

## q-space imaging in the clinical cases with Alzheimer disease: Analysis of fibers in the limbic system.

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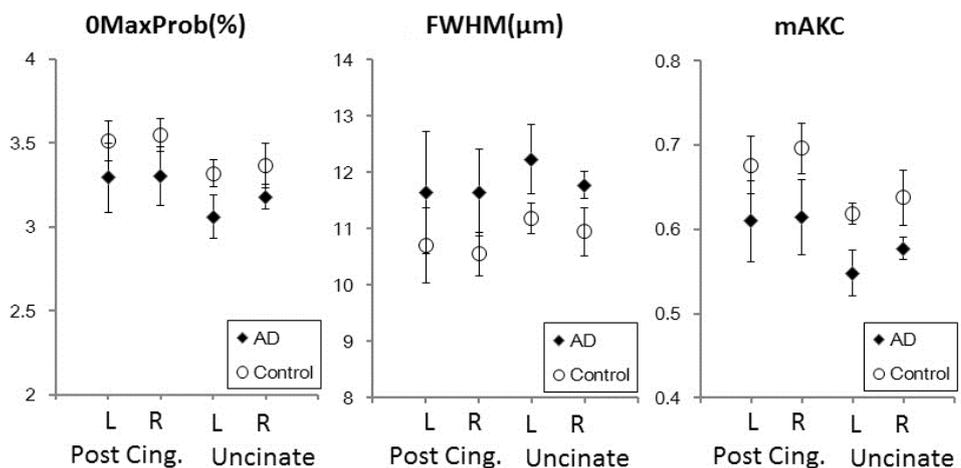
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**Purpose:** q-space imaging (QSI) can identify the molecular diffusion probability density function without assuming a Gaussian distribution, and can provide quantitative information on tissue architecture. This method can estimate the barrier spacing such as the axon diameter in white matter. The purpose of the current study is to make tract based analysis of QSI for the limbic system including uncinate and posterior cingulum in the clinical cases with Alzheimer diseases (AD) and to compare them with that of controls.

**Materials and Methods:** The subjects of the current study were 6 cases with AD (MMSE score: 17 to 23, mean 20.3) and 6 controls. We made QSI by using a 3.0T clinical scanner (Magnetom Verio, Siemens, Erlangen, Germany) with EPI sequence (TR=6100ms, TE=131ms, small delta=50.5ms, large delta=62.6ms, b=1000 to 10000:10 steps, Motion proving gradient: 6 axes, FOV=250mm, Matrix=128x128, Slice thickness=3mm, 24 slices to cover uncinate and posterior cingulum, Acquisition time=6.5minutes, Work in progress). For the post-processing, we used software for analyzing diffusion image (VOLUME-ONE, dTV.FZR) developed by Masutani et al. (Tokyo University) in the data analysis of QSI. Tract based analysis of the QSI was made for uncinate fascicles and posterior cingulum to get mean values of provability for 0 displacement (0MaxProb), full width at half maximum (FWHM) and mean apparent kurtosis coefficients (mAKC).

**Results:** In AD cases, mean 0MaxProb for the uncinate were 3.06% in the left and 3.18% in the right side. Mean 0MaxProb for posterior cingulum were 3.29% in the left and 3.31% in the right side. These 0MaxProb showed statistically significant ( $p<0.001$ ) smaller values compared to these parameters of the controls. While, in the AD cases, FWHM for the uncinate were 12.2 $\mu\text{m}$  in the left and 11.8 $\mu\text{m}$  in the right side. FWHM of the for the posterior cingulum were 11.6 $\mu\text{m}$  in the left and 11.6 $\mu\text{m}$  in the right side for the AD cases. These FWHM showed statistically significant

( $p<0.001$ ) broader values compared to the parameters in the controls except for the left posterior cingulum. In AD cases, mean mAKC for the uncinate were 0.55 in the left and 0.58 in the right side. Mean mAKC for posterior cingulum was 0.61 in the left and 0.61 in the right side. These mAKC showed statistically significant ( $p<0.001$ ) lower values compared to these parameters of the controls.



**Conclusion:** QSI using multiple b-value diffusion-weighted data provides information on tissue microstructure including barrier structure of the tissues. In the current study on clinical cases with AD, we observed decreased 0MaxProb, broader FWHM and sharper mAKC in AD cases, which may reflect the altered permeability or damage in the membrane and /or myelin. These changes in QSI parameters in AD seem to be due to the changes in histological structures along the tracts within limbic system.

### References:

1. Magnetic Resonance in Medicine 47:392–397 (2002)