Treatment of Prostate Cancer: a Planning Study Comparison of Direct Step and Shoot IMRT and VMAT Optimisation

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Background and Purpose

Intensity modulated radiation therapy (IMRT) is an established technique for the treatment of prostate cancer. Volumetric modulated arc therapy (VMAT) has recently been introduced clinically. Nucletron BV (Veenendal, Netherlands) offers both optimisation algorithms on the same platform in Oncentra® MasterPlan 3.3. They are compared regarding dose distribution and treatment time.
Material and Methods

- 5 patients with localised prostate cancer
- Regions of interest:
  - PTV
  - Urinary bladder
  - Rectum
  - Femoral heads
- Linac: Elekta SynergyS with Beam Modulator
- Planning system: Oncentra MasterPlan, Nucletron
# Planning Conditions

<table>
<thead>
<tr>
<th></th>
<th>IMRT</th>
<th>VMAT</th>
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</thead>
</table>
| **Gantry**     | 7 fields, equispaced, 0°, 51°, 103°, 154°, 206°, 257°, 308° | a) Dual arc, 182°-178°, CW and CCW  
b) Single arc, CW |
| **Dose Volume Objectives** | PTV min 68 Gy, 3000  
PTV max 72 Gy, 3000  
Urinary bladder 40 Gy, 50%, 1000  
Rectum, 40 Gy, 30%, 1000  
Femoral heads, max 30 Gy, 300 | |
# Results

<table>
<thead>
<tr>
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<th>IMRT</th>
<th>VMAT, Dual Arc</th>
<th>VMAT, Single Arc</th>
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</thead>
<tbody>
<tr>
<td>Homogeneity $(D_{5%}-D_{95%})/D_{AV}$</td>
<td>0.094</td>
<td>0.088</td>
<td>0.094</td>
</tr>
<tr>
<td>Rectum vol. 30%</td>
<td>44.7 Gy</td>
<td>46.1 Gy</td>
<td>45.4 Gy</td>
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<tr>
<td>Bladder vol. 50%</td>
<td>44.1 Gy</td>
<td>43.3 Gy</td>
<td>40.4 Gy</td>
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<tr>
<td>Fem. Heads max.</td>
<td>32.1 Gy</td>
<td>34.1 Gy</td>
<td>31.7 Gy</td>
</tr>
<tr>
<td>Average MU</td>
<td>698</td>
<td>1016</td>
<td>794</td>
</tr>
<tr>
<td>Treatment time (one case)</td>
<td>10.14min/775 MU</td>
<td>8.09min/1088 MU</td>
<td>4.50min/845 MU</td>
</tr>
</tbody>
</table>

![Comparison of VMAT, Dual Arc, Single Arc, and IMRT techniques](chart.png)
Conclusion

The results of the dose distribution are similar enough that VMAT is an interesting alternative to IMRT for the treatment of prostate cancer. The treatment time, which is the crucial factor regarding intrafractional organ movements is advantageous for both VMAT techniques, but again shorter for single arc with comparable plan quality.