Effect of 16-Channel Flex Array Coil on PET Standardized Uptake Values for PET/MR Imaging of the knee

Feliks Kogan[1], Jarrett Rosenberg[1], Sloane Brazina[1], Audrey Fan[1], Dawn Holley[1], and Garry Gold[1]
[1]*Department of Radiology, Stanford University, Stanford, CA, United States*

Introduction: Simultaneous PET/MR imaging is an exciting new technology for quantitative assessment of osteoarthritis (OA). Compared to CT, MRI provides versatile soft tissue contrast and superior diagnostic accuracy without ionizing radiation as well as quantitative information about early cartilage breakdown[1]. PET, on the other hand, may provide complementary metabolic information about inflammatory processes and bone remodeling[2]. However, MR hardware used during simultaneous PET/MR imaging with hybrid systems may affect both qualitative and quantitative accuracy of PET images[3]. For rigid coils such as the body coil or the head/neck coil, which have a fixed position, a pre-computed attenuation map of the coil is incorporated into the PET image reconstruction. Alternatively, flexible coil arrays do not have a fixed size, shape, or position and thus cannot utilize a pre-computed static attenuation map. Flexible coil arrays tend to be more transparent to gamma rays and thus have a considerably smaller effect on PET data. In this work, we study and characterize the effect of a 16-channel flexible wrap coil on calculated PET standard uptake values (SUV) in the knee using a hybrid PET/MR system.

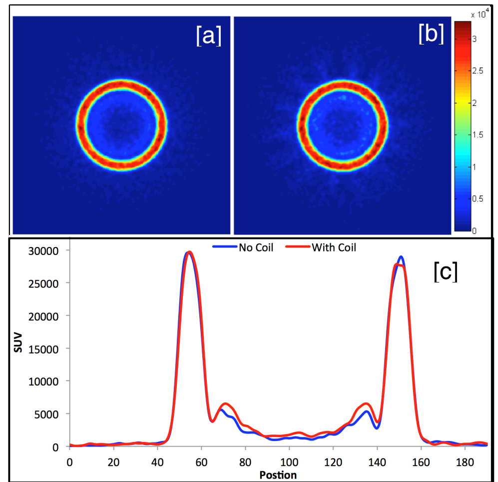

Figure 1: Axial PET SUV maps of a cylindrical [^{68}Ge] Phantom [a] without and [b] with a MR flex coil around it. [c] Sagittal Projection of SUV values through the phantom

Materials & Methods: Simultaneous time-of-flight PET and MR imaging experiments were performed on a 3T PET-MRI hybrid system (GE Healthcare, Milwaukee, WI) using a 16-channel flex coil (NeoCoil, Pewaukee, WI) under an approved IRB protocol. Phantom experiments were performed using a uniform cylindrical germanium-68 [^{68}Ge] phantom. PET imaging of the phantom was performed for 5 minutes with and without the MR coil. This was repeated 9 times with repositioning. For in vivo experiments, two subjects with previous ACL tears and unilateral radiographic OA (Kellgren-Lawrence grade 2-3) were imaged in 2 separate sessions following injection of 5 mCi ^{18}F-FDG or ^{18}F-NaF PET radiotracer respectively. Each knee was scanned with and without the 16-channel flex coil for 5 minutes.

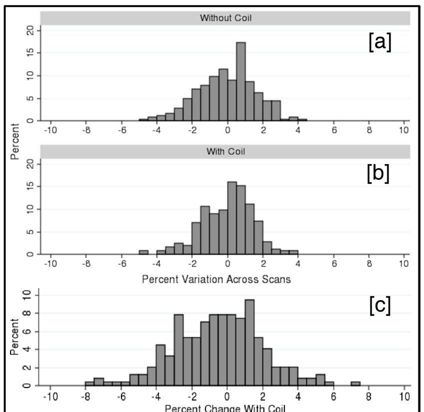

Figure 2: Histogram of the percent variation in SUV for phantom imaging (a) without and (b) with the coil and variation in differences between SUV with and without the coil (c)

Analysis: SUV maps were generated from PET images by normalizing for the patient weight and injected tracer dose4. Average SUV values from a constant ROI in the phantom was observed across 30 slices and 9 repetitions for images with and without the coil. 3 slices were omitted from analysis due to a discontinuity in phantom anatomy. Variation in SUV measurements were compared across slices and repetitions as well as in SUV differences between paired scans with and without the coil. 1-D projections of SUV were recorded in phantoms and in vivo to observe potential differences due to coil attenuation.

