

Diffusion Tensor Imaging (DTI) Correlates with Symptomatic Cervical Spondylotic Myelopathy and its Progression

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Introduction

Imaging biomarkers of spinal cord injury that correlate with function are needed for noninvasive and effective assessment of the progression of cervical myelopathy (CM). Conventional magnetic resonance imaging (MRI) lacks sensitivity to detect and characterize spinal cord lesions. We previously demonstrated that decreased axial diffusivity (AD; water diffusion parallel to fiber tracts) reflects axonal damage, increased radial diffusivity (RD; water diffusion perpendicular to fiber tracts) correlates with myelin damage, and the decreased fractional anisotropy (FA) is a marker of the overall integrity correlating with function in rodent and human spinal cord injury. In this report, we demonstrate how diffusion tensor imaging (DTI) derived biomarkers may be used to assess progression of CM.

Methods

Subjects underwent cervical spine imaging. DTI parameters were obtained from both posterior column (PC) and cortical spinal (CS) tracts (at C1 – C6) to correlate with sensory and motor function. Immediately after MRI, subjects underwent a detailed neurological assessment including upper and lower limb vibration perception threshold (VPT), pinch and grip strength, Nine Hole Peg Test (9HPT), 30-Meter Walk (30MW) Test, and the Myelopathy Disability Index (MDI).

Results

In cervical myelopathy patients, increased RD, decreased AD, and decreased FA were commonly observed. In the example of a patient who underwent two examinations 6-months apart, the increased extent of DTI detected white matter tract damage (Fig. 1) was consistent with the progression of functional deficits (e.g., VPT: 6 vs. 3; 30MW: 27.6 s no assistive device vs. 27.8 s with walker; MDI 16.7% vs. 53.3%).

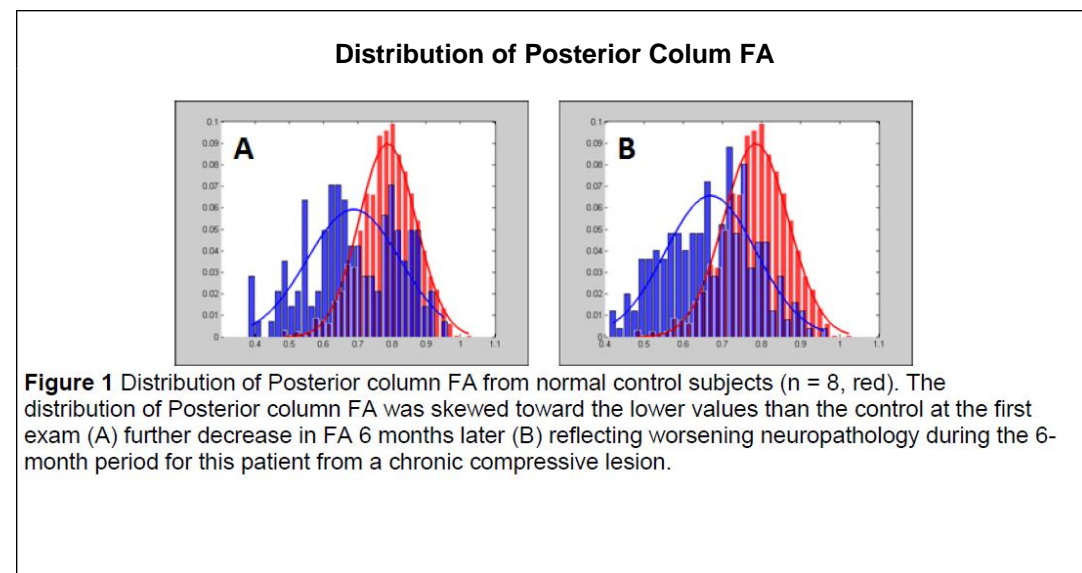


Figure 1 Distribution of Posterior column FA from normal control subjects (n = 8, red). The distribution of Posterior column FA was skewed toward the lower values than the control at the first exam (A) further decrease in FA 6 months later (B) reflecting worsening neuropathology during the 6-month period for this patient from a chronic compressive lesion.

Learning Objectives

DTI can be used in addition to clinical parameters to measure progression of disease.

Conclusions

When compared with the control, a shifted distribution of DTI parameters in cervical myelopathy patients may be used to reflect the severity of the injury.