Table 1. Fractions where CTV is displaced outside the PTV

	Centre of markers			Bony anatomy		
	LR	SI	AP	LR	SI	AP
Before off-line (Number)	3	6	48	59	20	121
Percentage	0.8%	1.6%	12.4%	15.1%	5.1%	31%
After off-line (Number)	0	0	10	34	20	27
Percentage	0%	0%	2.6%	8.7%	5.2%	7%
After on-line (Number)	1	0	0	4	9	10
Percentage	0.3%	0%	0%	1.0%	2.3%	3%

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Tomotherapy in patients with prostate cancer

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Background: Tomotherapy is a new technique for image guided radiotherapy in patients with prostate cancer. By this technique dose escalation up to 80 Gy is possible.The treatment of patients with tomotherapy was analysed.
Material and Methods: Since December 2006 13 patients with prostate cancer were treated with tomotherapy, nine of them for primary tumors and four patients for salvage after prostatectomy. In 8 cases small volumes (prostate +/− seminal vesicles) and in 5 cases also larger volumes including the pelvis were treated. A comparative treatment planning was done for tomotherapy, 3D-conformal and intensity modulated radiotherapy (IMRT). Daily adjustments in the optimisation process by matching KV-CT and MV-CT and table and treatment times were analysed. Acute toxicity was documented.
Results: In all cases tomotherapy showed a reduction of dose to the rectum and the femoral heads in the dose-volume-analyses in comparison to 3D-conformal and intensity-modulated radiotherapy. By these dose-reductions a dose-escalation of 76−80 Gy was possible in primary radiotherapy. Tabletimes and treatment times were 26 and 4 minutes for small volumes and 28 and 6.7 minutes for large volumes. Daily adjustments for translations (*x, y, z*, roll) were 4.9±3.4 mm, 2.1±1.3 mm, 7.3±3 mm, 0.350±0.30 for small volumes and 3.1±2.1 mm, 1.4±1.4 mm, 5.5±2.7 mm, 0.250±0.230. Acute toxicity (CTC-score) for rectum and bladder was maximal grade 2.
Conclusions: Tomotherapy had better dose-volume-parameters in comparison to IMRT and 3d-conformal radiotherapy. Median table times for the patients were 26 and 28 minutes. Median adjustments for *x, y, z* were under 10 mm. Acute toxicity was tolerable.

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Survival and PSA relapse data after hypofractionated radiotherapy for early stage prostate cancer

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Background: Radiotherapy is often used for localised early stage prostate cancer. Radiation schedules vary and hypofractionated regimes aim to exploit a potential radiobiological advantage of low α/β ratio. The use of neoadjuvant hormone treatment has been shown to increase control. We report the results from radical treatment of early prostate carcinoma (T 1 and 2) with 3 months of neoadjuvant hormone therapy and then 5250 cGy in 20 fractions to prostate +/− seminal vesicles.
Methods: Using the Edinburgh database we identified 201 patients treated for T1/T2 prostate cancer from 1996 to 2001. Results were analysed for survival and PSA relapse free survival. The results were analysed according to pre-treatment prognostic groups – good (PSA $\leqslant$ 10, Gleason $\leqslant$ 6), poor (PSA $\geqslant$ 10, Gleason $\geqslant$ 6) or intermediate (one of prognostic indicators raised).
Results: *Survival*: Minimum follow up was 47 months. 64 patients have died, giving an overall actuarial 5-year survival rate of 77.6%, 56.5% at 10 years. Good Prognostic group 97.1% (95% CI 91.1–100.0); Intermediate 92.2% (86.6−97.8); Poor 75.4% (64.8−85.9).
PSA Relapse: 110 patients have had a PSA relapse. The actuarial rates were 6.0%, 21.1%, 34.5%, 44.7% and 48.8% at 1, 2, 3, 4 and 5 years, respectively. The 5-year relapse rate was 22.8% for the good prognosis group, 44.2% for the intermediate prognosis group and 71.0% for the poor prognosis group.

