

# Kurtosis: A Potential Imaging Marker In Depression?

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## Purpose:

Although bipolar disorder (BPD) usually presents in adolescence or young adulthood, most patients with BPD follow a life-long recurrent course, with ongoing psychosocial and functional deficits and high utilization of health services that persist into later life. Currently, there is a lack of data in geriatric BPD overall and in geriatric bipolar depression in particular. Bipolar depression, both in adulthood and later life, represents the predominant and least successfully treated phase of this devastating illness and is associated with an elevated risk of suicide<sup>1</sup>. The role of microstructural white matter changes impacting the clinical presentation of mood disorders in later life is increasingly recognized owing to advances in neuroimaging techniques. The newly developed diffusion MRI technique, Diffusion Kurtosis Imaging (DKI)<sup>2</sup>, is a clinically feasible and possibly more sensitive extension of conventional diffusion tensor imaging (DTI). However, it has not been studied in the context of geriatric BPD. In this study, we utilized DKI to assess its sensitivity in detecting microstructural changes in the brain of older adults with BPD.

## Methods:

We enrolled nine older adults with BPD (3 females; mean age: 63.11±5.21 years) and 8 healthy control subjects (2 females; mean age: 62.13±7.08 years). Subjects with BPD met DSM IV-TR criteria for bipolar disorder, current episode depressed. Written informed consents were provided prior to participation in this McLean Hospital IRB approved study. All imaging procedures were performed on the McLean Hospital Imaging Center Siemens 3-Tesla (3T) Trio scanner with a TIM upgrade. A 32- channel head coil was used in order to improve the ratio of signal to noise. After conventional imaging sequences had been taken, DKI was acquired by use of a single-shot, spin-echo echo planar imaging sequence following repetition time/echo time: 6940 / 100 ms; number of signals acquired: one; section thickness: 3.5 mm; 42 slices; field of view: 224 x 224 mm; matrix: 160 x 160; imaging time: approximately 17 min; and three diffusion weighting (b) values (0, 1000, 2500 s/mm<sup>2</sup>), with diffusion encoding in 72 directions for every b value. Mean kurtosis (MK), radial kurtosis (RK), axial kurtosis (AK) and the more commonly measured anisotropy index fractional anisotropy (FA) were calculated from each group using a region of interest (ROI) method focusing on the prefrontal cortex (PFC) (Figs 1 and 2). Mood symptom severity of the bipolar disorder patients was evaluated with the Young Mania Rating Scale (YMRS) and the Montgomery-Asberg Depression Rating Scale (MADRS) (mean scores: 2.89 and 19.89, respectively). A receiver operating characteristic (ROC) analysis was used to compare the diagnostic characteristics of each index (MK and FA). Pearson correlation coefficient analysis was used to correlate each index with mood symptom severity in the BD group.

## Results:

MK and RK were significantly decreased in the BPD group (p=0.02 and p=0.04, respectively) while FA showed no significant differences (Table 1). MK had a better diagnostic performance with the areas under the ROC curve of 0.92 compared to 0.64 for the FA. MK was correlated with the MADRS (r=-0.66; p=0.05), though no correlation was identified with the YMRS.

## Discussion:

These preliminary findings suggest that DKI may be more sensitive to brain tissue microstructural changes in the PFC than conventional DTI. The correlation with MADRS, used to rate depressive symptoms, seems to indicate that DKI might be useful for the prediction of the severity of depression. Changes in mean and radial kurtosis, but not axial kurtosis, suggests decreased orientational fiber coherence.

## Conclusion:

While the findings should be replicated in a larger sample size, these promising preliminary results indicate that the DKI technique is a powerful method for investigating brain microstructural changes in BPD. Further development of such methods will elucidate the biological correlates of clinical symptom presentation in geriatric mood disorders and may ultimately improve our ability to detect and efficiently treat older adults with mood disorders.

## References:

- [1] Kalin NH. "Management of the depressive component of bipolar disorder". *Depress Anxiety*, 1996;4(4): 190-8.
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## Acknowledgments:

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	BPD	HCS	p
FA	0.454±0.029	0.468±0.014	0.07
MK	0.839±0.032	0.878±0.002	0.02

Table 1: Group comparisons of diffusion indices

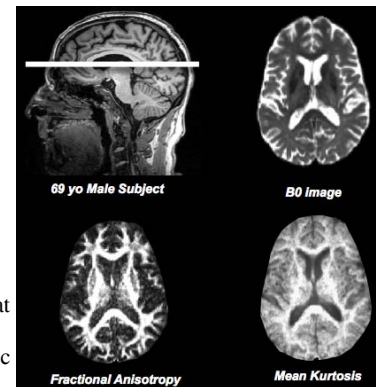


Fig 1: Representative axial slices of diffusion maps from a 69 yo male subject

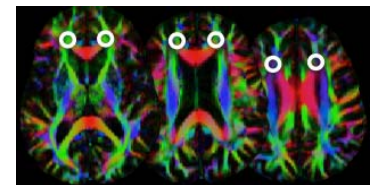


Fig 2: Axial slices with PFC ROI placements