Associazione Italiana Radioterapia Oncologica
Gruppo di Studio per la Patologia Mammaria

II Zoom Journal Club 2012

Coordinatore: Luigia Nardone
Centro Congressi EATALY
Roma, 25 Gennaio 2013

PBI: Confronto fra IORT, Brachiterapia e 3D-CRT

a cura di: Cynthia Aristei, Antonella Ciabattoni, Elisabetta Perrucci, Luigia Chirico, Marcello Mignogna, Simona Borghesi, Edy Ippolito

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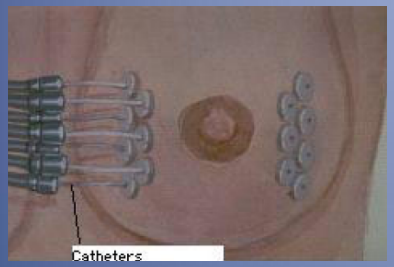
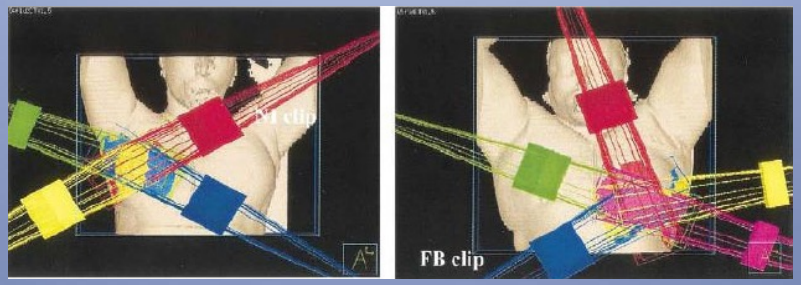
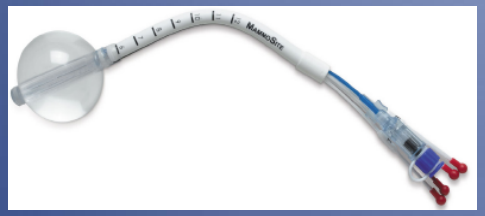
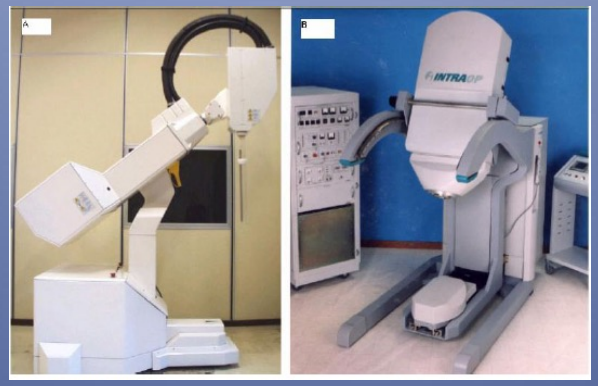
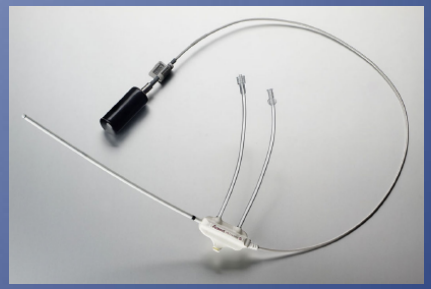
What are the optimal TECHNIQUE and DEVICE?

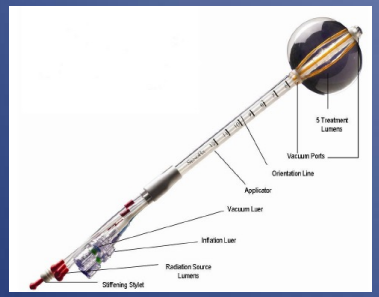












Njeh CF, Rad Oncol 2010

Completed Randomized Controlled Trials (RCTs)

TRIAL	INCLUSION CRITERIA	CONTROL ARM	EXPERIM ARM	RESULTS
CHRISTIE GROUP Ribeiro, 1993	Lumpectomy, invasive pT≤4cm, cN0, EIC admitted, age≤70yrs	WBI+regional lymph nodal RT: 40 Gy/15 fx	40-42.5 Gy/8 fx with 8-14 MeV electrons	Med f-up 65 months N=708, PBI vs WBI: LR 19.6% vs 11%, marked fibrosis G3 14% vs 5%, teleangectasia 33% vs 12%
YORKSHIRE BREAST CANCER GROUP Dodwell,2005	Lumpectomy, pT1-2 pN0-1	WBI: 40 Gy/15 fx +15 Gy boost	Cobalt/ Caesium/ electron beam/ small mega-voltage tangential pair to 55 Gy/20fx	Med f-up 96 months N=174, (prematurely closed), PBI vs WBI: LRR 24% vs 9%
HUNGARIAN NATIONAL INSTIT. OF ONCOLOGY Polgar, 2007	Lumpectomy, pT1 pN0-1,G≤2, neg margins, non-Lobular, no EIC, Age>40yrs	WBI: Cobalt or Photon beams 50 Gy/25 fx	HDR 36.4 Gy/7 fx or electrons 50 Gy/25 fx	Med f-up 66 months N=258, PBI vs WBI: IBR 3.1% vs 4.7% Excellent/good cosmesis 77.6% 62.9%

