Establishing an SBRT Program in a smaller Community Cancer Center: our Experience

presented by
IU Health Bloomington Team

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Radiation Therapists
Some History

- It all started in Sweden in the mid 1990 at the Karolinska Hospital.

- January 1997- Robert Timmerman MD and Lech Papiez PhD went to Karolinska to learn about the Elekta frame

- February 1997- first SBRT treatment at Indiana University

- 1998 -lung protocol supported by NIH grant was launched at IU

- 2002 -RTOG 0236 was designed based on the IU lung study
Introducing SBRT/SABR at IU Health Bloomington

- General presentation on SBRT/SABR to all the staff at IU Health Bloomington
- Introducing SBRT process to Radiation Oncology personnel
State of the Art Treatment - Stereotactic Ablative Radiotherapy

- SABR (traditionally known as SBRT) is a new procedure to IU Health Cancer Centers Bloomington. This technology will allow the radiation oncologist to eradicate with pinpoint accuracy those tumors which are medically inoperable.

- During SBRT, the Clinac iX linear accelerator delivers concentrated, highly focused radiation to the target area with an ablative intent.

- This highly potent treatment can be delivered in 1 to 5 fractions
State-of-the-Art Technology
SBRT continued

• Per NCCN Guidelines for early stage non-small cell lung cancer: SBRT has achieved high primary tumor control rates and favorable overall survival in prospective studies, comparable to surgery.
• SBRT is more cost-effective than 3DCRT and radiofrequency ablation, largely owing to its high efficacy.
Benefits for patients

This year, 225,000 people will be diagnosed with lung cancer in the US.

20% of these i.e. 45,000 will have early stage diagnosis.
25% from this 20% i.e. 11,250 will be medically inoperable.
In 1990, 3-yr survival for conventional radiation for these patients was 30%.

In 2010, 3-yr survival post SBRT was 60%.
Patient education

Patient education package
SBRT frequently asked questions
SBRT lung patient instructions
What is SBRT

- Radiation delivery to a demarcated tumor target using:
  - optimal immobilization
  - motion accounting
  - many small fields
  - accurate targeting
  - heterogeneous target dose
  - steep dose gradients outside targets
  - few large dose treatments
  - ablative intent
SBRT Teamwork

Radiation Oncologist
Physicist
Dosimetrist
Radiation Therapists
Nurses
SBRT process

• Simulation
  - Immobilization
  - Motion assessment
  - Imaging
• Treatment Planning
  - Target definition
  - Beam arrangement
  - Dose conformality
  - Documentation
• Dry run
• QA
• Patient setup for treatment
• Delivery
Immobilization

• RTOG trials do not specify how to immobilize

• Goal number 1, 2, and 3: Comfort, comfort, and comfort
  – Treatment sessions are long (20-60+ minutes)
  – Uncomfortable patients squirm
  – Squirming negates corrections from image guidance

• Strategy
  – Uniform support
    o Large vacuum bag
    o Body Frame
  – Support the arms, raise the knees
  – Analgesics, anti-inflammatory (steroids)
Put the patient in a bowl

Arms supported

Head up

Gravity

Knees up

Make Gravity your friend

Courtesy of R. Timmerman
Equipment at our Center

SBRT frame

Wing board

Appropriate size vacloc (80cm x 100cm) to be indexed to SBRT frame
Checklist - equipment

Items to be available during the simulation:

1 indexing bar, 1 compression bridge, knee sponge, foot strap,

Ruler with 1cm interval opaque markings

Set-up sheets, consent form

Camera, marking pen, BB's, permanent marking kit,
Initial task

- Create patient in Eclipse using existing diagnostic CT or PET/CT
- Create plan with setup fields with pseudo isocenter in the center of the tumor
- Schedule 1 hour on treatment machine for immobilization and motion study followed by 1 hour on CT sim
SBRT-offset for peripheral

**Left sided lesion**

Offset the wing board 3 cm to the patient’s right. This will put the patient’s left side more in the center of the table/couch. Now you need to position patient such that sagittal room laser is in the middle of the patient. You will set your couch lateral to 3. Patient should be centered between the wing board.

