

MAGNETOM Trio Upgrade to Prisma^{fit} Better Imaging Technique Combined with Higher Throughput in Clinical Practice

Stephan Zangos; Thomas J. Vogl

Institute for Diagnostic and Interventional Radiology, University Hospital Frankfurt, Frankfurt/Main, Germany

The decision to purchase a new MRI system is based on several factors. The cost of the purchase and installation are a particularly important factor in such a decision. However, a new MRI system with innovative technology offers unique features and the opportunity to develop into new markets. The use of new technology can lead to improved patient comfort, better image quality and an increase in the number of examinations.

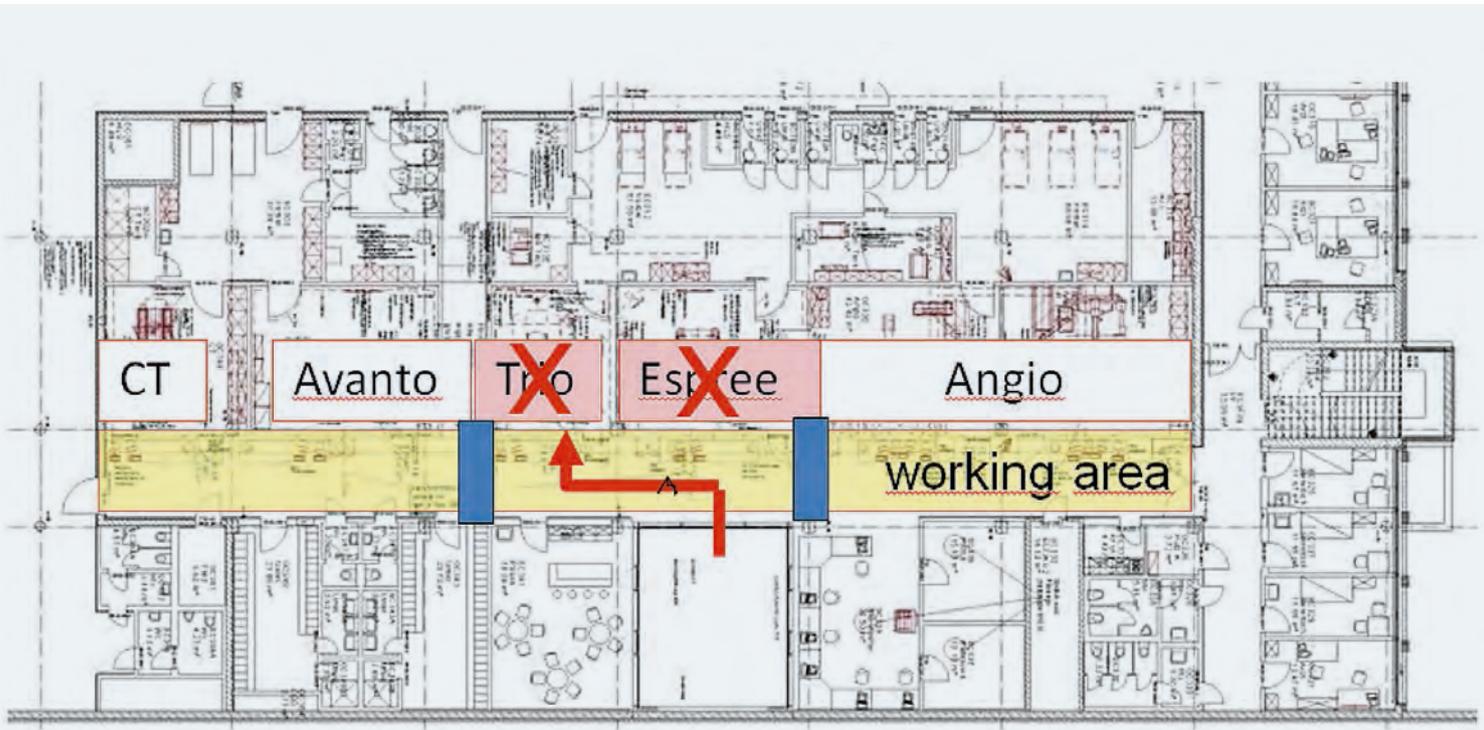
The installation of a new MRI system in an ongoing clinical routine always poses a logistical challenge. In a worst-case scenario this may involve the decommissioning of neighboring devices. However, replacing the devices after several years cannot be avoided for ever.