RCTs with interim analysis

TRIAL	INCLUSION CRITERIA	CONTROL ARM	EXPERIM ARM	RESULTS
TARGIT Vaidya, 2010	Unifocal T (non-lobular, no EIC), age>45 yrs	WBI according to participating Center	IORT: 20 Gy 50 kV X-rays single fraction	N=2232, PBI vs WBI 4-yrs LR1.2%vs0.95% Seroma 2.1%vs0.8%, RTOG tox G3-4 0.5%
GEC-ESTRO Strnad,2012	Lumpectomy,pTis-T2≤3cm, ≤1 micromet in axilla, neg margins,age>40	WBI: 50-50.4 Gy+ 10 Gy boost	HDR 32 Gy/8 fx or 30,3 Gy/7 fx PDR 50 Gy	N=1170, PBI vs WBI acute dermatitis G3 0.2 vs 7.1%, breast pain G2 3.4% vs 3.1%, , haematoma G2 0.8% vs 0.6%, infection 0.2% vs 0.2%
NSABP39/ RTOG 0413 Julian, 2010	Lumpectomy pTis-T2≤3cm, pN1, neg margins, any age	WBI: 50-50.4 Gy± 10-16 Gy boost	34 Gy with MBI or MammoSite or 38.5 Gy (3D-CRT)	Med f-up 42.6 months N=1391(3D-CRT): Fibrosis G2≤12%, G3≤3%
RAPID Whelan, 2013	Lumpectomy,pTis-T2≤3cm,pN0, non-lobular, age>40 yrs	WBI: 42.5 Gy/16 fx or 50 Gy/25 fx ± 10 Gy boost	3D-CRT: 38.5 Gy/10 fx twice daily	Med f-up 30 months N=2135, PBI vs WBI adverse cosmesis 35.1% vs 16.6%
UNIVERSITY of FLORENCE Livi, 2010	Lumpectomy/ quadrantectomy pTis-T2≤2.5cm, neg margins, age>40 yrs	WBI: 50Gy-50.4 Gy+ 10-16 Gy boost	IMRT: 30 Gy in 6 Gy fx	N=259, PBI vs WBI acute skin tox G1 5%vs22%, G2 0.8% vs 19%,no late skin tox

Ongoing RCTs

TRIAL	INCLUSION CRITERIA	CONTROL ARM	EXPERIMENTAL ARM	STATE
RAPID	Lumpectomy,pTis-T2≤3cm,pN0,age>40 yrs, non-lobular, no BRCA1-2	WBI: 42.5 Gy/16 fx or 50 Gy/25 fx ± 10 Gy boost	3D-CRT: 38.5 Gy/10 fx twice daily	ONGOING
IRMA	Lumpectomy, Invasive T<3cm, N≤3,neg margins, age≥49 yrs	45 Gy/18 fx or 50-50.4 Gy/ 25 fx	3D-CRT: 38.5 Gy/10 fx twice daily	ONGOING
ELIOT	Quadrantectomy Invasive T≤2.5cm, pN0, age>48 yrs	WBI: 50 Gy± 10 Gy boost	IORT: single fraction with electrons up to 21 Gy	ONGOING
IMPORT-LOW	Lumpectomy, pT≤2cm, pN0, non-lobular, G1-2,neg margins, age>50 yrs	WBI 40 Gy/15 fx	IMRT:Arm1:36Gy/ 15fx(T region)+40Gy/ 15fx (low risk area) Arm2:40Gy/ 15fx (T region)	ONGOING
SHARE	Lumpectomy, invasiveT≤2 cm, pN0 neg margins, age≥50 yrs	WBI: 40-42.5Gy/ 15-16 fx or 50 Gy+16 Gy boost	3D-CRT: 40 Gy/10 fx over 5-7 days	ONGOING

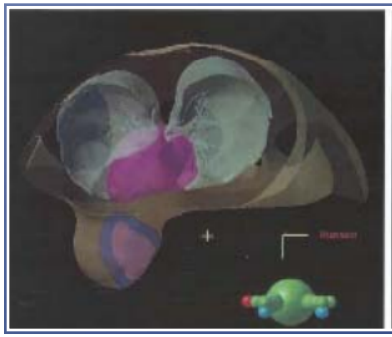
What technique is best for which patient?

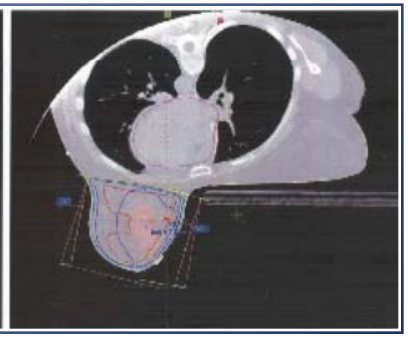
Prone Accelerated Partial Breast Irradiation After Breast-Conserving Surgery: Five-year Results of 100 Patients

Silvia C. Formenti, M.D.,* Howard Hsu, M.D.,* Maria Fenton-Kerimian, N.P.,* Daniel Roses, M.D.,† Amber Guth, M.D.,† Gabor Jozsef, Ph.D.,* Judith D. Goldberg, Sc.D.,‡ and J. Keith DeWyngaert, Ph.D.*

Advantages of **PRONE POSITION**:

✓sparing of OARs
(lung, heart, contralateral breast)
✓ minimization of target tissue movement during breathing
✓particularly useful for patients with large pendulous breasts
(at risk of more acute skin reactions and inferior cosmetic outcome)





Int J Rad Onc Biol Physics 2012

STUDY POPULATION

- ✓ 100 postmenopausal women
- ✓ pT1(< 2 cm) pN0
- ✓ Negative margins (at least 5 mm)
- ✓ HR positive

CTV: the surgical cavity
PTV: CTV + 2 cm
PTV_EVAL: from the PTV by cropping 0.5 cm from the skin edge and excluding the chest wall.

