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Paul Kremer, MD, PhD, head of the neurosurgical department at Asklepios Clinic



Intra-operative MR enables superb resection in Hamburg

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When constructing a new neuro-OR building at Asklepios Clinic (Hamburg, Germany), the decision was made to include an intra-operative MR suite. To offset the potentially high costs of an MR system that might only be used a few times per week, a dual-use suite was designed for use both intra-operatively and by outpatients. So far, more than 1,000 patients have been scanned, about 30 of whom were examined intra-operatively.

Paul Kremer, MD, PhD, is head of the neurosurgical department at Asklepios Clinic, one of the first non-academic neurosurgery departments with intra-operative MRI. He helped to implement the intra-operative MRI suite in Heidelberg in 1995, then brought the concept to Asklepios, where the intra-operative MR suite was installed in July 2011.

“The difference between our center and others in the region is that we have a head and neck center, which includes ENT, facial maxillofacial surgery, neurosurgery, neurology, neuroradiology, neuropaediatrics and neuropathology,” says Dr. Kremer. “We do intra-operative MRI on Tuesdays and Fridays so we can share the imaging time with the other departments.”

Dr. Kremer says the intra-operative MRI is usually used for patients who are having surgery for gliomas, both malignant and benign. “It’s very important to check the resection because it’s difficult during the microsurgery to determine the tumor margins. It’s very difficult. That is why we perform intra-operative MRI, including different image types – T1- or T2-weighted imaging – to check the resection. In Heidelberg several studies were performed on the benefits for the patient, and these indeed showed a large benefit for the patient.”

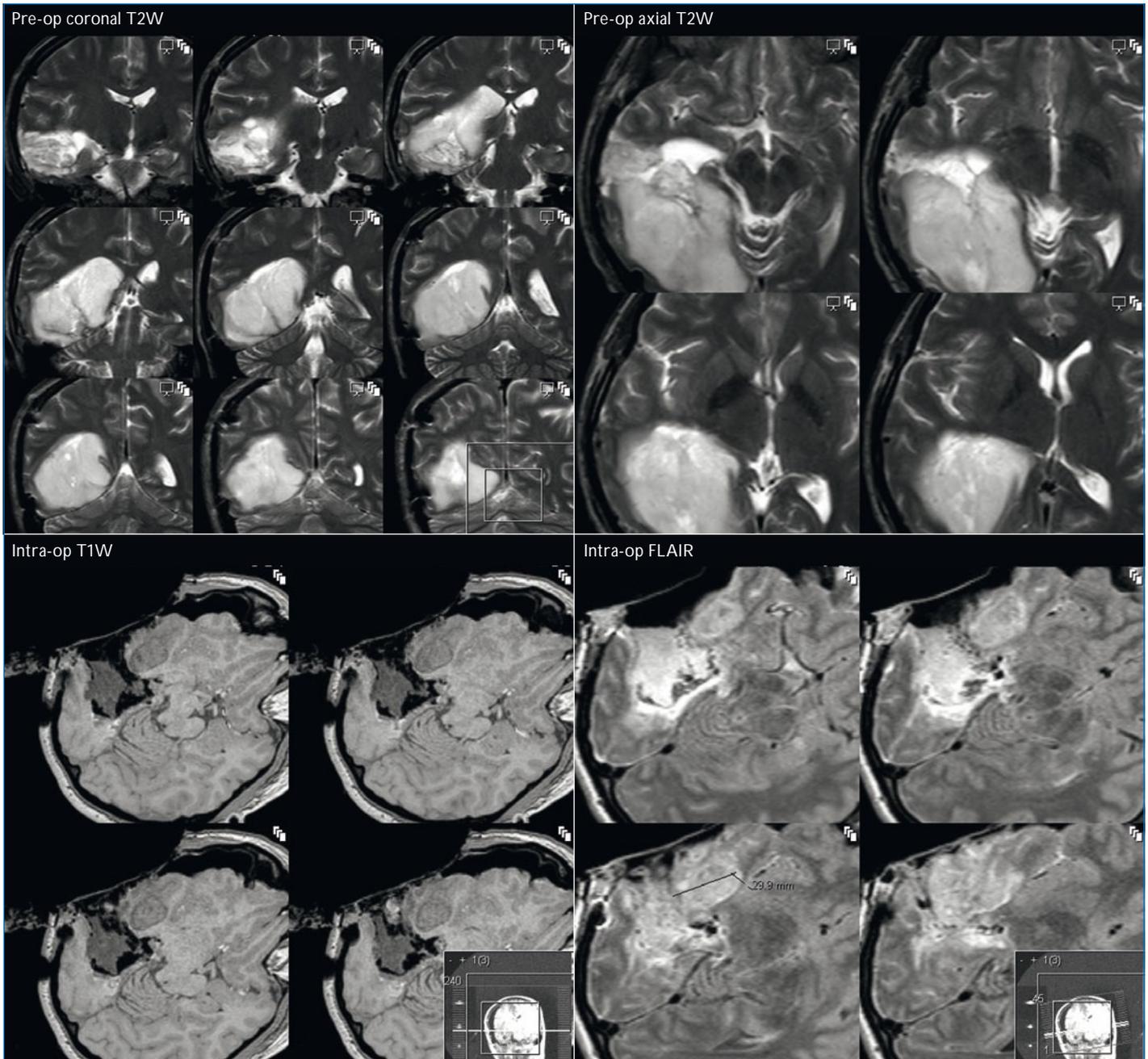
Special solutions for intra-operative MRI