PSA relapse 5 years

Group	Relapse	95% CI
Overall	48.8%	41.6−55.9
Prognostic group		
Good	22.8%	8.9−36.7
Intermediate	43.2%	32.9−53.5
Poor	71.0	59.8−82.3

Discussion: Overall PSA relapse free survival and overall survival is poorer in this series compared to other series using longer fractionation. It is likely that the hypofractionated dose used may be too low (equivalent dose in 2 Gy fractions is 61.9 Gy if α/β ratio is 1.5). The use of neoadjuvant hormones does not seem to compensate for this low dose.
Compared to the Canadian study (Lukka et al) that used the same dose fractionation in one arm but without neoadjuvant hormone treatment, our results are worse [their PSA relapse rate (defined by Houston criteria) at 5 years was 42%, ours is 49%]. The Gleason score were similar in both studies (60% had Gleason $\leqslant$6) though mean PSA was less in Canadian study (10.6 vs 23.6).
The margins in the Canadian study were larger (1.5 cm compared to 1 cm anteriorly and laterally) and (1 and 0.6 cm posteriorly) respectively. Also all the patients were CT planned in the Canadian study, whilst only 30% were CT planned in our series in this time period. These differences and the higher average PSA may explain the lack of improvement in our series despite the addition of neoadjuvant hormone treatment.
Conclusion: The results of this series are not as good as other published results and we have subsequently increased our radiotherapy dose to 55 Gy in 20 fractions. We also now CT plan all radical prostate patients.

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Confirmation of proton beam by positron emission tomography apparatus in patients with prostate cancer

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Background: Proton therapy is promising and sophisticated treatment modalities against prostate cancer and other malignancies. The proton-irradiated area can be confirmed by coincidence detection of pair annihilation gamma rays from positron emitting isotopes generated by nuclear reaction of irradiated proton nuclei and nuclei in the irradiation target, called autoactivation. Thus, the purposes of this study are to investigate which positron emitting isotopes are detected in our clinical settings, and to evaluate whether anatomical or physiological factors affected or not in patients with prostate cancer treated with proton therapy.
Methods and Materials: Autoactivation data were evaluated in thirty patients treated with 210 MeV proton beam to a fraction dose of 2 Gy equivalent (GyE). Those patients were received totally 74 GyE. Doses were calculated on the basis of the pencil beam algorithm. Beam parameters including width of spread-out Bragg peak (SOBP) and degrader thickness were adequately selected with 3D treatment-planning system. Calculation of radioactivity induced by the autoactivation started at 5 min after proton irradiation for 10 min by using a PET apparatus and a vendor-provided software for interpreting image data. Regions of interest were set in following 5 portions; PTV center, urinary bladder within PTV, urinary bladder outside PTV, rectum (outside PTV), and contra-lateral femoral head (outside PTV). Experimentally, 6 GyE of proton beam was irradiated to following materials containing certain percentage of several target nuclei for positron emitting: Tough water phantom (^{12}C, ^{16}O), charcoal (^{12}C), blood sample (^{12}C, ^{16}O). Diffusion effect of water in the autoactivation was compared to that of ice-block ($20\times20\times20$ cm^3) both with setting a 6 cm width of SOBP.
Result: Isodose curve (95%) and distribution of the autoactivation were well-matched in terms of beam range in axial image of PTV center level in all patients. However, in sagital and coronal image, and axial image of bladder level, the autoactivation spread out of 95% of the isodose curve. Mean calculated radioactivities in those 30 patients with prostate cancer were 39 Bq in PTV center, 36 Bq in urinary bladder within PTV, 19 Bq in urinary bladder outside PTV, 4 in rectum (outside PTV), and 2 in contra-lateral femoral head, respectively. From this result, urine in the urinary bladder seemed to be a major diffusion mediator of autoactivation after the proton irradiation. In our experimental setting and time point, the major