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# Neuronavigation auf der Grundlage intraoperativer 3D-Datensätze - vorläufige Erfahrungen bei 10 Patienten

## Neuronavigation based on intraoperative 3D-Ultrasound during tumor resection – preliminary experiences in 10 cases

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### Objective

Neuronavigation systems have been demonstrated to improve planning and performance of brain tumor surgery. Intraoperative imaging such as ultrasound is beneficial for intraoperative orientation, detection of brain shift and resection control. A combination of preoperative MRI with intraoperative 3D-ultrasound (3D-iUS) may enhance the convenience of neuronavigation by adding intraoperative information. Limitations may be the required time for intraoperative data transfer, a possibly lower quality of resliced planes from 3D-ultrasound datasets in comparison to conventional 2D-US and the costs for a special configured navigation system. The aim of our study was to evaluate fusion accuracy, the benefit of 3D US navigation for the extent of resection and the suitability of iUS for detection and capture of intraoperative brain shift.

### Methods

A freehand 3D ultrasound navigation system consisting of a standard personal computer containing a video grabber card in combination with an optical tracking system (NDI Polaris) and an standard ultrasound device (Siemens Omnia) with a 5,0 MHz probe was used in the study. Preoperative 3D-MRI-Dicom data was acquired with an 1,5T Siemens Scanner and transferred to the navigation system (Localite Navigator). 3D-iUS datasets were acquired after craniotomy, at different subsequent times of the procedure and overlayed with preoperative MRI. The study included 10 patients. The tumors contained a

size from 1-7 cm with a supratentoriell localisation in 9/10. In a standard protocol four surgeons removed four metastasis, three glioblastomas, one meningeoma, 1 angioma and one cystic process. Intraoperative 3-D ultrasound datasets were acquired three to seven times per procedure and tumor resection was carried out applying updated navigation. All patients underwent early postoperative MRI within 24 hours after surgery.

## Results

There was no observed neurological impairment after surgery. In all cases the acquisition of 3D-iUS and the fusion with preoperative MRI was successful. The expenditure of time was at least 5 minutes for one 3D-iUS dataset. Handling of the system was accepted by all users but there was a learning curve. The image quality of extracted slices in different planes was comparable to 2D images, however the quality of ultrasound images in cases of metastasis, meningeoma and angioma was superior to those in glioblastomas. Brain shifting ranged from 2 – 25 mm depending on localisation and kind of tumor. In all cases anatomical structures could be identified. A resection control was possible in 80%. A good correlation between postoperative MRI and the last 3D-iUS dataset showed only 4/8 cases.

## Conclusions

Accurate fusion of MR images and intraoperative acquired 3D-iUS was successful in all cases. Configurating both the 3D-iUS based on a standard ultrasound system and the MR-navigation system is time- and especially cost-effective. Tumor resection control was excellent in cases of metastasis and meningeoma. Additional the interpretation of 3D-iUS depends on size, localisation and times of operation procedure.