ASSESSING CARTILAGE HEALTH WITH THREE-DIMENSIONAL DGEMRIC IN PATIENTS WITH FEMOROACETABULAR IMPINGEMENT

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Introduction

Femoroacetabular impingement (FAI), in which femoral deformities lead to damage of the labrum and/or cartilage, has been proposed as a mechanism explaining idiopathic osteoarthritis in non-dysplastic hips (1). This hypothesis is supported by histological analysis showing that femoral head cartilage from young patients with impingement exhibits degenerative changes similar to osteoarthritis (2). Further tests of this hypothesis and its implications for prevention and treatment will rely on identifying a noninvasive method for assessing cartilage degeneration at the hip. Delayed gadolinium enhanced MRI of cartilage (dGEMRIC) permits inference of glycosaminoglycan (GAG) distribution in articular cartilage from measurements of the tissue T1 value after injection of the MRI contrast agent gadolinium (3). However, few studies have implemented this method at the hip and those that have were limited to analysis of a single slice (4). Our objective was to assess the feasibility of a three-dimensional (3D) dGEMRIC protocol to assess GAG distribution in articular cartilage of patients with hip impingement.

Methods

We assessed GAG concentration in four patients diagnosed with femoroacetabular impingement syndrome (hip pain, positive impingement test) and four controls matched for age and body mass index using a 3D dGEMRIC protocol. All subjects were intravenously injected with 0.2 mM/kg gadolinium (Magnevist, Berlex Laboratories, USA) and asked to perform hip rotations for 10 minutes followed by 20 minutes of walking to facilitate diffusion of the contrast agent into the cartilage. Imaging started 75 minutes after injection. We used a Philips Intera 3T scanner with a flexible surface coil around the hip. 20 slices in a ‘true’ sagittal plane were acquired using a 3D IR-TFE sequence with the following parameters: TR tfe/TE/flip = 4.7ms/1.6ms/15 º, inversion time TI = 1600, 1200, 800, 400, 200, 150, 100 ms, FOV = 220 mm, matrix: 256 x 256 (interpolated to 512 x 512), 3 mm slice thickness. Scan time was approximately 35 minutes. To attain sufficient signal-to-noise at the short TIs, TR shot was held constant at 1700 ms for each TI.

All 3D scans were volume registered prior to analysis to compensate for any subject movement during the examination. Quantitative T1 maps were generated with custom programs (IGOR, Wavemetrics, USA) through pixel-based curve fitting of the magnitude signal intensities versus inversion times (Figure 1 & Figure 2). The geometric center of the femoral head cartilage was identified and used to divide the cartilage surface into anterior and posterior regions. Regions of interest (ROIs) were manually segmented on the four middle slices for each subject and the average of all pixels within the four-slice ROI was defined as the dGEMRIC index for that region. The dGEMRIC index (T1-value) provides an estimate of GAG concentration in the cartilage.

Results

Two of the four symptomatic subjects had dGEMRIC indices that were more than 150 ms lower than those from their matched controls and fell in the range of values for subjects with osteoarthritis in a previous study (5) (Table 1). The other two symptomatic subjects had dGEMRIC indices similar to those from their matched controls and in the normal range for hip cartilage. In all but one of the eight subjects the anterior dGEMRIC index was lower than that in the posterior region.

Discussion

These results suggest that 3D dGEMRIC can be used to assess cartilage changes in studies of femoroacetabular impingement. Our findings suggest that there are detectable changes in cartilage in some patients with femoroacetabular impingement, but no detectable changes in others. These changes may be linked to the extent of impingement and/or the amount of time the patient has experienced impingement.

Table 1: Average T1 for symptomatic subjects and matched controls.

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Acknowledgements

We wish to thank Trudy Harris, Ashley Williams, Dr. Deborah Burstein and Dr. Charles McKenzie for their assistance in protocol development.

Affiliated Institutions for Co-Authors

** Philips Medical Systems Canada

References