Ente Ospedaliero Cantonale

RT della mammella/parete toracica e stazioni linfonodali con tecnica 3DRT o IMRT-LINAC based

Mariacarla Valli MD

European Cancer Care Certification
The Requirements of a Specialist Breast Unit 2010
Certification n° ES010 / 2011 - 3

Centro di Senologia della Svizzera Italiana

Breast/chest wall: *where?*

- ***CTV** after appropriate mastectomy*

cranial	caudal	anter ior	posterior	lateral	medial
clinical references + second rib insertion	clinical references	skin	includes pectoralis muscles, chest wall muscles, ribs	clinical referenc es+ mid axillary line, excludes latissim us dorsi muscle	sternal-rib junction

http://www.rtog.org/pdf_file2.html?pdf_document=breastcanceratlas.pdf

SC nodes: *where?*

Regional nodes: *anatomical boundaries*

	cranial	caudal	anterior	posterior	lateral	medial
supra-clavicular	caudal to cricoid cartilage	caudal edge clavicle head	sternocleido mastoid muscle	anterior aspect of scalene m.	cranial:lat edge of SCM caudal: junction 1° rib-clavicle	excludes thyroid and trachea
axilla-level I	axillary vessels cross lateral edges of pect minor m.	pect major muscle insert into ribs	anterior surface pect maj m. and lat dorsi m.	anterior surface subscapulari s m.	medial border of lat.dorsi m.	lateral border of pec. minor m.
axilla-level II	axillary vessels cross medial edges of pect minor m.	axillary vessels cross lateral edge of pec.minor m.	anterior surface pec. minor m.	ribs and intercostal muscles	lateral border of pec. minor m.	medial border of pec. minor m.
axilla-level III	pect.minor m. insert on cricoid	axillary vessels cross medial edge of pec.minor m	posterior surface pec. minor m.	ribs and intercostal muscles	medial border of pec. minor m.	thoracic inlet
internal mammary	superior aspect of the medial 1° rib	cranial aspect of the 4° rib				

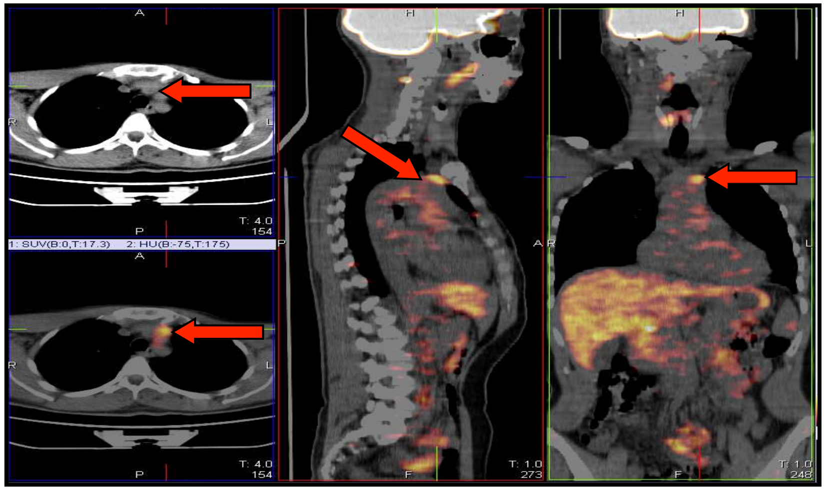
http://www.**rtog**.org/pdf_file2.html?pdf_document=breastcanceratlas.pdf

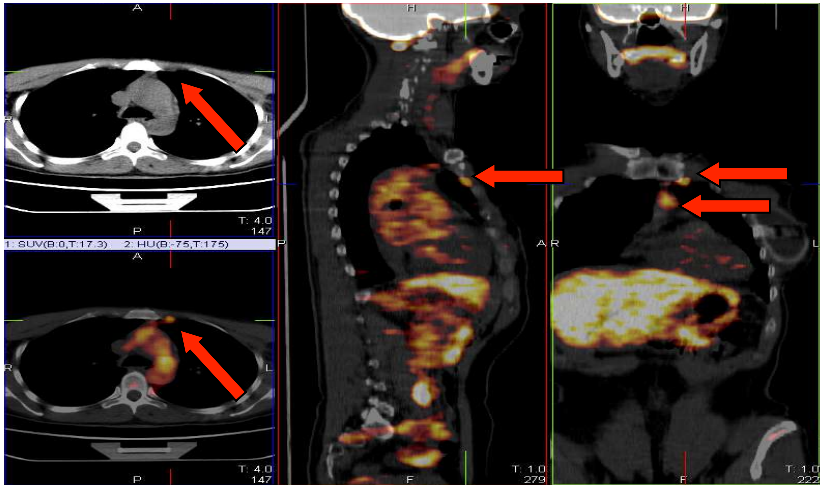
IM chain: *where?*

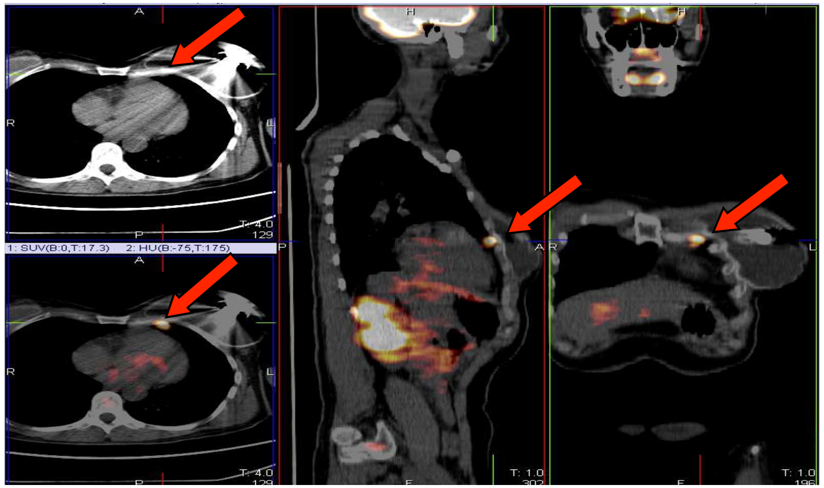
- ***IMC (internal mammary chain) in the EORTC 22922 trial:*** the IM chain is located in the parasternal region, and approximately 85% of the lymph nodes lie within **4 cm lateral to the midline and within 4 cm depth in the first 3 intercostal spaces.** The top of the IM chain lies behind the insertion of the sternocleidal muscle in the medial supraclavicular area .....

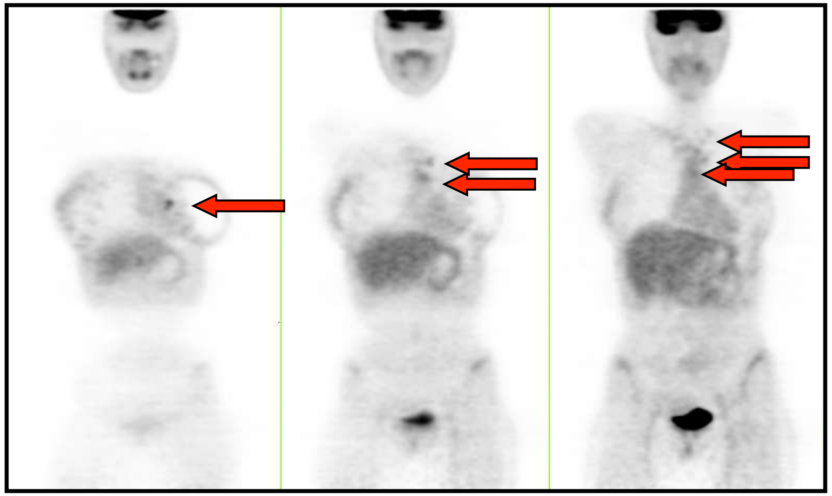
- ***IMC (internal mammary chain) in the French trial:*** the IM chain is located in the **first five intercostal spaces**....