Offset 3cm-pins on the indexing bar at mark -3cm

Couch lateral position at 3cm

Sagittal laser
Checklist - Immobilization

- Frame and accessories are to be indexed - enter information into "SBRT body setup-sheet"

- Place indexing bar at superior end of tabletop (set correct lateral offset if target not central)

- Attach wingboard to index bar and place headrest noting location

- Prepare vacloc bag (flatten it on the floor, remove some air out to make it more rigid)

- Lay vacloc over couch and wingboard, making sure that there is enough bag to support arms

- Position handles of wingboard at A/C with top of vacloc abutting posts
Checklist – Immobilization cont.

- Conform vacloc, building up area over headrest for support
- Make lip over table and wingboard edges for stability
- This lip cannot extend past compression arc
- Position patient with arms above head, hands not holding posts, but resting above head
- Place knee sponge under knees, abutting vacloc
- Remove air with pump to form vacloc
Immobilization-cont.

Place indexing bar at SUP wingboard notch (set correct LAT offset if target not central)
SBRT Body setup-sheet - IU Health/ Bloomington

Patient Name: ___________________________ Date: __________
Patient ID#: ___________________________ Protocol 0813
Physician: ________________________________

1. Indexing bar for indexing the Wing board are indexed to Varian couch at: 5.5
2. Headrest 8
3. Wing board: Hand bar D/F
4. Indexed at 3 / offset cm RT/ LT
5. Vaclock 80cm/100cm
6. Knee roll Large x Small x 1 styro w/feet strapped
7. Respiratory Plate Bridge Index (Inf edge) 80.0
   A. Bridge [Large][Small] height 8.0 B. Respiratory Plate height 4.5
   C. Lateral position 1.0 D. Knob position 4

Note: ________________________________

Physician_________ Dosimetrst_________ Therapist_________
Setup

- Setup information - marking reference points
Checklist cont.- marking reference points

• Mark patient with 2 points. Superior mark at the sternal notch and inferior mark at the xiphoid process
  • At each point, set SSD to 100cm and record couch coordinates

• Mark leveling points on each side of patient

• Place mark on the vacloc in line with the inferior mark

• Record all couch coordinates corresponding to the markings and all other setup information on the SBRT setup sheet

• Place tape on vacloc with patient setup information

• Attach abdominal compression arc and compression plate and adjust to fit
Marking reference points-

**Stereotactic Body Radiation Therapy**
**IUHealth**

**Patient:**

**Simulation Date:** __________ Tentative

**Attending Physician:** __________

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**Patient Set-up**

**Equipment and supplies:** *Body frame ( ), diaphragm control ( ), wingboard ( ), headrest ( ), vacloc (checked for leaking), camera ( ), marking pen ( ), BBs for sternum and lateral marking points ( ).*

**Set up info [cm]**

<table>
<thead>
<tr>
<th>info</th>
<th>Superior sternum mark-sternal notch</th>
<th>Inferior mark-xiphoid relapt</th>
<th>RT lat Inferior</th>
<th>LT last Inferior</th>
<th>Shifts from Isocenter Couch coordinates</th>
<th>CBCT Tx 1</th>
<th>CBCT Tx 2</th>
<th>CBCT Tx 3</th>
<th>CBCT Tx 4</th>
<th>CBCT Tx 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRT* [cm]</td>
<td>22.1</td>
<td>23.9</td>
<td>18.1</td>
<td>18.1</td>
<td>Isocenter coordinates</td>
<td>21.4</td>
<td>21.4</td>
<td>21.4</td>
<td>21.4</td>
<td>21.4</td>
</tr>
<tr>
<td>LNG [cm]</td>
<td>109.5</td>
<td>119.5</td>
<td>119.5</td>
<td>119.5</td>
<td>Isocenter coordinates</td>
<td>107.3</td>
<td>107.3</td>
<td>107.3</td>
<td>107.3</td>
<td>107.3</td>
</tr>
<tr>
<td>LAT [cm]</td>
<td>997</td>
<td>997</td>
<td></td>
<td></td>
<td>Isocenter coordinates</td>
<td>997</td>
<td>997</td>
<td>997</td>
<td>997</td>
<td>997</td>
</tr>
</tbody>
</table>

**Physics check_______ Date__________**

Additional detailed information on SBRT frame set-up sheet.

