

# Detection of early response after radiosurgery for vestibular schwannoma using an eigen vector based approach

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## Introduction:

Stereotactic radiosurgery (SRS) of vestibular schwannoma (VS) has shown to reduce or arrest tumor growth [1]. Conventional MRI for evaluating the outcomes was based on the volumetric change and morphological enhancement patterns [2], which only manifested after long term follow-up for months to years. Recently, diffusion MRI has been suggested as an early biomarker to the tumors treatment response. The change in water anisotropy, in addition to mean diffusivity, can be attributed to a secondary effect due to the shift in balance in the cellular compartmental diffusion [3]. This study prospectively examined the changes of directional coherence in a region of interest at an acute stage of VS after SRS treatment, compared to the measured diffusion anisotropy within the voxel of interest. An eigenvector based index, intervoxel diffusion coherence (IVDC)<sup>[4]</sup>, was calculated, which described the coherence in the distribution of the white matter tracts in a voxel and its neighborhood. The results were compared with fractional anisotropy (FA).

## Methods and Materials:

Five patients with unilateral VS were planned for the SRS using single dose of 12-13 Gy. Serial DTI studies were scheduled as: (1) 1 day before SRS; (2) 1 week; (3) 2 weeks; (4) 4 weeks and (5) 7 weeks after SRS. DTI studies were performed on a 3T MR scanner with 12 non-collinear directions and b factor of 1000 s/mm<sup>2</sup>. The post-treatment DTI data were spatially co-registered to the pretreatment T2 weighted images. The IVDC was calculated as the equivalent of Relative Anisotropy of the scatter matrix in the voxel of interest. The scatter matrix is a second order dyadic tensor calculated by taking the outer product of each major eigenvectors on the 26 neighboring voxels. The mean values of IVDC and FA in the tumor were monitored longitudinally.

## Results and Discussion

The figure showed the reconstructed maps of IVDC (a) and the corresponding FA (b) from a patient at the level of the tumor. Both showed a hypo-intensity within the tumor and hyper-intensity in the surrounded normal appearing white matter. The longitudinal changes of IVDC and FA within the tumor were plotted in (c). The IVDC increased significantly immediately after the treatment while FA remained stable throughout the period of investigation. The result suggested that the orientation coherence of the water diffusion in the tumor was restored after treatment, which can be early detected by IVDC. In contrast, FA in each individual pixel still remained consistently low.

## Conclusion:

The IVDC is more sensitive than FA in early detection of the response to the SRS treatment for VS patients at an acute stage. The result indicated a restoration of directional coherence in white matter tracts, which occurred before it can be detected by FA.

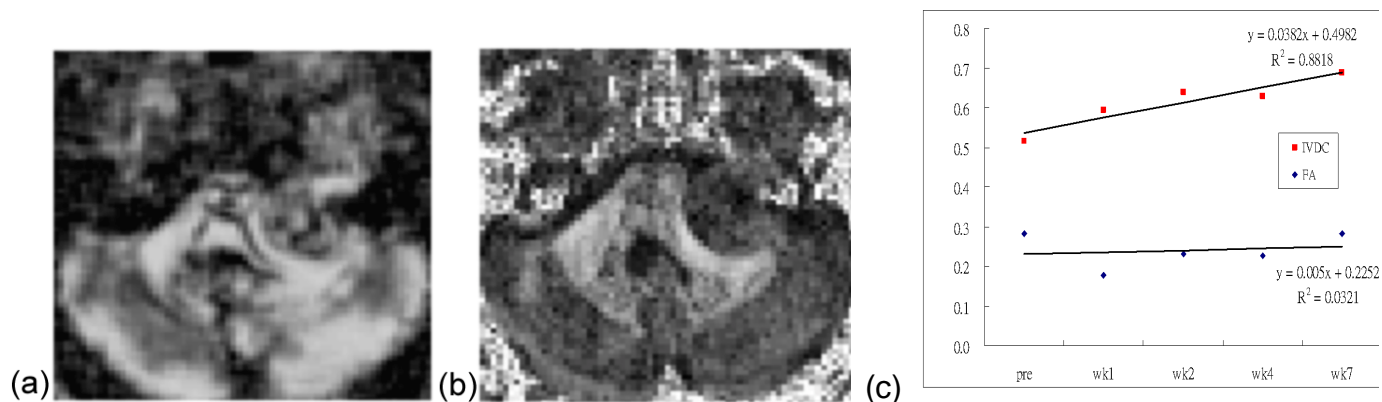


Fig. Reconstructed maps of IVDC (a) and FA (b) from a patients with AN before treatment. The change of IVDC and FA from all patients in the tumor was plotted against time (c).

## References:

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2. Okunaga T, et al., J Neurosurg 2005;103(1):53-8.
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4. Wang JJ., et al. Magn Reson Med, 2007; in press.