DOSE:
30 Gy/5 Fx of 6 Gy to the 95% isodose surface, given within 10 days.

CONSTRAINTS:
- ✓Ipsilateral breast: 50% of the volume to receive <50% of the prescribed dose.
- ✓Heart and lung: the included volume <10%.

Formenti SC, IJROBP 2012

Table 4 Treatment outcomes at 5 years (100 patients; intent-to-treat)

Endpoint	No. of failures	
	All follow-up	At 5 y
All IBF	1	1
IBF w/o concurrent distant failure	1	1
Ipsilateral Nodal failure	0	0
Contralateral Breast failure	1	1
Distant failure	1	0
Disease-free survival	9	4
Overall survival	6	2
Cause-specific survival	0	0

Abbreviation: IBF = in breast failure.

5-year isolated IBF: 1%
(occurred in another quadrant of the breast, different hystology)
5-year DFS: 95%

Formenti SC, IJROBP 2012

Table 5 Treatment of late toxicities per LENT/SOMA classification (98 patients)

Site	Grade 0	Grade 1	Grade 2	Grade 3
Breast, Subjective				
Pain	85 (87%)	11 (11%)	1 (1%)	1 (1%)
Breast Objective				
Skin, pigmentation change	69 (70%)	29 (29%)	0 (0%)	0 (0%)
Edema	89 (91%)	7 (7%)	1 (1%)	1 (1%)
Telangiectasia	95 (97%)	3 (3%)	0 (0%)	0 (0%)
Fibrosis	90 (92%)	8 (8%)	0 (0%)	0 (0%)
Fat necrosis*	79 (81%)	19*(19%)	0 (0%)	0 (0%)

LATE TOXICITIES

G1-2:
hyperpigmentation (29%), fibrosis (8%),telangiectasia (3%),breast pain (13%) and breast edema (9%).

G3:
1 transient breast pain,
1 breast edema.

Table 6 Cosmetic results over time

Cosmetic results	Cosmesis at last follow-up (n = 87)	>12 months follow-up (n = 90)	>24 months follow-up (n = 86)	>36 months follow-up (n = 74)
Excellent	45 (52%)	45 (52%)	42 (51%)	35 (47%)
Good	33 (38%)	33 (38%)	33 (40%)	31 (42%)
Total Excellent/Good	78 (90%)	78 (90%)	75 (90%)	66 (89%)
Fair	8 (9%)	8 (9%)	7 (8%)	7 (9%)
Poor	1 (1%)	1 (1%)	1 (1%)	1 (1%)

COSMESIS was rated good/excellent in 89% of patients with at least 36 months follow-up.

Formenti SC, IJROBP 2012

Tumor characteristics	No. (%)
ER+	99 (99)
ER−	1 (1)
PR+	65 (65)
PR−	35 (35)
HER2 (+)	
Yes	5 (5)‡
No	93 (95)
N/A	2
Ki67 (available in 78/100)	
Proliferation <14%	68 (87)
Proliferation >14%	9 (11)

AUTHORS' CONCLUSION:

The five-fractions course tested in this study is a **valid option** for women at low risk of recurrence, particularly **postmenopausal women** whose tumors satisfy the immunohistochemical criteria for being carriers of **luminal A cancers**.

Formenti SC, IJROBP 2012

Selection criteria according to ASTRO and GEC-ESTRO.

	ASTRO	GEC-ESTRO	ASTRO	GEC-ESTRO	ASTRO	GEC-ESTRO
	Suitable	Low-risk	Cautionary	Intermediate-risk	Unsuitable	High-risk
Age	≥60 years	>50 years	50–59 years	>40–50 years	<50 years	≤40 years
Tumor size	≤2 cm	≤3 cm	2.1–3.0 cm	≤3 cm	>3 cm	>3 cm
Histology	Invasive ductal carcinoma or other favorable subtypes	Invasive ductal, mucinous, tubular, medullary and colloid carcinoma	Invasive lobular carcinoma allowed	Invasive lobular carcinoma allowed	Any	Any
Grade	Any	Any	Any	Any	Any	Any
Pure DCIS	Not allowed	Not allowed	<3 cm	Allowed	>3 cm	Any
EIC	Not allowed	Not allowed	≤3 cm	Not allowed	>3 cm	Allowed
Associated LCIS	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed
Multicentricity	Unicentric only	Unicentric only	Unicentric only	Unicentric only	Multicentric	Multicentric
Multifocality	Clinically unifocal ≤2 cm	Unifocal	Clinically unifocal 2.1–3.0 cm	Multifocal (limited within 2 cm of the index lesion)	Clinically multifocal	Multifocal (>2 cm of the index lesion)
Lymph-vascular invasion	Not allowed	Not allowed	Limited/focal	Not allowed	Extensive	Allowed
Estrogen receptor	Positive	Any	Negative	Any	Any	Any
Surgical margins	≥2 mm	≥2 mm	Close (<2 mm)	Close (<2 mm)	Positive	Positive
Lymph node status	pN0 (i−,i+)	pN0	pN0 (i−,i+)	pN1mi, pN1a	≥pN1	pNx, ≥pN2a
BRCA1/2 mutation	Not present	Not defined	Not present	Not defined	Present	Not defined
Neoadjuvant therapy	Not allowed	Not allowed	Not allowed	Not allowed	If used	If used

Despite the lack of data from randomized trials with durable follow-up, the practice of PBI outside a clinical trial has increased over the past decade, prompting an ASTRO and a GEC-ESTRO task forces to issue consensus statements defining groups of patients for PBI performed off protocol. ASTRO and GEC-ESTRO consensus panel guidelines for the use of APBI list **DCIS** in the cautionary/intermediate risks or unsuitable/high risk categories.