Results and Discussion: Figure 1 shows axial PET SUV maps and a sagittal 1-D projection of SUV from the [^{68}Ge] phantom without (1a) and with (1b) the 16-channel flex coil. Allthough a distinct noise pattern is observed in the SUV maps around the Ge-68 phantom with the coil, SUV values in the phantom as well as the full width half max (FWHM) of PET SUV in the 1-D projection stayed largely the same between scanning with and without the coil. Figure 2a,b shows histograms of the percent variation in SUV within slices across 9 scans (as percentage of the mean of the slice's scans). Figure 2c shows the variation in SUV differences between paired scans with and without the coil, as percentage of the mean of the two measurements. The median percent variation across scans was 0.11%, (range = -4.5% to 4.4%), while the median percent difference between SUV measurements with and without the coil (per slice and per scan) was 0.36% ranging from -7.6% to 7.0%. This demonstrates that the variance between SUV measurements with and without the coil is small and similar to the variance in scan repeatability. Figure 3 shows 18F-NaF PET SUV maps without (3a) and with (3b) the MR coil of a subject with radiographic OA. Two areas of increased NaF uptake are observed in the lower extremity of the femur. As in phantom scans, a 1-D projection across the areas of increased uptake shows a similar SUV profile in the two lesions (peaks) between SUV maps with and without the coil (figure 3c). The subject was repositioned between scanning with and without the coil. PET SUV maps with and without the coil were registered to reduce errors due to repositioning, but some error due to rotation likely remains.

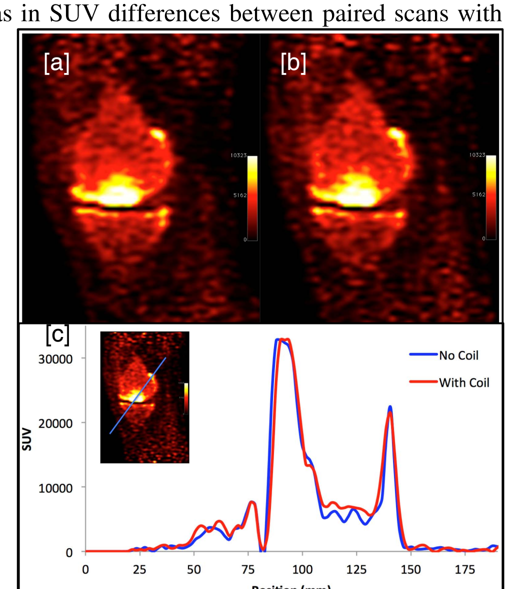

Figure 3: 18F-NaF PET SUV maps [a] without and [b] with a MR flex coil around it of a subject with radiographic OA. [c] Projection (blue line) of SUV values through the phantom

Conclusion: We measured the effect of a 16-channel flexible coil on measured PET SUV in a time-of flight PET/MR scan. Results showed that the coil had a minimal impact on SUV profiles and values in phantoms and *in vivo* in the knee.

References: [1] Shapiro et al. *J Magn Reson Imaging*. 2014;39(6). [2] Draper et al. *J Magn Reson Imaging*. 2013;36. [3] Wagenknecht et al. *Magn Reson Mater Phy* 2013; 26 [4] Schomburg *Eur J Nucl Med* 1996; 23. **Research support:** GE Healthcare, NIH.

*__Disclaimer:__ Data acquired using an investigational device that is 510k pending at FDA. Not approved for sale. Not for sale in all regions.