Comparison of qualitative assessment of knee osteoarthritis on three 3.0T MR systems from different manufacturers.

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Introduction: The National Institute of Health Osteoarthritis Initiative (NIH OAI) is a large, longitudinal, multi-centre study targeted at discovering biomarkers of osteoarthritis (OA). A motivation behind the study is to obtain accurate non-invasive markers of cartilage degradation which can assess progress in clinical trials of disease-modifying drugs for OA. The NIH OAI MR knee protocol has been optimised for detection of features of OA at 3.0 Tesla on the Siemens platform. There are two other major manufacturers of MR scanners – Philips Medical Systems and GE Healthcare. The aim of the study is to demonstrate whether detection of OA pathology in the knee is comparable between three MR scanners of different manufacturers at 3.0T. The acquisition of images for this study on all three scanners is based on the quadrature NIH OAI protocol [1].

Method: 11 subjects with a history of knee symptoms had their symptomatic knee scanned on each of the three scanners of different vendors. Subjects had a mean age of 49.3±10 years (range 32-59y) with mean BMI 28.3 ±6.2 (range 22.1-44.2) and had one or more risk factors for OA. The three 3.0T MR systems employed in this study are located as follows: Manchester (Philips), York (GE), Liverpool (Siemens). With collaboration of clinical scientists at Philips and GE, corresponding quadrature OAI protocols were devised and optimised for the respective platforms. The protocol for the Siemens scanner was essentially identical to the NIH protocol for this study. A summary of parameters for three selected sequences is given in Table. 1.

Sequence parameter	Siemens	Philips	GE	Siemens	Philips	GE	Siemens	Philips	GE
	3D DESS	3DWATSf	3D GE	2D TSE FS	PD SPIR	2DFRFS	2D TSE	2D TSE	2DFRFSE
Slice thickn. (mm)	0.7	0.7	1	3	2.7	3	3	2.7	3
Flip angle (deg)	25	25	25	180	110	180	180	90	180
TE/TI (ms)	4.7	9.2	4.9	30	30	30	29	29	30
TR (ms)	16.3	20	16.7	3200	3632	3475	3850	4782	2850
X-resolution (mm)	0.37	0.36	0.55	0.36	0.36	0.36	0.37	0.36	0.37
Y-resolution (mm)	0.46	0.48	0.62	0.51	0.53	0.5	0.46	0.46	0.49

Table 1: Table summarising selected MR sequence parameters for three sequences assessed qualitatively on the three different MR scanners

Imaging was performed using a transmit-receive quadrature extremity RF coil at Liverpool (Siemens) and York (GE) and an 8-channel phased-array coil at Manchester (Philips). Imaging times for the full protocol were similar at 37min 41s, 39min 9s and 41min for the Siemens, Philips and GE scanners respectively. Subjects underwent a 30 minute non-weightbearing period prior to each scan.

Qualitative assessment ranked the 11 scans for overall severity of OA. The scans were ranked by consensus of two experienced observers blind to subject identity for each scanner. Corresponding sequences were assessed from the GE, Philips and Siemens protocols.

Results: The subjects demonstrated a broad range of OA pathology from almost normal to severe OA. Statistical analysis using Kendall's tau-b correlation is shown in Table 2.

Figure 1 (above) Corresponding slices acquired on the three scanners on the same subject from the optimized OAI protocols (2D TSE +fat suppression). Subchondral bone marrow oedema and cysts detected by all scanners.

Table 2 (left) Summary of correlation analysis of qualitative ranking of the 11 scans.

Scanners	Correlation coefficient	Sig. 2-tailed
Siemens vs Philips	0.82	0.000
Philips vs GE	0.64	0.006
GE vs Siemens	0.60	0.01

Discussion: Similar comparison studies have previously been performed but this is the first to compare all three manufacturers at 3.0T and use subjects with knee pathology [2,3]. This pilot study demonstrates that comparable NIH OAI protocols can be implemented on Philips and GE scanners with similar duration as the Siemens protocol. Qualitatitive ranking of subjects produces comparable results on all three scanners. The inter-scanner variability was found to be greatest at the lower end of the OA severity spectrum. This may be due to variability in depiction of milder pathology.

References: 1.Coordinating Center, U.o.C.S.F. (2006) *The Osteoarthritis Initiative, Protocol for the cohort study*. 2. Morgan, S.R., et al., *Magnetic resonance imaging measurement of knee cartilage volume in a multicentre study*. Rheumatology, 2004. **43**(1): p. 19-21. 3. Kornaat, P.R., et al., *Comparison of quantitative cartilage measurements acquired on two 3.0T MRI systems from different manufacturers*. J Magn Reson Imaging, 2006. **23**(5): p. 770-3.