

The Evolving Role of Radiotherapy in Treatment of Breast Cancer

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The Evolving Role of XRT in Treatment of Breast Cancer

- The Big Picture: Why XRT?
- Surface-Image Guidance
- Hypofractionation
- Accelerated Partial Breast
- Radiosurgery
- Stereotactic Body Radiotherapy



Why XRT?



70 Gy in 31 fractions

5 year result



Why BCT and Why Include Radiotherapy?

NSABP B-06

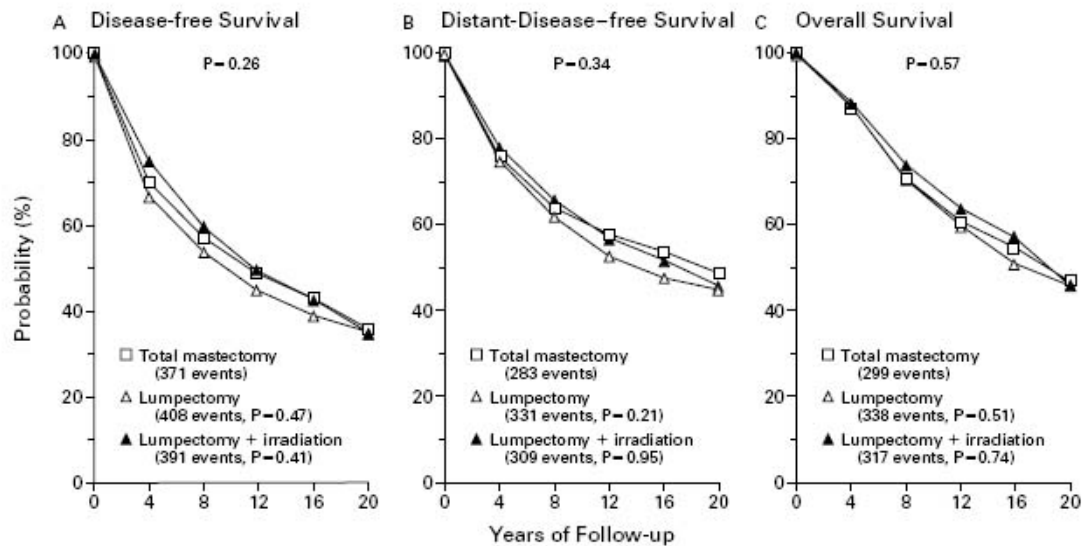


Figure 2. Disease-free Survival (Panel A), Distant-Disease-free Survival (Panel B), and Overall Survival (Panel C) among 589 Women Treated with Total Mastectomy, 634 Treated with Lumpectomy Alone, and 628 Treated with Lumpectomy plus Irradiation. In each panel, the P value above the curves is for the three-way comparison among the treatment groups; the P values below the curves are for the two-way comparisons between lumpectomy alone or with irradiation and total mastectomy.

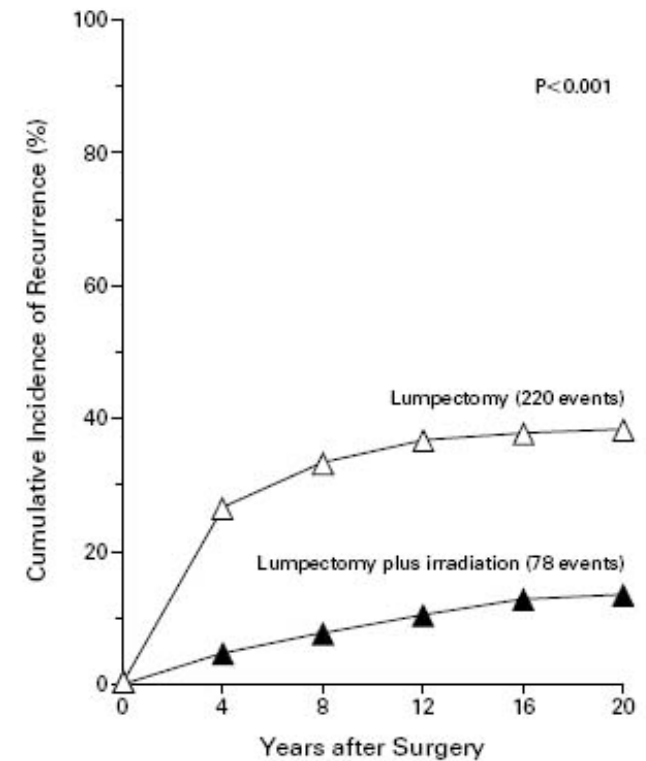
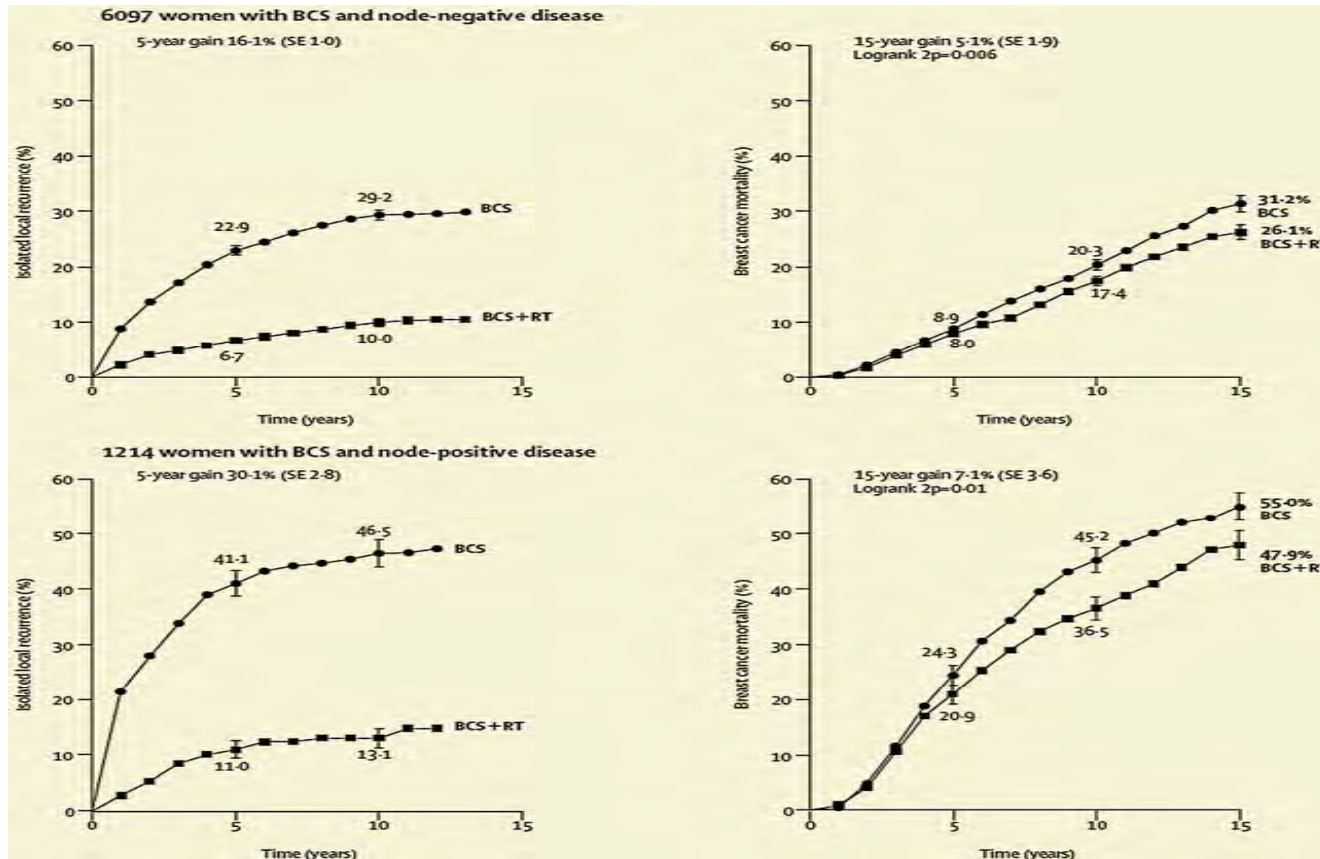


Figure 1. Cumulative Incidence of a First Recurrence of Cancer in the Ipsilateral Breast during 20 Years of Follow-up among 570 Women Treated with Lumpectomy Alone and 567 Treated with Lumpectomy plus Breast Irradiation. The data are for women whose specimens had tumor-free margins.

Survival Benefit

Oxford Meta-Analysis



For every four LR prevented, one death is prevented at 15 years.

