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

IV SESSIONE

IGRT vs 3D-CRT: Vantaggi e Limiti

a cura di: Elisa D'Angelo, Lucia Anna Ursini,
Alba Fiorentino, Vincenzo Fusco , Giovanni Silvano

Moderatori: Laura Lozza, Marica Valli

Rapporter: Alba Fiorentino

Discussant: Giovanni Silvano

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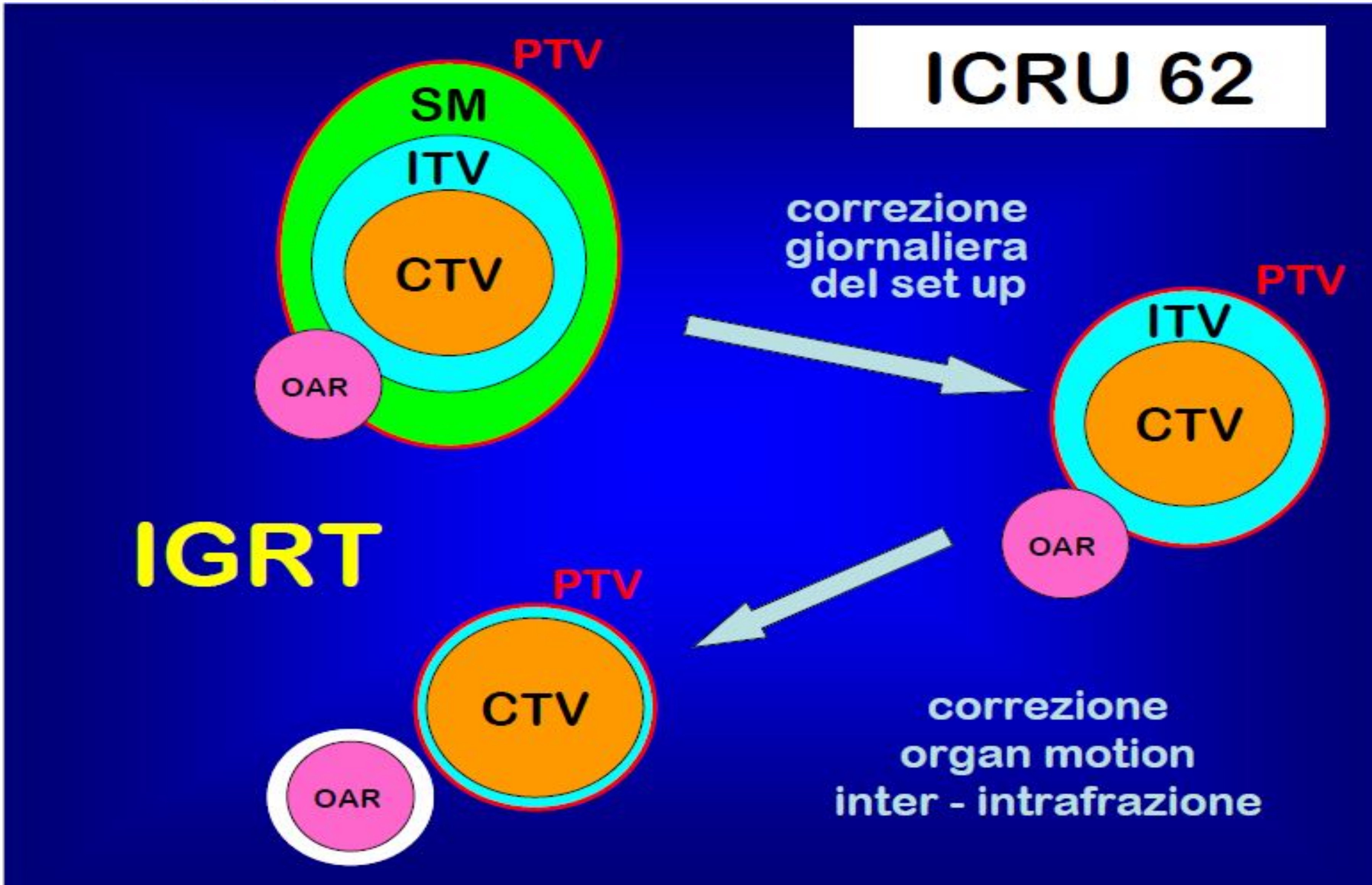

