Association Between Long Head Bicep Tendon and Shoulder Range of Motion and Isometric Strength

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The windmill softball pitch is a dynamic upper extremity movement that requires the arm to accelerate in a 360° arch of motion prior to ball release for the overall goal of producing ball speed, movement, and accuracy. Great stress is placed on the anterior shoulder, similar to those stresses occurring in baseball pitching.[1-3] Thus, the mechanics of the windmill softball pitch predispose softball pitchers to great stresses on the long-head biceps tendon (LHBT) and long-term range of motion (ROM) compensation could result in additional stress to the LHBT. Due to the repetitive nature of the windmill softball pitch and the high force loads at the LHBT, anterior shoulder pain and injury are of primary concern in youth softball pitchers. Additionally, it has been reported that those pitching with upper extremity pain have altered pitching mechanics compared to those pitching without pain.[3] Understanding the association of upper extremity ROM and LHBT physiological responses after a bout of pitching could prove beneficial to comprehending injury pathology in youth softball pitchers. The purpose of this study was to identify functional measures, rotational ROM and isometric strength (ISO), of the upper extremity that are associated with changes in LHBT physiological changes following a simulated game.

Eleven youth softball pitchers (12.5± 2.3 years; 162.7 ± 9.7 cm; 57.6 ± 17.9 kg) volunteered to participate. Inclusion criterion required the participants to be actively competing on a team roster as a pitcher. The Institutional Review Board of Auburn University approved all testing protocols and parental and participant informed written consent and assent was obtained. Dominate shoulder ROM, ISO and LHBT ultrasound measurements (transverse width, transverse depth, and longitudinal depth) were taken prior to and following the participant pitching a simulated game. Shoulder ROM and ISO were assessed utilizing previously established methods.[4-8] The average differences of each LHBT measurements from pre to post pitching were used for analysis. The examiner performed bilateral shoulder ROM and ISO with the participant supine, shoulder abducted to 90° in the frontal plane and elbow flexed to 90°. A digital inclinometer was placed on the forearm and the examiner measured shoulder internal and external rotation ROM. For ISO, a handheld dynamometer was placed on the forearm. Participants were instructed to push against the examiner in the direction of internal rotation and external rotation. The average differences of each LHBT measurements from pre to post pitching were used for analysis. Ultrasound measurements were obtained using a 4-12 MHz linear array transducer in B-mode using previously established methods.[9,10] Three ultrasound images per measurement (transverse width, transverse depth, and longitudinal depth) were averaged and the difference of each measure from pre to post pitching was utilized for analysis. Pearson product correlations were run between pre-simulated game domination shoulder ROM and ISO and the average difference of each LHBT measure.

No significant correlations between internal and external ROM and ISO were found with the changed LHBT measures ($p > 0.05$). Means and standard deviations of all LHBT measures may be found in Table 1. The lack of significant relationships in shoulder ROM and ISO and acute changes in the LHBT may be partially explained by participant's total pitch count, age, and experience level. Further investigation into changes of the LHBT, ROM, and ISO pre and post pitching a simulated game is warranted. Softball pitchers are continually reporting high prevalence of pain in the throwing arm. With previous work reporting changes in LHBT pre to post simulated game, there is reason to believe intrinsic factors such as ROM and ISO may be related to increased pain and changes in the LHBT. While the current study included youth pitchers, research on older and more experienced athletes, specifically collegiate and profes-

sional softball pitchers should be considered as it may present contrasting results.

Table 1: Means and Standard Deviations of LHBT measures pre and post pitching a simulated game.

	Pre Simulated Game	Post Simulated Game
Transverse Width	5.81 ± 0.47 mm	6.24 ± 0.38 mm
Transverse Depth	3.30 ± 1.10 mm	3.70 ± 0.35 mm
Logitudinal Depth	4.52 ± 0.42 mm	4.79 ± 0.65 mm

Statement of Research Advisor

Caroline's work highlights the importance of shoulder ROM and strength in softball pitching and injury prevalence. Though we had a lack of significant association between shoulder ROM and strength biceps tendon responses following a pitching outing, these findings highlight the need for further investigation into the repetitive nature of windmill softball pitching and the residual effects occuring at the biceps tendon.
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