# AbstractID: 3329 Title: Multi-Day Multi-Modality Image Co-Registration

**Purpose:**
To develop a methodology for multi-day co-registration of multi-modality images taken throughout the course of radiotherapy, for the assessment of tumor response to treatment.

**Method and Materials:**
CT and PET image data sets of canines with various tumors were taken on a PET/CT scanner and were automatically co-registered to each other by the scanner software. Using a commercial software package, ROI segmentation was performed on the CT data to define the tumor boundaries. Each PET data set was then masked by the ROI of its aligned CT image and then rigidly co-registered with the masked PET data from other days. To align more specific uptake regions within the tumor, image warping was performed via landmarks placed on the co-registered multi-day PET data.

**Results:**
We found that ROIs can be roughly aligned by rigid registration of the outer tumor region as defined by the segmentation of CT data. Histogram correlation plots, aided by visual assessment, illustrated that normalized mutual information and Euclidean distance were the best-suited criteria for rigid registration, and that increased accuracy in co-registration was gained from image warping via landmarks placed on specific structures within the day-to-day rigidly co-registered PET data. A review of warping techniques on the co-registered PET data and generated data phantoms demonstrated that thin-plate spline warping provided the most complete warping of landmarked structures, while flow warping was not as aggressive with non-landmarked structures.

**Conclusion:**
Using this methodology of rigid registration of tumor boundaries defined from CT data, followed by inner feature warping of PET data proves to be an accurate and usable way to perform multi-day multi-modality image co-registration. Further investigations include additional contouring of segmented regions, adding scaling parameters to the initial registrations, and refining landmark placement and warping techniques.