Credentialing for the Use of IGRT in Clinical Trials

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Prescription and Margins as Defined in RTOG 0236

- 20 Gy x 3 fractions = 60 Gy
- An additional 0.5 cm in the axial plane and 1.0 cm in the longitudinal plane (craniocaudal) will be added to the GTV to constitute the PTV

RADIATION THERAPY ONCOLOGY GROUP - RTOG 0236
Phase II Trial of Stereotactic Body Radiation Therapy (SBRT) in the Treatment of Patients with Medically Inoperable Stage I/II Non-Small Cell Lung Cancer

Principal Investigator/Radiation Oncology
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RADIATION THERAPY ONCOLOGY GROUP - RTOG 0618
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Other RTOG IGRT Protocols Under Development

- Lung SBRT (x2)
- Sarcoma
- Spine
- Head & Neck (x2)

Using IGRT in RTOG Protocols

- The RTOG has developed Guidelines for the use of IGRT in their protocols
- The Advanced Technology Consortium (ATC) is working on having a uniform set of guidelines for all cooperative groups using radiation in studies

Definition of IGRT

- Process extending from CT-simulation imaging through the step of imaging the patient on the treatment unit
  - Process includes the following steps:
    - Manual or automatic registration of the two datasets
    - Determination of a series of mechanical movements of the patient support system to correct for detected positioning errors

IGRT Techniques

- In-room diagnostic quality CT scanner
- MV and kV cone-beam CT attachments
- MV helical CT capabilities
- Stereoscopic 2D images obtained with kV x-rays
Internal Organ Motion Control (as defined in RTOG #0236)

- Acceptable maneuvers include reliable abdominal compression, accelerator beam gating with the respiratory cycle, tumor tracking, and active breath-holding techniques

Many Different Approaches to IGRT

- There are many different ways of imaging the patient in the treatment room
- There are many different ways for registering the CT-sim and IGRT datasets
- There are many different ways for adjusting the patient’s position based on registration information

Procedure for including IGRT in RTOG Protocols

- Protocol must include:
  - IGRT Specifications
  - IGRT Questionnaire
  - Phantom Irradiation
    - Treatment units that do not include a robotic couch
    - Test to evaluate the performance of robotic couches with pitch and roll capabilities
  - Image Registration Software Tests
    - Tests that use patient datasets

ITC Remote Review Tool
IGRT Methodologies Not Currently Included

- The guidelines presented here do not include IGRT techniques that use ultrasound or infrared systems that place fiducial markers on the patient’s skin
- Deformable fusion techniques are not included at this time

Phantom Requirements

- Phantom must work for IGRT technologies that use either dual radiographic imaging or volume imaging
  - Both kV and MV imaging must be accommodated
  - All images must be artifact-free
- Using the treatment beam, markers must be visible when using EPID, radiographic film, or radiochromic film

Phantom Requirements (continued)

- Phantom must check both linear and rotational couch adjustments
- Phantom must work for collimators with a restricted field size (e.g., Novalis or Synergy S)
- Phantom must work for robotic systems like the CyberKnife unit

Design Features of TJU Phantom

- Simple cubic phantom made of acrylic
- Precision slide that holds three stainless steel balls (approx. 4 mm dia.)
  - Holes where ball markers are placed are used for artifact-free kV CT imaging
  - One ball is placed at the phantom center and the other two balls are shifted 4 cm from the center
- Phantom has extra base so that rotational errors of 3 degrees along a diagonal can be introduced at the treatment unit
Using Phantom to Check Performance of Robotic Couches

2007 AAPM Annual Meeting
Minneapolis, MN
Orthogonal Pair Shows Deviation Compared to DRR
Conclusions

- Image Guided Radiation is the Next QA Hurdle for Cooperative Groups
- The IMRT Model is a Reasonable Starting Point
- However, the Challenge is Significant