16-channel TORO Knee coil

S. M. Schillak[1], J. J. Holwell[2], J. R. Hadley[3], D. Parker[4], and K. M. Bradshaw[2]

[1]MR Instruments, Minneapolis, MN, United States, [2]MR Instruments, MN, United States, [3]Radiology, University of Utah, UT, United States, [4]University of Utah, UT, United States

Introduction

It is widely desired for knee imaging at high field strengths (3T and above) to achieve better signal to noise compared to existing designs while there exists a capability to perform parallel imaging along all the directions of the Cartesian coordinate system. This will help to avoid aliasing artifacts during the use of certain desired MR sequences. In addition, maintaining the B_1 profile across the entire field of view of the knee as well as to have the capability to perform imaging over a large field of view is a necessity.

In the present paper a novel 16-channel extremity coil for the knee imaging has been developed at 3T. RF stimulation is provided by a local TEM volume coil to reduce overall RF to the body, a reduction of SAR. This transmit-only-receive-only (TORO) has been proposed before for a different technology [1]. The positioning of the surface coils is chosen to provide the highest sensitivity for the most crucial anatomy in knee coil studies. Coil geometry and structure were chosen to maximize field of view, while maintaining high SNR local to critical anatomy.

Methods and Materials

The 16-channel extremity coil is constructed using an 8x2 loop configuration of two different coil sizes in order to maintain higher SNR over critical anatomy and also to allow for a larger field of view (Fig. 1). The coil geometry allows for an acceleration of 2 in Z and 4 in XY planes. Loop decoupling is performed using a combination of coil overlapping [2] for the nearest neighbors and capacitive decoupling for nearest corner elements [3]. To minimize noise insertion, all pre-amps are placed within close proximity to the coil. The coil internal diameter is 18 cm. Reduction of SAR is achieved by using a local transmit TEM volume coil. With an internal diameter of 27 cm, the local TEM coil provides a controllable and homogeneous B_1 field. In order to minimize the space the TEM coil takes a smaller ID coil has been proposed.

Results and Discussion

Loop isolation between nearest neighbors is better than -15 dB, diagonal neighbor isolation is better than -20 dB and returned loss is less than -20 dB loaded with a knee phantom (2 Liter, 2.5g $NiSO_4*6H_2O$ +10g NaCL). Testing was performed on both a phantom and volunteer's knee using a Siemens TIM Trio system at the University of Utah, Center for Advanced Medical Technologies. The coil sensitivity profile verifies the objective of the design was achieved. The smaller (higher SNR) coil was placed over the critical anatomy of the knee, i.e. meniscus (Fig. 3). Mapping of Noise shows a correlation of less than 0.5. It is believed that this can be improved. A FATSAT image had a TE of 35 ms and a TR of 3630 ms with a slice thickness of 7 mm; an axial TSE was performed using a TE of 8.5 ms and a TR of 718 ms with a slice thickness of 7 mm; a coronal TSE was also performed with a TE 8.5 ms of TR 796 ms of with a slice thickness of 7 mm (Fig. 4).

Fig. 1: 16-channel extremity Receive coil.

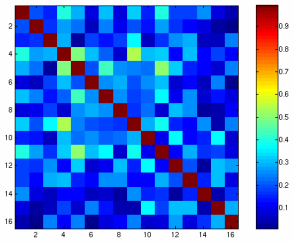

Fig. 2: Noise Correlation.

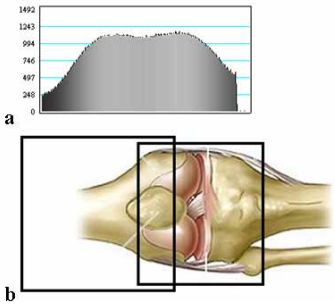

Fig. 3: **a:** Centerline profile of the phantom image shown in Fig. 1. **b:** Coil loop geometry and positioning with respect to knee anatomy.

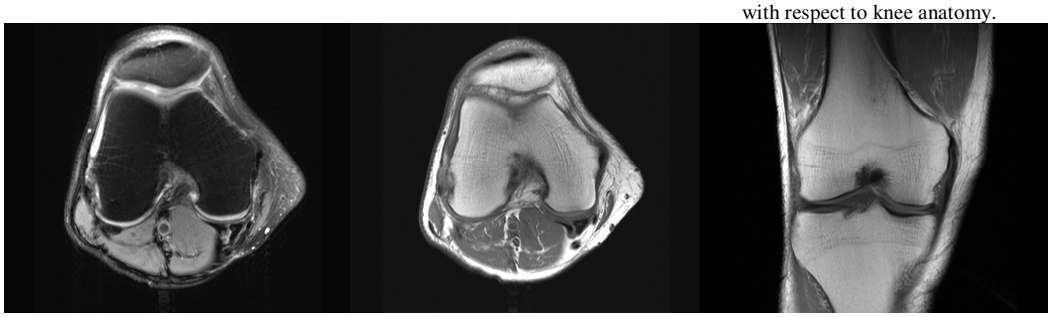

Fig. 3: From left to right: FATSAT with a TE of 35 ms, TR of 3630 ms, slice thickness of 7 mm; axial TSE with a TE of 8.5 ms, TR of 718 ms, slice thickness of 7 mm; coronal TSE with a TE of 8.55 ms, TR of 796 ms, slice thickness of 7 mm;

Conclusion

With a 16-channel receive-only structure and local TEM transmit, anatomy in the knee is seen with high sensitivity and low patient SAR (as compared to using the body coil). The coil

References:

[1] E A Barberi, et al, MRM 43:284-289 (2000)
[2] P B Roemer, et al, MRM 16:192-225 (1990
[3} J Wang, #1434, Proceeding of ISMRM, 1996