Positron emission tomography (PET) provides physiological information that may not be imaged on computed tomography (CT) or magnetic resonance (MR) studies. PET images may allow more accurate delineation of three-dimensional treatment planning (3DTP) target volumes of brachytherapy gynecologic (GYN) implants. This study evaluates the feasibility of using PET images as the sole source of target and normal structure geometries for intracavitary GYN implant treatment planning.

A standard Fletcher-Suit brachytherapy tandem and colpostat applicator is used for radiation delivery. After insertion of the applicator in the operating room, the patient is taken to a PET scanner where $^{18}$F-fluorodeoxyglucose ($^{18}$F-FDG) is intravenously administered. At this time, a set of three tubes containing $^{18}$F-FDG is inserted into the tandem and colpostat applicator. A Foley catheter was inserted into the urinary bladder. A whole-pelvis scan is performed and the images are transferred to a commercial brachytherapy 3DTP system.

The three small tubes are contoured for reconstruction of the applicator, along with bladder, rectum, and target volumes. A treatment plan is generated that includes dose-volume histograms (DVH) and three-dimensional dose distribution displays, allowing the physician an opportunity to determine if adequate target coverage and normal tissue sparing has been obtained. For a more conservative approach, 3D dose distributions and DVHs delivered with conventional source arrangements and loading can be observed.

Applicator reconstruction in axial direction is accurate within 2.0 mm. Reconstruction accuracy in the longitudinal direction is 4.3 mm with imaging parameters used in this study, within PET scanner’s resolution in the same direction.