CORTICAL THICKNESS MEASUREMENTS AS A FUNCTION OF CHOICE OF T1-WEIGHTED VOLUME

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Introduction

The thickness of the cerebral cortex is a highly informative morphological characteristic that is a function of both age [1] and pathological state (e.g. schizophrenia [2], Huntington's disease [3]). Automated techniques for isolating the cortical ribbon and estimating its thickness eliminate the subjective bias of manual methods. Previous studies have demonstrated the influence on automated cortical thickness measurement of MRI field strength [5]. Here the impact on cortical thickness measures of using a range of different 3D T1-weighted volumes at 1.5T has been investigated with the aim of determining the sensitivity of cortical thickness measures to acquisition parameters.

Methods

Structural MR images of 12 normal subjects were acquired on a 1.5T NV/i GE MR system using 7 different 3D T1-weighted SPGR volumes used at our institution as detailed in Table 1. Cortical thickness measures were automatically generated using the method of Fischl et al [4] under the Freesurfer package. Both mean global cortical thickness and local thickness of cortical lobes was considered. Correlations of whole brain cortical thickness measurements were determined for each pair of volumes.

Volume	Orientation	Scan time (mins)	FOV (mm)	Voxel size (mm)	Flip angle θ (°)	TE (ms)	TR (ms)	TI (ms)
a	Axial	4.97	220	0.86 x 0.86 x 1.5	20	5.4	12.3	450
b	Coronal	8.27	220	0.86 x 0.86 x 1.5	20	5.8	13.1	450
c	Coronal	6.45	240	0.94 x 0.94 x 1.5	20	2.8	13.8	450
d	Coronal	7.23	240	0.94 x 0.94 x 1.5	35	5.0	35.0	-
e	Coronal	5.71	220	0.86 x 0.86 x 1.5	20	5.1	17.9	450
f	Coronal	25.1	200	0.78 x 0.78 x 1.5	35	5.0	35.0	-
g	Coronal	8.60	220	0.86 x 0.86 x 1.5	20	2.8	13.0	450

Table 1. Acquisition parameters for the seven T1-weighted volumes.

Results and Discussion

The mean and standard deviation (sd) of the whole brain cortical thickness measurements is summarised in Table 2 for each of the different volumes. The results show small systematic differences in the global mean cortical thickness between volumes but these do not exceed 0.16 mm. Whole brain cortical thickness measurements were largely consistent between volumes as shown in Table 3, in which the range of coefficients is 0.94 - 0.53. This consistency is difficult to interpret unambiguously in the absence of within-subject retests. The mean thicknesses of cortical lobes were found to vary consistently between different volumes in the frontal, parietal and occipital lobes (Figure 1). However temporal lobe measures did not follow this pattern. This may be a result of the challenges of automatically isolating the cortical ribbon in this region (which includes the hippocampus) as well as areas which may be affected by geometric distortions and signal intensity variations caused by local susceptibility differences. Further studies comparing the impact of scanner field strength and RF coil are under way.

Volume	Whole brain cortical thickness mean (sd) (mm)
a	2.41 (0.10)
b	2.41 (0.07)
c	2.39 (0.10)
d	2.25 (0.08)
e	2.32 (0.10)
f	2.32 (0.07)
g	2.41 (0.08)

Table 2. Mean (sd) whole brain cortical thickness for all subjects.

	a	b	c	d	e	f	g
a	-	.80	.75	.82	.70	.62	.94
b	.80	-	.65	.57	.67	.53	.80
c	.75	.65	-	.90	.84	.74	.88
d	.82	.57	.90	-	.84	.79	.87
e	.70	.67	.84	.84	-	.67	.74
f	.62	.53	.74	.79	.67	-	.62
g	.94	.80	.88	.88	.74	.62	-

Table 3. Covariance matrix of whole brain cortical thickness.

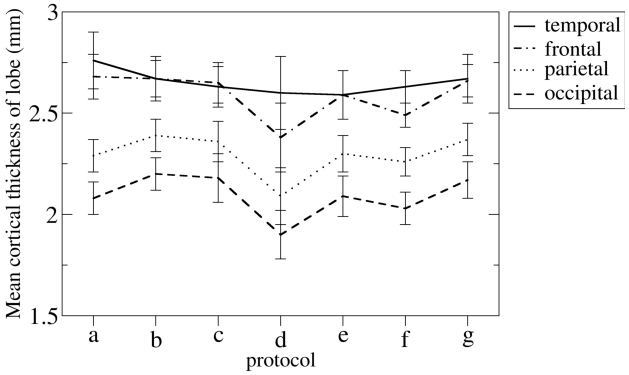

Figure 1. Lobar mean cortical thickness as a function of volume.

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