The MAGNETOM Trio a Tim System was used in the clinical routine in our institution for 6 years to obtain

images across the entire diagnostic spectrum, including angiograms, as well as musculoskeletal, thoracic and abdominal imaging.

In order to regain access to the latest MR technology in our clinic and to pursue new research areas, the possibility of a new acquisition was evaluated.

Due to the physical layout of our Institute, our working area would have



- 1 This plan shows the problem of access via the pathway to our department. This would require shutting down the 1.5T MAGNETOM Espree and 3T MAGNETOM Trio and installing dust protection walls (blue) to be used in the work area.



- 2 These images show the building steps during the fit-upgrade of the MAGNEOM Trio a Tim System (2A). After removing all the old system components (2B) the installation of the new Prisma^{fit} components was carried out by introducing the new gradients (2C) the new Tim covers (2D) and examination table (2E).

had to be used for the installation of this new device. This would have led to additional decommissioning of the neighboring 1.5T MAGNETOM Espree for at least 10 days (Fig. 1).

In addition to the initial cost of the new unit, considerable additional costs for the use of a crane, the cabin construction, the clearance of the transport paths and the restoration of the premises would have been incurred (Table 1). Examining alternatives, an upgrade to the Trio a Tim System was offered by a Prisma^{fit}. The upgrade included the latest MRI technology including an XR 80/200 gradient system, Tim 4G architecture and Dot (Day optimizing throughput) workflow engines. The new Tim table can combine up to 204 coil elements.

After analysis of the additional costs, an upgrade seemed to be the only economically meaningful option. After successfully upgrading our 1.5T

MAGNETOM Avanto to Avanto^{fit} in the spring, the decision was easily made for a MAGNETOM Prisma^{fit} upgrade.

During the upgrade of the scanner, the original 3 Tesla magnet was left in the magnet room (Fig. 2). All covers, the body coil, and the gradients were replaced with new ones. All analog cables were eliminated and the new all digital-in/ digital-out DirectRF design was installed directly at the scanner. In the technical room, all cabinets were removed and a new cooling control unit and gradient power amplifier were installed. Additionally, all workstations, monitors, and keyboards were removed and replaced with new ones. Finally, all installed licenses were migrated into the new software version *syngo* MR D13.

After installation and quality tests, the upgrade to the MAGNETOM Prisma^{fit} was completed in only

15 working days. A great advantage of this upgrade during the installation was that there were no restrictions to the operational capability of the surrounding MRI in the working area. For this reason, the upgrade could be made without limitations to patient care and the workflow. After a short training phase, the system was smoothly integrated into the clinical routine. Since the focus of our department is on abdominal and hepatobiliary imaging, the use of the Abdomen Dot Engine in particular has led to an improvement of the workflow.

