Accelerated Partial Breast Irradiation (APBI) HDR brachytherapy (Mammosite and Contura)

A. Treatment Regime:

	ABS	ABSS2	ACRO	ASTRO4	
				Suitable	Cautionary
Age (yrs)	≥50	≥45	≥45	≥60	50 - 59
Diagnosis	Unifocal, invasive ductal carcinoma	Invasive ductal carcinoma or ductal carcinoma in situ (DCIS)	Invasive ductal carcinoma or DCIS	Invasive ductal or other favorable subtypes (ie: mucinous, tubular, colloid)	Pure DCIS ≤ 3cm EIC ≤ 3cm
Tumor Size	≤ 3cm	≤ 3cm	≤ 3cm	≤ 2cm	2.1 – 3.0cm
Surgical Margins	Negative microscopic margins of excision	Negative microscopic surgical margins of excision	Negative microscopic surgical margins of excision	Negative by at least 2mm	Close (<2mm)
Nodal Status	NØ	NØ	NØ	NØ (i-,i+)	

B. Dose Prescription:

- 3.4Gy BID x10 fx = 34Gy
- Dose prescribed to a physical treatment distance of 1.0cm from the inflated balloon surface (effective prescription depth is close to 2cm beyond the edge of the cavity)

C. Planning criteria

Contours:

CTV = PTV = PTV_EVAL = 1.0 cm expansion of cavity (remove balloon volume)
Others: skin, lung, ribs; trapped air

Mammosite: (per NSABP B-39; RTOG-0413)

PTV_eval: V90 > 90 %
%PTV_EVAL coverage – [(vol_trapped_air/volPTV_EVAL) x 100] = ≥90%
Critical normal tissue DVHs within < 5%
60% of the WBRV (whole breast reference volume) should receive ≥ 50% of the prescribed dose
Volume of tissue receiving: 150% (V150) ≤ 50 cc
200% (V200) ≤ 10 cc
If skin dist <7mm, skin dose <145%

Contura MLB : (per SenoRx S07-002)

PTV_eval: V95 > 95% (V90>90% acceptable)
Max skin: ≤ 125% (42.5Gy) (<145% acceptable)
Max rib : ≤ 145% (50Gy)
V150 : ≤ 50cc
V200 : ≤ 10cc
Dose Homogeneity Index (DHI) = the volume ratio (1 –V150/V100)

D. Radionuclide physics:

		Ir-192	
Energy	(keV)	Avg 380keV (EC, β decay, complicated γ ray: 0.136-1.06MeV	
HVL		HVL lead = 2.5mm	
Half-life	days	73.8	
Source Strength	mCi	10ci (40820U)	
Physical Size		Capsule L:4.5mm ϕ: 0.9mm	
Exp Rate Constant		4.66 $R \cdot cm^2/mCi \cdot hr$	
S_k constant		4.082 U/mCi	
Dose Rate Constant Λ		1.11 $cGy \cdot hr^{-1}$ / U	
Calibration			
Seed Spacing			
Init DR			

RBE			

E. Clinical Workflow:

E.1. Surgery and Applicator placement

Balloon filled with saline/contrast (2-3% contrast).

Balloon volume: MammoSite: 4-5cm Spherical: 35-70cc; 5-6cm: 70-120cc; 4x6 ellipsoidal: 60-65cc
Contura MLB: 4-5cm: 33-58cc

E.2. Simulation

CT scan (<3mm slice thickness; 3cm both cephalad and caudal)

Dummy seed train to determine treatment length and reference point

E.3. Tx Planning

1. Assessment of:

- **tissue conformance to balloon's surface**: (airtrap)/PTV < 10%
- **balloon to skin distance**: recommended >7mm; min: 5mm (145% for Mammosite) ; 3-7mm may be possible by adjustment of lumens
- **balloon symmetry**: <2mm for Mammosite (because the dose gradient for the smallest Mammosite is ~7% per mm => 2mm x 7% = 15% which is the criterion of precision of dose to the prescription point per TG-40
- **balloon size**: determine max transverse ϕ of Mammosite balloon
  dose rate @1cm from balloon surface: 7.79cGy/min/Ci for 40cc
  6.97cGy/min/Ci for 50cc
  Dwell time = Prescribed dose / (Ir192-Activity(Ci) x DR@1cm)
  Ex: t = 340cGy / (10ci x 7.79cGy/min/Ci) = 4.36min

2. Catheter Recon

3. Dose planning and optimization

E.4. Tx delivery:

1. Films/CT verification: balloon size (+/-5%), balloon rotation, air trap, catheter position/length
2. HDR spot check
3. Tx delivery

F. Record/Documentation:

- Written Directive (signed by AU-MD)
- HDR plan with isodose print out (signed by AU-MD, planning AMP, secondary check AMP**)**
- Daily TX record machine printout (signed by AU-MD, AMP every day)
- HDR TX record log (signed by AU-MD, init by AMP every day)
- Special Physics Consult (signed by AU-MD, AMP) → summary of plan/check/QA
- QA forms (Contura Ir-192 QA Form)

G. References:

NSABP (National Surgical Adjuvant Breast and Bowel Project)B-39;
RTOG-0413 protocol (**http://www.rtog.org/members/protocols/0413/0413.pdf**)
SenoRx S07-002 protocol