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IGRT

(Radioterapia Guidata dalle immagini)

> Precisione

> Risparmio OAR

Dose escalation

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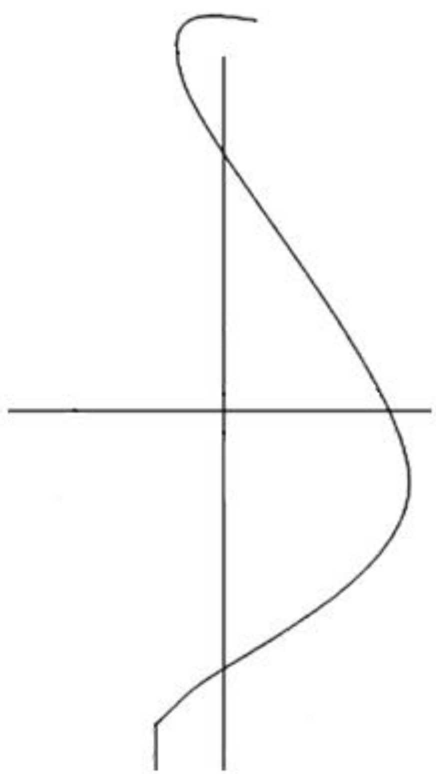
> Precisione



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RADIATION ONCOLOGY—REVIEW ARTICLE

Inter- and intra-fraction motion during radiation therapy to the whole breast in the supine position: A systematic review

Andrea Michalski,[1,2] John Atyeo,[1] Jennifer Cox[1,2] and Marianne Rinks[1,2]

Journal of Medical Imaging and Radiation Oncology **56** (2012) 499–509

Table 1. Measurements typically taken to determine the magnitude of inter- and intra-fraction motion

Measurement	Definition
Central lung distance	The distance between the chest wall and posterior border at the level of central axis
Central beam edge to skin/ central flash distance	The distance from the anterior breast outline to the anterior field edge at the level of central axis
Cranio-caudal distance	The distance from the infra-mammary fold to the inferior field edge
Central irradiated width	The distance between the posterior field border and the anterior breast outline
Central breast distance	The distance between the chest wall and the anterior breast outline at the level of central axis
Inferior central axis margin†	The distance between the inferior breast outline to the inferior field border at the level of central axis

†This parameter is not commonly measured and will therefore not be discussed further.

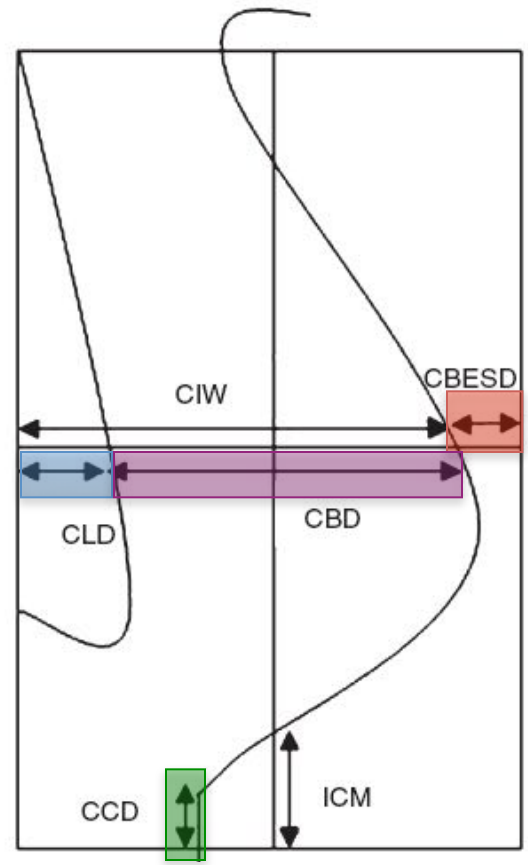

Fig. 1. Measurements typically taken to determine the magnitude of inter- and intra-fraction motion: Central lung distance (CLD), central beam edge to skin distance (CBESD), cranio-caudal distance (CCD), central irradiated width (CIW), central breast distance (CBD) and inferior central axis margin (ICM).