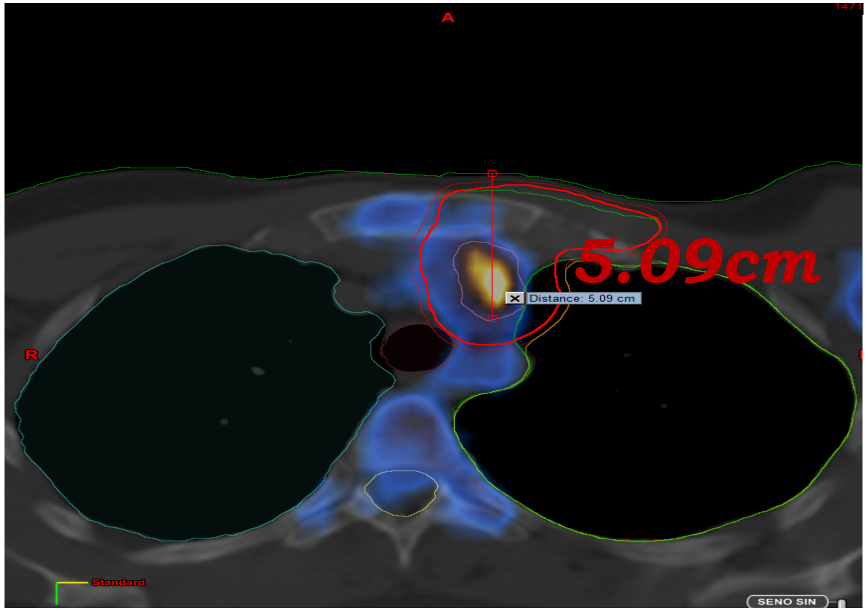
18FDG-PET/CT for treatment planning

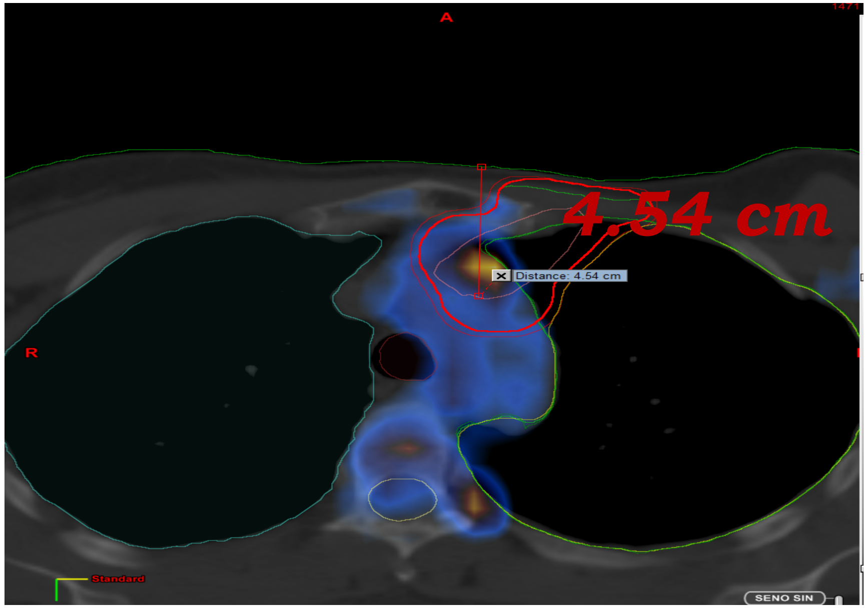


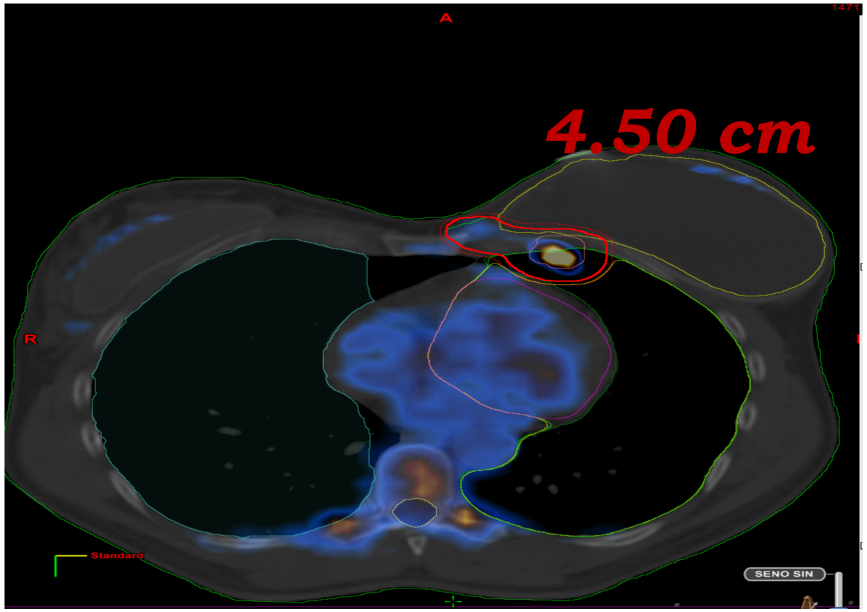


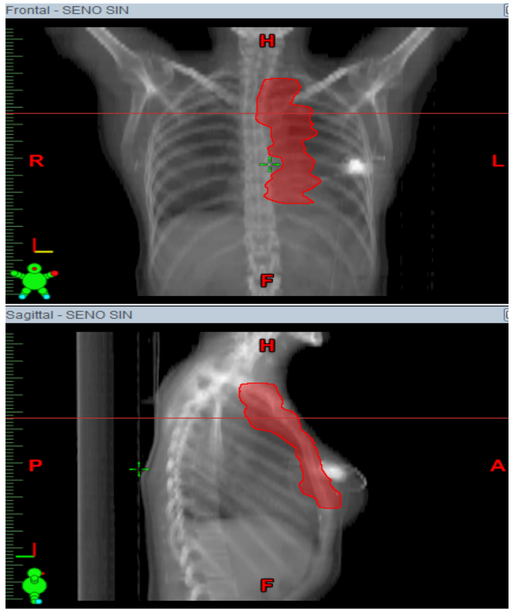





A
R
5.09cm
Distance: 5.09 cm
Standard
SENO SIN


A
R
4.54 cm
Distance: 4.54 cm
Standard
SENO SIN


A
4.50 cm
R
Standard
SENO SIN


Frontal - SENO SIN
H
R
L
F
Sagittal - SENO SIN
H
P
A
F

Radiotherapy and Oncology 108 (2013) 259–265

Contents lists available at SciVerse ScienceDirect

Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com

Breast cancer radiotherapy

Influence of internal mammary node irradiation on long-term outcome and contralateral breast cancer incidence in node-negative breast cancer patients

Adel Courdi [a,*], Emmanuel Chamorey [b], Jean-Marc Ferrero [c], Jean-Michel Hannoun-Lévi [a]

[a] Radiotherapy Department; [b] Department of Biostatistics and Epidemiology; [c] Department of Medical Oncology, Centre Antoine-Lacassagne, Nice, France

Patients and methods *1630 node-negative breast cancer patients treated in our institution between 1975 and 2008 with primary conservative surgery and axillary dissection or sentinel node examination. All patients received post-operative breast RT. IMN RT was more frequent in inner or central tumours. Kaplan–Meier (K–M) overall survival (OS), cancer-specific survival (CSS), and disease-free survival (DFS) according to IMN RT were calculated for all patients and for patients with inner/central tumours. The K–M rate of contralateral breast cancer (CBC) was also analysed and correlated with IMN RT.*

Results *Prognostic variables such as tumour size, histological grade, and hormone receptors were not significantly different in the groups having received IMN RT or not. Considering all patients, OS was strictly comparable in the 2 groups: 10-year values were 85% (IMN RT) and 86% (no IMN RT), respective values at 20years were 66.6% and 61.0% (p=0.95). However, in patients presenting with inner/central tumours,* ***OS was significantly improved in the IMN RT group with respective values of 92.5% and 87.2% at 10years, and 80.2% and 63.3% at 20years****: Hazard ratio (HR)=0.56 (0.37–0.85); p=0.0052. Again, CSS was improved in patients with inner/central tumours having received IMN RT, with 20-year rates of 89.5% versus 79.1% in patients not receiving IMN RT (p=0.047). No difference in DFS was noticed. The actuarial rate of CBC development was comparable between patients having received IMN RT and other patients. However, considering only patients alive 10years after primary breast surgery, the K–M rate of CBC at 20years was 5.3% in patients without IMN RT and 7.2% in patients with such RT; HR=2.47 (1.23–4.95); p=0.008.*

Conclusions ***IMN RT in node-negative tumours was associated with increase in OS and CSS in patients with inner or centrally located lesions. An increase in CBC development was also noticed in long-survivors of IMN RT patients;*** *however, these findings have to be interpreted with caution because of the difference in follow-up between the 2 groups.*

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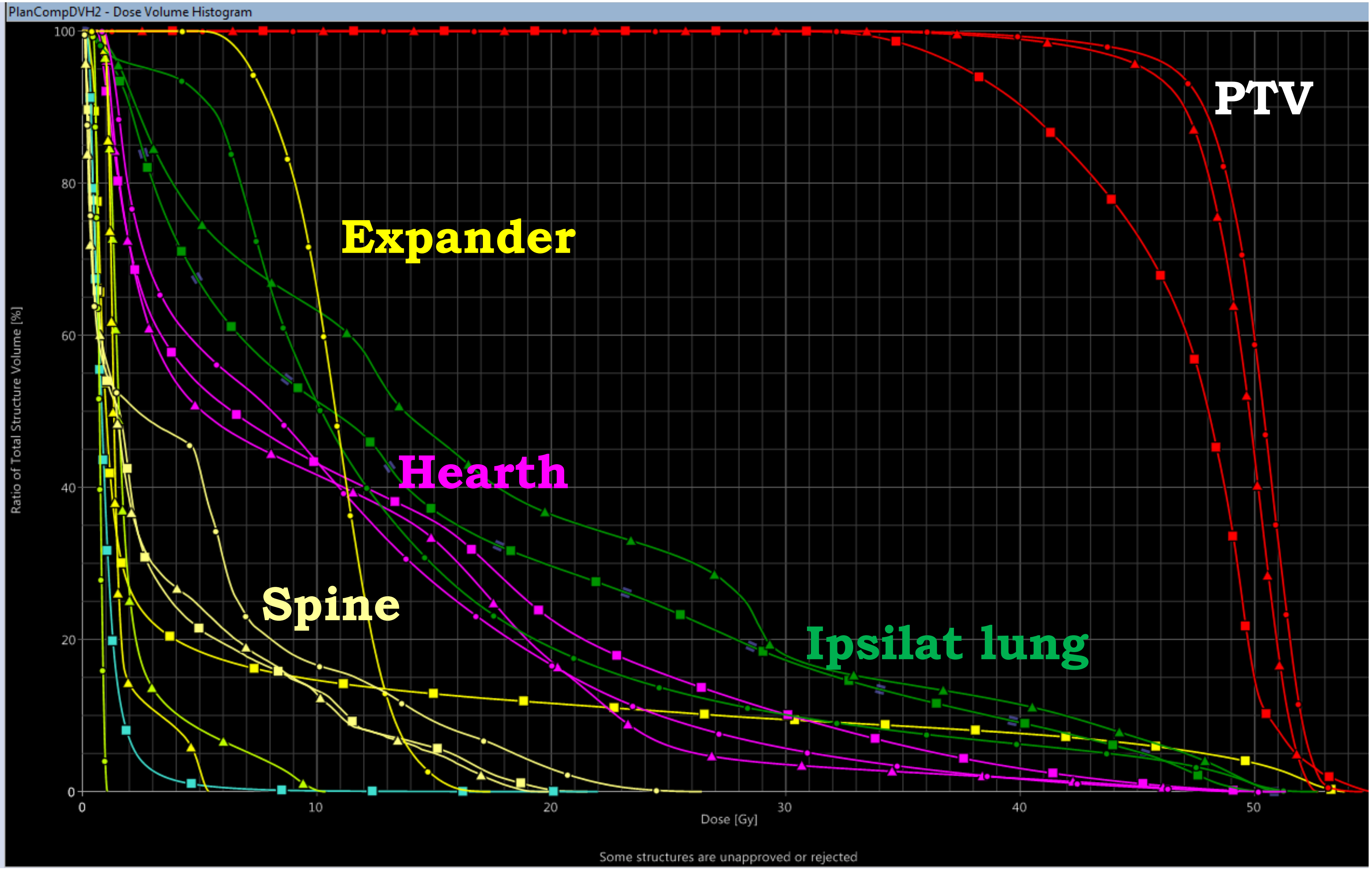
RT technique:

…post-op RT to the breast by two tangential fields of photon beams.

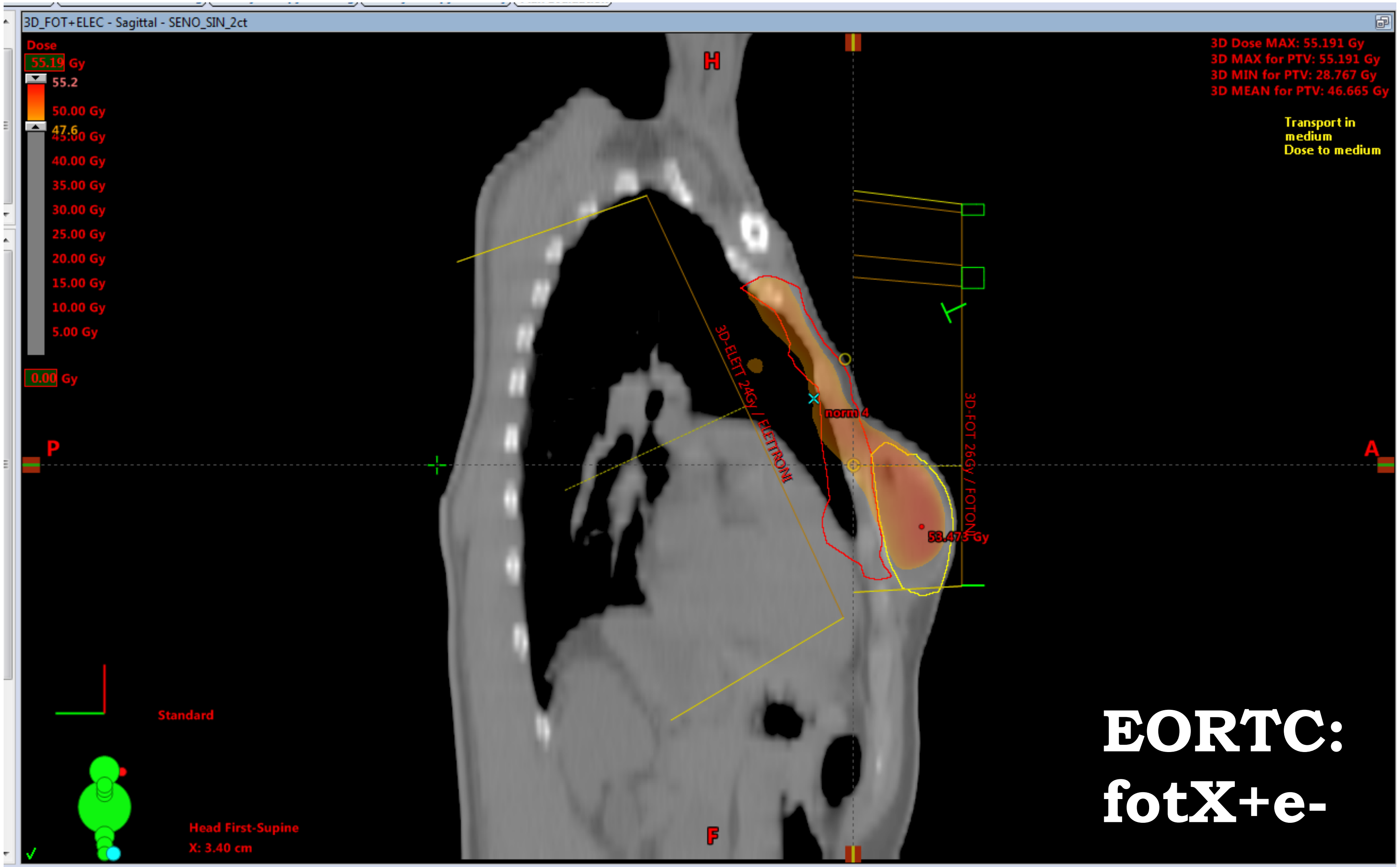
…RT on IMN in 489 patients: a typical IMN field size was 5 or 6 cm wide by 10 long, with the upper border at the supraclavicular notch, and the medial edge set 1 cm beyond the midline. A mixture of photons and electrons was used, with the photon field angled 10°. The dose was prescribed mostly at 3 cm depth.

IM chain: *which technique?*

- ***EORTC technique:*** direct photons field 26 Gy + direct electrons field 24 Gy ■
- ***3DCRT 6MV*** ▲
- ***RapidArc 6MV*** ●



EORTC technique: *direct field Photons 26 Gy+ direct field electrons 24 Gy* ■
3DCRT 6MV▲ RapidArc 6MV ●



EORTC: fotX+e-

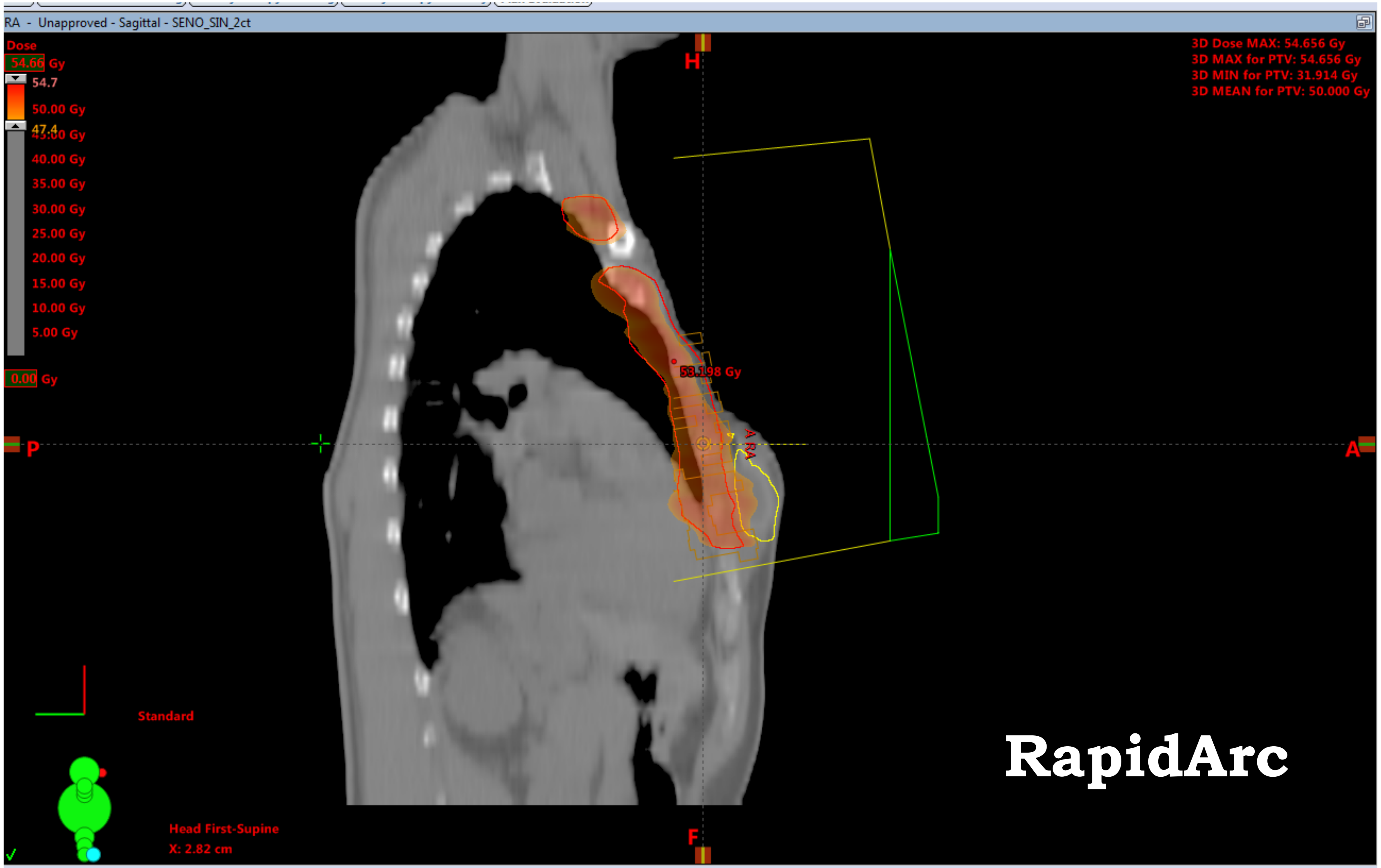
Plan Sum

Operation	Plan Weight	Target Volume	Primary Reference Point [Volume]	Prescribed Percentage [%]	Dose / Fraction [Gy]	Number of Fractions	Total Prescribed Dose [Gy]	Plan Normalization Mode	Field ID	MU	Field Weight
	1.00	PTV	norm 4 [PTV]	100.0	2.000	13	26.000	100% in Reference Point norm 4	FOTONI	163	1.000
	1.00	PTV	norm 4 [PTV]	100.0	2.000	12	24.000	Plan Normalization Value: 87.00	ELETTRONI	201	1.000

