Pre- and postoperative MR brain imaging with automatic planning and scanning software in tumor patients: an intraindividual comparative study at 3 Tesla

M. Nelles[1], J. Gieseke[1,2], H. Urbach[1], R. Bloemer[1], H. H. Schild[1], and W. A. Willinek[1]

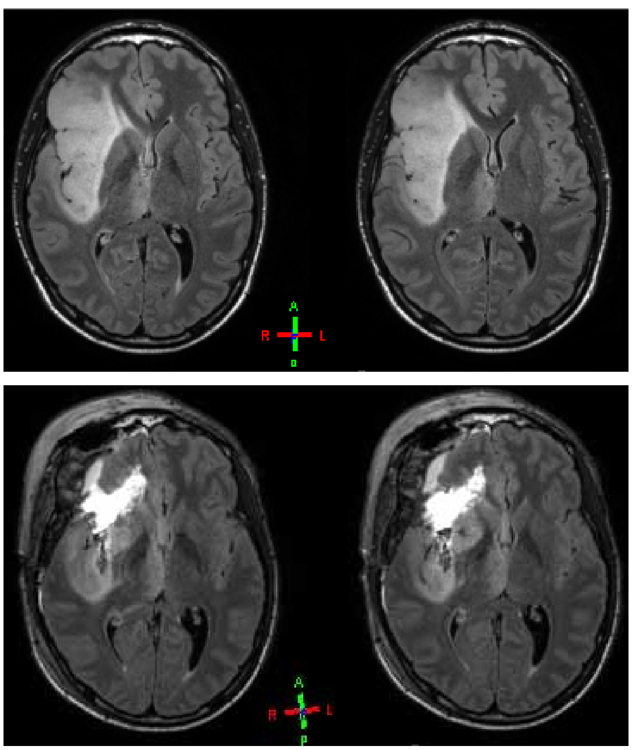
[1]Department of Radiology, University of Bonn, Bonn, Germany, [2]Philips Medical Systems, Best, Netherlands

Introduction

Automatic MRI planscan software (APS) has been proposed to minimize inter- and intrasubject alignment inconsistencies in brain imaging (1). However, in patients with intracranial mass lesions postoperative shape deviations may occur that may affect the efficacy of automatic planning. Up to now APS has primarily been validated on healthy subjects, and not been evaluated in the same patients before and after brain surgery.

Materials and Methods

12 patients (5 male, 7 female), mean age 34 (3 – 62) years were scanned with APS prior to and after neurosurgery. The mean interval between both scans was 5,4 (2 – 10) days. Pathologies comprised 11 gliomas or focal mass lesions (glioma, 8, dysembryoblastic neuroepithelial tumor (DNT), 1, cavernoma, 1, metastasis, 1) as well as one large cystic right-hemispheric defect zone in a 3-year old scheduled for functional hemispherectomy. For the APS, a 112 * 112 T1-TFE 3D dataset (100 slices, voxel size 2.2 mm^3, scan time 53 seconds) was acquired in the sagittal plane, based upon which axial and coronal MPRs and a planning geometry were generated (total processing time, 30 seconds). The planscan was derived from a database of healthy subjects by a 9 parameter intensity-based 3D registration and identification of several anatomical landmarks, such as the anterior/posterior commissure (ac/pc), vertex, the protuberantia occipitalis or the frontal pole (2). This approach was available in a commercial scanning environment (SmartExam; Achieva 3.0 Tesla, Release 2.1, Philips Medical Systems, Best, The Netherlands). The APS was adaptive to training geometries learned from the operator on the basis of 10 subjects not belonging to the study group. An axial T2-TSE sequence with flip angle sweep (3) (scan time, 8 seconds, slices, 24) of the whole brain was acquired using the planscan geometry proposed by the APS prior to the regular imaging protocol. If the APS-geometry was insufficient regarding offcenter, AC/PC and midline alignment, it was corrected by the scanner operator. All planning geometries were documented with screenshots for later comparison of the APS and operator’s planscan geometry.



Results

APS was successful in planning scans in all 12 clinical cases. APS geometry was corrected by the operator in none of the preoperative and three (25%) of the twelve postoperative patients. Mean offcenter correction was 0.75 mm (0 – 2,61 mm), mean angle change towards the midline and AC/PC was 1,23 degrees (0 – 4,33 degrees). Midline shift was present in five preoperative and three postoperative scans, postoperative galea hematoma was present in all cases, more extensive intracranial blood (subdural or with an intraventricular component) was seen in two subjects. One of the latter belonged to the postoperatively geometry-corrected APS examinations, which also included the functional hemispherectomy patient; there was no obvious midline shift or intracranial bleeding in the third corrected case.

Conclusion

Automatic MRI planning software yields robust results even in patients with mass lesions and postoperative hemorrhage or substantial shape deviations. Operator interaction and geometry correction is necessary in a minority of cases only. The dimensions of necessary geometric corrections are small.

References

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