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Table 7. Combined results for the magnitude of systematic error in breast cancer patients

Parameter (mm)	Combined results		
	Range of average difference (SD)†	Average difference	Range maximum deviations‡
CLD (eight articles)[5,7,40,42,45–47,49]	0.03 (3.9)–4.0 (–)	2.42	2.2–20
CIW (three articles)[46,47,49]	0.98 (3.6)–3.3 (2.6)	1.99	7.6–16.3
CBESD (five articles)[5,7,46,47,49]	1.94 (3.3)–3.4 (4.3)	2.49	6.9–14.1
CCD (five articles)[5,45–47,49]	0.63 (3.8)–4.2 (–)	1.92	4.6–17.7

Inter-fraction motion is larger than intra-fraction motion, but the average magnitude of movement is generally very small and similar across a number of the studies reviewed.

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Clinical Investigation: Breast Cancer

Int J Radiation Oncol Biol Phys, Vol. 84, No. 2, pp. 331–335, 2012

Four-Dimensional Measurement of the Displacement of Internal Fiducial and Skin Markers During 320-Multislice Computed Tomography Scanning of Breast Cancer

Hideomi Yamashita, M.D., Ph.D.,* Kae Okuma, M.D.,* Keiichiro Tada, M.D., Ph.D.,† Kenshiro Shiraishi, M.D., Ph.D.,* Wataru Takahashi, M.D.,* Shino Shibata-Mobayashi, M.D.,* Akira Sakumi, Ph.D.,* Naoya Saotome, M.Sc.,* Akihiro Haga, Ph.D.,* Tsuyoshi Onoe, M.D.,* Kenji Ino, R.T.T.,* Masaaki Akahane, M.D., Ph.D.,* Kuni Ohtomo, M.D., Ph.D.,* and Keiichi Nakagawa, M.D., Ph.D.*

20 pazienti

Table 1 Average marker displacements between maximum and minimum

Parameter	Mean (mm)	SD (mm)	Range (mm)
Skin marker			
X (L/R)	1.1	0.26	0.3–1.9
Y (A/P)	2.1	0.61	0.7–3.4
Z (S/I)	1.6	0.41	0.7–2.6
Internal clip			
X (L/R)	0.9	0.24	0.3–1.8
Y (A/P)	1.7	0.49	1.0–2.2
Z (S/I)	1.1	0.28	0.3–1.8

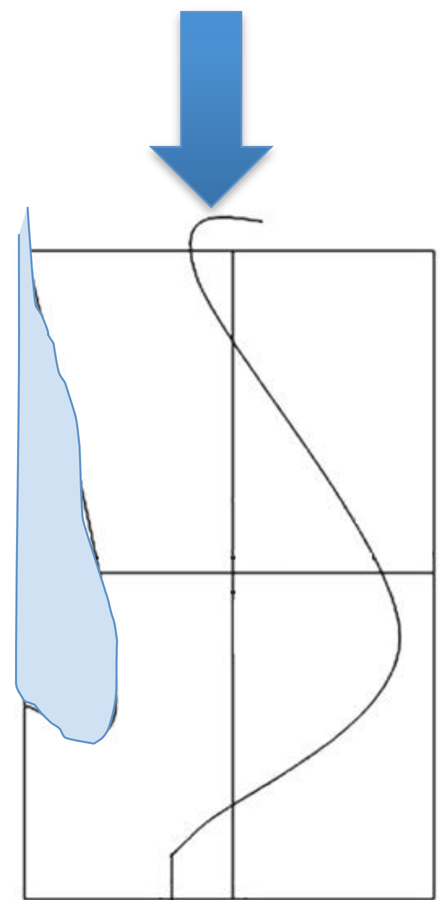
Abbreviations: L/R = left–right; A/P = anterior–posterior; SI = superior–inferior.