n Sum

peration	Plan Weight	Target Volume	Primary Reference Point [Volume]	Prescribed Percentage [%]	Dose / Fraction [Gy]	Number of Fractions	Total Prescribed Dose [Gy]	Plan Normalization Mode	Field ID	MU	Field Weight
	1.00	PTV	norm 4 [PTV]	100.0	2.000	13	26.000	100% in Reference Point norm 4	FOTONI	163	1.000
	1.00	PTV	norm 4 [PTV]	100.0	2.000	12	24.000	Plan Normalization Value: 87.00	ELETTRONI	201	1.000

LC	Field Weight	Scale	Gantry Rtn [deg]	Coll Rtn [deg]	Couch Rtn [deg]	Wedge	Field X [cm]	X1 [cm]	X2 [cm]	Field Y [cm]	Y1 [cm]	Y2 [cm]	X [cm]	Y [cm]	Z [cm]	Calculated SSD [cm]	MU	Ref. D [Gy]
tic	0.550	Varian IEC	300.0	10.0	0.0	W30R20	8.8	+7.3	+1.5	20.3	+5.8	+14.5	3.50	-18.78	-0.00	97.0	80	0.629
tic	0.750	Varian IEC	0.0	0.0	0.0	None	7.7	+5.2	+2.5	18.1	+5.7	+12.4	3.50	-18.78	-0.00	96.1	74	0.833
tic	0.100	Varian IEC	40.0	0.0	0.0	W30L20	8.8	+4.6	+4.2	18.0	+5.6	+12.4	3.50	-18.78	-0.00	93.2	17	0.141
tic	0.450	Varian IEC	120.0	350.0	0.0	W15L20	9.0	+1.6	+7.4	20.1	+5.6	+14.5	3.50	-18.78	-0.00	89.7	64	0.649



	Field Weight	Scale	Gantry Rtn [deg]	Coll Rtn [deg]	Couch Rtn [deg]	Wedge	Field X [cm]	X1 [cm]	X2 [cm]	Field Y [cm]	Y1 [cm]	Y2 [cm]	X [cm]	Y [cm]	Z [cm]	Calculated SSD [cm]	MU	Ref. D [Gy]
T	1.189	Varian IEC	295.0 CW 90.0	10.0	0.0	None	17.0	+7.1	+10.0	20.5	+6.4	+14.1	3.50	-18.78	-0.00	96.5	229	

Peripheral dose: *risk of secondary cancer*

4’581 patients at least 2-year survivors of pediatric solid cancer of lymphoma treated between 1942 and 1986.
Median follow-up **15.4 years**
162 patients presented a SMN at least 2 years after diagnosis of FMN:
27 did not receive RT
115 were included in the analysis

FREQUENCY DISTRIBUTION OF SECOND SOLID CANCER LOCATIONS IN RELATION TO THE IRRADIATED VOLUME AMONG 115 PATIENTS TREATED FOR CHILDHOOD CANCER

IBRAHIMA DIALLO, PH.D.,*†‡§ NADIA HADDY, PH.D.,*†‡§ ELISABETH ADJADJ, PH.D.,*†‡§ AKHTAR SAMAND, PH.D.,*†‡§ ERIC QUINIOU, PH.D.,|| JEAN CHAVAUDRA, PH.D.,§ IANNIS ALZIAR, M.SC.,*†‡§ NATHALIE PERRET, M.SC.,*†‡§ SYLVIE GUÉRIN, PH.D.,*†‡§ DIMITRI LEFKOPOULOS, PH.D.,§ AND FLORENT DE VATHAIRE, PH.D.*†‡§

*U605 Institut National de la Santé et de la Recherche Médicale (INSERM), Villejuif, France; †Institut Fédératif de Recherche Santé Publique Paris Sud (IFR 69), Villejuif, France; ‡Université Paris XI, Villejuif, France; §Institut Gustave-Roussy, Villejuif, France; and ||U759 Institut National de la Santé et de la Recherche Médicale (INSERM), Orsay, France

Three-dimensional geometry was used to evaluate the distances between the irradiated volume, for RT delivered to each FMN, and the site of the subsequent SMN.

Results The spatial distribution of SMN relative to the irradiated volumes in our cohort was as follows: 12% in the central area of the irradiated volume, which corresponds to the planning target volume (PTV), 66% in the beam-bordering region (i.e., the area surrounding the PTV), and 22% in regions located more than 5 cm from the irradiated volume. At the SMN site, all dose levels ranging from almost zero to >75 Gy were represented.
A peak SMN frequency of approximately 31% was identified in volumes that received <2.5 Gy
A greater volume of tissues receives low or intermediate doses in regions bordering the irradiated volume with modern multiple-beam RT arrangements.

Int. J. Radiation Oncology Biol. Phys., Vol. 74, No. 3, pp. 876–883, 2009

Cardiac dose: *risk of hearth disease*

…..the main life-threatening risk of breast cancer radiotherapy is earth disease, which increases with increasing dose received by the hearth. Cardiac doses have reduced since old trials were performed: ***the average hearth dose from post-mastectomy RT worldwide is now around 7 Gy for left sided irradiation which is likely to result in around 1% absolute increase in risk of death from hearth disease for a previously healthy 50 year old woman!!!…….***

…..a joint analysis of the Hodgkin's and breast cancer data (59,60), summarized by QUANTEC, produced a dose– response curve for cardiac mortality. ***QUANTEC proposed a conservative approach, predicting that a V25 <10% of the heart will be associated with a <1% probability of cardiac mortality at 15 years after radiotherapy.***

EBCTCG 29 september 2013

Reports of Radiotherapy and Oncology **Tolerance of Normal Tissue to Therapeutic Radiation** Dr Emami B Department of Radiation Oncology, Loyola University Medical Center, Maywood, Illinois, USA

Radiotherapy and Oncology 108 (2013) 254–258

Contents lists available at SciVerse ScienceDirect

Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com

Cardiac dosimetry in breast cancer

Inter-observer variation in delineation of the heart and left anterior descending coronary artery in radiotherapy for breast cancer: A multi-centre study from Denmark and the UK

Ebbe L. Lorenzen[a,b,*], Carolyn W. Taylor[c], Maja Maraldo[d], Mette H. Nielsen[e], Birgitte V. Offersen[f], Maria R. Andersen[a], Dean O'Dwyer[a], Lone Larsen[g], Sharon Duxbury[h], Baljit Jhitta[h], Sarah C. Darby[c], Marianne Ewertz[e,b], Carsten Brink[a,b]

[a] Laboratory of Radiation Physics, Odense University Hospital; [b] Institute of Clinical Research, University of Southern Denmark, Odense, Denmark; [c] Clinical Trial Service Unit, Oxford, United Kingdom; [d] Department of Radiation Oncology, Rigshospitalet, Copenhagen; [e] Department of Oncology, Odense University Hospital; [f] Department of Oncology, Aarhus University Hospital; [g] Department of Oncology, Hospital of Aalborg, Denmark; [h] Radiotherapy Department, Churchill Hospital, Oxford, United Kingdom

Background and purpose *extent of inter-observer variation in delineation of the heart and left anterior descending coronary artery (LADCA) and its impact on estimated doses.*

Methods and materials *9 observers from 5 centres delineated the heart and LADCA on 15 patients receiving left breast radiotherapy. The delineations were carried out twice, first without guidelines and then with a set of **common guidelines**.*

Results *For the heart, **most spatial variation in delineation was near the base of the heart** whereas for the **LADCA most variation was in its length at the apex of the heart**.*
Common guidelines reduced the spatial variation for the heart and the length of the LAD, but increased the variation in the anterior–posterior/ right–left plane.
The coefficients of variation (CV) in the estimated doses to the heart were: mean dose 7.5% without and 3.6% with guidelines, maximum dose 8.7% without and 4.0% with guidelines. The CVs in the estimated doses to the LADCA were: mean dose 27% without and 29% with guidelines, maximum dose 39% without and 31% with guidelines.