* Max couch VRT not to exceed 17cm

Reminder: Take set-up photo and tattoo lateral and sternal markers.
Checklist cont.-Breathing motion study

• Place ruler in the proximity of the tumor (take photo of ruler location)

• Mode up AP kV setup field and acquire fluoroscopic image to observe tumor motion

• Apply compression, observe under fluoroscopy tumor for diaphragm movement

• Repeat this process until tumor motion becomes less than 1cm

• Enter respiratory bridge and plate information into "SBRT body setup-sheet"
- We visualize the tumor OR use the dome of diaphragm
- Use abdominal compression (typically) to control tumor
- motion to less than 0.5-1.0 cm.
With abdominal compression - diaphragm movement <1cm

No compression

With compression
Target definition

- Since we do not have 4DCT imaging study available for ITV definition we used CBCT for that purpose
Target definition

CT

4DCT or CBCT
Checklist cont.-Simulation

Take photos of the setup

Mode up CBCT setup field, acquire CBCT (Full scan, large FOV-thorax, half bowtie filter, # pulses =20

With isocenter approximated, record possible gantry/couch kick combinations for ease of planning.

If the following combinations cannot be obtained, please record which combinations WILL work.

Assume the collimator is at 0 degrees.

If collimator needs turned for a particular beam for clearance, please note.
SBRT Dry Run Right Lung
Gantry/Couch Rotation combination check

With isocenter approximated, record possible gantry/couch kick combinations for ease of planning. If the following combinations cannot be obtained, please record which combinations WILL work. Assume the collimator is at 0 degrees. If collimator needs turned for a particular beam for clearance, please note.

Approximate iso couch coordinates: Vert 11.2  Lat 9.5  Lng 117.2

<table>
<thead>
<tr>
<th>Gantry</th>
<th>Couch</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-30 -&gt; 60</td>
<td>0</td>
</tr>
<tr>
<td>45</td>
<td>320</td>
</tr>
<tr>
<td>90 no</td>
<td>0</td>
</tr>
<tr>
<td>+80-165-125-180</td>
<td>0w/bar pushed IN, move couchLAT</td>
</tr>
<tr>
<td>180</td>
<td>0</td>
</tr>
<tr>
<td>340-330</td>
<td>323</td>
</tr>
<tr>
<td>315</td>
<td>0</td>
</tr>
<tr>
<td>270</td>
<td>330 330</td>
</tr>
<tr>
<td>270</td>
<td>23</td>
</tr>
<tr>
<td>220-240 all cw</td>
<td>26 26</td>
</tr>
<tr>
<td>180</td>
<td>0</td>
</tr>
<tr>
<td>240</td>
<td>330</td>
</tr>
<tr>
<td>35</td>
<td>270</td>
</tr>
</tbody>
</table>
Checklist-CT simulation

- Bring patient to the CT suite
- Position patient in a frame according to the “SBRT body setup sheet”
- Place BBs on marks (SUP and INF sternum, Rt and Lt lateral)
- Apply compression
- Acquire final CT dataset
- Send the data set to Eclipse for planning
- Tattoo all marks
Treatment planning

- Fuse CT and CBCT
- Follow RTOG protocol to create treatment plan (RTOG 0813)
- Enter shifts from reference point on “Patient Setup in the Frame” form
- Calculate final isocenter in couch coordinates Use couch LAT, VRT LNG readings)
- Print out Tx Plan parameters for “Dry Run”
Beam arrangement
Dose distribution
1. Prescription (cumulative in 5 fractions) – 60 Gy to 80% isodose line
2. Gradient and isotropic property of dose distribution defined in columns 3 and 4