Table 3 Rate of geographic miss by margins

Margin (mm)	Missed cases (%)	Missed respiratory phases (%)
L/R		
<0.5	24	1.5
<1	4	0.1
<1.5	0	0
A/P		
<0.5	96	30
<1	30	3
<1.5	4	0.2
<2	0	0
S/I		
<0.5	64	15
<1	18	1
<1.5	1	0.01
<2	0	0

> Risparmio OAR

Do



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Physics Contribution

Image-Guided Radiotherapy for Left-Sided Breast Cancer Patients: Geometrical Uncertainty of the Heart

Rajko Topolnjak, Ph.D., Gerben R. Borst, M.D., Ph.D., Jasper Nijkamp, M.Sc., and Jan-Jakob Sonke, Ph.D.

Int J Radiation Oncol Biol Phys, Vol. 82, No. 4, pp. e647–e655, 2012

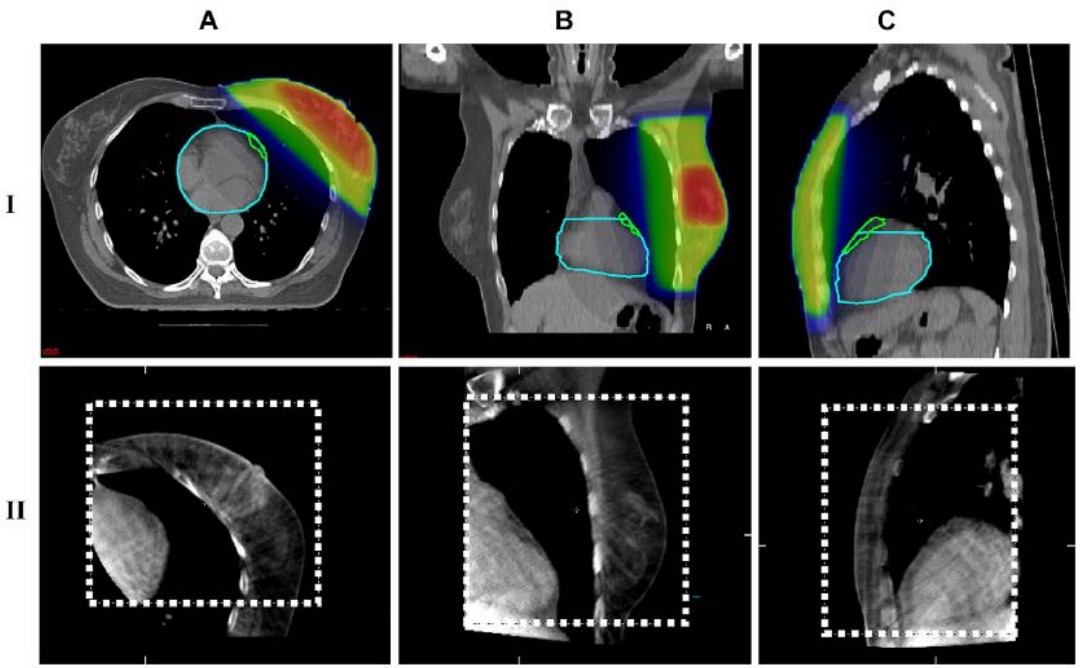

Table 1 Heart position uncertainties (group mean [M], systematic [Σ], random [σ] error, uncertainties induced by breathing [σ_{resp}], total random error [σ_{tot}]) and required planning organ at risk volume (PRV) margins (M_{heart}) when offline and online setup corrections were based on the ribs and sternum

	Offline			Online		
	LR	CC	AP	LR	CC	AP
M (mm)	0.7	1.7	−0.5	0.0	1.4	0.8
Σ (mm)	2.4	3.7	2.2	2.2	3.2	2.1
σ (mm)	2.9	4.1	2.7	2.1	2.9	1.4
σ_{resp} (mm)	1.4	2.9	1.4	1.4	2.9	1.4
$\sigma_{tot} = \sqrt{\sigma^2 + \sigma^2_{resp}}$ (mm)	3.2	5.0	3.0	2.5	4.3	2.5
$M_{heart} = 1.3\Sigma\text{-}0.5\sigma_{tot}$ (mm)	1.6	2.3	1.3	1.6	2.1	1.4

Abbreviations: AP = anteroposterior; CC = craniocaudal; LR = left-right.

