

University of Stuttgart Germany

ISEK XXIV - Québec City, Canada June 22-25, 2022

BACKGROUND AND AIM:

Ultrasound shear wave elastography (SWE) was shown to represent in vivo active [1] and passive [2, 3] muscle mechanics. We hypothesized that SWE reflects changes in mechanical properties of the Biceps Brachii muscle (BB) due to

- Activity level changes, (i)
- (ii) Muscle length changes,
- (iii) Aging.

PARTICIPANTS:

- 14 healthy young (7 females) $(28.07 \pm 5.06 \text{ years old})$
- 10 healthy older (5 females) $(67.80 \pm 5.69 \text{ years old})$

METHODS:

- Simulateneous SWE, surface electromyography (sEMG) of the BB, and elbow torque measurements at 60°, 90°, 120°, 150°, and 180° elbow angles.
- Rest, maximum voluntary contractions (MVC), and isometric ramp contractions (up to 25%, 50%, 75% of MVC torque) were performed.



Aging of skeletal muscles: A shear wave elastography approach to detect changes in mechanical properties in vivo

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Figure 1. Schematic experimental setup showing a subject seated with 60° elbow angle. Surface electromyography (sEMG) electrodes are placed at the Biceps Brachii and Triceps Brachii. The ultrasound (US) probe is aligned with muscle fiber direction. An examplary shear wave elastography image during submaximal isometric contraction is shown above.

Funded by



DFG Deutsche Forschungsgemeinschaft German Research Foundation

Figure 2. Elbow torque during MVC (top) and active shear elastic modulus at 50% of MVC (bottom) are shown as mean values and standard deviation with respect to the elbow angles (60°-180°) studied.

CONCLUSIONS:

1) The shear elastic modulus represents muscle's lengthdependent force production characteristics in vivo 2) The shear elastic modulus increases with increased torque for each joint position and SWE reflects the decreased active force production capability with age 3) Passive muscle stiffness increases with age

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2-way ANOVA post-hoc results (p < 0.05): *,**: significant differences with the values measured at 180° and 150° ***: significant differences between the values measured at 90°-180°

References: [1] Ates F. et al. 2015, J Electromyog Kinesiol, 25:703-708 [2] Ates F. et al. 2018, Eur J Appl Physiol, 118:585-593 [3] Eby S.F. et al. 2015, Clin Biomech, 30:22–27