Clinical Outcomes Using Accelerated Partial Breast Irradiation in Patients With Ductal Carcinoma In Situ

Chirag Shah,[1] Mackenzie McGee,[1] J. Ben Wilkinson,[1] Sameer Berry,[1] Inga Grills,[1] Michelle Wallace,[1] Christina Mitchell,[1] Frank Vicini[2]

99 patients treated with **PBI**

INTERSTITIAL BRACHYTHERAPY
50 Gy over 96 hours at 0.52 Gy/h,
32 Gy/8 fx or 34 Gy /10 fx (td)

BALLOON-BASED BRACHYTHERAPY
(MammoSite or Contura)
34 Gy in 10 fx twice daily

3D-CRT
38.5 Gy
in 10 twice-daily fx

Clin Breast Cancer 2012

Variable	All N = 99	Interstitial N = 3 (3%)	Balloon N = 53 (54%)	3D-CRT N = 43 (43%)
Age (y)				
Mean	61.8	58	62.3	61.4
Range	37-84	48-65	48-84	37-82
Median	60	61	59	60.5
Age (y)				
< 50	13 (13%)	1 (33%)	7 (13%)	5 (12%)
> 50	85 (87%)	2 (67%)	46 (87%)	37 (88%)
Tumor Size (mm)				
Mean	7.5	6.7	7.9	6.9
Range	1-28	5-9	1-25	1-28
Median	6	6	7	5.5
ER Status				
Positive	76 (87%)	2 (100%)	45 (88%)	29 (85%)
Negative	11 (13%)	0 (0%)	6 (12%)	5 (15%)
PR Status				
Positive	56 (80%)	2 (100%)	30 (79%)	24 (80%)
Negative	14 (20%)	0 (0%)	8 (21%)	6 (20%)
Margins				
Negative	54 (59%)	1 (33%)	29 (56%)	24 (67)
Positive	8 (9%)	0 (0%)	5 (10%)	3 (8%)
Close (< 2 mm)	29 (32%)	2 (67%)	18 (34%)	9 (25%)

Outcome (median f-up 3 yrs)	All N=99	Interstitial N=3 (3%)	Balloon N=53 (54%)	3D-CRT N=43 (43%)
5-year LR	1.4%	0	2.6%	0
5-year OS	94%	67%	96%	94%
5-year CSS	100%	NR	NR	NR

Although a difference was noted in survival by treatment technique (interstitial 67% vs. balloon 96% vs. 3D-CRT 94%; P<.006), this is likely due to the small number of patients who underwent interstitial therapy.

Shah C, Clin Breast Cancer 2012

Table 2 Review of Outcomes With Accelerated Partial Breast Irradiation and Excision Alone in Patients With DCIS

Technique and Reference	Number of Patients	Follow Up (mo)	Local Recurrence Rate
APBI			
Georgia Breast Center[12]	126	24	2.4%
University of Wisconsin[18]	32	60	0%
Bryn Mawr[17]	46	36	0%
ASBS Registry[16]	194	60	3.4%
Current study	99	36	1.4%
Excision Alone			
NSABP B-17[3]	818	144	31%
EORTC 10853[4]	1010	120	26%
UKCCCR[5]	1701	52.6	22% (no tamoxifen)/18% (tamoxifen)
SweDCIS[6]	1046	96	27.1%
MGH[9]	158	40	12%
ECOG E-5194[10]	565/105	74	6.1%/15.3%
Schwartz et al[8]	70	49	15.3%
Whole-Breast Irradiation			
NSABP B-17[3]	818	144	14.9%
EORTC 10853[4]	1010	120	15%
UKCCCR[5]	1701	52.6	8% (no tamoxifen)/6% (tamoxifen)
SweDCIS[6]	1046	96	12.1%
Solin et al[7]	1003	102	19%

Outcome (median f-up 3 yrs)	All N=99	Interstitial N=3 (3%)	Balloon N=53 (54%)	3D-CRT N=43 (43%)
5-year LR	1.4%	0	2.6%	0
5-year OS	94%	67%	96%	94%
5-year CSS	100%	NR	NR	NR

Outcome (ECOG E-5194 trial stratification)	Group 1 DCIS G1-2, T<2.5 cm N=65	Group 2 DCIS G3, T<1 cm N=10
5-year LR	2%	0%

Shah C, Clin Breast Cancer 2012

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ASBS Registry[16]	194	60	3.4%
Current study	99 65/10	36	2% / 0%
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Schwartz et al[8]	70	49	15.3%

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AUTHORS' CONCLUSION

When compared with trials omitting RT, even in low-risk patients with DCIS, reduced rates of LR are still noted with APBI, highlighting the need for improved patient stratification.

Patient factors	Surgical factors	Other radiotherapy factors	Chemotherapy factors
Increasing age [56,75]	Large excision volume [11,14,76]	Total dose [12,47,48,56]	Timing of chemotherapy: concomitant or sequential [56,77–79]
Smoking [53,75]	Post operative complications including haematoma seroma or infection [10,11,53]	Radiotherapy quality and technique [10,56]	Type of chemotherapy [80,81]
Large breast size [53,56,57,82–84]	Axillary dissection [48,76]	Tumour bed Boost [6]	
Tumour location [11,48]		Boost dose [9]	
Genetic variation [47,85]		Boost technique: electron, photon or brachytherapy [19,86]	
		Nodal irradiation [48,79]	
		Dose inhomogeneity (double trouble [87,88]	
		Hypofractionation and dose inhomogeneity (triple trouble) [88]	

Mukesh M, Radiother Oncol 2012

Many factors influence NTC after breast RT. In addition, the current literature seems to suggest that **volumetric parameter** is also important.

