High Energy Brachytherapy Dosimetry as it applies to Accelerated Partial Breast Irradiation

Educational Session: AAPM 2013

CHRISTIANA CARE HEALTH SYSTEM

Firas Mourtada, Ph.D.
Christiana Care Hospital, Newark, DE

Susan Richardson, Ph.D.
Swedish Medical Center, Seattle, WA

SWEDISH

Outline

- Firas will talk about:
  - TG186 & TG229 – High energy photon emitting brachytherapy dosimetry (HEB)
- Susan will talk about:
  - Current status of HEB as applied to Accelerated Partial Breast Irradiation

Learning Objectives

- To understand when TG43 calculations may not accurately describe the clinical situation
- To understand the nature of these dose discrepancies and be able to provide magnitudes for clinical approximations
- To understand the physics behind high energy brachytherapy as applied to APBI

Report #229

Dose Calculation for Photon-Emitting Brachytherapy Sources with Average Energy Higher than 50 keV: Full Report of the AAPM and ESTRO

Report of the

High Energy Brachytherapy Source Dosimetry (HEBD) Working Group

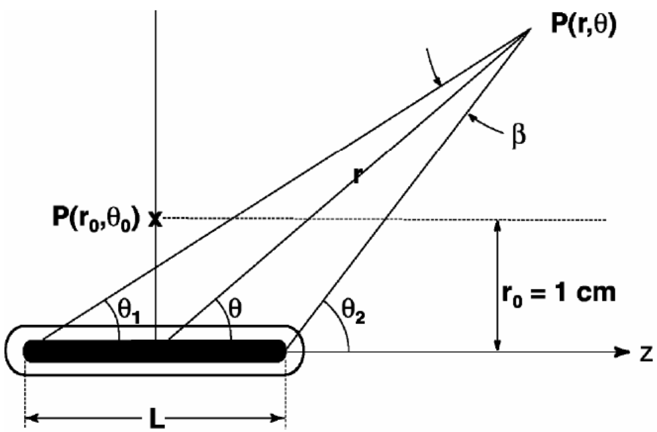
August 2012

Purpose of the Reports

- 229:
  - Recommendations for >50keV photon emitting brachytherapy sources.
  - Considerations of the TG43U1 with attention to phantom size effects, dose calculation grid size, active lengths of sources.
  - Provides newest consensus datasets for commercially available sources.
  - Discussion on how to obtain Monte Carlo and experimental data.
- 189:
  - Provide guidance for early adopters of MBDCAs

Current status of Brachytherapy

- TG43 and updates are standard methodology for dose calculation.
- TG43 was created primarily for interstitial low energy brachytherapy purposes.
- Dose calculation is done assuming material is uniform water phantom.



Rivard *et al.*, *Med. Phys.* 31, 633-674 (2004)

$$\dot{D}(r,\theta) = S_K \cdot \Lambda \cdot \frac{G_L(r,\theta)}{G_L(r_0,\theta_0)} \cdot g_L(r) \cdot F(r,\theta)$$

$\dot{D}(r,\theta)$	dose rate to water in water at point P(r,θ)
S_K	air kerma strength
Λ	dose rate constant
$g_L(r)$	radial dose function
$G_L(r,\theta)$	geometry function (line source approximation)
$F(r,\theta)$	2D anisotropy function

Phantom Size

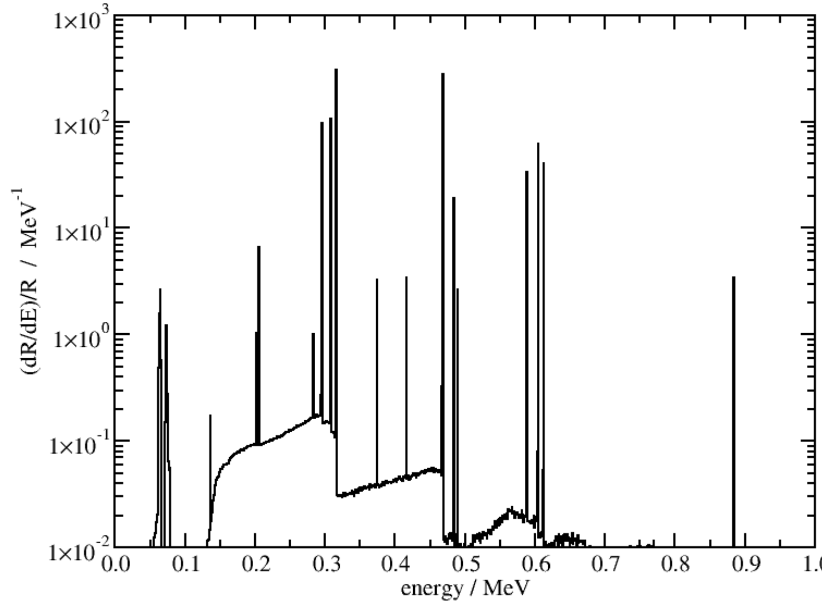
- TG43 has recommendations for “along and away” dose rate tables to distances far away from the source (e.g. 5cm for I-125)
  – While doses in this region are low (<1%) it is important in the context of combined EBRT doses.
- Requires phantom sizes in MC calculations to be large enough to give full scatter at large distances (10+ cm for HEB)
  – Radius of 40 cm recommended.

Consensus Data Sets

- Report gives recommendations on how to experimentally and theoretically obtain dosimetric parameters for sources.
  - Experimentally: detector type, volume averaging effects, phantom materials, energy response characterization, etc.
  - Theroetically (MC): Cut off thresholds, good practice guidelines (e.g. # of histories)
- Uncertainty analysis

Device Registry

- 3 current source registries available
  - RPC
  - Carlton University (CAN)
  - ESTRO



History

- 1995 – TG43 (Ir, I, Pd)
  - Provided recommendations for dose calculation for low energy source dosimetry (E<50keV).
- 2004 – TG43U1
  - Clarifications, 1D vs 2D formalism, etc.
- 2007 – TG43U1S1
  - Increased number sources, etc.
- 2010 “Erratum” of TG43U1S1

High Energy Sources

- Previously there was no report which contained all high energy sources (Ir, Co, Cs).
  - Need for Yb, Tm

Monte Carlo-aided dosimetry of a new high dose-rate brachytherapy source

Georgi M. Daskalov
Radiation Oncology Center, Mallinckrodt Institute of Radiology, Washington University School of Medicine, St. Louis, Missouri 63110

Edgar Löffler
Nucletron B.V., Waardgelder 1 3905 TH Veenendaal, P.O. Box 930 3900 AX Veenendaal, The Netherlands

Jeffrey F. Williamson[a)]
Radiation Oncology Center, Mallinckrodt Institute of Radiology, Washington University School of Medicine, St. Louis, Missouri 63110

(Received 28 August 1997; accepted for publication 19 August 1998)

Phys. Med. Biol. 40 (1995) 2015–2036. Printed in the UK

TLD, diode and Monte Carlo dosimetry of an ^{192}Ir source for high dose-rate brachytherapy

A S Kirov, J F Williamson, A S Meigooni† and Y Zhu
Radiation Oncology Center, Mallinckrodt Institute of Radiology, Washington University School of Medicine, St Louis, MO 63110, USA

Experimental validation of Monte Carlo dose calculations about a high-intensity Ir-192 source for pulsed dose-rate brachytherapy

R. K. Valicenti, A. S. Kirov, A. S. Meigooni, V. Mishra, R. K. Das, and J. F. Williamson
Radiation Oncology Center, Mallinckrodt Institute of Radiology, Washington University School of Medicine, St. Louis, Missouri 63110

(Received 16 September 1994; accepted for publication 15 March 1995)

Report Contains

1. Review the construction and available published dosimetry data for high-energy 192Ir, 137Cs, and 60Co sources.
   - Sources not covered: Au, Xoft, IVB sources
2. Perform a critical review of the existing TG-43U1 formalism applied to HEB.
3. Develop a complete consensus dataset to support clinical planning for each source model.
4. Develop guidelines for investigators on the use of computational and experimental dosimetry or determination of high-energy brachytherapy source dosimetry parameters.

Advantages of TG43

- Modeling of seeds using point-source approximation
  - Average the anisotropy over all solid angles
  - Prostate seed brachy
- Geometric dependence on dose fall-off just depends on radial distance and the angle.
  - Allows users a robust dose calculation with a limited data set.
- An analytic, uniform approach standardizes dose calculation worldwide.

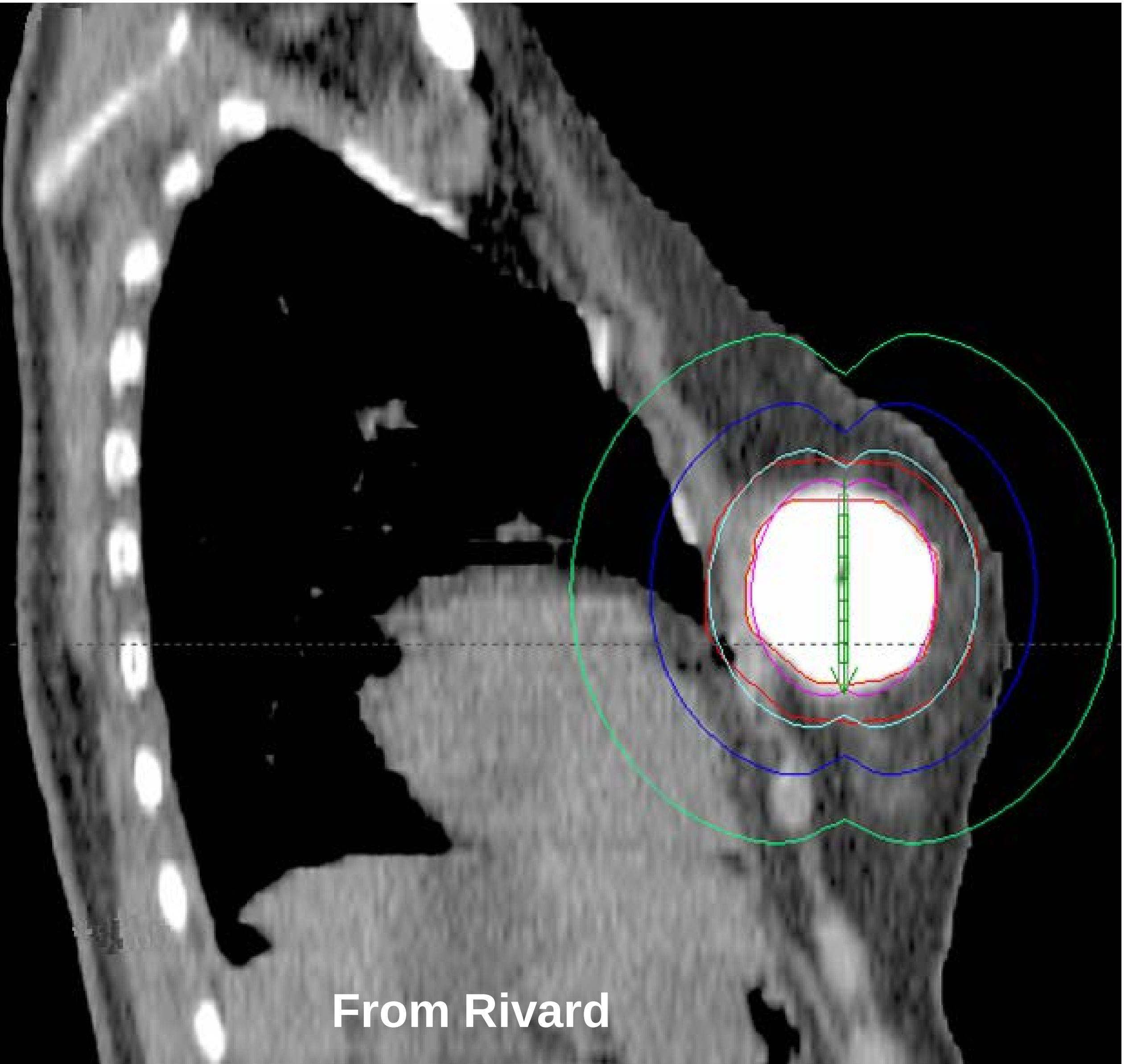
Limitations of TG43

- Assumes a water medium with superpositions of single source positions.
  - No inter-source attenuation effects
    - Effects both high and low energy sources
  - Full scatter conditions
    - Most low energy applications have full scatter e.g. prostate implants
  - No variable tissue composition
    - More of an issue for low energy sources than for high energy sources

TG43 has served us well!

- Is still!
- Worldwide uniformity
- Well-define process for source parameters
- Source specific
- Fast
- Dose optimization (IP)

TG43-based TPS can fail to accurately calculate dose



air ≠ water?

tissue ≠ water?

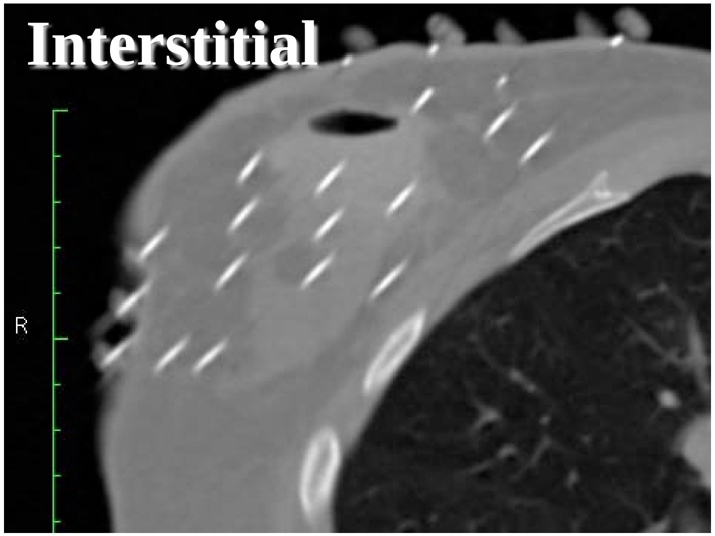
contrast?

