

Hybrid MR and X-Ray Fluoroscopy

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Interventional Magnetic Resonance Imaging (IMRT) is gaining more and more widespread acceptance. The main clinical indications so far, are nonvascular interventions. Among those the marking and biopsy of breast lesions, which are only visible and detectable by MRI, is probably the most important clinical application. For most other indications IMRI is a “me-too application”, where MRI has to compete with Computed Tomography or Ultrasound for example. Different MR scanner types have been explored for IMRT¹. In addition new features had to be developed, i.e. communication within the room, availability of at least simple scan commands within the room and safety features to mention at few. In addition to these hard- and software problems related directly to the MR environment, special sequence development was necessary. For nonvascular but especially for vascular interventions real time imaging was needed. This was achieved along with good vessel contrast already at the end of the last century leading to more and more sophisticated MR-guided vascular interventions². Nonetheless, there are still drawbacks of the tomographic imaging modality MR compared to the projection technique of X-ray fluoroscopy. In order to easily find the tip of an interventional instrument, passive visualization techniques alone are inadequate, which lead to active techniques. These allow for reliable imaging of the instrument tip within a relatively thin two-dimensional MR imaging slice. By now different safe methods for active visualization have been proposed³. The availability of fully MR-compatible (and safe) interventional instruments turned out to be the major obstacle for vascular interventions. Up to now, there is still a need for the development of interventional guidewires for IMRI. Patient access is another issue, which has to be discussed for IMRI. Imaging close to the standard vascular access site in the groin for example, is not possible with closed bore magnets or at least very uncomfortable for the interventionalist. As a consequence of the above mentioned problems, there are three points, which motivate to have an X-ray system available during MR-guided vascular interventions: 1. availability of the full range of interventional instruments, 2. almost instant visualization of instruments as a backup possibility, 3. easy and full access to the patient.

Consequently, different setups have been built to combine an MR scanner with an X-ray fluoroscopy unit. The flexibility of use for these systems differs. Being placed in the same room only the use of one or the other system is possible. For two different systems standing apart in different rooms with the possibility for fast patient exchange between the systems a simultaneous use of both systems is possible. Indications for IMRT, openness of magnet design, development of interventional instruments and further improvement of real time MRI will decide about the further need for a backup X-ray system for IMRI, which is still mandatory for complex vascular interventions.

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