Table 1: Conformality of Prescribed Dose for Calculations Based on Deposition of Photon Beam Energy in Heterogeneous Tissue

<table>
<thead>
<tr>
<th>PTV Volume (cc)</th>
<th>Ratio of Prescription Isodose Volume to the PTV Volume</th>
<th>Ratio of 50% Prescription Isodose Volume to the PTV Volume, R_{50%}</th>
<th>Maximum Dose (in % of dose prescribed) @ 2 cm from PTV in Any Direction, D_{2cm} (Gy)</th>
<th>Percent of Lung Receiving 20 Gy Total or More, V_{20} (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deviation: None</td>
<td>Minor &lt;1.2</td>
<td>Deviation: None</td>
<td>Minor &lt;5.9</td>
</tr>
<tr>
<td>1.8</td>
<td>&lt;1.5</td>
<td>&lt;1.2</td>
<td>&lt;5.9</td>
<td>&lt;1.5</td>
</tr>
<tr>
<td>3.8</td>
<td>&lt;1.5</td>
<td>&lt;1.2</td>
<td>&lt;5.5</td>
<td>&lt;1.5</td>
</tr>
<tr>
<td>7.4</td>
<td>&lt;1.5</td>
<td>&lt;1.2</td>
<td>&lt;5.1</td>
<td>&lt;1.5</td>
</tr>
<tr>
<td>13.2</td>
<td>&lt;1.5</td>
<td>&lt;1.2</td>
<td>&lt;4.7</td>
<td>&lt;1.5</td>
</tr>
<tr>
<td>22.0</td>
<td>&lt;1.5</td>
<td>&lt;1.2</td>
<td>&lt;4.5</td>
<td>&lt;1.5</td>
</tr>
<tr>
<td>34.0</td>
<td>&lt;1.5</td>
<td>&lt;1.2</td>
<td>&lt;4.3</td>
<td>&lt;1.5</td>
</tr>
<tr>
<td>50.0</td>
<td>&lt;1.5</td>
<td>&lt;1.2</td>
<td>&lt;4.0</td>
<td>&lt;1.5</td>
</tr>
</tbody>
</table>
Intermediate dose

Meeting R50
Constraint tries to attain steep, isotropic falloff

Strategies for meeting R50
Add beams (spread out entrance dose)
Use non-coplanar beams
Accept more target heterogeneity

Employ “negative” margins
### Table 2

<table>
<thead>
<tr>
<th>Serial Tissue</th>
<th>Volume</th>
<th>Volume Max (Gy)</th>
<th>Max Point Dose (Gy)</th>
<th>Avoidance Endpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinal Cord</td>
<td>&lt;0.25 cc &lt;0.5 cc</td>
<td>22.5 Gy (4.5 Gy/fx) 13.5 Gy (2.7 Gy/fx)</td>
<td>30 Gy (6 Gy/fx)</td>
<td>myelitis</td>
</tr>
<tr>
<td>Ipsilateral Brachial Plexus</td>
<td>&lt;3 cc</td>
<td>30 Gy (6 Gy/fx)</td>
<td>32 Gy (6.4 Gy/fx)</td>
<td>neuropathy</td>
</tr>
<tr>
<td>Skin</td>
<td>&lt;10 cc</td>
<td>30 Gy (6 Gy/fx)</td>
<td>32 Gy (6.4 Gy/fx)</td>
<td>ulceration</td>
</tr>
<tr>
<td>Parallel Tissue</td>
<td>Critical Volume</td>
<td>Critical Volume Dose Max (Gy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lung (Right &amp; Left)</td>
<td>1500 cc</td>
<td>12.5 Gy (2.5 Gy/fx)</td>
<td></td>
<td>Basic Lung Function</td>
</tr>
<tr>
<td>Lung (Right &amp; Left)</td>
<td>1000 cc</td>
<td>13.5 Gy (2.7 Gy/fx)</td>
<td></td>
<td>Pneumonitis</td>
</tr>
</tbody>
</table>