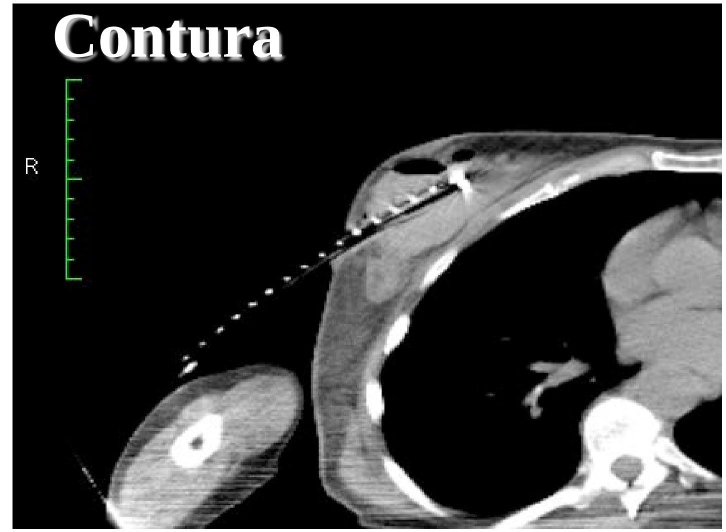
source superposition?

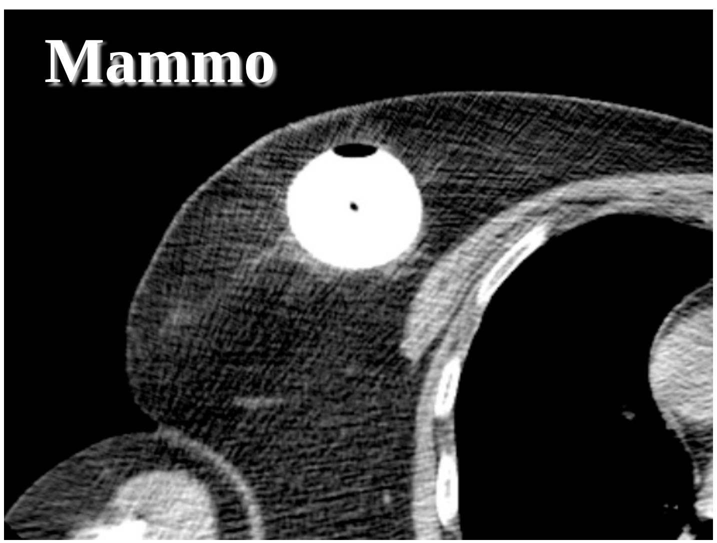
source shielding?

radiation scatter?

One size does not fit all!







Vision 20/20 Paper

Medical Physics

The evolution of brachytherapy treatment planning

Mark Rivard,[1] Jack L. M. Venselaar,[2] and Luc Beaulieu[3]
[1]*Department of Radiation Oncology, Tufts University School of Medicine, Boston, Massachusetts, USA*
[2]*Department of Medical Physics, Instituut Verbeeten, P.O. Box 90120, 5000 LA Tilburg, The Netherlands*
[3]*Département de Radio-Oncologie et Centre de Recherche en Cancérologie de l'Université Laval, Quebec*

Brachytherapy is a mature treatment modality that has benefited from technological advances. Treatment planning has advanced from simple lookup tables to complex, computer-based dose calculation algorithms. The current approach is based on the AAPM TG-43 formalism with recent advances in acquiring single-source dose distributions. However, this formalism has clinically relevant limitations for calculating patient dose. Dose-calculation algorithms are being developed based on Monte Carlo methods, collapsed cone, and the linear Boltzmann transport equation. In addition to improved dose-calculation tools, planning systems and brachytherapy treatment planning will account for material heterogeneities, scatter conditions, radiobiology, and image guidance. The AAPM, ESTRO, and other professional societies are coordinating clinical integration of these advancements. This Vision 20/20 article provides insight on these endeavors.

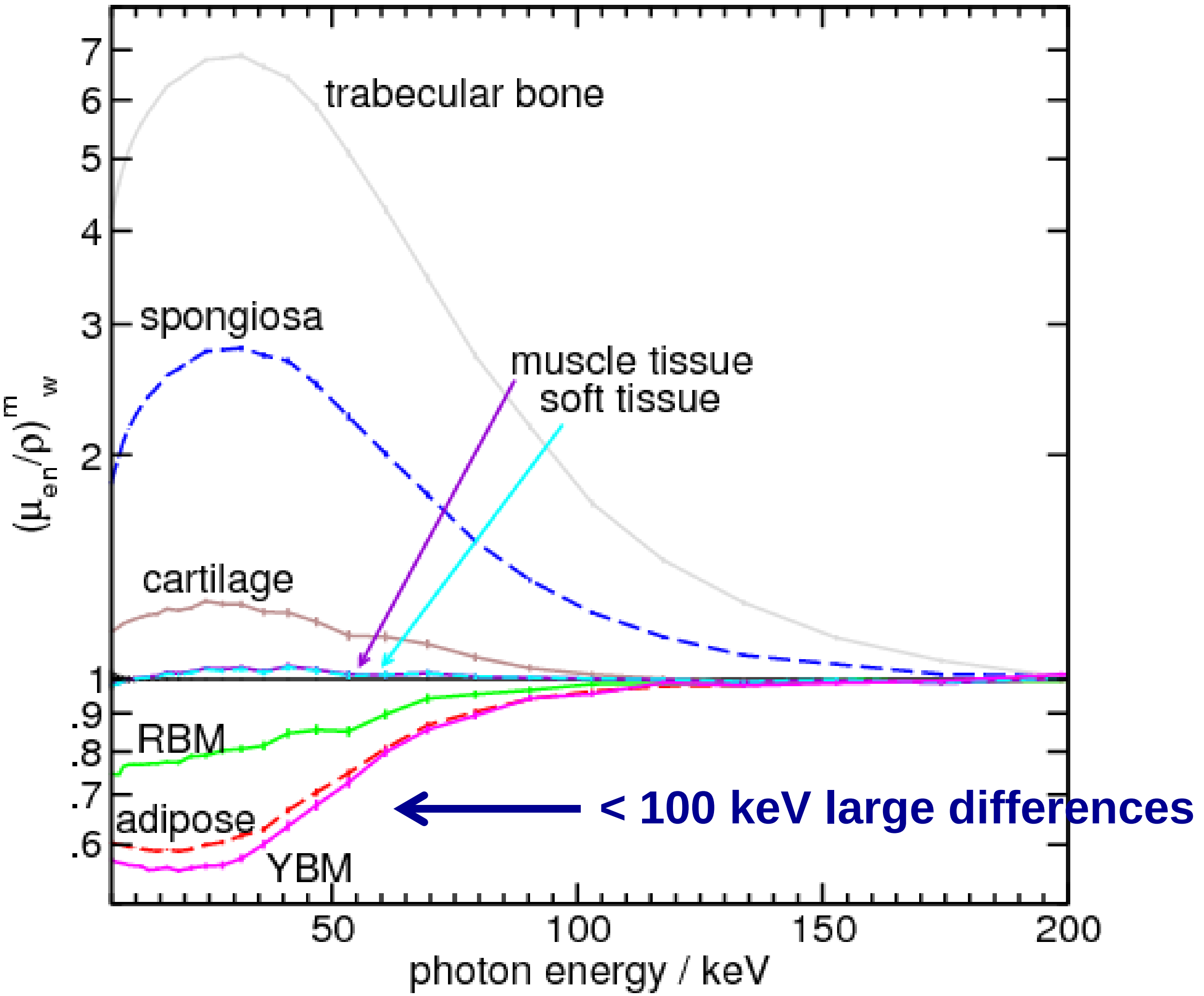
Med. Phys. 36, 2136-2153 (2009)

Sensitivity of Anatomic Sites to Dosimetric Limitations of Current Planning Systems

anatomic site	photon energy	absorbed dose	attenuation	shielding	scattering	beta/kerma dose
prostate	high				↓	
	low	XXX	XXX	XXX		
breast	high				XXX	
	low	XXX	XXX	XXX		
GYN	high			XXX		
	low	XXX	XXX			
skin	high			XXX	XXX	
	low	XXX		XXX	XXX	
lung	high				XXX	XXX
	low	XXX	XXX		XXX	
penis	high				XXX	
	low	XXX			XXX	
eye	high			XXX	XXX	XXX
	low	XXX	XXX	XXX	XXX	

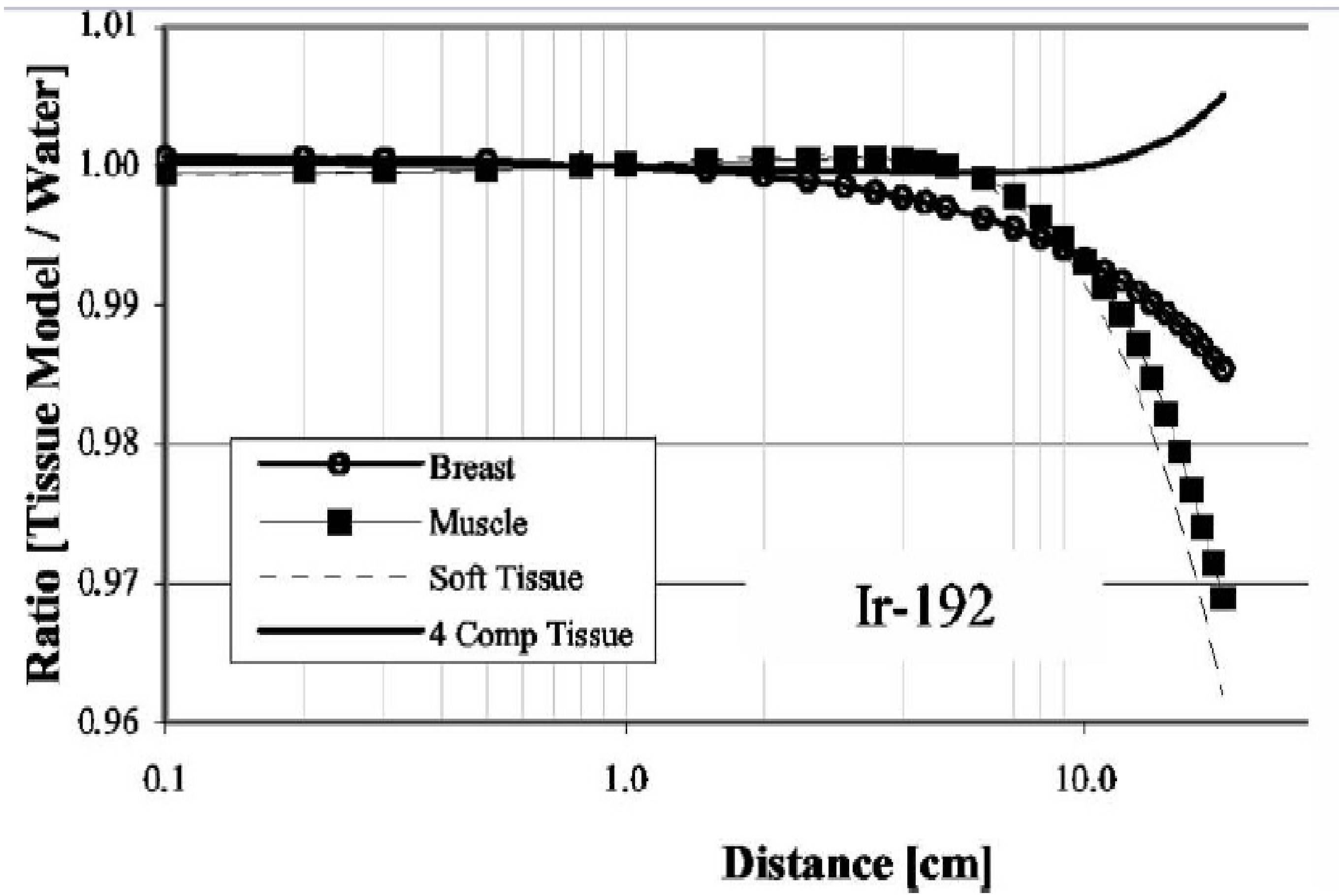
Rivard, Venselaar, Beaulieu, *Med Phys* 36, 2136-2153 (2009)

