

Translating State-Of-The-Art Spinal Cord MRI Techniques To Clinical Use: A Systematic Review Of Clinical Studies Utilizing DTI, MT, MWF, MRS, and fMRI

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Objectives

A recent meeting of international imaging experts sponsored by the International Spinal Research Trust (ISRT) and the Wings for Life Foundation identified 5 state-of-the-art MRI techniques with potential to transform the field of spinal cord imaging by elucidating aspects of microstructure and function: diffusion tensor imaging (DTI), magnetization transfer (MT), myelin water fraction (MWF), MR spectroscopy (MRS), and functional MRI (fMRI).

Method

A systematic review was conducted using MEDLINE, Embase, and Cochrane databases to identify English language studies that investigated utility, in terms of diagnosis, correlation with disability, and prediction of outcomes, of these techniques in spinal cord pathologies. Data regarding study design, subjects, technical methods, clinical measures, and analysis techniques were extracted to identify trends. Studies were assessed for risk of bias, and overall quality of evidence was assessed using GRADE.

Results

Our search returned 6597 unique citations, and after full-text review of 274 articles, 104 were included. 69 DTI and 25 MT studies were identified, with both recently showing sharp increases, in addition to 1 MWF, 11 MRS, and 8 fMRI studies. Most studies were exploratory, showing high (73%) or moderately high (21%) risk of bias. Acquisition techniques varied widely across studies. The DTI metric fractional anisotropy (FA) showed moderate evidence of correlating with disability in several pathologies, low evidence of group differences vs. controls, and insufficient evidence for diagnosis or prognosis. Numerous other metrics show very low evidence to demonstrate group differences, and insufficient evidence as diagnostic tests, biomarkers, or prognostic tools.

Conclusions

Novel MRI techniques have tremendous potential to enhance management of spinal pathologies, but current evidence shows limited clinical utility. DTI is the most mature, but requires further refinement and standardization prior to widespread utilization. Studies with *a priori* hypotheses, standardized acquisitions, detailed clinical assessments, and automated analysis tools are needed to facilitate clinical translation.