DTI Metrics for Multi-site/Multi-scanner Study of Adult Cervical Spinal Cord

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Background and Objective

A major variable in DTI spinal cord studies is the diversity in MRI scanner vendor and field strength. While there are several techniques proven to acquire DTI data, there are no standardized accepted methods for acquisition and processing. As more medical systems are utilizing this technology to evaluate the spinal cord, it is important to study the reproducibility of the DTI metrics among various scanner platforms, coil configurations and software implementations to determine the variance in obtaining normative spinal cord DTI data. This preliminary data for a multi-site DTI study examines the effects of these different MR vendors and field strengths on the DTI values of the adult cervical spinal cord.

Results

	Philips 1.5T		Philips 3T		Siemens 1.5T		Siemens 3T	
	Avg	Std	Avg	Std	Avg	Std	Avg	Std
FA (x10^{-3} mm^2/s)	0.72	0.02	0.62	0.01	0.61	0.03	0.64	0.03
MD (x10^{-3} mm^2/s)	0.78	0.02	1.30	0.08	1.23	0.08	1.14	0.05
AD (x10^{-3} mm^2/s)	1.56	0.07	2.32	0.1	2.18	0.08	2.08	0.03
RD (x10^{-3} mm^2/s)	0.39	0.02	0.79	0.07	0.75	0.08	0.67	0.06

Average DTI metrics for all subjects by scanner.

DTI Metric	Average	St Dev
FA (x10^{-3} mm^2/s)	0.65	0.05
MD (x10^{-3} mm^2/s)	1.11	0.21
AD (x10^{-3} mm^2/s)	2.03	0.03
RD (x10^{-3} mm^2/s)	0.65	0.17

Average values and standard deviations for all subjects and scanners.

DTI Metric	St Dev Range
FA	0.04 – 0.07
MD	0.20 – 0.27
AD	0.31 – 0.40
RD	0.15 – 0.21

Within subject standard deviation for DTI metrics between scanners.

DTI Metric	Coefficient of Variance
FA	0.08
MD	0.21
AD	0.17
RD	0.28

Average coefficient of variance within subjects for all scanners.

Methods and Materials

Population

- Four subjects (age range 20 to 30 years) were scanned with 20 direction DTI protocols on four different scanners for a total of 16 scans

Scanning Equipment

- Siemens 3T Prisma
- Siemens 1.5T Avanto
- Philips 3T Ingenia
- Philips 1.5T Achieva

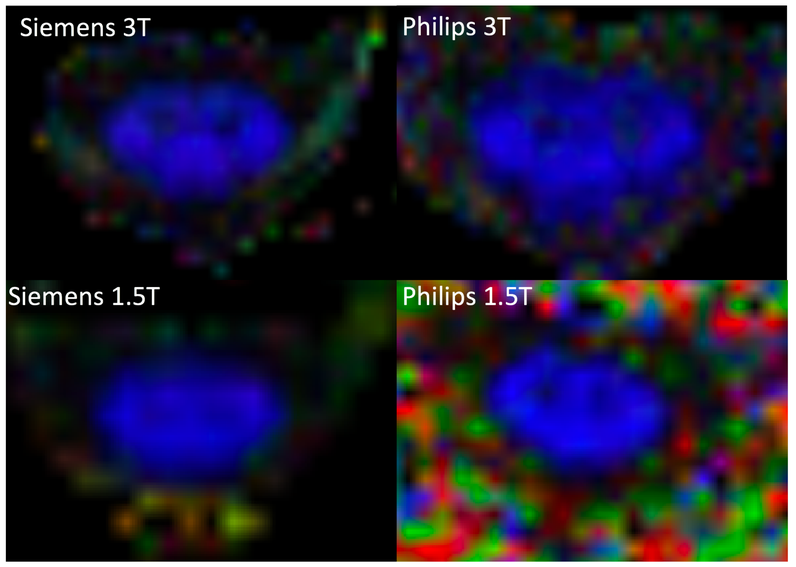
Data Acquisition and Processing

- All images were collected using a reduced field of view imaging sequences
  - Except 1.5T Avanto where the feature was unavailable and a full field of view sequence was used.
- Diffusion weighted images of cervical spinal cord were acquired on each scanner.
- Motion and eddy current correction algorithms were applied to reduce distortion effects.
- Diffusion tensor maps fractional anisotropy (FA), mean diffusivity (MD), axial diffusivity (AD), and radial diffusivity (RD) maps were generated from the corrected images for the full cervical cord.
- Manual ROIs were drawn on the axial maps to calculate the DTI parameters for the complete cervical cord through the C7-T1 disc.

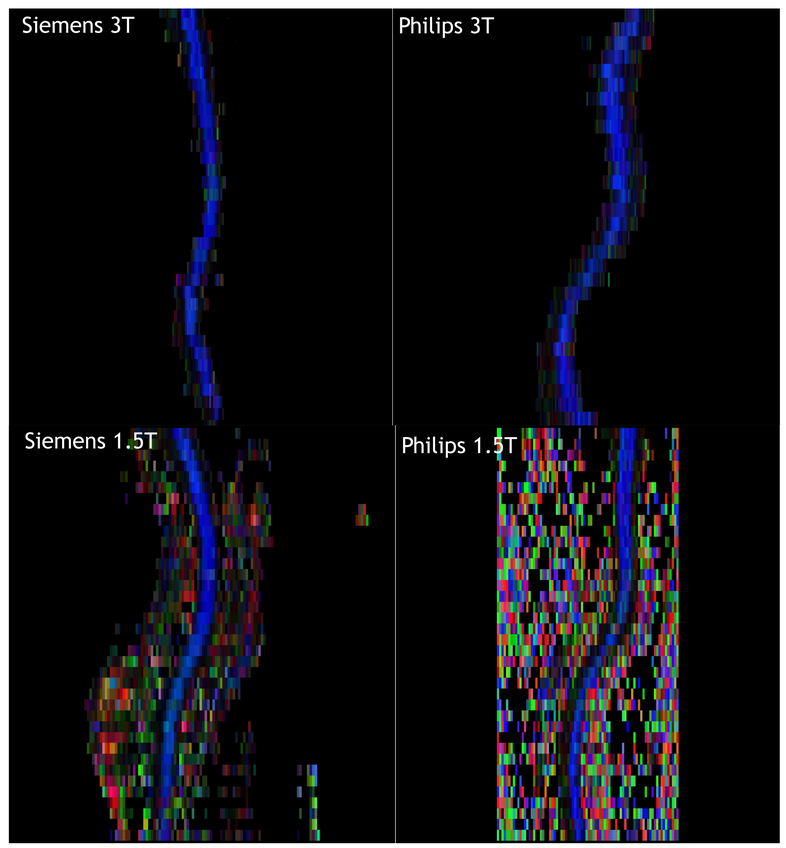
Conclusion

DTI metrics can vary between scanner for the same subject for the spinal cord. Further examination of within subject differences has potential to provide important information on making DTI of the spinal cord more translatable between sites.

Figures



Representative axial color FA maps from a single subject for each scanner at C5 vertebral level.



Representative sagittal color FA maps from a single subject for each scanner.

Acknowledgment

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