Conventional Tangent-Field XRT



 Mays Cancer Center

UT Health MDAnderson
San Antonio Cancer Center

Conventional Tangent-Field XRT (circa 1995)

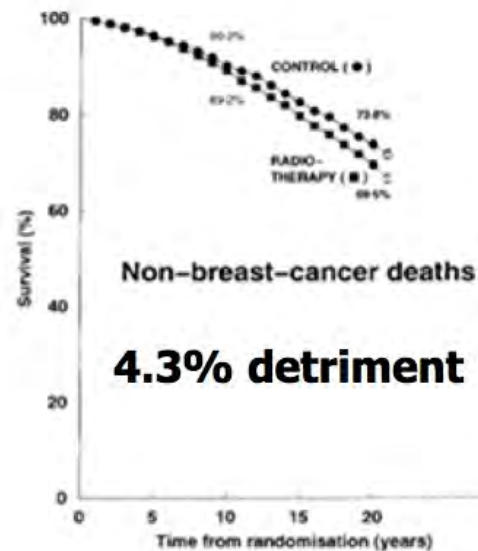
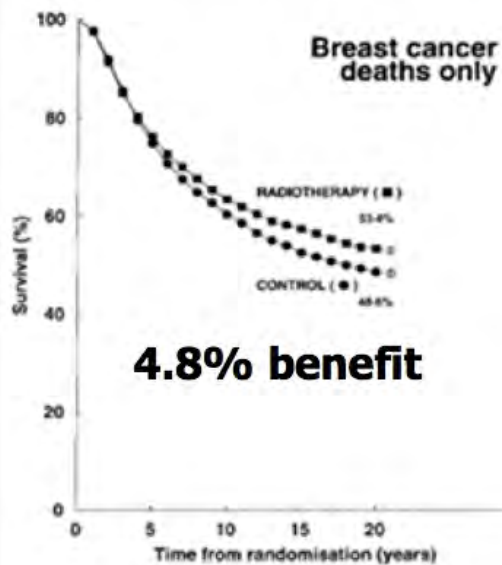


XRT Survival Impact Oxford Meta-Analysis

Oxford Overview 1995: Breast Cancer and Overall Mortality

Early Breast Cancer Trialists Collaborative Group Lancet 355: 1757, 2000.

40 randomized trials; 20,000 women



Points out the importance of reducing toxicity

Radiation-Related Cardiac Impact

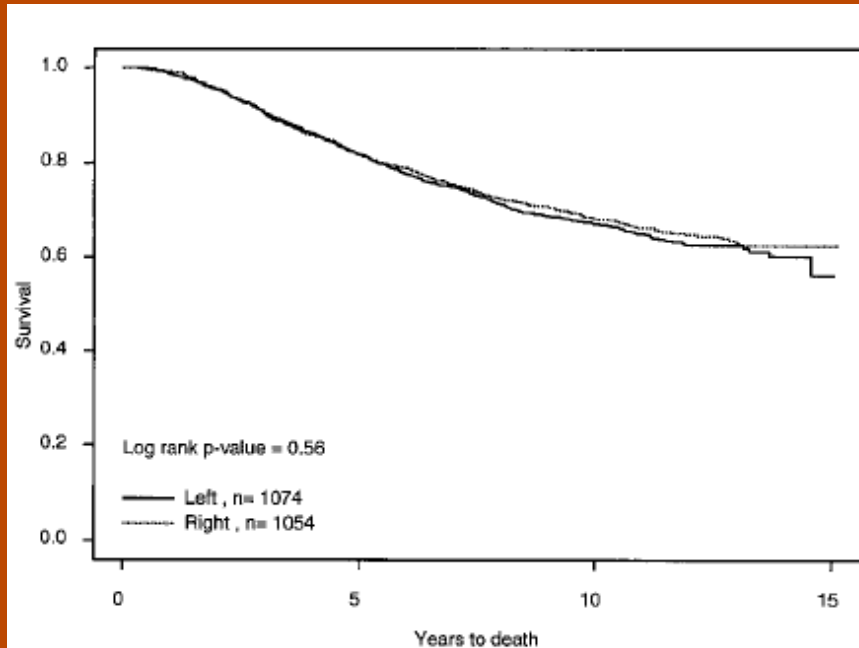


Fig 1. Survival curves according to laterality of breast cancer.

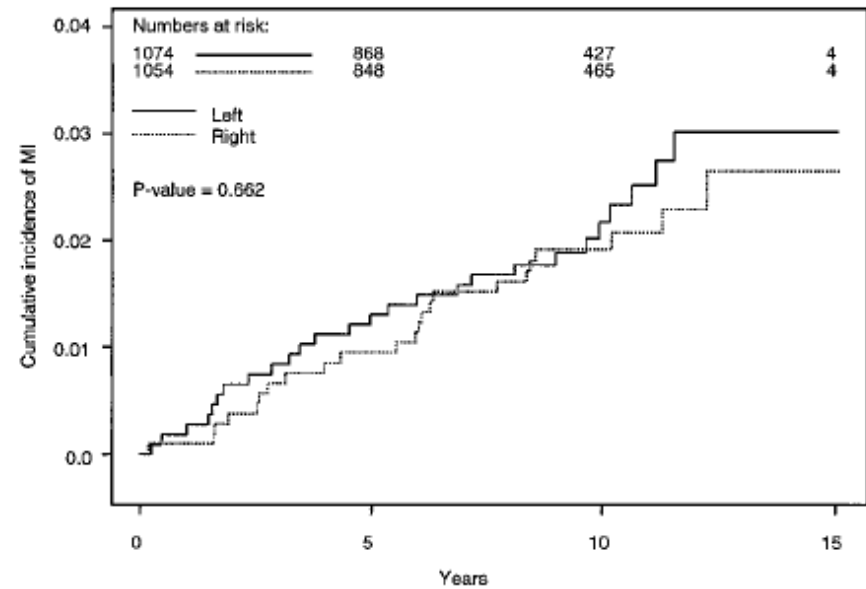


Fig 2. Time to occurrence of MI according to laterality of breast cancer.

Vallis et al., JCO 20(4): 1036-1042, 2002

Radiation-Related Cardiac Impact

Based on 300,000 US women with breast cancer (SEER data)

Relative Risk (95% confidence interval) for left versus right sided tumors

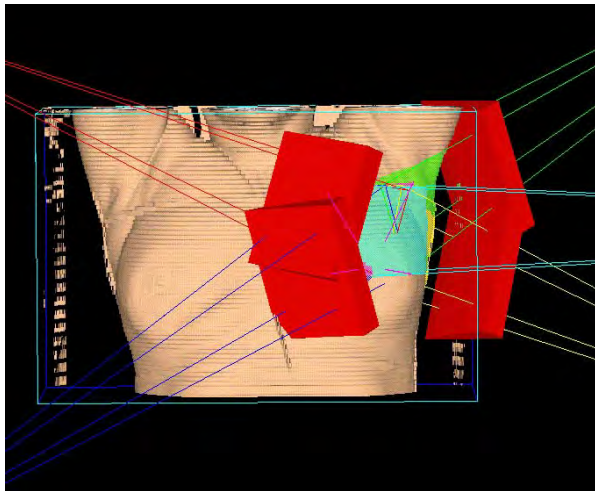
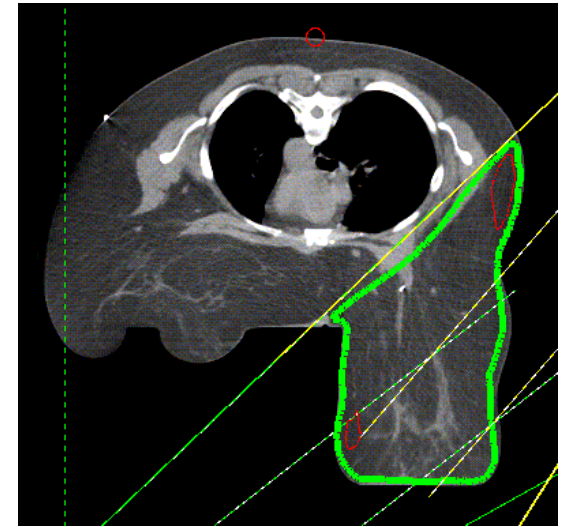
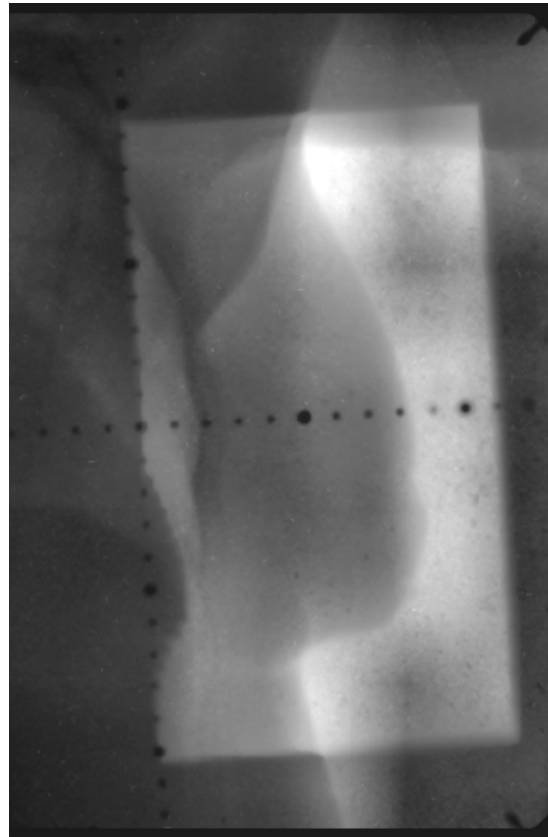
	< 10 years	10-14 years	≥ 15 years
1973 - 1982	1.2 (1.04-1.38)	1.52 (1.11-1.82)	1.58 (1.29-1.95)
1983 - 1992	1.0 (0.91-1.18)	1.27 (0.99-1.63)	NA
1993 - 2001	1.0 (0.82-1.12)	NA	NA