There are several good reasons to have a dual-use MR scanner, from both a scheduling aspect and an economic one, but several challenges had to be overcome first.

“When using an MRI scanner only for intra-operative use, just one or two times a week, it’s too expensive,” says Dr. Kremer. “But the door between the OR room and the MR room allows us to directly go from the OR into the MR room for intra-operative MRI. And when the door is closed, the scanner can be used independently for regular MRI examinations. This is a very good approach.”

Special solutions were designed for intra-operative MR. “We use a trolley to transport the tabletop with the patient from the OR to the MRI system, and it works very smoothly,” Dr. Kremer explains. “Also very important is head fixation for neuro procedures. Fixation devices are usually made of metal, but we have found an MR-compatible solution.”

“The door between the OR and MR room allows direct transfer. When the door is closed, the scanner can be used independently for regular MRI examinations. This is a very good approach.”



Resection of anaplastic astrocytoma

A 31-year-old female with an incompletely resected tumor in another neurosurgical unit some months before. Pre-operative T2-weighted MRI demonstrates a huge residual tumor mass right temporal. The tumor was resected under neuro-navigational guidance. Intraoperative T1-weighted and FLAIR images show a complete tumor resection, however, some fluid contents within the resection area make interpretation of the intra-operative images more difficult. The patient could be discharged from the hospital 10 days after surgery with the recommendation of following chemotherapy.

Dr. Kremer explains that at Asklepios, the MR room and the OR room share an air-conditioning system, so the air in the magnet room is filtered by the same system as the OR. "First, the MR room is cleaned the day before a procedure," says Dr. Kremer, "Then we clean the magnet again one hour before the procedure. The room is closed for about half an hour, and all the air is treated again. The patient's head and surgical wound still is open but covered, and the patient is transported into the magnet room."

"It sounds like a difficult process, with the sterilization system, the trolley system, the head fixation system and the navigation system

all working at the same time," says Dr. Kremer. "But the results are very impressive."

