Interfractional Dosimetric Verification of Lung Patients Treated by Passive Double Scattering Proton Radiotherapy

Introduction: A cohort of 20 patients were selected from lung patients treated with passive proton radiotherapy in our institution. All those patients were screened by 4D-CT scans to make sure the tumor motion less than 1 cm in order to minimize the risk potentially caused by proton range uncertainty. The internal target volumes (ITV) were derived from the full inspiration and expiration phases and checked against all respiratory phases. The average of the 4D-CT, full inspiration and expiration scans were used for the initial treatment planning. The planning objective is 95% of the prescription dose to at least 95% volume of the ITV. Bi-weekly verification 4D-CT scans were performed to assess the robustness of the initial treatment plan. The treatment plan was forward calculated on the full inspiration phase (CT0), full expiration phase (CT50), and the average (AVE) of verification scans. The deviations of target coverage and OAR sparing were calculated to quantify the treatment robustness. Lung tumors were further classified into centrally located tumors (9 cases) and non-centrally located tumors (11 cases) to check the location dependences. The results are shown in the following:

Figure 1. ITV-coverage deviation of the verification plans with respect to the initial plan. Left panel shows the absolute dose deviation (Gy) and right panel shows the percentage dose deviation. The blue lines denote the results of centrally located tumors, and the black lines denote the results of tumors located on side. Red lines indicate the standard deviations, and blue and black vertical lines indicate the upper and lower limits.

Figure 2. The mean lung dose deviation of the verification plans with respect to the initial treatment plan. The line styles have the same meaning as in Figure 1.