In this population, baseline JSW in the JSN knee did not significantly predict radiographic progression in the same knee (whatever the location), neither did baseline JSW in the no-JSN knee predict progression in the no-JSN knee except at location x = 0.25 (r = −0.28, p = 0.02) (Spearman correlation coefficients).
Conclusions: In 70 patients selected from the OAI database for having unilateral medial JSN (as well as BMI > 25 and bilateral knee pain), average change in JSW over one year was very similar in JSN knees versus no-JSN knees. However, the higher variability of change in the no-JSN knees resulted in lower sensitivity to change in these knees as compared to the knees with JSN at baseline. The x-coordinate system appears to have greater responsiveness than mJSW in knees with JSN.

377 DIGITAL SCORING OF HAEMOPHILIC ARTHROPATHY USING RADIOGRAPHS: IS IT FEASIBLE?

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Purpose: Radiographs are important tools to evaluate structural changes in many joint diseases. In case of haemophilic arthropathy (HA), the Pettersson-score is widely used. The rising of digital radiography enables evaluation of these structural change in a more quantitative and detailed manner, potentially improving diagnosis and follow-up. In the present study, it is evaluates whether digital image analysis in case of HA is feasible, using a presently available method for radiographic changes in knee osteoarthritis (OA), Knee-Digital-Image-Analysis (KIDA).
Methods: 62 knee radiographs were scored according to Pettersson and with KIDA, each by two independent observers. Inter-observer variation and correlations between the two scoring methods were determined.
Results: Overall the inter-observer variation was smaller for KIDA than for Pettersson and for KIDA not significantly different from inter-observer variation in case of evaluation of OA joints. Good correlations were found for the two methods where comparison of parameters was appropriate. For instance, the Pettersson-scoring item “narrowing of the joint” correlated well with the mean and minimum joint space width as measured with KIDA (R = −0.64; p = 0.00 and R = −0.71; p = 0.00 respectively), and the item “osteoporosis” correlated well with bone density measures obtained with KIDA (e.g. R = 0.44; p = 0.01 for the mean bone density of femur and tibia). Importantly, for each of the parameters within one point in the ordinal Pettersson-score a large window still existed in the continuous KIDA-grading.
Conclusions: Digital analysis of radiographs is feasible to quantify joint damage in HA. The use of a continuous variables, as used in a digital method such as KIDA has the advantage that it enables objective and much more sensitive detection of small changes than by use of an ordinal analogue method such as the Pettersson-score. Based on the present results, it would be worthwhile to adapt the KIDA method for the specific characteristics of HA and extend the method to elbow and ankle radiographs, the joints affected in haemophilia.

378 TWO-TENSOR DIFFUSION MRI ANALYSIS ENABLES VISUALIZATION OF ARTICULAR CARTILAGE FIBER CROSSINGS

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Purpose: Hyaline articular cartilage is composed predominantly of an extracellular matrix that consists of a framework of collagenous fibers, which provide tensile properties to the cartilage. Loss of integrity within this framework is regarded a hallmark process in cartilage degeneration, which is considered an important factor in the pathogenesis of OA. Diffusion tensor magnetic resonance imaging (DTI) can be employed to study anisotropic properties of tissues and is widely used for analyzing brain structures. In limited capacity, DTI has been applied to study the alignment of the collagen framework in cartilage, and it has been demonstrated that the direction of the eigenvector relates to characteristic variations in the zonal architecture of collagen fibers. A limitation of the standard DTI model, however, is that it allows only one fiber orientation per voxel. Thus, fiber orientation heterogeneity, such as crossings, cannot be modeled. Therefore, the aim of this study was to investigate that whether a two-tensor model enables visualization of fiber crossings within the mesh of collagen macrofibrillar bundles. This work is the first investigation of analysis of crossing fibers in the cartilage, using DTI.
Methods: The measurements were performed on 2 cartilage-on-bone samples acquired from total knee replacement. The DTI data was acquired by applying a diffusion-weighted pulse-gradient spin-echo sequence, on a high-field 8.5T Bruker BioSpin (TR = 2000 ms, TE = 14.5 ms, $\delta = 2.1$ ms, $\Delta = 8$ ms). Two measurements with a b-value of 0 s/mm^2, and 30 measurements with a b-value of 1000 s/mm^2 applying diffusion gradients in 30 isotropically distributed directions, were performed. Using a 10×10 mm^2 FOV, a spatial resolution of $100 \times 100 \times 2000$ μm^3 was achieved. The total acquisition time (10 averages) was 23 hrs. The sequence was validated on an Agarose phantom.
For estimating two-fiber orientations, a recently proposed model was utilized. The model is a constrained bi-Gaussian model for analysis of crossing fibers, utilizing the information present in the single-tensor. This two-tensor approach models a voxel containing 2 fibers as 2 cylindrical tensors that lie in the plane spanned by the two largest eigenvectors of the single-tensor fit.
Single-tensor was estimated for every voxel, whereas the two-tensor model was fitted only to “planar” voxels, as determined by the planar anisotropy (C_p) measure. Scalar measures, such as mean diffusivity (MD), and fractional anisotropy (FA) were estimated from the single-tensor.
Results: MD showed maximum values at the surface (1.6×10^{-3} mm^2/s) and decreased at the cartilage-bone interface (0.9×10^{-3} mm^2/s), whereas FA varied in between 0.02−0.31, and was maximal at the cartilage-bone interface. Fig. 1b depicts regions of fiber heterogeneity in a sample cartilage; these were predominant at the surface of the cartilage where the direction of the two eigenvectors was both parallel and perpendicular to the cartilage surface.

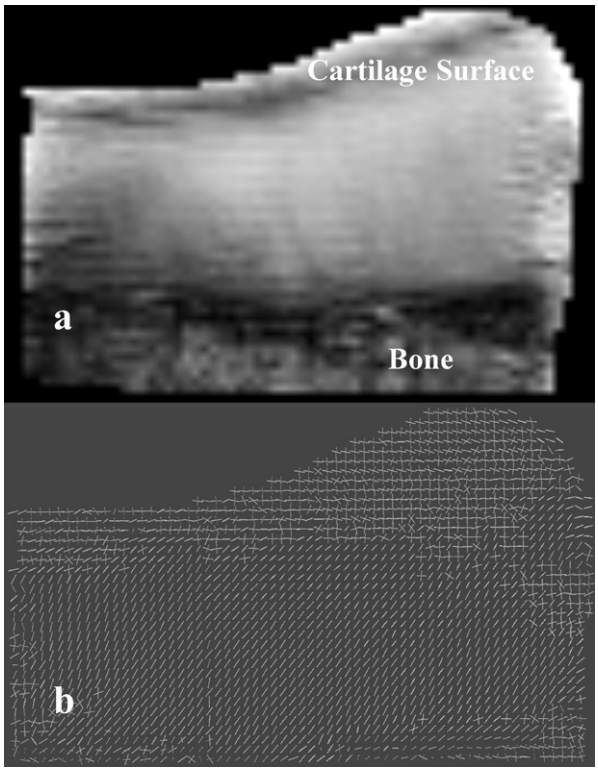

Figure 1. (a) T2 MR image; (b) fiber orientations (cartilage).

Conclusions: Our study highlighted the feasibility of DTI for structural analysis of the articular cartilage. A limitation of this study is the small number of samples and lack of histological comparison. Our findings (MD & FA) appear to be consistent with those reported in literature, however, additionally, we have shown that by describing the underlying diffusion by a more complex model, we are able to non-invasively visualize fiber crossings at the cartilage surface. This may help in understanding the dynamics of degradation in the articular cartilage during development of early OA.