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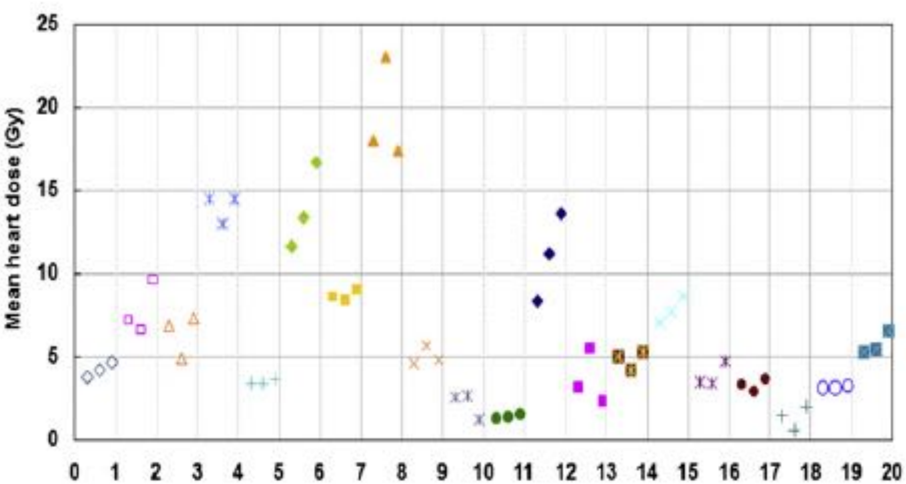
I. J. Radiation Oncology ● Biology ● Physics Volume 82, Number 5, 2012

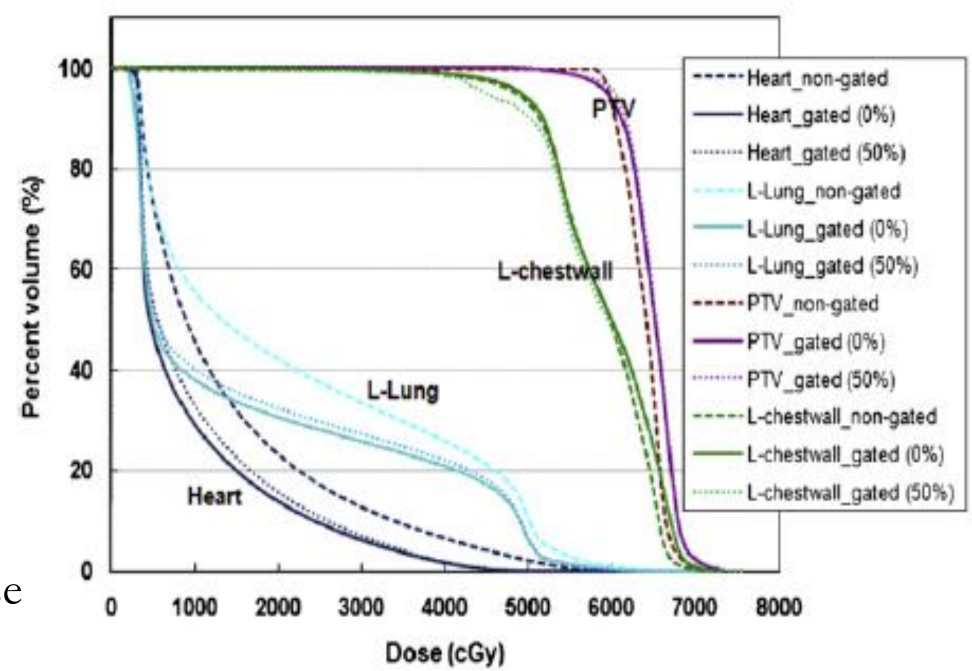
PHYSICS CONTRIBUTION

RESPIRATION INDUCED HEART MOTION AND INDICATIONS OF GATED DELIVERY FOR LEFT-SIDED BREAST IRRADIATION

X. Sharon Qi, Ph.D.,* Angela Hu, Ph.D.,* Kai Wang, M.D.,† Francis Newman, M.S.,* Marcus Crosby, M.D.,† Bin Hu, M.S.,† Julia White, M.D.,† and X. Allen Li, Ph.D.†



