Bilateral Surface Coil for Lower Extremity Imaging at 3T

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Introduction: For lower extremity applications, it is often desirable to obtain data from both legs simultaneously (1,2). Whereas a unilateral coil necessitates patient repositioning, a bilateral coil enables the side-by-side evaluation of both legs in the same scan time. This could be useful to compare artery structure or other injuries in the patient. For this purpose, a bilateral eight channel receive-only array tailored to lower extremity imaging is introduced. The phased array coil design provides a large imaging field of view (FOV) while improving the local signal-to-noise ratio (SNR) (3,4). This characteristic is useful for plaque imaging in the superficial femoral arteries, as the arteries lie close to the surface of the legs.

Materials and Methods: The receive-only bilateral coil consisted of eight rectangular elements wrapped around two 17.8 cm diameter cylindrical formers with four coils distributed azimuthally around each former (Fig.1). The coil former was divided into separate anterior and posterior pieces to make patient entry more convenient. Each element was laid out using ½" copper tape and measured 25 cm in length with an arc length of approximately 90° (14 cm). This orthogonal relationship between neighboring pairs reduced coil coupling. Further isolation was provided by preamplifier decoupling (3). Each coil was tuned to 127MHz using six distributed capacitors and capacitively matched to 50Ω. Network analyzer measurements showed that the unloaded *Q* was approximately 180 which reduced to 20 with loading, indicating that the leg was the dominant noise source. Signal was transferred to the preamplifiers through high-impedance baluns and coaxial cable. Active detuning circuits at the drivepoints were used to deactivate the coils during RF excitation.

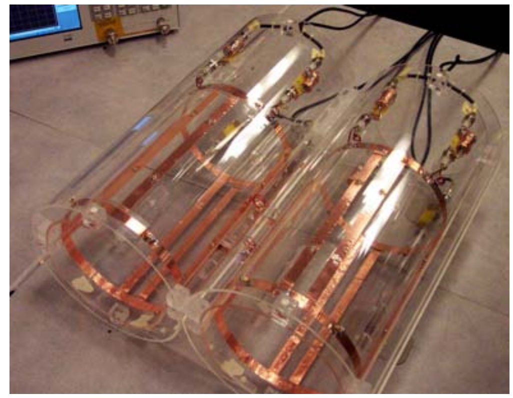

Fig. 1. Photograph of the 8-channel bilateral coil.

Experiments were performed on a 3T MR scanner (GE Medical Systems, Excite). For SNR comparison, phantom images were obtained with the 8-ch bilateral coil as well as three standard GE coils (4-ch torso, quadrature head, and body coils). The coils were loaded with two 3L water filled bottles doped with 60mMol NaCl and 10mMol $CuSO_4$. In vivo experiments were performed on three volunteers who gave written consent for this study. T1 weighted spin echo sequences were used for image acquisition.

Results: Fig. 2 shows a phantom image and SNR profiles through the image center. Due to the increased number of coil elements surrounding the phantom, the 8-ch bilateral coil provided an SNR increase at the periphery and similar SNR in the middle of the phantom compared to other coils tested. Images (Fig. 3) depict the superficial femoral arteries and show that both arteries are patent with no occlusion. We demonstrate that surface coils can be utilized for bilateral lower extremity imaging and, due to the speed-up factor of two compared to a conventional knee coil, can improve the diagnosis of atherosclerosis. The coils were heavily coupled to the sample as evidenced by the *Q* factor ratio of ~9:1, illustrating that there is room for further sensitivity improvement by using smaller elements and additional receiver channels.

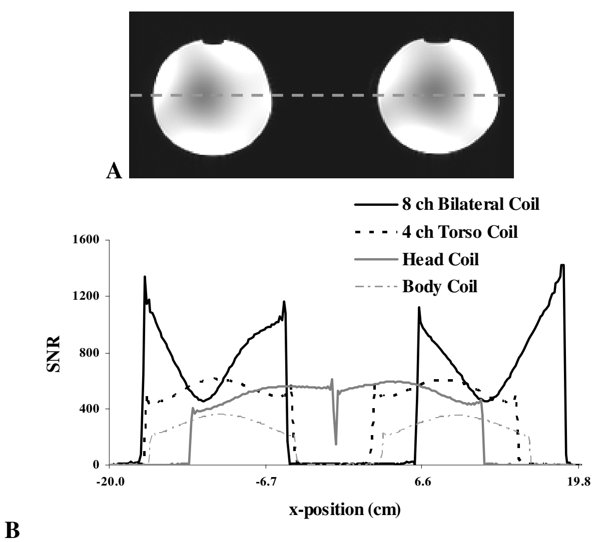

Fig. 2. A) Phantom image in the transverse plane using the 8-ch bilateral coil. **B)** SNR profiles across the dashed line in (A) from the 8-ch bilateral, 4-ch torso, quadrature head, and body coils. Data was acquired using a grad echo pulse sequence (TR/TE=100ms/6.8ms, α=60°, FOV=42x21cm^2, slice thickness=4mm, 256x256 matrix).

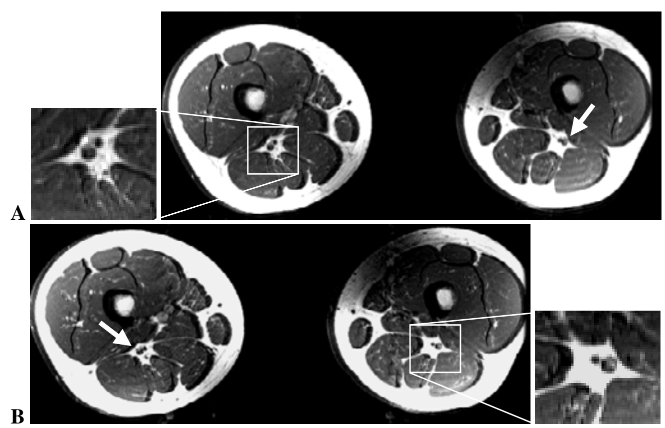

Fig. 3. Consecutive slices from a normal volunteer depicting the femoral arteries. The slices are approximately 15 cm above the patella and were obtained with a spin echo pulse sequence (TR/TE=650/21ms, FOV=42x25cm^2, slice thickness=3mm, 512x384 matrix, NEX=1, BW=15kHz, ETL=3).

References:
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