

collections/questionnaires per patient varied from 1 to 11 (median: 6). In both the pre-RT and post-RT settings, there was strong correlation between saliva flow rates, RTOG toxicity scores, and most questionnaire responses. There was no measured correlation between flow rates (stimulated or unstimulated) and pilocarpine use. The relationship between speech toxicity and saliva flow rates was variable: In the pre-RT time period, there was strong correlation between toxicity and both stimulated ($p = 0.04$) and unstimulated ($p < 0.01$) saliva flow rates. In the post-RT follow-up period, there was weak correlation between stimulated saliva flow rates and toxicity ($p = 0.06$), and no correlation between unstimulated flow and toxicity ($p = 0.3$).

Conclusion: There is strong correlation between most quality of life endpoints, RTOG toxicity, and stimulated and unstimulated saliva flow rates, which makes the sparing of salivary tissue a worthwhile planning goal in head and neck IMRT treatments. We did not observe a statistically significant relationship between post-RT saliva flow rates and speech toxicity.

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ORAL

Dose reduction to the heart with respiratory gated radiotherapy

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Purpose/Objective: Because there are hints for an increased risk of cardiovascular diseases after radiotherapy of the left chest wall the dose to the heart should be reduced as far as possible. With respiratory gating technique irradiation can be restricted only in the inspiratory plateau phase and so the distance between heart and chest wall will be increased. As a result the dose to the heart, in particular to the anterior wall, can be reduced. We investigated in all patients with left sided breast cancer dose reduction to the heart when treated only in the inspiration phase compared with not gated treatments.

Materials and methods: Between Sep. and March 2005 32 patients with left sided breast cancer were treated with respiratory gating technique based on a retrospective 4D CT scan. With this technique we irradiate only in maximum inspiration with a range between 10%-20%. For the investigation of real dose reduction to the heart we performed for all of these patients a normal and a respiratory gated planning CT. Planning was done with the same treatment parameters in both CT. DVH for the entire heart and the anterior left ventricle wall were calculated. All of these patients were treated with 2 Gy single dose to a total dose of 50 Gy to the entire left breast/chest wall. 18 patients had an additional boost of 10 Gy. The PTV was in 36 patients after breast conserving surgery the left breast, in 6 patients after mastectomy the left chest wall.

Results: The mean dose to the entire heart was 1.7 Gy (0.5 Gy-3.2 Gy) without and 0.8 Gy (0.5 Gy-2.0 Gy) with respiratory gating ($p = 0.03$). To mean dose to the anterior ventricle wall was 7.1 Gy (0.9 Gy-15.3 Gy) without and 2.4 Gy (0.7 Gy-6.0 Gy) with respiratory gating ($p = 0.003$). The mean maximal dose to the anterior wall was 40.6 Gy (27.3 Gy-53.6 Gy) without and 24.9 Gy (1.9 Gy-42.3 Gy) with respiratory gating ($p = 0.001$). For the 26 pat after breast conserving surgery the mean doses to the anterior wall was 7.5 Gy in the non gated compared to 2.4 Gy in the gated group. After mastectomy the doses were 6.5 Gy (non-gated) and 3.1 Gy (gated).

Conclusions: Respiratory gating and irradiation only in the inspiratory phase reduce radiation dose to the heart and especially to the anterior wall of the heart significantly.

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ORAL

To pee or not to pee? A randomized study of Full vs. Empty Bladder instructions during prostate radiotherapy and its impact on organ motion and targeting accuracy

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Objective: To determine whether bladder filling (full vs. empty) instructions during radiotherapy (RT) affects inter-fractional prostate motion and targeting precision during a 7-week course of radical conformal RT.

