## Target Delineation of Gross Tumor Volume for Radiation Therapy Planning Using Fusion Images of <sup>18</sup>F-fluorodeoxyglucose Positron Emission Tomography and Computed Tomography

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## Abstract

Modern radiation therapy planning (RTP) has been performed using a large number of images obtained with computed tomography (CT), namely 3-dimensional RTP. Recently, F-18-fluorodeoxyglucose positron emission tomography (FDG-PET) has been used for RTP. FDG-PET can often distinguish between benign and malignant lesions when CT and magnetic resonance cannot. Although FDG-PET images lack anatomical precision (**Fig. 1A**), fusion images of FDG-PET and CT (PET/CT) have been extremely useful for determining the active sites of malignant disease. Particularly for patients with non-small cell lung carcinoma, both primary lesions and active lymph node metastases are well recognized (**Fig. 1B**). With PET/CT, which yields fewer false-negative results, smaller target volumes for radiation therapy can be delineated than with other imaging modalities (**Fig. 2**). The small radiation field (**Fig. 3**) leads to less toxicity in normal tissue, allows high radiation doses to be administered, and improves local control.

The patient in this case was a 61-year-old woman with hoarseness and abnormalities on chest x-ray films. Thoracic CT revealed a 2-cm apical tumor in the left lung and multiple enlarged mediastinal lymph nodes. The diagnosis of non-small cell lung cancer was established with transbronchial lung biopsy. Because the clinical stage was IIIB, concurrent chemoradiation therapy was performed.

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Radiotherapy Planning Using PET/CT Images



Fig. 2





- **Fig. 1** FDG-PET images (A) and fused PET/CT images (B): The areas with high uptake of FDG indicate the primary tumor (**arrows**) and multiple lymph nodes sites, which likely indicate metastasis.
- **Fig. 2** The treatment volume contour (jagged green line) using an FDG accumulation image: The doughnut-shaped uptake area (**pink arrow**) is the normal left ventricle.
- **Fig. 3** A Beam's Eye View photograph: The actual radiation therapy field (the area outlined with jagged line) was drawn on the basis of PET/CT images. The overwritten rendering areas were the probable extents of lymph node metastasis (orange) and the primary site (red).

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