Adaptive Slice Shifting for Continuous Moving Table Acquisition Using hyperHASTE

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INTRODUCTION

Compared to multistation techniques moving table techniques provide the advantage of a continuous imaging in which the whole body is scanned in a single measurement without temporal or spatial steps of the acquisition [1]. An axial imaging technique on the basis of a single-shot RARE with Half-Fourier-reconstruction (HASTE) in combination with a continuous table movement and hyperecho signal formation has already been presented [2]. Compared to other continuous moving table acquisitions, the HASTE sequence provided regular T_2-contrast and proved to be motion insensitive to free breathing and table motion, since slow table speeds of 2.4mm/s were chosen. Table speeds above 5mm/s however, caused a loss in image quality and signal-to-noise ratio (SNR), since due to the continuous table movement the refocusing pulses do not exactly affect the same slice as the excitation pulse. To account for this spatial shift and to allow faster table motions, the slice position for each refocusing pulse within one echo train of the hyperHASTE sequence was adapted to the table motion providing regular T_2-weighted images for clinical diagnosis without any loss in SNR and image quality.

MATERIALS AND METHODS

All experiments were performed on a 1.5T whole body scanner (Siemens Sonata) using local coil arrays. The moving table (AngioSURF™) was controlled by a homemade RF shielded electrical drive. For regular T_2-weighted images a single-shot HASTE sequence with the use of the TRAPS algorithm (hyperHASTE) to reduce the RF power was chosen [3]. To obtain similar image quality and SNR with faster table motions compared to a stationary acquisition, the hyperHASTE sequence was modified by adapting the slice position for each refocusing pulse to the actual table speed. This slice shift itself results in a change of the frequencies for the refocusing pulses to account for the spatial shifts between the excitation and the refocusing pulses. To compare the image quality and the SNR, images with and without adaptive slice shifting were acquired while the table moved with constant speed of 10mm/s. The experimental parameters were as follows: TE/TR=77/833ms, 3 slices, slice distance=24mmm, slice thickness=6mm, Matrix size=256x176, in-plane resolution=(1.6x1.6)mm2, ESP=4.2ms, 195 repetitions, total measurement time approx. 4min.

RESULTS

Two examples of original axial slices with and without adaptive slice shifting are shown in ***Fig. 1***. Although the images without adaptive slice shifting appear to be more noisy, no visible image artifacts due to faster table motion can be seen in both cases. All images are free of breathing and saturation artifacts. To get a quantitative comparison of the image quality, the SNR was determined in the gray matter, the liver and in the abdominal fat in both cases. The results are shown in ***Tab. 1***.

	with slice Shifting	without slice Shifting
SNR gray matter	44.6	34.8
SNR abdominal fat	57.3	50.1
SNR liver	33.9	20.5

Tab.1

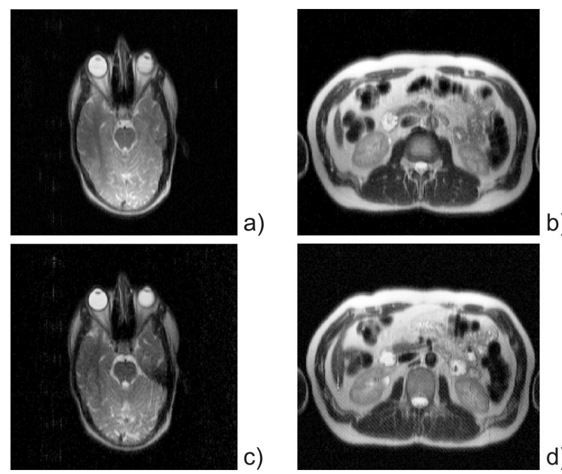

Fig. 1: Original T_2-weighted axial images obtained with hyperHASTE ***a)*** to ***b)*** with adaptive slice shifting and ***c)*** to ***d)*** without adaptive slice shifting.

DISCUSSION

For higher table speeds above 5mm/s during continuous whole body imaging using RARE-based sequences, it could be demonstrated, that it is necessary to adapt the slice position for the refocusing pulses within one echo train to the actual table speed. With the implemented adaptive slice shifting regular T_2-weighted data sets of the whole human body could be acquired in less than 5 minutes without any loss in image quality and SNR compared to a stationary acquisition. This fast acquisition technique is only possible in combination with the TRAPS algorithm to reduce the RF power. The adaptive slice shifting seems to be a robust method to enable faster table speeds during continuous whole body imaging resulting in less than half the measurement time as usually needed. A future clinic application will be a fast and effective method for metastasis screening.

REFERENCES

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