Importance of the Physics: Water vs Tissues



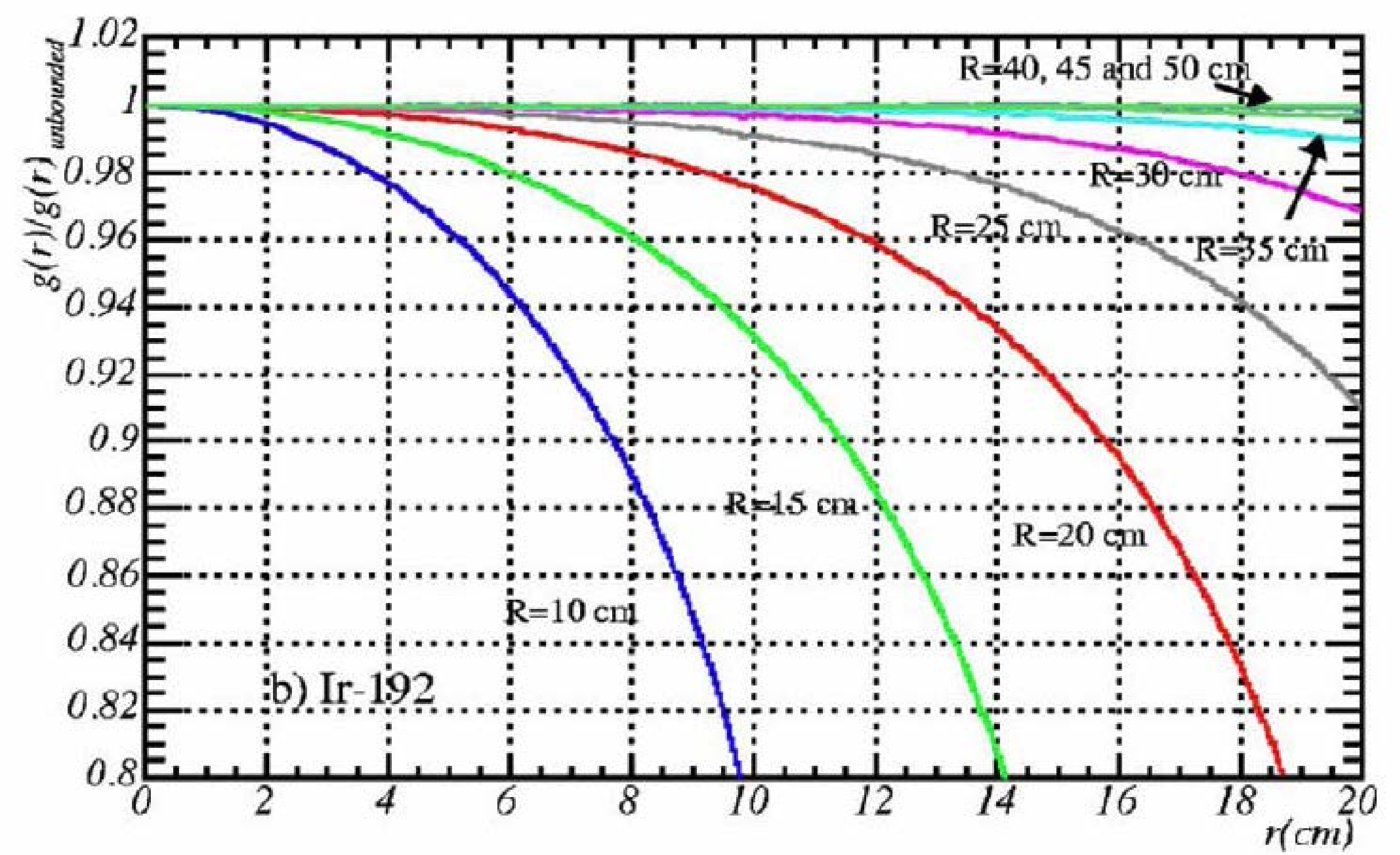
TG-186

Impact of tissue composition: 192Ir



Melhus C S, Rivard M J, « Approaches to calculating AAPM TG-43 brachytherapy dosimetry parameters for Cs-137, Ir-192, Pd-103, and Yb-169 sources », Med. Phys., 33(6), 2006

Effect of Phantom Size



Perez-Calatayud, Granero, Ballester MedPhys (2004)

Phantom Size Effects

- TG43 assumes fixed (full) scatter conditions without consideration of tissue boundaries.
  - Results in overestimation of absorbed dose at a low-density interface
  - Especially important when the sources are near the surface of the patient
    - Breast*
    - Sarcoma
    - Intraoperative

Limitations of TG43, cont

- High energy brachytherapy sources suffer more from effects of the scatter conditions than low energy brachytherapy sources.
  - Applications can range from deep (gyn) to shallow (skin).
- Neglects applicator shielding effects for treatments such as shielded ovoids or cylinders.
  - Incorrect correlation of doses reported with toxicities
- Assumes cylindrically symmetric sources.
  - No source on a wire

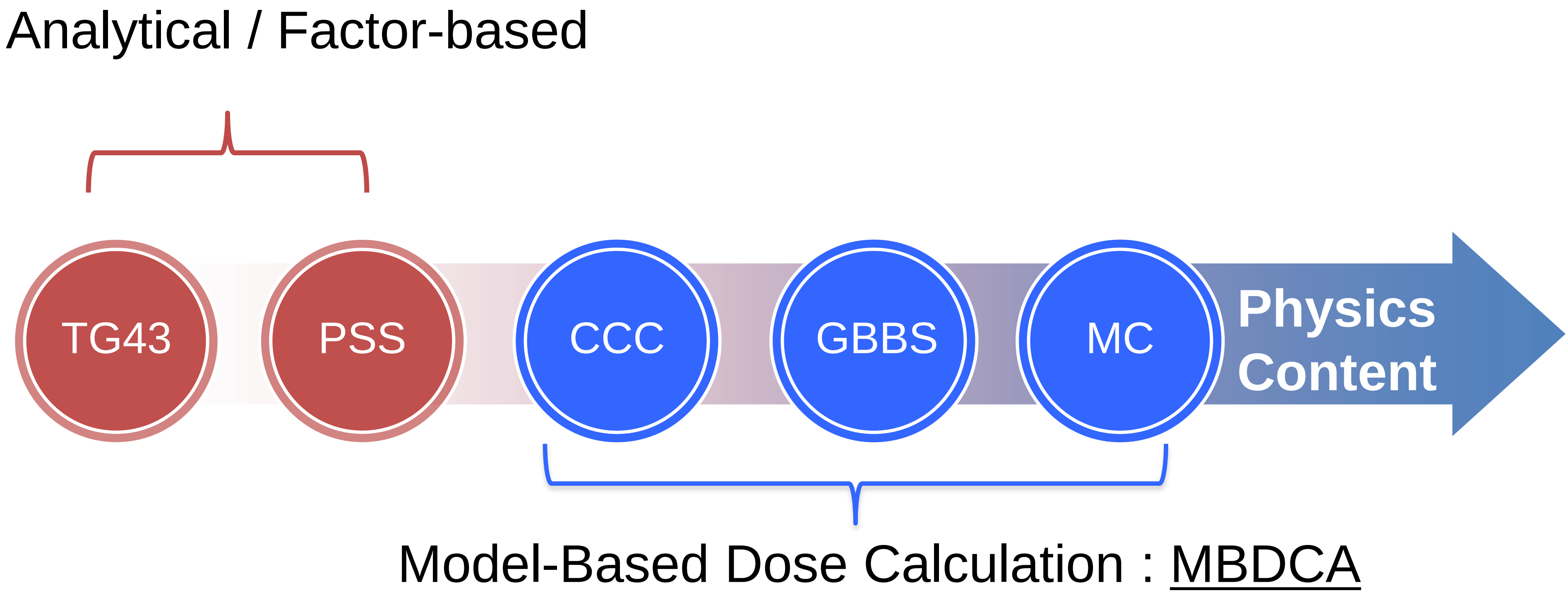
Alternatives to TG43

TABLE I. Status of MBDCAs that can account for radiation scatter conditions and/or material heterogeneities and were useable in brachytherapy treatment planning systems as of 12 May 2010.

MBDCA system	Sponsor(s)	Radiation type	Clinical use	FDA/CE mark status	Release date
PLAQUE SIMULATOR	Astrahan[a]	^{125}I + ^{103}Pd photons	Y	N	1990
Collapsed cone	Ahnesjö, Russell, and Carlsson[b]	^{192}Ir photons	N	N	1996
BRACHYDOSE	Yegin, Taylor, and Rogers[c]	0.01–10 MeV photons	N	N	2004
MCPI	Chibani and Williamson[d]	^{125}I + ^{103}Pd photons	N	N	2005
GEANT4/DICOM-RT	Carrier *et al.*[e]	Any	N	N	2007
Scatter correction	Poon and Verhaegen[f]	^{192}Ir photons	N	N	2008
Hybrid TG-43:MC	Price and Mourtada[g] and Rivard *et al.*[h]	Any	Y	Y	2009
ACUROS	Transpire/Varian[i]	^{192}Ir photons	Y	Y	2009

Rivard, Beaulieu and Mourtada, Vision 20/20, Med Phys 2010

Brachytherapy Dose Calculation Methods



Rivard, Beaulieu and Mourtada, Vision 20/20, Med Phys 2010

Med. Phys. 39 (10), October 2012

Report of the Task Group 186 on model-based dose calculation methods in brachytherapy beyond the TG-43 formalism: Current status and recommendations for clinical implementation

Luc Beaulieu[a)]
Département de Radio-Oncologie et Centre de Recherche en Cancérologie de l'Université Laval, Centre hospitalier universitaire de Québec, Québec, Québec G1R 2J6, Canada and Département de Physique, de Génie Physique et d'Optique, Université Laval, Québec, Québec G1R 2J6, Canada

Åsa Carlsson Tedgren
Department of Medical and Health Sciences (IMH), Radiation Physics, Faculty of Health Sciences, Linköping University, SE-581 85 Linköping, Sweden and Swedish Radiation Safety Authority, SE-171 16 Stockholm, Sweden

Jean-François Carrier
Département de radio-oncologie, CRCHUM, Centre hospitalier de l'Université de Montréal, Montréal, Québec H2L 4M1, Canada and Département de physique, Université de Montréal, Montréal, Québec H3C 3J7, Canada

Stephen D. Davis
Department of Medical Physics, University of Wisconsin-Madison, Madison, Wisconsin 53705 and Department of Medical Physics, McGill University Health Centre, Montréal, Québec H3G 1A4, Canada

Firas Mourtada
Radiation Oncology, Helen F. Graham Cancer Center, Christiana Care Health System, Newark, Delaware 19899

Mark J. Rivard
Department of Radiation Oncology, Tufts University School of Medicine, Boston, Massachusetts 02111

Rowan M. Thomson
Carleton Laboratory for Radiotherapy Physics, Department of Physics, Carleton University, Ottawa, Ontario K1S 5B6, Canada

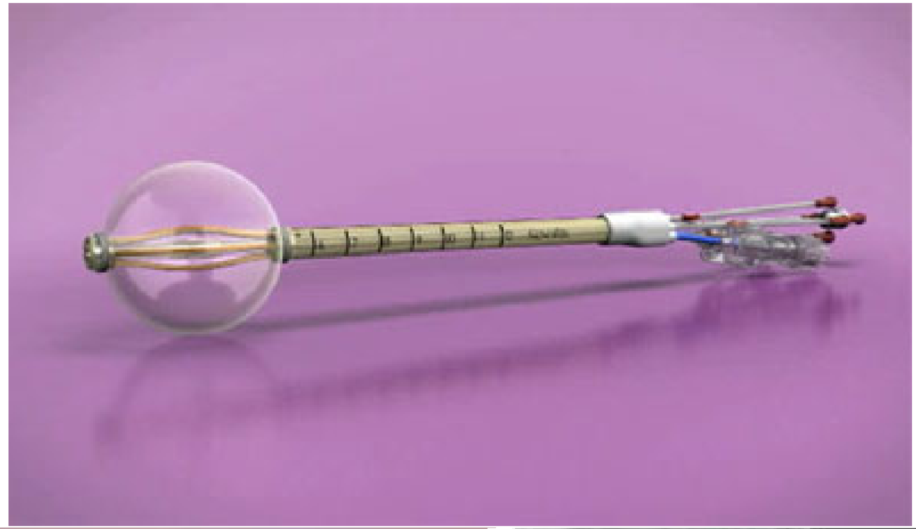
Frank Verhaegen
Department of Radiation Oncology (MAASTRO), GROW, School for Oncology and Developmental Biology, Maastricht University Medical Center, Maastricht 6201 BN, the Netherlands and Department of Medical Physics, McGill University Health Centre, Montréal, Québec H3G 1A4, Canada

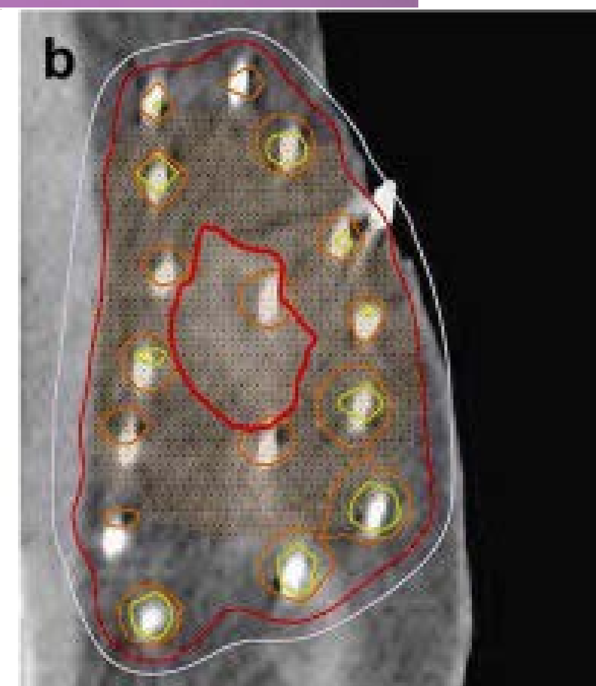
Todd A. Wareing
Transpire Inc., 6659 Kimball Drive, Suite D-404, Gig Harbor, Washington 98335

Jeffrey F. Williamson
Department of Radiation Oncology, Virginia Commonwealth University, Richmond, Virginia 23298

See Next 2 Sessions
Tuesday PM
Wednesday AM

- TU-E-116-1 **Clinical Implementation for Advanced Brachytherapy Dose Calculation Algorithms Beyond the TG-43 Formalism , 2-3PM**
- WE-C-141-1 **Research and Relevance of Brachytherapy Dose Calculation Advancements, Wed 10:30-12:30PM**





CLINICAL APPLICATION TO APBI

Why doing APBI well is important

VOLUME 30 · NUMBER 35 · DECEMBER 10 2012

JOURNAL OF CLINICAL ONCOLOGY

ORIGINAL REPORT

Patterns of Use and Short-Term Complications of Breast Brachytherapy in the National Medicare Population From 2008-2009

Carolyn J. Presley, Pamela R. Soulos, Jeph Herrin, Kenneth B. Roberts, James B. Yu, Brigid Killelea, Beth-Ann Lesnikoski, Jessica B. Long, and Cary P. Gross

