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DEPARTMENT OF RADIATION ONCOLOGY

SBRT for Breast Cancer – from Idea to Clinical Reality

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More than 1.5 Million New Cases Per Year

% CHANCE
OF
breast
CANCER



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Stage Distribution Over Time

	1974 - 1985	1995- 2001
Localized	48%	63%
Regional	41%	29%
Metastatic	7%	6%



83% are Early Stage
(NCI Cancer Trend Progress
Report - 2008)

Cancer Statistics, 1990, 2005, CA Cancer J Clin.

NIH Consensus Statement. Treatment of early-stage
breast cancer; 1990 18–21

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Oxford Overview of Trials of BCS +/- RT

NSABP B-06 NSABP B-21
 Milan 3 West Midlands
 Uppsala-Orebro CRC UK
 St. George's Swedish
 Ontario Scottish

EBCTCG, Lancet 366, 2087:2005
 Punglia RS et al, NEJM 356, 2399, 2007
 EBCTCG, Lancet. 378: 1707-16, 2011 (17 trials, n=10,800)



Summary of Trials of BCS +/- RT

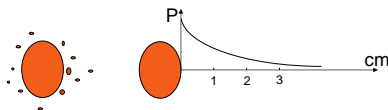
(At 15 years)	BCS Alone	BCS + RT
Local Recurrence	32.0%	10.3%
BC Mortality	35.9%	30.5%
Any Death	40.5%	35.2%



Why RT improves LC & OS?

Multi-focal, multi-centric nature

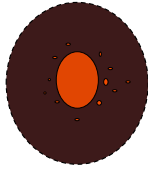
Gallagher and Martin, Cancer 24:1170-78, 1969 (N=113)
 Holland R, et al: Histologic multifocality of Tis, T1-2 breast carcinomas. Cancer 56:979-90, 1985 (<4cm IBC, N=264, 63% ext. foci)



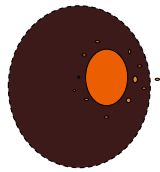
Most LR happens near the excision site.



A Reasonable Model



68% do not need RT



32% need RT

Role of RT: sterilize residual tumorlets or microextension left in the breast by surgeons



No Need to Treat the Entire Breast

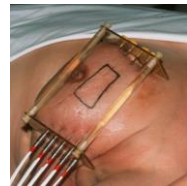
Pioneered by Clinicians at
W. Beaumont Hospital

LDR

I-125 implants

HDR

Breast HDR template



Mounting Clinical Evidence

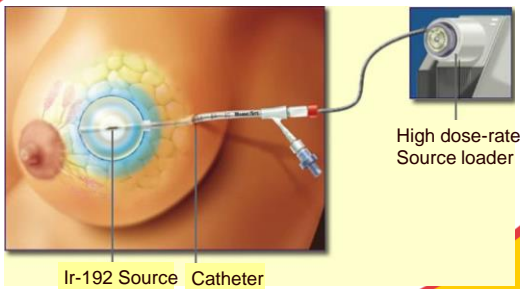
Vicini, et al. Low-dose-rate brachytherapy as the sole radiation modality. *Int J Radiat Oncol Biol Phys.* 1997;38:301–310.

Chen PY, et al. Long-term cosmetic results and toxicity after accelerated partial-breast irradiation ... by interstitial brachytherapy *Cancer* 2006 106(5):991-9

Wazer, et al. ...HDR brachytherapy alone for T1/T2 breast cancer. *Int J Radiat Oncol Biol Phys.* 2002;53:889–897



MammoSite



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MammoSite Result Paper

Chao KK, et al. Analysis of treatment efficacy, cosmesis, and toxicity using the MammoSite breast brachytherapy Int J Radiat Oncol Biol Phys. 2007; 69(1):32-40.

Dragun AE, et al. Patient satisfaction and quality of life after MammoSite breast brachytherapy. Am J Surg. 2008; 196(4):545-8.

Harper JL, et al. Six-year experience: long-term disease control outcomes for partial breast irradiation using MammoSite balloon brachytherapy. Am J Surg. 2010; 199(2):204-9.

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NSABP B-39 (RTOG 0413) APBI trial

NSABP B-39/RTOG 0413: "a randomized Phase III study of conventional whole breast irradiation (WBI) versus partial breast irradiation (PBI) for women with Stage 0, I or II breast cancer," activated March 21, 2005.

