Contouring, Target Volume Delineation, 3D CT Based Planning Of BCT and Plan Evaluation

Dr. Piyush Kumar
Professor & Head,
Department of Radiation Oncology, SRMSIMS, Bareilly
BACKGROUND

Steps of Radiotherapy planning
- Positioning using immobilization device
- Simulation
- Target Volume Delineation
- Treatment Planning
- Dose & Fractionation
Positioning using immobilization device
Why breast board?

- Adjustable features allow for the manipulation of patients arms, wrists, head & shoulders.
- Make chest wall surface horizontal
- Arms do not obstruct lateral beams
- Thermoplastic breast support can be added for immobilization of large pendulous breast
Prone position not routinely practised

- Advantages vs disadvantages
Simulation

• NCCT / CECT thorax for Radiotherapy Planning (RTP)
  – Flat Couch, Slice Thickness (3mm), Full body Contour, 3 fiducial markers visible in single slice

• Clinical reference mark using radiopaque wires (scars, field borders, breast tissue)

Courtesy - last ICRO slides (Dr. Ashwani Budrukar)
Road Map

SECTION-A
Contouring, Target Volume Delineation
• Chapter 1: Breast
• Chapter 2: Breast & Chestwall
• Chapter 3: Chestwall
• Chapter 4: SCF
• Chapter 5: Axillary Nodes

SECTION-B
3D CT Based Planning
• Chapter 6: Planning techniques

SECTION-C
Plan Evaluation
• Chapter 7: Dose Volume Histograms
BACKGROUND

• Knowledge of Surface Anatomy, 3D Anatomy, Radiological Anatomy of structures enumerated in RTOG Guidelines
SECTION-A
CONTOURING, TARGET VOLUME
DELINEATION

Chapter 1: Breast
### Breast and Chestwall Contour: Anatomical Boundaries

<table>
<thead>
<tr>
<th></th>
<th>Cranial</th>
<th>Caudal</th>
<th>Anterior</th>
<th>Posterior</th>
<th>Lateral</th>
<th>Medial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast¹</td>
<td>Clinical Reference + Second rib insertion&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Clinical reference + loss of CT apparent breast</td>
<td>Skin</td>
<td>Excludes pectoralis muscles, chestwall muscles, ribs</td>
<td>Clinical Reference + mid axillary line typically, excludes latissimus (Lat.) dorsi m.</td>
<td>Sternal-rib junction&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Breast + Chestwall²</td>
<td>Same</td>
<td>Same</td>
<td>Same</td>
<td>Same</td>
<td>Same</td>
<td>Same</td>
</tr>
<tr>
<td>Chestwall³</td>
<td>Caudal border of the clavicle head</td>
<td>Clinical reference + loss of CT apparent contralateral breast</td>
<td>Skin</td>
<td>Rib-pleural interface. (Includes pectoralis muscles, chestwall muscles, ribs)</td>
<td>Clinical Reference/ mid axillary line typically, excludes latissimus dorsi m.&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Sternal-rib junction&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
RECALL ANATOMY
Cranial, Caudal Borders

Step 1: Recall the anatomy (Surface, 3 Dimensional and Radiological)
Step 2: Identify the number of sections in which you need to delineate that structure (Cranial to Caudal)
Cranial & Caudal

- Clinical reference - Reciprocated by Wires
- Use copper wires to reduce artefacts

Courtesy - last ICRO slides (Dr. Ashwani Budrukar)
Step 3: Start delineation around the middle of the bundle of sections selected, first towards cranial/ caudal and then in the opposite direction. Verify caudal limit in sagittal sections
Step 4: In each section identify the structures limiting the delineation in rest of the 4 directions (Anterior, Posterior, Medial, and Lateral)
Practical Case

• Not so good breast contours as you see in guidelines!
• Step 5: After complete delineation, review the complete delineation as a structure existing in the body to see whether it is fitting into your knowledge of anatomy (3-dimensional/Surface/Radiologically)

• Step 6: Once you have delineated all the structures, get it verified from your colleague
  – (Remember he/she is your best judge, and not your faculty!)
SECTION-A
CONTOURING, TARGET VOLUME
DELINEATION

Chapter 2: Breast & Chestwall
Breast & Chestwall
SECTION-A
CONTOURING, TARGET VOLUME
DELINEATION

Chapter 3: Chest wall
Cranial

- Step 1: Recall the anatomy (Surface, 3 Dimensional and Radiological)
Caudal
Anterior, Posterior, Medial & Lateral
SECTION-A
CONTOURING, TARGET VOLUME DELINEATION

