

Characterization of [^{18}F]-FDG uptake by hybrid PET-MRI in osteoarthritis of the hip

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Target audience. Physicians and scientists interested in PET-MRI hybrid imaging of joint osteoarthritis.

Purpose. Osteoarthritis (OA) disease is an active process of joint degeneration driven both by biomechanical and by pro-inflammatory factors [1]. [^{18}F]-FDG uptake is a potential PET marker of musculoskeletal inflammation that may enable diagnosis of early joint disease and stratify patients for treatments [2, 3]. However, the biodistribution of this radiopharmaceutical in OA and its colocalization with morphological changes in OA are not well understood. This observational study aims to characterize the [^{18}F]-FDG uptake within different areas of hip joint damage as identified on simultaneously acquired structural MRI scans.

Methods. *Acquisition.* Twenty patients (12 females, age = 67 ± 12 years) were recruited for this study from a population undergoing [^{18}F]-FDG PET for clinical oncologic assessment. Simultaneous whole-body time-of-flight PET and MRI was performed on a 3 Tesla PET-MRI hybrid system (GE Healthcare, Milwaukee, WI) with a torso array receive coil. Patients were injected with 10 mCi of [^{18}F]-FDG and imaged via time-of-flight PET at multiple stations (~3-5 min per bed position). Coronal MRI scans of the hip were simultaneously acquired with a 2D T₂-weighted STIR (short TI inversion recovery) sequence. MR imaging parameters included TR = 4300ms; TE = 41ms; inversion time = 190ms; slice thickness = 8mm; matrix = 512x512; resolution = 0.9x0.9mm²; and flip angle = 111°.

Analysis. Mean standard uptake value (SUV_{mean}) maps were generated from PET images by normalizing for the patient weight and injected tracer dose [4]. PET images were co-registered with the structural MRI images in OsiriX software. An experienced musculoskeletal radiologist identified areas of joint fluid and OA changes including subchondral cysts and bone marrow lesions (BMLs) on the MR images. Areas of bony metastasis were excluded. Average SUV_{mean} was quantified from a region-of-interest (ROI) in each MRI abnormality and normalized to the SUV_{mean} value from a separate ROI (mean area ~87cm²) in a normal region of the femoral head from the same patient.

Results. We identified 7 subchondral cysts and 10 areas of BML on the MR images. Joint fluid was present in all cases. Normalized SUV_{mean} values in each region are depicted in Figure 1. [^{18}F]-FDG uptake was highest in joint fluid, which may be a marker of increased [^{18}F]-FDG diffusion or high glucose metabolism due to inflammation. Normalized SUV_{mean} was elevated in both subchondral cysts (1.7 ± 0.5) and in bone marrow lesions (1.4 ± 0.4). Areas of OA damage identified on the MRI tended to co-localize with increased [^{18}F]-FDG uptake, as depicted in Figures 2 and 3.

Discussion. This study characterizes [^{18}F]-FDG SUV_{mean} values in various regions of OA damage within the hip joint identified on structural MRI. Our observations enable improved understanding of [^{18}F]-FDG uptake levels in normal and diseased joint tissue. [^{18}F]-FDG PET-MR is a promising potential marker to identify early metabolic and inflammatory processes in OA.

References. [1] Griffin *Exerc Sport Sci Rev* 33 (2005); [2] Wandler *AJNR* 185 (2005); [3] Kubota *Annals Nucl Med* 23 (2009); [4] Schomburg *Eur J Nucl Med* 23 (1996). **Acknowledgements:** 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.

