Diffusion kurtosis imaging in vivo; from basics to clinical applications.

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Purpose:

Diffusion kurtosis imaging (DKI) is an MR imaging technique estimating excess kurtosis and which provides non-Gaussian water diffusion in the tissue [1-3]. This sequence has showed promise for evaluating brain , head and neck and spinal disorders in vivo [4, 5] because it is possible to provide additional diffusion metric, which are complementary information to the apparent diffusion coefficient (ADC) and fractional anisotropy (FA) computed using monoexponential model. The purpose of this exhibit is to present the basics of DKI, normal DKI atlas of the brain, and to discuss clinical usefulness.

Outline of contents:

We will explain the basics of the DKI, imaging sequence, post processing algorism and the factors that influence the values of kurtosis (e.g. numbers and values of *b* factor).

We will present a diffusional mean kurtosis imaging atlas of normal brain with corresponding FA map.

In general, mean kurtosis values show correlation with corresponding FA values because it is thought to be influenced by micro structural complexity. However, there are differences between mean DKI and FA map and it is important to understand them in clinical use. For example, at the non-crossing white matter fiber, both DKI and FA map show the higher values than surrounding brain parenchyma (Fig. 1). However, mean DKI map shows higher values instead of lower values in FA map at the same crossing fiber voxel (Fig. 2).

Our data for man DKI map were acquired on a 3T MR scanner (Philips Medical Systems, Best, The Netherlands), and imaging parameters for DKI are as follows: repetition time msec/echo time msec, 3000/80; number of signals acquired, one; section thickness, 5 mm; 10 sections; field of view, 256 x 256 mm; matrix, 128 x 128; imaging time, approximately 13 minutes; six *b* values (0, 500,1000, 1500, 2000, and 2500 sec/mm 2) with diffusion encoding in 32 directions for every *b* value.

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).

We will show example cases from our data including cerebral infarction, multiple sclerosis and other neural diseases and discuss the clinical usefulness of DKI with reviewing the current publications.

Summary:

DKI is recently developed technique that characterizes non-Gaussian water diffusion, which are different from conventional diffusional metrics, such as FA. In some clinical situations, DKI has showed better results, compared with FA or ADC investigation.

This technique has potential to provide new and additional information to conventional diffusional metrics in routine clinical study.

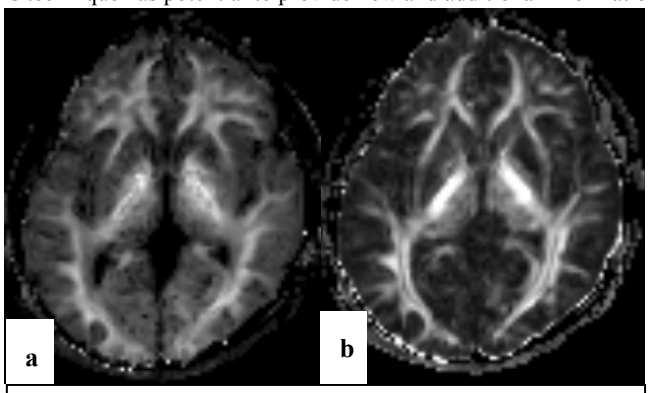

Fig. 1. Mean DKI map (a) is similar to corresponding FA map (b).

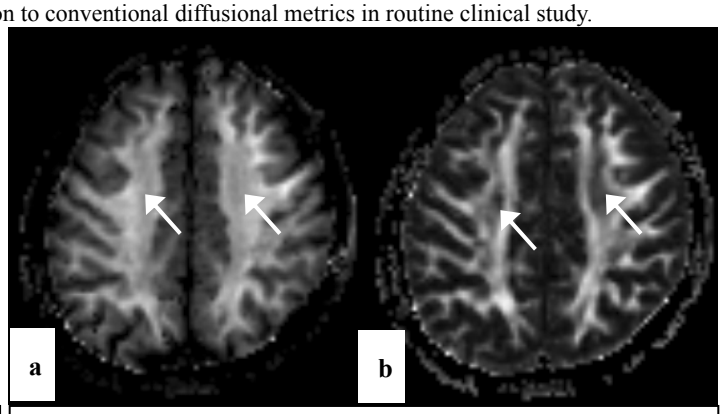

Fig. 2. Mean DKI map (a) shows relative higher values at fiber crossing areas (arrow), whereas FA map (b) shows lower values than surrounding white matter at the same region (arrow).

Reference: [1] Jensen JH, et al. Magn Reson Med. 2005;53:1432-40. [2] Wu EX, et al.NMR Biomed. 2010 Aug;23(7):836-48. [3] Farrell JA, et al. Magn Reson Med. 2010;63:1323-35. [4] Raab P, et al. Radiology. 2010;254:876-81. [5] Jansen JF, et al. AJNR Am J Neuroradiol. 2010;31:741-8.