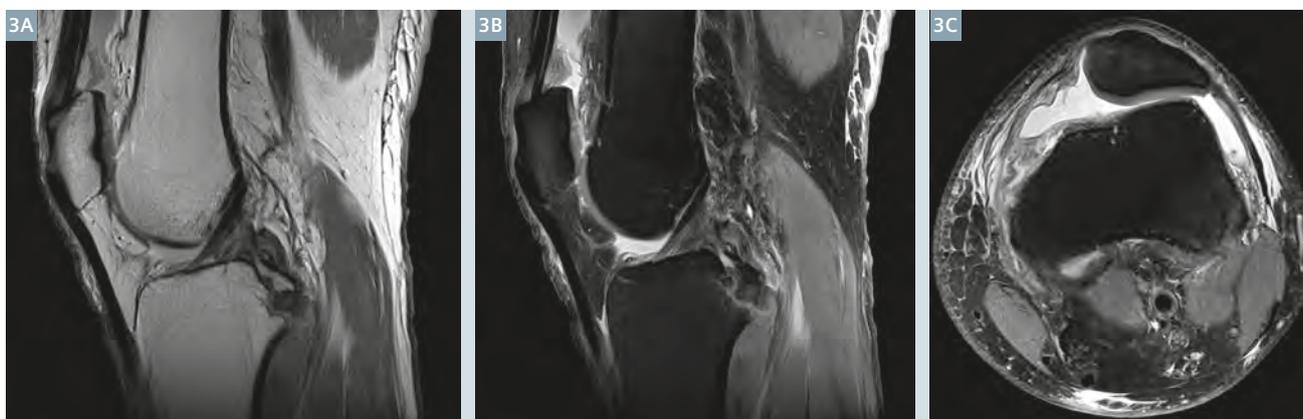
The resulting reproducibility of the investigations has led to a better comparability of the images during follow-up. In particular, the timing of the arterial phase is made much more efficient by using Dot. In general, the new technology has led to improvement in image quality. In liver imaging, the use of CAIPIRINHA Dixon VIBE technology has led to a significant improvement in image quality compared to the standard VIBE sequence.

For the technical staff, the Dot software provides a significant reduction in study planning and implementation through the automatic positioning of the examination area, as well as automatic breathing commands. In addition, the Dot engines are routinely used for neurological, cardiac, and spinal diagnostics. Whenever the workflow allows, we try to investigate the joints in the new 3 Tesla system due to the significantly better image quality compared to the other MRI systems in the department.