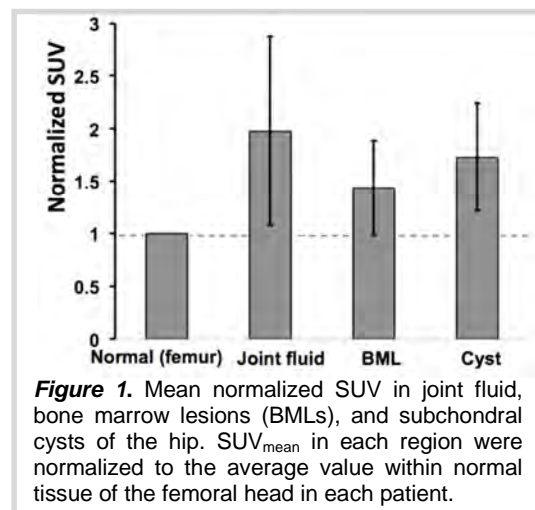


Figure 1. Mean normalized SUV in joint fluid, bone marrow lesions (BMLs), and subchondral cysts of the hip. SUV_{mean} in each region were normalized to the average value within normal tissue of the femoral head in each patient.

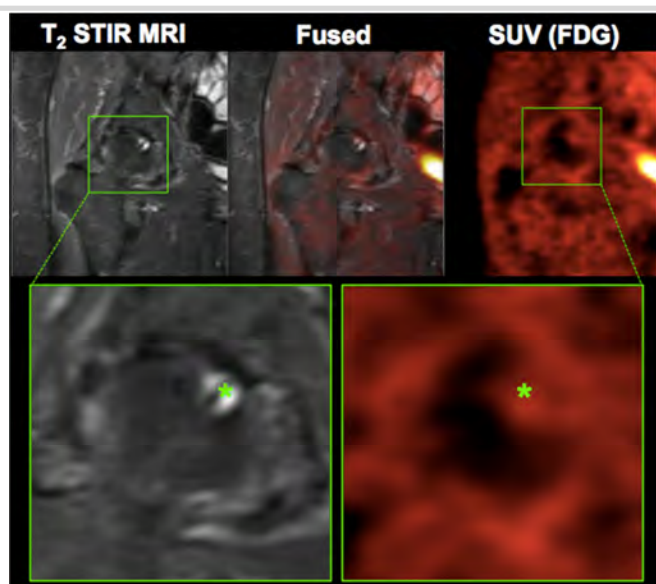


Figure 2. [^{18}F]-FDG PET images in the hip of a 76-year old patient, co-registered and fused with T2-weighted STIR MRI. Asterisk indicates a cyst in the femoral head that appears topographically co-localized with increased tracer uptake on the FDG PET image.

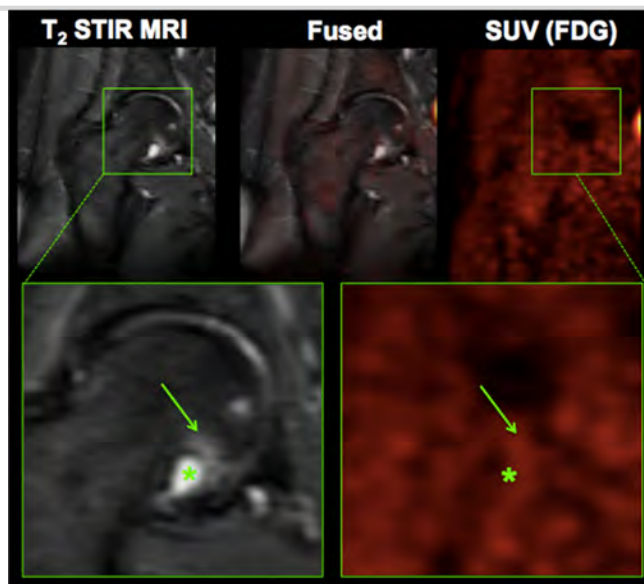


Figure 3. [^{18}F]-FDG PET images in the hip of a 64-year old patient, co-registered and fused with T2-weighted STIR MRI. Cyst identified on the MRI (asterisk) has higher mean SUV of 1.9 ± 0.3 relative to the adjacent area of edema (arrow) with SUV of 1.4 ± 0.3 .