No Apparent Progressive Change to Knee Cartilage Volumes Over One Year in Rheumatoid and Osteoarthritis.


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Introduction

Magnetic Resonance Imaging is an important imaging modality for investigating structural changes to hyaline cartilage associated with arthritis [1]. Quantitative, accurate measurement of cartilage volumes [2] over time using MRI has the potential to visually demonstrate cartilage disease progression [1], and may allow for more effective treatment of the disease using pharmacological or other interventions.

Aims and Objectives

To quantify femoral, tibial and patellar cartilage volume changes over a period of one year in patient volunteers with osteoarthritis (OA) and rheumatoid arthritis (RA).

Methods

Thirty-three patients (17 RA, 16 OA) were selected for imaging following a clinical examination of their arthritis. The OA patient group comprised 10 males (age range 52-75 years, mean 63 years) and 6 females (age range 45-70 years, mean 64 years), whilst the RA patient group comprised 8 males (age range 44-65 years, mean 60 years) and 9 females (age range 41-67 years, mean 56 years).

Knee imaging was performed on a Siemens Impact clinical scanner (field strength 1.0T) using a 3D gradient-echo imaging sequence with fat suppression. Imaging parameters were TR/TE = 5/11 (40° flip angle), allowing excitation of a 100mm slice block and generation of a series of 64 contiguous sagittal image slices each 1.5mm thick. Phase encoding was limited to 192 steps, and zero-filling was to 4 affected compartments per individual (mean 3.3, median 3 for OA, and mean 3.4, median 4 for RA). Of the 33 individuals, 32 had cartilage lesions in the femoral condyle, 27 had lesions in the lateral tibial plate; 26 had lesions in the medial tibial plate, and 24 had lesions in the patella. In many cases each compartment had more than one distinct cartilage lesion, and lesions varied considerably in size.

Cartilage remodeling was evident in many of the individuals over the one-year study as demonstrated qualitatively by changes in the size and shape of the cartilage lesion. Both decreases and increases in cartilage lesion size were observed.

Analysis of the rate of cartilage volume change in each compartment stratified for disease, sex and BMI is shown in Table I. The intra-patient standard deviation (SD 95%) for cartilage volume over one year was 6.1% for femoral, 6.5% for patellar, 10.5% for lateral tibial and 8.1% for medial tibial cartilage volume. This standard deviation included the variance associated with disease progression, together with the variance associated with scan-to-scan variation and intra-observer segmentation variation. As can be seen from the data there was little change in cartilage volume; the greatest change was observed in individuals with BMI > 30. Femur cartilage volume appeared to contribute the most to this measurement. There did not appear to be any difference between the OA and RA groups.

Results

Qualitative assessments showed that all of the patient volunteers studied had cartilage lesions detectable by MRI (see example, Figure 1). The number of compartments with cartilage lesions ranged from 2 to 4 affected compartments per individual (mean 3.3, median 3 for OA, and mean 3.4, median 4 for RA). Of the 33 individuals, 32 had cartilage lesions in the femoral condyle, 27 had lesions in the lateral tibial plate; 26 had lesions in the medial tibial plate, and 24 had lesions in the patella. In many cases each compartment had more than one distinct cartilage lesion, and lesions varied considerably in size.

Figure 1 Reconstructed MR image of the cartilage of the right knee of a 70 year old male with OA (duration 10 years). Panel A: medial tibial plateau (top); lateral tibial plateau (bottom); patella (right). Panel B: medial (top) and lateral (bottom) femoral condyle. Panel C: patella (left); medial (top) and lateral (bottom) tibial plateau.

Discussion

Our data show that using a random cohort of OA or RA patients, the rate of disease progression as assessed by total cartilage volume in a joint compartment was very small. This is in contrast to results reported from other centres [3]. Our results suggest that arthritis patients do not exhibit a significant and uniform rate of loss of cartilage throughout the duration of their symptomatic disease. This data set indicates that the real issues in the use of MRI to assess disease progression in RA or OA are use of better defined patient cohort and a more sensitive measure of disease progression. The former is supported by the preliminary data presented here on individuals with BMI > 30. We are investigating whether cartilage thickness maps offer a way forward for more sensitive measure.

References