We reconstructed superior colliculus (SC) tracts in 6 normal subjects as well as 2 Hs with and without blindsight. Absence of connections from the hemispherectomized SC to the contralateral hemisphere. Ipsilateral projections were weaker and only observed from the ipsilateral SC to the cuneus.

RESULTS

Healthy subjects (Fig. 2)
Ipsilateral connections to visual association areas (x = ±28, y = -74, z = 20), parietal-occipital cortex (x = ±32, y = -50, z = 50), frontal areas (x = ±20, y = 62, z = 2), and close to an area (right SC: x = 18, y = -6, z = 50; left SC: x = -20, y = -6, z = 46) that has previously been described as frontal eye fields (FEF; Paus, 1996; x = ±24, y = 6 to 1, z = 44 to 51), but not to primary visual areas.

DATA ACQUISITION

1.5 Tesla MRI Sonata scanner (Siemens) using echo-planar imaging Parameters for diffusion weighted data: Repetition time: 9300 ms, echo time: 94 ms; flip angle: 90°; slice thickness = 2.25 mm; number of slices: 60; in-plane resolution: 2.1875 mm x 2.1875 mm; acquisition time approximately 9.30 minutes. Diffusion weighting was performed along 60 independent directions with a b-value of 1000 s/mm². A reference image with no diffusion weighting was also obtained.

IMAGE PROCESSING

Raw DTI data was corrected for motion and eddy currents Probability distribution function was estimated on the principal fiber direction at each voxel using Bayesian Techniques (Ref. 2, 3) Probabilistic fiber tracking was initiated from seed masks of the right and left SC Analysis was restricted to fibers crossing at the level of the SC by using an exclusion mask (saggital slice along the midline, Fig. 1)

CONCLUSIONS

We were able to demonstrate the existence of strong ipsilateral and contralateral projections from the SC to primary visual areas, visual association areas, precentral areas/FEF and the internal capsule of the remaining hemisphere only in those hemispherectomized subjects with ‘Type I’ or ‘attention-blindsight’. No such connections could be identified in those hemispherectomized subjects without ‘Type I’ or ‘attention-blindsight’. A control tract was chosen to validate DTI data quality and analysis methods: All participating subjects showed similar tracings of the corticospinal tracts (results not shown, for further details see Ref. 4). These results strongly support an essential role of the SC in blindsight. This study also demonstrates the usefulness of DTI tractography in investigating cerebral plasticity, compensation and reorganization following various cerebral lesions.

REFERENCES

1. Leh, S.E. et al. The involvment of the superior colliculi in hemispherectomized subjects with blindsight. VGG 2006 Annual Meeting, Sarasota, USA.