The Effect of Dose-Volume Parameters and Interfraction Interval on Cosmetic Outcome and Toxicity After 3-Dimensional Conformal Accelerated Partial Breast Irradiation

Kara Lynne Leonard, MD, MSc,* Jaroslaw T. Hepel, MD,*,‡ Jessica R. Hiatt, MSc,‡ Thomas A. Dipetrillo, MD,*,‡ Lori Lyn Price, MSc,† and David E. Wazer, MD*,‡

Int J Rad Onc Biol Physics 2012

STUDY POPULATION

80 women
pTis-T2 pN0-N1mic
ER+ 81%

CTV: the surgical cavity +1.5 cm
PTV: CTV + 1 cm
PTV_EVAL: the PTV limited by 0.5 cm from the skin edge and the chest wall.

After a median follow-up time of 32 months:
LC: 99%, LRC: 99%, DMC: 99%.

DOSE:
38.5 Gy/10 Fx, twice daily

CONSTRAINTS (NSABP-B39/RTOG 0413):

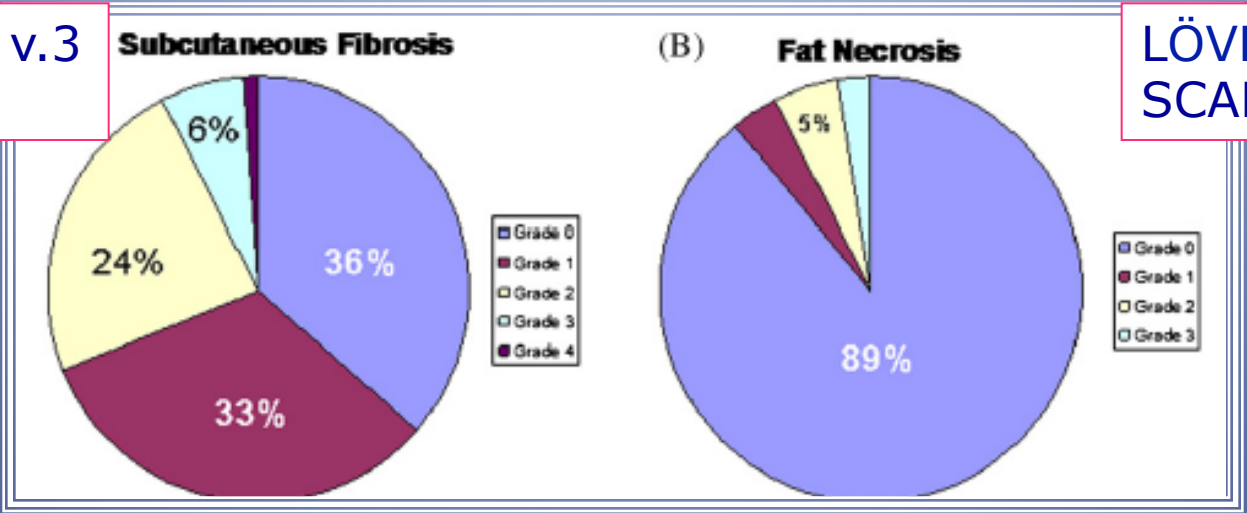
- ✓ Ipsilateral breast: <35% of the volume to receive the prescribed dose.
- ✓ Heart: <5% <40% of the prescribed dose.
- ✓ Lung: < 15% <30% of the prescribed dose.

Leonard KL, IJROBP 2012

Overall, G2-4 and G3-4 **LATE TOXICITY** developed in 51% and 11% of women, respectively.

CTCAE v.3 SCALE

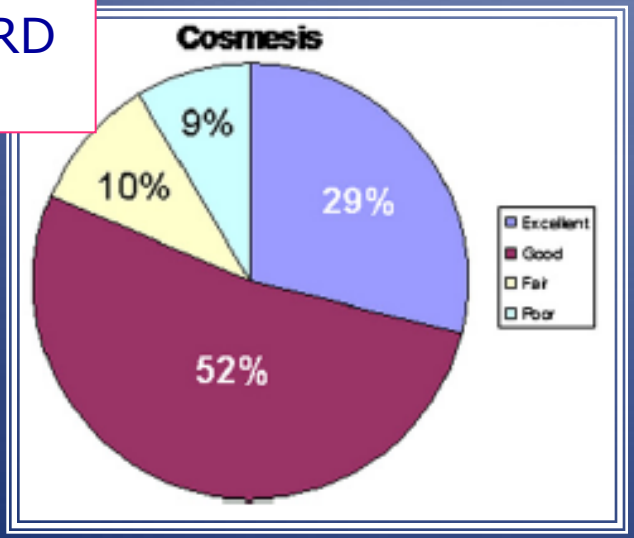
G3-4 fibrosis: 7.5%



LÖVEY SCALE

Fat necrosis 11%

HARVARD SCALE



COSMETIC OUTCOME was excellent/good in 81% of women.

