Figure S1 Box-plot diagrams illustrating UTE-MTR (A), UTE-AdiabT1ρ (B), UTE-T2* (C), and CubeQuant-T2 (D) values according to the PLM-CO scoring. Only sign differences are indicated in this figure (*, r<0.05; **, r<0.01; ***, r<0.001). PLM-CO, the polarized light microscopy-collagen organization score; UTE-MTR, ultrashort echo time-based magnetization transfer ratio; UTE-T2*, ultrashort echo time-based T2*; UTE-AdiabT1ρ, ultrashort echo time-based Adiabatic T1ρ.

ROC Curve

Diagonal segments are produced by ties.
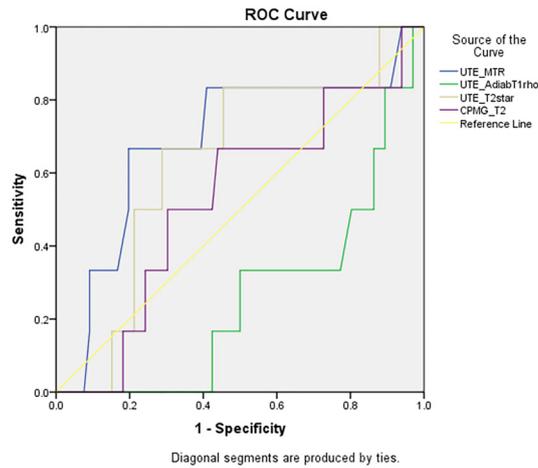
Area Under the Curve

Test Result Variable(s)	Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
UTE_MTR	.687	.125	.132	.443	.931
UTE_AdiabT1rho	.260	.092	.053	.081	.440
UTE_T2star	.634	.110	.280	.418	.849
CubeQuant_T2	.529	.119	.815	.295	.763

The test result variable(s): UTE_MTR, UTE_AdiabT1rho, CubeQuant_T2 has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

a. Under the nonparametric assumption

b. Null hypothesis: true area = 0.5

Figure S2 ROC curves and its results of each qMRI parameter for the diagnostic efficacy of mild cartilage degeneration. The PLM-CO was chosen for reference standard. The diagnostic efficacy of the qMRIs were: UTE-MTR) ≈ UTE-T2* > CubeQuant-T2 > UTE-AdiabT1ρ. ROC, receiver operating characteristic; qMRI, quantitative magnetic resonance; PLM-CO, the polarized light microscopy-collagen organization score; UTE-MTR, ultrashort echo time-based magnetization transfer ratio; UTE-T2*, ultrashort echo time-based T2*; UTE-AdiabT1ρ, ultrashort echo time-based adiabatic T1ρ; ρ:rho.

Table S1 The PLM qualitative score standard (24)

The PLM-CO score	Score description
0	Fibre organization seen as sparse bright patches throughout the specimen. These patches are randomly oriented in the specimen
1	Fibres oriented mainly perpendicular (±30°) to the cartilage-bone interface and occupying less than approximately 50% of the thickness of the non-calcified tissue on average in the deep zone. Little additional evidence of birefringent tissue is apparent. Birefringent tissue may have inconsistent thickness and intensity of birefringence across the lateral direction of the specimen. The specimen texture may be smooth, patchy or granular
2	The appearance of deep zone is identical to Score of 1. Alternatively, a second region of birefringent tissue may be present above the deep zone that may have any orientation except for vertical. In this case, the deep zone may then occupy less than 50% of the thickness of the non-calcified tissue
3	Zonal organization with birefringent tissue in the DZ perpendicular to the cartilage-bone interface (±30°), and birefringent tissue at the articular surface that is either aligned parallel to the surface or that has multiple orientations. These two zones are separated by a third non-birefringent region that is appropriate to the species from which the specimen was taken. Alternatively, the two birefringent zones are separated by a birefringent region with orientation that is neither parallel nor perpendicular. Zonal thicknesses are heterogeneous across the lateral direction of the specimen. The specimen texture may be smooth, patchy or granular
4	Identical to a Score of 3 except that the orientation in the superficial zone must be parallel to the surface, and the transitional zone must be appropriate to the species. In addition to these characteristics each zone should approximate the zonal proportions. The transitional and superficial zones are smaller, and the transitional zone may be larger than the superficial zone
5	Displays distinct superficial and deep zones separated by an appropriate thickness of Transitional Zonal. Overall, the specimen birefringence has a uniform, smooth texture and is neither granular nor patchy

Table S2 Results of Normality of each qMRI sequence

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
UTE_MTR	0.090	72	0.200[*]	0.948	72	0.005
UTE_AdiabT1rho	0.080	72	0.200[*]	0.985	72	0.541
UTE_T2star	0.061	72	0.200[*]	0.977	72	0.202
CubeQuant_T2	0.217	72	0.000	0.618	72	0.000

*, this is a lower bound of the true significance; [a], Lilliefors significance correction.