AbstractID: 11213 Title: Four-dimensional carbon ion dose assessment in respiratory-gated lung therapy: simulation study in respiratory pattern variation cases

Purpose:
To estimate the effects of the irregular respiratory pattern during the carbon-beam treatment of lung cancer in the four-dimensional treatment planning, we simulated the irregular respiratory motion by the NCAT phantom and calculated the accumulated dose for respiratory gated and ungated treatment.

Method and Materials:
4D NCAT phantom was used to simulate the irregular respiratory tumor motion during several cycles of respiration. The treatment planning was performed based on the first cycle of the respiration. The cycle was subdivided into 10 phases and the prescribed dose was distributed so that all points in the planning target volume (PTV) receives more than 90 percent of the total prescribed dose. The total of 52.8 GyE was delivered from four beam ports with angles selected to be 340, 70, 20, and 110 degrees. The plan was scheduled both for ungated and gated treatment. For the respiratory-gated treatment, the gating window was set in T40%-T60% phases. The dose calculation was based on the pencil beam algorithm. The accumulated dose was evaluated and compared between gated- and ungated-results in terms of V20, D95 and dose-volume histogram (DVH).

Results:
For the ungated case the dose conformation was deteriorated compared to the ideal case where the respiratory pattern was completely the same as in the treatment planning, while, for the gated treatment, the improved dose conformation was observed in terms of both D95 and V20.

Conclusion:
Though the 4D planning is effective to estimate internal margin, the irregular respiratory pattern may deteriorate the conformation of the accumulated dose during the whole treatment. The gating treatment, if appropriately synchronized, is effective both for the dose conformity and the reduction of the extra dose to the normal tissues or organs at risks.