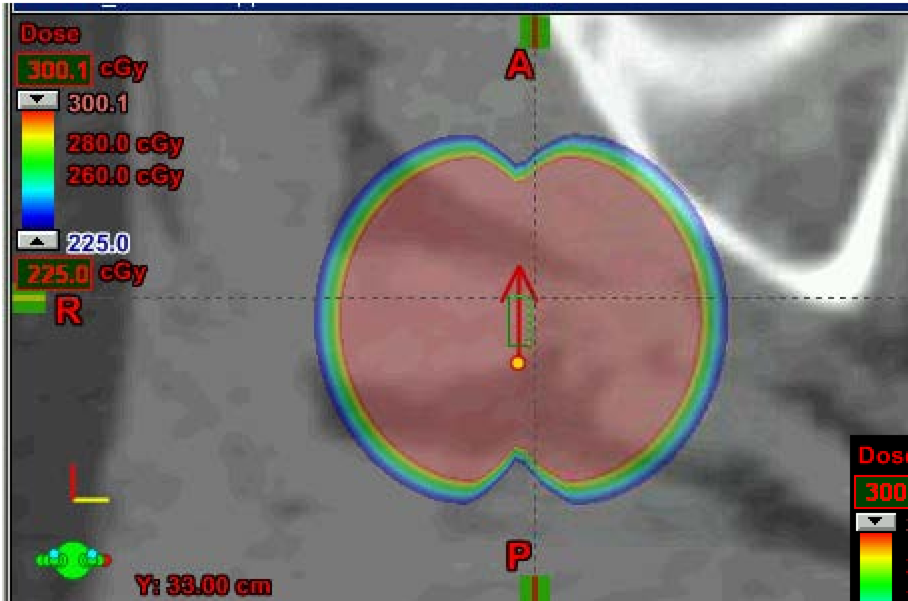
Results

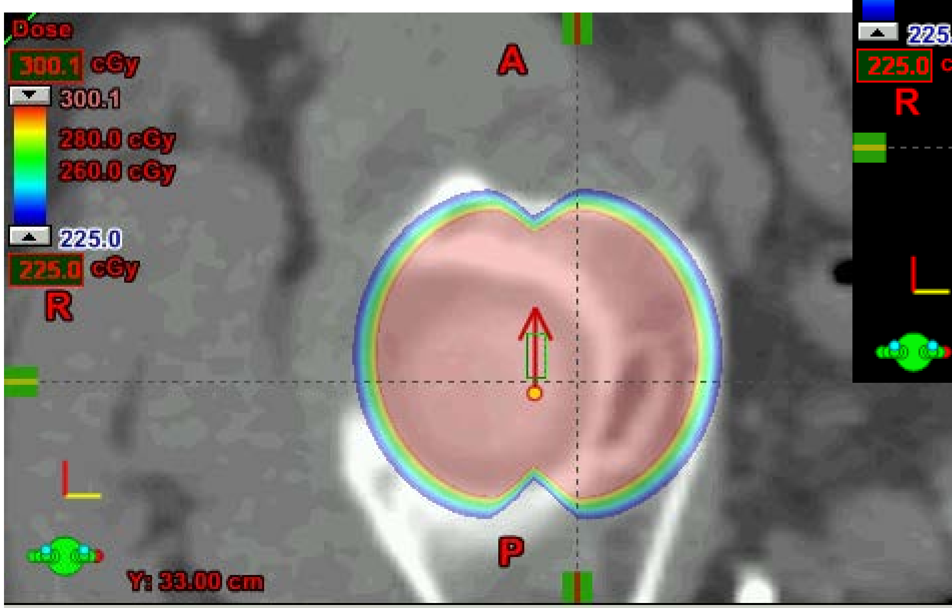
Of 29,648 women in our sample, 4,671 (15.8%) received brachytherapy. The percent of patients receiving brachytherapy varied substantially across HRRs, ranging from 0% to over 70% (interquartile range, 7.5% to 23.3%). Of women treated with brachytherapy, 34.3% had a complication compared with 27.3% of women undergoing WBI ($P < .001$). After adjusting for patient and clinical characteristics, 35.2% of women treated with brachytherapy (95% CI, 28.6 to 41.9) had a complication compared with 18.4% treated with WBI (95% CI, 15.5 to 21.3; P value for difference, <.001). Brachytherapy was associated with a 16.9% higher rate of wound and skin complications compared with WBI (95% CI, 10.0 to 23.9; $P < .001$), but there was no difference in deep-tissue and bone complications.

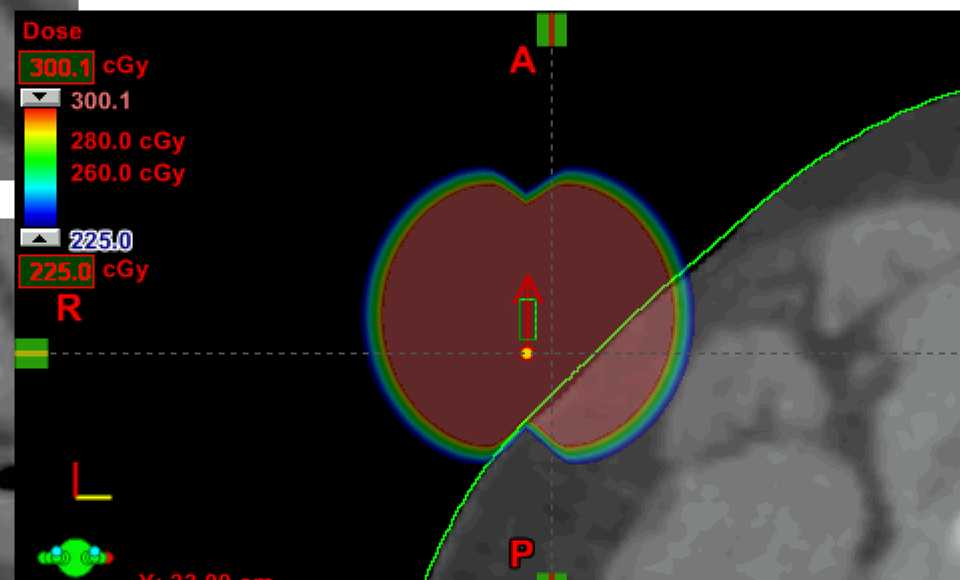
Conclusion

Brachytherapy is commonly used among Medicare beneficiaries and varies substantially across regions. After 1 year, wound and skin complications were significantly higher among women receiving brachytherapy compared with those receiving WBI.

One thing we, as physicists can improve: Our dose calculation!
…or at least our understanding of the *real* dose

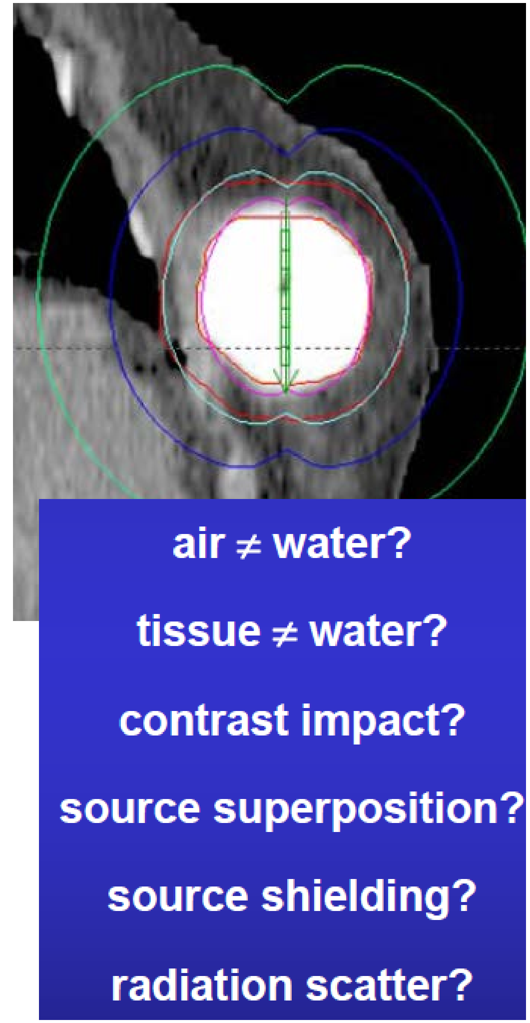






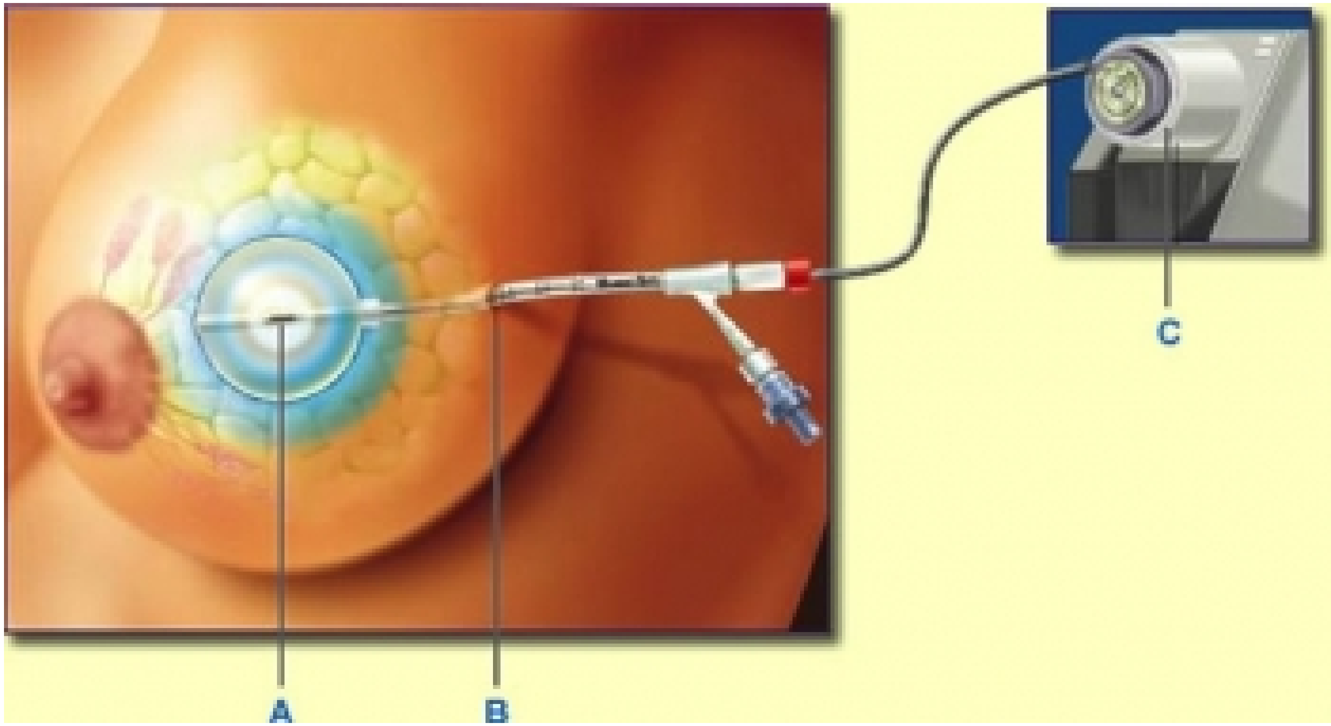
Dose issues effecting APBI

- Dose perturbations due to contrast medium and air
- The effect of patient inhomogeneities
- Dose to skin
- Chest wall/rib dose
- Patient specific planning vs class solutions to guesstimate the effect



Rivard, "Brachytherapy Dose Calculation Formalism Dataset Evaluation, and treatment planning system Implementation (AAPMSS 2009)

In the beginning….



- Single lumen Mammosite® only!
- Physicists worried about the contrast in the balloon.

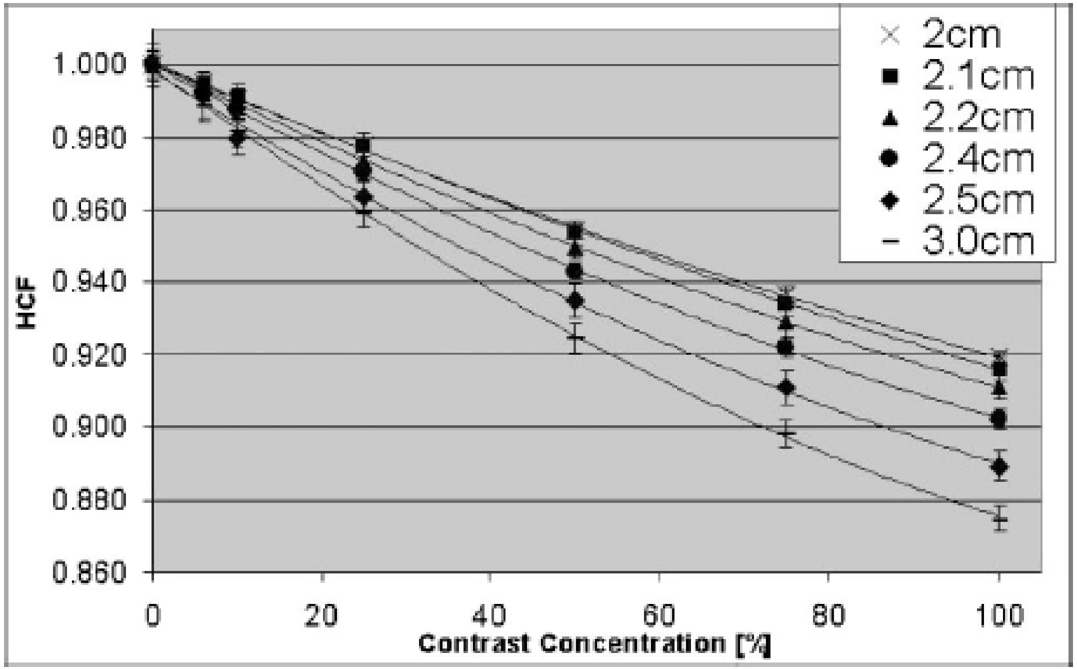


FIG. 4. The Monte Carlo calculated heterogeneity correction factors as a function of contrast concentration level (0, 6, 10, 25, 50, 75 and 100%) at a distance 1 cm from balloon surface for various balloon radii: 2 cm (cross), 2.1 cm (squares), 2.2 cm (triangles), 2.4 cm (circles), 2.5 (diamonds) and 3 cm (dash). The solid lines represent a 2nd-order polynomial fit. The relative uncertainty in the HCF values is less than 0.5%.

