General Inclusion Criteria:
- Life expectancy > 5 years
- Clinical stage
  - T1b-T2c and selected T3
- Gleason score
  - Gleason scores 2-10
- PSA
  - In almost all cases, a PSA ≤ 50 ng/mL
- No pathologic evidence of pelvic lymph node involvement
- No distant metastases

Exclusion Criteria:
- Relative contraindications
  - Severe urinary irritative/obstructive symptomatology
  - Extensive TURP defect
  - Substantial median lobe hyperplasia
  - Prostate dimensions larger than the grid (i.e., > 60 mm in width and > 50 mm in height)
  - Severe pubic arch interference
  - Gross seminal vesicle involvement
  - Prior pelvic radiotherapy
  - Inflammatory bowel disease
  - Pathologic involvement of pelvic lymph nodes

- Absolute contraindications
  - Distant metastases
  - Life expectancy < 5 years

Physics and dosimetry:
- Sources
  - Pd-103 or I-125
  - Sources included on the joint AAPM/RPC Registry should be used
• **Treatment planning system**
  o Commissioned prior to first use, with source-specific documentation and QA
  o Image-based
    • Volumetric based upon contiguous slice acquisition
    • Slice spacing appropriate to resolution requirements
      • Typical preplanning and intraoperative procedures: ≤ 5 mm
      • Typical post implant evaluation: ≤ 5 mm
  o Three-dimensional calculation
  o DVH-based analysis

• **Dosimetry**
  o Dosimetry in accordance with 2004 AAPM TG-43U1 methodology
  o 2-D source characterization preferred only when source orientation is evident
  o The prescribed dose, or mPD, will normally be the intended minimum dose delivered to the planning target volume (PTV)
  o The reference dose will normally be the prescribed dose. For non-standard prescriptions, particularly when evaluating dose to critical structures, the reference dose should be that stated in the section on prescription doses.
  o D and V quantifiers for structures with ill-defined extent (urethra and rectum) may be cited in terms of cubic centimeters in addition to percentage of the volume of the structure

**Treatment Planning:**

• **Planning target volume:**
  o Prostate
  o Prostate with margin
  o Seminal vesicles
  o Prostate minus non-cancerous regions of the gland (e.g., anterior base)
  o Image-guided target volumes such as indium-111 or MR spectroscopy

• **Seed loading approach:**
  o Modified uniform
  o Inverse planning
  o Computer optimized
  o Modified peripheral

• **Treatment Planning**
  o Can be performed prior to or at the time of brachytherapy using nomograms or treatment planning computers
  o Prescription dose must encompass the target volume
  o Evaluated prostate dose parameters may include $V_{100}$, $V_{150}$, $V_{200}$, $D_{90}$
Evaluated urethral dose parameters may include $UV_{125}$, $UV_{150}$, $UD_{50}$, $UD_{30}$, $UD_{3}$ and/or maximum and minimum doses.

Evaluated rectal dose parameters may include the volume (cc) of the rectum exposed to prescription doses ($RV_{100}$) and/or the posterior treatment margin (in mm).

- **Dose homogeneity:**
  - The importance of dose homogeneity is unclear, however, efforts should be made to limit the volume of the high dose regions.

- **Urethral sparing techniques:**
  - Attempts should be made to maintain the average urethral dose below 150% mPD.

### Intraoperative Procedure:

- **Standard brachytherapy procedure consists of a transperineal template approach with image-guidance usually using biplanar transrectal ultrasonography, although MR and CT have been used:**
  - Geometric accuracy of the ultrasound image should be verified with a quality assurance phantom.
  - Coincidence of the template position and the image grid should be demonstrated.