1 Gy increase in mean heart dose was associated with a 7% relative increase in cardiac events

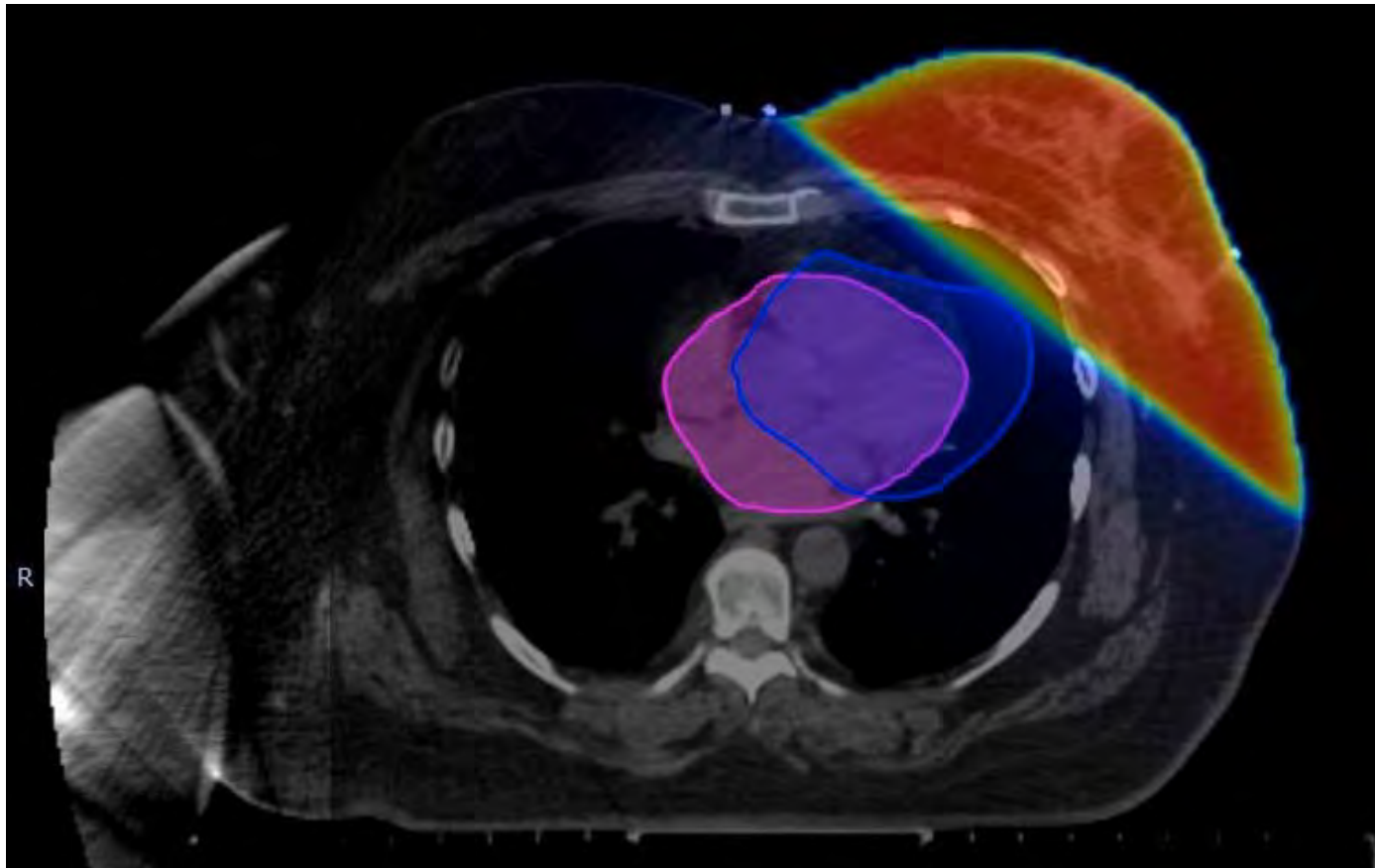
2013

Darby et. al. NEJM 368: 987-998,

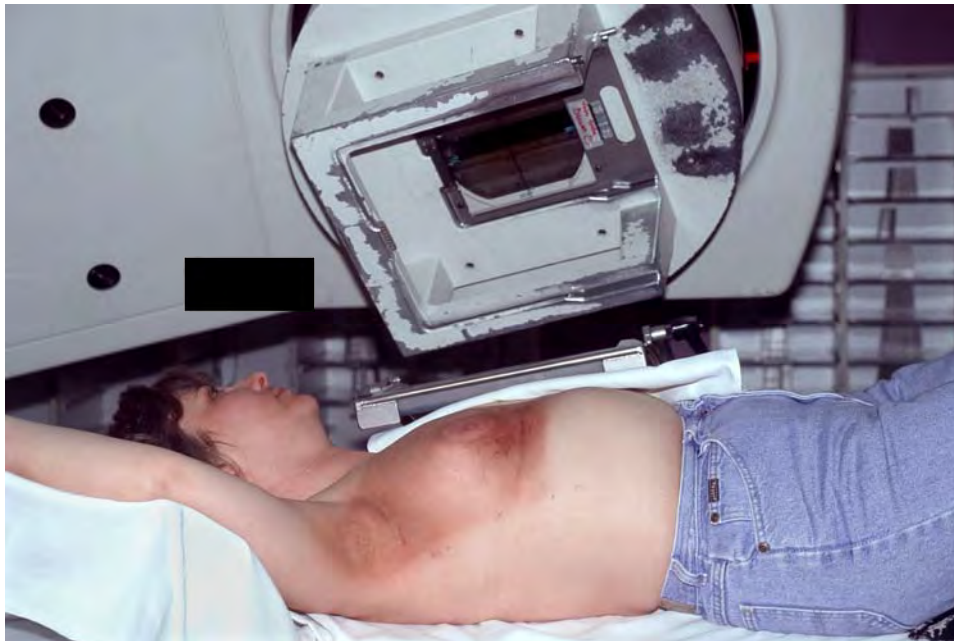
Techniques for Cardiac Avoidance



Deep-Inspiration Breath Hold



Changing Technology and Patient Experience

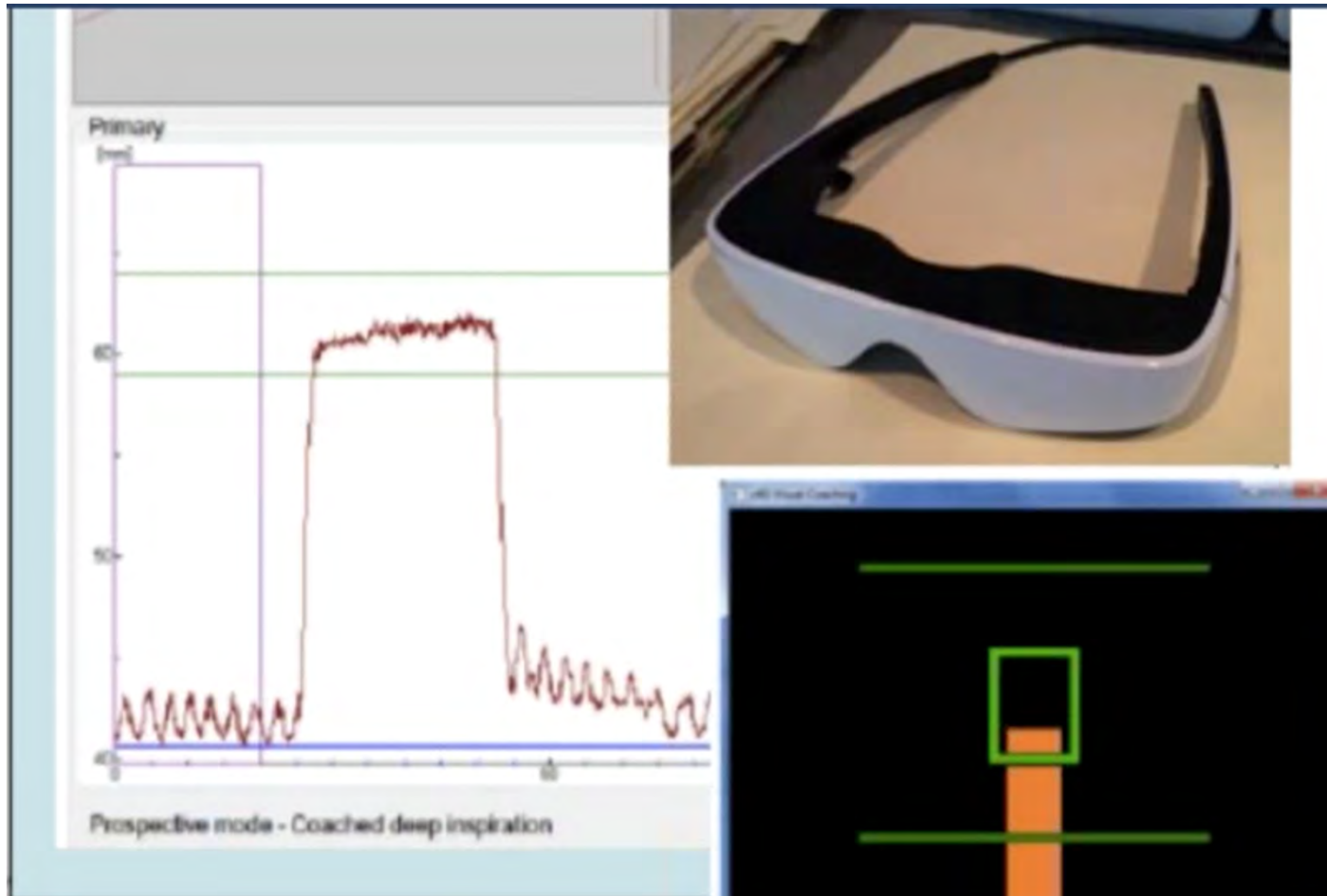


1995

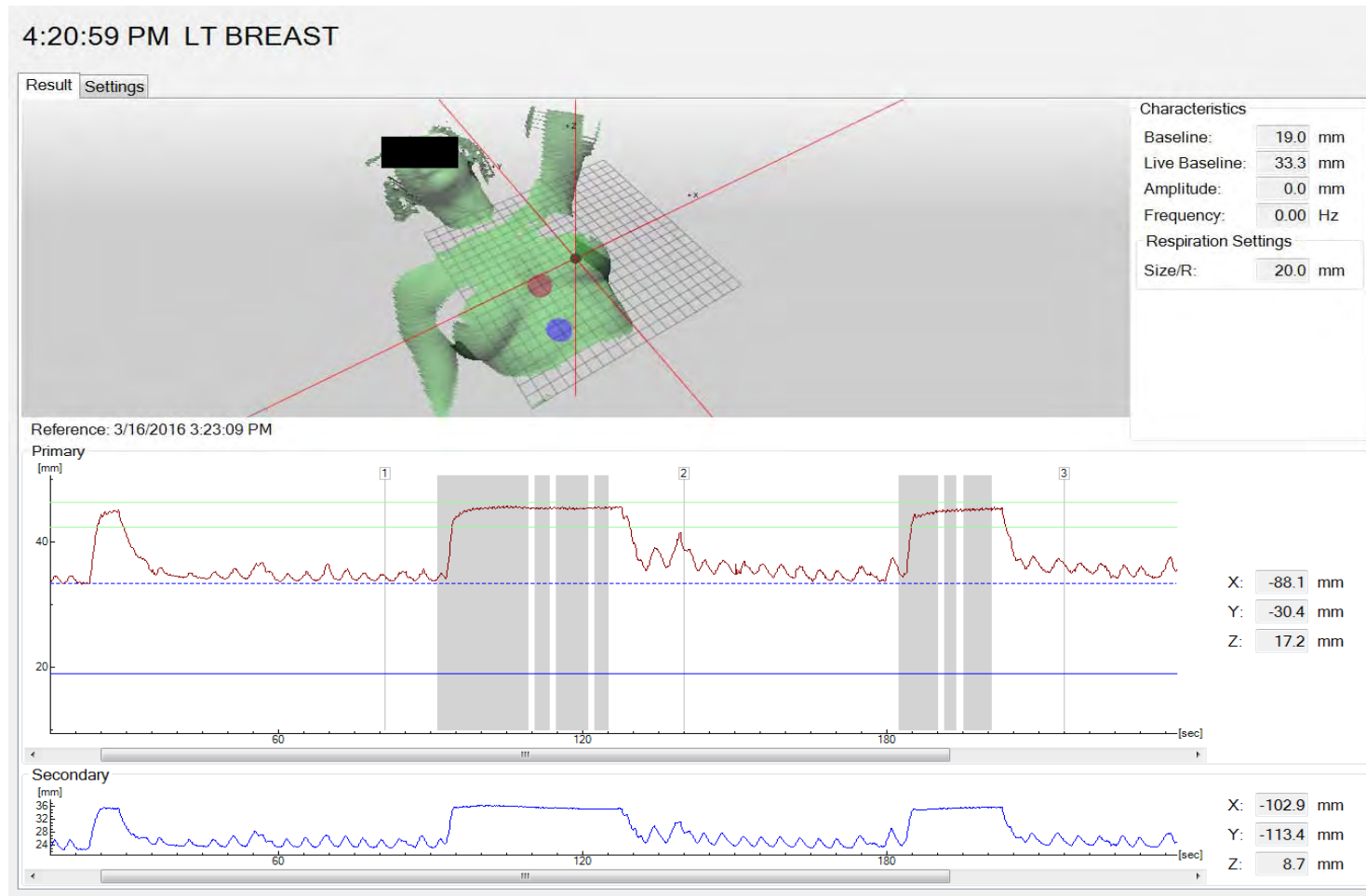


2019

Deep Inspiration Breath Hold



