# Segmented-True FISP for abdominal MR imaging: assessment of the portal vein, the hepatic vein and the bile duct

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## Introduction

TrueFISP (fast imaging with steady-state free precession) is a fast imaging that provides high SNR (signal to noise ratio) and has been applied to abdominal imaging (1)(2). The contrast of this sequence depends on the mixture of T2/T1, and water or vessels with slow flow are usually demonstrated as high signal intensity on TrueFISP. Therefore TrueFISP is potentially suited for visualization of portal veins, hepatic veins and bile ducts, and moreover the fat suppression technique would improve the quality of the images. However, the number of segmentation of the k-space influences the fat saturation effect. In addition, the flip angle is known as an important factor that affects the relaxation time of target tissue (3). With these backgrounds, the purpose of this study was to optimize segmented and fat-suppressed True FISP sequence for the imaging of portal veins, hepatic veins and bile ducts.

## Methods

All examinations were performed on a 1.5T MR scanner (Magnetom Symphony, Siemens AG). Each measurement was performed on the liver parenchyma phantom (agars/ Gd-DTPA phantom), saline (as for vessels and bile ducts phantom), olive oil (as for fat tissue phantom) and 5 healthy volunteers. A CP head coil was used in phantom studies and a 4-element phased body array coil was used in volunteer studies. Segmented True FISP images with chemical fat suppression pulse (FS segmented TrueFISP) was obtained with the following parameters: TR/ TE = 1.8 ms/ 3.6 ms, FOV = 375 mm, bandwidth = 1026 Hz/ pixel, and matrix size = 256 x 256. First, FS segmented True FISP images were applied to the phantoms studies with various flip angles of 5 to 65 degrees and k space segmentations of 3 to 99. Next, healthy volunteers were imaged with FS segmented True FISP sequence with variable parameters like as phantom study. Each image was analyzed for signal intensity (SI) and contrast ratio ((SIa-SIb)/{(SIa+SIb)/2}) measurement.

## Results

In the liver parenchyma phantom studies, the maximum signal intensity was obtained with flip angle of 45 degrees and there were no differences between 45, 55 and 65 degrees. In contrast, the larger the flip angle was, the higher the signal intensity of the saline and oil phantoms was. As a result, the largest flip angle of 65 degree provided the best contrast ratio between the saline, oil, and liver parenchyma phantom (Fig.1). For k-space segmentations, the larger the number of the segmentation was, the lower the signal intensity of the liver parenchyma phantom was, then the largest 99 of segmentation provided the best contrast ratio between the saline and liver parenchyma phantoms (Fig.2). However, the signal intensity of the oil phantom was higher than that of the liver parenchyma at 99 of segmentation (Fig.2). With these results, 75 segments were required to optimize the images with the better contrast ratio between the liver parenchyma and saline phantom. The volunteer studies also revealed that the flip angle of 65 degrees and the 75 segments was recommended. Optimized FS segmented TrueFISP images showed the excellent anatomical delineation of the portal vein, hepatic vein, and common bile duct in all 5 volunteers (Fig.3).

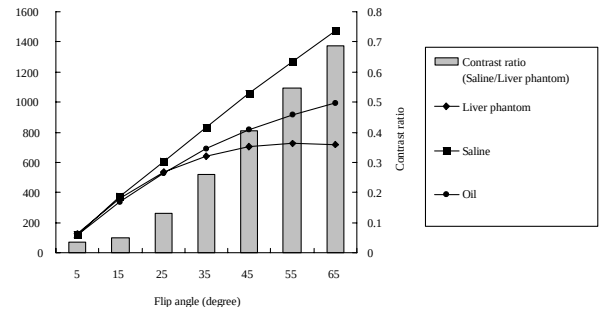


Figure 1. Contrast ratio and signal intensity related with the flip angle.

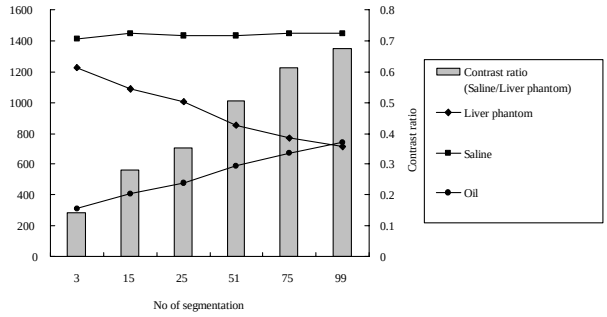


Figure 2. Contrast ratio and signal intensity related with segmentations

## Conclusions

FS segmented True FISP provided the anatomical delineation of portal veins, hepatic veins and bile ducts with excellent image quality. The large flip angle of 65 degrees and 75 segments were suggested to optimize the images.

## Reference

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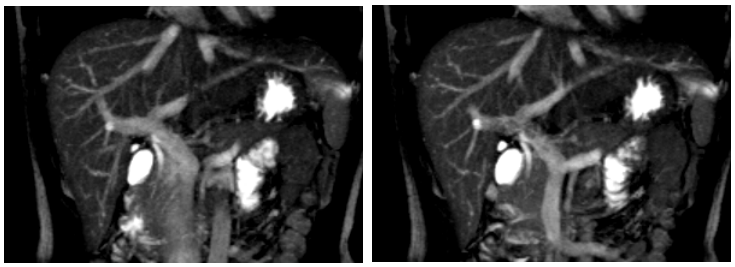

Figure 3. The images of portal vein, hepatic vein, and common bile duct obtained with optimized FS segmented TrueFISP sequence.