### Table 3

<table>
<thead>
<tr>
<th>Serial Tissue*</th>
<th>Volume</th>
<th>Volume Max (Gy)</th>
<th>Max Point Dose (Gy)</th>
<th>Avoidance Endpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esophagus, non-adjacent wall</td>
<td>&lt;5 cc</td>
<td>27.5 Gy (5.5 Gy/fx)</td>
<td>105% of PTV prescription</td>
<td>stenosis/fistula</td>
</tr>
<tr>
<td>Heart/Pericardium</td>
<td>&lt;15 cc</td>
<td>32 Gy (6.4 Gy/fx)</td>
<td>105% of PTV prescription</td>
<td>pericarditis</td>
</tr>
<tr>
<td>Great vessels, non-adjacent wall</td>
<td>&lt;10 cc</td>
<td>47 Gy (9.4 Gy/fx)</td>
<td>105% of PTV prescription</td>
<td>aneurysm</td>
</tr>
<tr>
<td>Trachea and ipsilateral bronchus, non-adjacent wall</td>
<td>&lt;4 cc</td>
<td>18 Gy (3.6 Gy/fx)</td>
<td>105% of PTV prescription</td>
<td>stenosis/fistula</td>
</tr>
</tbody>
</table>

*The volume maximum column shows suggested limits for these structures for planning purposes. Exceeded these limits is not a protocol violation. However, exceeding the Maximum Point Dose column is a violation per Section 6.7.2.*
Treatment Planning QA
Dry Run

- Set up vacloc and bridge on table
- Using new coordinates from treatment planning, check beam angles for collisions on the treatment unit.
- Record table parameters of potential collision and return to physics
SBRT Body setup-sheet - IU Health/Bloomington

Patient Name: ____________________________ Date: __________________
Patient ID#: ____________________________ Protocol: 0813
Physician: ________________________________

1. Indexing bar for indexing the Wing board are indexed to Varian couch at: 5.5
2. Headrest
   
3. Wing board: Hand bar
   
   Indexed at 3 /offset cm RT/LT.

4. Vaclock 80cm/100cm

5. Knee roll
   Large ______ Small_x ______ 1styr wfeet strapped

6. Respiratory Plate Bridge Index (Inf edge) 80.0

A. Bridge [Large][Small] height 8.0
B. Respiratory Plate height 4.5

C. Lateral position 1.0
D. Knob position 4

Note: ____________________________

Physician _______ Dosimetrist _______ Therapist _______
Treatment Planning and Dosimetry QA

- 2nd MU check and QA measurement with ion chamber prior to 1st treatment by physicist
- Isocenter coordinates 2nd check.
Dosimetry QA

- CIRS lung phantom
- MU, gantry, couch collimator angles as per treatment plan
- Absolute point dose measurement

MU VERIFICATION / POINT DOSE MEASUREMENT

<table>
<thead>
<tr>
<th>Patient:</th>
<th>MR #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment Site:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Energy (MV)</th>
<th>MU</th>
<th>IC Rdg</th>
<th>Cal factor</th>
<th>Dose (cGy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPIO</td>
<td>6</td>
<td>164</td>
<td>4.468</td>
<td>30.661</td>
</tr>
<tr>
<td>RIO</td>
<td>6</td>
<td>159</td>
<td>4.361</td>
<td>30.661</td>
</tr>
<tr>
<td>RS0</td>
<td>6</td>
<td>174</td>
<td>4.717</td>
<td>30.661</td>
</tr>
<tr>
<td>RAO</td>
<td>6</td>
<td>168</td>
<td>4.860</td>
<td>30.661</td>
</tr>
<tr>
<td>AP</td>
<td>6</td>
<td>187</td>
<td>5.279</td>
<td>30.661</td>
</tr>
<tr>
<td>AS0</td>
<td>6</td>
<td>185</td>
<td>5.062</td>
<td>30.661</td>
</tr>
<tr>
<td>AI0</td>
<td>6</td>
<td>182</td>
<td>4.930</td>
<td>30.661</td>
</tr>
<tr>
<td>LAO1</td>
<td>6</td>
<td>182</td>
<td>3.880</td>
<td>30.661</td>
</tr>
<tr>
<td>LAO2</td>
<td>6</td>
<td>236</td>
<td>3.987</td>
<td>30.661</td>
</tr>
<tr>
<td>LPO1</td>
<td>6</td>
<td>143</td>
<td>2.338</td>
<td>30.661</td>
</tr>
<tr>
<td>LPO2</td>
<td>6</td>
<td>171</td>
<td>4.372</td>
<td>30.661</td>
</tr>
</tbody>
</table>

