Reduced PTV margins for prostate IMRT with daily online IGRT: a retrospective analysis

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Introduction and objective

The addition of daily online IGRT for prostate IMRT patients enhances treatment accuracy and presents the possibility of a reduction in PTV margins. A reduction in the PTV margin would lead to reduced bladder and rectal doses and in turn may allow for dose escalation. However any decrease in PTV margins should be undertaken with caution to ensure that the CTV will still receive the intended dose during treatment delivery.

This study investigates the possibility of reducing our PTV margin for prostate IMRT patients treated with daily online IGRT using CBCT matching.

Materials and methods

• 11 prostate patients who received treatment in our centres between July 2012 and September 2013 were included in the analysis.
• Patients received 74Gy/37F using 7-field Step & Shoot IMRT with an isotropic 7mm CTV to PTV margin, planned in Pinnacle TPS.
• Treatment was delivered with Elekta Synergy Linear Accelerators with XVI using daily CBCT imaging and online correction.
• All 37 CBCTs for each patient were exported to the TPS and fused with the 7mm margin plan in their treated position.
• The prostate and base of seminal vesicles, rectum & bladder were re-contoured on every CBCT.
• All 7mm margin plans were re-optimised twice with 5mm & 3mm isotropic margins (Figures 1-3).
• Plans were reviewed to determine the number of fractions where at least 99.9% of the CTV received 95% of the prescribed dose (PD) since the purpose of the PTV margin is to ensure the entire CTV receives the intended dose.

Figures 1–3. Sagittal view of 7mm, 5mm and 3mm margin plans

Results and discussion

Figure 4 and Table 1 summarise the number of fractions where the CTV is covered by 95% PD. Table 2 considers the mean volume of CTV receiving at least 95% PD across the entire treatment. The range of results per patient is further illustrated in Figures 5-7.

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<tr>
<th>Frac#on</th>
<th>Mean CTV V95%</th>
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<tr>
<td>7mm margin</td>
<td>99.9 ± 0.2</td>
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<tr>
<td>5mm margin</td>
<td>99.7 ± 0.5</td>
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<tr>
<td>3mm margin</td>
<td>99.2 ± 0.7</td>
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Patient 2 appears to be an outlier, but for the remaining 10 out of 11 patients a 7mm margin ensures the entire CTV is covered for at least 32 fractions. This falls to 27 for a 5mm margin and 10 for a 3mm margin.

Conclusion

The analysis shows that when treated with daily CBCT and online correction, a 7mm PTV margin for prostate IMRT is clearly adequate to ensure the entire CTV receives the intended dose.

A 3mm margin is too small. While the average volume of CTV receiving the intended dose was 99.2%, the high proportion of fractions where the whole CTV was not covered is deemed unacceptable.

It should be highlighted that this analysis assumes consistency of CTV contouring. Clinicians and choice of PTV margin should certainly consider this effect.

References