Surface Monitoring of Breath Hold



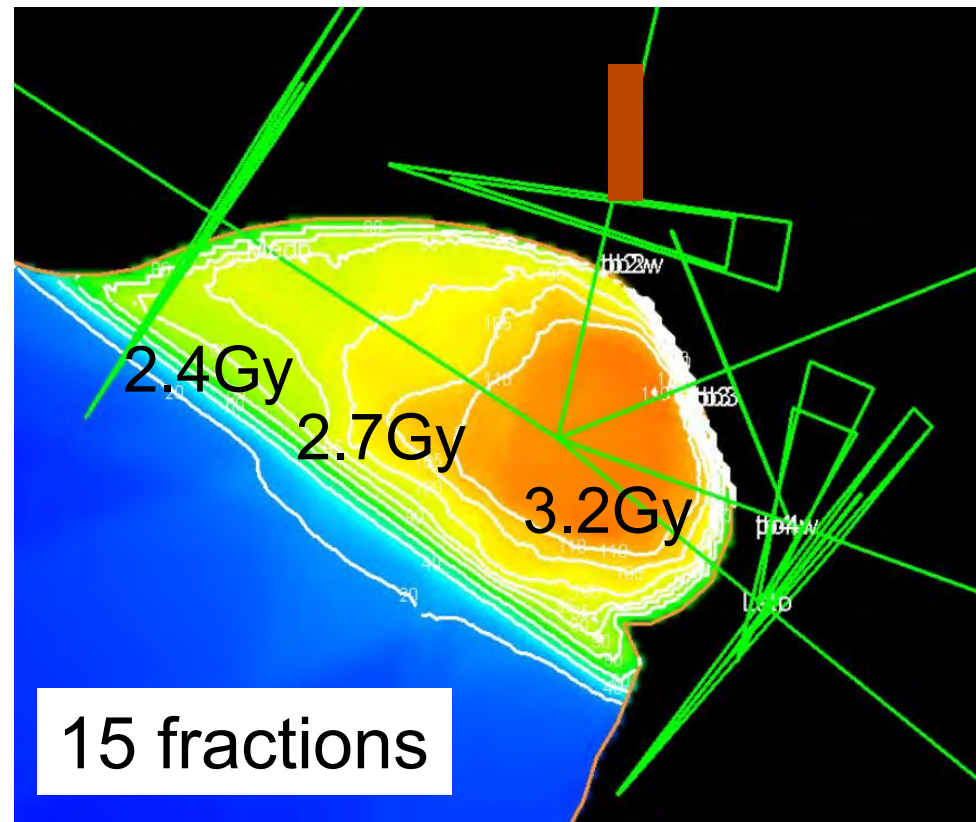
DIBH Reduction in Cardiac Dose

	<u>Free Breathing</u>	<u>DIBH</u>	<u>Ours</u>
<u>Heart</u>			
median	3.62 Gy	1.86 Gy	1.34 Gy
2 cm ³	45.7 Gy	21.5 Gy	
> 42 Gy	17 pts	4 pts	
<u>Ipsilateral Lung</u>			
median	8.7 Gy	6.3 Gy	
V ₂₀	17%	12%	

Daily median treatment time was 9 minutes

Hepp et al, Strahlenther Onkol 191:710-716 2015

Risk adaptation of breast RT: high risk - simultaneous integrated breast boost (SIB)



