found to have reduced volumes during their course of treatment, and patients with very small rectal volumes at planning CT were also unable to maintain this very small volume during treatment. A literature review of published rectal preparation protocols was carried out and an investigation into the range of products that are currently administrated to patients affected by this problem in other institutions was also completed.A comprehensive protocol was established in our centre combining the findings of the reviews and our own experience to date. This protocol consists of nutritional advice for all prostate patients and identification and intervention with 30ml Milk of Magnesia daily for patients with rectal distension at the planning CT stage defined as an AP rectal diameter > 4cm at the base of prostate.
Results: The protocol was clinically implemented in April 2009 for all prostate CRT patients. The efficacy of this protocol will be assessed throughout the course of treatment in relation to PTV displacement and changes in rectal diameter. Patient compliance will also be assessed.
Conclusions: Results and conclusions will be available for the 10th Biennial ESTRO meeting.

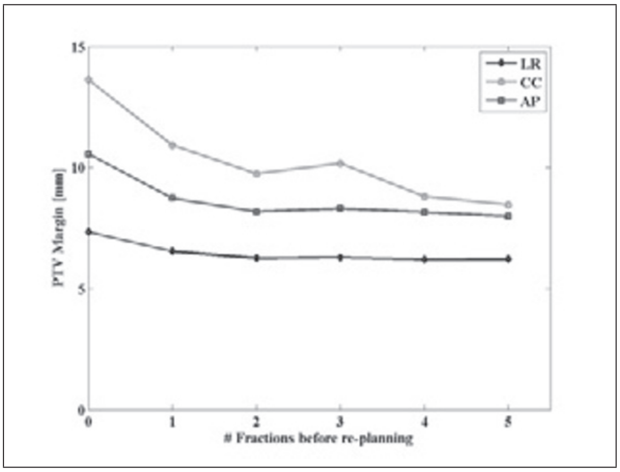
IGRT: Volume definition, treatment margins and geometric uncertanties

480 poster (Physics Track)

ADAPTIVE RADIOTHERAPY FOR LUNG CANCER PATIENTS

J. J. Sonke[1], M. van Herk[1]
[1] ANTONI VAN LEEUWENHOEK HOSPITAL, NETHERLANDS CANCER INSTITUTE, Department of Radiation Oncology, Amsterdam, Netherlands

Purpose: Considerable inter-fraction tumor baseline variations have been observed in lung cancer patients. Four dimensional cone beam (CB) CT guided correction protocols have been clinically implemented to reduce these variations for node negative patients. In case of involved lymph nodes, however, differential motion between primary tumor and nodes invalidates the use of couch shifts to reduce these errors, thus currently requiring generous planning target volume (PTV) margins. The purpose of this study was therefore to quantify possible PTV margin reduction by an adaptive re-planning strategy for this patient group.
Materials: Twenty-seven node positive lung cancer patients were included in this retrospective study. Target delineation and treatment planning were performed on the mid-ventilation CT scan. Four-dimensional-CBCT scans (Elekta Synergy, augmented with in-house developed software) were routinely acquired (9-20 scans per patient) for an offline shrinking action-level setup correction protocol based on bony anatomy. Baseline variation were quantified in terms of systematic and random errors, while bony anatomy was used as a surrogate for the position of the nodes. Margins were calculated taking into account delineation uncertainty (Σ=2mm), residual setup error after online setup correction (Σ=σ=1mm), baseline variation and respiratory motion (10mm peak-to-peak amplitude). Subsequently, repeat 4D-CBCTs were analyzed to determine the number of initial fractions of scanning required to give an adequate prediction of the systematic baseline errors.
Results: Uncorrected baseline variations were 1.7mm (LR), 4.2mm (CC) and 3.1mm (AP) systematic and 1.2mm (LR), 2.1mm (CC) 2.2mm (AP) random. Margins required to account for the geometrical uncertainties are 7mm (LR), 14mm (CC) and 11mm (AP). Adaptive re-planning after one fraction already reduces the required margins considerably (Fig 1), indicating that the planning CT is not a good representation of the anatomy during treatment delivery. Increasing the number of initial fractions of imaging to estimate the systematic baseline shifts further reduced the residual baseline shifts for the remaining fractions and corresponding margins, especially in the CC direction. After 5 fractions, the required margins were reduced to 6-8mm.
Conclusions: Adaptive radiotherapy for lung cancer patients after the firsts 5 fraction considerably reduces the systematic baseline shifts and PTV-margins required to account for such uncertainties at the cost of a second treatment plan to be made. Future work includes more accurate quantification of nodal baseline shifts.



481 poster (Physics Track)

ANALYSIS AND MANAGEMENT OF SET-UP UNCERTAINTIES IN RECTAL CANCER RADIOTHERAPY

D. Jurado Bruggeman[1], C. Muñoz[1]
[1] INSTITUT CATALA D'ONCOLOGIA-HOSPITAL DR. JOSEP TRUETA, Medical Physics, Girona, Spain

Purpose: The aim of this work was to study set-up uncertainties for the group of rectal cancer patients treated in our institution. The efficiency of several correction protocols was analyzed. Set-up time trends were also evaluated.
Materials: 140 rectal cancer patients were arbitrarily chosen. Patients were simulated and treated in prone position without immobilization devices. Patients were positioned by alignment of lasers with skin tattoos. For each patient, set-up errors in each direction *i*, where *i*=medial-lateral (*ml*), cranial-caudal (*cc*) and anterior-posterior (*ap*), were measured using EPID imaging during the first treatment sessions (from 3 to 8; 4 on average). From these measurements, systematic and random set-up uncertainties were determined in each direction for each patient.To characterise our group of patients, mean systematic errors (μi) and standard deviations of systematic (Σi) and random (σi) uncertainties were determined. Patients with large random set-up uncertainties (random vector length > 7 mm) were excluded from the group as they were positioned using an on-line correction protocol.Margins considering only set-up uncertainties (*SMi*) were obtained using the expression proposed by Van Herk et al.In order to establish our correction strategy for the group, the impact of the following correction protocols was simulated by Monte Carlo: first-day correction (*FD*), no action level (*NAL*) (*n*=2,3,4) and shrinking action level (*SAL*) (α=9 mm; *nm*=2,3,4) with and without adaptive maximum likelihood correction (*AML*).Set-up time trends were also evaluated in sessions ten and twenty. We considered that a time trend appeared when the measured displacement vector length exceeded two times the random set-up uncertainty of the patient with a threshold value of 5 mm.
Results: 20 patients (15%) had large random uncertainties and were excluded from the group. Group parameters and *SMi* for the most common (*FD*) and for the most efficient (*NALn*=3) correction protocols are shown in Table 1:

		ml (mm)	cc (mm)	ap (mm)
Group characterization	σ_i	2.4	-1.2	3.1
	μ_i	1.9	-1.5	2.6
	Σ_i	3.3	-7.2	5.0
First-day correction	μ_i	0.0	0.0	0.0
	Σ_i	2.4	1.9	3.3
	SM_i	7.7	6.1	10.6
$NAL_{n=3}$	μ_i	0.0	0.0	0.0
	Σ_i	1.4	1.1	1.9
	SM_i	4.2	3.5	5.5

Table 1. Set-up uncertainties and influence on margins. The group value of μap is large because some patients tight their buttocks in the preparation stage, and even in the first sessions, but then they relax during the treatment. This is difficult to detect and to correct, and introduces a systematic error in *AML* corrections.Set-up time trends were detected for 30% of patients either in session ten or twenty.
Conclusions: Patients with large random errors should be positioned using an on-line correction protocol. *NALn*=3 off-line correction protocol improves