BrainLAB
neurosurgery solutions

the next step in surgical planning

iPlan® FiberTracking

New iPlan® planning module introduces diffusion tensor imaging to neurosurgery

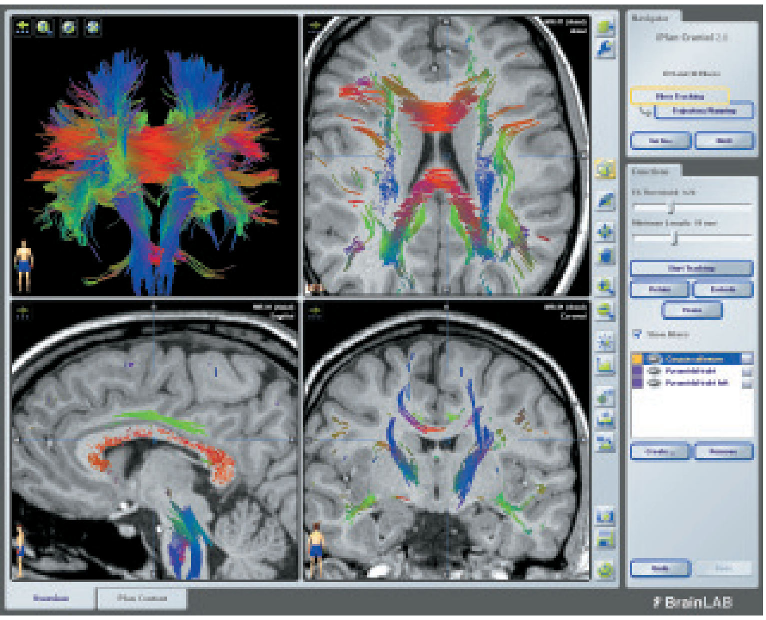

Image courtesy of Erlangen University Hospital, Germany

Diffusion Tensor Imaging represents a significant leap for neurosurgical planning, providing more detailed information about eloquent white matter structures than even before.

BrainLAB takes this technology to the next level with full integration into iPlan surgical planning software. This unique combination allows surgeons to make best use of DTI imaging information and apply it to treatment plans for navigated surgery. The results are safer surgery and better patient outcomes.

- Full integration of DICOM DTI data import
- Automatic detection of diffusion directions
- Calculation of the fractional anisotropy (FA) map and diffusion information
- New user interface for fiber tracking with options for tracking parameters
- Definition of region of interest
- Interactive selection of fiber tracts
- Overlay to other anatomical or functional images
- Conversion of fiber tracts to 3D structures for usage with the navigation

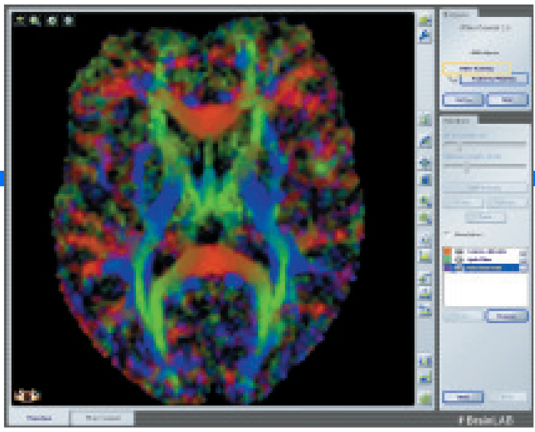

fig. 1

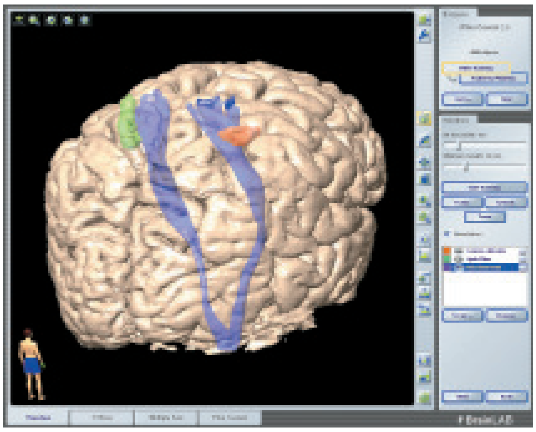

fig. 2

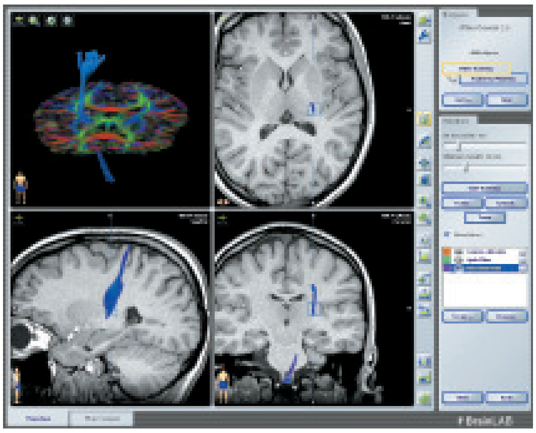

fig. 3

Image courtesy of Erlangen University Hospital, Germany

INTEGRATING FIBER TRACKING INTO NAVIGATION FOR IDENTIFICATION OF MAJOR WHITE MATTER TRACTS

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Diffusion Weighted Imaging (DWI) depicts differences in tissue anisotropy by measuring the self-diffusion properties, e.g. Brownian motion, of water molecules. Diffusion is orientation-dependent (anisotropic) in areas with a strongly aligned microstructure. DTI is based on measuring diffusion-weighted images to resolve the orientation of the white matter tracts. DTI can resolve the dominant fiber orientation in each voxel element (fig. 1).

The direction of greatest diffusion parallels the dominant orientation of the tissue structure in each voxel, representing the mean longitudinal direction of axons in white matter tracts. It is possible to delineate major white matter tracts, such as the pyramidal tract, by applying fiber tracking algorithms (fig. 2).

This new tool makes it possible to integrate this fiber tracking data into navigational datasets. Fractional anisotropy maps are registered with standard anatomical images. A tracking algorithm then applies user defined-seed volumes. This allows a differentiation between major white matter tracts. Figure 3 depicts a screenshot of the planning software with fiber tract visualization. The right pyramidal tract was registered with a T1-weighted 3-D sequence.

Our first experiences with a software prototype proved the feasibility of this approach. It allowed us to integrate generated fiber tract data into 3-D navigation datasets, which we applied in over 20 glioma cases. Fiber tract data integrated into navigation data-sets allows intra-operative visualization of white matter tracts with microscope-based navigation.

After major tumor parts are resected, one must still account for potential shifts of white matter tracts. Intra-operative high-field MRI can be applied to visualize this shifting, offering the possibility of compensating for brain shift in relation to major white matter tracts.

Nimsky C, Ganslandt O, Hastreiter P, Wang R, Benner T, Sorensen AG, Fahlbusch R. Intraoperative diffusion tensor imaging: shifting of white matter tracts during neurosurgical procedures – initial experience. Radiology

Nimsky C, Ganslandt O, Hastreiter P, Wang R, Benner T, Sorensen AG, Fahlbusch R. Pre- and intraoperative diffusion tensor imaging based fiber tracking in glioma surgery. Neurosurgery

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