Volumetric Modulated Arc Therapy with a gentle hypo-fractionated concomitant integrated prostate boost: Toxicity and Quality of Life outcomes.

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Background and Purpose
Pelvic irradiation is controversial in prostate cancer and has been associated with significant late toxicity, but may be beneficial in patients with high risk disease. We hypothesized that reduction of dose to OAR achieved by volumetric intensity modulated arc therapy (VMAT) with a gentle hypo-fractionated concomitant integrated prostate boost could reduce late effects and maintain pre-treatment urinary and bowel quality of life outcomes.

Methods and Materials
Ninety five patients with high risk prostate cancer underwent fiducial marker implantation and were planned using VMAT. The CTV included prostate and proximal seminal vesicles expanded by 6 mm for the PTV1. Pelvic LN were delineated and expanded by 3 mm for the PTV2. Volume based equivalent dose at 2Gy/fx (EQD2) doses were calculated using alpha/beta ratios of 1.5 Gy for the prostate and 3 Gy for normal tissues. VMAT prescription was 73.6 Gy (EQD2-80 Gy) to PTV1 and 54.4 Gy to PTV2 (EQD2-50 Gy) in 32 fractions of 2.3 Gy and 1.7 Gy, respectively. Image guidance was daily kV imaging using both fiducial markers and pelvic brim for the match. CTC version 4.0 three months or more after radiation was used to code late toxicity and the shortened Expanded Prostate cancer index Composite (EPIC-26) was performed prior to treatment and 3-12 months after therapy.

Results
• Median follow-up was 11.3 months (4-26). Late GU toxicity grade 0, I and II was 79%, 19% and 3%. Late GI toxicity grade 0, I and II was 94%, 3%, and 2%. There was no grade III toxicity.

Conclusions.
• VMAT with a gentle concomitant integrated boost of 2.3 Gy per fraction to the prostate was well tolerated in this study with only up to 3% grade II toxicity and no grade III or more toxicity. Three months to one year post-radiation, the domains of urinary incontinence, irritation and bowel scores maintained excellent function compared to pre-radiation scores.

Furthermore, reduced dose to organs at risk, reduction of treatment planning time and both individual fraction and overall treatment delivery time inherent in this approach, offer significant advantages for both providers and patients.

Table 1. (n=20)  Mean dose ± SD

<table>
<thead>
<tr>
<th>OAR</th>
<th>VMAT</th>
<th>Sequential IMRT</th>
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</thead>
<tbody>
<tr>
<td>Rectum</td>
<td>38.32±3.1*</td>
<td>52.73±3.4</td>
</tr>
<tr>
<td>Bladder</td>
<td>40.46±8.3</td>
<td>58.35±4.6</td>
</tr>
<tr>
<td>Bowel</td>
<td>27.36±4.3</td>
<td>34.32±3.3</td>
</tr>
<tr>
<td>Femur head</td>
<td>31.62±7.7</td>
<td>36.25±2.0</td>
</tr>
<tr>
<td>Penile bulb</td>
<td>39.32±5.9</td>
<td>59.52±11.5</td>
</tr>
<tr>
<td>Body</td>
<td>17.22±1.7</td>
<td>18.54±1.9</td>
</tr>
</tbody>
</table>

*p<0.001

Typical VMAT DVH


• 20 high risk prostate cancer patients comparing dose to OAR from 2 plans
• VMAT- Volumetric intensity modulated arc therapy with hypofractionated concomitant integrated prostate boost
• Sequential IMRT: Sequential 3-D conformal 4-field pelvic plan and prostate IMRT boost.
• A significant reduction in mean dose was observed for rectum, bladder, bowel, femur head, and penile bulb for VMAT vs. Sequential IMRT (Table). Rectal V95 and V45Gy was 62% and 11.2% for VMAT vs. 13.6% and 19% for Sequential IMRT (p<0.001). Bowel V90 Gy was 0.35 cm³ vs. 24.1 cm³ (p<0.001), respectively.

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Figure 1.