Dose perturbation induced by radiographic contrast inside brachytherapy balloon applicators

Michael C. Kirk,[a] Wen C. Hsi, James C. H. Chu, Honquan Niu, Zenan Hu, Damian Bernard, Adam Dickler, and Cam Nguyen
Department of Medical Physics and Radiation Oncology, Rush University Medical Center, Chicago, Illinois 60612

(Received 22 September 2003; revised 21 February 2004; accepted for publication 23 February 2004; published 22 April 2004)

TABLE II. Percentage reduction (Δ%) in dose rate at 1 cm from the balloon due to contrast, relative to water, f the various balloon diameters.

Balloon diameter (cm)	Δ%				
	5% contrast	10% contrast	15% contrast	20% contrast	25% contras
4	−0.8%	−1.6%	−2.4%	−3.2%	−4.0%
5	−1.0%	−1.6%	−2.7%	−3.8%	−4.9%
6	−1.4%	−2.9%	−4.3%	−5.4%	−5.7%

Contrast effects on dosimetry of a partial breast irradiation system

Bassel Kassas,[a)] Firas Mourtada, John L. Horton, and Richard G. Lane
The University of Texas MD Anderson Cancer Center, Box 94, 1515 Holcombe Boulevard, Houston, Texas 77030

(Received 24 February 2004; revised 6 April 2004; accepted for publication 22 April 2004; published 17 June 2004)

Contrast recommendations were made!

Measurements of dose discrepancies due to inhomogeneities and radiographic contrast in balloon catheter brachytherapy

Seungjong Oh
Department of Biomedical Engineering, The Catholic University of Korea, Seoul 137-701, Korea and Research Institute of Biomedical Engineering, The Catholic University of Korea, Seoul 137-701, Korea

Jacob Scott
Department of Radiation Oncology, Moffitt Cancer Center, Tampa, Florida 33612

Dong Hoon Shin
Korea Institute of Nuclear Nonproliferation and Control, Daejeon 305-348, Korea

Tae-Suk Suh[a)]
Department of Biomedical Engineering, The Catholic University of Korea, Seoul 137-701, Korea and Research Institute of Biomedical Engineering, The Catholic University of Korea, Seoul 137-701, Korea

Siyong Kim[a)]
Department of Radiation Oncology, Mayo Clinic, Jacksonville, Florida 32224

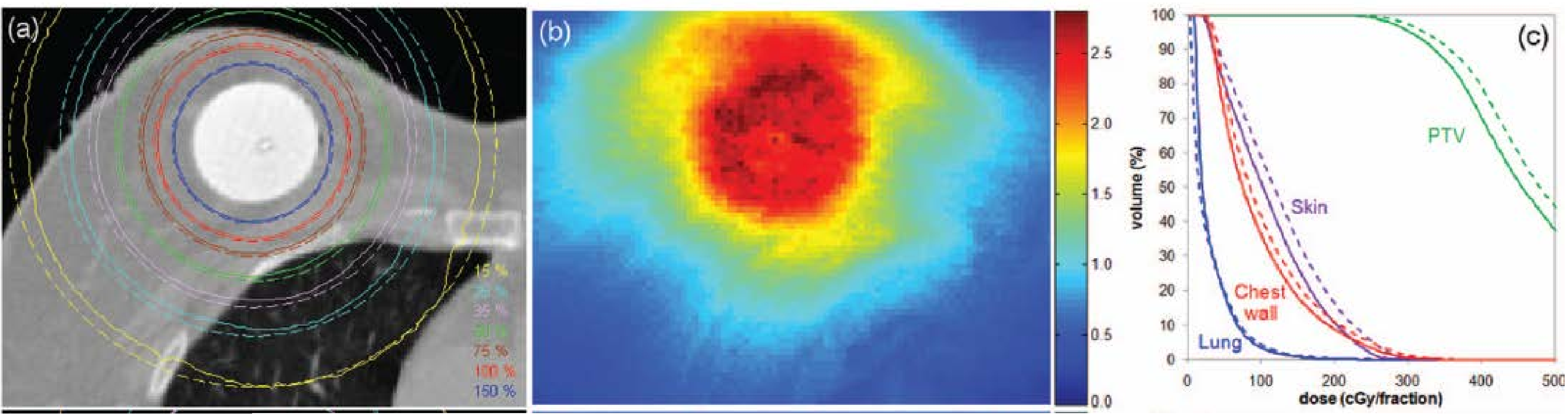
(Received 15 July 2008; revised 29 June 2009; accepted for publication 29 June 2009; published 12 August 2009)

TABLE IV. Comparison of the effect of contrast with published data when FS condition existed. The effect of contrast was represented as the ratio between dose with contrast in balloon and dose with water only in balloon. Published data were obtained at 1 cm from the balloon surface, which indicated 3.0 cm SDD with 4.0 cm balloon diameter (BD) and 3.5 cm SDD with 5.0 cm BD. However, our measurement was performed at 3.5 cm SDD with 4.0 cm BD and 4.0 cm SDD with 5.0 cm BD. The data show the effect of contrast and two sided confidence interval of 80%.

		This study		Kassas *et al.*[a]		Zhang *et al.*[b]				Kirk *et al.*[c]	
		Method									
BD	SDD	MOSFET		MC		MC		MOSFET		MC	
(cm)	(cm)	10%	20%	10%	20%	10%	20%	10%	15%	10%	25%
4	3.0			0.984	0.968	0.986	0.971	0.991	0.986	0.990	0.980
	3.5	0.982 ± 0.025	0.963 ± 0.024								
5	3.5			0.984	0.962	0.979	0.960	0.982	0.975	0.978	0.964
	4.0	0.948 ± 0.024	0.921 ± 0.023								

Moving on to absorbed dose…

TG-43 overestimates the target volume receiving the prescribed dose by 4% and the dose to the hottest 0.1 cm^3 of the skin by 9%.



A CT-based analytical dose calculation method for HDR ^{192}Ir brachytherapy

Emily Poon
Medical Physics Unit, McGill University, 1650 Cedar Avenue, Montreal, Quebec H3G 1A4, Canada

Frank Verhaegen[a)]
Medical Physics Unit, McGill University, 1650 Cedar Avenue, Montreal, Quebec H3G 1A4, Canada and Department of Radiation Oncology (MAASTRO), GROW, University Hospital Maastricht, Maastricht 6229ET, The Netherlands

Determination of exit skin dose for ^{192}Ir intracavitary accelerated partial breast irradiation with thermoluminescent dosimeters

Julie A. Raffi,[a] Stephen D. Davis, Cliff G. Hammer, John A. Micka, and Keith A. Kunugi
Department of Medical Physics, University of Wisconsin-Madison, Madison, Wisconsin 53705
Jana E. Musgrove and John W. Winston, Jr.
El Paso Cancer Treatment Center, El Paso, Texas 79902
Terresa J. Ricci-Ott
Texas Cancer Center at Medical City, Dallas, Texas 75230
Larry A. DeWerd
Department of Medical Physics, University of Wisconsin-Madison, Madison, Wisconsin 53705

And dose to skin…

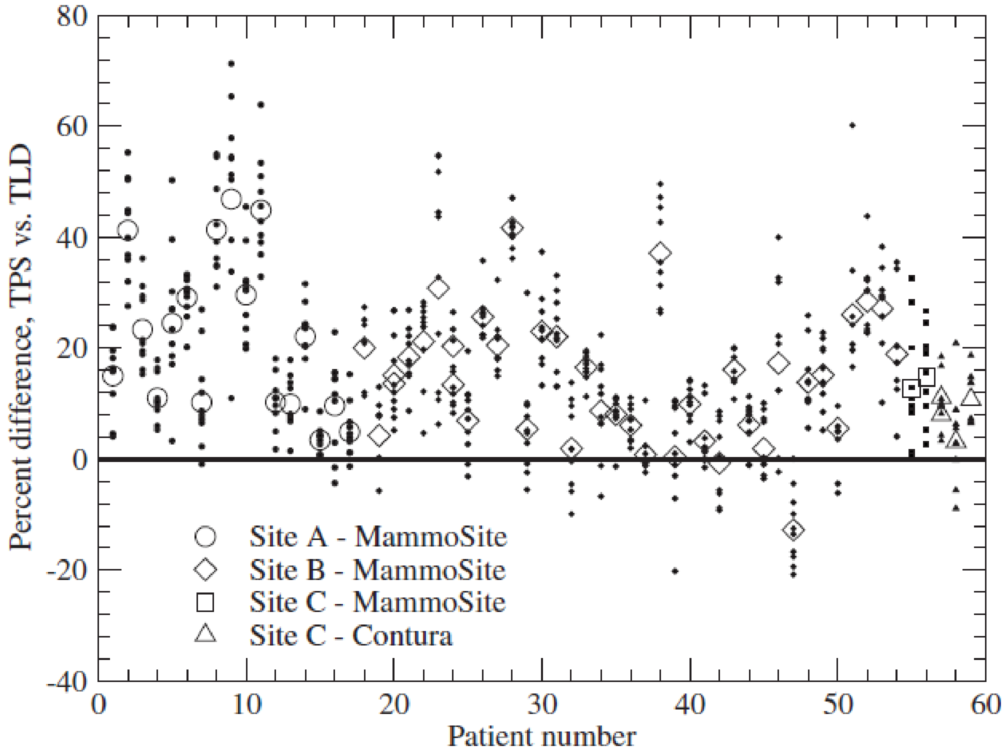


FIG. 4. Percent difference between the TPS predicted dose and TLD measured dose for 59 intracavitary APBI patients from three different clinics. Closed symbols represent percent difference for each fraction. Open symbols represent the average for each patient. Patients with two open symbols (20, 24, and 57) had two different treatment plans during the course of their treatment.

The TPS overestimated the exit dose on the skin by 16% on average

And a air bubble…

Dose perturbations due to contrast medium and air in MammoSite® treatment: An experimental and Monte Carlo study

C.-W. Cheng[a)]
Arizona Oncology Associates, 2625 N. Craycroft Road, Suite 100, Tucson, Arizona 85712

R. Mitra
Ochsner Clinic Foundation, 1516 Jefferson Highway, New Orleans, Louisiana 70121

X. Allen Li
Department of Radiation Oncology, Medical College of Milwaukee, Milwaukee, Wisconsin 53226

Indra J. Das
Department of Radiation Oncology, University of Pennsylvania, Philadelphia, Pennsylvania 19104

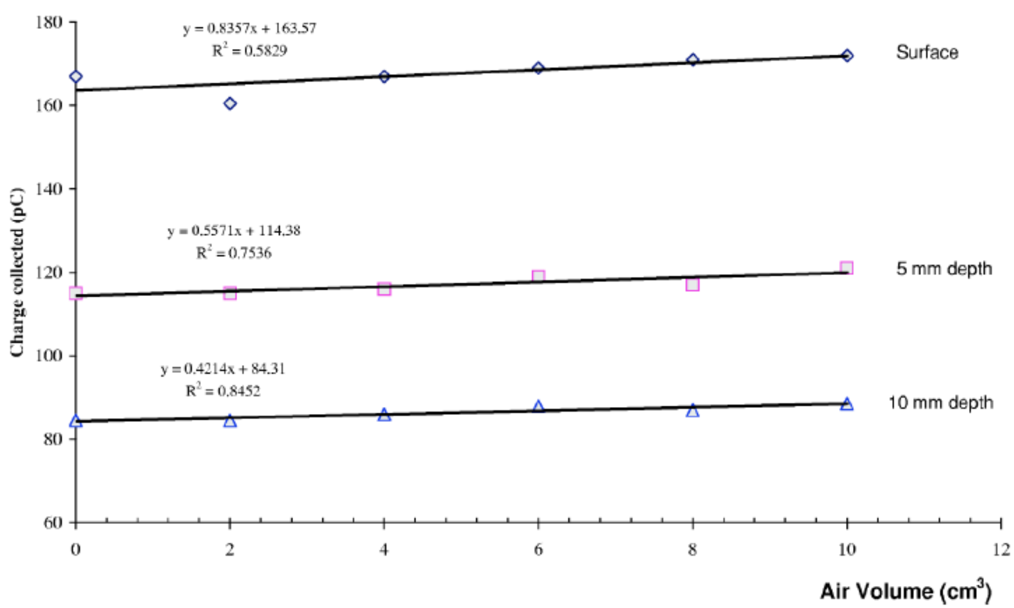


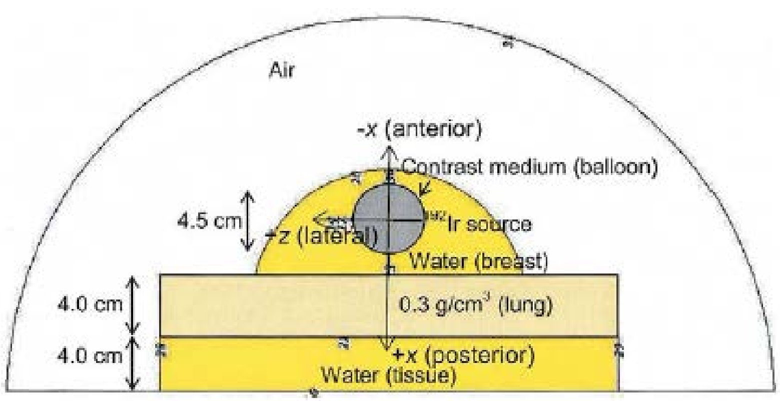
FIG. 3. The effect of air bubble inside the balloon on dose at different distances from the balloon surface.