RAPID Trial

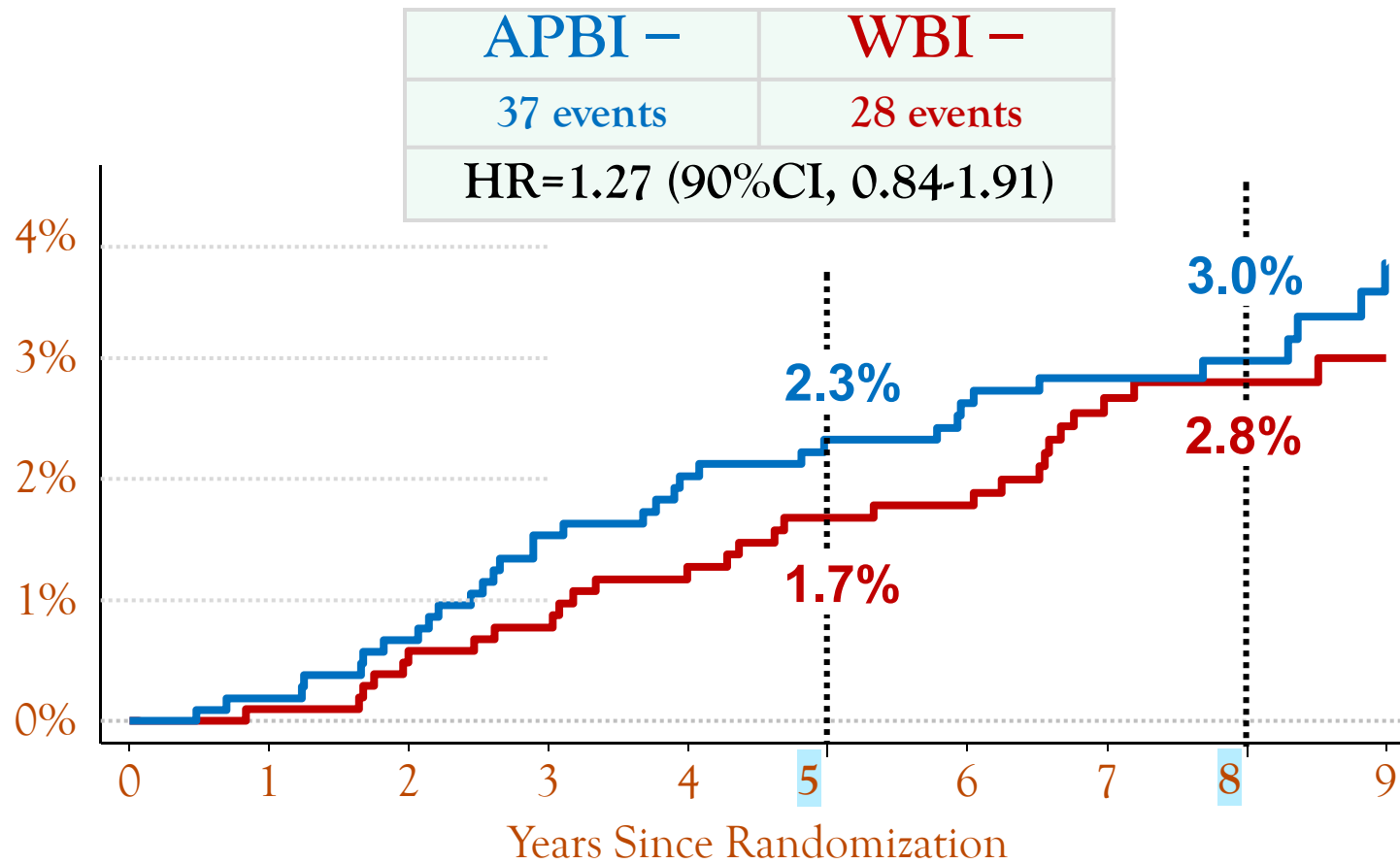
Randomized Trial of Accelerated Partial Breast Irradiation using 3-Dimensional Conformal Radiotherapy (3D-CRT)

T Whelan, J Julian, M Levine, T Berrang, DH Kim, CS Gu,
I Germain, A Nichol, M Akra, S Lavertu, F Germain, A Fyles,
T Trotter, F Perera, S Balkwill, S Chafe, T McGowan,
T Muanza, W Beckham, B Chua, I Olivotto,
for the RAPID Trial Investigators

