

Reference: Nichols Jr CW, Brismée JM, Hooper TL, Bertrand-Grenier A, Kapila J, Gilbert KK, St-Pierre MO, Sobczak S. Glenohumeral Joint Capsule Tissue Tension Loading Correlates Moderately with Shear Wave Elastography: A Cadaveric Investigation

Context: Joint capsular tissue restrictions result in joint range of motion (ROM) limitations. Ultrasound shear wave elastography (SWE) has been used in vivo to measure stiffness in organs, tendons, and muscles. However, no study has investigated the reliability and validity of SWE readings in measuring capsular tissue property changes against a reference standard.

Objective: To investigate: (1) capsular tissue mechanical property changes using SWE and a durometer, a device validated to measure tissue hardness, under various tensile loads; (2) SWE and durometer measurement reliability; and (3) correlation of SWE and durometer measurements to evaluate if SWE technology could allow measurement of tissue changes during joint mobilizations and capsule stretching techniques.

Design: Experimental test-retest reliability and correlation study.

Setting: Laboratory.

Specimens: The inferior glenohumeral joint (GHJ) capsule from 5 fresh human cadaveric specimens (mean age 77.8+/-5.4 years) was harvested.

Intervention(s): Tissue specimens were placed in a fixed stand using custom clamps and tensile loading was applied to the capsular tissue using 1, 3, 5 and 8kg weights. Investigators blinded to the loads applied to the capsular tissue recorded measurements during loading with B-Mode SWE using the region of interest identified in the Q-box and a durometer.

Main Outcome Measure(s): Durometer measures of tissue hardness expressed in Shore Unit (HA) and SWE of tissue stiffness measured in kilopascals (kPa) were recorded during the selected loads.

Results: Reliability for the durometer measurements using ICC_{3,5} was .90 (95% CI .79-.96) and SWE using ICC_{3,5} was .95 (95% CI .88-.98). Pearson Correlation Coefficient values for 1, 3 and 5kg were .56, .36, and -.56, respectively, 1 and 3kg combined was .72 and 1, 3 and 5kg combined was .62. The 8kg measurements were severely limited due to thinness and SWE measurement saturation of tissue samples.

Conclusions: Both the durometer and SWE measurements were highly reliable and correlated moderately when measuring GHJ capsule elasticity. This study suggests validity for the SWE to measure capsular tissue stiffness changes in vitro at lower loads (1 and 3kg). Likewise, GHJ capsule hardness measurements with a durometer had excellent reliability and could be used as a control method to validate diagnostic methods such as SWE. This study provides a baseline for future non-invasive

evaluation of the mechanistic effects of joint loading and mobilization on capsular tissues in vivo.