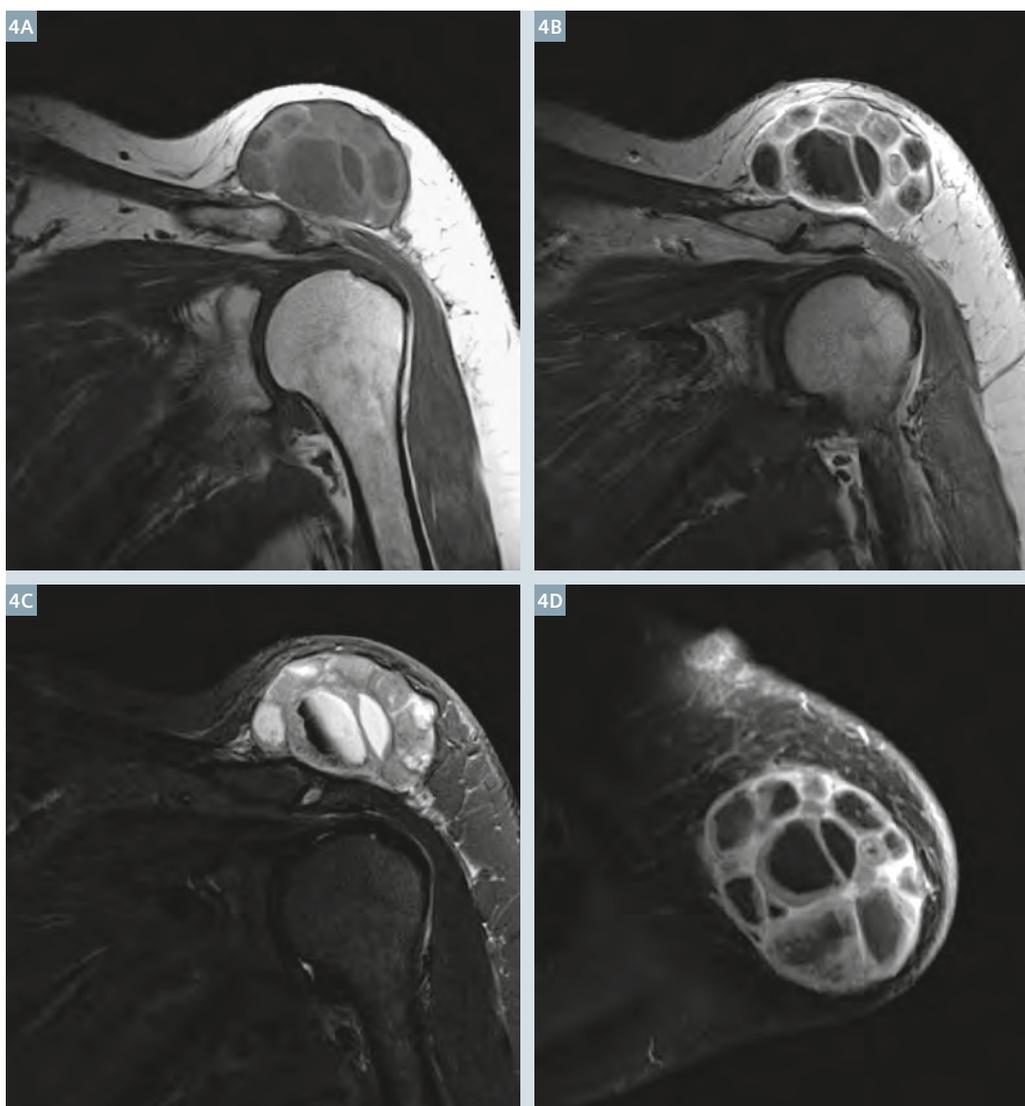
Over the last half year, the Prisma^{fit} could be used after the upgrade without any problems in routine clinical practice and research, and more than 1,700 patients have been examined to date. In particular, there has been improvement of image quality resulting in clinical partners stimulating demand for Prisma^{fit} examinations.