Leonard KL, IJROBP 2012

Table 2 Chi-squared associations between dose-volumes and late toxicity

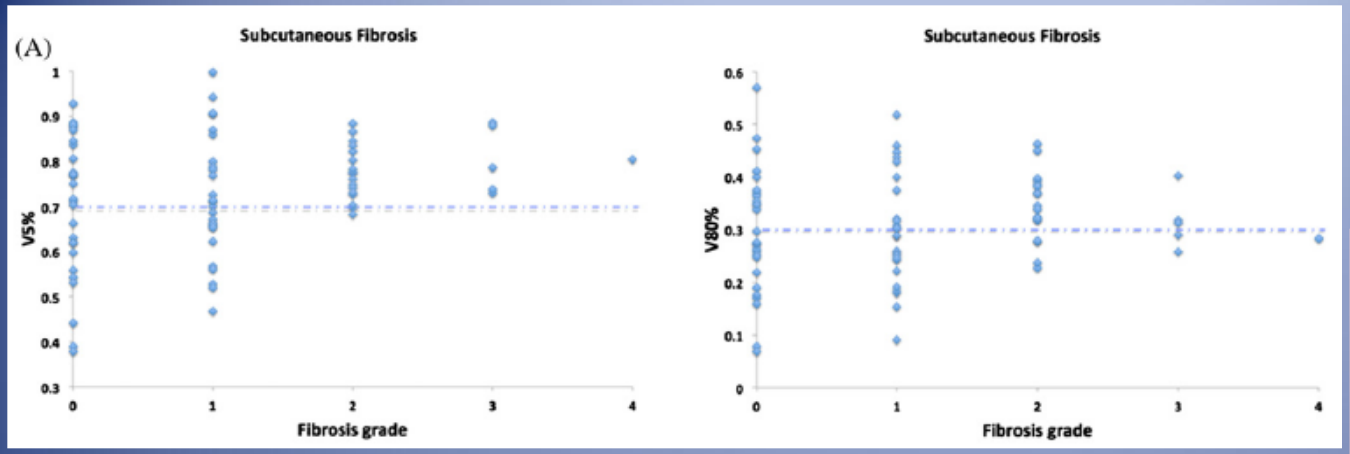
	V5%	V20%	V50%	V80%	V100%	DMAX
Subcutaneous fibrosis	$P = .04$	$P = .005$	$P = .01$	$P = .03$	$P = .001$	$P = .01$
Fat necrosis	NS	NS	$P = .008$	$P = .008$	NS	NS
Cosmesis	NS	NS	$P = .04$	$P = .04$	$P = .02$	$P = .05$
Grade 2-4 toxicity	NS	$P = .003$	$P = .003$	$P = .04$	$P = .009$	$P = .04$

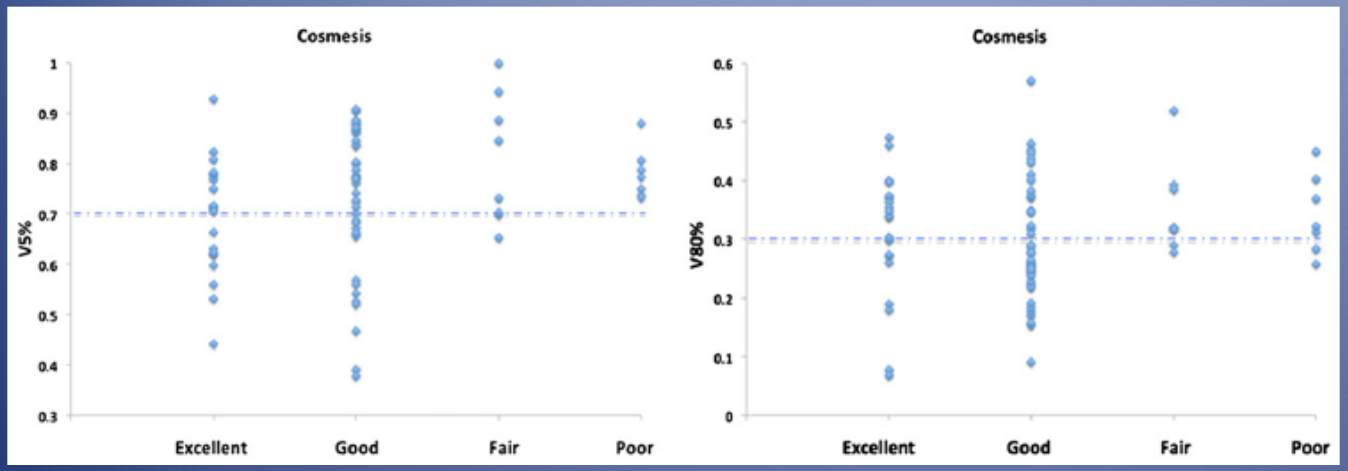
✓ The relative volume of breast tissue receiving 5%, 20%, 50%, 80%, and 100% (**V5-V100**) of the prescribed dose and the maximum hot spot (**Dmax**), were associated with risk of G2-4 **SUBCUTANEOUS FIBROSIS**.

✓ **V50** and **V80** were associated with risk of **FAT NECROSIS**.

✓ The volume receiving 50%, 80%, and 100% (**V50-V80-V100**) and **Dmax** were associated with **FAIR/POOR COSMESIS**.

