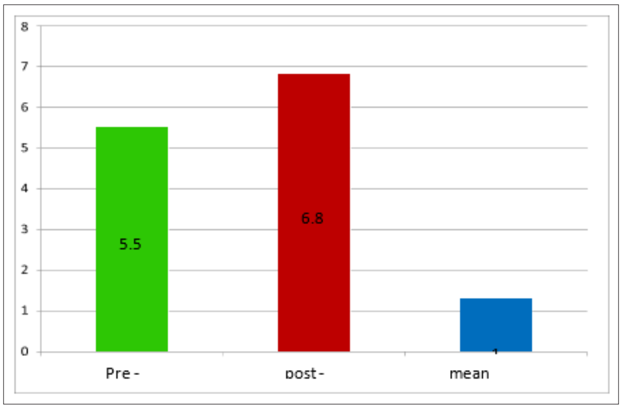


Table 2: The Table Shows Mean Value, Mean Difference, Standard Deviation and Paired ‘t’ Value Between Pre and Post-Test Scores of Throwing Distance for Group B

Measurement	Mean	MeanDifference	StandardDeviation	Paired ‘t’Value
Pre-test	5.23	0.19	0.097	8.76*
Post-test	5.42			

* 0.005 level of significance

In Group B for throwing distance the calculated paired ‘t’ value is 8.76 and ‘t’ table value is 2.861 at 0.005 level. Since the calculated ‘t’ value is more than ‘t’ table value above value that there is significant difference in throwing distance following serratus anterior training in overhead throwing athletes.

Graph 2: Shows the Pre-Test Mean, Post-Test Mean and Mean Difference of throwing Distance for Group B

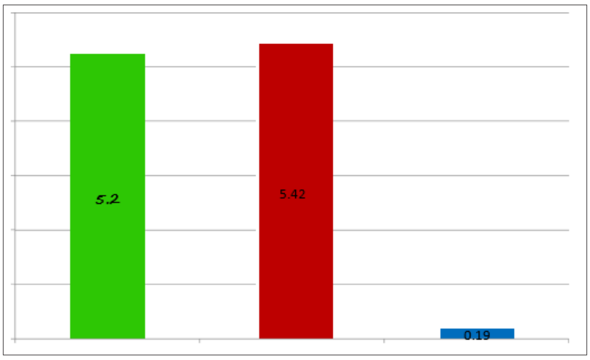


Table 3: The Table Shows the Group A Mean, Group B Mean, Standard Deviation and Unpaired ‘t’ Value for Throwing Distance

S.N	Variable throwing distance	Mean Differen ce	Standard Deviation	unpaired ‘t’ Value
1.	Group A	1.31	0.308	33.47*
2.	Group B	0.19		

* 0.005 level of significance

In Group A and B for throwing distance the calculated unpaired ‘t’ value is 33.47 and ‘t’ table value is 2.756 at 0.005 level. Since the calculated ‘t’ value is more than ‘t’ table value above results shows that there is significant difference between Subscapularis Training Versus Serratus Anterior Training in overhead throwing athletes.

Graph 3: Shows the Group A Mean, Group B Mean and

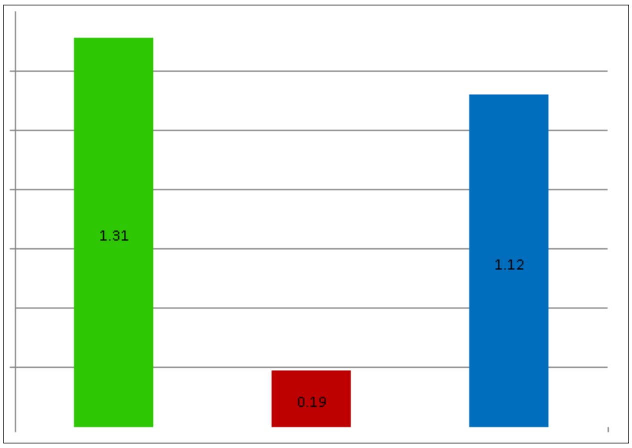


Table 4: The Table Shows Mean Value, Mean Difference, Standard Deviation and Paired ‘t’ Value Between Pre-Test, Post-Test Scores of Accuracies for Group A