Chapter 4: Supraclavicular LNs
• Step 1: Recall the anatomy (Surface, 3 Dimensional and Radiological)
Step 1: Recall the anatomy (Surface, 3 Dimensional and Radiological)
Cranial
Caudal
Anterior, Posterior, Medial & Lateral
Breast Contouring
RADCOMP Consortium
v.3
February 23, 2016
SECTION-A
CONTOURING, TARGET VOLUME DELINEATION

Chapter 5: Axillary Nodes
AXILLA ANATOMY

• Step 1: Recall the anatomy (Surface, 3 Dimensional and Radiological)
Step 1: Recall the anatomy (Surface, 3 Dimensional and Radiological)
SECTION-B
3D CT BASED PLANNING OF BCT

Chapter 6:

- Tangential fields
- Field in field
- Small Tangentials
- Mono isocentric for 3 fields
Tangentials
Beam’s Eye View of Tangentials
Dose wash reveals ‘hot spot’
‘Field in Field’ Technique
‘Hot spot’ tackled

Before FIF

After FIF
Quick revision of Chest wall RT in MRM

Re-enhancement of Radiotherapy planning concepts
Tangentials
Beam’s Eye View of Tangentials
Dose wash reveals ‘cold spot’
Additional ‘small tangential’ fields
‘Cold spot’ tackled

Before adding small tangential

After adding small tangential
Mono Isocentric Technique for 3 fields
SECTION-C
PLAN EVALUATION

Chapter 7:

• Prescription
• Dose to OARs
• DVH
### TABLE 59.26 TREATMENT POLICY FOR CONSERVATIVE MANAGEMENT OF EARLY-STAGE INVASIVE BREAST CANCER

<table>
<thead>
<tr>
<th>Treatment Volume</th>
<th>Indication</th>
<th>Fraction Size/Technique</th>
<th>Total Dose</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole breast</td>
<td>Routinely following BCS</td>
<td>2 (prefer) or 1.8 Gy/tangents with wedges or dynamic wedges to optimize homogeneity</td>
<td>45—50.4 Gy</td>
<td>Consider omission of RT in elderly with stage I disease and comorbidities</td>
</tr>
<tr>
<td>Boost</td>
<td>Routinely following whole breast</td>
<td>2 or 1.8 Gy (prefer 2 Gy)/en face electrons</td>
<td>10—16 Gy to bring total dose to &gt;60 Gy</td>
<td>Consider no boost for widely negative margins in women over 60</td>
</tr>
<tr>
<td>Accelerated whole</td>
<td>On protocol or ASTRO</td>
<td>2.66 Gy tangents with no nodal fields/no boost</td>
<td>42.5 Gy</td>
<td></td>
</tr>
</tbody>
</table>
## Constraints for organs at risk

<table>
<thead>
<tr>
<th>Organ</th>
<th>Dose/volume parameters</th>
<th>Guidelines</th>
<th>1/3 VOLUME</th>
<th>2/3 VOLUME</th>
<th>3/3 VOLUME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinal Cord PRV</td>
<td>Dmax = 50</td>
<td>QUANTEC</td>
<td>50</td>
<td>50</td>
<td>47</td>
</tr>
<tr>
<td>Lung</td>
<td>V20 ≤ 30%</td>
<td>QUANTEC</td>
<td>45</td>
<td>30</td>
<td>17.5</td>
</tr>
<tr>
<td></td>
<td>Mean Dose = 13</td>
<td>QUANTEC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V20 &lt; 20%</td>
<td>RTOG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dmean &lt; 20</td>
<td>RTOG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart</td>
<td>Mean Dose &lt; 26</td>
<td>QUANTEC</td>
<td>60</td>
<td>45</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>V30 &lt; 46%</td>
<td>QUANTEC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V50 &lt; 33%</td>
<td>RTOG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V45 &lt; 67%</td>
<td>RTOG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Esophagus</td>
<td>Mean Dose &lt; 34</td>
<td>QUANTEC</td>
<td>60</td>
<td>58</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>V35 &lt; 50%</td>
<td>QUANTEC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V50 &lt; 40%</td>
<td>QUANTEC</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Dose Volume Histograms

PTV

Spinal Cord

Heart

Opposite Breast
Lung
Take Home Message

• Know your anatomy (3D, surface and radiological)
• Delineation should be cross checked by your peers
• Practice latest techniques, but know your conventional planning (*will help to crosscheck your fields*)
• Learn from your mistakes & Keep reading...