Multi-element coil for animal imaging at 3T

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Introduction

Standard imaging coils are not particularly well suited for most animal studies. They are usually optimised for human imaging and are just too large or not the right shape for many aspects of animal MR studies. Here we show an applications where we have built an optimised multi-element coil : a 7 channel spine coil array for 3.5 to 4kg cats

Method

The coil array we have put together is greatly inspired by the work of Larry Wald and his team (ref 1 and 2). First, the dimensions of the coil were dictated by the size of the animals we wanted to image. To fit the 3.5 to 4kg cats, we decided to use a half cylinder design of 4 inches in diameters, at the bottom of which we fixed an array of seven 2 inch coils placed in a hexagonal pattern. The form was made by vacuum moulding a preheated 2mm Plexiglas onto a Styrofoam shape. This design helps to keep the cat steady in the supine position while keeping the coils as close to the body as possible.

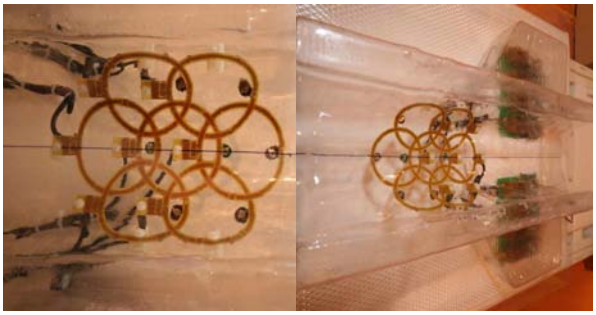

Figure 1 Cat spine coil array

The distance between adjacent coils was optimized to reduce the crosstalk. Then, each coil was tuned to the 3T frequency using nonmagnetic capacitors and a small circuit (nonmagnetic PIN diode, capacitor and an inductor) was also tuned to the 3T frequency for the active coil detuning during the RF transmitting. The coils are plugged to a preamplifier board via a short coaxial wire and the ground is filtered by a boxed cable trap using semi rigid coaxial wire. The preamplifiers themselves are standard from Siemens. Finally, the boards are connected to the scanner via short coaxial cables.

The coils are programmed in such a way that all elements can be used together or individually, as wanted. Test images we done using a bottle phantom and the SNR versus the distance from the coil was calculated.

Results

Each element had an average unloaded/loaded Q of 205/70. With the detuning, a less than 15 % effect was observed on the homogeneity of the image when using the body coil.

We can see in figure 1 the resulting multi element coil and the preamplifier board. The gain in SNR with the cat spine coil in the area of the spinal cord was a factor of approximately 3 over the CP knee coil (figure 2).

In figure 3, we show images of a cat in the spine coil and in the knee coil from a 3D acquisition. We can see the standard drop of signal of a surface coil as opposed to the volume coil and the improvement in SNR at the spinal coil area. We can also notice the reduction of movement artefact with the cat spine coil due to the improved contention of the animal.

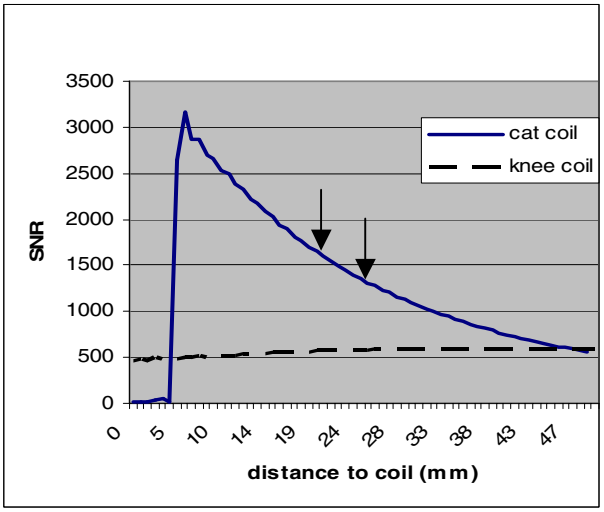

Figure 2 Relative SNR versus distance from the coil for the cat spine coil array (solid line) and the CP knee coil (dotted line). Arrows mark the approximate distance of the spine to the coil.

Conclusion

We have found that special coils are a definite improvement in SNR over the CP knee coil which was the best coil available at 3T for this small animal imaging. To follow up on this success, we are currently working on an 8 channel monkey head coil.

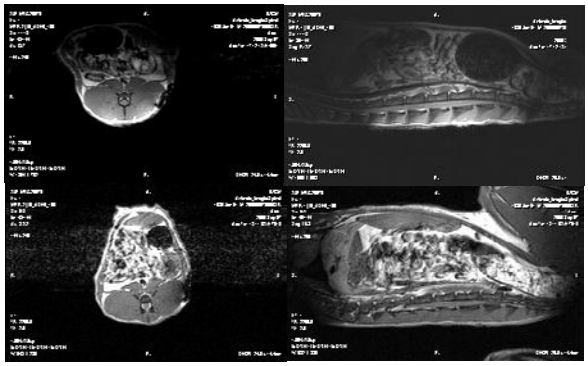

Figure 3: Images of a cat using (top) the cat spine coil and (bottom) the standard knee coil.

References

1 - Graham Charles Wiggins, Andreas Potthast, Christina Triantafyllou, F Lin, Thomas Benner,Christopher John Wiggins, Larry Wald "A 96-Channel MRI System with 23- And 90-Channel Phase Array Head Coils at 1.5 Tesla" Proceeding ISMRM #671, 2005.

2 - Graham Charles Wiggins, Christina Triantafyllou, Andreas Potthast, A Reykowski, Matthias Nittka, Larry L. Wald. "A 32 Channel Receive-Only Phased Array Head Coil for 3T with Novel Geodesic Tiling Geometry." Proceeding ISMRM #679, 2005.

Acknowledgments

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