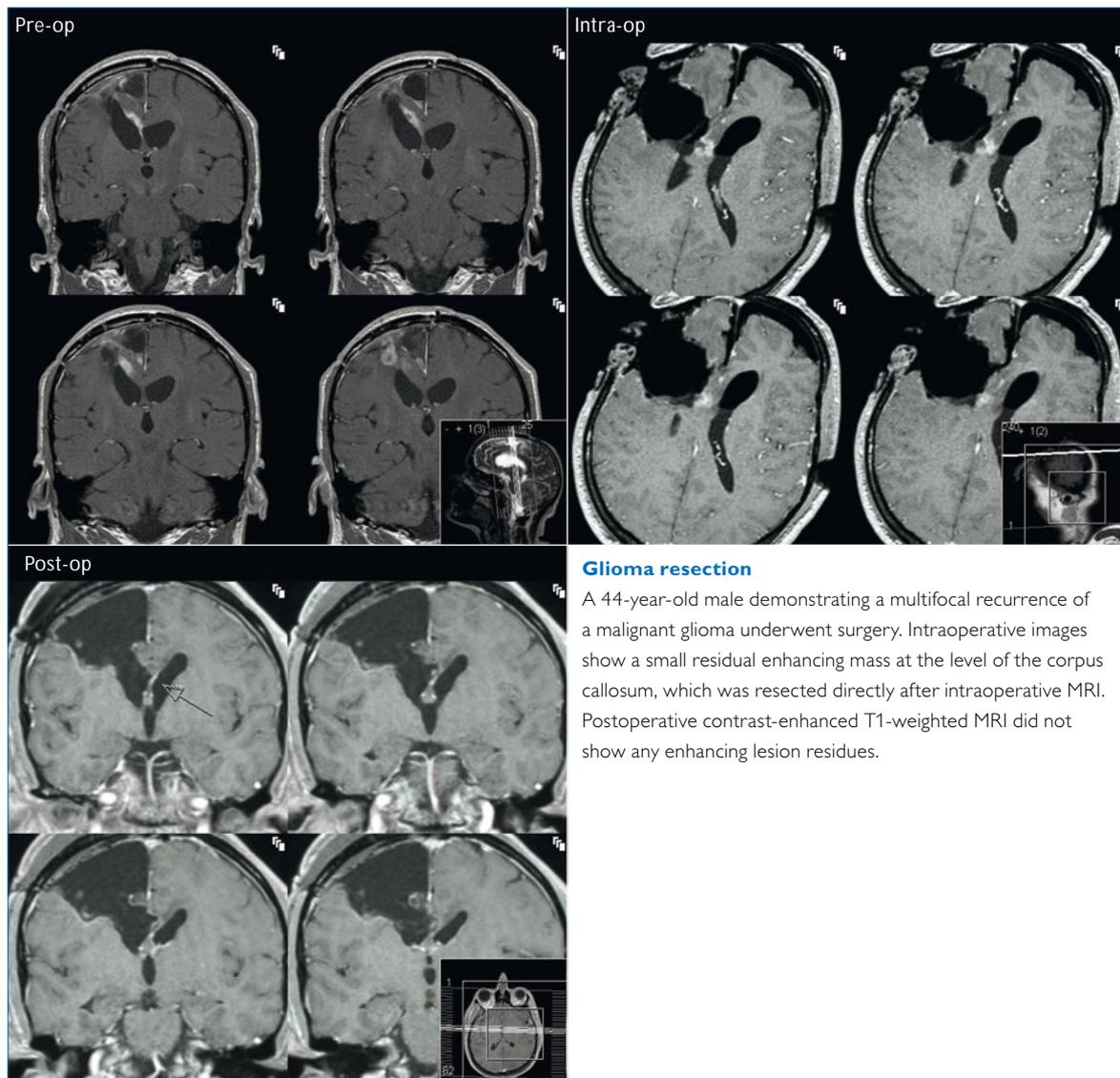
Resolution to see small remnants

"We have found the image quality is very good," says Dr. Kremer. "In Heidelberg we used a 0.2T magnet, and the imaging quality was quite nice. Now we have the Philips Achieva 1.5T magnet and the image quality is outstanding. It helps that the head of the patient is fixed into the head fixation system so the patient is lying motionless. We have the resolution to see small tumor remnants – it's really impressive."

"The time it takes for intra-operative imaging is about half an hour," explains Dr. Kremer.

"We bring the patient into the magnet, which is done quickly, then perform the imaging, and then the patient comes back into the OR and we can start the surgery again. If there are some tumor remnants we resect again; if not, we close the wound. We go back and forth as much as we need to."

