EP-1259: Influence of the type of headrest (individual or standard) on the actual given dose in target volumes and organs at risk
Free, J.; Wittendorp, P.W.H.; Brouwer, C.L.; Schaaf, A. van der; Langendijk, J.A.; Veld, A.A. van 't; Steenbakkers, R.J.H.M.; Sijtsema, N.M.

DOI:
10.1016/S0167-8140(15)33565-9

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2013

Link to publication in University of Groningen/UMCG research database

Citation for published version (APA):

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Download date: 19-05-2019
The lowest movement of individual parts of the SC were detected for the C1-C2 and the highest for the C7-Th1. The mobility of the individual parts of the spinal cord were different for different parts of SC: the lowest for the C1-C2 part and the highest for the C7-Th1. Finally, our study showed that for CRT of the oropharyngeal cancer with daily image guidance and proper plan adaptation scheme, the currently used PRV margin for the spinal cord (5 mm) could be reduced to 4 mm.

**EP-1259**

Impact of the spinal cord position uncertainty on the dose received during head and neck helical tomotherapy

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**Purpose/Objective:** To establish the optimal planning risk volume to the spinal cord (SC) for oropharyngeal cancer patients during adaptive radiation therapy with concurrent chemotherapy (CRT).

**Materials and Methods:** Prospective study based on the 875 observations from 25 oropharyngeal cancer patients was performed. Geometrical uncertainties of the SC were evaluated. Differences between planned and delivered maximum doses to four parts of the SC (C1-C2, C3-C4, C5-C6, C7-Th1) were established for every fraction dose and for cumulative dose. Maximum doses were evaluated as a dose received in 0.5 cm³ and 1 cm³ of the analysed part of the SC. Finally, relations between dose differences and geometrical uncertainties were analysed using a relative risk (RR), dose gradient (DG) and the importance of the PRV dose gradient (IDG) to establish optimal planning risk volume for the SC. The importance of the dose gradient (IDG) was established for each part of the SC as the ratio of the maximum dose received in a part of the PRV corresponding to the analysed part of the SC to the maximum dose in a whole PRV. The relative risk (RR) was defined as a ratio of the maximum delivered dose in selected part of the SC (D Delivered) to the maximum dose in the whole PRV (D PRV) multiplied by IDG: (RR=D Delivered/DPRV x IDG).

**Results:** The C1-C2 part of the SC is most exposed to risk of overdosage during chemoradiation for patients with oropharyngeal cancer due to its proximity to the CTV. Doses received by other parts of the SC are smaller, with the lowest dose delivered to the C7-Th1.

**Conclusions:** The likelihood of over-dose in the spinal cord is most affected by the geographical location to the PTV. The C1-C2 part of the SC is most exposed to risk of over-dose during CRT in patients with oropharyngeal cancer. Doses received by other parts of the SC are smaller, with the lowest dose delivered to the C7-Th1.
Evaluation of individual margins to account for motion during the treatment of moving targets

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Purpose/Objective: Treatment planning and dose calculation are based on static images in radiotherapy. But some targets are subject to regular movements like breathing motion. Profile and magnitude of motion affect the applied dose leading to dose blurring. Taking into account motion during treatment, margins around the target are used to compensate motion induced effects on dose distributions. As magnitude of motion is patient specific, the associated margin has to be individual. The aim of this work is to analyze the effect on dose distributions. Parameters having an impact are amplitude and target size. Individual margins are investigated to compensate for motion induced dose blurring resulting in a better adapted treatment for each patient.

Materials and Methods: Simulating different sized lung targets, Gafchromic EBT2 films (ISP, Wayne) are irradiated using a static thorax phantom. Different target and margin related field sizes are measured. Transmission of the film is determined with a flatbed scanner, evaluation and extraction of dose profiles are executed with MATLAB routines (R2011a, TheMathworks). The static dose profiles are blurred with MATLAB simulating breathing motion (symmetric cos function) with peak-to-peak-amplitudes in the range of 0-30 mm in the direction of the profile. The target region of the profile is analyzed in static and motion case each having various margins. Mean dose and EUD of the target region are calculated for several target sizes and compared for different combinations of motion amplitudes and margins.

Results: In figure 1, EUD of the target region as function of the applied margin is shown for different motion amplitudes. Data are normalized to the value without motion and margin. For a moving target, EUD and mean dose decrease with increasing motion amplitude. Magnitude of this effect depends on the target size, additionally. To reach the same EUD and mean dose in case of motion as in static case, a margin has to be applied. Thus EUD and mean dose increase for all amplitudes and target sizes, but not in the same ratio. For growing target size the margin decreases for a constant increase for all amplitudes and target sizes, but not in the same ratio. As in static case, a margin has to be applied. Thus EUD and mean dose of the target region are calculated for several target sizes and compared for different combinations of motion amplitudes and margins.

Conclusions: Individual margins are important applying the treatment best possible for each patient. To compensate for motion effects, the margin must depend not only on motion amplitude but also on target size. In the future, a mathematical correlation is questded for to calculate an individual margin for known motion amplitude and target size.

Impact of polyethylene glycol spacer injections on interfraction prostate motion in patients undergoing IGRT

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Purpose/Objective: The injection of a polyethylene glycol spacer (PGS) in the Denonvilliers fascia aiming to separate the prostate from the anterior rectal wall has been recently introduced for curative radiotherapy (RT) delivered to patients with localized prostate cancer. Sparing of the rectum from the high RT doses with PGS will be achieved and a decrease of radiation-induced toxicities is awaited. In this study we assessed the impact of PGS in the interfraction prostate motion in patients undergoing curative RT for prostate cancer.

Materials and Methods: Twenty patients with (n=10) or without (n=10) PGS were treated to the prostate ± seminal vesicles according to a hypofractionated RT protocol (14x4 Gy, twice/thrice-a-week). All patients were implanted with three fiducial markers (FM) before the start of RT and underwent between 4 to 8 cone-beam computed tomography (CBCT) scans during the RT course. Constant bladder and rectal filling was controlled by proper patient instruction and, if necessary, using rectal enemas before every RT fraction. Relative displacements between the prostate isocenter based on the FM’s position and the bony anatomy were quantified in the LR (left-right), AP (anterior-posterior), SI (superior-inferior) axes for every patient by offline analyses of CBCTs. A total of 122 CBCTs were evaluated. Systematic (ς) and random (σ) setup errors were determined and planning target volumes (PTV) margins computed with the Van Herk formula (ς = 2.5 Σ + σ0.7 Σ).

Results: The overall mean errors and the average of the standard deviations of the prostate displacements during the RT course were -0.03 and 0.67 mm, 0.35 and 1.60 mm, and -0.26 mm and 1.56 mm for the LR, AP, and SI axes, respectively. A mean interfraction motion ≥ 4 mm was observed in LR, AP, and SI directions in 0, 3 (15%), and 2 (10%) patients, respectively. Mean prostate interfraction movements in patients treated with or without PGS were 0.32 mm vs. -0.38 mm, 0.12 mm vs. 0.59 mm and -0.36 mm vs. -0.17 mm in the LR, AP and SI directions, respectively. Despite an overall prostate motion less marked of 0.44 mm in the AP direction for patients with PGS, the Σ and σ errors remained similar for both groups in the three axes. Estimated PTV margins using a CBCT-based bony alignment were similar for patients treated with or without a PGS implant, requiring 1.97 mm vs. 2.11 mm, 8.92 mm vs. 8.55 mm and 7.19 mm vs. 8.55 mm for the LR, AP and SI axes, respectively.

Conclusions: The implant of PGS does not significantly influence the interfraction prostate motion in patients treated with curative RT for...