Conclusions *For the heart, there was little inter-observer variation in the estimated dose, especially when guidelines were used. In contrast, for the **LADCA there was substantial variation in the estimated dose, which was not reduced with guidelines**.*

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Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com

Phase III randomised trial

The UK HeartSpare Study: Randomised evaluation of voluntary deep-inspiratory breath-hold in women undergoing breast radiotherapy

Frederick R. Bartlett[a,*], Ruth M. Colgan[b], Karen Carr[a], Ellen M. Donovan[b], Helen A. McNair[a], Imogen Locke[a], Philip M. Evans[b,c], Joanne S. Haviland[d], John R. Yarnold[a,e], Anna M. Kirby[a]

[a] Department of Academic Radiotherapy, Royal Marsden NHS Foundation Trust; [b] Joint Department of Physics, Royal Marsden NHS Foundation Trust and Institute of Cancer Research, Sutton; [c] Centre for Vision, Speech and Signal Processing, Faculty of Engineering and Physical Sciences, University of Surrey, Guildford; [d] Clinical Trials and Statistics Unit (ICR-CTSU); and [e] Division of Radiotherapy and Imaging, Institute of Cancer Research, Sutton, UK

Purpose: *To determine whether* ***voluntary deep-inspiratory breath-hold (v_DIBH) and deep-inspiratory breath-hold with the active breathing coordinator™ (ABC_DIBH)*** *in patients undergoing left breast radiotherapy are comparable in terms of normal-tissue sparing, positional reproducibility and feasibility of delivery.*

Results: ***23 patients*** *were recruited. All completed treatment with both techniques. EPI derived R were 61.8 mm (v_DIBH) and 62.0 mm (ABC_DIBH) and r 62.5 mm (v_DIBH) and 62.2 mm (ABC_DIBH) (all p non-significant). CBCT-derived R were 63.9 mm (v_DIBH) and 64.9 mm (ABC_DIBH) and r 6 4.1 mm (v_DIBH) and 6 3.8 mm (ABC_DIBH). There was no significant difference between techniques in terms of normal-tissue doses (all p non-significant). Patients and radiographers preferred v_DIBH (p = 0.007, p = 0.03, respectively). Scanning/treatment setup times were shorter for v_DIBH (p = 0.02, p = 0.04, respectively).*

- **v_DIBH and ABC_DIBH are comparable in terms of positional reproducibility and normal tissue sparing.**
- **v_DIBH is preferred by patients and radiographers, takes less time to deliver, and is cheaper than ABC_DIBH.**

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Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com

Cardiac dosimetry in breast cancer

Left-sided breast cancer radiotherapy with and without breath-hold: Does IMRT reduce the cardiac dose even further?

Mirjam E. Mast [a,*], Loes van Kempen-Harteveld [a,1], Mark W. Heijenbrok [b,2], Yamoena Kalidien [a,1], Hans Rozema [a,1], Wim P.A. Jansen [c,3], Anna L. Petoukhova [a,1], Henk Struikmans [a,c,3]

[a] Radiotherapy Centre West; [b] Department of Radiology, Medical Center Haaglanden, The Hague; [c] Department of Clinical Oncology, Leiden University Medical Center, The Netherlands

Purpose: *RT for left-sided breast cancer, Active Breathing Control enables a decrease of cardiac and Left Anterior Descending (LAD) coronary artery dose. We compared 3D-CRT to IMRT (Step-and Shoot) treatment plans based on free-breathing (FB) and breath-hold (BH).*
We investigated whether IMRT enables an additional decrease of cardiac dose in radiotherapy plans with and without BH.

Methods and materials: 20 patients referred for whole breast irradiation were included. The whole breast, heart and LAD-region were contoured. 4 treatment plans were generated: FB_3D-CRT; FB_IMRT; BH_3D-CRT; BH_IMRT. Several doses were obtained from Dose Volume Histograms and compared.

- Heart and LAD-region: **significant dose reduction (20%) was found in BH ($p < 0.01$)**
- Both BH and FB: significant dose reduction was found using IMRT ($p < 0.01$)
- IMRT an average reduction of **5%** was noted in the LAD-region for the volume receiving 20 Gy.

In 5 cases the LAD-region close to the radiation portals even in BH: with IMRT the LAD dose was reduced in these cases.

IMRT results in a significant additional decrease of dose in the heart and LAD-region in both breath-hold and free-breathing.

Objective: *To report the advantages and disadvantages of the Deep Inspiration Breath-Hold (DIBH) in patients (pts) treated with post-operative RT after conservative surgery or mastectomy for left breast cancer.*

Materials and Methods: *235 pts treated from january 2009 to january 2012 were analyzed: 208 were treated on the whole breast, 11 on the surgical bed with Partial Breast Irradiation (PBI) and 16 on the left chest wall. A free-breathing CT and a DIBH CT were acquired and compared for each pt; DVH for heart, ipsilateral lung and controlateral breast were assessed. Patients were monitored with Varian RPM system and the gating window was individually set. We checked the correct positioning with three consecutive daily portal vision (PV) and then once a week PV until the end of treatment.*

No gating if*…inability to correctly breath (15,7%), neurological/psychiatric disorders (6%).*

Conclusion: *In our RT series the main reason preventing the use of gating RT was pts' inability to maintain a correct deep inspiration for the due time. We strongly recommend a* ***careful selection of pts and a wider use of DIBH RT in left breast pts taking into account the dosimetric consequences***

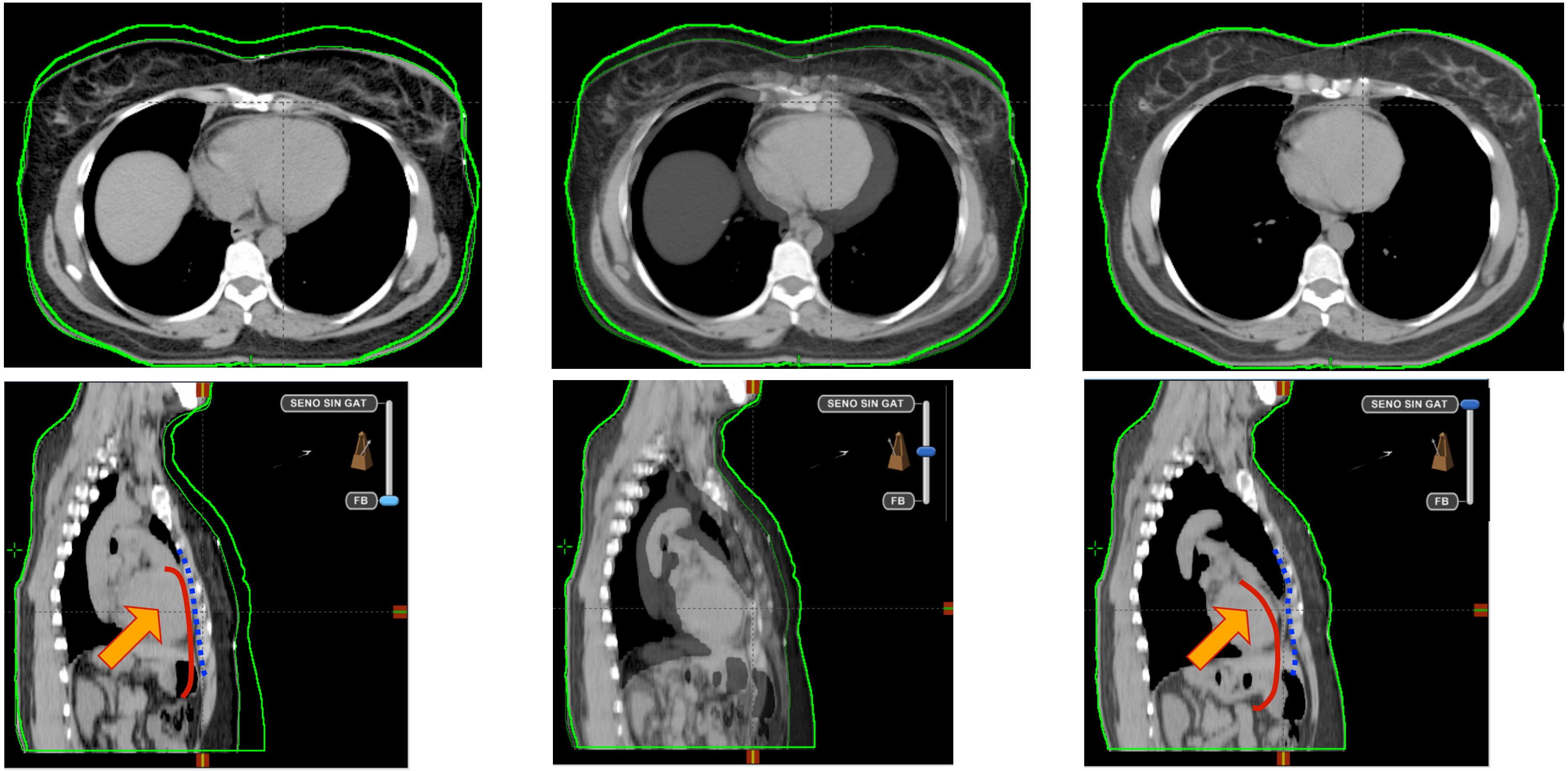
RESPIRATORY GATING RT IN BREAST CANCER: *LIGHT AND SHADE* Abstract, SASRO 2012

Valli MC, Fanti P, Leva S, Rottoli G, Martucci F, Pittoni P, Azinwi NC, Pesce G, Richetti A
Radiation Oncology, Oncology Institute of Southern Switzerland, Bellinzona CH

Gated RapidArc: left breast case

- DIBH for all left breast carcinoma (from 2005, 3DCRT&IMRT)

