Comparison of Stationary and Moving Surface Coil Setups for Continuously Moving Table MRI

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INTRODUCTION

Moving table acquisition techniques provide the advantage of continuous whole body imaging within a single measurement, without temporal or spatial discontinuities of the acquisition. There are several approaches to signal reception: The use of the body coil suffers from low signal-to-noise ratio (SNR) [1][2]. Surface coils can either be positioned on the moving patient, or be mounted to the magnet as close to the moving patient as possible. Here, the latter two approaches are compared concerning image quality and SNR. Advantages and drawbacks of both setups are discussed.

MATERIALS AND METHODS

All experiments were performed on a 1.5T whole body scanner (MAGNETOM Sonata, Siemens Medical Solutions, Erlangen, Germany). Setup A consisted of a commercially available rolling table platform (AngioSURF, MR Innovation, Essen, Germany). The table was controlled by a homemade rf-shielded electrical device to obtain a continuous table movement. For detection of the MR signal two original phased array coils (body array and a subset of the spine array) were used, which were placed in the isocenter of the magnet using the AngioSURF mounts [3]. The rolling platform and the patient were then moved between the two coil arrays. For setup B the original patient table with a modified drive for reduced rf interference was used. The locally available coil setup (CP head coil, spine array, and body array) was placed on the scanned object, using the coil connectors integrated into the patient table. The signals of all coil elements were acquired simultaneously using the systems 8-channel receiver.

To obtain a diagnostic T_2-contrast we established an axial imaging technique on the basis of a single-shot RARE with Half-Fourier-reconstruction (HASTE). Due to rf absorption rate (SAR) concerns, the rf power was minimized using TRAPS [4]. The experimental parameters were as follows: TE 77ms, TR 833/400ms (setup A/B), 3 slices, slice thickness 6mm, in-plane resolution (1.6x1.6)mm^2, echo spacing 4.2ms, 270/135 repetitions (A/B), total measurement time approximately 11/2.3min (A/B), table speed 2.4/5mm/s (A/B). Image reconstruction consisted of the standard Fourier transform reconstruction provided by the scanner. Written informed consent was obtained from each subject prior to the experiment. The study was approved by the local ethics committee.

RESULTS

Figure 1 shows T_2-weighted axial slices and coronal reformations obtained with setup A (AngioSURF, a, c) and setup B (patient table, b, d). Neither breathing artifacts nor saturation artifacts due to the excitation of neighboring slices are visible in the original axial images (fig. 1 a, b). Slight stripe artifacts due to free breathing can be seen in the coronal reformations (fig. 1 c, d). The spatial shift in the slice positions for different phase encoding steps within the same echo train does not result in visible image artifacts, either.

While the images obtained with the AngioSURF platform show a more homogeneous intensity profile, the images obtained with the patient table possess a slightly better contrast. The SNR was determined in the gray matter of the brain, where both methods show a similar SNR of approx. 52.

DISCUSSION

The achieved image quality of the original, axial images is very similar for both approaches. With the two presented experimental setups continuous whole body imaging can be easily performed without any breathing artifacts or artifacts due to table motion.

Excitation adjustments neglected, setup A should theoretically have a more homogeneous distribution of local SNR, since the slice position relative to the coil arrangement is fixed, while setup B should provide a higher maximum local SNR, because the coils are closer to the body. For the comparison here, coils optimized for direct contact with the patient are also used for setup A, which might be sub-optimal. With optimized coils this approach could be best for systems with a limited number of local coils and/or receiver channels. Using the total available range of coils for setup B would provide full coverage of the body, and would improve the homogeneity of image intensity as well as local SNR.

A problem of setup B is the restriction of the current hardware to approx. 1.4m translational range through the isocenter of the magnet, so that the human body cannot be scanned completely in one sweep. Patient comfort is definitely higher with the patient table than with the rolling table platform, since the latter reduces the available vertical space inside the scanner, and has a width of only 50cm. This makes the use of setup A for very large patients difficult.

To further increase the diagnostic potential of the measurements, short tau inversion recovery (STIR) imaging by means of an inversion recovery preparation is currently being investigated.

CONCLUSION

No fundamental differences between the two presented approaches could be found. Both result in good image quality and high SNR through the use of surface coils.

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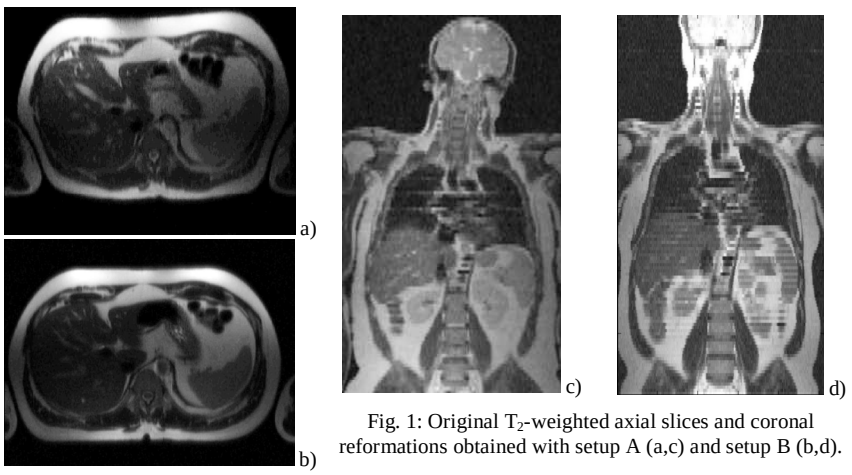

Fig. 1: Original T_2-weighted axial slices and coronal reformations obtained with setup A (a,c) and setup B (b,d).