Three Dimensional SPI PC-MRA at 3 Tesla

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INTRODUCTION: A three-dimensional Spiral Projection Imaging (SPI) trajectory[(1)] has excellent potential for Phase Contrast MRA (PC-MRA)[(2)] because each encoding trajectory begins from the center of k-space. With no slice select gradient employed, there are low contributions from the imaging gradients to the motion-encoding moments. Its rapid scan times enable the use of multiple-Venc scans, which can use high-Venc data to unalias very high SNR low-Venc data[(2,3)]. This work investigates 3D SPI PC-MRA on GE 3T94 EXCITE scanner and HD 8 channel high resolution brain array. We also investigate the effect of retrospective ECG gating on head blood vessels.

METHODS and RESULTS: Three-dimensional SPI PC-MRA has been deployed a GE 3T EXCITE scanner. Typical parameters for application this sequence in the head using the HD 8 channel high resolution coil are: $(24\ cm)^3$ FOV, $(0.8\ mm)^3$ resolution, TR 26ms, 20 variable density spiral interleafs per spiral plane, 120 planes, scan time 1minute or less (depending upon the # of interleaves and degree of undersampling) per volume. This technique uses 7 sets of velocity encodings, for a total scan time of 7 minutes. Phase contrast images are reconstructed as shown in Fig.1[(4)] in each orthogonal direction for low-Venc and high-Venc. High SNR low-Venc data are then unaliased using high-Venc and signal loss data[(2)]. The image shown in Fig. 3 is the rms velocity for unaliased high SNR low-Venc data reconstructed using measured ECG waveform to weight the data (Fig. 4) during sampling density correction.

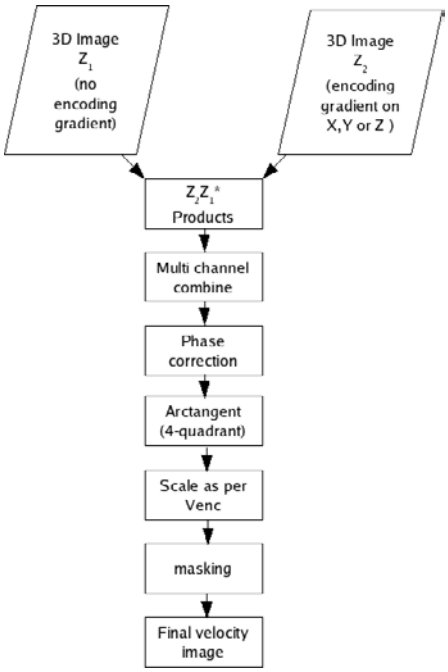

Fig.1 flowchart for multichannel PC-MRA

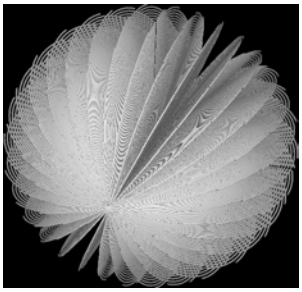

Fig.2 Illustration of the Spiral Projection Imaging 3D trajectory

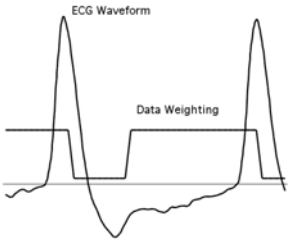

Fig.4 data weighting according to ECG waveform

Fig.3 Axial limited MIP of unaliased high SNR low-Venc acquired using the SPI PC-MRA in a normal volunteer (Low-Venc=20cm/sec, High-Venc 80 cm/sec) .

DISCUSSION: Implementation of this technique on a 3T scanner with an 8 channel coil improves SNR significantly. Blurring at 3T is worse compare to 1.5T but expansion of current 2D deblurring methods[(5,6)] may improve image quality as well as allow longer ADC values to be used, increasing the SNR and efficiency of this method. Aliasing effects are less pronounced than with a quadrature head coil, due to the 8 channel coil's reduced FOV. Implementation of motion correction techniques should also improve the image quality, especially in the case of patient movement.

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