Free Breathing | *Blending View* | Deep Insp Breath Hold



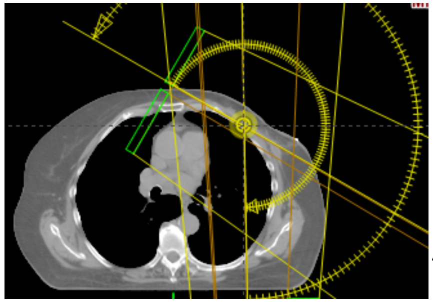
Gated RapidArc Treatment:

Gated RapidArc

Clinical introduction (world wide)

at IOSI

in July 2010 for breast patients



Plan Properties

MU=396
Arc length=240deg
Average DR=239 MU/min
BOT=1.7min

From treated sessions

Duty Cycle = 70%± 12
Average N Inter. <6
Ses: 20/25

1st session example

Gated RapidArc Treatment:

Full treatment <3min

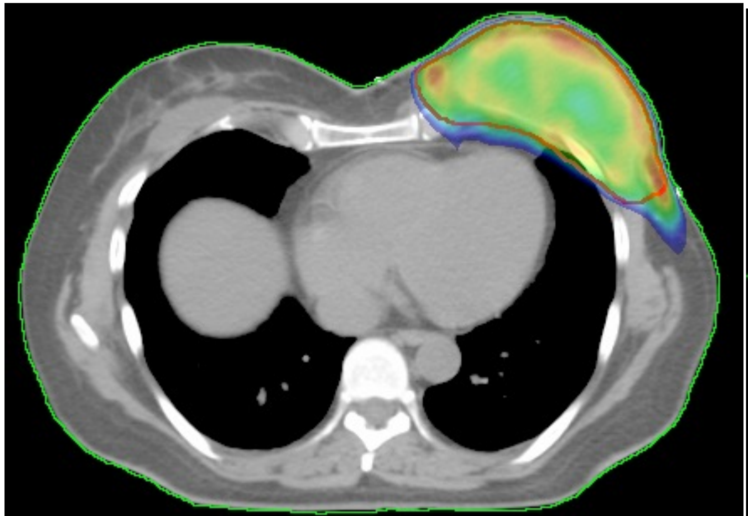
movie speed x 2

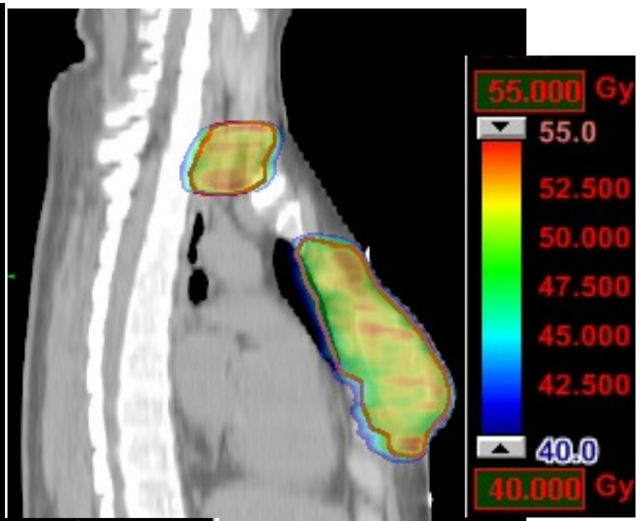
Centro di Senologia della Svizzera Italiana