Method: 34 patients with T1-T2 prostate cancer undergoing routine 3D RT (4-field, 70 Gy/35#/7 weeks) were randomized to either full bladder (500 mL water 1 hr before treatment) or empty bladder instruction for the entire treatment course. TRUS-guided insertion of three gold markers into the prostate was done prior to treatment planning. Routine patient set-up by bone-anatomy verification and correction was performed during first week of treatment. Thereafter, twice-weekly orthogonal aSi-EPI images were

taken to measure set-up error (image mismatch on bone) and targeting error (mismatch by gold markers). Prostate motion was determined as the arithmetic difference between set-up error and targeting error. All images were analyzed by one expert user of Varian Vision software.

Results: Eighteen and 16 patients were randomized to full and empty bladder set-up respectively. No significant difference in inter-fractional prostate motion and targeting error was observed (Table 1). However, absolute prostate motion >5 mm in the sup-inf direction was seen in 13% of 422 images analyzed for all patients. Targeting error >5 mm was observed in 19% of 424 images. Prostate motion and set-up error both contributed to targeting variability, which remained constant during the 7-week course treatment. No difference in treatment-related bladder or rectal morbidity has been observed (median F/U 12 months).

Table 1: Measurements of prostate motion and targeting accuracy on patients treated with either full or empty bladder instructions

Measurement	Bladder Instruction	Median Standard Deviation		
		Right-Left	Ant-Post	Sup-Inf
Prostate motion	Full (n = 18)	0.7 mm	1.9 mm	1.9 mm
	Empty (n = 16)	0.5 mm	1.7 mm	1.7 mm
Targeting variability	Full (n = 18)	2.0 mm	2.6 mm	2.3 mm
	Empty (n = 16)	1.9 mm	2.6 mm	2.2 mm

Conclusions: Inter-fractional prostate motion and targeting accuracy were not influenced by bladder filling instructions given to patients. Improvement of treatment precision to within 5 mm will likely require daily pre-treatment target-imaging with table adjustments.

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ORAL

A randomised study to investigate the role of abdominal compression in prostate intrafraction motion

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Background: Intrafraction prostate motion may contribute to target volume underdosage when using small PTV margins. Abdominal compression may decrease intrafraction motion by reducing respiratory effect. Therefore, to evaluate the role of abdominal compression in prostate intrafraction motion we performed a randomized study using 2 different immobilization devices, one of which incorporated a component to reduce abdominal movement (Bodyfix).

Methods: 32 patients receiving conformal radiotherapy (RT) for localized prostate cancer (PTV = 7 mm post and 10 mm elsewhere) provided informed consent and were assigned to Vac Lok (n = 16) or Body Fix (n = 16). All patients had daily on-line correction of interfraction errors of ≥ 3 mm using electronic portal imaging (EPI) of implanted fiducial markers (at the apex, posterior and base) as a surrogate for prostate position. During every 4th fraction of RT, EPI's were also taken at the start and end of the first and last lateral beams. Absolute maximum displacements from the planned position for each EPI were measured for centre of mass (COM) and individual markers.

Results: A total of 1242 images were reviewed, taken an average of 10 fractions per patient, distributed over their course of treatment. The mean time between the first and last EPI was 6.5 min (range 3.5 to 14.5). The displacements measured from the EPI's are shown in table 1. There were no statistical differences in displacements of the COM or markers with or without abdominal compression at the 5% confidence level (Mann Whitney U-test).

With current PTV margins, absolute maximum displacements from the planned position would have resulted in target underdosage in $\leq 1.6\%$ of fractions analysed. Absolute maximum displacements from the planned position incorporate both intrafraction prostate motion and the residual displacements after the application of online correction strategies. When these residual errors were mathematically eliminated from the measured displacements, intrafraction prostate motion would have resulted in target underdosage in $\leq 1.4\%$ of treatment fractions.

Conclusions: When using the Bodyfix system, abdominal compression produced no statistically significant effect on intrafraction motion of the prostate. Our current PTV margins appear to adequately encompass both inter and intrafraction prostate displacements in more than 98% of patients. With daily online image guidance and correction protocols, intrafraction prostate motion appears to be the major contributor to residual errors and possible target underdosage.