Brachy: ~5% LR in 5 yrs, >80% with good cosmesis

- Invasive, operator dependent

MammoSite: ~1% LR in 3 yrs, (93% ER+, 6% node+)

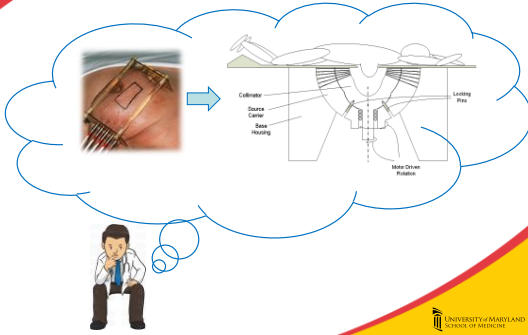
- Infection (9.3%), persistent seroma (32.6% at 5yr)

3DCRT or IMRT (~73%): 3.85Gy x 10 BID, ~2.3% LR @ 3yrs

- 25% grade 2+ subcu fibrosis (Hepel et al), 29% adverse cosmesis compared to WBI (RAPID trial).

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*Is there a convenient, consistent,
noninvasive, less toxic way?*



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Time to validate idea

Questions:

- 1) Can it compete with Brachy?
- 2) Can it do better than IMRT?

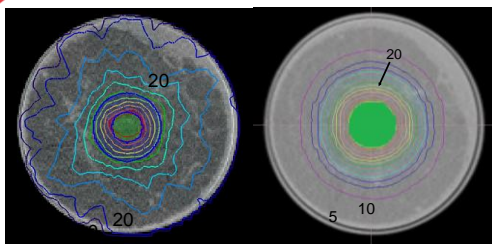
Method:

- Monte-Carlo simulation of a focal spot with 36 2.5cm diameter Co-60 beams, 36cm SAD
- Dynamic Dose Painting ignoring shot deformations



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7-field IMRT vs GammaPod™

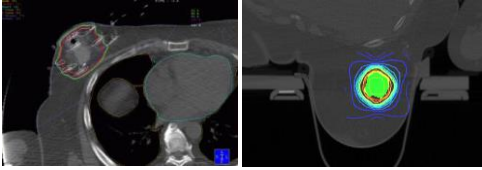


7-field IMRT

GammaPod

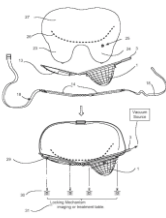
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Brachy-like dose distribution

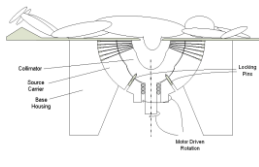


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The SBIR Grant Proposal



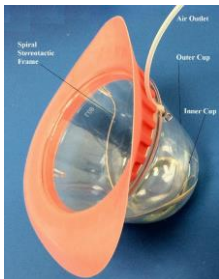
Prone Breast Stereotaxy



Breast SBRT Treatment Machine

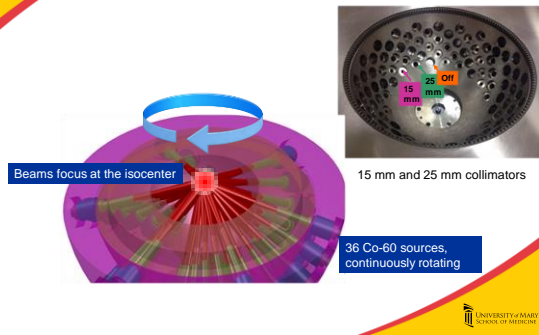
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Vacuum Cups and Imaging Couch



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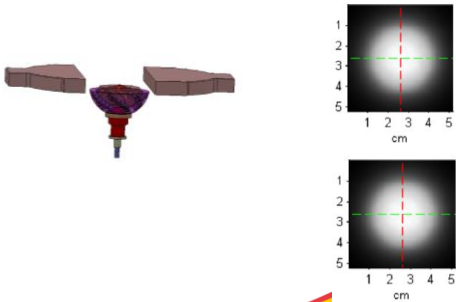
Beam Configuration



Prototype in 2010

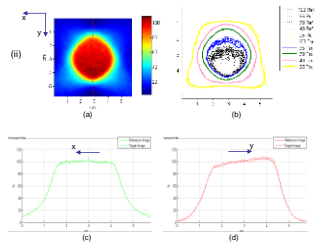


Close up of source geometry



Dose Distribution Measurement

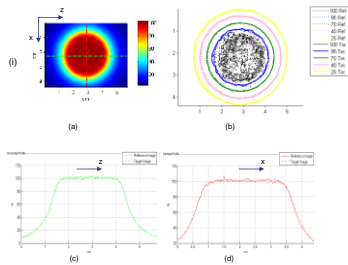
Dose Distribution for 25 mm Static Shot- xy plane (axial)



