

Recent advances in MRI markers of disc degeneration

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INTRODUCTION: Magnetic resonance imaging (MRI) has also been used as a non-invasive measure of disc degeneration. In this paper the recent quantitative MR methods and their implications for characterizing degenerative disc disease will be discussed.

METHODS: Normal intervertebral discs show a bright clear signal from the nucleus pulposus, and there is no signal from the annulus fibrosus. Disc degeneration is shown by a change in the signal from the nucleus pulposus to give an irregular outline and a reduction in signal intensity. In the intervertebral disc, the uptake of Gd DTPA enhancement has been observed clinically often in normal appearing discs (1) and there is a high prevalence disc degeneration in asymptomatic populations. Post-operatively contrast enhanced MR is used to distinguish scar tissue from recurrent herniation (2-4). However, it is still not possible to define the precise anatomic source of a patient's symptoms on the basis of the MR. In an effort to improve the capability of MR techniques to quantitatively assess disc degeneration, surrogate MR measures of tissue hydration, such as relaxation times (T_1 , $T_{1\rho}$ and T_2), water diffusion, and spectroscopic (HRMAS) methods are also proposed.

RESULTS: In vitro $1/T_1$, showed significant effects of hydration and collagen content (5); similarly $1/T_2$ and water content for disc tissue show significant correlations (5), (6). Boos et al. (7) using age and gender matched symptomatic and asymptomatic disc herniations, showed that symptomatic disc herniations showed significantly shorter T_1 and T_2 . Grading T_2 weighted images has also gained recent popularity (8). Relaxation time, $T_{1\rho}$ depends on the proteoglycan content and to some extent water content. Molecular diffusion

shortens the spin-echo signal and has been used to study disc degeneration in vitro. In the spine, the addition of diffusion has been shown in multiple applications (9-13) to provide additional diagnostic information. Line Scan Diffusion Imaging (14), (15), gives high quality diffusion weighted images and apparent diffusion coefficient (ADC) and anisotropy maps in the human spine. HR-MAS data correlated well with Thompson grade and an increase was seen in the levels of unbound hydroxyproline and glycine in annular tissue which is directly associated to collagen breakdown. HR-MAS also detected a decrease in N-acetyl concentration of nucleus pulposus associated with proteoglycans with degeneration.

DISCUSSION & CONCLUSIONS: Quantitative imaging appears promising may potentially provide information with regards to disc degeneration and biochemistry and further studies are warranted.

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