Purpose:
To utilize serial PET imaging it is important to minimize the effect of repositioning errors and anatomical changes. Compensating for these errors requires an objective and reliable method of deformable image registration. Here we report on the methodology used to deformably co-register serial PET images using CT anatomy and compare intratumoral distributions of FDG and FLT as imaged in the same animal with PET/CT on two consecutive days.

Methods:
Nude mice bearing FaDu (human H&N) tumor xenografts were imaged with 18F-FDG and 18F-FLT on two consecutive days using a dedicated small animal PET/CT scanner (Siemens Inveon). Both data sets were reconstructed and loaded into Pinnacle 9.1. Despite careful repositioning of the animal using an animal-specific pad with recorded landmarks, misalignment of FDG and FLT PET images hindered direct voxel-by-voxel analysis. To perform an objective co-registration of the PET images, we relied on associated CT images. Animal bodies and tumors were contoured on both CT scans. A mesh was generated from the contours for visualization purposes. The CT images were deformably registered with a demons algorithm, and the resulting displacement vector field was applied to the FLT image, allowing for voxel-by-voxel analysis of co-registered FLT and FDG PET images in Matlab.

Results:
Based off of visual inspection, the deformable image registration tools available in Pinnacle are adequate for co-registration of the animal PET/CT images despite the deformations caused by repositioning. Voxel-by-voxel analysis of co-registered FLT and FDG PET/CT images produced correlation coefficients ranging from .45 to .55, $p<10\text{-}4$.

Conclusions:
Using corresponding CT anatomy with the tools in Pinnacle 9.1 to generate deformation matrices is a viable approach to deformable PET image registration. The images produced facilitated a voxel-by-voxel comparison of FLT vs. FDG.