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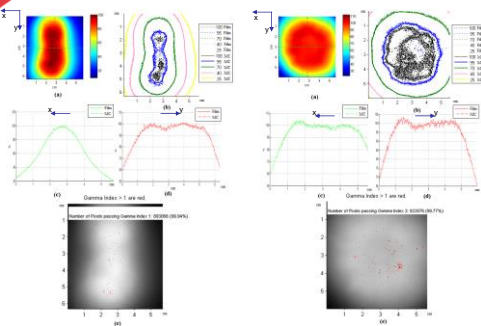
Dose Distribution Measurement

Dose Distribution for 25 mm Static Shot- xz plane (coronal)



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Patient Plan Verification



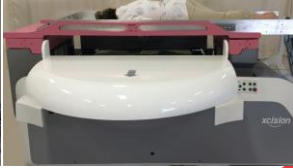
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New Design

Prone, external beam, partial breast irradiation



Patient standing on the treatment loader, with shielding doors closed.



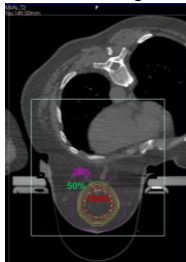
Patient lying prone, above the treatment position, with shielding doors open.

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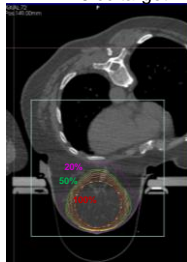
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Example Dose Distributions

45 cc target



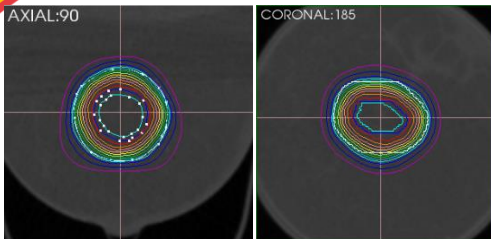
215 cc target



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SRS + APBI

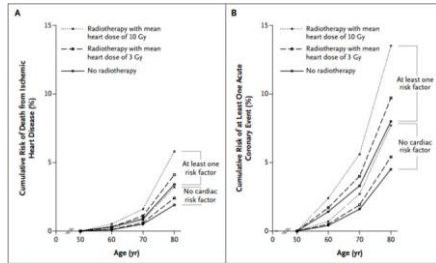


3.5cm Tumor+3mm gets 18Gy
6.1 cm Tumor bed gets 10Gy

No need for surgery
No need for 5-7 weeks of radiation
1-3 irradiation is enough

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Cardiac Toxicity of Radiotherapy

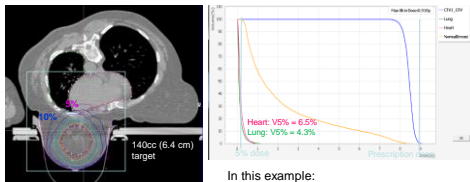


From Darby et al: Risk of Ischemic Heart Disease in Women after Radiotherapy for Breast Cancer, NEJM 368(11), 2013

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Heart and lung dose estimates (left breast target)



In this example:

Heart V5% = 6.5%
 Lung V5% = 4.3%

RTG0413/NSABP B39

constraints:

Heart V5% < 40%
 Lung V30% < 15%

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Ypod Consortium

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MARLENE AND STEWART GREENBAUM
CANCER CENTER

KU
MEDICAL
CENTER

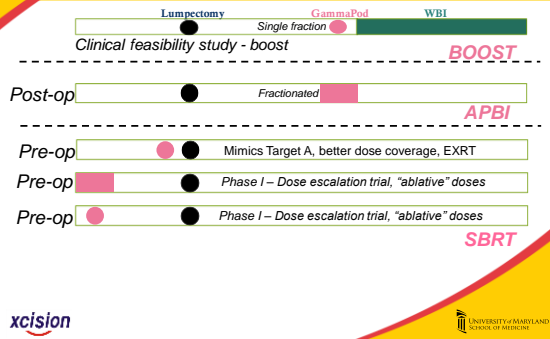
UT SOUTHWESTERN
Medical Center

Allegheny
Health Network

The Ottawa
Hospital
Foundation
La Fondation
de l'Hôpital
d'Ottawa

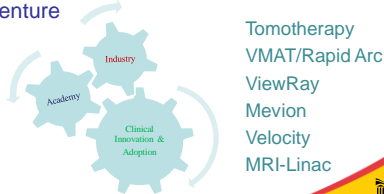
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Currently Proposed Consortium Trials



Summary

- An idea of a dedicated breast SBRT system conceived during clinical service
- Enabled by grant funding
- Clinical realization through a commercial venture



Acknowledgement

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 Clinical Consortium Members
 Xcision Employees