- **Fluoroscopy may be used as a supplement**

### Source Delivery System:

- **Pre-loaded needles**
  - Free
  - Sutured or connected

- **Mick applicator**

### Patient Selection Criteria:

- **Monotherapy:**
  - Clinical stage T1b-T2b and Gleason score $\leq 6$ and PSA $\leq 10$ ng/mL
  - Select higher risk patients
  - Salvage of select radiation therapy failures

- **Boost:**
  - $\geq$ clinical stage T2c and/or Gleason score $\geq 7$ and/or PSA $> 10$ ng/mL

- **Special clinical situations:**
  - Inadequate information exists to recommend supplemental XRT based on perineural invasion, percent positive biopsies and/or MRI-detected extracapsular penetration

### Isotopes and Prescription Doses

- **Pd-103**
Monotherapy

- 125 Gy mPD
- Boost (with 41.4 – 50.4 Gy XRT)
  - 90-100 Gy mPD

I-125

- Monotherapy
  - 145 Gy mPD
- Boost (with 41.4 – 50.4 Gy XRT)
  - 108-110 Gy mPD

Supplemental XRT

- **Target volume:**
  - Prostate and seminal vesicles with margin
  - Prostate, seminal vesicles and pelvic lymph nodes for patients with a substantial risk of pelvic lymph node involvement

- **XRT technique:**
  - Conventional
  - 3-dimensional conformal
  - Intensity modulated

- **Rectal dose:**
  - For patients receiving 45 Gy of external beam radiation therapy, the $D_{50}$ (the dose delivered to 50% of the rectum) should be kept as low as possible

- **Timing:**
  - Either before or after brachytherapy is acceptable.

Androgen Deprivation Therapy

- **Accepted regimens:**
  - LHRH agonist with or without an anti-androgen
  - Anti-androgen with or without a 5α-reductase inhibitor

- **Indications:**
  - Cytoreduction for select large glands or significant pubic arch interference
    - Neoadjuvant androgen deprivation therapy should be initiated 2-3 months prior to brachytherapy
  - Adjuvant treatment
    - Controversial
    - If indicated, optimal duration is unknown

Postoperative Dosimetry

- **Imaging:**
  - CT-based
- MRI-based
- Fusion of CT and/or MRI and/or ultrasound

- **Timing:**
  - CT most commonly obtained on either day 0, 1, or 30
  - Timing should be consistent within each brachytherapy program

- **Recommended evaluated postoperative dosimetric parameters:**
  - $V_{100}$
  - $V_{150}$
  - $V_{200}$
  - $D_{90}$
  - Urethral doses – should include $UV_{125}$, $UV_{150}$, $UD_{50}$, $UD_{30}$, $UD_{5}$ and/or maximum and minimum dose
  - Rectal doses – cubic centimeters of rectum which received $\geq$ prescription dose ($RV_{100}$)

**Post-Treatment Evaluation**

- **Biochemical assessment:**
  - Serial PSA determinations – baseline at 3-6 months and then every 6 months and/or as per institutional protocol

- **Physical examination:**
  - Role of routine DRE is controversial

- **Quality of Life:**
  - Urinary, bowel, and sexual function should be prospectively assessed

- **Post-Treatment Biopsy:**
  - Should be reserved for protocol settings or in clinical situations where salvage local therapy is being considered
SELECTED READING

OVERVIEW


TREATMENT PLANNING


PHYSICS and DOSIMETRY


**ULTRASOUND QA**


**BIOCHEMICAL OUTCOMES**


**SUPPLEMENTAL XRT**


**ANDROGEN DEPRIVATION THERAPY**


**URINARY MORBIDITY**


**RECTAL MORBIDITY**


**SEXUAL DYSFUNCTION**


**PSA SPIKES**


The American Brachytherapy Society (ABS) low dose rate prostate cancer task group has developed generalized criteria for the use of brachytherapy in the management of prostate cancer. These criteria are intended to guide radiation oncologists, urologists and physicists in making decisions regarding therapy. The complexity and severity of a patient’s clinical condition should dictate the selection of appropriate treatment. The availability of equipment and/or personnel may influence therapy. Approaches classified as investigational by the U.S. Food and Drug Administration (FDA) has not been considered in developing these criteria. The ultimate decision regarding the appropriateness of any treatment must be made by the attending physician.