RapidArc: left breast case

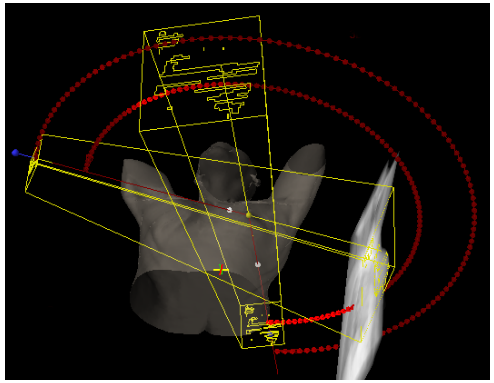
on Unique

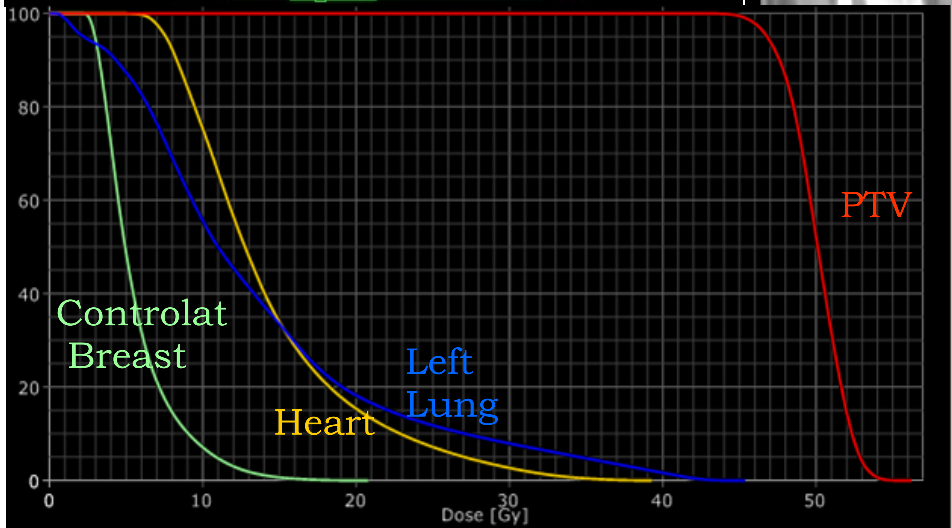
25 x 2.0Gy =50.0 Gy





2 partial isocentric arcs





PTV: 717 cm^3

Heart, mean dose= 14.2 Gy

Left Lung, mean dose= 13.5 Gy

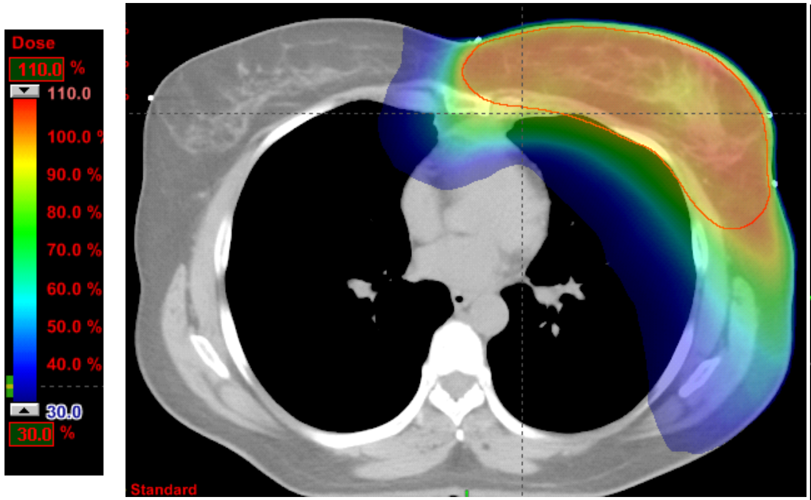
Contr. Breast, mean dose= 5.2 Gy

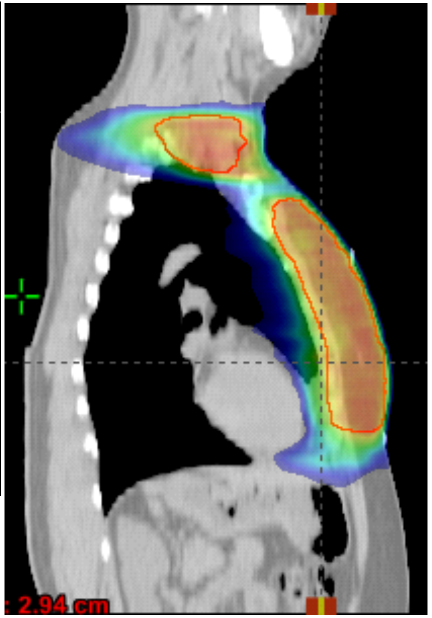
273 + 207 MU / 58 + 58 sec

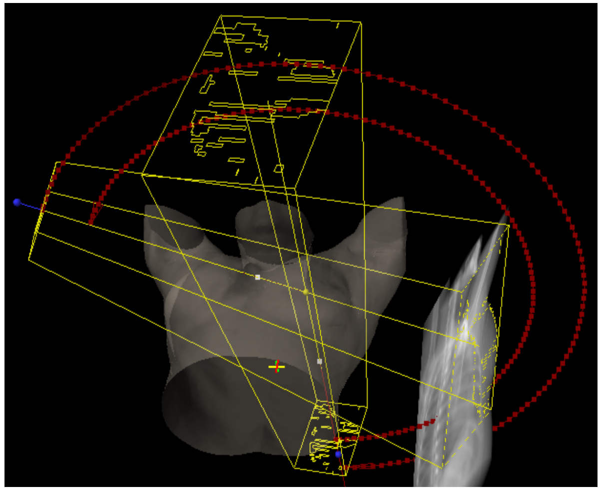
Courtesy by Antonella Fogliata

Gated RapidArc: left breast case in DIBH

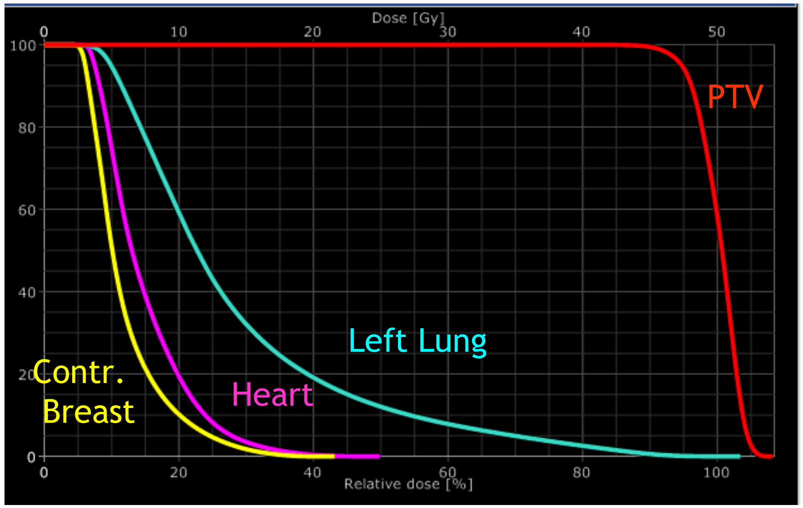
25 x 2.0Gy =50.0 Gy







2 partial isocentric arcs



PTV: 1294 cm^3

Heart, mean dose= 7.4 Gy

Left Lung, mean dose= 14.1 Gy

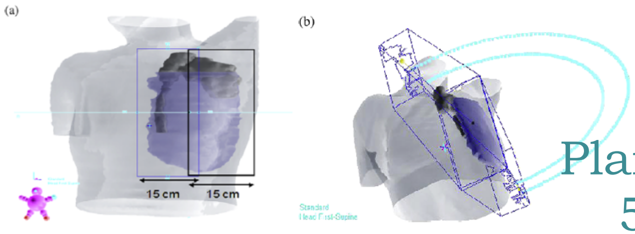
Contr. Breast, mean dose= 5.8 Gy

257 + 244 MU

51 + 51 sec

Courtesy by Antonella Fogliata

Left-side breast and IMN



Planning study
5 patients

VOLUMETRIC MODULATED ARC THERAPY IMPROVES DOSIMETRY AND REDUCES TREATMENT TIME COMPARED TO CONVENTIONAL INTENSITY-MODULATED RADIOTHERAPY FOR LOCOREGIONAL RADIOTHERAPY OF LEFT-SIDED BREAST CANCER AND INTERNAL MAMMARY NODES

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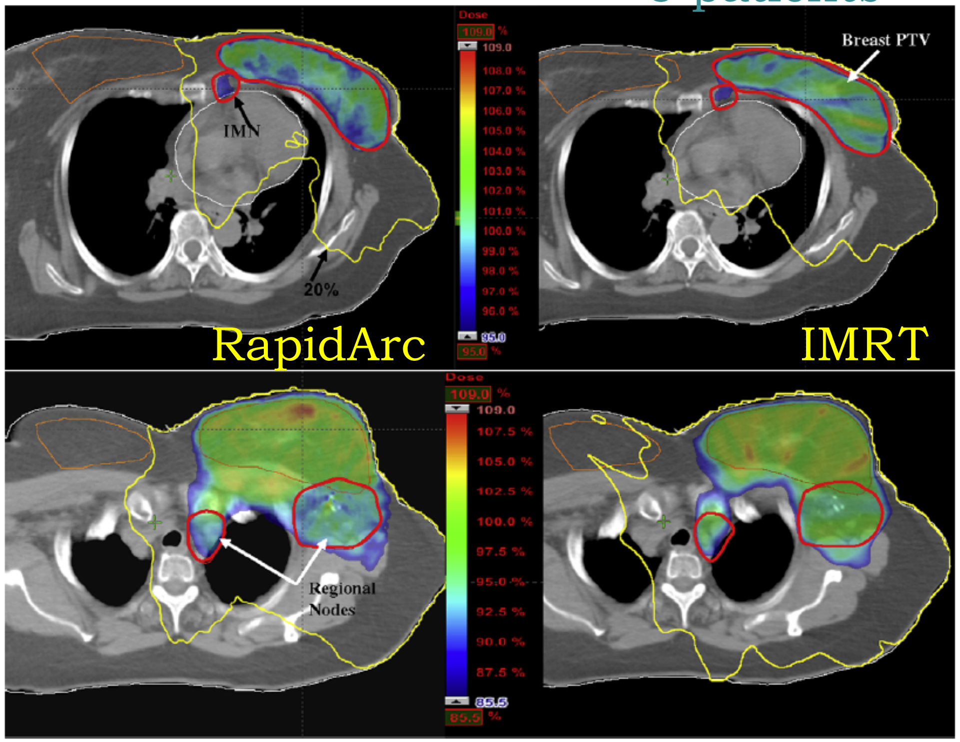
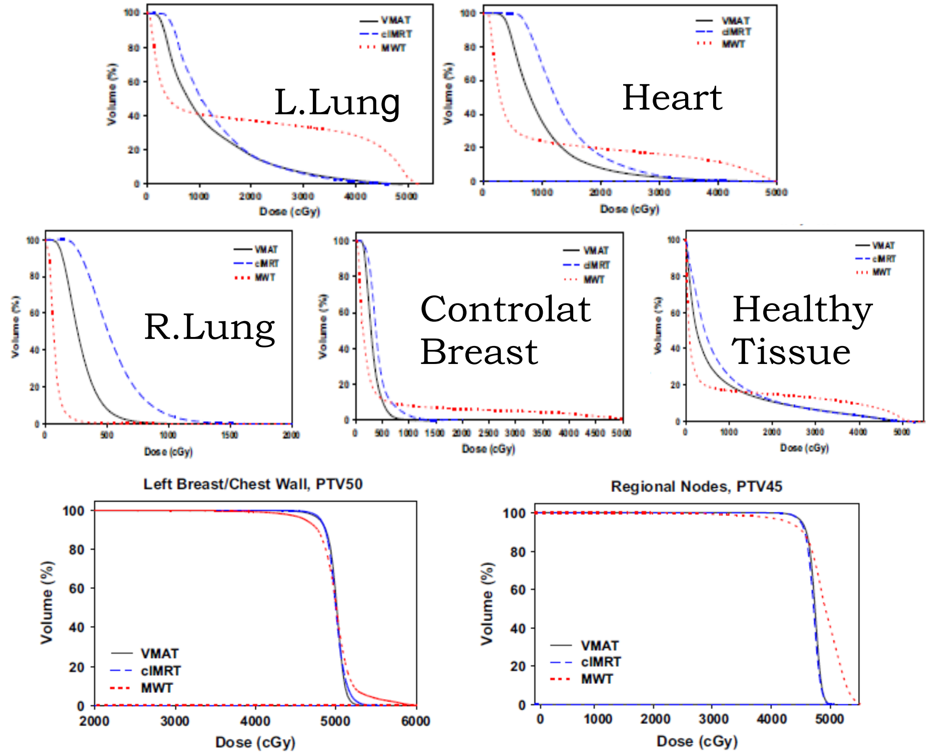
Int J Radiat Oncol Biol Phys. 2010 Jan 1;76(1):287-95





RapidArc vs 9 fields IMRT vs Modified Wide-Tangents

Node-positive left-sided breast cancer: *does VMAT improve treatment plan quality with respect to IMRT?*

Pasler M, Georg D, Bartelt S, Lutterbach J. SourceLake Constance Radiation Oncology Center Singen, Röntgenstr. 12, 88048, Friedrichshafen, Germany. pasler@strahlentherapie-fn.de

PURPOSE: *The aim of the present work was to explore plan quality and dosimetric accuracy of intensity-modulated radiotherapy (IMRT) and volumetric modulated arc therapy (VMAT) for lymph node-positive left-sided breast cancer.*

METHODS: *VMAT and IMRT plans were generated with the Pinnacle (3) V9.0 treatment planning system for 10 lymph node-positive left-sided breast cancer patients.* ***VMAT plans were created using a single arc and IMRT was performed with 4 beams using 6, 10, and 15 MV photon energy****, respectively. Plans were evaluated both manually and automatically using ArtiView™. Dosimetric plan verification was performed with a 2D ionization chamber array placed in a full scatter phantom.*

RESULTS: ***Photon energy had no significant influence on plan quality for both VMAT and IMRT.*** Large variability in low doses to the heart was found due to patient anatomy (range V(5 Gy) 26.5-95 %).

CONCLUSION: ***VMAT for node-positive left-sided breast cancer retains target homogeneity and coverage when compared to IMRT and allows maximum doses to organs at risk to be reduced.***

Strahlenther Onkol. 2013 May;189(5):380-6. doi: 10.1007/s00066-012-0281-2. Epub 2013 Mar 24.

Original article

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Chest wall radiotherapy with volumetric modulated arcs and the potential role of flattening filter free photon beams

….the present study aimed to address two further aspects of RapidArc in the management of breast patients.
•assess the **applicability of rotational-modulated therapy to chest wall patients**, i.e., a complex category of patients where IMRT was already proven to be usable with good dosimetric findings
•assessment of the **role of flattening filter free (FFF) beams in reducing involvement of organs at risk**, while preserving adequate target coverage.

Why FFF?