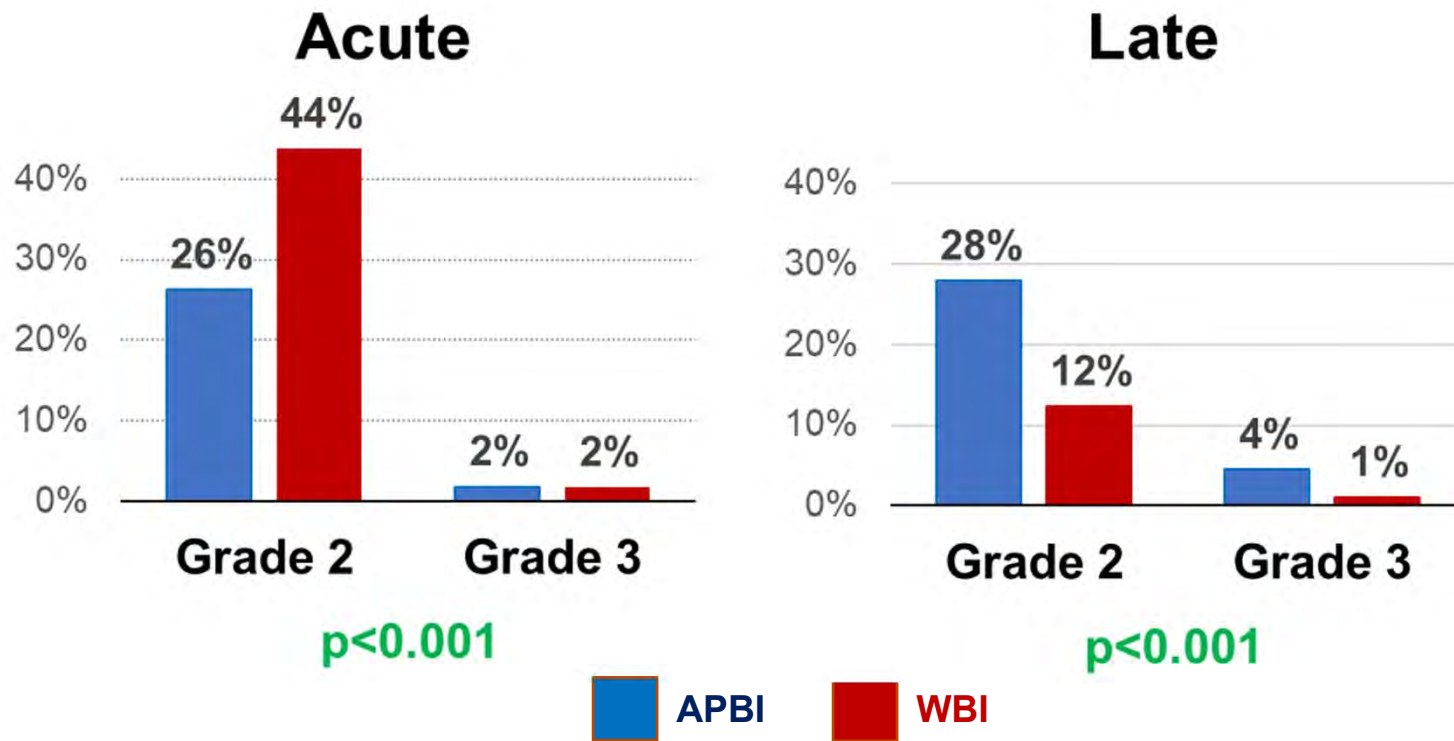
Ontario Clinical Oncology Group



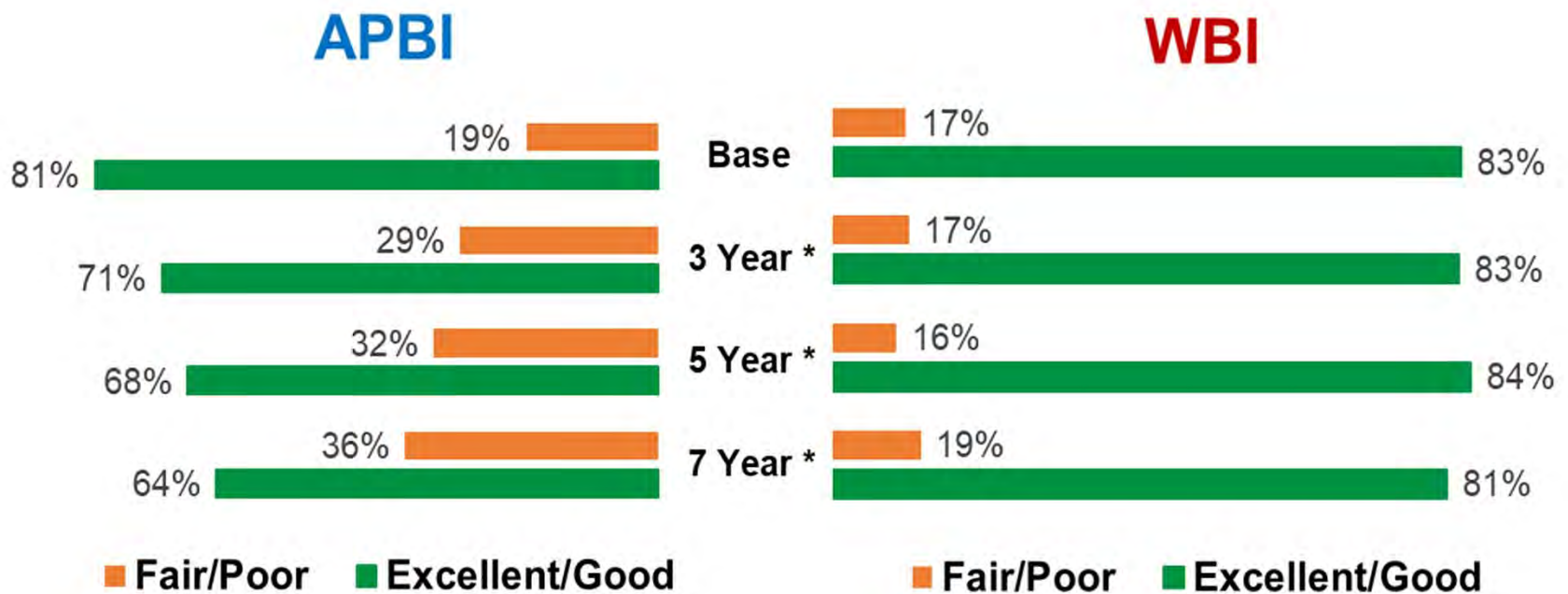
In Breast Tumor Recurrence



Radiation Toxicity \geq Grade 2

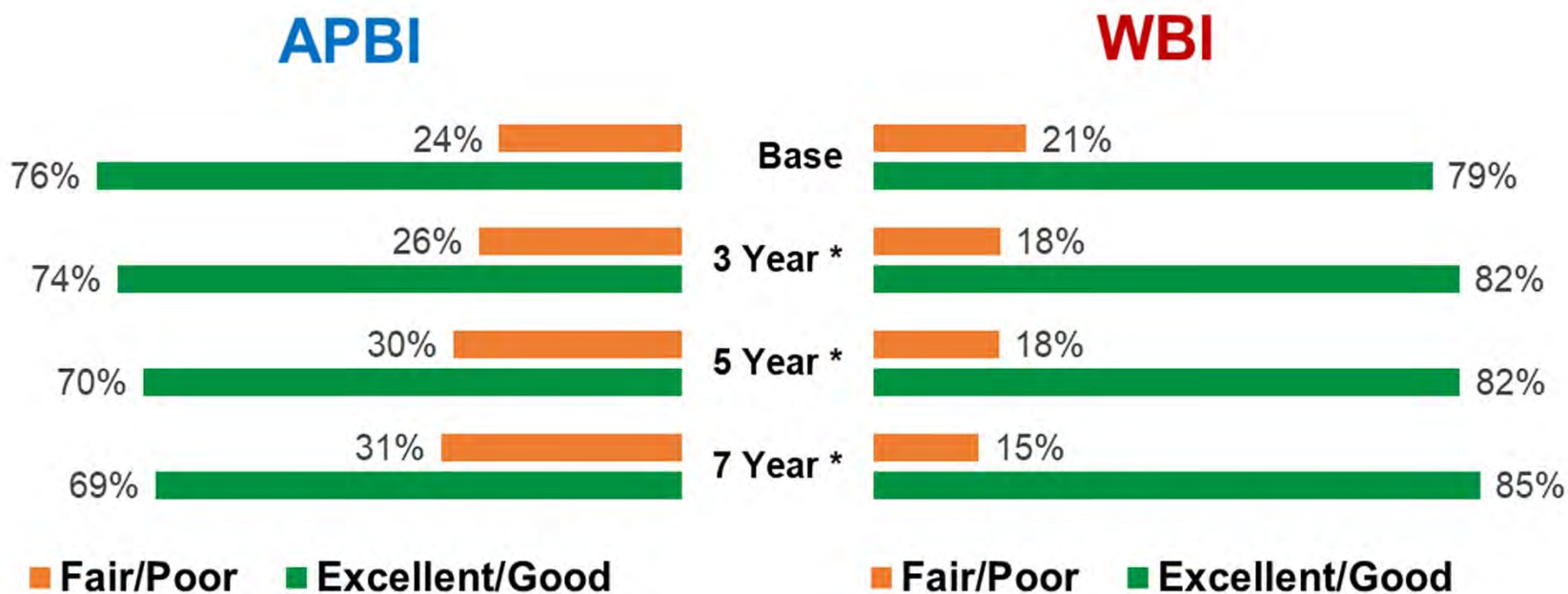


Cosmetic Rating (Nurse) by Treatment and Time



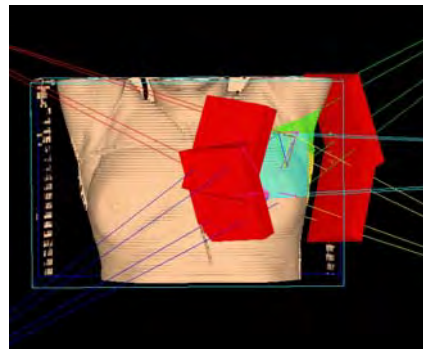
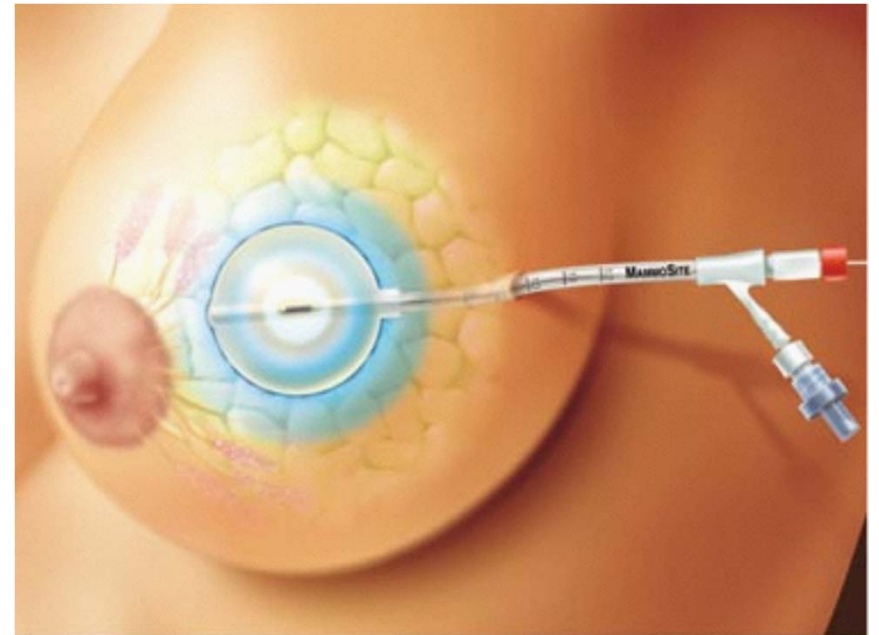
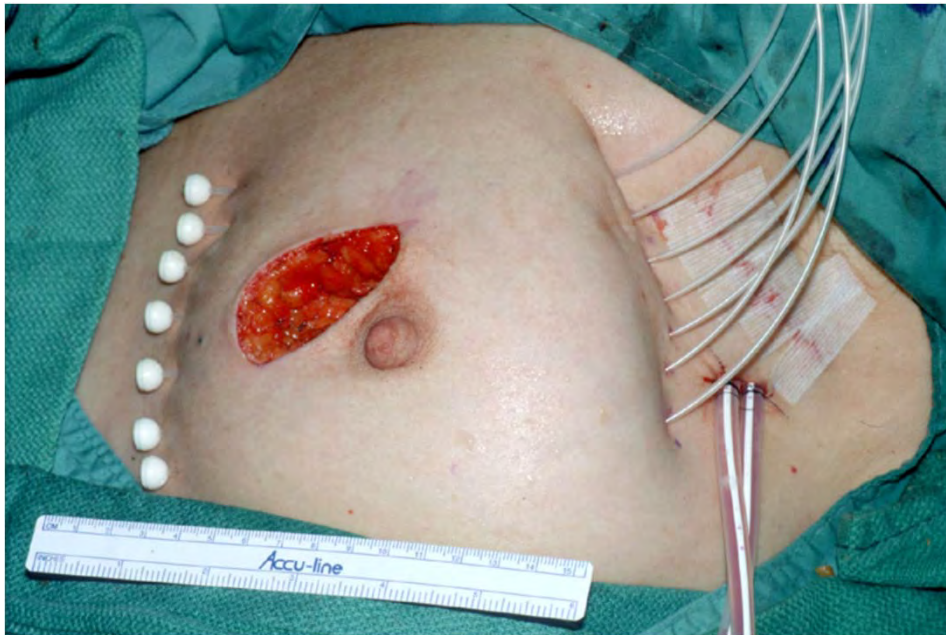
* p < 0.001