Generally, the same sequences are used before and during the surgery. "If the tumor has shown contrast enhancement before, we also scan sequences with gadolinium during surgery; if there's no enhancement we use T2-weighted or FLAIR sequences. We can also do fiber tracking if we want." In the near future, the clinic plans to begin using fMRI as well. ■



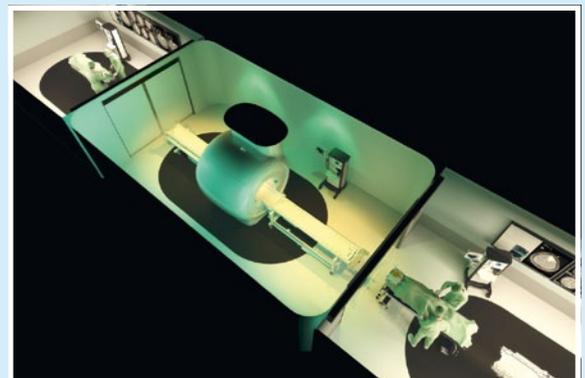
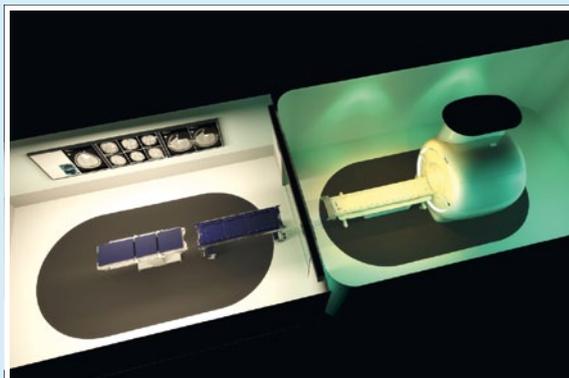
Glioma resection

A 44-year-old male demonstrating a multifocal recurrence of a malignant glioma underwent surgery. Intraoperative images show a small residual enhancing mass at the level of the corpus callosum, which was resected directly after intraoperative MRI. Postoperative contrast-enhanced T1-weighted MRI did not show any enhancing lesion residues.

“After intra-operative imaging the patient comes back into the OR. If there are some tumor remnants we resect again. We go back and forth as much as we need to.”

Philips intra-operative MRI takes next step with Ingenia MR-OR*

Philips has been a leader in interventional MR since 1995, and has been offering both 1.5T and 3.0T MR-guided neurosurgery. An MR-OR suite for intra-operative MRI adds value to neurosurgical facilities, supporting resection procedures that can save precious time for both surgeon and patient: when intra-operative MR reveals incomplete resection, the resection can be completed in the same procedure and reduce the need for subsequent surgery. When Philips introduced Ingenia, the first digital broadband MR system, the next generation MR-OR was conceived as well.



Wide-bore Ingenia 1.5T and 3.0T use dStream architecture, so that the signal is digitized in the coil at the patient and transported via fiber-optic cables, increasing SNR by up to 40% compared to its predecessor. MR-OR using Ingenia 1.5T or 3.0T provides faster, easier and comfortable intra-operative MRI. The dual-room concept is designed for high-end intra-operative MR with smooth workflow. It is developed to offer MR and OR, which can be used together or alone to promote high usage and cost effectiveness. For intra-operative use, the Ingenia is combined with a Maquet OR table, a choice of two types of head frames, and coils. It can be combined with neuro navigation systems such as those from BrainLAB or Medtronic.

MR-OR provides MRI during neurosurgery, enabling surgeons to see the results of the surgery before finishing it. Smooth in-line transfer of the patient between MR and OR keeps transfer times down to just a few minutes.

With front and rear docking capabilities to increase flexibility and throughput, as well as a 70 cm bore, the Ingenia MR-OR system is developed for both brain and spine neurosurgery, with a focus on fast, smooth workflow. It's the most versatile and fastest intra-operative MRI ever developed by Philips.

* Earliest availability of Ingenia MR-OR is expected end 2012.