Calculated dose (cGy): 1470.300  Total Dose (cGy): 1479.503

Ion Chamber Cross-Calibration

<table>
<thead>
<tr>
<th>PTW31010 (serial #1095)</th>
<th>Energy (MV)</th>
<th>Rdg 200cGy (calibration)</th>
<th>Calibration Factor cGy/MU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
<td>6.525</td>
<td>6.521</td>
</tr>
</tbody>
</table>

Electrometer, Pel Phantom

Measured Dose (cGy): 1479.50  Calculate dose (cGy): 1470.30

Difference (%): 0.63%  Photographer: EP  Date: 7/15/2013
Pretreatment QA

- Winston-Lutz like test is performed using MARBLE PHANTOM and “SBRT QA” plan.
- MARBLE PHANTOM is aligned to the isocenter using lasers and verified using CBCT.
- MV images of a 3cm MLC aperture are acquired at 0° and 270° gantry angle.
- Evaluation of the aperture versus beam center is performed in Offline Review using diagonal distance tool traces to identify the center of the 3 cm MLC aperture and orthogonal distance tool traces to identify the center of the marble.
- Distance tool is used to verify the orthogonal shifts are less than 1 mm.
Pretreatment “Winston Lutz” test
SBRT treatment steps

• Position frame, wingboard and headrest as per "SBRT body setup-sheet"
• Realign vaclock
• Position patient in a frame as per "SBRT body setup-sheet"

• Move couch to VRT, LAT and LNG marks for both sternum mark according to "Patient Setup in the Frame" form

• Realign patient so sternum marks line up with crosshair

• Attach respiratory bridge and plate as per "SBRT body setup-sheet"

• Bring patient to the iso center, use couch readouts provided by Dosimetry
SBRT treatment steps-cont.

• Place 1cm ruler, mode up AP kV field, assure that motion is as per Sim

• Acquire CBCT and perform 3D3D match

• Enter shifts information into CBCT patient shift log.

• If necessary acquire second CBCT

• Start treatment

• Acquire CBCT and perform 3D3D match, mid-course
Patient setup for treatment

SBRT Body setup sheet - IU Health Bloomington

Patient Name: __________________ Date: __________
Patient ID#: ___________________ Protocol 0813
Physician: ______________________

1. Indexing bar for indexing the Wing board are indexed to Varian couch at 5.5
2. Headrest
   8
3. Wing board: Hand bar
   DIF
   Indexed at 3 /offset cm RT/LT

5. Vaclock 80cm/100cm

6. Knee roll Large _____ Small x _____ 1styro wfeet strapped
7. Respiratory Plate Bridge Index (Inf edge) 80.0
   A. Bridge [Large][Small] height 8.0
   B. Respiratory Plate height 4.5
   C. Lateral position 1.0  D. Knob position 4

Note: ______________________

Physician ________ Dosimetrist ________ Therapist ________

Set up info [cm]   Treatment info [cm]