Table 1

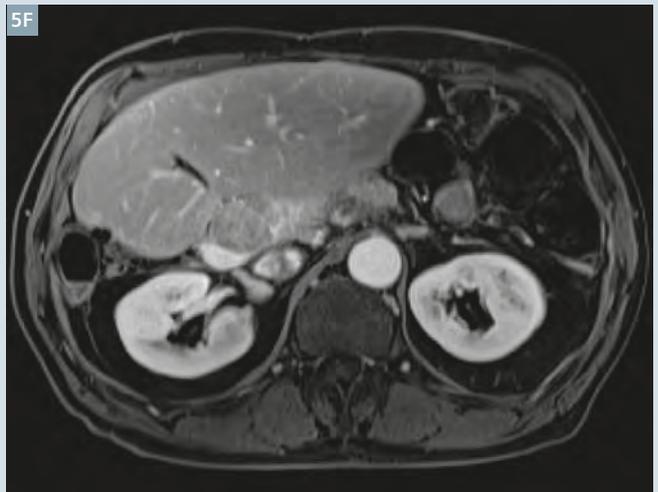
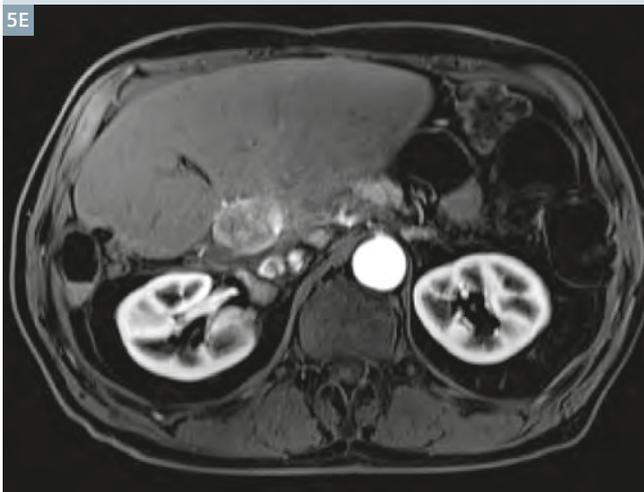
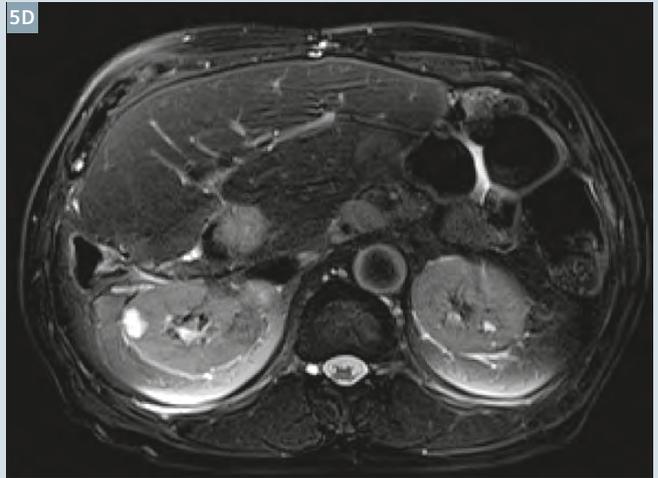
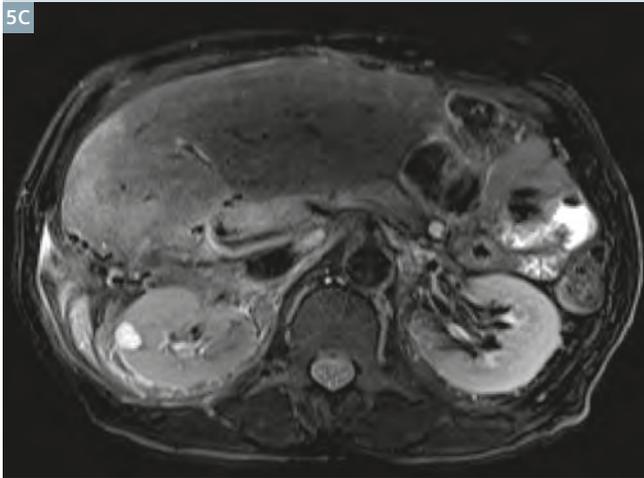
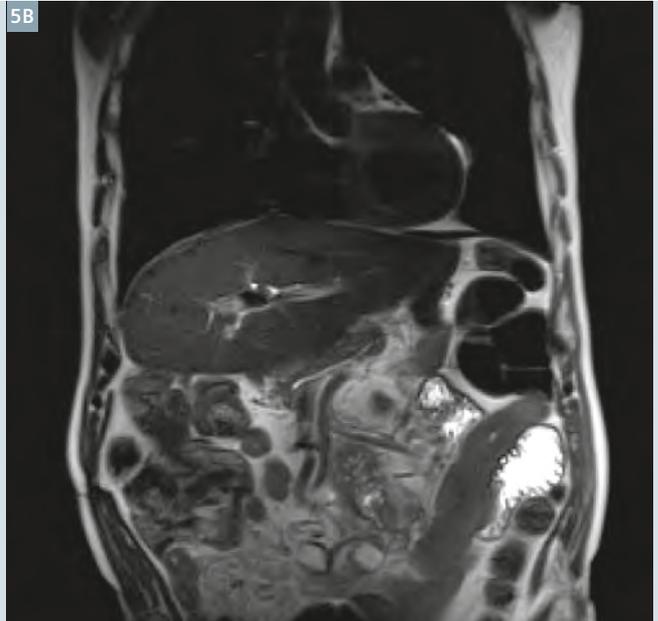
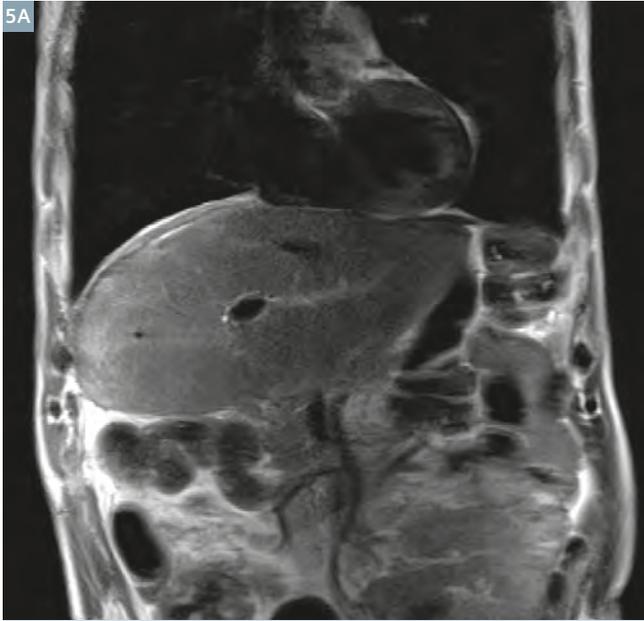
| Costs | Upgrade (fit) | Ex-Factory |
|---|-------------------------|-----------------------------|
| Invest costs | <<< | >>> |
| Local costs | | |
| Architectural | | |
| Structural | not necessary | new infrastructure |
| Power | not necessary | new infrastructure |
| Cooling | not necessary | new infrastructure |
| RF-Cabin | not necessary | high cost (customer choice) |
| Other | | |
| Crane | not necessary | depends on site, high cost |
| Local permits | not necessary | see above |
| System downtime | 15 working days | n.a. |
| Taxes | Local (Germany: 19%) | Local (Germany: 19%) |
| Applications Training Standard 1–2 (weeks) | equal for either option | |
| Service | equal for either option | |
| Table 1 shows a comparison of the construction costs between an upgrade and a new installation. | | |