Cosmetic Rating (Patient) by Treatment and Time



* p < 0.001

Brachytherapy for Breast Cancer



Primary Results of NSABP B-39
A Randomized Phase III Study of
Conventional WBRT vs. PBI
for Women with Stage 0, I, or II Breast Cancer

F Vicini (NSABP PI), R Cecchini, J White (RTOG PI), T Julian, D Arthur,
R Rabinovitch, R Kuske, D Parda, P Ganz, M Scheier, K Winter, S Paik, H Kuerer,
L Vallow, L Pierce, E Mamounas, J Costantino, H Bear, I Germain,
G Gustafson, L Grossheim, L Petersen, R Hudes, W Curran, N Wolmark

NSABP B-39/RTOG 0413 Schema

STRATIFICATION

- Disease Stage (DCIS; Invasive N0; Invasive N1)
- Menopausal Status (pre- and post-)
- Hormone Receptor Status (ER and/or PR+; ER and PR-)
- Intention to Receive Chemotherapy

RANDOMIZED

Whole Breast Irradiation after Adjuvant Chemotherapy

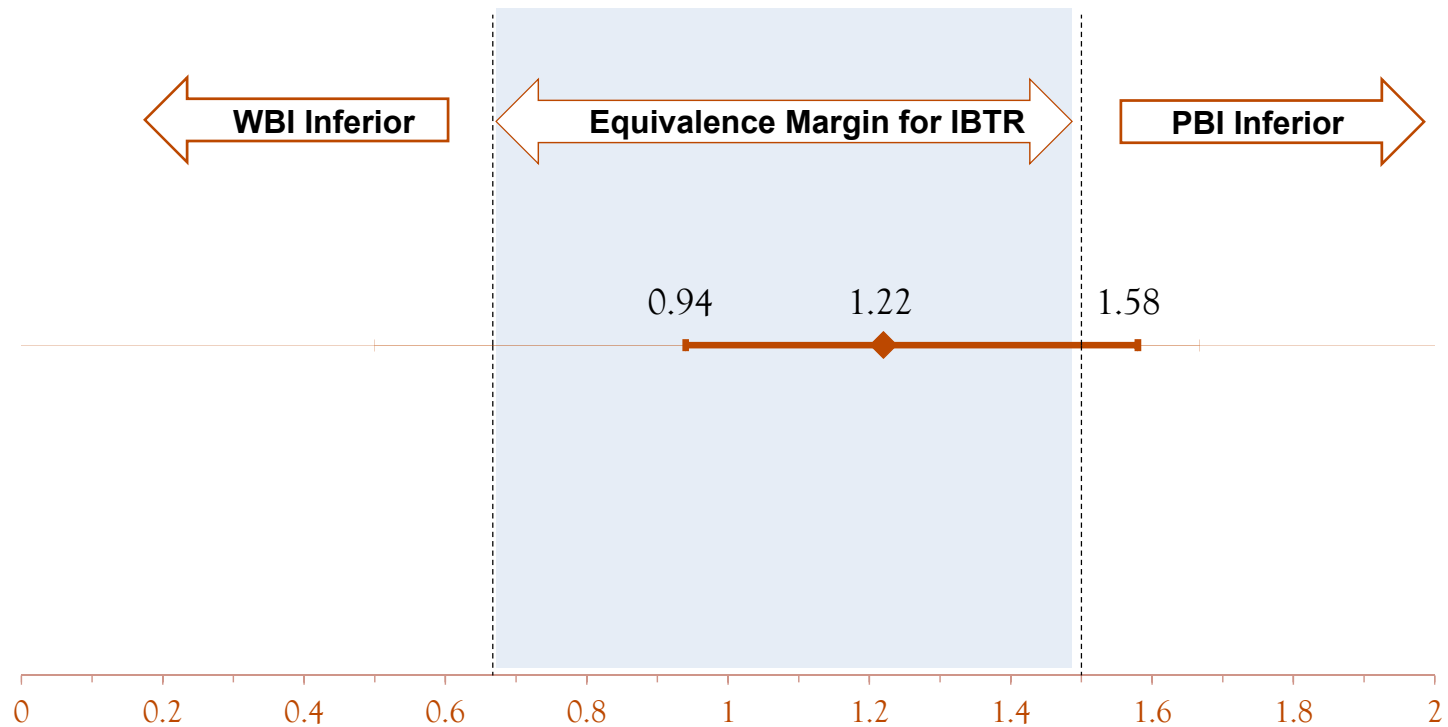
50 Gy (2.0 Gy/fraction) or
50.4 Gy (1.8 Gy/fraction) to whole breast,
followed by optional boost to ≥ 60 Gy

Partial Breast Irradiation prior to Adjuvant Chemotherapy

**For a total of 10 treatments given on
5 days over 5 to 10 days:**

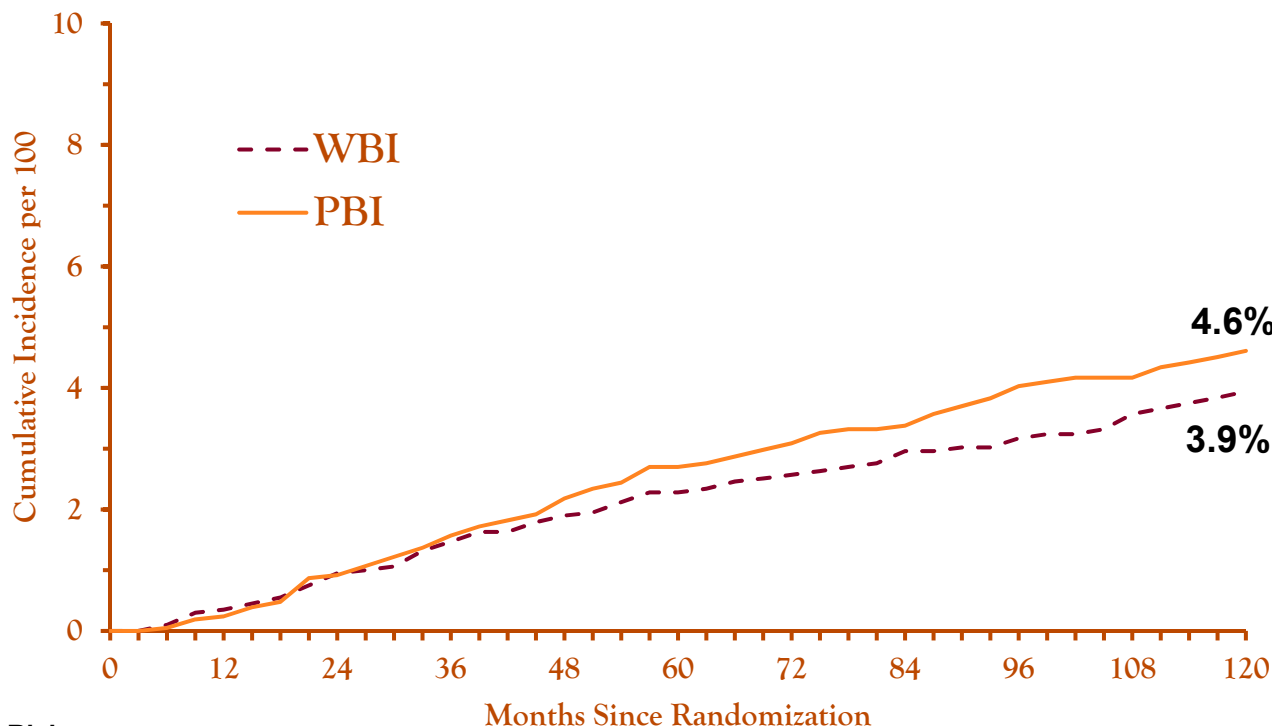
34 Gy in 3.4 Gy fractions Interstitial Brachytherapy
or Mammosite Balloon Catheter
or 38.5 Gy in 3.85 Gy fractions
3D Conformal External Beam

Ipsilateral Breast Tumor Recurrence (IBTR)



Hazard Ratio and 90%CI for IBTR

Cumulative Incidence of In-Breast Tumor Recurrence



No. at Risk

WBI	2109	1920	1759	1557	1236	869
PBI	2107	1993	1834	1608	1269	876

In-Breast Tumor Recurrence by PBI Method

Treatment Group	# of Pts	# of Events	Hazard Ratio (HR)	HR 95% Confidential Interval	10-yr Cum Incidence
WBI	2,011	67	REF		3.8%
PBI					
Multi-catheter brachytherapy	130	9	2.21	1.10 – 4.46	7.7%
Single-entry brachytherapy device	358	24	2.15	1.34 – 3.44	7.8%
3DCRT (external beam)	1,535	55	1.04	0.73 – 1.49	3.7%