A respiro libero, MHD e DLAD variano fino a 9-11mm, determinando un incremento della dose media al cuore e della V25



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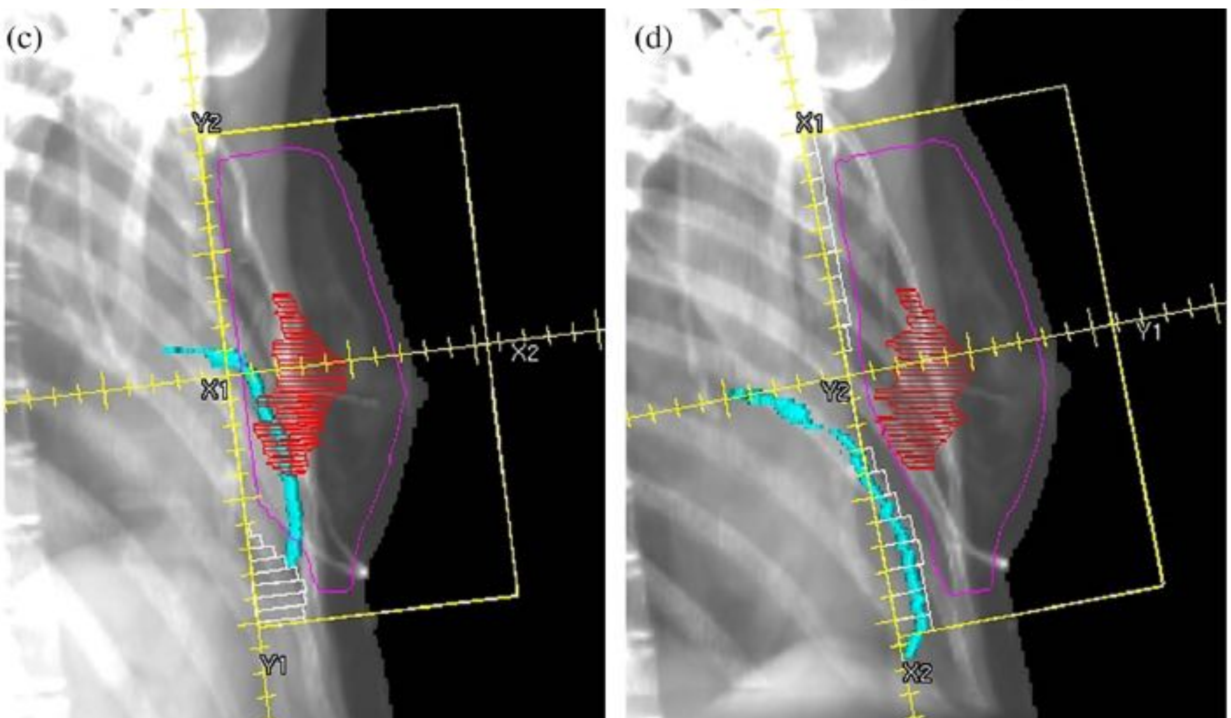
CLINICAL INVESTIGATION **Physics**

RAPID AUTOMATED TREATMENT PLANNING PROCESS TO SELECT BREAST CANCER PATIENTS FOR ACTIVE BREATHING CONTROL TO ACHIEVE CARDIAC DOSE REDUCTION

WEI WANG, M.B.B.S.,*† THOMAS G. PURDIE, PH.D.,*† MOHAMMAD RAHMAN, B.SC.,*
ANDREA MARSHALL, B.SC.,* FEI-FEI LIU, M.D.,*† AND ANTHONY FYLES, M.D.*†

