The application of intraoperative MRI (iMRI) in different neurosurgical procedures --- Initial Experience with Intraoperative MRI.

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Abstract. The PoleStar N-20 represents a new generation of iMRI that let neurosurgeons can use near real time images to control the tumor resection. In this paper, our initial experience with this system was described. The benefits and shortcomings were evaluated for the effectiveness of the system in gross-total resection.

1. Introduction

Surgical navigation are commonly used in intracranial and spinal procedures by providing near real-time information on location, orientation and guidance. The major drawback of this technology is they use images acquired preoperatively, on which the planning of the operative procedure as well as its intraoperative performance is based on. This situation was adequate in some cases, but made accurate navigation vulnerable to movement of surface fiducials between imaging and surgery. The brain deformation and shift are the major sources of the error during the intraoperative navigation. Intraoperative MRI (iMRI) provides almost real time images which can effectively update patient's image information and is particularly helpful in determining tumor margins, optimizing surgical approaches, achieving complete resection of intracerebral lesions and monitoring potiential intraoperative complications.

2. Methods

In this study, we report our preliminary observations using iMRI with 26 adult patients for brain tumor resection (12 Female, 14 male, mean age 45.6). The diagnosis for these include GBM, low grade glioma, pituitary tumor, chordoma et al. The intraoperative MRI system, commercially known as the PoleStar N-20 (Odin Medical Technologies, Yokne'am, Israel) includes a 0.3 Tesla permanent magnet that docks under a regular OR table. A passive infrared-based optical navigation system is integrated with system for the neuro-navigation.

3. Results

Each patient, pre-surgery scan and post tumor resection scan were taken. The brain surface coordinates were compared to determine the brain deformation and shift. The maximum shift is 12mm that related with CSF leaking. Additional time for using of the PoleStar system reduced with increasing experience. The accuracy of navigation tool is comparable to other "frameless stereotactic" devices. In brain tumor surgery intraoperative resection control showed significant tumor remnants in nearly 40 % of all patients. In 10 patients tumor resection was completed by a section look, guided with additional information by an updated of neuronavigation.

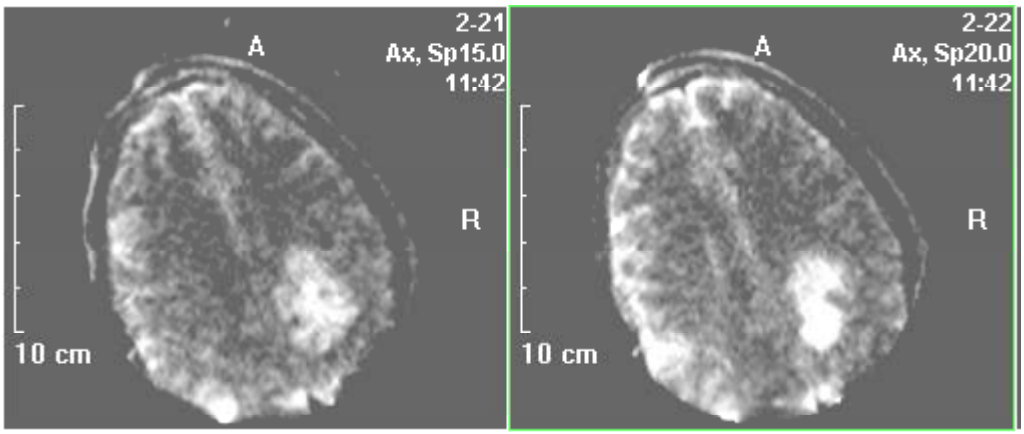

Figure 1. Before tumor resection, iMRI T2 images

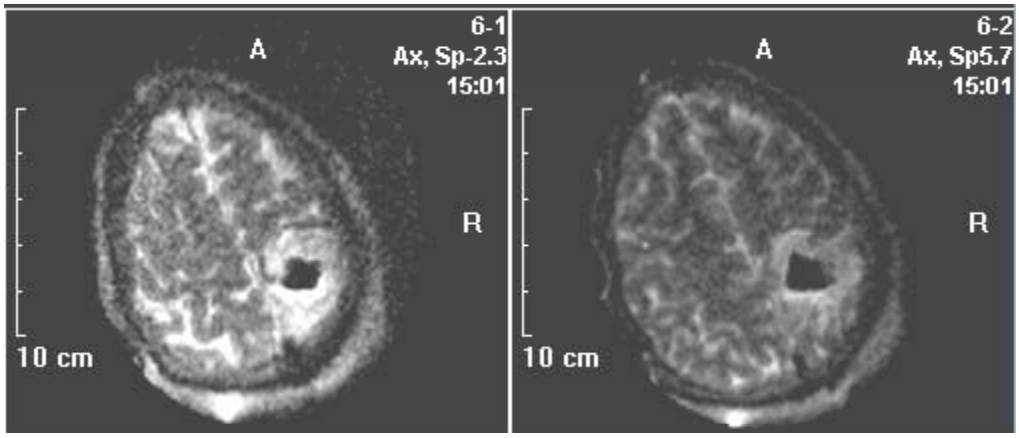

Figure 2. After tumor resection, iMRI T2 images.

4. Discussion

Our preliminary experience suggests that intraoperative MRI is a very useful tool to evaluate the extent of resection intraoperatively and the neurosurgeon can directly get the information of brain deformation and shift. This update information makes the accurate neuronavigation possible and real-time.

Interpretation of iMRI is complicated by artifacts which may be caused by surrounding environment such as the OR equipment and the whole electrical set-up. The patients have to be selected to fit the scanner. In order to get high quality of images, the target point have to be located at center of the scanner

5. Conclusions

The introduction of new, faster imaging sequences and targeting tools has helped to make the PoleStar N-20 a routine tool for intracranial surgical navigation, with the added benefit of updated imaging during the procedure. It is very useful tool to surgery that big brain shift happened during the craniotomy.