# Diffusion tensor and non-Gaussian diffusion-weighted imaging in spine and spinal cord in vivo

Masaaki Hori[1], Issei Fukunaga[1], Yoshitaka Masutani[2], Nozomi Hamasaki[3], Koji Kamagata[1], Atsushi Nakanishi[1], Keigo Shimoji[1], Koichi Asahi[1], Yuriko Suzuki[4], and Shigeki Aoki[1]

*[1]Radiology, School of Medicine, Juntendo University, Bunkyo, Tokyo, Japan, [2]Graduate School of Medicine, The University of Tokyo, Japan, [3]Juntendo University Hospital, Japan, [4]Philips Electronics Japan, Ltd, Minato-ku, Tokyo, Japan*

**Purpose:**

Diffusion tensor imaging (DTI) has been widely used in evaluation of cerebral disease in vivo. However, its application for spine and spinal cord disease remains little used because of technical problems, such as artifacts. The purpose of this exhibit is to present the optimal sequences and their parameters for DTI in the spine and spinal cord, including clinical cases. Moreover, recent introduced diffusion technique, non-Gaussian diffusion imaging in vivo will be also presented.

**Outline of contents:**

We will explain optimized MR sequences for spine and spinal cord DTI including each characteristics, artifacts and imaging parameters.

1) In general, DTI using single-shot echo-planar imaging technique in spine and spinal cord suffered artifacts and distortion. Non echo-planar sequences, such as spin-echo based or ssfse based sequences are alternative choices, if possible.

2) Parallel imaging techniques are needed in the most of the cases to avoid image distortion, instead of decreased signal-to-noise.

We will present examples that illustrate the additional value of DTI in the assessment of spine and spinal cord disease. Moreover, we will also present non-Gaussian diffusion MR imaging including q-space imaging (QSI) [1] and diffusional kurtosis imaging (DKI) [2].

1) In general, measurement of fractional anisotropy (FA) and apparent diffusion coefficient (ADC) has been a valuable method for the diagnosis of spine and spinal cord disease [3].

2) Tractography using DTI data shows a clear deformation and displacement of the white matter tracts at the pathological lesions, such as tumor, in the spinal cord (Fig.1).

3) Recent advanced technique in vivo, non-Gaussian diffusion MR sequences, such as QSI and DKI also provide additional information to ADC and FA (Fig.2), and in some cases, QSI and DKI demonstrates the abnormality in the spine and spinal cord with higher sensitivity [4].

**Summary:**

This exhibit will demonstrate the explanation and clinical usefulness of DTI in the spine and spinal cord. In some condition that it is difficult for radiologists to reach comprehensive diagnosis with conventional MR imaging in clinical cases, complementary combination use of DTI or non-Gaussian DWI and conventional MR imaging will be helpful for diagnosis of spine and spinal cord disease.

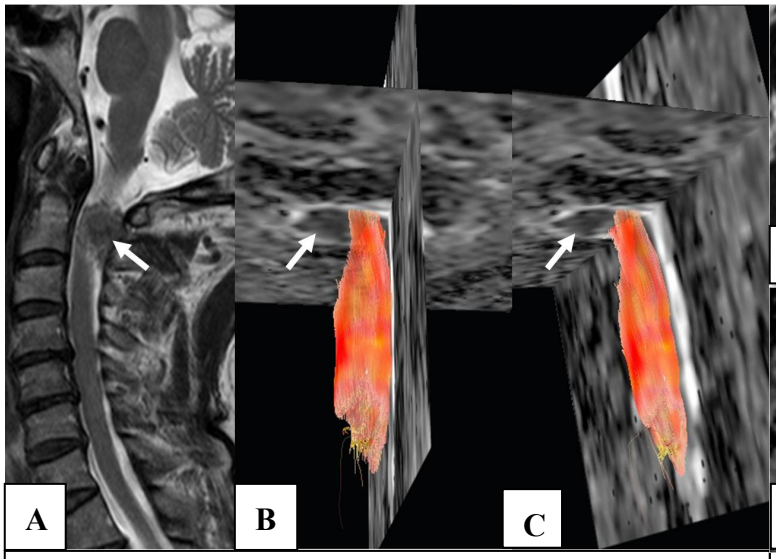


**Figure 1.** Meningioma in a 67-year-old woman. Intra-spinal canal tumor was seen at the C2 level on a T2-weighted image (A, arrow). Displacement of the white matter tract by the meningioma (arrow) was clearly demonstrated on ADC maps (B and C).

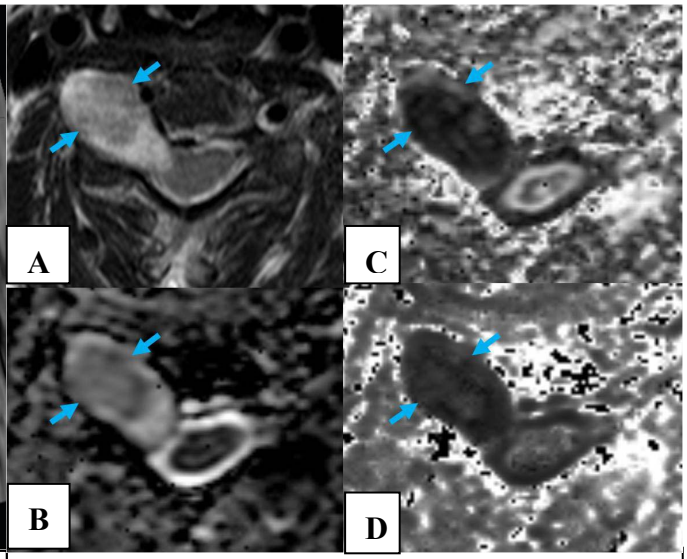


**Figure 2.** Neurinoma in a 62-year-old woman. A tumor extending through the right intervertebral foramen on a T2-weighted image (A, arrow). Various diffusion metrics maps including ADC (B), FA(C) and diffusional kurtosis (D) provide additional information of intra-tumoral structure.

Diffusion metric maps were calculated by using the free software dTV II FZR (Image Computing and Analysis Laboratory, Department of Radiology, The University of Tokyo Hospital, Japan).

**Reference**: [1] Hori M, et al. Acta Radiol.in press. [2] Jensen JH, et al. Magn Reson Med. 2005;53:1432-40.
[3] Hori M, et al. JMRI 2006;23: 183-8.[4] Farrell JA, et al. Magn Reson Med. 2010;63:1323-35.