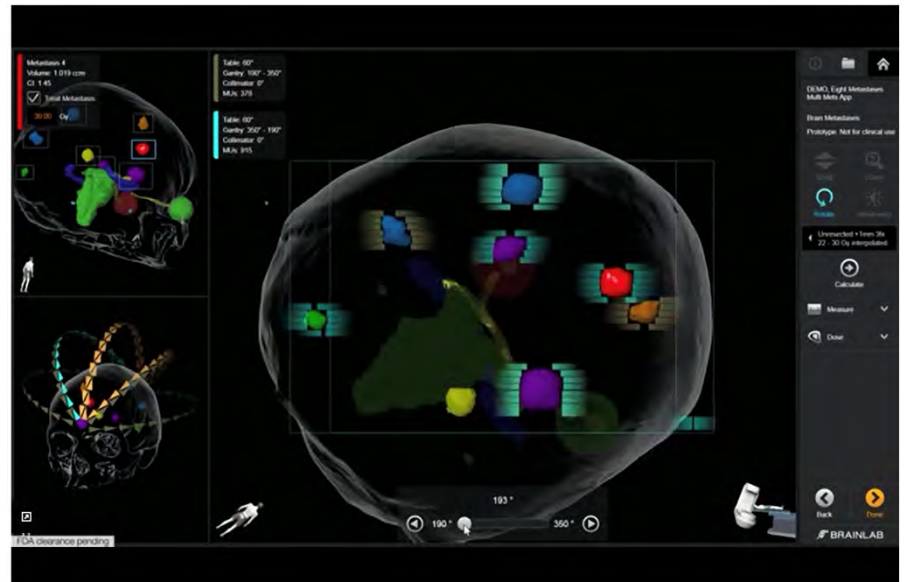
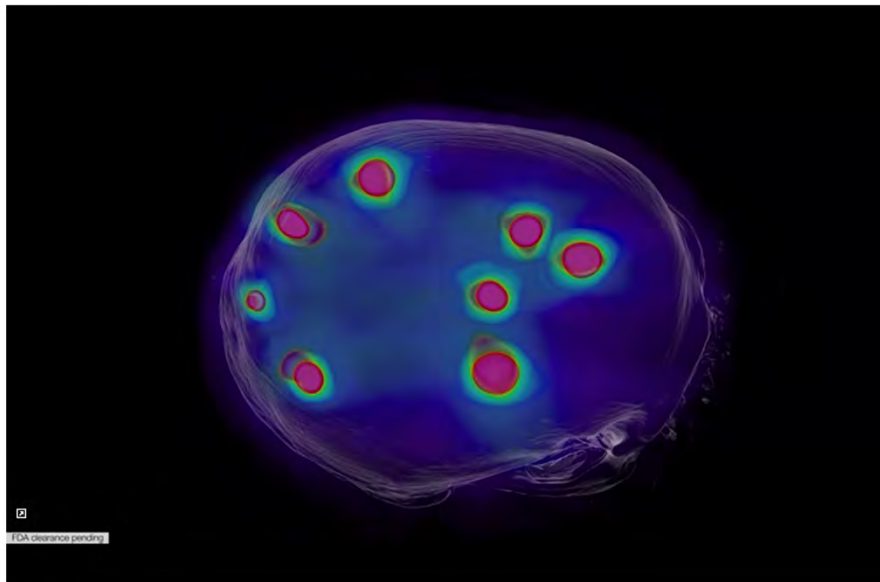
Shrinking Indications for Whole Brain Radiotherapy

- Patient with Limited Life Expectancy, < 3 months*
- Patient with Very Poor Performance Status, KPS < 70*
- Patient with a Very Large Number of Lesions
- Patient with High “Metastatic Velocity”

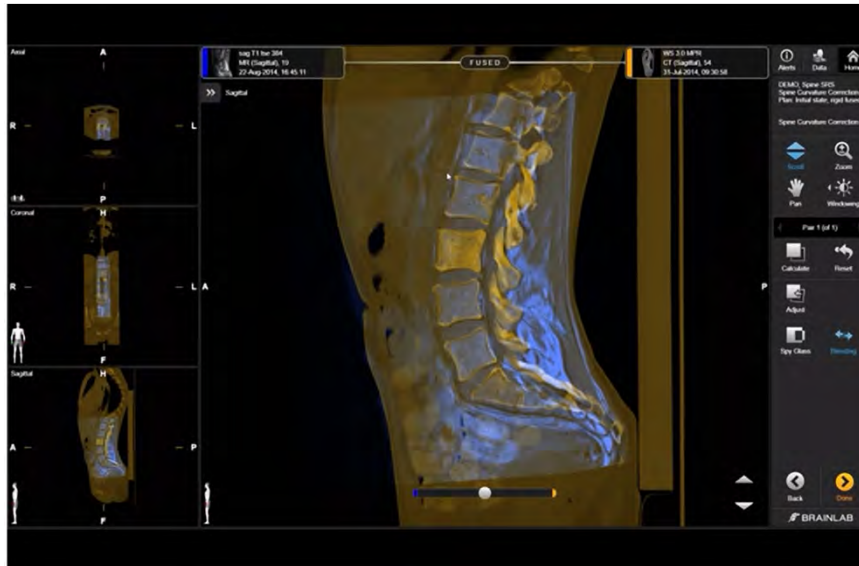
*Exception may be pt with new diagnosis who has never received effective systemic therapy



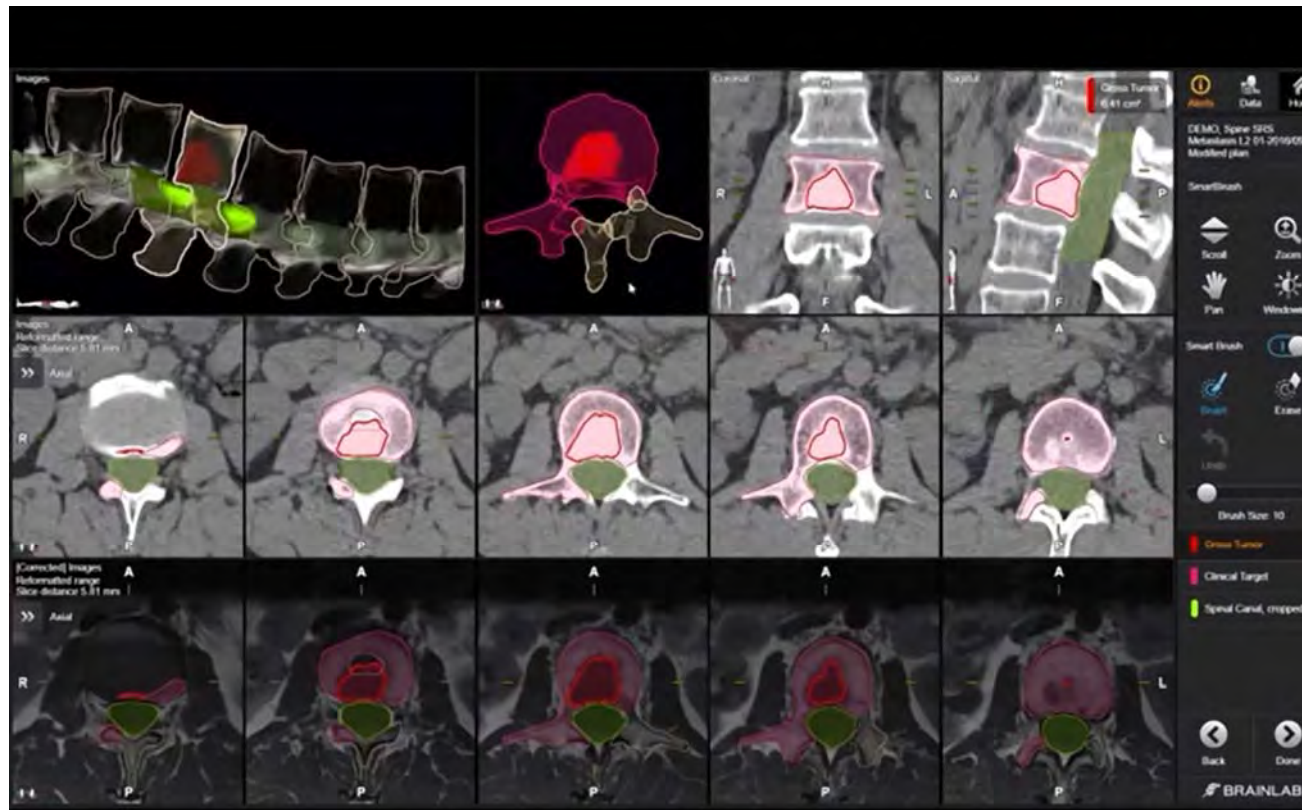
Multiple Metastases: BrainLab Elements



Spine SBRT: Novalis Elements



Spine SBRT: Novalis Elements



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