

21 Automated Delineation of Regional Target Volumes for Patients with Head and Neck Cancer Treated Conformally

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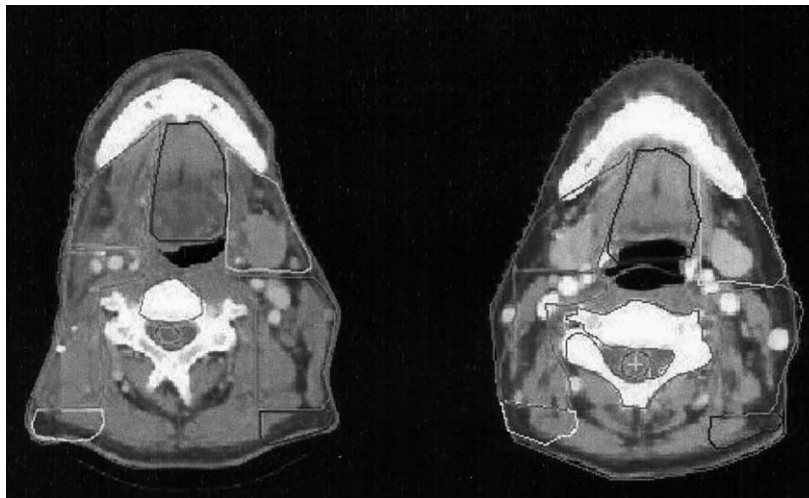
Purpose/Objective: Despite advances in radiotherapy planning and delivery systems, conformal head and neck radiotherapy continues to require labor-intensive target delineation on axial slices of a treatment-planning CT scan. In addition to being time-consuming and complex, manual contouring is also potentially inaccurate. The purpose of this study was to design a computer algorithm that could accurately and automatically contour the cervical lymph node levels (Ia-V) for patients receiving conformal radiotherapy/IMRT.

Materials/Methods: We selected a head and neck CT scan that could be used as a reference model for creating standard lymph node regions. We then separately contoured individual nodal levels on each axial image from the reference CT scan using PRISM radiotherapy planning software, according to a standardized imaging-based classification (Som PM, Curtin HD, Mancuso A. An Imaging-Based Classification for the Cervical Nodes Designed as an Adjunct to Recent Clinical Based Nodal Classification. Arch Otolaryngol Head Neck Surg. 125:388-96, 1999). Nodal regions were therefore defined as a series of two dimensional contours in three dimensional space.

We generated an image registration algorithm that could coregister two unique CT scans. The algorithm uses mutual information to measure similarities (or discrepancies) between the scans. Mutual information is an entropy-based measurement of image alignment derived from probabilistic measures of image intensity values. By assuming the anatomy has similar characteristics between the reference CT scan and a second patient CT scan, the algorithm can transform a region from the reference image set to the patient image set.

Results: A sample image transformation is shown in Figure 1. The first image is from the reference CT scan and demonstrates the reference nodal regions. The second image is from a test patient and shows the transformed test contours resulting from the image registration process.

Conclusions: While the alignment of the transformed contours on the test image are close enough to suggest this approach is promising, they do not exactly conform to clinical criteria. We are first attempting to further refine the algorithm by incorporating landmark-based initialization to enhance the deformation from mutual information. Following completed development, this algorithm will be integrated with the PRISM radiation therapy planning system so that it can be evaluated in a clinical setting.



22 Impact of Image Coregistration with Computed Tomography (CT), Magnetic Resonance (MR) and Positron Emission Tomography with Fluorodeoxyglucose (FDG-PET) on Delineation of GTV's in Oropharyngeal, Laryngeal and Hypopharyngeal Tumors

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Purpose/Objective: To evaluate the potential added-value of MR and FDG-PET over CT for the delineation of primary tumor GTV in oropharyngeal, laryngeal and hypopharyngeal tumors.

Materials/Methods: Twenty patients with locally advanced oropharyngeal (n = 10) and laryngeal/hypopharyngeal (n=10) tumors primarily treated with radiotherapy were included in the study. Before treatment, CT, MR and FDG-PET examinations were performed, the patients being immobilized with a customized thermoplastic mask. MR and FDG-PET acquisitions were coregistered to the CT images using an in house developed software allowing a rigid, manual, segmentation-based coregistration. The accuracy of the whole procedure has been measured in the range of 1-2 mm at +/- 2 Standard Deviations. For CT and MR, GTVs were delineated blindly on axial sections. For PET, GTVs were automatically delineated based on levels of isoactivity, and corrected for air cavities when judged necessary. Differences in individual (GTV-CT, GTV-MR and GTV-PET) and combined (GTV-CT+MR, GTV-CT+PET and GTV-MR+PET) volumes were assessed using a Wilcoxon signed-rank test on coregistered images.