The Relationship between Glenohumeral Laxity and Proprioception

INTRODUCTION:
Due to the repetitive nature and large forces placed on the shoulder during the throwing motion, baseball players have been shown to have increased anterior glenohumeral (GH) laxity in the dominant arm compared to the non-dominant [1]. As such, many clinicians have hypothesized that this increased laxity may decrease proprioceptive abilities, such as joint position sense and are associated with various orthopedic injuries. However, no data are available detailing the relationship between proprioception and laxity among athletes without shoulder injury. Therefore, the purpose of this study was to determine the strength of the relationship between anterior GH laxity and active joint position sense among baseball players without dysfunction. Identifying such a relationship may be beneficial for clinicians in the prevention, evaluation, and treatment of various shoulder injuries associated with increased GH laxity.

METHODS:
Thirty collegiate baseball players (age=20±1.4 years, height=185.0±5.0 cm, mass=88.9±9.9kg) participated in this study. At the time of testing, no subjects presented with any recent upper extremity pain or discomfort within the past 2 years and no subject had any history of upper extremity surgery or neurological disorder that may have affected their proprioceptive abilities.

The Biodex System 4 isokinetic dynamometer (Biodex Medical Systems, Inc, Shirley, New York) was used to measure proprioception (active joint position sense) of the dominant shoulder at positions of 75° of external rotation, 30° of external rotation, and 30° of internal rotation. A total of 3 repetitions for each position were completed with the average of these trials used for data analysis. The LigMaster™ arthrometer (Sport Tech, Inc, Charlottesville, VA) was used to measure anterior GH laxity. Each subject was seated with the shoulder in 90° of abduction and external rotation, while the elbow was in positioned in 90° of flexion and full pronation. Twelve dN of anterior force was applied to the posterior proximal humerus (Figure 1) at a rate of approximately 1 daN/sec. The LigMaster™ then calculated a force-response curve, which provided the total amount of soft tissue compression and stiffness of the anterior inferior GH ligament, resulting in total amount of joint displacement (mm).

RESULTS:
The average amount of error from the target position for 30° of internal rotation, 30° of external rotation, and 75° of external rotation were 4.8±2.1°, 5.6±2.5°, and 5.4±2.7°, respectively. The mean and standard deviation for anterior GH laxity was 22.9±7.0 mm.

There were no relationships between anterior GH laxity and active joint position sense at 30° of GH internal rotation (r=0.05, P=0.47) and 30° of GH external rotation (r=0.10, P=0.32). However, there was a moderate positive relationship between anterior GH laxity and joint position sense at 75° of shoulder external rotation (r=0.56, P=0.001) (Figure 2).

DISCUSSION:
Previous research has shown that the shoulder external rotators of the throwing arm among baseball players have neuromuscular imbalances [2]. The relationship shown in the current study between decreased joint position sense at 75° of shoulder external rotation and increased GH laxity support these previous findings. However, our findings did not show a significant relationship when at 30° of external rotation. This is most likely due to the increased tension placed on the mechanoreceptors at the higher range of shoulder external rotation motion [3]. Previous investigations have shown that mechanoreceptors are not sufficiently stimulated during the early ranges of motion [4].

Our results support the theory that increased laxity decreases proprioception. More specifically we found increased GH laxity has a moderate relationship with decreased joint position sense at the higher ranges of motion. Therefore, clinicians may use laxity measurements as a partial predictor of joint position sense. Furthermore, because our subjects were without upper extremity injury it may be important to recognize those players with large amounts of laxity and incorporate proprioceptive training prior to the development of injury. As such, these results may prove beneficial in the prevention, evaluation, and treatment of various upper extremity injuries associated with GH laxity.

REFERENCES: