Target Delineation for Prostate Cancer

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Keys for Successful Contouring

• Familiarity with the target anatomy

• Understanding the extent of disease and areas at risk for microscopic extension

• Familiarity with the juxtaposed normal tissue structures
Zonal Anatomy

- SV
- pre-prostatic sphincter
- periurethral stroma
- central zone (CZ)
- median lobe
- transition zone (TZ)
- verumontanum
- external sphincter
- anterior fibromuscular stroma (AFS)
Sagittal View
Anatomy of Imaging
IMRT @ MSKCC: Target Volume Definitions

Clinical Target Volume (CTV)
- Prostate and seminal vesicles (SV)
- Regional lymph nodes included for high risk disease

Planning Target Volume (PTV)
- 1 cm margin around CTV
- Rectal-prostate interface - 6 mm margin only
- Superior border at tips of the SV
- Inferior border above penile bulb

Treatment Volume
- PTV plus 5 mm except 10 mm at superior and inferior aspects to account for penumbra
Planning Target Volume (PTV)

6mm margin around CTV

3mm posterior margin used for hypofractionated treated patients and seeded patients receiving supplemental EBRT

Superior border at tips of the SV

Inferior border above penile bulb

prostate apex generally 1.2 cm above the penile bulb
Simulation and Treatment Conditions

- Empty rectum (bowel prep for sim)
- Empty bladder
- Fiducial markers placed 3-5 days before simulation
- Calypso used for hypofractionated patients
- Aquaplast immobilization
**IMRT: Dose Prescription and Delivery**

**Dose Prescription**

PTV encompassed by 100% isodose line
Isocenter dose (ICRU dose) 5-7% higher
Hot spots in the range 109-111%

**Dose/Volume Restriction**

> 30% of rectal wall carried to 75.6 Gy

53% of rectal wall not receiving more than 47 Gy

For patients treated to 81 Gy - max rectal wall dose 83.4 Gy

> 50% of bladder wall carried to prescription dose

Maximal large bowel dose - < 60 Gy
Full Bladder Conditions

- All post-op cases
- Small bladder volume or small capacity where greater bladder sparing is necessary
Mid-Gland- CTV Only
Mid-Gland- with PTV
Near Apex- CTV only
Towards the Base- CTV Only
Towards the Base with PTV
At the Level of SV- CTV only
At the Level of SV-with PTV
Challenging Areas to Contour

• Apex

• Base
Errors in Measurement

• Cephalocaudad dimension
  – Identification of the first slice that the base appears
  – Identification of the last section that the apex appears

• Lateral and anteroposterior margins also source of error
Case #5-Apex
Common Errors in Prostate Contouring

• Overestimating the extent of the apex
• Underestimating the extent of the base
• Widening contours to include levator muscles or peri-prostatic tissues and ligaments
Identification of the Prostatic Apex
Looking for the Penile Bulb
Apical Region

1.3 cm

GU Diphragm
User Interface – “Look ahead – Look back”
Below Apical Region
Identification of Membranous Urethra
MRI anatomic correlation: can help improve accuracy of our target delineation for CT-based treatment planning
Transition between Apex and GU Diaphragm
MRI Configuration at the Prostatic Apex
McLaughlin et al IJROBP 2009
Enhancing Visualization with CT

- Use of IV contrast to delineate apex and base
- Utilization of other imaging modalities
  - Image Fusion with registration
- User Interface – “Look ahead – look back”
  - Real time 3D view / reconstruction
- Comparative with MRI – visual confirmation
  - Most helpful at the base
IV Contrast Enhancement
Base of the Gland
Issues at the Prostate Base
McLaughlin et al IJROBP 2009 (in press)
Relationship of the NVB
Defining the Prostate Target: Contouring Tips

- Start contouring prostate at mid-gland
- Avoid contouring levator muscles or obturator internis or venous plexi
- As you approach apex apply a “look forward and back approach”
- Identify penile bulb and in general the apex should be located 1-1.5 cm above this landmark
Defining the Prostate Target: Contouring Tips

- For identification of apex and base CT contrast may be helpful
- If intravesical component is present, IV contrast can be particularly helpful
- Using beams eye views as you contour will eliminate contours that “jut out or in” too much which probably erroneous
Contouring Post-Op Case

General Comments

• Clips help define superior border.

• Volumes generally larger than typical definitive prostate.

• Urine or contrast can define the UV anastomosis which helps define the apex for CTV
Towards the Anastomosis-Apex
Towards the Anastomosis-Apex
At the Symphysis, begin to Taper CTV
Status Post Robotic RP
At the Base- Covering SV
Remnants- No Clips Placed
Contouring Post-Op Cases

• Superior Aspect: Include the clips and any residual seminal vesicle remnants.

• Mid-Gland:
  – Include bladder up with lateral inclusion up to the obturator internis muscles.
  – Start tapering the volume as you approach the superior aspect of the pubic symphysis

• Apex: 1 cm below the UV anastamosis
What about nodes?

3 options:

1. Nodes+prostate to 45 with 3DCRT, then prost with IMRT

2. Nodes+prostate to 45 with IMRT, then separate IMRT plan for prost

3. Nodes+prostate in single IMRT plan, but nodes at lower daily fraction size
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Contouring of Pelvic Lymph Nodes

- Give IV contrast for target visualization
- Superior aspect at L5-S1
- At MSKCC 1-1.5 cm margin drawn for PTV around nodal or vascular structures
Conclusions

• Familiarize yourself with the anatomic borders of the prostate
• After contouring mid-gland levels, turn attention to apex and apply look ahead and back approach
• IV contrast especially for large intravesicle component can be helpful
• Knowing extent and location of intra-prostatic disease should fine tune the delineation of your PTV for more generous margin