Manual Fusion Reproducibility with ProstaScint/CT Image Volumes

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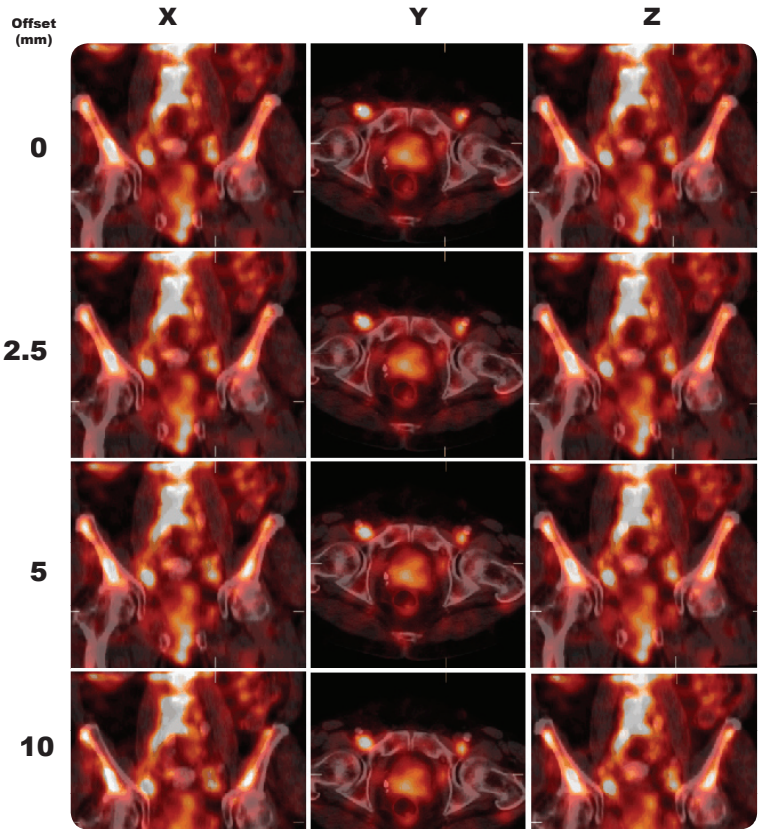
ABSTRACT ProstaScint (111IN-Capromab Pendetide) prostate cancer image volumes were aligned to Computed Tomography (CT) using MIM image fusion software. This is a comparison study of the variations in alignments completed by two experienced observers. Alignment deviations of both inter and intra observer alignment procedures are examined.

SPECT images of ten prostate cancer patients were obtained approximately 96 hours post injection of Indium111 ProstaScint solution. Images were obtained with a 128x128 acquisition matrix in a step-and-shoot motion with fifty seconds per stop and 128 projections over a 360' rotation. Upon completion of SPECT, a CT is acquired with the patient positioned flat with legs straight as in positioning for the SPECT. The CT is typically done within one or two hours of the SPECT to ensure similar anatomy. Images were processed with Iterative OSEM reconstruction techniques and CT based attenuation correction. Each of the ten patients' data were aligned by both observers (AD,BK). Typically, bony pelvis anatomy such as the spine, iliac crests, pubic symphysis, and external iliacs are structures that are aligned in the transverse, sagittal, and coronal planes. Alignments are typically completed in less than five minutes. The alignments were completed three times for each of the ten patients by each observer.

The results of the alignment consistency study are shown in the following table. The alignment consistency was <1.40mm, observer AD, and <3.60mm, observer BK. Between both observers, differences were <1.40mm,<1.20mm, and <2.80mm in the X,Y, and Z directions, respectively. Decreased Z axis accuracy may be due to the CT voxel thickness of 5 mm.

Observers achieved an overall consistency of minimal deviations in alignments, concluding that the manual alignment procedure is consistent in terms of inter and intra observer variability.



Images misaligned to demonstrate manual alignment technique in one slice. Actual alignment includes alignment in multiple slices and ability to vary amount of ProstaScint or CT in the fused image

ALIGNMENT METHODS

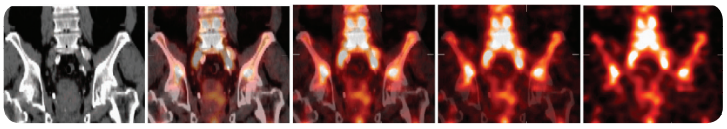
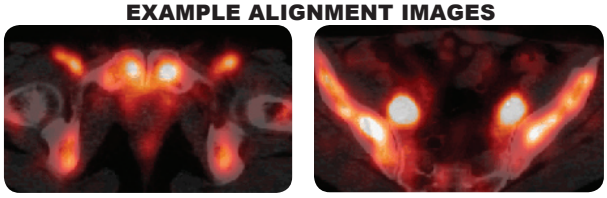
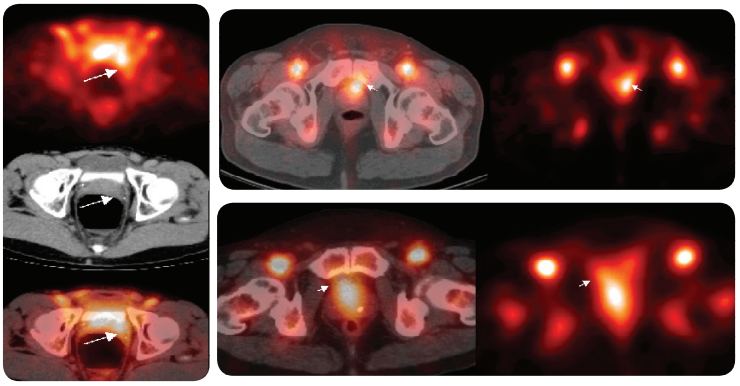


Image fusion display is based on a true color addition of both image volumes. These images demonstrate varying the percentage of both image volumes included in the fusion display. The added percentage is under continuous operator control which enables concentration on a particular point and "painting" in any percentage of the CT or ProstaScint image in a cine type fashion.

EXAMPLE ALIGNMENT IMAGES



Bones & blood vessels in operator-selected slices are typically used for alignment.



Capsular Penetration & Seminal Vesicle Involvement diagnosed with image fusion.

INTEROBSERVER VARIABILITY

	X	Y	Z
MEAN	0.96mm	1.78mm	2.05mm
STD Dev	0.59mm	0.82mm	0.70mm

Mean and standard deviation of alignment differences between two observers who aligned each of ten patients three times. The CT voxel sizes in mm are 1.88 x, 1.88 y, 5.0 z and SPECT 4.8 x, 4.8 y, 4.8 z.

CONCLUSION It is important to define the accuracy of ProstaScint/CT fusion for both diagnostic and therapy purposes. The prostate is surrounded by structures which normally uptake ProstaScint including the rectum, penile blood volume, symphysis, and bladder. Activity in these structures can be mistaken for tumor in the prostate. Patient management is affected when tumor penetrates the prostate capsule or invades the seminal vesicles. The accuracy of image fusion impacts making these distinctions. Identifying the location of tumor within the prostate has been used to guide brachytherapy seed placement in order to give the highest radiation dose to the most active tumor.