STUDY TITLE : "T2 MAPPING OF ARTICULAR CARTILAGE IN OSTEOARTHRITIS OF THE KNEE USING 3 T MRI''

ABSTRACT :

BACKGROUND :

Osteoarthritis (OA) is a heterogeneous and multifactorial disease characterized primarily by the progressive loss of hyaline articular cartilage. Plain radiographs have been used primarily in the evaluation of OA, which depict only narrowing of the joint space or gross osseous changes that tend to occur late in the disease. Early changes in the articular cartilage may not be visible on plain radiographs. Cartilage loss can only be indirectly inferred by the development of joint space narrowing, which can be highly unreliable even with careful attention to proper technique. In addition, plain radiographs are insensitive to focal cartilage loss, and widening of the joint space despite significant cartilage loss can occur in one compartment of the knee simply as a result of narrowing in the other compartment. Magnetic resonance imaging (MRI) has been found useful to visualize cartilage directly yet morphologic imaging shows damage at a stage when cartilage is already irreversibly lost. Standard cartilage dedicated magnetic MR techniques are inconclusive in quantifying early degenerative changes of the cartilage matrix, especially biochemical changes such as proteoglycan (PG) loss. Early diagnosis of cartilage injury would require the ability to noninvasively detect changes in PG concentration and collagen integrity before gross morphologic changes occur.

T2 relaxation reflects the ability of free water proton molecules to move and to exchange energy inside the cartilaginous matrix. Damage to collagen-PG matrix and increase of water content in degenerating cartilage may increase T2 relaxation times. With the improvement in cartilage resurfacing procedures and development of disease modifying drugs for OA, there is a need to develop a noninvasive method to monitor early cartilage degeneration or restoration. In this study, we investigated the changes in T2 relaxation times in normal and osteoarthritic patients using 3 T MRI. Our hypothesis was that there would be an increase in T2 values in cartilage in osteoarthritic patients compared to normal controls.

AIM :

To determine the ability of MR T2 mapping to detect cartilage matrix degeneration in OA patients and to compare the T2 relaxation values in normal subjects and cartilage patients with OA.

MATERIALS AND METHODS :

It was a prospective study with a sample size of 40 subjects. Groups were based on x-ray & MR findings and consist of fifteen subjects with known OA & twenty five healthy volunteers without evidence of OA & with normal MR findings served as controls. The inclusion criteria were patients with clinical osteoarthritis symptoms and radiological findings who are referred for MRI and patients refered to MRI for other clinical symptoms besides osteoarthritis. Patients with orthopnea,

claustrophobia and patients with MRI non-compatible implants were excluded from the study. Native T2 cartilage mapping was performed using a 3-T scanner.

RESULTS :

The average T2 values were significantly higher in test subjects with OA when compared to controls without OA (36.9 ± 7.0 ms vs 27.4 ± 2.1 ms, P=0.0005) as shown in the above tables and bar diagrams. Among the 15 OA patients, ten patients had more severe cartilage loss in medial compartments, two patients had more severe cartilage loss in lateral compartments and three patients had similar cartilage loss in both the compartments. There were no significant differences in the average cartilage thickness in OA patients and controls.The average T2 values increased as KL scores increased based on x rays, with T2 values of 29.65, 32.58, 39.30 and 45.69 for KL scores 1,2,3 and 4 respectively.

CONCLUSION :

Our study has shown that T2 mapping is a non invasive imaging technique that may improve our ability to detect early cartilage matrix degeneration, at the initial stage of pathogenesis of osteoarthritis i.e. collagen network alteration. Diagnosing cartilage damage prior to the detection by routine sequences that detect morphological cartilage lesions at a stage where the cartilage has already irreversibly damaged is potentially important in initiating early treatment and in monitoring disease progression in OA.

DISSCUSSION :

Advanced MR imaging sequences to evaluate the morphology of articular cartilage have evolved recently. 0.3 mm spatial resolution is needed to detect the superficial changes in cartilage, which is beyond the resolution of the morphological imaging sequences. T2 mapping does not rely on spatial resolution to detect the cartilage damage. They depict the areas of increased water content and altered collagen matrix in the degenerated cartilage. Thus T2 mapping helps in detection of changes in cartilage composition and three dimensional ultrastructure of cartilage, before the morphological changes occur, thereby helping in early initiation of treatment.

KEY WORDS : Osteoarthritis, T2 Mapping, Articular cartilage, Cartilage imaging, Magnetic Resonance Imaging, KL score.