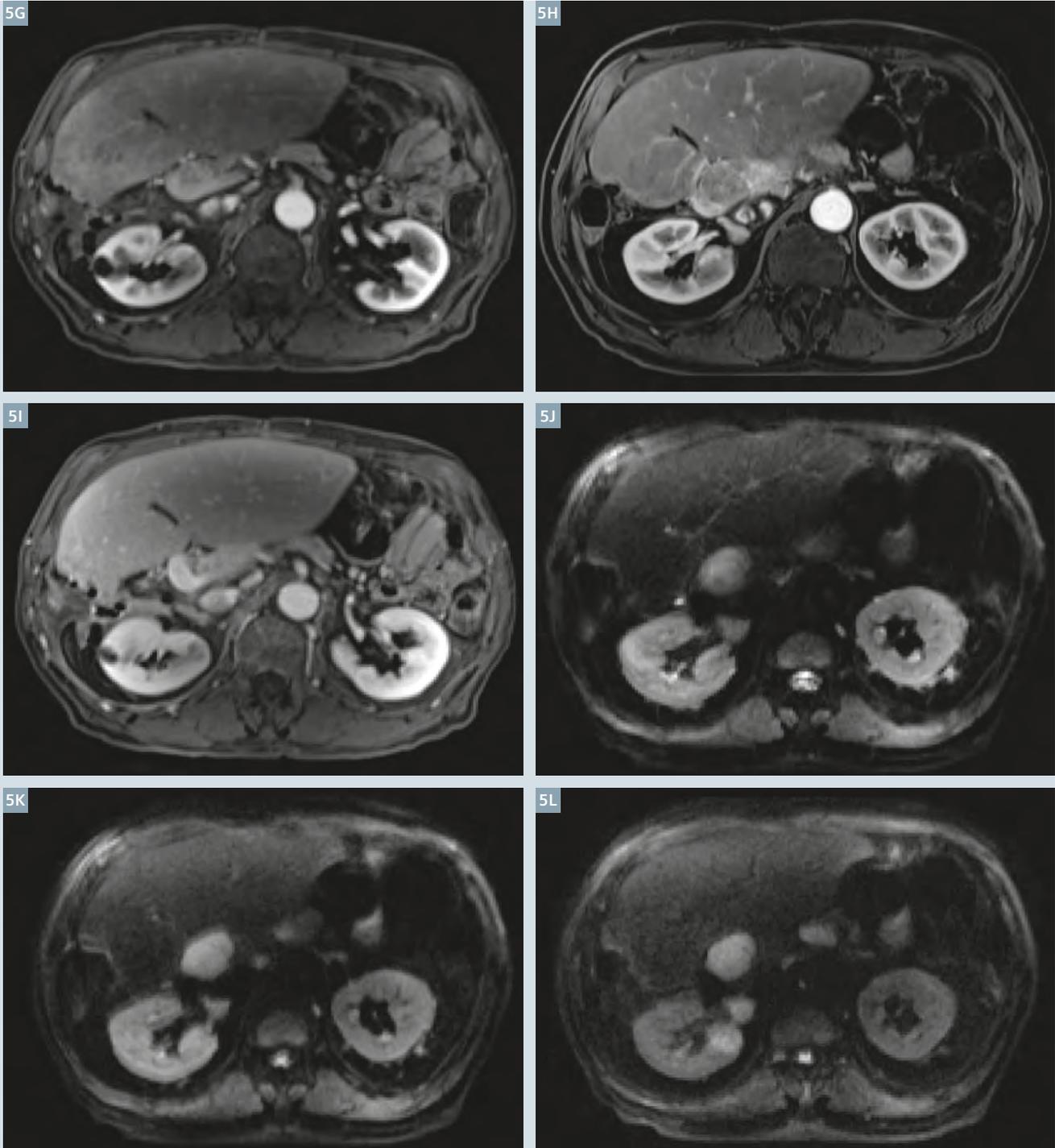


3 Figure 3 shows a patient with bony avulsion of the posterior cruciate ligament: T1-weighted (**3A**) and T2w PD FS sequences (**3B, C**) in sagittal and transverse orientation. For imaging, a 15-channel knee coil was used.

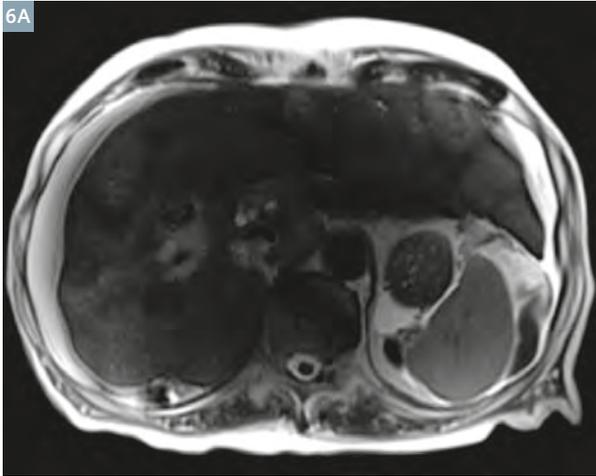


4 Metastasis of a malignant melanoma investigated in a shoulder coil. Native and contrast-enhanced T1w sequences (**4A, B**) and T2w PD FS (**4C**) in paracoronal orientation. Contrast-enhanced T1w FS sequence in transverse orientation (**4D**).

