Epworth Radiation Oncology has commissioned and implemented Novalis Tx™ linear accelerator in April 2013. The Novalis Tx™ is equipped with High-Definition MLC (HD120) with 2.5 mm resolution, a 6D robotic couch, infrared patient positioning system and X-ray-based image guidance tools to provide high accuracy radiation delivery for Stereotactic Radiosurgery (SRS) and Stereotactic Body Radiation Therapy (SBRT) procedures.

This paper will discuss the process of commissioning Epworth’s Novalis Tx™ by performing comprehensive measurements and testings of the new technology, and to develop technical guidelines for ongoing Quality Assurance and clinical use of the equipments for SRS/SBRT treatment.

Commissioning of the Novalis Tx™ was performed according to various international protocols (See References). The Varian SRS 6 MV beam data were collected using different ion chambers including PTW Pin Point chamber, Diodes that are suitable for small field measurements, and IBA cc04, cc13 chambers for small field and large field data measurements respectively. This data was then sent to Brainlab™ for independent verification and modelling of the algorithms for the iPlanNet™ planning system. End-to-End tests were performed with both LUCY phantom with 4 mm brass ball and a pelvis phantom with 5 mm tungsten sphere embedded to demonstrate the overall accuracy from CT scan, image fusion in TPS, isocentre definition, Exactrac x-ray correction and verification, shifts and rotations calculated and applied by 6D robotic couch, and eventually to treatment delivery. We also investigated appropriate patient specific QA for various treatment techniques available in Brainlab iPlanNet planning system: Point dose verification for Conformal and Dynamic Conformal Arcs using mini-chamber positioned in the Lucy Phantom™ (Figure 2); Plane dose distribution for IMRT beams verification is performed with Sun Nuclear MapCHEC K; Hybrid Arc™ plans are verified by Delta 4™ as the authors have considered the improved volumetric information provided by this device.

Epworth Radiation Oncology – Medical Physics

Results and Discussions

Figure 3 and 4 gives the example of the beam data collection for implementing SRS 6 MV in iPlanNet planning system. The hidden ball test is illustrated in Figure 5 with the phantom setup under Novalis-TX. Figure 6 presents the result of end-to-end test using 2x2 cm DMLC field and EPID to expose the position of the tungsten sphere. The overall positioning accuracy is better than 0.52 mm. To maintain the maximum accuracy of Brainlab Exactrac system, our experience is that medical physicist must calibrate the IR and x-ray system and correct the irradiation centre right after Winston Lutz test that determines the isocentre in space.

<table>
<thead>
<tr>
<th>Gantry rotation</th>
<th>0</th>
<th>90</th>
<th>180</th>
<th>270</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pixel difference</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Deviation</td>
<td>0.52 mm</td>
<td>0.26 mm</td>
<td>0.26 mm</td>
<td>0.52 mm</td>
</tr>
</tbody>
</table>

Figure 6. End-to-End Test Result Verified By Varian EPID

Conclusion

1. Epworth Radiation Oncology has established a series QA assurance programs for HD120 MLC, 6D robotic couch, Exactrac system calibrations, as well as clinical procedures to guarantee the overall treatment positioning accuracy is always within sub-millimeter.
2. The dosimetry accuracy of the iPlanNet TPS system has been verified by ion-chamber point dose measurement, Mapcheck 2 plane dose measurements and Delta 4 volumetric dose measurements for the various techniques available of Novalis-TX system: conformal and dynamic arcs, IMRT, HybridArc. Those methods will be used for ongoing patient specific QA.
3. We have developed comprehensive clinical and physics protocols and procedures to safely use Novalis TX system to achieve international standard of patient care and patient satisfaction.

References

3. Brainlab User Manuals, Brainlab Academy 2013