Simultaneous image acquisition of human extremities using a super-parallel MRI

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INTRODUCTION

MR imaging of human extremities such as hand, foot, ankle, and knee requires intense magnetic field gradients as well as high signal to noise ratio (SNR) of the NMR signal, because high spatial resolution is required. However, conventional whole body MRI systems do not have sufficient magnetic field gradient strengths for this purpose. In such case, use of insertable or local gradient coils is desirable (1). In this study, we have used a novel MRI system (the super-parallel MRI) that has a local gradient coil with two homogeneous regions where intense magnetic field gradients are available, and demonstrated the advantage of the system for the musculoskeletal system.

MATERIALS AND METHODS

A super-parallel MRI system implemented on a permanent magnet (magnetic field strength: 0.2 T, gap width: 25 cm, homogeneous region: 15 cm dsv) was used in this study (Fig.1) (2-4). This system has a two-channel gradient coil array and two parallel transceiver units. The gap width of the gradient sets was 96 mm. The maximum field gradients were 20 mT/m, 21 mT/m, and 49 mT/m for Gx, Gy, and Gz, when a 3 channel 10 A constant current power supply was used. Two oval aperture solenoid RF coils (aperture: 93 mm × 53 mm, 13 turns) were used for simultaneous image acquisition of extremities.

RESULTS AND DISCUSSION

Figures 2 and 3 show 2D cross sections selected from 3D image datasets of both wrists of a subject simultaneously acquired with a gradient echo sequence (TR/TE/FA=50 ms/6 ms/60°, NEX = 2, image matrix: 256 × 256 × 32, voxel size: 0.5 mm × 0.5mm × 2mm). Anatomical structures of the wrists are clearly visualized. Figures 4 and 5 show 2D cross sections of both wrists of another subject simultaneously acquired with a STIR sequence (TR/TE/TI =1000 ms/40 ms/100 ms, NEX = 4, image matrix: 256 × 256, slice thickness: 16 mm, voxel size: 0.5 mm × 0.5mm). Bone marrow fat signal is well suppressed and joint fluid is visualized.

Advantages of the super-parallel MRI for human extremities over conventional MRI systems are two-fold acceleration with no SNR penalty and availability of intense magnetic field gradients. Because the super-parallel MRI architecture can be combined with conventional parallel MRI, the acceleration rate can be further improved.

Fig.1 Super-parallel MRI

Fig.2 Left wrist (GE)

Fig.3 Right wrist (GE)

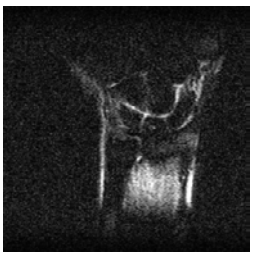

Fig.4 Left wrist (STIR)

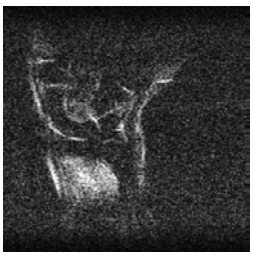

Fig.5 Right wrist (STIR)

CONCLUSION

The super-parallel MRI was applied to wrist imaging and two-fold acceleration was demonstrated. Because the super-parallel MRI architecture can be combined with conventional parallel MRI, the acceleration rate can be further improved.

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