<table>
<thead>
<tr>
<th>info</th>
<th>Superior sternum mark</th>
<th>Inferior sternum mark</th>
<th>RT lat</th>
<th>LT lat</th>
<th>Shifts from Superior sternum mark</th>
<th>Isocenter Couch coordinates</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRT* [cm]</td>
<td>22.1</td>
<td>23.9</td>
<td>18.1</td>
<td>18.1</td>
<td>11.1 POST</td>
<td>11</td>
</tr>
<tr>
<td>LNG [cm]</td>
<td>109.5</td>
<td>119.5</td>
<td>119.5</td>
<td>119.5</td>
<td>7.5 INF</td>
<td>117</td>
</tr>
<tr>
<td>LAT [cm]</td>
<td>997</td>
<td>997</td>
<td>12.5 RT</td>
<td>9.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Physics check__________
CBCT-3D3D match, patient shifts

- Check clearance with gantry, if it does not clear you must follow these steps
- Move patient to acquired treatment iso center
- Exit room
- Mode up CBCT at the acquired treatment iso center
- Select 3D/3D Match
- Acquire New Scan (on 1st day) and/or Quick Scan
- Enable OBI Arm Movement
- When the Enable Couch or Gantry Movement que comes up, Enter the treatment room
  - Move the treatment couch for CBCT clearance
  - Exit treatment room
  - Enable Couch or Gantry Movement
  - Start Scan
  - Ready for CT, press foot switch
- After CBCT is complete the Enable Couch or Gantry Movement que will come up to return the patient to the acquired treatment iso center
- Enter treatment room and move patient manually to the acquired treatment iso center
- Exit treatment room
- Enable Couch or Gantry Movement
- Accept and Export
<table>
<thead>
<tr>
<th>Set up info [cm]</th>
<th>Treatment info [cm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>info</td>
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</tr>
<tr>
<td>Superior sternum mark-sternal notch</td>
<td></td>
</tr>
<tr>
<td>Inferior mark-xyphoid ref.pt</td>
<td></td>
</tr>
<tr>
<td>RT lat Inferior</td>
<td></td>
</tr>
<tr>
<td>LT lat Inferior</td>
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<tr>
<td>Shifts from Superior sternal mark</td>
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<tr>
<td>Isocenter Couch coordinates</td>
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</tr>
<tr>
<td>CBCT Tx 1</td>
<td>CBCT Tx 2</td>
</tr>
<tr>
<td>VRT* [cm]</td>
<td>22.1</td>
</tr>
<tr>
<td>LNG [cm]</td>
<td>109.5</td>
</tr>
<tr>
<td>LAT [cm]</td>
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Physics check_________ Date______________

IU Health/ Bloomington

<table>
<thead>
<tr>
<th>SBRT LUNG</th>
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<tbody>
<tr>
<td>Patient shifts after 3d3D match</td>
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**PATIENT NAME:**

<table>
<thead>
<tr>
<th>Therapist:</th>
<th>Date:</th>
<th>Initial Vertical</th>
<th>long</th>
<th>Lateral</th>
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<tbody>
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<td>NB,KS, ES</td>
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## SBRT lung shifts - IU Health-Bloomington

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<td>18.1</td>
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<tr>
<td>11.1 POST</td>
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<td>7.5 INF</td>
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<td>LAT [cm]</td>
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<td>12.5 RT</td>
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### IU Health/ Bloomington

**Patient shifts after 3d3D match**

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We will assess intrafraction variance in patient position by using shift coordinates recorded during our conebeam CTs obtained during treatment.

This is to ensure that our patient is being treated safely and accurately during the 45 minute SBRT treatment process.
QI study results

– For 33 patients, we assessed the shift coordinates recorded during the conebeam CTs obtained during treatment.

In 80% of the fractions, the intrafraction shifts for this population of patients were 0.0cm.

For 100% of the fractions, the shifts were below 0.5cm.

The results for intrafraction shifts are an indication of the patient positioning accuracy during treatment.
Benefits of reproducible immobilization

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Initial CT – 1st-4th fractions

New setup, new CT, same plan-5th fraction
Conclusion

SBRT for lung cancer is effective and tolerable

SBRT became an established standard therapy for medically inoperable patients
Thank you for your attention