Three dimensional Distribution Of Hip Cartilage T2 Mapping Assessed By Radial Mr Imaging: Comparison Between Healthy Volunteers And Patients With Hip Dysplasia

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Disclosures:

Introduction: Hip dysplasia is one of the main causes for developing hip osteoarthritis, and sensitive and accurate detection of early cartilage lesions is important to estimate disease prognosis and plan conservative or surgical treatments. Several quantitative magnetic resonance (MR) imaging techniques have been developed for assessment of early cartilage degeneration, including delayed gadolinium-enhanced MR imaging of cartilage, T2 and T1rho mapping in the knee joint. [1][2] Previous hip arthroscopic studies showed frequent involvement of acetabular cartilage degeneration predominantly at anterosuperior limited regions before appearance of radiographic osteoarthritic changes in patients with hip dysplasia.[3] In spite of clinical requirement of detained three-dimensional (3D) assessment over the entire acetabular cartilage, few studies have reported on 3D evaluation with quantitative cartilage MR imaging in the hip joint. The purpose of this study was to investigate 3D distribution of cartilage T2 mapping over the whole acetabular cartilage using radial MRI techniques, and to examine association between cartilage T2 and adjacent labral lesions in healthy volunteers and patients with hip dysplasia.

Methods: Eight symptomatic patients with hip dysplasia (all female, mean age; 31.2 ±10.3 years) and seven asymptomatic healthy volunteers (all female, mean age; 27±1.5 years) were evaluated with 3.0-T MR imaging system. Patients with hip dysplasia had mean lateral center edge angle of 5.5° (range; -18° to 17°) with no osteoarthritic changes on plain radiographs. Consecutive radial T2 map images of the unilateral hip were obtained at 30° intervals passing through the center of the acetabular dome and perpendicular to the acetabular rims (Plane A90 to P90, Fig 1) for evaluation of the acetabular cartilage (TR: 1500 ms; TE: 8 echoes between 10- 80 ms; in-plane resolution: 0.39 mm; slice thickness: 3 mm; acquiring time: 12min54sec. Radial fast spin-echo T2-weighted images with matched planes were also obtained for evaluation of the acetabular labrum. (TR/TE:12.7/6.3ms; in-plane resolution: 0.39 mm; slice thickness: 1.5mm; FOV: 12 cm; acquiring time: 6min5sec.) In each radial image, the acetabular cartilage area on the weight bearing was defined manually, which was further subdivided into medial and lateral zones of equal length using our custom-made software (Fig 2). Average cartilage T2 values in each zone, and lateral-medial (LM) ratio, which was defined as cartilage T2 value in the lateral zone divided by that in medial zone, were calculated. LM ratio was employed due to adjust physiological variations among individuals.[4] Labral tear was defined as abnormal internal signal or exhibiting effusion extending into labrum, and relationships between labral tear and cartilageT2 value or LM ratio at the adjacent cartilage zones was analyzed.

Results: Acetabular cartilage T2 values at lateral zones were significantly greater in patients with hip dysplasia than in healthy volunteers on all zones except the A90 zone, while T2 values at medial zones was significantly greater only on S and P90 zones in patients with hip dysplasia (p<0.05, Fig 3). The LM ratios on A60 and A30 zones were significantly greater in patients with hip dysplasia (p<0.05, Fig 4).

Labral tear was observed in 6/8 joints (17/56 zones) in patients with hip dysplasia and in 4/7 joints (7/49 zones) in healthy volunteers. In patients with hip dysplasia, labrum tear was found most frequently in A60 and A30 zone, followed in A90, and P30 zones. Cartilage T2 values at lateral zones and LM ratios were significantly higher in cartilage with adjacent labral tear than cartilage without labral tear (p<0.01).

Discussion: 3D cartilage assessment of hip joints is challenging mainly due to difficulty in acquiring MR images with satisfactory quality for thin cartilage deeply located in a tightened ball-and-socket hip structure. In this study, radial imaging techniques with high-resolutional T2 mapping allowed sufficient visualization and quantification of articular cartilage over the whole acetabular dome with clear differentiation between the acetabular and femoral cartilages. Distribution of cartilage T2 value in dysplastic hip without radiological osteoarthritis was different from that in healthy volunteer. After adjusting individual variations of cartilage T2 using LM rations, T2 values at lateral zones were significantly greater in the anterosuperior zones in patients with dysplastic hip. These results were supported by significant associations between labral tear and T2 increase at the adjacent cartilage, and were in accordance with previous arthroscopic findings in patients with hip dysplasia. [3] In conclusion, radial imaging with T2 mapping was useful to evaluate cartilage degeneration over the whole acetabular dome. In further studies, it is important to...
investigate associations between degree and location in acetabular and femoral cartilage degeneration, and clinical symptom among patients with hip dysplasia and femoracetabular impingements.

**Significance:** Distribution of cartilage T2 value in dysplastic hip without radiological osteoarthritis was different from that in healthy volunteer and T2 values at lateral zones were significantly greater in the anterosuperior zones in patients with dysplastic hip. Cartilage T2 values at lateral zones were significantly higher in cartilage with adjacent labral tear than cartilage without labral tear.

**Acknowledgments:**

Fig. 1 Definition of radial planes

Superior

Anterior

A30  S  P30

A60

A90

P60

P90
Fig.2 Radial T2 mapping in a patient with dysplastic hip (A) and a healthy volunteer (B)
(L: lateral zone, M: medial zone)

(A) Dysplastic hip

(B) Healthy volunteer
Fig. 3  T2 values of both groups at lateral zones (A) and medial zones (B) in each region. *p<0.05
Fig. 4  LM ratio of both groups in each region *p<0.05

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