QUANTIFICATION OF THORACOLUMBAR FASCIA SHEAR PLANE MOTION DURING PASSIVE FLEXION IN HUMAN SUBJECTS WITH CHRONIC LOW BACK PAIN USING ULTRASOUND ELASTOGRAPHY

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BACKGROUND: In previous ultrasound based studies of human subjects with and without chronic low back pain (LBP) matched for age, sex and BMI, we found increased thickness and ultrasound echogenicity of the perimuscular connective tissues forming the thoraco-lumbar fascia. It was also observed that, during passive flexion/extension, the loose and dense connective tissue layers within the thoracolumbar fascia are capable of moving independently. Individual connective tissue layers can be observed to be moving in a direction counter to those above or below. It was hypothesized that the morphological differences observed between LBP and No-LBP groups would be associated with differences in the quality and quantity of these motions. The goal of this study is to fully characterize and quantify the motion between these connective tissue layers in LBP and No-LBP groups.

METHODS: So far, we have tested 87 subjects (51 with LBP and 36 with No-LBP). Subjects were placed prone on a motorized articulated table capable of inducing passive flexion/extension of the back standardized with respect to rate and range. An ultrasound cineloop was collected over a 10 second period of a 15 degree flexion/extension at 0.5 Hz. The ultrasound transducer head was placed longitudinally 2 cm lateral to the midline at the level of the L2/3 interspace. The ultrasound transmission frequency was 10 MHz and the cineloop frame rate was 25 Hz. The ultrasound RF data were collected and analyzed for displacement using elastography techniques.

In preliminary analyses, we quantified the motion between the connective tissue layer closest to the muscle boundary relative to the connective tissue layers immediately superficial to it, identifying this as the perimuscular shear plane. Two rectangular ranges of interest (ROI) were identified on each ultrasound B-scan image. These ROIs measured 10 mm wide and 2mm depth and were located superior and inferior to the perimuscular shear plane. Total displacement was determined within these ROIs over the period of the flexion portion of one cycle of the table. Relative motion of tissue between the two ROIs was determined by integrating the area under the curve of the difference in the time based displacement history.

RESULTS: In a preliminary analysis of the data from 87 subjects, subjects with LBP had on average less relative tissue motion across the perimuscular/muscular boundary than subjects without LBP. Mean±SE relative tissue motion was 1.04±0.038 cm^2 vs. 1.31±0.042 cm^2 for LBP and No-LBP respectively (t-test $p=0.015$). We also observed a greater left/right variability in the LBP compared with the No-LBP group, as well as variable motion in more superficial shear planes that will be the subject of further analyses.

CONCLUSION: These preliminary findings suggest that the observed morphological differences in connective tissue structure between LBP and No-LBP groups may have associated functional differences.

This work was supported by NCCAM Research Grant RO1-AT003479.