

# Comparison of Diffusion Tensor Imaging-Derived Fractional Anisotropy in Multiple Vendors at 1.5T

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## Introduction

Diffusion Tensor Imaging (DTI) is an MRI technique that measures the spatial diffusion characteristics of water and provides novel contrast to study the fiber architecture of the central nervous system in vivo [1]. Prominent scalar quantities include fractional anisotropy (FA), which describes the degree of diffusion anisotropy. FA in white matter (WM) arises in part due to axonal and myelin barriers to water diffusion and has been used to assess and monitor WM damage [2]. However, it is known that FA changes with scan parameters (ex. Motion Probing Gradient (MPG)-directions, signal to noise ratio (SNR), etc.) [3,4]. It is expected that FA differs between multiple vendor scanners, and therefore is important to compare these values. In this study, we compared the FA value between three nominally identical 1.5-T scanners at different sites in healthy controls.

## Methods

5 healthy volunteers (mean age,  $30.6 \pm 2.7$  years; range, 27-33 years, 5 men) participated in this study. Informed consent was obtained from the subjects. A 1.5-T scanner was used at each site, with a slew rate

vendor	No. of head coil channel	TR	TE	slice thickness	resolution (interpolated)	dir. of MPG	b-value	average
SIEMENS	1	7200	90	3 mm	128x128(256x256)	12	1000	2
GE	8	7200	90	3 mm	128x128(256x256)	12	1000	2
PHILIPS	8	7200	90	3 mm	128x128(256x256)	15	1000	2

Fig. 1: scan parameters of three vendors.

125mT/m/s (SIEMENS), 120mT/m/s (GE), 120mT/m/s (Philips). The head coil was used for signal reception. Each image was acquired using a multi-slice spin echo EPI sequence. Although we selected the same values of each scan parameter as much as possible (Fig. 1), the number of head coil channels and MPG-directions were different due to mechanical restrictions. Additionally, each MPG-schema is of a different type. We used dTV II SR (freely available software: [http://www.ut-radiology.umin.jp/people/masutani/dTV/dTV\\_frame-e.htm](http://www.ut-radiology.umin.jp/people/masutani/dTV/dTV_frame-e.htm)) for calculation of the diffusion tensor and hemispheric ( $\phi 3$ mm) regions of interest (ROI) for measurement of the mean FA in the following seven regions, genu and splenium of corpus callosum (GCC and SCC), crus cerebri (CC), posterior limb of internal capsule (PLI), optic radiation (OR), middle cerebellar peduncle (MCP), and putamen. Then, we used a parametric test to evaluate the relationships between the three vendors for the seven measurement regions.

## Results

Scatter plots for FA of the three vendors in the seven measurement regions in 5 healthy volunteers are presented in Fig.2. At GCC and SCC, there were significant differences ( $p < 0.01$ ) between GE and SIEMENS, PHILIPS (Fig. 3). On the other hand, there was no significant difference between SIEMENS and PHILIPS in all regions. At GCC, the three eigenvalues ( $\lambda_1$ ,  $\lambda_2$ ,  $\lambda_3$ ) are presented in Fig.4.  $\lambda_1$  of GE was lower than the others, and,  $\lambda_2$  and  $\lambda_3$  were higher than others. This phenomenon was present in the SCC, as well.

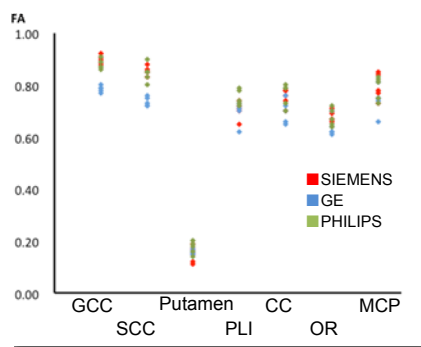


Fig.2: FA of three vendors in seven regions in 5 healthy volunteers.

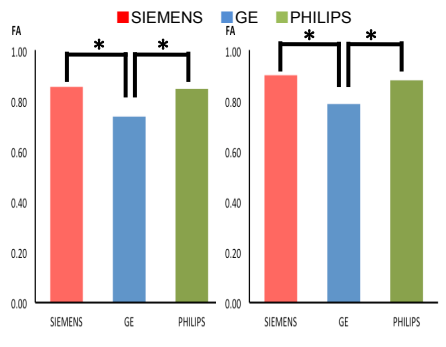


Fig.3: FA of three vendors in GCC (Left) and SCC (Right).

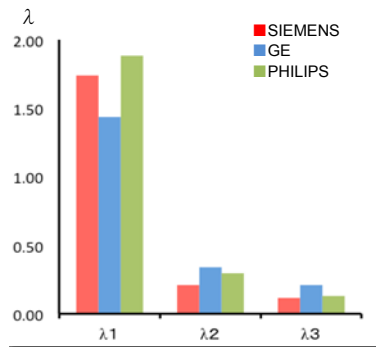


Fig.4: eigenvalues  $\lambda_1$ ,  $\lambda_2$ ,  $\lambda_3$  of three vendors in GCC.

## Discussion

For the scanners and scan parameters that we selected, the FA which does not have a significant difference in five regions. However, it is interesting that only one vendor's FA differed in the regions of higher-FA compared with other regions (GCC and SCC). In these regions, its  $\lambda_1$  is lower than others and set up low FA. This phenomenon occurred between vendors for the same directions of MPG (12 directions), and did not occur between vendors for the different directions (12 and 15 directions). It is reported that FA also changes if the MPG-directions change. [3]. Our results showed that FA is dependent on not only MPG-directions but also MPG-schemas, especially in the regions of higher-FA.

## Conclusions

We compared FA between the scanners of three vendors. In the regions of higher-FA, FA and  $\lambda_1$  of one vendor specifically differed from the values in the other vendors.

## References

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