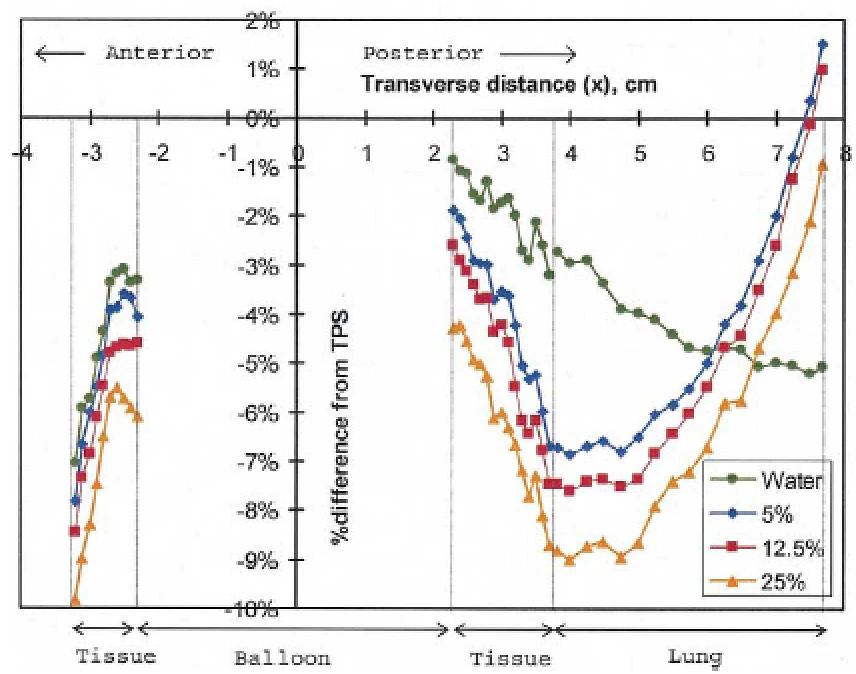
And lung

PHYSICS CONTRIBUTION Int. J. Radiation Oncology Biol. Phys., Vol. 60, No. 2, pp. 672–677, 2004

DOSE ERRORS DUE TO INHOMOGENEITIES IN BALLOON CATHETER BRACHYTHERAPY FOR BREAST CANCER

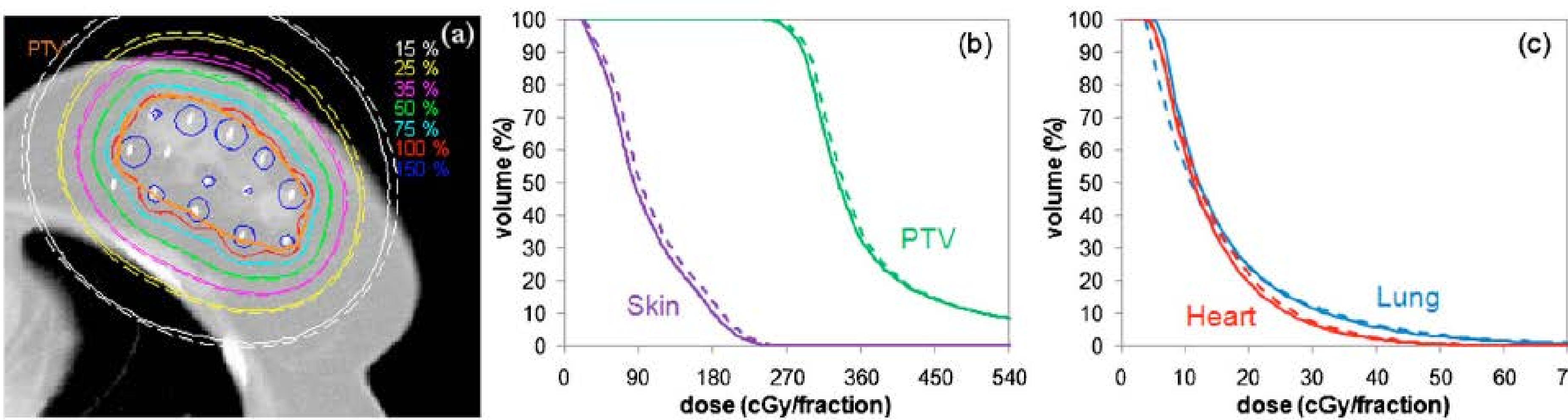
SUNG-JOON YE, PH.D.,* IVAN A. BREZOVICH, PH.D.,* SUI SHEN, PH.D.,* AND SIYONG KIM, PH.D.†





MultiCath Breast

- On average, TG-43 overestimates the target coverage by 2% and the dose to the hottest 0.1 cm3(D0.1 cc) of the skin by 5%.



Development of a scatter correction technique and its application to HDR ^{192}Ir multicatheter breast brachytherapy

Emily Poon
Medical Physics Unit, McGill University, 1650 Cedar Avenue, Montreal, Quebec H3G 1A4, Canada

Frank Verhaegen[a)]
Medical Physics Unit, McGill University, 1650 Cedar Avenue, Montreal, Quebec H3G 1A4, Canada and Department of Radiation Oncology (MAASTRO), GROW, University Hospital Maastricht, Maastricht, The Netherlands

And SAVI

3919 Med. Phys. 37 (8), August 2010

Dosimetric effects of an air cavity for the SAVI™ partial breast irradiation applicator

Susan L. Richardson[a)]
Department of Radiation Oncology, Washington University School of Medicine, St. Louis, Missouri 63110

Ramiro Pino
Department of Radiation Oncology, The Methodist Hospital, Houston, Texas 77030 and Texas Cancer Clinic, San Antonio, Texas 78240

Purpose: To investigate the dosimetric effect of the air inside the SAVI™ partial breast irradiation device.
Methods: The authors have investigated how the air inside the SAVI™ partial breast irradiation device changes the delivered dose from the homogeneously calculated dose. Measurements were made with the device filled with air and water to allow comparison to a homogenous dose calculation done by the treatment planning system. Measurements were made with an ion chamber, TLDs, and film. Monte Carlo (MC) simulations of the experiment were done using the EGSnrc suite. The MC model was validated by comparing the water-filled calculations to those from a commercial treatment planning system.
Results: The magnitude of the dosimetric effect depends on the size of the cavity, the arrangement of sources, and the relative dwell times. For a simple case using only the central catheter of the largest device, MC results indicate that the dose at the prescription point 1 cm away from the air-water boundary is about 9% higher than the homogeneous calculation. Independent measurements in a water phantom with a similar air cavity gave comparable results. MC simulation of a realistic multidwell position plan showed discrepancies of about 5% on average at the prescription point for the largest device.
Conclusions: The dosimetric effect of the air cavity is in the range of 3%–9%. Unless a heterogeneous dose calculation algorithm is used, users should be aware of the possibility of small treatment planning dose errors for this device and make modifications to the treatment delivery, if necessary. [DOI: 10.1118/1.3457328]

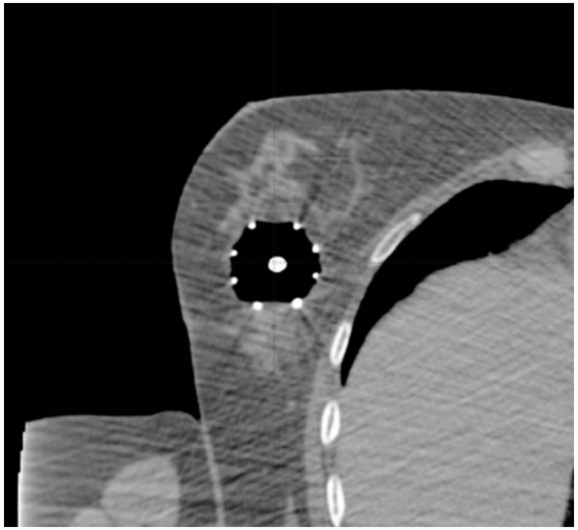


TABLE I. Summary of the dose difference at the prescription point (1 cm from the device edge, except for the TLD which was measured at 1.5 cm) between a water and air-filled cavity for the single-dwell position–central strut scenario.

Strut size	Monte Carlo (%)	Ion chamber (%)	TLD (%)	Average (%)
10	8.3	6.0	6.9	7.0
8	6.0	7.0	N/A	6.5
6	3.6	2.5	N/A	3.0

Contrast errors

- The density of contrast solution was 10% less than that obtained from the CT calibration.
- The cross section of the contrast solution for the HDR source was 1.2% greater than that of muscle.
- Both errors could be addressed by overriding the density of the contrast solution in the treatment planning system.

Technical Note: Contrast solution density and cross section errors in inhomogeneity-corrected dose calculation for breast balloon brachytherapy

Leonard H. Kim[a)] and Miao Zhang
Department of Radiation Oncology, University of Medicine and Dentistry of New Jersey: Robert Wood Johnson Medical School and Cancer Institute of New Jersey, New Brunswick, New Jersey 08903

Roger W. Howell
Department of Radiology, University of Medicine and Dentistry of New Jersey: New Jersey Medical School, Newark, New Jersey 07103

Ning J. Yue and Atif J. Khan
Department of Radiation Oncology, University of Medicine and Dentistry of New Jersey: Robert Wood Johnson Medical School and Cancer Institute of New Jersey, New Brunswick, New Jersey 08903

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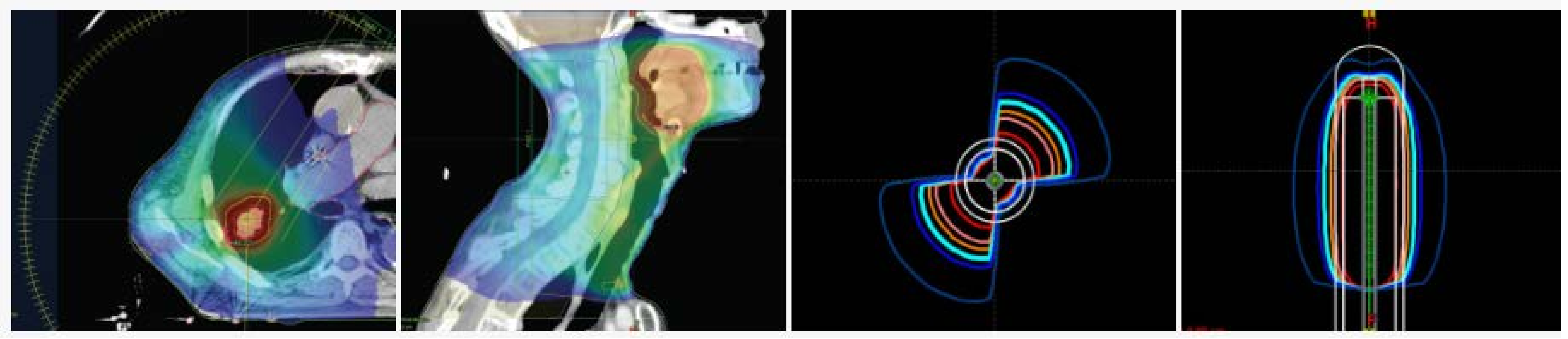
011703-1 Med. Phys. 40 (1), January 2013