I. J. Radiation Oncology ● Biology ● Physics Volume 82, Number 1, 2012



Respiro libero

Inspirazione

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RAPID AUTOMATED TREATMENT PLANNING PROCESS TO SELECT BREAST CANCER PATIENTS FOR ACTIVE BREATHING CONTROL TO ACHIEVE CARDIAC DOSE REDUCTION

Table 1. Dosimetric comparison between free-breathing and moderate deep inspiration breath-hold technique plans for 20 patients

Variable	FB plans	mDIBH plans	Relative reduction (%)	*p* (paired *t* test)
Heart				
Heart V_{50}, absolute volume (cm^3)				
Mean	29.9	3.7	88	<.001
Range	10.6–96.7	0–23.4		
Heart V_{50}, proportion (%)				
Mean	4.7	0.6	87	<.001
Range	1.5–14.3	0–2.9		
Heart dose (cGy)				
Mean	317.4	131.7	59	<.001
Range	153–738.5	74.2–224.5		
LAD				
Length within radiotherapy field (cm)				
Median	6	0	–	–
Range	4–10	0–6		
LAD dose (cGy)				
Mean	2,047.4	594.6	71	<.001
Range	1,174–3,146	193.4–1,943		
D0.2 cm^3				
Mean	4,155.5	1,507.5	64	<.001
Range	3,080–4,920	350–4,150		
Left lung				
Left lung dose (cGy)				
Mean	520.9	503.6	3	.056
Range	321.9–925.5	292.6–923.3		
Left lung V_{20} (%)				
Mean	10.4	9.6	8	.002
Range	5.2–20.3	3.2–20.7		

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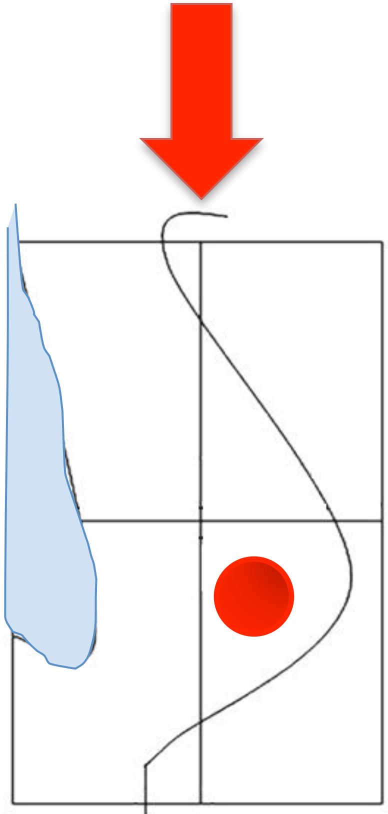
Dose escalation



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Clinical Investigation: Breast Cancer

Validating Fiducial Markers for Image-Guided Radiation Therapy for Accelerated Partial Breast Irradiation in Early-Stage Breast Cancer

Catherine K. Park, M.D., M.P.H.,* Jakub Pritz, M.S.,† Geoffrey G. Zhang, Ph.D.,* Kenneth M. Forster, Ph.D.,* and Eleanor E.R. Harris, M.D.*

