Real-Time In Vivo Dosimetry for SBRT Prostate Treatment

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Outline

- OARtrac Dosimetry System
- Treatment
- Dosimetry
- Patient Specific QA
- Image Fusion
- Results
- More Results
- Discussion
- Future Work
OARtrac Dosimetry System

- Single-use prostate immobilization and dose verification system
- Two PSDs located on the anterior surface along the length of the balloon (labeled proximal and distal)
- Light is transmitted to a charged-coupled device camera via fiber optic cables
Treatment

- Linac Based SBRT (Elekta Infinity with Agility head)
- Total of 37.25 Gy at 7.25 Gy per fraction for 5 fractions
- Balloon inserted and filled with 40 cc of water
- PSDs positioned to rest on anterior rectal wall
- CBCT used for position verification
Dosimetry
Dosimetry
Patient Specific QA

- Solid water phantom
- Patient treatment plan superimposed on phantom
- Initial data used to adjust machine measurements
- All PSD systems used for patient measurements matched QA predicted dose within 4% (one exception)
Image Fusion - CBCT
# Results

Table 1: Measured and expected doses for the proximal detector. All doses are in cGy.

<table>
<thead>
<tr>
<th></th>
<th>Fraction 1</th>
<th>Fraction 2</th>
<th>Fraction 3</th>
<th>Fraction 4</th>
<th>Fraction 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured Dose</td>
<td>417.11</td>
<td>603.90</td>
<td>425.91</td>
<td>291.71</td>
<td>420.66</td>
</tr>
<tr>
<td>Pinnacle Dose</td>
<td>458</td>
<td>458</td>
<td>458</td>
<td>458</td>
<td>458</td>
</tr>
<tr>
<td>% Difference</td>
<td>-8.93%</td>
<td>+31.86%</td>
<td>-7.01%</td>
<td>-36.31%</td>
<td>-8.15%</td>
</tr>
<tr>
<td>MIM Dose</td>
<td>531</td>
<td>399</td>
<td>497</td>
<td>395</td>
<td>474</td>
</tr>
<tr>
<td>% Difference</td>
<td>-21.45%</td>
<td>51.35%</td>
<td>-14.30%</td>
<td>-26.15%</td>
<td>-11.25%</td>
</tr>
</tbody>
</table>

Table 2: Measured and expected doses for the distal detector. All doses are in cGy.

<table>
<thead>
<tr>
<th></th>
<th>Fraction 1</th>
<th>Fraction 2</th>
<th>Fraction 3</th>
<th>Fraction 4</th>
<th>Fraction 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured Dose</td>
<td>433.25</td>
<td>323.17</td>
<td>593.22</td>
<td>692.72</td>
<td>521.98</td>
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<tr>
<td>Pinnacle Dose</td>
<td>456.7</td>
<td>456.7</td>
<td>456.7</td>
<td>456.7</td>
<td>456.7</td>
</tr>
<tr>
<td>% Difference</td>
<td>-5.13%</td>
<td>-29.24%</td>
<td>+29.89%</td>
<td>+51.68%</td>
<td>+14.29%</td>
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<tr>
<td>MIM Dose</td>
<td>429</td>
<td>407</td>
<td>435</td>
<td>549</td>
<td>457</td>
</tr>
<tr>
<td>% Difference</td>
<td>+0.99%</td>
<td>-20.60%</td>
<td>+36.37%</td>
<td>+26.18%</td>
<td>+14.22%</td>
</tr>
</tbody>
</table>
More Results

<table>
<thead>
<tr>
<th></th>
<th>Fraction 1</th>
<th>Fraction 2</th>
<th>Fraction 3</th>
<th>Fraction 4</th>
<th>Fraction 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DTA – Proximal</strong>&lt;br&gt;Detector (mm)</td>
<td>4.5</td>
<td>5.0</td>
<td>2.5</td>
<td>3.5</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>DTA – Distal Detector</strong>&lt;br&gt;(mm)</td>
<td>0.6</td>
<td>9.0</td>
<td>4.5</td>
<td>4.0</td>
<td>2.5</td>
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</tbody>
</table>
Discussion

- Measured doses were typically within a few millimeters of the exact same plan dose.
- Uncertainties in placement can change the location of PSDs by several millimeters.
- Single fiducial does not allow for precise localization of the PSDs.
- Dose difference most likely due to positioning uncertainties.
Future Work

- Localization of the PSDs
- Dose measurements in other treatment modalities
- Surface dose measurements
- Use in verification of new technologies
Thank You

Acknowledgements
Rodney Ellis, MD
Chee-Wai Chang, PhD
RadiaDyne LLC