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**CLINICAL INVESTIGATION** **Head and Neck**

# COMPARISON OF CT- AND FDG-PET–DEFINED GROSS TUMOR VOLUME IN INTENSITY-MODULATED RADIOTHERAPY FOR HEAD-AND-NECK CANCER

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**Purpose:** To compare the gross tumor volume (GTV) identified on CT to that obtained from fluorodeoxyglucose (FDG) positron emission tomography (PET) and determine the differences in volume and dose coverage of the PET-GTV when the CT-GTV is used for radiotherapy planning.

**Methods and Materials:** A total of 40 patients with intact squamous cell carcinoma arising in the head-and-neck region underwent intensity-modulated radiotherapy (IMRT) at one department. All patients underwent CT simulation for treatment planning followed by PET-CT in the treatment position. CT simulation images were fused to the CT component of the PET-CT images. The GTV using the CT simulation images was contoured (CT-GTV), as was the GTV based on the PET scan (PET-GTV). The IMRT plans were obtained using the CT-GTV.

**Results:** The PET-GTV was smaller, the same size, and larger than the CT-GTV in 30 (75%), 3 (8%), and 7 (18%) cases respectively. The median PET-GTV and CT-GTV volume was 20.3 $cm^3$ (range, 0.2–294) and 37.2 $cm^3$ (range, 2–456), respectively. The volume of PET-GTV receiving at least 95% of the prescribed dose was 100% in 20 (50%), 95–99% in 10 (25%), 90–94% in 3 (8%), 85–89% in 1 (3%), 80–84% in 2 (5%), 75–79% in 1 (3%), and <75% in 3 (8%) cases. The minimal dose received by 95% of the PET-GTV was ≥100% in 19 (48%), 95–99% in 11 (28%), 90–94% in 5 (13%), 85–89% in 2 (5%), and <75% in 3 (8%) cases.

**Conclusion:** The PET-GTV was larger than the CT-GTV in 18% of cases. In approximately 25% of patients with intact head-and-neck cancer treated using IMRT, the volume of PET-GTV receiving at least 95% of the prescribed dose and minimal dose received by 95% of the PET-GTV were less than optimal. © 2005 Elsevier Inc.

**Gross tumor volume, Intensity-modulated radiotherapy, Radiotherapy planning, PET-CT, Head-and-neck cancer.**

## INTRODUCTION

The use of $^{18}$F-fluoro-deoxy-2-glucose (FDG) positron emission tomography (PET) in treatment planning has recently gained acceptance in the radiation oncology community. Some of the reasons for this include better staging, with possible changes in management, and better delineation of the target volume (1). Most of the reports regarding changes in the target volumes have dealt with non–small-cell lung cancer (2, 3). For head-and-neck cancers, limited information exists. Ciernik *et al.* (4) reviewed 12 cases of head-and-neck cancer and found that the gross tumor volume (GTV) was increased in 17% by ≥25% and decreased in 33% of cases by ≥25% with use of PET. Nishioka and colleagues (5) studied 12 patients with oropharyngeal and 9 with nasopharyngeal carcinoma and found that the GTV was altered in 11% of cases by fusion of PET with MRI/CT. Parotid-sparing radiotherapy (RT) was able to be performed with the information available from PET in 71% of cases because of better target delineation (5). Since July 2002, we have used PET-CT as part of the RT planning process for patients with intact head-and-neck cancers. This report examines our experience with respect to the primary tumor GTV defined by PET compared with that obtained by CT.

## METHODS AND MATERIALS

Between July 2002 and February 2004, 40 consecutive patients (32 men and 8 women, median age, 56 years; range, 32–75 years) with intact squamous cell carcinoma arising in the head-and-neck

