Dokumenttyp: journal article

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Titel des Beitrags:
Four-dimensional patient dose reconstruction for scanned ion beam therapy of moving liver tumors.

Abstract:
Estimation of the actual delivered 4-dimensional (4D) dose in treatments of patients with mobile hepatocellular cancer with scanned carbon ion beam therapy. Six patients were treated with 4 fractions to a total relative biological effectiveness (RBE)-weighted dose of 40 Gy (RBE) using a single field. Respiratory motion was addressed by dedicated margins and abdominal compression (5 patients) or gating (1 patient). 4D treatment dose reconstructions based on the treatment records and the measured motion monitoring data were performed for the single-fraction dose and a total of 17 fractions. To assess the impact of uncertainties in the temporal correlation between motion trajectory and beam delivery sequence, 3 dose distributions for varying temporal correlation were calculated per fraction. For 3 patients, the total treatment dose was formed from the fractional distributions using all possible combinations. Clinical target volume (CTV) coverage was analyzed using the volumes receiving at least 95% (V95) and 107% (V107) of the planned doses. 4D dose reconstruction based on daily measured data is possible in a clinical setting. V95 and V107 values for the single fractions ranged between 72% and 100%, and 0% and 32%, respectively. The estimated total treatment dose to the CTV exhibited
improved and more robust dose coverage (mean V95> 87%, SD< 3%) and overdose (mean V107< 4%, SD< 3%) with respect to the single-fraction dose for all analyzed patients. A considerable impact of interplay effects on the single-fraction CTV dose was found for most of the analyzed patients. However, due to the fractionated treatment, dose heterogeneities were substantially reduced for the total treatment dose. 4D treatment dose reconstruction for scanned ion beam therapy is technically feasible and may evolve into a valuable tool for dose assessment.

Zeitschriftentitel / Abkürzung:
Int J Radiat Oncol Biol Phys

Jahr:
2014

Band:
89

Heft / Issue:
1

Seiten:
175-81

Sprache:
eng

Pubmed:

Print-ISSN:
0360-3016

TUM Einrichtung:
Klinik und Poliklinik für RadioOnkologie und Strahlentherapie

Occurences:
- Einrichtungen > Fakultäten > Fakultät für Medizin > Kliniken und Institute > Klinik und Poliklinik für RadioOnkologie und Strahlentherapie > 2014

entries: