Estimation of the linear displacement and rotation movement of the extensor digitorum communis tendon based on ultrafast ultra-high frequency ultrasound imaging.

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Summary (100 to 300 words):
Injuries to the hands, wrists and fingers often involve damage to multiple tissues. The most important soft-tissue concerns in metacarpal fractures is maintaining extensor digitorum communis (EDC) tendon glide. The ability to measure tendon displacement during the rehabilitation process would provide important information for quantifying tendon injuries for clinicians. Movement of tendon includes not only linear displacement but also itself rotation. Traditional ultrasound imaging cannot provide enough spatial and temporal resolution to estimating such the detail motion and structure, which means that the image quality and the sudden movement in ultrasound would alter the estimation results. Therefore, the purpose of this study is to estimate movement and rotation of EDC tendon by ultrafast high frequency ultrasound imaging.

In the experiment setup, we use an ultrafast imaging system (Vantage 256) with a 256-element high frequency array transducer (MS550D) to acquire IQ signals from EDC tendon. The operational frequency of transducer is 40 MHz. Seven plane wave angles were transmitted to hand for acquiring the compounding image of tendon at a high frame rate of 200 Hz. The transducer was placed on EDC tendon in longitudinal view and its cross view, respectively, and applied the speckle-tracking method for estimating the displacement and velocity of tendon motion and rotation. To reduce the artificial error, we use the Transcutaneous electrical nerve stimulator (TENS) to ensure the tendon movement almost consistent. In addition, the subjects have to wear the fixture to reduce the Tremor during experiment.

The motion of tendon was observed clearly at this high resolution ultrasound image with an ultra-high frame rate. So we can analyze the movement and rotation in the tendon from the image. The next works will focus on reconstructing the motion of the EDC tendon in 4D.