Int J Radiation Oncol Biol Phys, Vol. 82, No. 3, pp. e425–e431, 2012

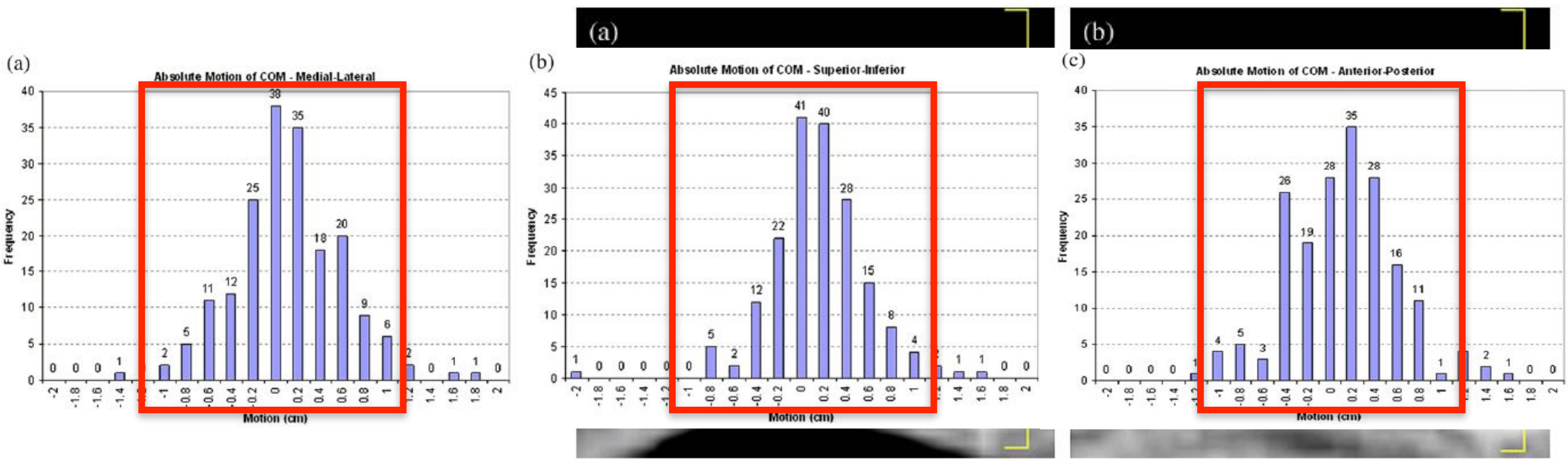

Fig. 1. Fiducials contoured at end-inspiration (green) and end-expiration (red).

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EDITORIAL

Int. J. Radiation Oncology Biol. Phys., Vol. 82, No. 4, pp. 1303–1306, 2012

USING RESPIRATORY MOTION TO GUIDE PLANNING TARGET VOLUME MARGINS FOR EXTERNAL BEAM PARTIAL BREAST IRRADIATION

LEONARD H. KIM, M.S., A.MUS.D., SHARAD GOYAL, M.D., BRUCE G. HAFFTY, M.D., NEIL K. TAUNK, M.S., AND NING J. YUE, PH.D.

Table. Partial breast respiratory motion studies

Study						Max or SD
Baglan *et al.* (1						9 mm (max)
Lee *et al.* (2)						7 mm (max 1D)
Becker *et al.* (3						2.5 mm (max)
Ahn (4)						).6 mm (SD)
Bert *et al.* (5)						1.1 mm (SD)
Chopra *et al.* (						5 mm (max 1D)
Morrow *et al.* (						).9 mm (SD)
Yue *et al.* (8)						11 mm (max)
Afghan *et al.* (						3 mm (max 1D)
Park *et al.* (10)						1 mm (SD)
Penninkhof *et*						).6 mm (SD)
Price *et al.* (12						3 mm (max)
Lee *et al.* (13)						4 mm (SD)
Liao *et al.* (14)						).8 mm (SD)
Qi *et al.* (15)						1.3 mm (SD)
Yue *et al.* (16)						).4 mm (SD)
Kirby *et al.* (17						5 mm (max 1D)
Bedi *et al.* (18)						5.5 mm (max)
Harris *et al.* (19)	2011	15	4D-CT	Gold markers	0.8 mm	0.6 mm (SD)

In conclusion, we believe there is something to be gained from assessing respiratory motion for each APBI patient. For most patients, a significant PTV margin reduction from the commonly used 5 mm to 0–2 mm could be justifiable, especially in the medial–lateral direction. Patients with larger or nonrigid motion needing special management can be identified. Intratreatment monitoring is advisable. Further study is needed of interfraction consistency of motion, the correlation of bony and surface surrogates with the target, and the dosimetric impact of using different margins. Similar approaches may be considered

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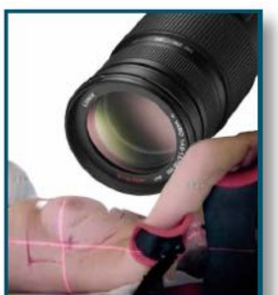
Grazie per l'attenzione



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