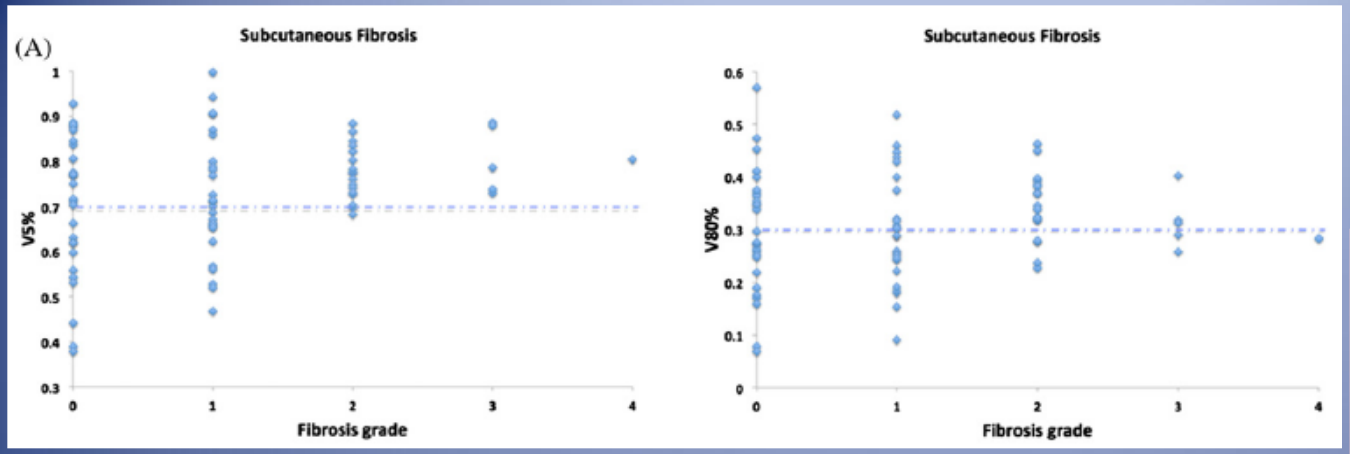
Leonard KL, IJROBP 2012

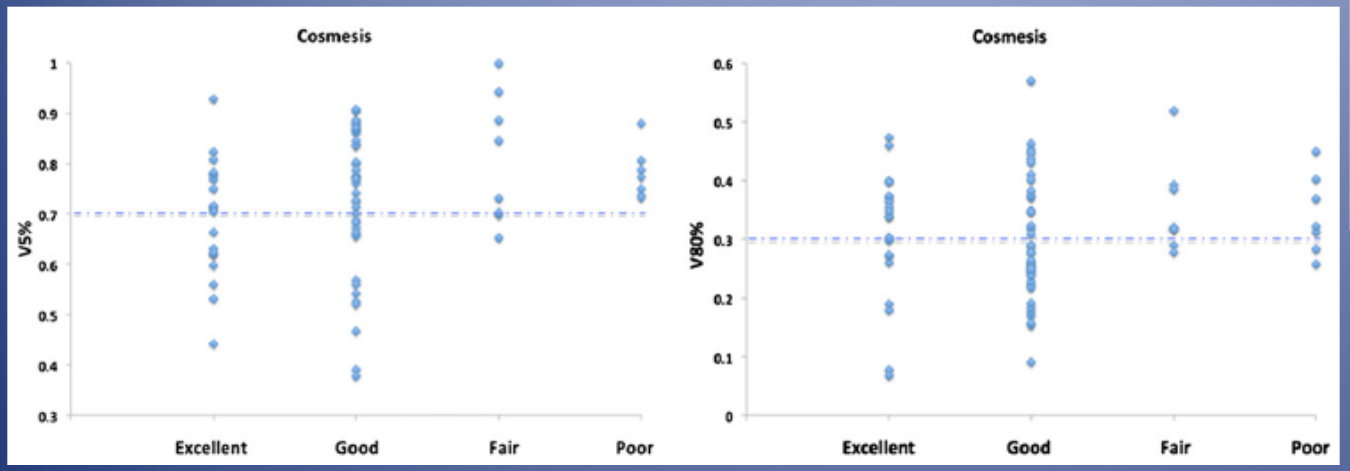


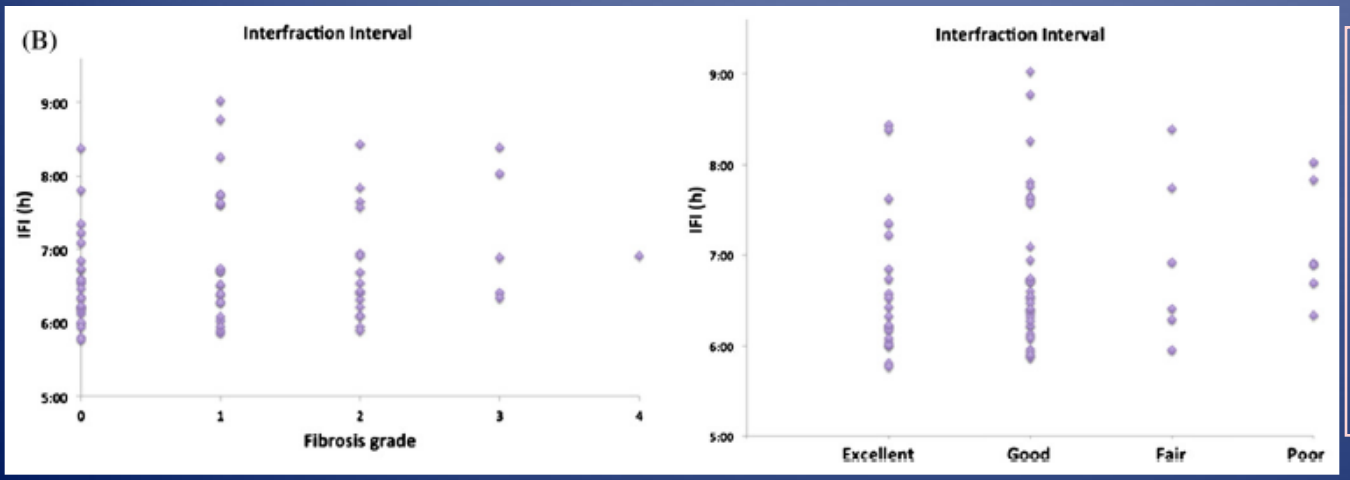


subcutaneous fibrosis as well as the

fair/poor cosmesis occurred with a V5 70% and a V80 25%.







