12:05 pm:
Quantitative Measurement of Achilles Tendon Elasticity Using Ultrasound Elastography: Measurement Repeatability and Normative Value

Presenting:
Yohei Yamamoto, MD
Chiba, Japan

Additional Authors:
Satoshi Yamaguchi, MD, PhD; Takahisa Sasho, MD, PhD; Taisuke Fukawa, MD; Yorikazu Akatsu, MD; Kenji Takahashi, PhD; Kengo Nagashima, PhD; Kazuhisa Takahashi, MD, PhD

Summary:
The purposes of this study were to measure intra- and interobserver repeatability of quantitative elastography for the Achilles tendon, to assess correlation between the quantitative measurement and the conventional qualitative measurements and to compare the elastography values among different age groups. Quantitative elastography had sufficient intra- and interobserver repeatability. The quantitative value correlated with the conventional ultrasound imaging methods to evaluate tendon degeneration. This technique may be useful to quantify degeneration of the tendon. The limitation was not to investigate correlation between quantitative elastography and histological assessment.

Introduction:
Elastography is an ultrasound technique to measure tissue elasticity. Studies have shown that elasticity of the Achilles tendon measured with elastography correlates with tendon degeneration. However, conventional elastography is qualitative measurement, and quantitative measurement is necessary to precisely assess the tendon degeneration. Recently quantitative elastography has developed. The purposes of this study were 1) to measure intra- and interobserver repeatability of quantitative elastography for the Achilles tendon, 2) to assess correlation between the quantitative measurement and the conventional qualitative measurements and 3) to compare the elastography values among different age groups.

Methods:
One-hundred asymptomatic Achilles tendons of 50 healthy subjects (5 men and 5 women in each decade of age from their 20’s to 60’s) were examined with ultrasound. The tendon was examined in the prone position with the foot hanging over the edge of an examination bed. The longitudinal image of the middle third of the tendon was evaluated. Degeneration of the tendon was assessed by three methods; quantitative elastography, conventional qualitative elastography and B-mode image. For quantitative elastography, an acoustic coupler which has a known Young’s module was attached on the ultrasound probe. Repetitive pressure was manually applied to the tendon using the probe. Then, tissue strain was color-coded and superimposed on the B-mode image (Figure). Strain value of the tendon was divided by that of the coupler, and strain ratio (SR) was calculated. For qualitative elastography, the color mapping of the tendon strain was visually divided into three grades (Grade 1:blue-hard, 2:yellow-medium, 3:red-soft). For the B-mode image, tendon degeneration was divided into three grades (Grade 1:normal, 2:enlarged,
Two independent observers measured the SR value of each tendon three times. Intra- and interobserver repeatability of the SR measurement was assessed using the intraclass correlation coefficient (ICC). SR values for each B-mode grade/quantitative elastography grade were compared using the Wilcoxon signed-rank test. The SR values were compared among the age groups (20’s to 60’s) using the Kruskal-Wallis test.

**Results:**
When the mean of the three measurements was used as the representative SR of the tendon, the intraobserver repeatability, ICCs (1, 3), were 0.93 and 0.87 for the two observers. They were classified as almost perfect repeatability. The interobserver repeatability, ICC (2, 2), was 0.75, which was classified as substantial. The median SRs were 0.36 and 0.68 for the B-mode grade 1 and 2, respectively. The SR of the grade 2 (degenerated) tendons was significantly higher (softer) than the grade 1 (normal) tendons (P = 0.005). No tendon was classed as grade 3. The SRs of each age group ranged from 0.37 to 0.46 except for the 30’s. The SR of the 30’s was 0.27, which was significantly lower (harder) than those of the other groups (P < 0.001).

**Conclusion:**
SR measurement of the Achilles tendon had sufficient intra- and interobserver repeatability. The quantitative value correlated with the conventional ultrasound imaging methods to evaluate tendon degeneration. Quantitative elastography may be useful to quantify degeneration of the Achilles tendon.