

# Scapular Strength in Presence of Scapular Winging and Tipping in Female Athletes Who Participate in Overhead Sports

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**Abstract.** The purpose of this study is to determine if scapular stabilizer weakness and instability is a plausible explanation for excessive winging and/or tipping of the scapula in females who participate in overhead sports. Instability may be an early sign of weakness that can contribute to shoulder injury. Literature regarding causes of scapular winging and tipping pertaining to weak scapular stabilizer muscle strength in overhead female athletes has not been widely studied. In this study subjects were 18-25 year-old volunteer female college-level athletes that participate in overhead sports. Observational measurements and isokinetic testing were taken to evaluate placement of the scapula and scapular muscle strength. By knowing the correlation of winging and tipping of the scapula and weakness of the scapular stabilizer muscles, prevention of shoulder injury may be feasible. From our findings, we hope to contribute prevention techniques for shoulder injuries to provide strengthening and rehabilitation methods.

## 1. Introduction

Female athletes who play overhead sports are prone to shoulder injury due to the repetitive motion, stress and overuse of the joint. This study investigated whether the strength of the surrounding scapular stabilizers, mainly the serratus anterior, correlate with the presence of scapular instability in the forms of winging and tipping. An assumption is made that weakness of the serratus anterior muscle, being a primary protractor, is one of the reasons for the presence of winging and tipping. Prevention of shoulder injury may be feasible by knowing the correlation between scapular kinematics and scapular stabilizer strength. We hypothesize that there will be an association between scapular strength and scapular winging and tipping.

## 2. Experiment, Results, Discussion, and Significance

Nineteen subjects participated in the study. All were 18-25 year-old volunteer female athletes who participated in overhead athlete sports in the Wichita area. Subjects were excluded from the study if they had a shoulder condition that caused them to not participate in more than one week of practice or games, or if the subject had had any upper extremity surgical procedures within the last year. Observational classification of winging and tipping was taken statically and dynamically. Tipping and winging were measured using a bubble inclinometer and digital calipers, respectively. An isokinetic machine was used to measure strength of scapular protraction and retraction in the scapular plane.

### *Results*

Nineteen female overhead athletes participated. All were right hand dominant. Three additional subjects were left hand dominant but their data is not included. Ten females were softball players; nine played volleyball. The average measurement of tipping and winging was generally greater on the right, dominant side as compared to the left, non-dominant side through the various positions. There is an evident strength difference between dominant and non-dominant extremities with the dominant arm being the stronger extremity. Significant correlations were found between left scapular tipping measurements and peak forces, peak forces per body weight, and total work data. No relationships were found between tipping measurements and peak torque variables at the slowest speed tested. Significant inverse correlations were found between winging measurements and the same peak force, peak force per body weight and total work data.

### Discussion

After analyzing the results, it was found that there was no apparent significance between the presence of winging and tipping and weakness of the scapular stabilizer muscles on the dominant arm. Although there was not a significant difference found on the dominant side, there was evidence of winging and tipping through observation of the movement of the scapula as viewed with the naked eye. Of the nineteen subjects tested, ten subjects presented with winging and/or tipping of the dominant, non-dominant, or bilateral shoulder girdle through observation. The presence of visual winging and/or tipping led us to believe that there should be a weakness in strength on the respective side, but the data did not support the finding. Unfortunately this finding was not what was originally hypothesized, but it may have some significance in the fact that it is commonly thought that weakness of the serratus anterior muscle may cause the medial and/or inferior border of the scapula to move posteriorly from the thorax. This study shows that there is no apparent weakness in the action of protraction of the dominant scapula as shown by the dynamometer, but there is an apparent abnormality of scapular movement.

### 3. Conclusion

Our intent was to compare the isokinetic muscular strength of the scapular stabilizer muscles, primarily serratus anterior, with the presence of winging and/or tipping of the scapula. Although the numbers do not support our hypothesis, it is still reasonable to believe that there is a relationship between scapular dyskinesis and scapular strength because the muscle that performs the motion of protraction also maintains the position of the scapula on the thoracic wall. If there is no strength correlation in the presence of winging and tipping as observed by an experienced clinician, what is the real cause of the scapula to wing and/or tip? A new question arises because of the fact that our data showed no relationship on the dominant arm, but did show a relationship on the non-dominant arm. Further studies should be done to fully investigate whether or not there is a relationship with the non-dominant arm and why this result occurred.

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