Use of Acuros® in APBI dose calculation



ACUROS benchmark

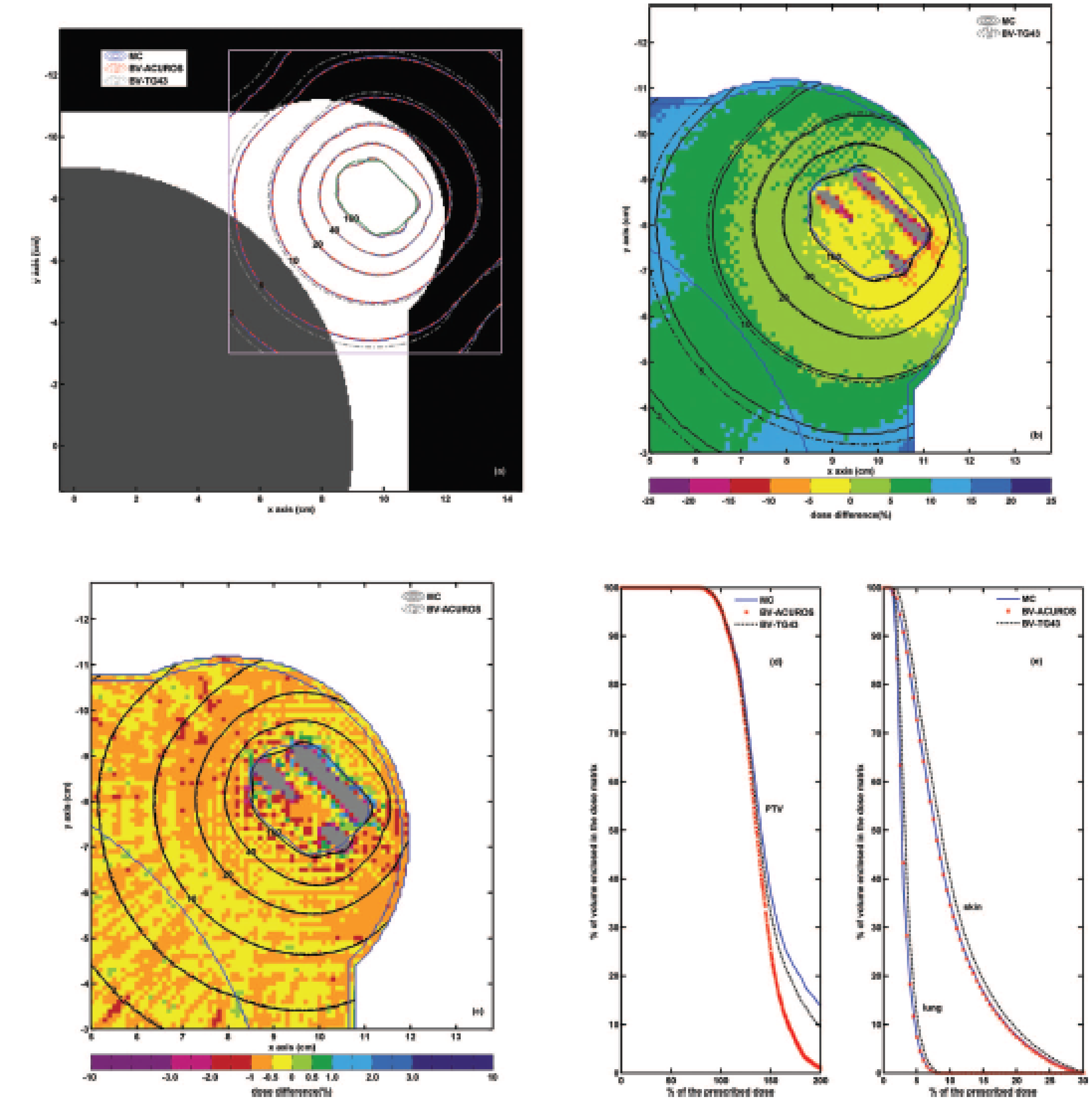


FIG. 2. (a) The central image of the voxelized mathematical breast model with BV-TG43, BV-ACUROS, and MC dose calculation results for the same breast brachytherapy plan presented in the form of percentage isodose lines within the extent of the dose calculation grid. (b) A colormap representation of the spatial distribution of percentage differences between BV-TG43 and MC results ($\frac{D_{\text{BV-TG43}}}{D_{\text{MC}}} - 1$) on the plane presented in (a). (c) A colormap representation of the spatial distribution of percentage differences between BV-Acuros and MC results ($\frac{D_{\text{BV-ACUROS}}}{D_{\text{MC}}} - 1$) on the plane presented in (a). (d) Cumulative DVH results for the PTV derived from the 3D dose distributions calculated using BV-TG43, BV-ACUROS and MC. (e) Same as (d) for the skin and lung OARs.

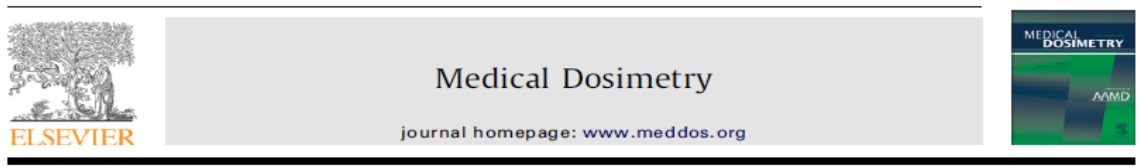
Dosimetric accuracy of a deterministic radiation transport based ^{192}Ir brachytherapy treatment planning system. Part III. Comparison to Monte Carlo simulation in voxelized anatomical computational models

K. Zourari,[a] E. Pantelis, and A. Moutsatsos
Medical Physics Laboratory, Medical School, University of Athens, 75 Mikras Asias, 115 27 Athens, Greece

L. Sakelliou
Department of Physics, Nuclear and Particle Physics Section, University of Athens, Ilisia, 157 71 Athens, Greece

E. Georgiou, P. Karaiskos, and P. Papagiannis[b]
Medical Physics Laboratory, Medical School, University of Athens, 75 Mikras Asias, 115 27 Athens, Greece

(Received 26 July 2012; revised 15 November 2012; accepted for publication 16 November 2012; published 18 December 2012)


Medical Dosimetry 38 (2013) 196–198

Medical Dosimetry

journal homepage: www.meddos.org

Heterogeneity-corrected *vs* -uncorrected critical structure maximum point doses in breast balloon brachytherapy

Leonard Kim, M.S., A.Mus.D., Venkat Narra, Ph.D., and Ning Yue, Ph.D.

Department of Radiation Oncology, Cancer Institute of New Jersey, Robert Wood Johnson Medical School, University of Medicine and Dentistry of New Jersey, New

- 20 patients – 15 contoura + 5 savi
- Linear relationship indicates predicatability

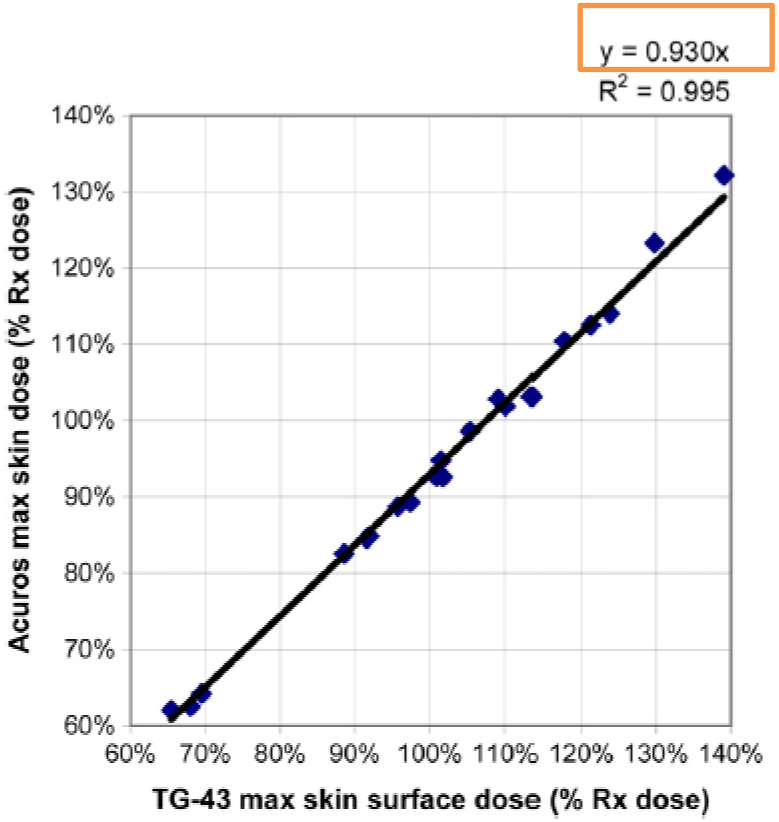


Fig. 1. Acuros-calculated *vs* TG-43-calculated maximum skin surface dose with fit.

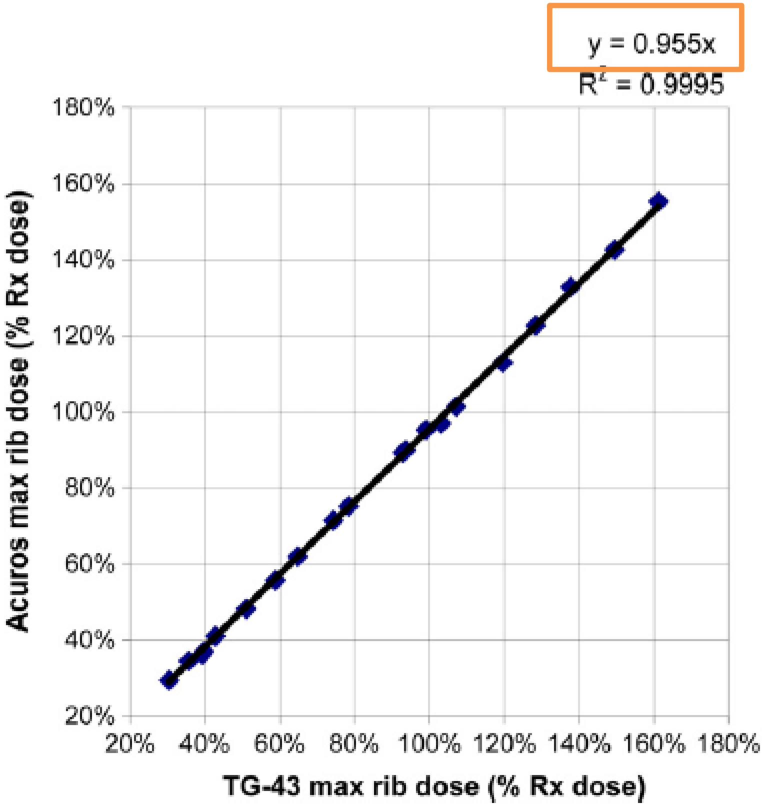


Fig. 2. Acuros-calculated *vs* TG-43-calculated maximum rib dose with fit.

Abstracts / Brachytherapy 10 (2011) S14–S101

PD57

Balloon-Based Accelerated Partial Breast Irradiation With Contura™: Comparison Between Conventional TG-43 and Brachyvision Acuros™ Dose Calculation Methods

Ruben Ter-Antonyan, PhD[1], Paul W. Read, MD, PhD[1], Bernard F. Schneider, MD, PhD[1], Anneke T. Schroen, MD, MPH[2], Stanley H. Benedict, PhD[1], Bruce P. Libby, PhD[1]. [1]Radiation Oncology, University of Virginia Health System, Charlottesville, VA; [2]Surgery, University of Virginia Health System, Charlottesville, VA.

- 5 Contura patients

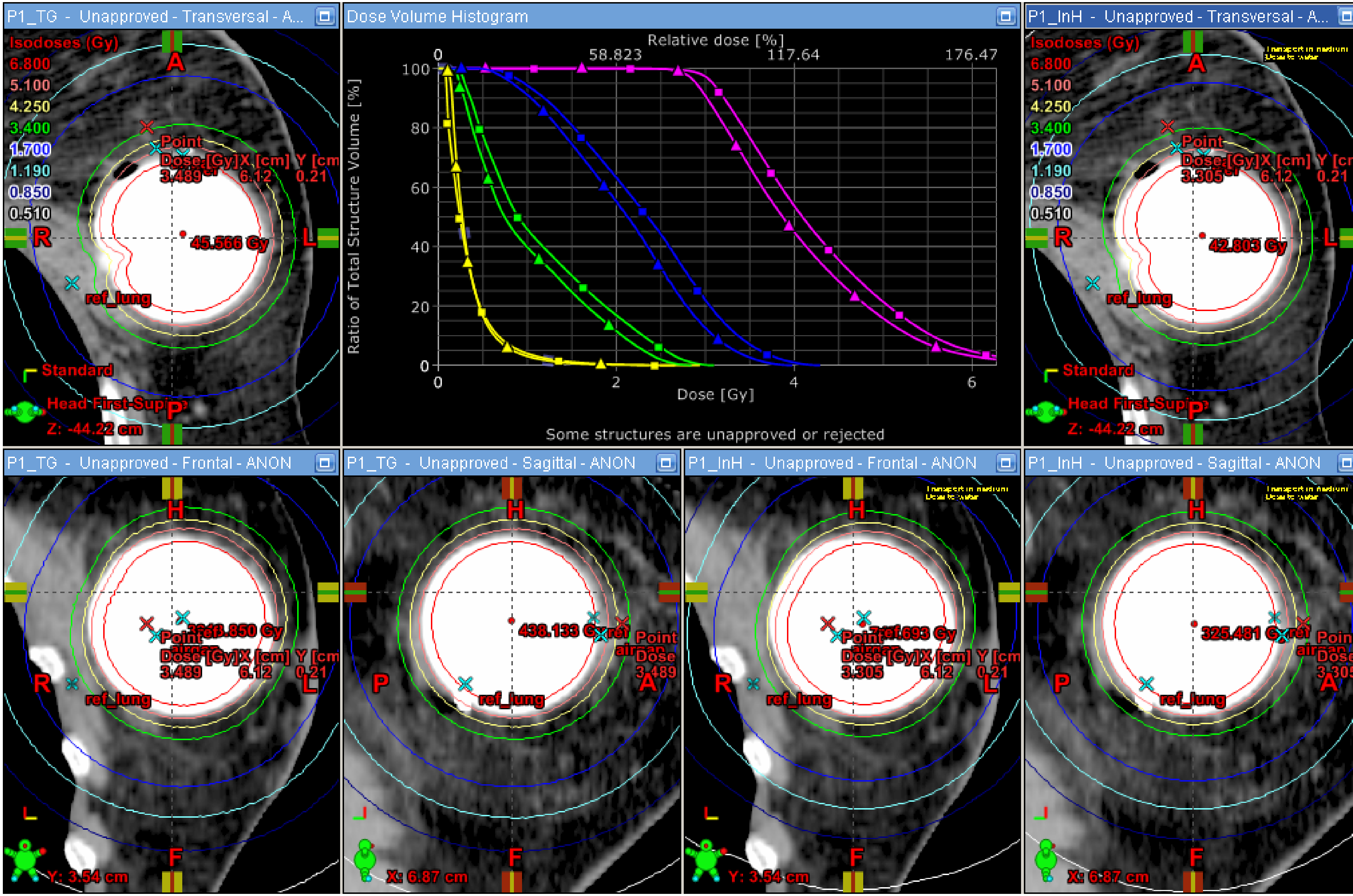
	TG-43	Acuros™	Difference
PTV_eval D95 (cGy)	322.7	311.9	(3.4 ± 0.5) %
PTV_eval D1 (cGy)	816.4	806.6	(1.2 ± 0.6) %
PTV_eval D_{min} (cGy)	238.4	254.1	(-7.1 ± 7.1) %
PTV_eval V150 (cm^3)	26.5	24.0	(9.2 ± 1.3) %
Skin D_{max} (cGy)	439.0	420.1	(4.6 ± 1.2) %
Skin D_{mean} (cGy)	242.8	226.6	(6.7 ± 0.6) %
Skin D_{skin_pt} (cGy)	297.1	278.1	(6.7 ± 1.7) %