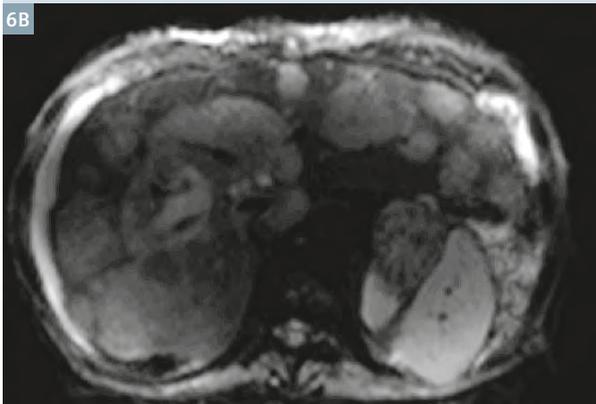




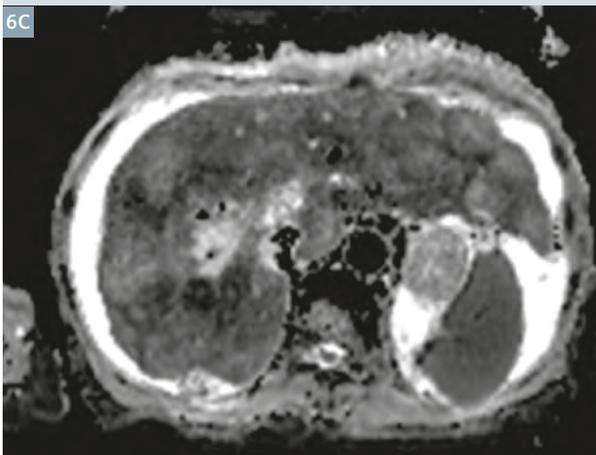
5 Staging in a patient with a neuroendocrine tumor of the pancreas. In the follow-up, one examination was performed with the MAGNETOM Trio a Tim System and one with the Prisma^{fit}. In direct comparison, an improvement in image quality could be observed in all sequences after the upgrade: Coronal HASTE sequence (Trio vs. Prisma^{fit}) (5A, B) / T2-weighted TSE FS (Trio vs. Prisma^{fit}) (5C, D) / T1-weighted VIBE FS (Trio) (5E, F) vs. CAIPIRINHA Dixon VIBE (Prisma^{fit} early and late arterial, venous phase) (5G–L). But even in the diffusion-weighted scans (b 50/400/800) the anatomical structures and pathologies can be better distinguished after the upgrade.



6
Even in patients with ascites, examinations on a 3 Tesla system are possible due to the new technology by the Prisma^{fit} upgrade.
(6A) HASTE sequence



(6B) diffusion-weighted imaging



(6C) ADC map

In our department, work is ongoing to optimize MRI scanning techniques in various parts of the body and for various diseases.

Summary

We have implemented the first upgrade of a MAGNETOM Trio a Tim System to a MAGNETOM Prisma^{fit} without any problems either during or after the upgrade. This upgrade has allowed us to access the latest technology on a 3T system for research and in daily routine, which has led to a significant improvement in image quality as well as the facilitation of the workflow through the use of Dot technology.

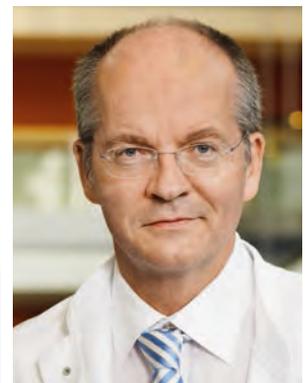
Prisma^{fit} is not commercially available in all countries. Due to regulatory reasons its future availability cannot be guaranteed.

Contact

Prof. Dr. med. Stephan Zangos
Institute for Diagnostic and Interventional Radiology
University Hospital Frankfurt
Theodor-Stern-Kai 7
Haus 23c
60590 Frankfurt am Main
Germany
Phone: + 49 (0)69 6301-87287
Fax: +49 (0)69 6301-7288
zangos@em.uni-frankfurt.de



Stephan Zangos



Thomas J. Vogl