

Assessment of Repeated Measurement Variance in Shear Wave Elastography of the Medial and Lateral Gastrocnemius and Soleus

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ABSTRACT

The use of shear wave elastography (SWE) as a method to measure intrinsic muscle stiffness is gaining increasing interest in the scientific community. To date, a few studies exist that have evaluated reliability of SWE of the gastrocnemius muscle under various conditions. However, data on day-to-day variance, inter-rater variance and frame use in reporting stiffness is missing. **PURPOSE:** The purpose of this study was to calculate the variance of repeated measures for SWE in 2 different muscles using different raters and to analyze the number of elastogram frames needed for stiffness assessment. **METHODS:** 12 raters measured SWE of the gastrocnemius and soleus in 2 different ankle positions of 1 subject (12 different subjects total) on 5 separate days, and calculated stiffness using both velocity (m/s) and young's modulus model (kPa) based on 10 separate elastogram frames. All subjects lay prone on the exam table with their bare foot and ankle hanging off. SWE of the visual center of the lateral head (LH) and medial head (MH) of the gastrocnemius, as well as the medial and lateral portion of the soleus were taken when the ankle was in a relaxed position (how the ankle naturally lay off the end of table) and a neutral position (requiring a strap to slightly dorsiflex the ankle joint to 90 degrees). **RESULTS:** Variance of young's modulus model data (kPa) were analyzed using a Bayesian model. Muscles and muscle state (neutral or relaxed) were considered to be fixed effects, and the variance components (for subject, rater, day, frame, and error) were estimated using a hyperprior structure for those effects. Variance component results for day (0.186) and frame (0.063) were very low. Variance components for rater (6.170) and subject (6.126). Variance of random error was higher than expected at 62.620, indicating incidences of non-systematic abnormal kPa measurement values. **CONCLUSION:** SWE measurements are consistent day to day results with minimal variation indicating that controlled multiple day measurements are valid. Rater variance indicates an expected variability of 2.5 Kpa combined for all muscles and positions tested. Frame variance indicates that 10 frames are not necessary for calculation of kPa values which has not been established in current literature.