Abstracts / Brachytherapy 9 (2010) S23–S102

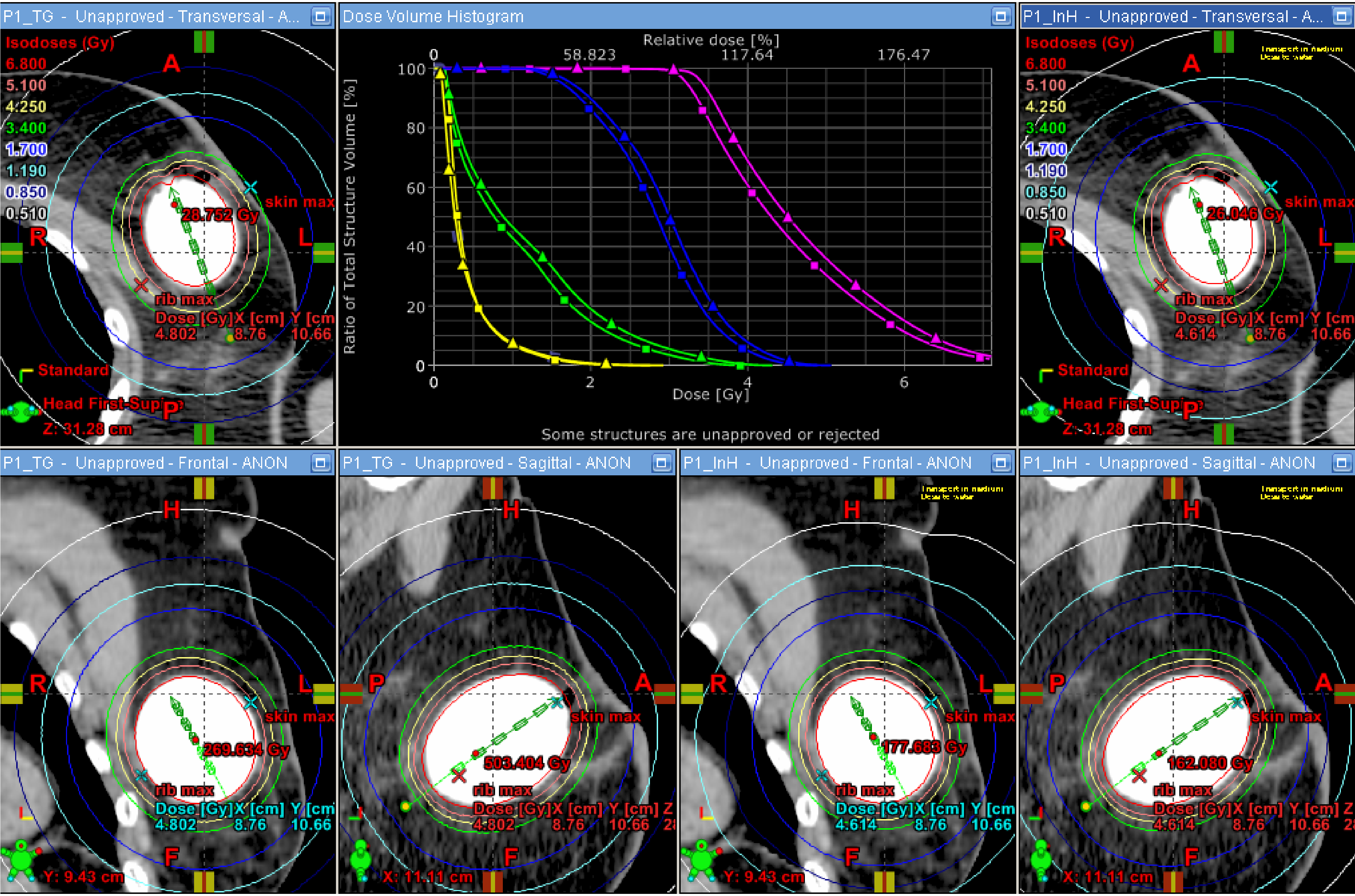
Comparison between Two Dose Calculation Methods, Acuros and TG43: Implications for Accelerated Partial Breast Irradiation

Jill P. Heffernan, M.D., Lynn Gilbert, C.M.D., Douglas W. Arthur, M.D., Dorin A. Todor, Ph.D. Radiation Oncology, Virginia Commonwealth University, Richmond, VA.

- 30 patients evaluated $Skin_{max}$, Rib_{max}, D90, V100, V150, V200
- Variety of applicators including interstitial
  - Results for interstitial were within 3% or 3cc
- Balloon based:
  - $Skin_{max}$ – 8% including >10% if only using central lumen/single dwell
  - Rib_{max}- 5% on average
  - Target coverage less (3.5% – 8%)
  - Larger balloons had greater differences in V100, etc.



P1_TG - Unapproved - Transversal - A...
Dose Volume Histogram
P1_InH - Unapproved - Transversal - A...
Isodoses (Gy)
6.800
5.100
4.250
3.400
1.700
1.190
0.850
0.510
Point
Dose [Gy] X [cm] Y [cm]
3.489 6.12 0.21
45.566 Gy
ref_lung
Standard
Head First-Supine
Z: -44.22 cm
Relative dose [%]
0
58.823
117.64
176.47
Ratio of Total Structure Volume [%]
100
80
60
40
20
0
2
4
6
Dose [Gy]
Some structures are unapproved or rejected
3.305
42.803 Gy
P1_TG - Unapproved - Frontal - ANON
P1_TG - Unapproved - Sagittal - ANON
P1_InH - Unapproved - Frontal - ANON
P1_InH - Unapproved - Sagittal - ANON
438.133 Gy
325.481 Gy
Y: 3.54 cm
X: 6.87 cm

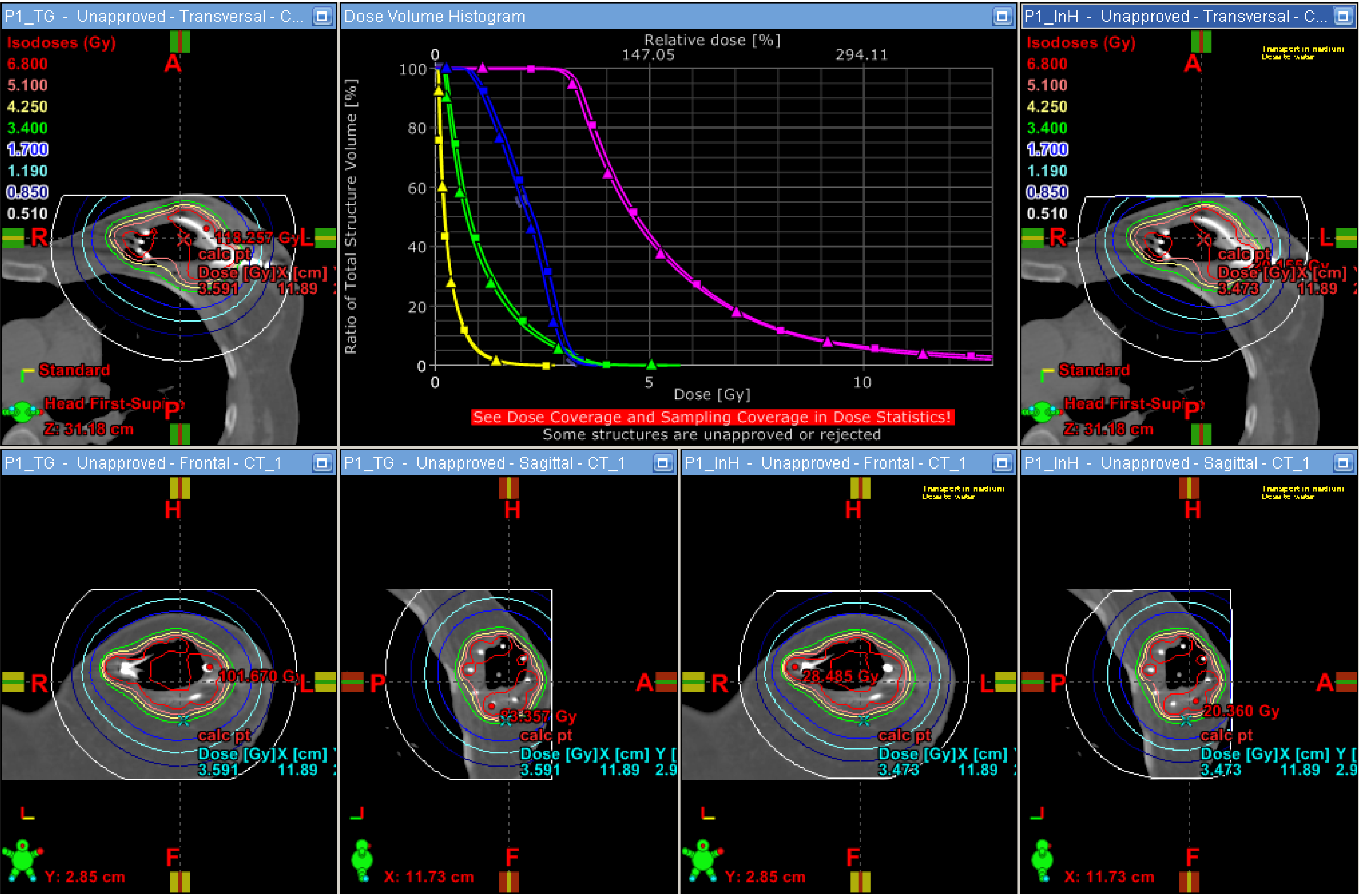

P1_TG - Unapproved - Transversal - A...
Dose Volume Histogram
P1_InH - Unapproved - Transversal - A...
Isodoses (Gy)
6.800
5.100
4.250
3.400
1.700
1.190
0.850
0.510
28.752 Gy
26.046 Gy
skin max
rib max
Dose [Gy] X [cm] Y [cm]
4.802 8.76 10.66
4.614 8.76 10.66
Standard
Head First-Sup
Z: 31.28 cm
Relative dose [%]
0 58.823 117.64 176.47
Ratio of Total Structure Volume [%]
Dose [Gy]
Some structures are unapproved or rejected
P1_TG - Unapproved - Frontal - ANON
P1_TG - Unapproved - Sagittal - ANON
P1_InH - Unapproved - Frontal - ANON
P1_InH - Unapproved - Sagittal - ANON
269.634 Gy
503.404 Gy
177.683 Gy
162.080 Gy
Y: 9.43 cm
X: 11.11 cm

Mammosite Results

MammoSite		PTV_mean(Gy)	Skin maxGy)	lung_max (Gy)	rib_max (Gy)
TG43	Average	**4.45**	**3.89**	**2.79**	**4.08**
	SD	**0.20**	**0.71**	**1.06**	**1.67**
Acuros	Average	**4.24**	**3.61**	**2.58**	**3.87**
	SD	**0.22**	**0.69**	**0.97**	**1.60**
TG43/Acuros		**1.05**	**1.08**	**1.08**	**1.06**
P-value		3.06705E-05	3.69364E-05	0.004	0.003

Dosimetric Comparison of TG-43 Formalism with BrachyVision Acuros and Monte Carlo Method for Partial Breast Irradiation with MammoSite Device

Kuan Ling Chen, PhD. Radiation Oncology, Washington University School of Medicine, St. Louis, MO.


P1_TG - Unapproved - Transversal - C...
Dose Volume Histogram
P1_InH - Unapproved - Transversal - C...
Isodoses (Gy)
6.800
5.100
4.250
3.400
1.700
1.190
0.850
0.510
Relative dose [%]
0
147.05
294.11
Ratio of Total Structure Volume [%]
Dose [Gy]
See Dose Coverage and Sampling Coverage in Dose Statistics!
Some structures are unapproved or rejected
118.257 Gy
calc pt
Dose [Gy] X [cm]
3.591 11.89
3.473 11.89
Standard
Head First-Supine
Z: 31.18 cm
P1_TG - Unapproved - Frontal - CT_1
P1_TG - Unapproved - Sagittal - CT_1
P1_InH - Unapproved - Frontal - CT_1
P1_InH - Unapproved - Sagittal - CT_1
101.670 Gy
23.357 Gy
28.485 Gy
20.360 Gy
Y: 2.85 cm
X: 11.73 cm

SAVI results

SAVI		PTV_v99 (%)	PTV_mean(Gy)	Skin (Gy(	lung_max (Gy)	rib_max (Gy)
TG43	Avg	87.79	6.06	6.84	1.21	1.55
	SD	5.49	0.36	2.74	1.05	1.54
Acuros	Avg	83.64	5.81	6.57	1.12	1.47
	SD	5.75	0.35	2.62	1.00	1.48
TG43/Acuros		1.05	**1.04**	**1.04**	**1.08**	**1.05**
P-value		5.7941E-06	2.43584E-05	0.091	0.011	0.043

OR24 Presentation Time: 4:15 PM

Dosimetric Comparison of TG-43 Formalism with Brachyvision Acuros and Monte Carlo Method for Patients Treated with the Savi Partial Breast Applicator

Susan Richardson, PhD[1], Kuan L. Chen, PhD[1], Ramiro Pino, PhD[2], Charles Bloch, PhD[1], Parag Parikh, MD[1]. [1]Radiation Oncology, Washington University School of Medicine, St Louis, MO; [2]Radiation Oncology, The Methodist Hospital, Houston, TX.

Conclusions

- The experts agree if you are using TG43 for APBI–
  - If you are using high levels of contrast – your overall dose is decreased
  - Skin dose is decreased ~ 4-10%
  - Dose to ribs is decreased ~ 5 -7%
  - Dose coverage is probably slightly reduced
- New methods of dose calculation are promising and show we have gains to be made in accuracy