Single breath-hold 3D cine imaging of the thorax using a new 32 element cardiac coil

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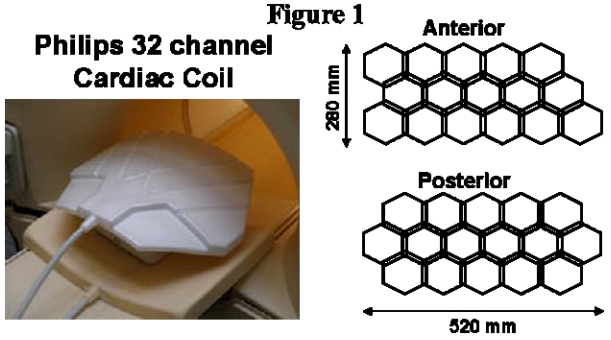
Introduction

In the quest for faster imaging and larger volume coverage, parallel imaging has played a pivotal role. Consequently, there has been a great drive to develop clinical MR systems with a large number of receive channels. As these are becoming available, new multi-element array coils are being developed. The clinical benefits of non-angulated 3D SSFP cine volumes have previously been shown on systems with 5 element coils. However these required multiple breath-holds (8-10) and only provided 5-8 cardiac phases [1]. In this abstract we present some of the first images acquired on a clinical 1.5T scanner with dedicated 32-element cardiac coil. Specifically, we explore how 3D, non-angulated, isotropic, whole heart, single breath-hold, cine acquisitions can be improved in terms of volume coverage and flexibility in scan orientation.

Materials and Methods

Three-dimensional, single breath-hold acquisitions were acquired using a Philips Achieva 1.5T clinical scanner with 32 receiver channels. A custom made 32 channel cardiac coil, designed and built by Philips Research Laboratories in Hamburg, was used for signal reception. A picture of the coil is seen in Fig. 1 along with the layout of the individual coil elements. The coil has 5-6 elements in the RL direction, 3 elements in the FH direction and 2 elements in the AP direction. In this application of the coil, the goal was to acquire a large 3D volume covering the heart and great vessels with an acquired spatial resolution of approximately 3.1x3.5x4.0 mm^3 and temporal resolution of 12-16 frames per cardiac cycle depending on heart rate. The planning of the scan was very straightforward because of the non-angulated large volume coverage. Here we compare three methods of acquiring the non-angulated volumes: A) a transverse acquisition with RL readout direction, B) a transverse acquisition with AP readout, using a higher acceleration factor in the RL direction where we have more available coils, and C) a sagittal acquisition with FH readout. For all three scans, the acquisition time was 20-28s depending on heart rate. The geometric parameters and selection of acceleration factors is seen in Table 1. Notice the large 22cm volume coverage, which is possible with the 32-channel coil. A retrospectively gated SSFP sequence was used with the following parameters: TR=3.2, TE=1.6, Flip = 60, Bandwidth=1250Hz/pixel. Half Fourier imaging was used for all scans with a *k*-space coverage of 62%.

Figure 1



Parameter	A	B	C
Orientation	Transverse	Transverse	Sagittal
Field of View (ROxPExSS) mm^3	500x250x220	500x500x220	500x250x220
SENSE SS	3 (FH)	3 (FH)	3 (RL)
SENSE PE	2 (AP)	4 (RL)	2 (AP)
Nominal Acceleration	6	12	6

Table 1. **Geometric Parameters for volume acquisitions. Readout (RO), phase encoding (PE), slice select (SS)**

Results

Figure 2 and 3 show examples in two volunteers of reformatted four-chamber images from each of the 3 scan types. The image quality was adequate for all orientations, however minor artefacts are seen. These minor residual aliasing artefacts vary in the different imaging orientations.

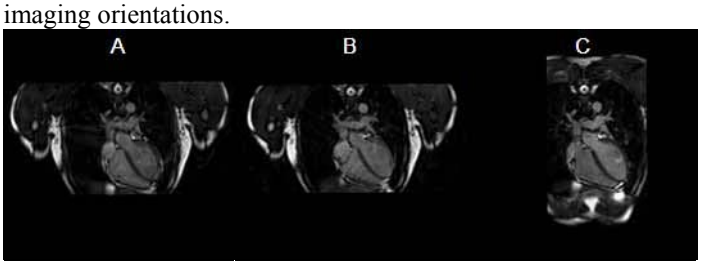


Figure 2. Four-chamber reformats from volunteer 1.

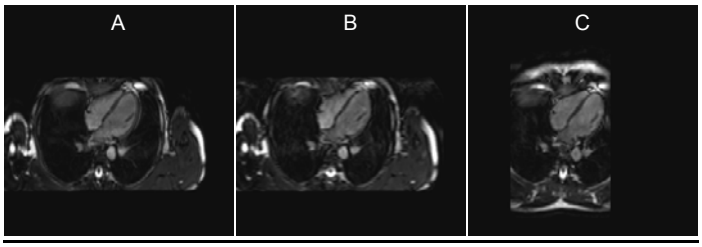


Figure 3. Four-chamber reformats from volunteer 2.

Conclusion

We have shown that a new 32 channel cardiac coil can be used to acquire 3D cine single breath-hold scans with different acquisition orientations. The higher SENSE factors (6-12) possible with this coil allow large volume coverage, making planning easier and providing full assessment of the thoracic contents from a single breath-hold scan.

References: [1] Razavi R, et al. Cardiol Young. 2003 Oct;13(5):461-5.