

Purpose:To reconstruct the planning target volume margin necessary in head and neck image-guided radiation therapy.

Methods:For two patients, deformable image registration was used to identify voxels of corresponding anatomy in 35 daily in-room CTs with reference to the planning CT. The resulting vector fields were applied to the original high-, medium-, and low-risk clinical target volumes to devise daily CTVs relative to the isocenter. A volume equivalent to the union of the daily CTVs was considered an effective planning target volume (PTV_{eff}) that retrospectively provided complete geometric coverage of the original CTV while minimizing the inclusion of normal tissue. 0mm, 1mm, 2mm, 3mm, and 4mm isotropic expansions to the original CTVs (CTV_{exp}) were compared with each PTV_{eff}, and evaluated based on the percent coverage of PTV_{eff} provided by CTV_{exp} as well as the volume of normal tissue included in CTV_{exp} but external to PTV_{eff}. An anisotropic expansion of 1mm in the transverse plane and 2.5mm in the superior-inferior direction was also evaluated.

Results:Both the percent coverage of PTV_{eff} provided by CTV_{exp} and the volume of normal tissue included in CTV_{exp} were proportional to the expanded margin. The values from the anisotropic expansion lay between those from the 1mm and 2mm isotropic expansions. For one patient, an isotropic expansion of 2mm was required to cover at least 95% of PTV_{eff} and actually covered at least 97% for the original CTVs. For the other patient, 3mm and 4mm expansions were necessary to provide 95% coverage of PTV_{eff}.

Conclusion:Deformable image registration may be utilized to retrospectively evaluate the efficacy of various CTV margin expansions. The two patients studied demonstrated different margin requirements for the desired coverage. Additional patients will be incorporated to establish empirically derived, clinically appropriate margins.