

Prostate IMRT with integrated tumor boost: margins for random position variations



University Medical Center
Utrecht

I.M. Lips¹, A.N.T.J. Kotte¹, U.A. van der Heide¹, M. van Vulpen¹, A. Bel²

¹ Department of Radiotherapy, University Medical Center Utrecht, The Netherlands

² Department of Radiation Oncology, AMC, University of Amsterdam, The Netherlands

Introduction

The purpose of this study is to characterize the influence of actual random variations and margins size on the dose distributions of prostate IMRT plans with an integrated boost to the tumor.

Methods

- 20 prostate cancer patients.
- IMRT with integrated boost of 84 Gy to the tumor.
- Marker-based position verification with portal images.
- For each patient: 4 new plans with margins of 2, 4, 6 and the clinically used 8 mm around BV and CTV.
- With a stand-alone dose algorithm from PLATO we calculated a 'static' dose distribution for each plan.

An 'actual' dose distribution was calculated by including the individual setup deviations as realized in the clinic with an off-line position correction protocol.

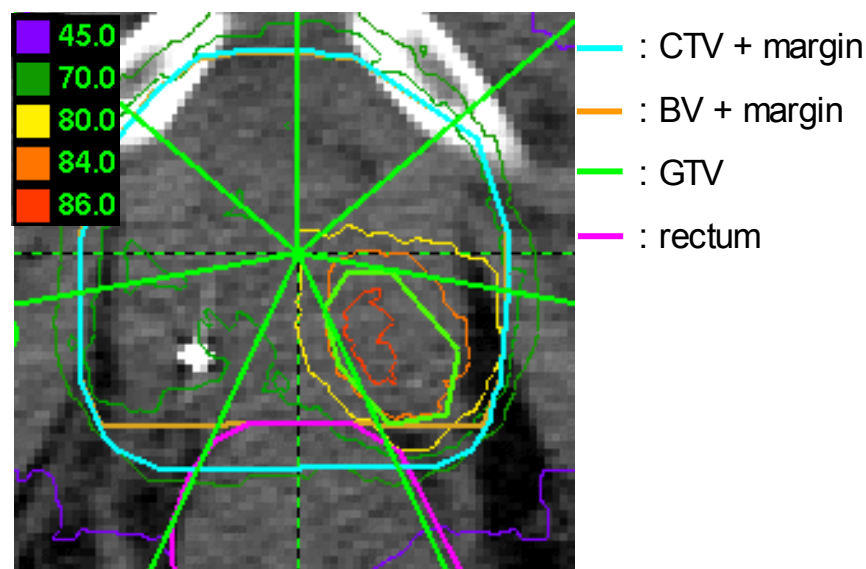
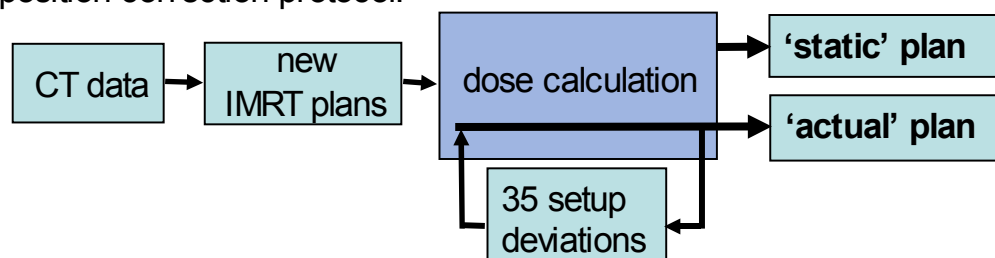


Figure 1: example of 7-beam IMRT plan with isodose curves.

Dose prescription

- CTV = prostate with seminal vesicles 70 Gy
- BV = (boost volume) prostate corpus 76 Gy
- GTV = intraprostatic lesion 84 Gy

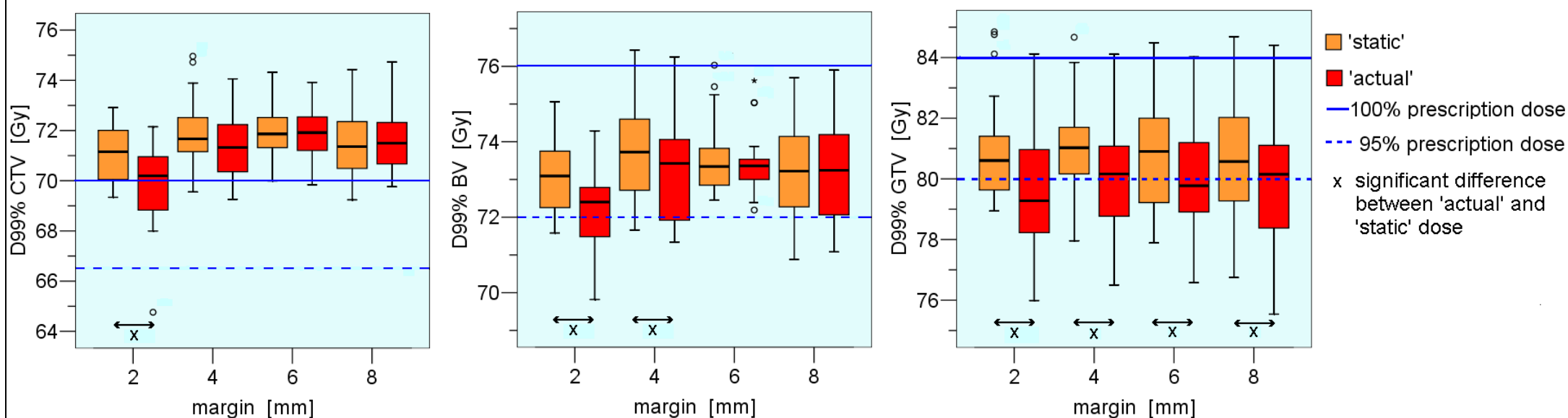
Results

• CTV: Taking the daily position variations after off-line position verification into account, the use of a 2 mm margin resulted in a significant reduction in the 'actual' dose distribution, leading to an underdosage for 1 patient.

• BV: Margins of 2 and 4 mm demonstrated a significant decrease in dose after including the setup deviations. Using a 2 mm margin, 5 out of 20 patients did not reach the 'actual' minimum D99% of 72 Gy, while for greater margins the D99% stayed adequate.

GTV: A significant reduction in dose was seen for all margins, probably because we did not use a margin around the GTV. The daily position variations after off-line position verification led to an average reduction to the mean dose of 0.9 ± 0.6 Gy. However, the mean dose still was 83.8 Gy (range 80.8-88.3Gy).

Figure 2: boxplots with the 'static' and 'actual' dose to 99% of the volume (D99%) for CTV, BV and GTV.



Conclusions and discussion

- Our daily off-line protocol provides adequate dose distributions for prostate IMRT with an integrated boost to the tumor.
- The random motion caused only modest changes in dose, even when the margins were reduced to 6, 4 or 2 mm.
- **In clinical practice, it is doubtful whether margins smaller than 4 mm can be used, because other uncertainties, like delineation uncertainties, must be taken into account.**
- Therefore, the benefit of further reduction of position uncertainty by on-line position verification seems small.