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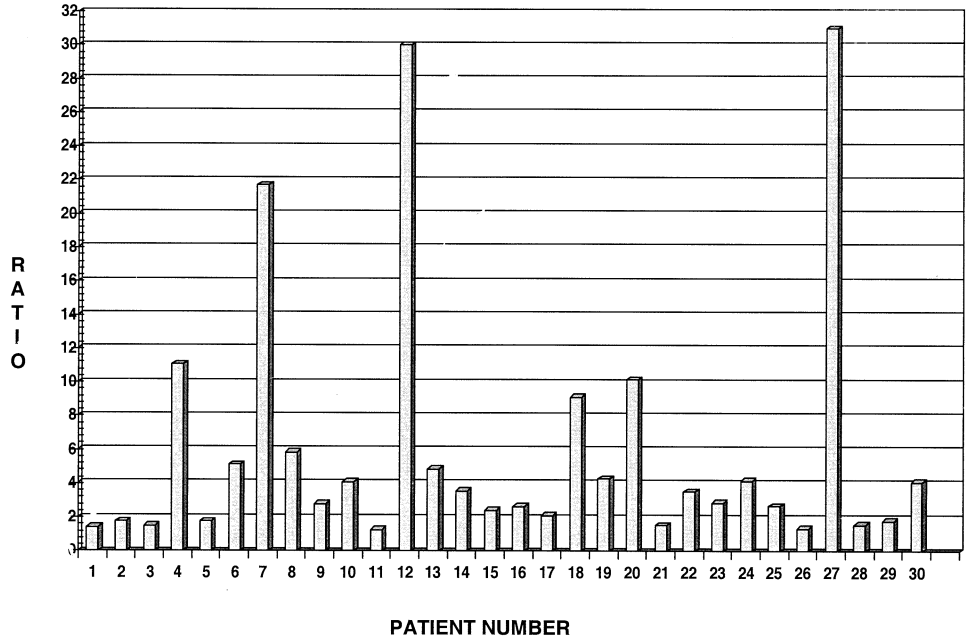


Fig. 1. Computed tomography – gross tumor volume/positron emission tomography-gross tumor volume (CT-GTV/PET-GTV) ratio in 30 patients with CT-GTV greater than PET-GTV.

region underwent RT planning. The primary site location was the tonsil in 12, base of tongue in 7, maxillary sinus in 5, nasopharynx in 4, soft palate in 3, supraglottic larynx in 2, posterior pharyngeal wall in 2 patients, and the floor of mouth, oral tongue, transglottic larynx, nasal cavity, and parotid gland in 1 patient each. Of the 40 patients, 8 and 30 (95% of patients) had American Joint Committee on Cancer Stage III and IV, respectively.

*CT simulation*

All patients initially underwent a planning CT simulation scan (with 100 mL i.v. contrast injected at rate of 2 mL/s) on the General Electric light speed scanner (General Electric, Milwaukee, WI) in the radiotherapy department. The planning volume from the top of the skull to the mid-thorax was scanned at 2.5-mm increments. Patients underwent simulation in the supine position and

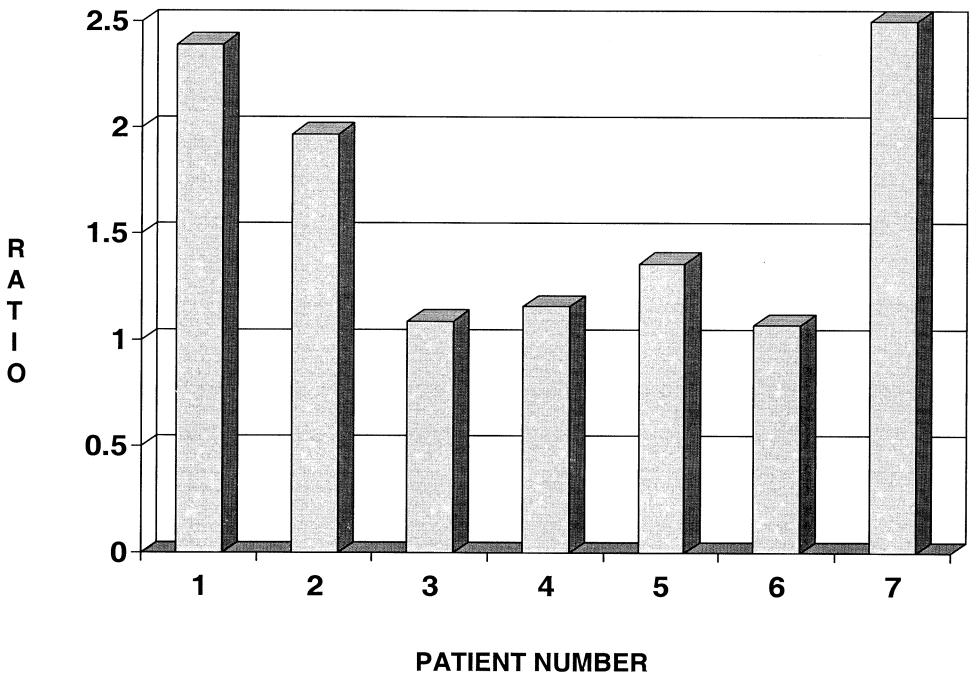


Fig. 2. Positron emission tomography-gross tumor volme/computed tomography-gross tumor volume (PET-GTV/CT-GTV) ratio in 7 patients with PET-GTV greater than CT-GTV.