

## Significance of interictal water diffusion changes in frontal lobe epilepsy. Correlations with Stereo-Electro-Encephalography (SEEG).

M. Guye<sup>1</sup>, J-P. Ranjeva<sup>1</sup>, F. Bartolomei<sup>2</sup>, S. Confort-Gouny<sup>1</sup>, P. Chauvel<sup>2</sup>, and P. J. Cozzone<sup>1</sup>

<sup>1</sup>Centre de Résonance Magnétique Biologique et Médicale (CRMBM), CNRS UMR 6612, Faculté de Médecine, Université de la Méditerranée, Marseille, France, <sup>2</sup>INSERM U751 et service de Neurophysiologie clinique, Université de la Méditerranée, Marseille, France

### Objective

We aimed at better understanding the significance of interictal changes in water molecule diffusivity defined by diffusion-weighted imaging (DWI) in frontal lobe epilepsy (FLE). We also tested the accuracy of interictal DWI in the definition of the epileptogenic zone (EZ) in such epilepsies.

### Methods

Diffusivity of water molecules was assessed by calculating mean diffusivity (MD) maps (average ADC values in each direction), obtained in the axial plane from a fast diffusion-weighted echo planar imaging (EPI) sequence (acquisition time = 1 min., TE=100 ms, 19 slices, thickness= 5 mm, FOV= 240 mm, matrix=128<sup>2</sup>, b= 0; 250; 500; 1000 s/mm<sup>2</sup> acquired sequentially in the x, y and z directions). We explored 14 patients with refractory FLE (9 negative-MRI) as well as in 25 controls. Diffusion imaging was acquired at least 6 hours after the last seizure. Statistical mapping analysis (SPM2) of diffusivity maps was used to detect, for each subject, significant diffusivity alterations. We then studied the relationships between diffusion and depth recorded electrical abnormalities using stereo-electroencephalography. Clinical correlates of the extent of diffusivity changes were also tested.

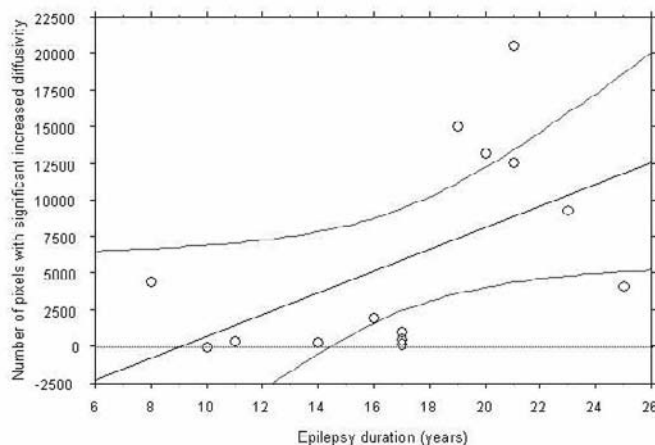
### Results

We found areas of significantly increased diffusivity (SID) in 13 patients. Eight had SID in the EZ, 9 within the irritative zone (IZ) and 12 outside, mainly in connected areas. In the 13 patients with diffusion abnormalities present outside the EZ, significant clusters were located in the ipsilateral and in the contralateral frontal lobe in 8 patients. Three out of the 9 patients with negative-MRI had SID in the EZ, 4 in the IZ and 8 outside the EZ and IZ.

We found a correlation between the extent of SID and the duration of epilepsy ( $p$  corrected = 0.026,  $R = 0.621$ ). In addition, SID was significantly less widespread in negative-MRI patients ( $p = 0.028$ ). However, we found no significant differences concerning either seizure frequency ( $p = 0.302$ ), seizure generalization ( $p = 0.841$ ), history of status ( $p = 0.396$ ), or surgical outcome ( $p = 0.606$ ).

### Discussion

We suggest that SID in normal appearing areas is not a specific signature of epileptogenicity in FLE, and is more likely to reflect multifactorial, and potentially evolving, neuro-glial injuries (Duncan, 2002a, Duncan, 2002b).



**Correlation between the extent of significant interictal increased diffusivity and epilepsy duration.** Increased diffusivity is particularly widespread in patients with an epilepsy duration superior to 18-20 years.

### References:

- Duncan, J. S., 2002a. Neuroimaging methods to evaluate the etiology and consequences of epilepsy. *Epilepsy Res* 50, 131-140.  
Duncan, J. S., 2002b. Seizure-induced neuronal injury: human data. *Neurology* 59, S15-20.