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Validation of three-dimensional reconstructed compositional T1rho mapping

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Background :

T1rho mapping reflects proteoglycans and allows noninvasive early detection and quantitative evaluation of arthropathic changes. Therefore, it is expected to be applied to understanding the pathogenesis of cartilage degeneration and determining the efficacy of treatment. We have developed a three-dimensional (3D) reconstruction evaluation method using T1rho mapping and have reported the usefulness of this method for the evaluation of cartilage lesions. However, it has not been examined whether the 3D reconstruction evaluation method reflects qualitative changes in the cartilage matrix in histological evaluation.

Objectives :

This study aimed to investigate the validity of this method from a histological perspective using resection specimens from patients who underwent total knee arthroplasty (TKA) and to compare with T2 mapping and two-dimensional (2D) T1rho mapping.

Study Design & Methods :

Seventeen knees (2 males and 15 females, mean age 74.9 years) of 17 patients with internal knee osteoarthritis who underwent TKA were included in this study. T1rho and T2 mapping were taken preoperatively, and 3D mapping was constructed using analysis software. The region of interest was set at the osteotomy site of the lateral femoral condyle and lateral posterior femoral condyle, and the mean T1rho and T2 values were calculated. Cartilage tissue specimens taken at the time of TKA were prepared, stained with Safranin-O and Collagen Type II antibody, and the staining ratio of cartilage was semi-quantified using ImageJ. The correlation between the mean T1rho and T2 values, the semi-quantified staining ratio of cartilage tissue, and the gross evaluation of the excised specimens according to the cartilage injury classification of the International Cartilage Repair Society were statistically investigated.

Results :

The quantitative T1rho 3D values were significantly correlated with the histopathological staining ratio (%), gross evaluation, T1rho 2D values, and T2 3D and 2D values for all items. The correlation coefficient with 3D T1rho was -0.55 for safranin O staining, -0.62 for collagen staining, 0.52 for gross findings, 2D T1rho 0.78, 3D T2 was 0.52, and 2D T2 was 0.56.

Conclusions :

T1rho values were positively correlated with the gross classification of severity and negatively correlated with the degree of pathological staining. It was suggested that the 3D T1rho mapping reflected the molecular structural changes in the cartilage matrix caused by arthropathic changes and was a useful noninvasive quantitative evaluation method.