Measurement	Mean	Mean Difference	Standard Deviation	Paired ‘t’ Value
Pre-test	47.1	0.8	6.92	1.99
Post-test	47.9			

* 0.005 level of significance

In Group A, for accuracy the calculated paired ‘t’ value is 1.99 and ‘t’ table value is 2.861 at 0.005 level. Since the calculated ‘t’ value is less than ‘t’ table value above study shows that there is no significant difference in throwing accuracy following subscapularis training in overhead athletes

Graph 4: Shows The Pre-Test Mean, Post-Test Mean and Mean Difference of Accuracy for Group A

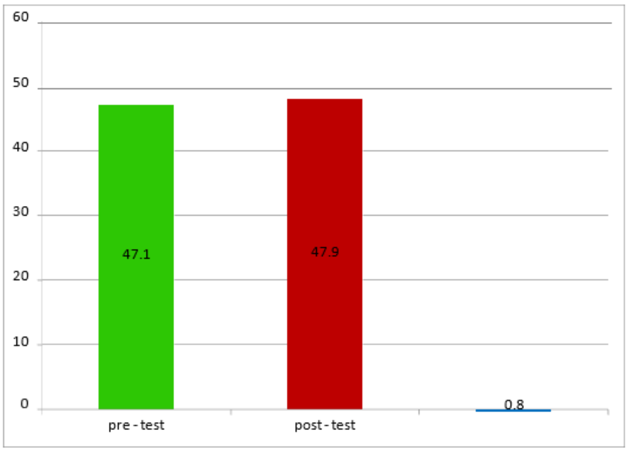


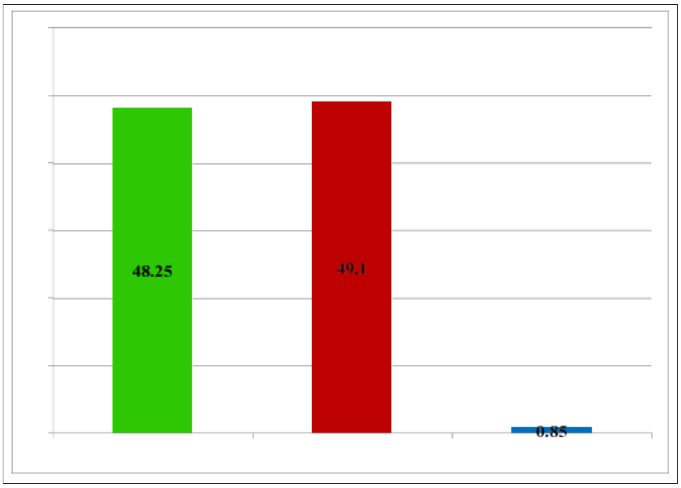
Table 5: The Table Shows Mean Value, Mean Difference, Standard Deviation and Paired 'T' Value Pre-Test and Post-Test Score of Accuracy for Group B

Measurement	Mean	MeanDifference	Standard Deviation	Paired't'Value
Pre-test	48.25	0.85	6.83	1.98
Post-test	49.10			

* 0.005 level of significance

In Group B for accuracy the calculated paired 't' value is 1.98 and the 't' table value is 2.861 at 0.005 level. Since the calculated 't' value is less than 't' table value above study shows that there is no significant difference in throwing accuracy following serratus anterior training in overhead throwing athletes

Graph 5: Shows The Pre-Test Mean, Post-Test Mean and Mean Difference of Accuracy for Group



Results

The results from the present study are very encouraging and demonstrate the benefits of subscapularis training in improving throwing distance as compared serratus anterior training. Thus, subscapularis training can be incorporated into training programs of overhead throwing athlete for enhancing their performance levels.

The subscapularis training should be preferably administered in the players especially when performance is to be improved and there is limited time for preparation.

A training program that would be more likely to adopt (do not take lot of time or effort) as a regime with low risk of muscle and connective tissue. This can be used during the last preparatory phase before in-season competition for athletes.

Conclusion

This study concludes that the results from the present study are very encouraging and demonstrate the benefits of subscapularis training in improving throwing distance as compared serratus anterior training. Thus, subscapularis training can be incorporated into training programs of overhead throwing athlete for enhancing their performance levels [1-16].

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