# Diffusion weighted imaging study of patients with essential tremor

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## Introduction

Essential tremor (ET) is the commonest movement disorder in adults -20 times more prevalent than Parkinson's disease-affecting up 6% of the general population and 23% of elderly subjects (1). Although the pathophysiology of ET is still unknown, [$^{15}$O]water PET and fMRI studies have pointed to a dysfunction of a circuit involving cerebellum, red nucleus and thalamus (2, 3). A recent $^{1}$H-MRS study detected a selective reduction of NAA/Cr in the cerebellum of ET patients, suggesting that ET may be a neurodegenrative disease (4)

The aim of our study was to look for evidence of neurodegeneration in the cerebellum and other brain areas of patients with essential tremor (ET) by using DWI that typically discloses increased water apparent diffusion coefficient (ADC) in brain area where neuronal loss occur (5).

## Methods

We studied ten ET patients (7 males, age 66y±11, mean±SD) and ten matched healthy volunteers. Diagnosis of ET was made according to the Consensus Criteria of the Movement Disorder Society. Informed consent was obtained from each patient and normal volunteer.

Subjects were studied in a 1.5T General Electrics Medical Systems (Milwaukee, Wisconsin) Signa Horizon LX whole-body scanner. Axial DW images were obtained (thickness = 5 mm, inter-slice gap = 1 mm) using a single-shot EPI sequence (matrix size = 192 x 192 mm). Orthogonal x, y, and z diffusion encoding gradients were applied with gradient strengths corresponding to b-values of 300, 600 and 900 mm$^2$/s. In addition, images without diffusion weighting were acquired corresponding to b = 0 s/mm$^2$ and exhibiting $T_2$-contrast.The apparent diffusion coefficient (ADC) of each direction was determined pixel-wise using a least-squares fit, assuming a signal attenuation depending mono-exponentially on the b-value. By calculating the mean of the three directions, the ADC trace map was generated.

Regions of interest (ROI) were defined to include left and right cerebellum, red nucleus, thalamus, caudate, putamen, pallidus and frontal white matter. For comparison with previous studies (6), histograms of ADC were generated for all pixels in the infratentorial compartment, comprising cerebellum and brainstem. The asymmetry of ADC distribution was assessed by finding the 25$^{th}$ and 50$^{th}$ percentile values along with the mean. Statistical significance, determined by the Student *t* test for unpaired data, was taken as $p<0.05$.

**Table.** ADC values in ROIs and cerebellar histograms in ET patients and controls

| Brain area | ADC (x10$^{-3}$ mm$^2$/s) | | |
|---|---|---|---|
| | Controls | ET patients | p |
| Cerebellar WM | 0.72±0.08 | 0.74±0.13 | 0.62 |
| Red nucleus | 0.78±0.13 | 0.81±0.11 | 0.59 |
| Thalamus | 0.81±0.06 | 0.83±0.06 | 0.48 |
| Caudate | 0.75±0.04 | 0.77±0.03 | 0.31 |
| Putamen | 0.70±0.02 | 0.74±0.08 | 0.25 |
| Pallidus | 0.74±0.08 | 0.80±0.08 | 0.17 |
| Frontal WM | 0.80±0.04 | 0.79±0.04 | 0.49 |
| Histogram of ADC for infratentorial compartment | | | |
| 25$^{th}$ percentile | 0.77±0.05 | 0.78±0.05 | 0.54 |
| 50$^{th}$ percentile | 0.93±0.07 | 0.95±0.07 | 0.58 |

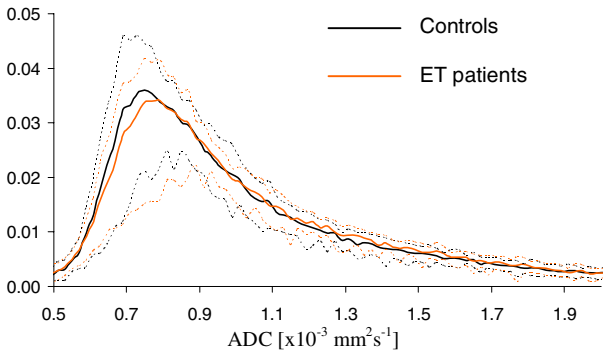


**Figure**. Histogram of ADC for infratentorial compartment, mean values (solid lines) ± standard deviation (dotted lines) for control and patient groups.

## Results

Water ADC values were similar in corresponding right and left hemisphere regions of interest (ROIs) in both normal subjects and patients and hence are reported as mean value. ADC values of all ROIs selected in ET patients were not statistically different from controls (Table). Similarly the histograms of ADC values in the infratentorial compartment were virtually identical for the two groups (Figure).

## Discussion

ADC values assessed in the cerebellum and other brain area were similar in ET patients and healthy subjects. These findings do not support a neurodegenerative processes in ET and suggest that the reduction in the neuronal marker NAA found in the cerebellum of ET (4) is secondary to functional neuronal changes rather than neuronal loss. This is consistent with a recent extensive neuropathological study of ET patients that did not find brain pathology (7).

## References

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