**Presentation Description**

Our understanding of tri-planar scapular kinematics and their association with select shoulder pathologies has evolved significantly in the last 10-15 years. Much of this evolution can be linked to the introduction of electromagnetic tracking systems. Unfortunately, clinicians often have limited access to this equipment making it difficult to observe the suggested scapular kinematic patterns in patient populations. The presenter will address the scapular kinematic patterns that have been identified in the literature and will present the findings of an EATA grant-sponsored project entitled “Establishing a Reliable Method of Measuring Scapular Anterior-Posterior Tilt”, which was designed to develop a clinically available method for monitoring scapular tilt.

**Abstract/Notes for the Presentation**

Establishing a Reliable Method of Measuring Scapular Anterior-Posterior Tilt
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**Context:** Electromagnetic tracking systems have enabled investigators to examine tri-planar scapular kinematics in healthy and shoulder injured subjects. Clinically, modified digital inclinometers have been used to quantify scapular upward rotation. However, a substantial amount of information suggests that anterior-posterior (AP) tilt is an important factor to consider when working with shoulder injured patients.

**Objective:** The purpose of our study was to test the hypothesis that static measurements of scapular AP tilt obtained with a newly validated digital inclinometer, at various points of shoulder elevation, would produce reliable results when measurements were made by multiple clinicians.

**Design:** Single group repeated measures design.

**Setting:** Study was performed in a controlled laboratory environment.

**Patients or Other Participants:** Twenty-four volunteers (20.42 ± 1.41 years; 1.70 ± 0.09 meters; 70.92 ± 13.96 kg; 12 males, 12 females), free from any diagnosed upper extremity, neck and or back injury agreed to participate. All subjects underwent an evaluation to ensure a healthy, dominant shoulder.

**Intervention:** All data collection involved the dominant shoulder in the scapular plane. Subjects performed three trials of 0°, 30°, 45°, 60°, 90°, and 120° of humeral elevation in a randomized fashion. Scapular AP tilt was measured using a previously validated \( r = 0.63 - 0.86 \) modified digital inclinometer. Two blinded examiners obtained AP tilt measures.

**Main Outcome Measures:** The dependent variable was scapular AP tilt for each humeral position. Two-way random effects model intraclass correlation coefficients
(ICC(2,2)) were used to assess inter-rater reliability. Standard error of measure (SEM) was quantified for each examiner by humeral position. To evaluate intra-rater reliability, two-way mixed model intraclass correlation coefficients (ICC(3,2)) were used. An $\alpha = 0.05$ was set a priori.

**Results:** Inter-rater reliability was determined to be good to excellent for each position of humeral elevation (ICC(2,2) 0 degrees = 0.92, 95% CI = 0.62 – 0.97; ICC(2,2) 30 degrees = 0.92, 95% CI = 0.82 – 0.97; ICC(2,2) 45 degrees = 0.88, 95% CI = 0.72 – 0.95; ICC(2,2) 60 degrees = 0.85, 95% CI = 0.67 – 0.94; ICC(2,2) 90 degrees = 0.83, 95% CI = 0.60 – 0.93; ICC(2,2) 120 degrees = 0.85, 95% CI = 0.64 – 0.93). SEM ranged from 1.59° to 2.67° and 1.44° to 2.59° for examiner One and Two, respectively. Intra-rater repeatability of inclinometer measures for each position were also determined to be good to excellent (ICC(3,2) = 0.86 – 0.99, p ≤ 0.001).

**Conclusions:** Utilizing a modified digital inclinometer to quantify scapular AP tilts resulted in acceptable levels of reliability. Clinically reasonable measurement error as compared to error associated with standard goniometric measures was also noted. Use of the modified digital inclinometer in this manner will enhance our ability to affordably quantify in-vivo scapular AP tilt in the clinical environment. This study was fully funded by the Eastern Athletic Trainers’ Association, Inc.