

## Comparison of multi nuclear coil designs for $^1\text{H}$ and $^{23}\text{Na}$ in the human knee

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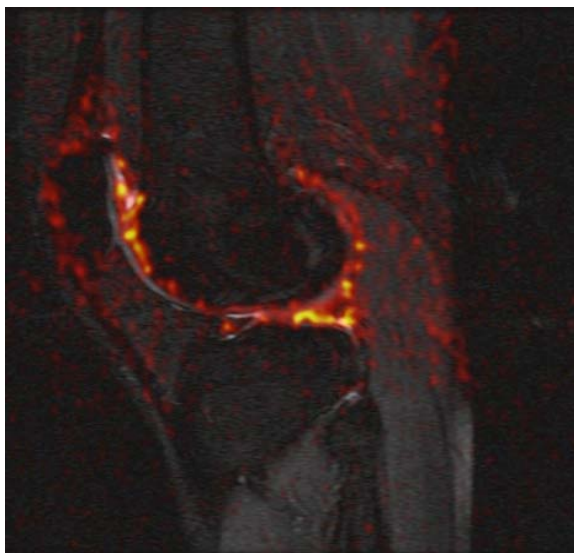
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**INTRODUCTION:** Sodium MRI is useful in knee imaging to identify articular cartilage pathology because of its ability to clearly depict proteoglycan depletion<sup>1</sup>. Current coil designs using four ring bird cages are adequate for sodium imaging, but have room for improvement, particularly in terms of field-of-view (FOV) and signal-to-noise ratio (SNR). Here we demonstrate the effect of synergistic use of concentric birdcage coils as proposed by Watkins et al with similar fields of view to improve the quality of SNR in sodium imaging of the knee<sup>2</sup>.

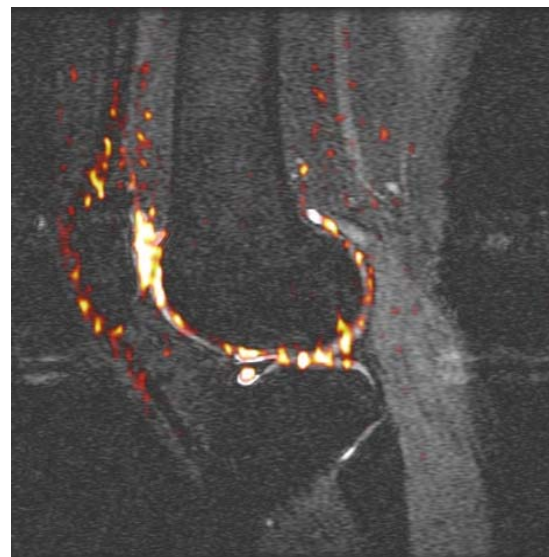
**METHODS:** Using a Discovery MR750 3T scanner (GE Healthcare, Waukesha, WI), we imaged 5 knees of healthy volunteers. Two coils were used to obtain proton and sodium images: the first employing a four ring bird cage design<sup>3</sup> and the second using the two birdcage coil design with concentric arrangement of the coils to minimize the effect of the proton on the sodium coil. Sodium images were obtained using a fast gradient-spoiled sequence with the 3D cones k-space trajectory using the following parameters: TR 35ms, TE 0.6ms, 70 degree flip angle, BW 488 kHz, 28 NEX, 256 x 256, 1.25x1.25x4mm, 21:33<sup>4,5</sup>. Proton images were obtained using a 3D Quantitative Double Echo Steady state (qDESS) sequence with the following parameters TR 30ms, TE 10ms, 35 degree flip angle, BW 122 kHz, 512 x 512, 0.31x0.31x4mm, 04:20<sup>6</sup>. SNR was measured using the subtraction method<sup>7</sup>. For both proton and sodium imaging, we compared the SNR of the optimized two birdcage coil to that of the four birdcage coil design using a 2-tailed, paired t-test.

**RESULTS:** SNR for proton imaging did not statistically differ between the two coils with an average SNR  $63.6 \pm 5.3$  for the two birdcage vs  $78.0 \pm 18.4$  for the four birdcage design,  $p = 0.19$ . For sodium imaging, the SNR was significantly improved with the optimized two birdcage coil design having an average SNR  $14.0 \pm 2.8$  for the two birdcage in comparison to the four birdcage design having an average SNR  $6.6 \pm 1.5$ ,  $p = 0.002$ . Images are shown in Figure 1.

**CONCLUSION:** The use of an optimized concentric coil design with differing frequency topologies provides a significant increase in the SNR for sodium imaging without a significant effect on the quality of proton images. Further work will aim to characterize the differences in uniformity and coverage between the proposed concentric coil design and previous designs.



FOUR COIL DESIGN



TWO COIL DESIGN

Figure 1: Sample sodium images for one subject overlaid on corresponding DESS images.

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