Effects of Mid Sagittal Plane Selection on Corpus Callosal Area

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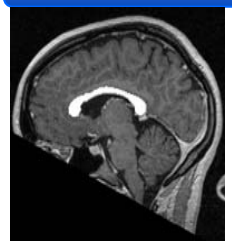
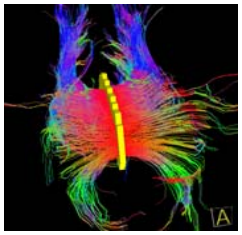
Background





Atrophy of the corpus callosum (CC) can occur in multiple sclerosis (MS) patients at a faster rate (-4.5% versus -1%) than the loss in whole brain volume. It can be useful as another measure of neuro-degeneration.

A change in the CC size is commonly quantified with magnetic resonance (MRI) by measuring the two dimensional cross sectional area of the CC in the mid sagittal plane (MSP).

However, accurate and repeatable identification of the mid sagittal plane (MSP) is difficult due to inter-hemispheric asymmetry, lack of landmarks and imprecise repositioning. These sources of error may confound the interpretation of changes in CC area.

Objective

To determine the effects of small positional variations of the MSP on CC cross sectional area for MS patients.

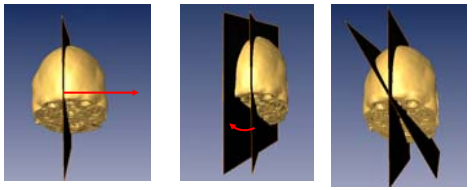
Methods

5 MS patients were scanned 3 times each using a 3-D inversion-prepared spoiled gradient echo (SPGR) MRI sequence.

MRI studies were assessed independently as if belonging to different subjects as this study was not looking at change in CC area over time. The MR volumes were re-sampled to an isotropic pixel resolution of 0.976mm x 0.976mm x 0.976mm. Each sagittal slice was a 256 x 256 matrix.

The 10 centre-most sagittal slices containing the CC were segmented semi-automatically and used to generate a 3D binary volume of the CC. The centre of each volume was selected as the reference MSP. This plane was perturbed (shifted) through small changes in elevation, azimuth angles, and/or translation from the centre of the volume creating 6615 “shifted” MSPs for each volume. The range of elevation and azimuth angles was from -2.0 to 2.0 degrees with a step size of 0.2 degrees and the translation range was 0.976 mm on both sides of the reference MSP with a step size of 0.488mm.

The cross sectional CC areas in the altered planes were measured and compared against the CC area in the reference MSP for each volume.



Results

The mean CC area was 569mm2 (SD 38mm2). The mean CC area change due to shifting (any perturbation) of the MSP was 2.67%, (Median 1.98%, SD 2.47%). A translational shift of one slice (0.97 mm) changed the CC area by a mean of 2.55% (SD 2.22%). A 2 degree change in elevation changed the CC area by a mean of 3.59% (SD 3.06%). A 2 degree change in azimuth changed the CC area by a mean of 3.26% (SD 2.36%). The maximum change in CC area for any of the MSP perturbations was 17.14%.

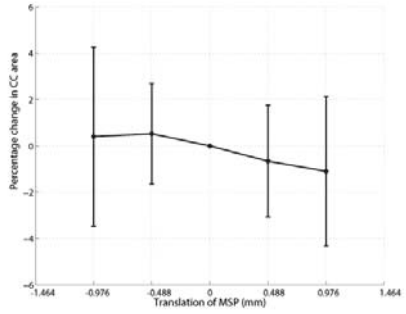


Figure 1: Mean and standard deviation of percentage change in CC area plotted against change in translation for cubic image interpolation.

Figure 2: Mean and standard deviation of percentage change in CC area plotted against change in elevation for cubic image interpolation.

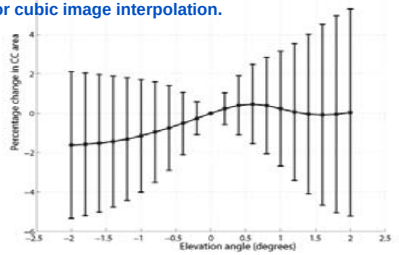
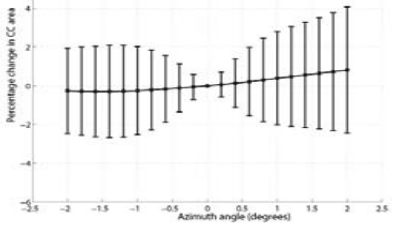


Figure 3: Mean and standard deviation of percentage change in CC area plotted against change in azimuth for cubic image interpolation.



Discussion

Imprecise selection of the MSP on follow-up MRI scans can occur because of patient repositioning and cerebral asymmetry.

Shifts in the MSP between serial MRI studies may falsely increase or decrease the cross sectional CC area. This potential source of error should be taken into consideration when using CC area to monitor disease progression or treatment effects in multiple sclerosis.