

A Prospective Study of a Clinically Significant Anatomical Change in Head and Neck Intensity-Modulated Radiation Therapy Using Transit Electronic Portal Imaging Device Images

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Abstract : The major factors of radiotherapy for head and neck (HN) cancers include patient's anatomical changes and tumour shrinkage. These changes can significantly affect the planned dose distribution that causes the treatment plan deterioration. A measured transit EPID images compared to a predicted EPID images using gamma analysis has been clinically implemented to verify the dose accuracy as part of adaptive radiotherapy protocol. However, a global gamma analysis dose not sensitive to some critical organ changes as the entire treatment field is compared. The objective of this feasibility study is to evaluate the dosimetric response to patient anatomical changes during the treatment course in HN IMRT (Head and Neck Intensity-Modulated Radiation Therapy) using a novel comparison method; organ-of-interest gamma analysis. This method provides more sensitive to specific organ change detection. Random replanned 5 HN IMRT patients with causes of tumour shrinkage and patient weight loss that critically affect to the parotid size changes were selected and evaluated its transit dosimetry. A comprehensive physics-based model was used to generate a series of predicted transit EPID images for each gantry angle from original computed tomography (CT) and replan CT datasets. The patient structures; including left and right parotid, spinal cord, and planning target volume (PTV56) were projected to EPID level. The agreement between the transit images generated from original CT and replanned CT was quantified using gamma analysis with 3%, 3mm criteria. Moreover, only gamma pass-rate is calculated within each projected structure. The gamma pass-rate in right parotid and PTV56 between predicted transit of original CT and replan CT were 42.8% (± 17.2%) and 54.7% (± 21.5%). The gamma pass-rate for other projected organs were greater than 80%. Additionally, the results of organ-of-interest gamma analysis were compared with 3-dimensional cone-beam computed tomography (3D-CBCT) and the rational of replan by radiation oncologists. It showed that using only registration of 3D-CBCT to original CT does not provide the dosimetric impact of anatomical changes. Using transit EPID images with organ-of-interest gamma analysis can provide additional information for treatment plan suitability assessment.

Keywords : re-plan, anatomical change, transit electronic portal imaging device, EPID, head, and neck

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