SBRT QA

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Disclosure

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Outline

SBRT QA
- SBRT prevalence
- Sources of Errors
- Resources
- Commissioning
- Periodic QA
- Treatment Planning
- Patient Specific QA
- Treatment Delivery
- References
ACR and ASTRO define SBRT as "an external beam radiation therapy method used to very precisely deliver a high dose of radiation to an extracranial target within the body, using either a single dose or a small number of fractions."

Oxford Dictionary defines Quality Assurance as "maintenance of a desired level of quality in a service or product, especially by means of attention to every stage of the process ..."

**SBRT QA**

ACR accredited institutions performing SBRT

<table>
<thead>
<tr>
<th>Year</th>
<th>1995</th>
<th>2003</th>
<th>2007</th>
<th>2014</th>
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<td>N/A</td>
<td>N/A</td>
<td>39%</td>
<td>90%</td>
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**SBRT QA: Errors**

The majority of errors in stereotactic procedures and more broadly in radiation therapy are caused by humans. Solberg et al, PRO 2012, 2(1):2-9.

A 2015 RO•ILS quarterly report concluded that “rushing” is a central theme in high priority incidents.
SBRT QA: Staffing

1 FTE/260 patients (180 academic)

0.008 FTE/SBRT patient

10 hrs/SBRT patient

SBRT QA: Staff Training

AAPM TG 101 states that staff training is of the highest priority and that special SBRT training is needed for all involved staff.

SBRT training should be obtained prior to treating patients.

SBRT training courses – onsite and online – are offered by a number of institutions.

SBRT QA: Resources
SBRT QA: Commissioning

Medical physicists are responsible for the technical aspects of SBRT. Responsibilities during acceptance and commissioning include quality assurance of

- Localization/imaging devices used to determine target coordinates
- Treatment planning system
- SBRT treatment machine


SBRT QA: Commissioning

Appropriate detectors for small field measurements

TG 101 recommends dosimeter with ≤ 1 mm spatial resolution

SBRT QA: Commissioning

Commissioning tests of …
• Imaging data integrity
• Dose calculation algorithms
• MLC leaf sequencing
• MU calculations algorithms
• Leaf speed
• Dose rate
• Small MU delivery
• Imaging/localization
• Tracking/gating

… in many cases can be used for QA tests.

SBRT QA: End to end testing

Before commissioning becomes a distant memory:
• Clearly document all work
• Develop policies and procedures, including checklists
• Establish a comprehensive QA program

**SBRT QA: Periodic machine QA**

TG 142 is the current standard for periodic machine QA. SRS/SBRT machines have the tightest tolerances.

**SBRT QA: Periodic Machine QA**

ASTRO and ACR recommend evaluating the accuracy of imaging and treatment delivery systems together.

1) offset target  
2) align target with kV imaging

3) validate with treatment beam, e.g., portal imaging, Winston Lutz

**SBRT QA: Robotic couch QA**

- Central BB insensitive to rotations
- Rotational errors can be important
- Robotic couches allow for 6 DoF corrections
- Quality assurance needed for robotic couches

Roper et al, 2015, IJROBP 93(3):540-46
SBRT QA: Robotic couch QA

Cook, Roper, Elder, Schreibmann, Unified imaging and robotic couch QA, Accepted in Medical Physics

SBRT QA: Simulation and Planning

Deformable Imaging Registration

Schreibmann et al, 2012 JACMP 13:126-139

SBRT QA: Simulation and Planning

Conventional Collision Check  Virtual Collision Check
SBRT QA: Simulation and Planning

Site specific expertise

https://www.rtog.org/ClinicalTrials/ProtocolTable

SBRT QA: Simulation and Planning

Monitor Unit Verification

Monte Carlo
AAPM TG 101 recommends that a QMP be present for the entire 1st SBRT fraction then be available for any subsequent fractions.
SBRT QA: Treatment Delivery

Spatial accuracy is paramount

Initial positioning
• Coarse: body frames/marks
• Final: imaging

During treatment
• Aggressive immobilization or
• Image based tracking


SBRT QA: Treatment Delivery

Does the time of day matter?

A failure mode and effect analysis study concluded that treating patients during lunchtime or at the end of the day could result in a greater rate of errors.

Solution: Schedule SBRT patients at times when there are fewer distractions.


SBRT QA: Beyond Periodic QA

TG 100: Application of risk analysis methods to radiation therapy quality management

SBRT QA: References


Task Group 101 report: Stereotactic body radiation therapy, Benedict et al, Medical Physics, 37, 4078-4101 (2010).


American Society for Therapeutic Radiology and Oncology (ASTRO) and American College of Radiology (ACR) practice guideline for the performance of stereotactic body radiation therapy, Potters et al, IJROBP, 76(2): 326-32 (2010).

https://www.astro.org/RO-ILS.aspx