CT may hamper contouring and dose calculation accuracy. Although not in widespread routine use, deformable image registration (DIR), preferable unsupervised, is used for auto-segmentation of organ volumes based on those delineated on a reference planning CT. Using the daily pre-treatment registrations between planning CT and CBCT the delivered dose at each fraction can be recalculated on the CBCT anatomy with proper calibration of the systems. Based on DIR, accumulation of the dose can be performed from day to day, and delivered dose can be compared directly with the planned dose, and dose-volume histograms for OAR can be evaluated. Alternatively, the consecutive DIRs can be combined to represent a mean deformation vector field which can be applied to the planning CT with planned dose distribution to obtain a measure of delivered dose. For dose-response relations, the accumulated delivered dose needs to be combined with validated clinical outcome measures.

**LOOK INSIDE: ADAPTIVE RADIOThERAPY IN PRACTICE**

**SP-0295**

Adaptive RT for head and neck cancer: Methodological approaches and clinical outcome

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Head and neck tumors become on the average 40% and 70% smaller after 2 and 4 weeks of radio(chemo)therapy, respectively. Tumor response, alterations in non-tumor anatomy and treatment-induced toxicity like weight loss or edema, cause a mismatch between pre-treatment planned dose distributions on the one hand and the shapes of tumor and organs-at-risk (OARs) on the other hand. By regularly adapting the treatment to changing anatomy, avoidance of OARs is maintained during the whole treatment. By simultaneously updating dose-painting to changing biology, optimal targeting of radiosensitive parts of the tumor is better secured. To investigate this dual hypothesis, dosimetrical effects of adaptive (ART) and non-adaptive (RT) dose-painted radiotherapy were investigated for 10 patients with head-and-neck cancer. Three treatment-phases were preceded by a planning PET/CT scan. In ART, phases II and III were planned using PET/CT2 and PET/CT3, respectively. In RT, the phase-I plan on PET/CT1, was used to calculate dose-distributions on PET/CT2 and PET/CT3. Deformable image co-registration was used to sum dose distributions and to propagate regions-of-interest (ROIs) drawn on PET/CT1 to PET/CT2, PET/CT3 and to a last-treatment-day CT-scan (CT4). Inaccurately deformed ROIs were manually adjusted if necessary. In target ROIs, ART provided higher minimum and lower maximum doses than RT and re-matched dose-painting. For OARs, ART improved critical dose/volume parameters. ART achieved average reduction of 4.6-7.1% in the parotids' median dose (p<0.05) and 3% in the nasopharynx. Favorable structures' mean dose (p<0.06). Improvements of dose/volume parameters by ART were more pronounced in individual patients reaching 24.4% minimum-dose increase in elective neck PTV and 29.5% mean-dose decrease in swallowing structures.

Conclusion: Compared to RT, ART readjusts dose-painting, increases minimum and decreases maximum doses in target volumes and improves dose/volume parameters of OARs. Reporting population-average effects in ROIs underestimates the patient-individual benefits of ART.

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**SP-0296**

Clinical implementation of Plan-of-the-Day strategies for prostate cancer.

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Currently, in external beam radiotherapy of locally advanced cervical cancer, a large safety margin around the tumour is needed to compensate for potentially large day-to-day variations in the target position and shape, as e.g. induced by bladder and rectum volume changes. At Erasmus MC we have developed an individualized adaptive RT approach resulting in significant margin reductions (Bondar et al. JROBP 2012 Aug 1;83(5):1617-23). In the treatment preparation phase, patients are stratified in two groups with small or large bladder-volume induced tumour motion. For the first group, a single IMRT plan is created with an individualized small margin. For the second group two IMRT plans are created, adequate for tumour positions and shapes corresponding to smaller and larger bladder volumes. Every treatment day, the best fitting plan is selected based on an in-room acquired Cone Beam CT scan (CBCT), showing internal anatomy and markers implanted around the primary tumour. The first part of this presentation will review the rationale of library-based Plan-of-the-Day strategies for this treatment site. Using data of 14 patients with two series of variable bladder filling CT scans (acquired pretreatment and after 40 Gy), we demonstrated the benefit of 1) individualizing the required margin by using an individualized internal target volume (ITV) and 2) of using two separate ITVs for patient with large cervix-uterus motion.

In the second part of the presentation, we will provide inside in practical issues concerning the implementation of the library-based Plan-of-the-Day strategies. The following issues in the preparatory phase will be discussed: 1) the acquisition of an empty and full bladder filling CT scan, 2) the choice of the number IMRT plans in the plan library, 3) the creation of the ITVs, 4) the implantation of markers around the primary tumour as an aid to quickly verify the position of the cervix at the treatment unit, and 4) the addition of a motion-robust backup plan to the plan library.

Next, inside will be provided in the image-guidance and plan-selection procedure at the linear accelerator. In this procedure daily CBCT scans are acquired for online patient-setup correction and assessment of the position of the uterus and markers (XVI software, Elekta AB). Contours of 10-mm margins around the markers, PTV, and ITV are projected on the bone-matched CBCT scan. The bony anatomy is used because of the nodal CTV to be treated. An intervention decision tree coaches RTTs through the whole plan selection procedure. Plan selection is completed by an online patient setup correction (based on the bony-anatomy match), followed by the manual selection of the plan of the day in the treatment record and verify system. In the final part of this presentation, an evaluation of the clinical protocol will be presented.

**SP-0297**

Adaptive plan of the minute strategies for prostate cancer: Methods for motion management

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In state of the art image guided, intensity modulated radiotherapy (iGyMRT) of primary prostate cancer, inter-and intra-fractional movements of the organ are still the main reason for safety margins between the clinical target volume (CTV) and the planning target volume(PTV). Margins and side effects in neighbouring structures hinder dose escalations. Even if daily pre-treatment imaging and faster rotational treatment delivery (VMAT) are performed, intra-fractional patient and target motion are limiting factors for a successful radiotherapy. Different spacer materials (injected gels, balloons) can be used to enlarge the distance between the high dose region (PTV) and an organ at risk (rectum). It was tested, if the bulky volume of spacers can also contribute to a reduction of uncertainties by constraining inter- and intrafractional movements. Preliminary results of our own investigations on >50 spacer patients show that there may be no significant reduction of movements, neither interfractionally nor intrafractionally.