PO-0940

Feasibility of planning CT to MVCT deformable registration for ìdose of the dayî calculation in helical Tomotherapy

M. Branchini[1], S. Broggi[1], C. Fiorino[1], M.L. Belli[1], G.M. Cattaneo[1], R. Calandrino[1]
[1]*Scientific Institute San Raffaele, Medical Physics, Milan, Italy*

Purpose/Objective: The aim of this study was to test the feasibility of deformable image registration (DIR) of the planning CT to MVCT taken during treatment for calculation of the dose of the day for head and neck (HN) patients.

Materials and Methods: kVCT/MVCT images of six HN patients treated with Helical Tomotherapy (HT) with a simultaneous integrated boost (54/66/69 Gy/30 fr) were retrospectively analyzed. For each patient the planning kVCT (CT-plan) was elastically registered (DIR) to the MVCT acquired at the 15th therapy session (MVCT15) with a B-Spline deformation algorithm using Mattes mutual information (open-source software 3D Slicer), resulting in a deformed CT (CTdef). At the same day of MVCT15, a kVCT was acquired with the patient in the same treatment position (CT15) and taken as reference for the calculation of the dose of the day. Then, CTdef and CT15 were re-sampled to the same slice thickness (3mm) through linear interpolation. The original HT plans were recalculated both on CTdef and CT15 in the HT planning station using the DQA (dose quality assurance) module, considering the two set of images as phantoms: images were rigidly aligned with the CT-plan, mimicking the true daily repositioning. Dose distributions on CTdef and CT15 were compared in order to assess the reliability of the method; local dose differences <2% of the prescribed dose (DD2%) and global gamma-index values (2%-2mm; considering points with dose >20% of the prescribed one) were assessed for all the available transversal slices (step: 6 mm) with Mapcheck SNC Patient Software (Sun Nuclear).

Results: The results of DIR was qualitatively satisfactory when comparing CTdef against CT15. Twenty-nine slices for each patient (range: 20 – 47) were on average available for the evaluation of local dose differences and gamma analysis. On average, 93.0% ± 1.2% of points passes the gamma analysis test and 86% ±2% of the body ‘s voxel were found for DD2%. A slight improvement was found when excluding the first/last slices near the treatment FOV (respectively 94.4% ± 1.4% for gamma and 88% ± 2% for DD2%). Excluding one patient where a significant number of slices were cut due to the narrow FOV of the MVCT15, the values further improved to 95.2% ± 1.4% and 89% ± 2% for gamma and DD2% respectively.

Conclusions: CT to MVCT DIR using an open source system was proven to be an accurate method for calculating the dose of the day in HT treatments for HN cancer and a reliable tool for the implementation of adaptive Tomotherapy strategies.

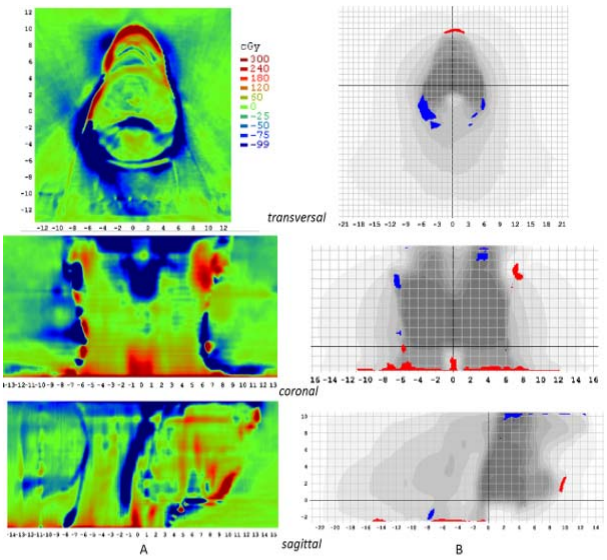

Figure: in column A the absolute dose differences between Ctdef and CT15; in column B gamma distributions (in red and blue voxels with gamma >1).

PO-0941

Adaptive radiotherapy based on integrated transit planar dosimetry for lung cancer patients

L.C.G.G. Persoon[1], A. Sanizadeh[1], B. De Ruiter[1], S. Nijsten[1], F. Verhaegen[1], E.G.C. Troost[1]
[1]*MAASTRO clinic, Medical Physics, Maastricht, The Netherlands*

Purpose/Objective: Automated decision-making for adaptive radiotherapy for lung cancer patients is increasingly important with dose escalation strategies and modern radiotherapy techniques such as volumetric modulated arc therapy (VMAT). It is known that anatomical changes requiring adaptive radiotherapy occur frequently (~20%) in lung cancer patients. The aim of this study was to investigate whether EPID dosimetry, more specifically integrated transit planar dosimetry (ITPD), was able to detect the dose discrepancies caused by these anatomy changes and could be used for informed decision making for adaptive radiotherapy. The hypothesis was that 'gross' changes, now only caught indirectly by qualitative visual inspection of the kiloVoltage ConeBeam CT (kV-CBCT) images, could be detected automatically by using ITPD.

Materials and Methods: For this study 60 lung cancer patients who underwent treatment adaptation in routine clinical practice were analyzed with ITPD. In this simulation study, a reference ITPD was predicted using the original planning CT and the original treatment plan. This was then compared to a second predicted ITPD of the original treatment plan on a later acquired planning CT, right before treatment adaptation. A global γ-evaluation with dose difference and distance-to-agreement criteria of 3% and 3mm was performed and the percentage pixels exceeding unity within the field shape P(γ>1) was scored for each beam. For all patients, the 3D dose was calculated on the original treatment plan and was also recalculated on the later planning CT with its new delineation. The planning target volume (PTV) coverage was compared between both 3D dose distributions to quantitatively confirm that treatment adaptation was necessary.