Transmit/Receive High Resolution Knee Array

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Introduction

The next generation of extremity MRI coils will require a phased array[1] design to support partial parallel imaging[2,3], decreased scan times and increased Signal to Noise Ratio(SNR). The additional desire to reduce the Specific Absorption Rate (SAR) and the phase wrap artifacts may require that the next generation of extremity coil be designed as a Transmit/Receive(T/R) phased array. This paper introduces an 8 element receive / 1 element transmit phased array designed for imaging the knee. The coil is ergonomically designed permitting the elements in the receive array to be located in close proximity to the knee, for increased SNR, while still being large enough to fit more than 95% of the patients.

Method

The design of the 8-receiver High Resolution Knee (HRK) coil is shown in Figure 1. In this design the 8-receiver coils are placed on the inner former in close proximity to the knee for high SNR. The transmit coil is a separate 8 pole resonator placed outside of the receive array. By separating the transmit and receive components in the design, the coil could be designed to separately optimize their characteristics. The receive array is optimized for high SNR and a low g-factor[3]. The transmit coil is optimized for low SAR, high efficiency and high B_1 homogeneity. For imaging the knee B_1 homogeneity is very important in order to get a reproducible and robust chemical suppression.

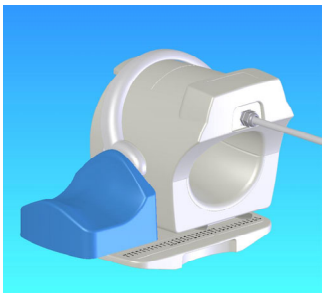

Figure 1a

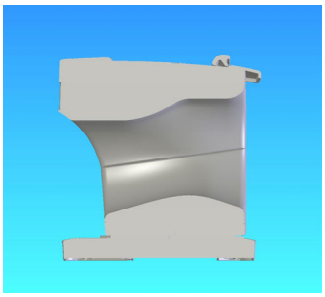

Figure 1b

Results

Figure 2 shows a high-resolution coronal slice of the knee imaged with the T/R model of the HRK. Figure 3a shows a FATSAT Sagittal image of the knee imaged with the T/R version of the HRK. Figure 3b shows an equivalent image made with a receive only version of the design. These images were collected on a 1.5T Signa EXCITE system.

Figure 2

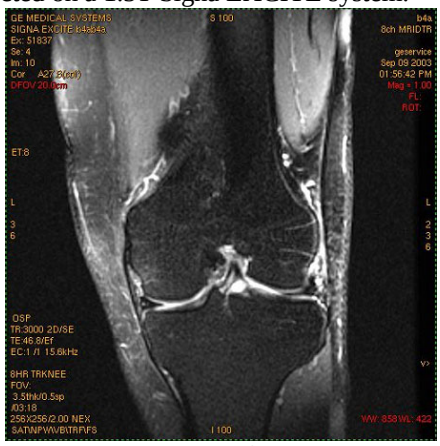

Figure 3a

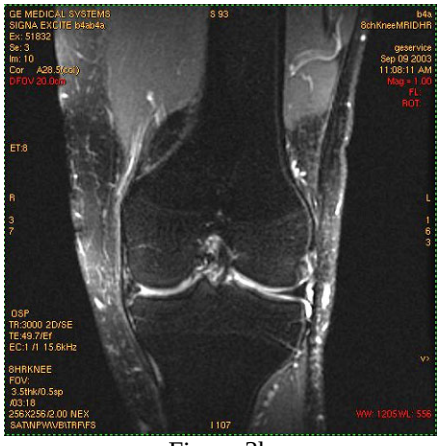

Figure 3b

Discussion

Figure 3 shows that while the T/R version of the HRK produces a high SNR image the FATSAT is not ideal because of B_0 inhomogeneities. A large component of poor B_0 homogeneity is the result of poor B_0 shimming. The auto shim algorithm, which sets the gradient shim of the magnet, was designed to function either using the high uniformity signal from the body coil or a single channel from the phased array. Using a single receive channel weights the signal with the B_1 sensitivity profile of that channel, resulting in poor shimming and in a non-uniform chemical suppression. Possible solutions to this problem include: a change in the software algorithm to include all of the receivers, to combine the signals from each of the channels in the array to produce a uniform signal using a hardware combiner[4], or to use the transmit coil as a low SNR, high uniformity receive coil for the single channel.

References

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