All cases of G3-4 **subcutaneous fibrosis** as well as the majority of cases of **fair/poor cosmesis** occurred with a V5 70% and a V80 25%.

No statistically significant association between mean or minimum IFI and **subcutaneous fibrosis** or **fair/poor cosmesis**.

STUDY	N	DOSE	G3 TOX%	Good/excel COSMESIS %	MEAN V50/WBV %	MEAN V100/WBV %
Beaumont H Chen 2010	94	3D-CRT 38.5 Gy/10 Fx	4	89	49	24
Beaumont H Shaitelman 2010	62	3D-CRT 38.5 Gy/10 Fx	3.2	88	V5-50 correlated with G1-2 teleangectasia	-
Uninversity of Michigan, Jagsi 2010	34	3D-CRT 38.5 Gy/10 Fx	-	78	38	18
NYU, Formenti 2004	25	3D-CRT 30 Gy/5 Fx	2	89	45	24
Tufts Univ, Hepel 2009	60	3D-CRT 38.5 Gy/10 Fx	25	82	PTV_EVAL/WBV correlated with fibrosis and cosmesis	-
Present Study	80	3D-CRT 38.5Gy/10 Fx	11	81	42	14

AUTHORS' CONCLUSION

On the basis of these data, they recommend consideration of the following **dose-volume constraints** for ipsilateral breast:

V5 <70%, V50 <40%,V80 <25%-30% and V100 <15%-18%

(more restrictive than those defined in the NSABP B39/RTOG 0413 trial).

Leonard KL, IJROBP 2012

STILL in 2012:

- although PBI is an appealing therapeutic option, **long-term data** from large, **phase III trials** on **efficacy**, **side effects** and **cosmesis** are needed to validate PBI as an equivalent treatment to WBI in selected patients with early-stage breast cancer

- **insufficient clinical** and **dosimetric data** are available to determine the optimal technique for PBI.

PBI in 2012: comparison among IORT, BRT, and 3D-CRT

	MIB	Ballon-based BRT			HYBRID BRT		EXTERNAL BEAM			IORT	
		Mammosite	Axxent Electr.	Contura	SAVI	Clear Path	Photons	Electrons	Protons	Electrons	Photons
Prescription point (cm)	1.5 – 2	1	1	1	1	1	1.5 – 2	1.5 – 2	1.5 – 2	1 – 3	0.2
Coverage of target volume	Var.	Good	Good	Good	Good	Good	Best	Good	Best	Good	Good
Dose homogeneity	Fair	Fair	Fair	Fair	Fair	Fair	Best	Fair	Best	Fair	Fair
Sparing of OAR	Good	Good	Better	Better	Better	Better	Least	Varies	Good	Good	Best
Skin dose	Least	Var.	Var.	Var.	Var.	Var.	Least	Max	Least	Least	Least
Expertise required	High	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.	Least	High	V. high	High
Suitability for various tumor size, location and shape	NS if inadequate tissue or near axilla	NS for large/ irregular cavities / periphery	NS for large cavities	NS for large cavities	NS for large cavities	NS for large cavities	NS for small breast	NS for deep seated cavities in large breast	Superficial tumor	NS for tumors near brachial plexus/ axilla/ skin	NS for large irregular cavities/ periphery
Potential for wide spread use	Fair	Very good	Very good	Very good	Very good	Very good	Very good	Very good	Limited	Limited	Fair
Main drawback	High expertise required & QA	Stringent QA, Cavity, shape & size	Cavity, shape & size	Cavity, shape & size	Treatment planning complex	Treatment planning complex	Setup & breathing errors	High skin dose	Expensive and 2nd neutrons	Pathology not available	Pathology not available

PBI in 2012: comparison among IORT, BRT, and 3D-CRT

	MIB	Ballon-based BRT			HYBRID BRT		EXTERNAL BEAM			IORT	
		Mammosite	Axxent Electr.	Contura	SAVI	Clear Path	Photons	Electrons	Protons	Electrons	Photons
Prescription point (cm)	1.5 – 2	1	1	1	1	1	1.5 – 2	1.5 – 2	1.5 – 2	1 – 3	0.2
Coverage of target volume	Var.	Good	Good	Good	Good	Good	Best	Good	Best	Good	Good
Dose homogeneity	Fair	Fair	Fair	Fair	Fair	Fair	Best	Fair	Best	Fair	Fair
Sparing of OAR	Good	Good	Better	Better	Better	Better	Least	Varies	Good	Good	Best
Skin dose	Least	Var.	Var.	Var.	Var.	Var.	Least	Max	Least	Least	Least
Expertise required	High	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.	Least	High	V. high	High
Suitability for various tumor size, location and shape	NS if inadequate tissue or near axilla	NS for large/ irregular cavities /	NS for large cavities	NS for large cavities	NS for large cavities	large cavities	NS for small breast	NS for deep seated cavities in large breast	Superficial tumor	NS for tumors near brachial plexus/ axilla/ skin	NS for large irregular cavities/ periphery
Potential for wide spread use	Fair	good	good	good	good	good	good	good	d	nited	Fair
Main drawback	High expertise required & QA	Stringent QA, Cavity, shape & size	Cavity, shape & size	Cavity, shape & size	Treatment planning complex	Treatment planning complex	Setup & breathing errors	skin dose	Expensive and 2nd neutrons	Pathology not available	Pathology not available

Thanks for your attention!