Supporting Document

Commissioning of Gated RapidArc Radiotherapy for Treatment of Moving Targets

We used an in-house developed programmable dynamic dosimetry phantom for verification of the geometry and dosimetry of gated RapidArc radiotherapy treatment. The phantom could facilitate measurement of dose and dose distribution using ion chamber and radiochromic films. It could also be programmed to generate 2-D motion of different patterns to simulate lung motions. We scanned the phantom in a CT simulator and acquired 4-D CT images using a Varian RPM system. Images acquired at the 40, 50 and 60% of the motion cycle were selected and transferred to a Varian Eclipse TPS for planning. A two-arc RapidArc treatment plan was generated for a C-shaped target volume (figures 1 and 2) and transferred to a Varian TrueBeam linear accelerator for treatment delivery. RPM gated RapidArc treatment was delivered with different patterns of phantom motion (Figure 3). Target dose and dose distributions were measured Figures. The measured dose and dose distributions were consistent and in close agreement with TPS calculated values. Treatment delivery time was recorded.

<table>
<thead>
<tr>
<th>Treatment Fraction</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
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<tbody>
<tr>
<td>Measured Dose</td>
<td>1.975Gy</td>
<td>1.979Gy</td>
<td>1.977Gy</td>
<td>1.976Gy</td>
<td>1.978Gy</td>
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TPS calculation: 2.01Gy
Measured mean dose: 1.977Gy +/- 0.002Gy (1SD)
Mean deviation from TPS calculation: -1.64%

Good agreement between measured and TPS calculated dose distributions in the C-shaped target in the sagittal and coronal planes.

 Gamma analysis of the overlay of TPS calculated and measured dose distributions in the sagittal plane showed good agreement between the two sets of data. Similar good agreement also observed in the coronal plane.

Good agreement between TPS calculated and measured dose profiles along the X- & Y- axes of the target in the sagittal plane. Similar good dosimetric agreement was also observed in the coronal plane.