AbstractID: 5556 Title: The Effects of PET reconstruction parameters on the delineation of heterogeneous target volumes

Purpose As emerging radiotherapy techniques incorporate biological targeting of sub-tumor volumes, steps must be taken to ensure the validity of the assumed substructures. This study measures the effects of PET image reconstruction on heterogeneous target definitions both *in vivo* and in a phantom.
Method and Materials: A known heterogeneous phantom composed of Y-86 and Ge-68 spheres with an F-18 background altering signal-to-background ratios tested the accuracy of reconstructions using ordered subset expectation maximization (OSEM) with varying numbers of iterations and filtered backprojection (FBP) with Hanning, Shepp-Logan, and ramp filters. *In vivo* measurements used heterogeneously proliferating tumor images obtained from a canine tumor imaged using [F-18]FLT at three stages of treatment using the same reconstruction methods. Difference images and standard deviations were used to assess the reconstruction differences. A three-dimensional form of the Moran I(d) spatial statistic was used to assess global heterogeneity at various correlation distances.
Results: Absolute difference images from FBP and 2 iteration OSEM reconstructions showed internal tumor voxel clusters deviating by more than 10% of the maximum SUV of the reference image (OSEM20) and relative voxel values varying by as much as 40% in tumor periphery. Image differences in OSEM reconstructions significantly decreased after 10 iterations, accompanied by decreases in the standard deviation of differences and slight increases in heterogeneity as global I(d) values decreased. FBP reconstructions both underestimated (Hanning, Shepp-Logan) and overestimated (ramp) global heterogeneity I(d) relative to reference values, but large standard deviations of absolute difference indicated images compared poorly to the reference.
Conclusion: Tumor heterogeneity obtained through PET may vary by at least 10% internally with larger variability at the periphery, greatly affecting both tumor volume delineation and internal heterogeneity. Prescriptions for dose painting based on proliferation measures can vary widely with the reconstruction algorithm.