CASE REPORT

Clinical Application for High Resolution 3D Free Breathing Technique

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Introduction

Thin slice 3D imaging has become a vital technique in today's diagnostic imaging environment for its ability to acquire microstructure and detailed anatomical position in relation to lesions. The major advantage of this sequence is to be able to reconstruct 3D volume in any direction without loss of detailed anatomical information. However, in terms of clinical application, this sequence has several disadvantages which including being more susceptible to movement and longer scan time compared to 2-D imaging.

Quick Star: Abdominal diagnostic imaging in a free breathing state

Quick Star sequence incorporates radial sampling data acquisition from the center in-plane direction and orthogonally in slice direction. This technique delivers high-resolution 3D T1-weighted images that are less influenced by body movements in a free breathing state. As shown in Figure 1, Quick Star is less susceptible to movement because it repeatedly collects data near the center of the k-space.

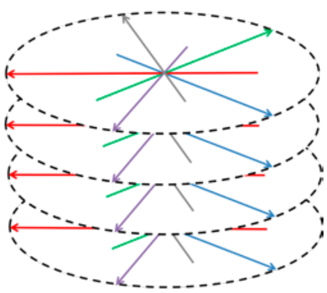

Figure 1: Quick Star: Filling the k-space --- Less susceptible to movements due to repeated collection of data near the center of the k-space.

Figure 2 shows an EOB-DTPA-MRI (T1-weighted image of pre-imaging fat suppression), taken as part of post-treatment follow-up care of a patient with hepatocellular carcinoma. While the standard fat suppression 3D T1-weighted image (Figure 2-1) fails to precisely show the treated site and vascular architecture, Quick Star (Figure 2-2)

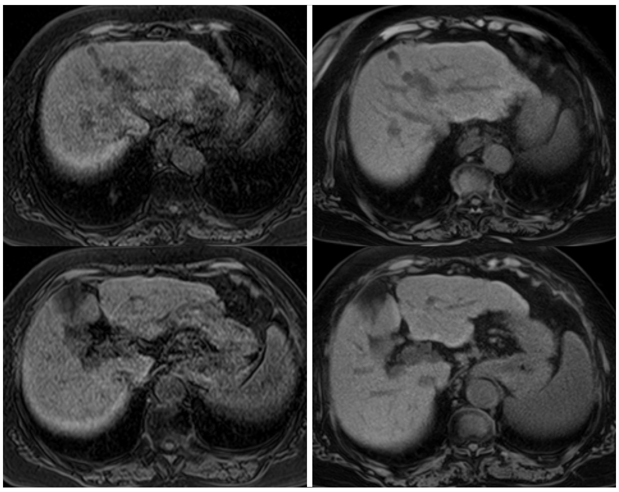

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Figure 2: Quick Star: Liver images of a patient with difficulty in holding his/her breath, taken in a breath hold state FFE3D (2-1) vs. taken in a free breathing state Quick Star (2-2) offering a high-resolution, clear image of the treated site and vascular architecture.

shows the lesion with higher clarity, which is beneficial for diagnosis. Quick Star is applicable to hepatobiliary phase of EOB-MRI and contrast-enhanced MRI of various regions. It is also an effective tool for the imaging of trunk areas of patients who have difficulty in holding their breath.

Fast 3D: State-of-the-art fast imaging technique

Fast 3D utilizes a scan mode that continuously collects data by encoding multiple numbers of slices within TR, primarily to deliver shorter imaging time and better image quality. As shown in Figure 3, k-space fills radially from the center outward on PE and SE slice by slice. The technique achieves shorter imaging time by combining with AFI in the PE direction without collecting data in the corners of the k-space.

Figure 4 shows MR images of a case with orbital pseudotumor in right side (T1-weighted image of post-imaging fat suppression). Fast 3D shortens imaging time while maintaining high quality images comparable to those offered by conventional techniques, contributing to workflow improvements in routine medical care. It also delivers improved image quality without extending imaging time when compared to existing FASE3D (Figure 4-3) through increased number of acquisitions (NAQ). Because Fast 3D utilizes SE sequences, vascular architecture is acquired even with low signals, delivering clearer images of lesions adjacent to vessels. In addition, Fast 3D has a tolerance for heterogeneous magnetic fields and is useful for acquiring lesions in the base of the skull and posterior fossa. As shown in Figure 4, Fast 3D (Figure 4-2) clearly shows the orbital tumor whereas in FFE3D (Figure 4-1), the margin of the tumor is not clear because of the susceptibility artifact caused by nasal sinues.

Conclusion

Quick Star delivers high resolution T1-weighted abdominal images in a free breathing state, while Fast 3D achieves shorter imaging time and high quality images as a result of increased NAQ. These sequences can potentially address shortcomings of 3D Imaging, applicable to various target regions in a clinical setting.

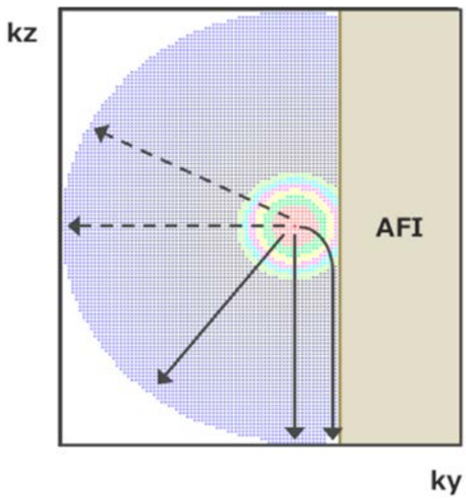

Figure 3: Fast 3D: Filling the k-space radially from the center outward on PE and SE flat surfaces.

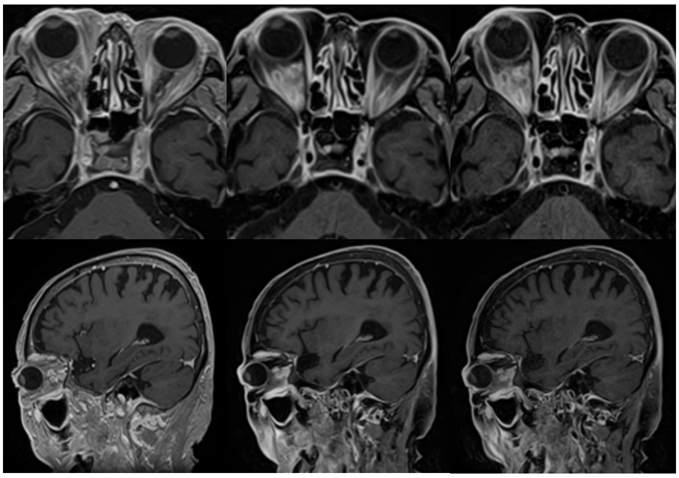

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Figure 4: Comparison ---- (4-1) FFE 3D, (4-2) Fast 3D, (4-3) Existing FASE3D Existing FASE3D takes 5 minutes 3 seconds (NAQ = 1) while it is 4 minutes 27 seconds for Fast 3D (NAQ = 2). Fast 3D delivers high quality images while reducing imaging scan time. (Voxel sizes of the three techniques are 1.1*1.1*1.0 mm.)

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