ASSESSMENT OF EARLY OSTEOARTHRITIS IN HIPS WITH FEMOROACETABULAR IMPINGEMENT USING DELAYED GADOLINIUM ENHANCED MRI OF CARTILAGE (dGEMRIC)

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INTRODUCTION

Clinical studies of patients with hip osteoarthritis (OA) suggest that structural abnormalities may result in accelerated or premature joint degradation. There is emerging clinical evidence that femoroacetabular impingement (FAI) is a distinct pathological entity which can cause early hip OA[1]. In FAI, the normal congruity of the hip joint has been lost due to anatomic abnormalities, such as excessive acetabular coverage, an insufficient femoral head-neck offset, or asphericity of the head. (Figure 1) In all of these conditions, the reduced joint clearance results in mechanical impingement leading to acetabular labral tears and articular cartilage damage. FAI is classified into two types, cam and pincer, based on the underlying anatomic anomaly. Pincer impingement results when a prominent femoral head-neck junction makes abnormal contact with the acetabular rim. Cam impingement is characterized by the squeezing or jamming of an abnormally shaped femoral head into the acetabulum [1]. Surgical outcome is directly related to the amount of pre-existing damage to the cartilage such that if cartilage delamination is present outcome is often poor [2]. Conventional radiography provides only an indirect measurement of cartilage integrity as reflected by joint space narrowing and osseous changes. The delayed Gadolinium Enhanced MRI of cartilage (dGEMRIC) was developed to directly monitor changes in articular cartilage as seen in early OA. The purpose of the current study was to determine the feasibility of using dGEMRIC to assess early OA in hips with FAI.

MATERIALS AND METHODS

A retrospective review of patients who presented with clinical FAI was performed. All patients were skeletally mature. Hips with prior arthroscopic surgery, were included, but hips with prior open reconstructive procedures were not. Institutional review board approval was obtained. Thirty eight hips in 31 patients who had radiographic evidence of FAI and a dGEMRIC scan were identified. Clinical symptoms were assessed using Western Ontario McMaster Universities (WOMAC) questionnaire. The WOMAC for each hip was calculated as the sum of the scores on the Likert Scale (0 for no pain to 4 for extreme pain) for the five questions on the pain assessment section. On standing AP pelvic radiograph, the following radiographic measurements were made to determine acetabular and femoral morphometry: lateral center edge angle (LCE), acetabular index of Tönnis (TILT), and femoral head ratio of Murray (FHR). Acetabular version was assessed by the presence of the cross-over and posterior wall signs. The minimum joint space width (JSW) was measured. The severity of radiographic OA was graded using the Tönnis classification (0-no arthritis, 1-subchondral space narrowing). The type of impingement was assessed according to the Ganz et al.[3] on the AP view and the lateral cross-table view: an abnormally shaped femoral head and head-neck junction with normal acetabulum was classified as cam impingement, and a coxa profunda, a hip in which the floor of the fossa acetabuli touches the ilioschial line, with a normal proximal femur was classified as pincer type, any combination of the two was labeled mixed type. Using a FSE T1-weighted sequence in the oblique sagittal plane, the alpha angle was measured as the angle formed between the midshaft line and the point where the femoral head anteriorly deviates from sphericity. The dGEMRIC scans were obtained on a 1.5T GE clinical scanner as previously outlined [4]. The average T1 value of the weight bearing femoral and acetabular cartilages was calculated and described as the dGEMRIC index. Along with patient age, correlations between dGEMRIC index, patient symptoms, morphologic measurements, and radiographic OA were determined.

RESULTS

Average age at the time of imaging was 25 years (range 13-48 years). 24 of the 31 patients were male. The average dGEMRIC index was 487 ± 70 msec which was significantly lower than the average dGEMRIC index in a morphologically normal hip (570 ± 90 msec)[4] (p<0.0001). The mean LCE was 31 degrees [range 18-45]. A significant negative correlation between dGEMRIC index and LCE was observed (p<0.05). Hips with deep acetabulums had evidence of more significant osteoarthritis. (Figure 2) A significant correlation was also observed between dGEMRIC and WOMAC pain (p<0.05). (Figure 2) The 17 hips in this cohort with cam type impingement had significantly lower dGEMRIC indices than the 18 hips with either pincer or mixed type (p<0.05). There was no correlation between pain and JSW or Tönnis grade. There were no correlations between dGEMRIC index and any of the other morphological measurements of the hip.

CONCLUSIONS

Our current data supports the hypothesis that dGEMRIC index is a useful measure of OA in hips with FAI. The results of osteoplasty for FAI depend on the amount of pre-existing OA in the joint. Our goal is to develop imaging techniques that may help identify hips that are good candidates for joint preserving surgeries. The result that dGEMRIC, representing a loss of proteoglycans, correlates with pain while neither the traditional measures of OA, minimum joint space width or Tönnis grade, did not consistent with the clinical finding that hip pain often preceeds radiographic signs of osteoarthritis. In this study dGEMRIC demonstrated a negative correlation to lateral center edge angle suggesting that a deep acetabulum such as acetabular protrusio and profunda are associated with early OA. The lower dGEMRIC index in hips with cam impingement is consistent with clinical finding of more extensive articular cartilage damage in cam impingement. Studies are underway to demonstrate the clinical usefulness of dGEMRIC in patient management.

REFERENCES


Figure 1.

Figure 2.