Quantitative Characterization of Mild and Moderate Degenerative Changes in Femoral Trochlear Cartilage *In Vivo*

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Background, Motivation and Objective

Osteoarthritis (OA) is a common articular cartilage degenerative disease and its early diagnosis is important for controlling the progression with proper treatment. Ultrasound imaging is a non-invasive and cost-effective method widely used in the clinic to detect the OA-related degenerative changes in the femoral trochlear cartilage. However, the identifications of cartilage damages rely much on the operator's experience. In order to objectively characterize and grade the mild and moderate degenerative changes, we quantitatively analyzed the B-mode images and compared with conventional OMERACT grading method.

Statement of Contribution/Methods

Ultrasound imaging was performed on 49 knee joints of 33 participants from the Xiangya Osteoarthritis (XO) Study I, using a Philips CX30 machine with a 4-12 MHz linear array transducer. The probe was placed transversely to the long axis of the femur and the most representative B-mode images were recorded in DICOM format for quantitative analysis. Normalization and interpolation were performed on the intensities of the B-mode images to minimize the influence of gain and imaging depth. The intensities on and 20 pixels (1.64 mm) below the anterior wall were used to calculate the contrast between the anterior wall and internal cartilage (ant_contrast). The mean value (ant_mean_intensity) and slop (ant_slope) of the intensities 5~20 pixels below the anterior wall were calculated to reflect the acoustic reflection and attenuation characteristics. The standard deviation (SD) of the intensities inside the cartilage (SD_cartilage) was calculated to characterize the degeneration changes related to the homogeneity of the cartilage. The quantitative indices were correlated with OMERACT grades using Spearman's rank correlation analysis.

Results/Discussion

Fig. a shows the B-mode images at different OMERACT grades. Statistically significant decrease of ant_contrast and the absolute slope of the intensities were observed as the OMERACT grade increases, while the mean intensities and the SD inside the cartilage showed increasing tendencies (Fig. b). Significant correlation between the quantitative indices and OMERACT grades was found. These findings demonstrate the potential of quantitative ultrasound for the assessment of OA-related mild and moderate degenerative changes in femoral trochlear cartilage.



Figure. (a) B-mode images of femoral trochlear cartilage at different OMERACT grades. (b) Quantitative indices of femoral trochlear cartilage at different OMERACT grades and the Spearman's rank correlation coefficient (r) between the indices and the grades (* indicates p<0.01).