Prostate LDR brachytherapy

A. Treatment Regime:

Low risk Prostate cancer

(Per ABS: patients with high probability of organ-confined disease are appropriately treated with brachytherapy alone. Patients with a significant risk of extra-prostatic extension should be treated with supplemental EBRT)

B. Dose Prescription:

Mono-therapy: 145Gy for I-125 125Gy for Pd-103 (115-120Gy per ABS)
+EBRT : 40-50Gy EBRT + 110Gy for I-125 (100-110Gy per ABS)
\+ 100Gy for Pd-103 (80-90Gy per ABS)

\+ Hormonal therapy (Androgen deprivation): if gland size > 60cc (technically difficult to implant because of pubic arch interference

C. Planning criteria:

Contours: Prostate; PTV (prostate+4mm margin except posterior); urethra, rectum

Per AAPM TG-137:

CTV: V100 > 95% D90 > 100% V150 < 50%
Rectum: D_{2cc} < 100% ; $D_{0.1cc}$(Dmax) < 150%
Urethra: D10< 150% D30< 130%

Per ABS :

Report D100, D90 and V100

IU:

CTV: V100 > 100% V200< 25%
PTV: V100 >95% V200<25%
Rectum: V100 < 1cc
Urethra: V150< 5%

D. Radionuclide physics:

		I-125	Pd-103
Energy	(keV)	Avg: 28 keV (27.4 and 31.4 keV X-ray photons and 35.5keV γ-ray, plus 22.1 and 25.2 keV Chara-xray) (EC)	Avg: 21 keV (Chara-X 2-23keV) (EC and Auger photon)
HVL		HVL lead = 0.025mm HVL tissue = 20mm	HVL lead = 0.008mm
Half-life	days	59.4 (1-1.5% per day)	17 (4% per day)
Source Strength	mCi	0.3~ 1 mCi	
Physical Size		L: 4.5mm Φ:0.8mm	
Exp Rate Constant		1.45 $R \cdot cm^2/mCi \cdot hr$	1.48 $R \cdot cm^2/mCi \cdot hr$
S_k constant		1.27 U/mCi	
Dose Rate Constant Λ		0.965~1.036 $cGy \cdot hr^{-1}$ / U	0.68 $cGy \cdot hr^{-1}$ / U
Calibration		S_k NIST-WAFAC2001	
Seed Spacing		Not critical	< 1.7cm (because of low E photon)
Init DR		7 cGy/hr	18-20cGy/hr
RBE		1.4	1.9 (predicted cell kill is better in rapidly proliferating tumors, with advantage for I-125 in slower growing tumors; however no significant evidences)
IU seeds:		0.514U (0.405mCi)	
		Typical implantation:	

E. Clinical Workflow:

E.1. Pre-plan:

Prescription; TRUR or CT (volume study); estimation of seeds

E.2. Receive seeds package

(see other instructions)

E.3. Intra-op

Patient instruction: radiation safety instruction

Source assay: 10% of seeds to be assayed
Measured mean strength within 5% of vendor value (TG-40, 3% mean of batch, 5% individual deviation from mean)

Planning/Seed preparation/implantation

Patient/Area Survey: OR room ~0.05mR/hr
Patient @ 1m: 0.2-0.5mR/hr (AP/ LATs)
[Pt can be released if DR < 1 mrem/hr for I-125, < 3 mrem/hr for Pd-103
Instructions needed if DR >0.2mrem/hr for I-125, > 0.7mrem/hr for Pd-103]

Return seeds:

- Loose seeds stored in lead pig with return label on exterior of the pig
- Complete return authorization form
- Wipe test (< 2200dpm/100cm^2)
- Measure radiation level @ surface and @1m
  (excepted package: DR < 0.05mrem/hr @1m, <0.5mrem/hr@ surface – white lable
  Total activity < 81mCi for I-125)
- Place UN2910 label (excepted package) and white label; leave RQ sticker if the package exceeds the limit

E.4. Post-op evaluation:

1 month +/- 1 week for I-125
16+/-4 days for Pd-103

F. Record/documentation

- Written Directive (signed by AU-MD) [also include OR implant summary]
- Special Physics Consult (signed by AU-MD, AMP) → summary of preplan/ORimplant/PostEval; Timeout, source assay and Radiation safety survey
- Pt Radiation safety insturction (signed by Pt)
- Source calibration certification
- Case Summary report from machine
- Source assay report from machine
- Pre-plan/intraOp/postOp plan printouts (signed by AU-MD)
- Post-op summary report (signed by AU-MD)
- Other forms for source receive and return (?)

G. References:

AAPM-TG64: Permanent Prostate Seed Implant Brachytherapy

AAPM-TG128: Quality assurance tests for prostate brachytherapy ultrasound systems: Report of Task Group 128.

AAPM-TG137: AAPM recommendations on dose prescription and reporting methods for permanent interstitial brachytherapy for prostate cancer: Report of Task Group 137