- *reduction of out-of-field dose due to reduced head scatter and residual electron contamination*
- *reduced peripheral doses*
- *decreased exposure of normal tissue to scattered doses outside the field.*
- *deliver treatments with higher dose rates and higher dose per pulse.*
- *potential radiobiology implications*

RapidArc is as effective in the treatment of chest wall patients as advanced 3DCRT techniques with better target coverage and sparing of ipsilateral organs at risk and acceptable trade-off for contralateral organs.
RapidArc with FFF beams showed the possibility to further reduce the dose delivered to healthy tissues compared to normal RA

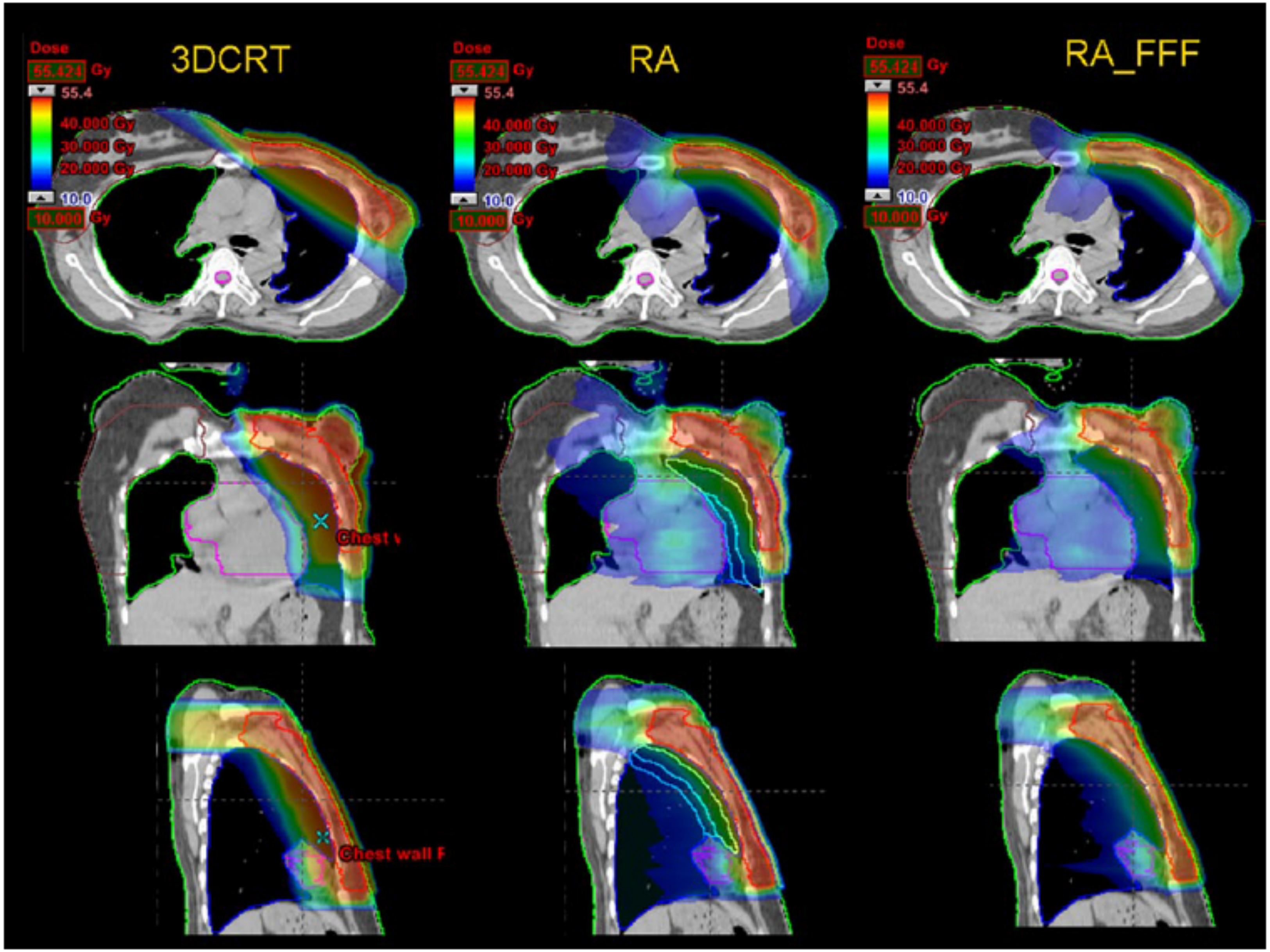
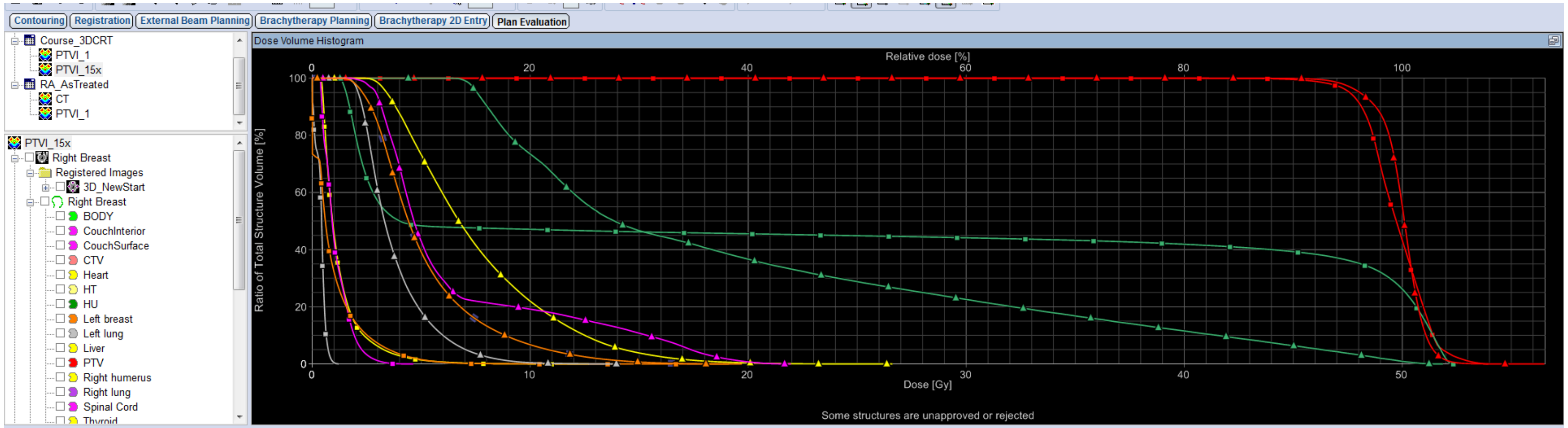


Fig. 1 ▲ Isodose distributions for one example patient in axial, coronal, and sagittal planes. The lower threshold for colorwash was 10 Gy and the upper was set to maximum dose in the plans (55.4 Gy)

Caso clinico

Paziente di 31 anni affetta da carcinoma mammario con aspetti di tipo duttale invasivo e lobulare invasivo multifocale (G3), pT3m, pN1a, M0, ER 80-90%, PR 0-70%, Ki-67: 40-50%, c-erbB-2 score 2+ FISH+, sottoposta ad intervento sopracitato.
Programma terapeutico proposto dopo discussione interdisciplinare: GnRH **e** CT (4 AC e taxolo settimanale con herceptin), **RT della parete +/- sovraclaveare**, counseling genetico



Dose Prescription | Dose Statistics

View	DVH Line	Structure	Approval Status	Plan	Course	Volume [cm³]	Dose Cover.[%]	Sampling Cover.[%]	Min Dose [Gy]	Max Dose [Gy]	Mean Dose [Gy]
☑	■	Heart	Unapproved	PTVI_15x	Course_3DCRT	336.5	100.0	100.0	0.393	12.745	1.260
☑	▲	Heart	Unapproved	PTVI_1	RA_AsTreated	336.5	100.0	100.0	2.358	26.655	7.556
☑	■	Left breast	Unapproved	PTVI_15x	Course_3DCRT	1073.9	100.0	100.0	0.000	19.753	0.978
☑	▲	Left breast	Unapproved	PTVI_1	RA_AsTreated	1073.9	100.0	100.0	1.238	19.116	5.175
☑	■	Left lung	Unapproved	PTVI_15x	Course_3DCRT	1106.8	100.0	100.0	0.000	1.262	0.387
☑	▲	Left lung	Unapproved	PTVI_1	RA_AsTreated	1106.8	100.0	100.0	1.438	14.174	3.789
☐	■	Liver	Unapproved	PTVI_15x	Course_3DCRT						
☐	▲	Liver	Unapproved	PTVI_1	RA_AsTreated						
☑	■	PTV	Unapproved	PTVI_15x	Course_3DCRT	964.1	100.0	100.0	22.702	53.975	49.743
☑	▲	PTV	Unapproved	PTVI_1	RA_AsTreated	964.1	100.0	100.0	40.100	56.555	49.997
☐	■	Right humerus	Unapproved	PTVI_15x	Course_3DCRT						
☐	▲	Right humerus	Unapproved	PTVI_1	RA_AsTreated						
☐	■	Right lung	Unapproved	PTVI_15x	Course_3DCRT	1274.8	100.0	100.0	0.577	51.064	16.206
☐	▲	Right lung	Unapproved	PTVI_1	RA_AsTreated	1274.8	100.0	100.0	2.684	49.087	13.319
☑	■	Spinal Cord	Unapproved	PTVI_15x	Course_3DCRT	47.8	100.0	100.1	0.337	4.669	1.083
☑	▲	Spinal Cord	Unapproved	PTVI_1	RA_AsTreated	47.8	100.0	100.0	1.766	21.956	6.601
☑	■	Thyroid	Unapproved	PTVI_15x	Course_3DCRT	14.7	100.0	100.0	1.178	52.453	23.536
☑	▲	Thyroid	Unapproved	PTVI_1	RA_AsTreated	14.7	100.0	100.0	5.851	51.914	19.784

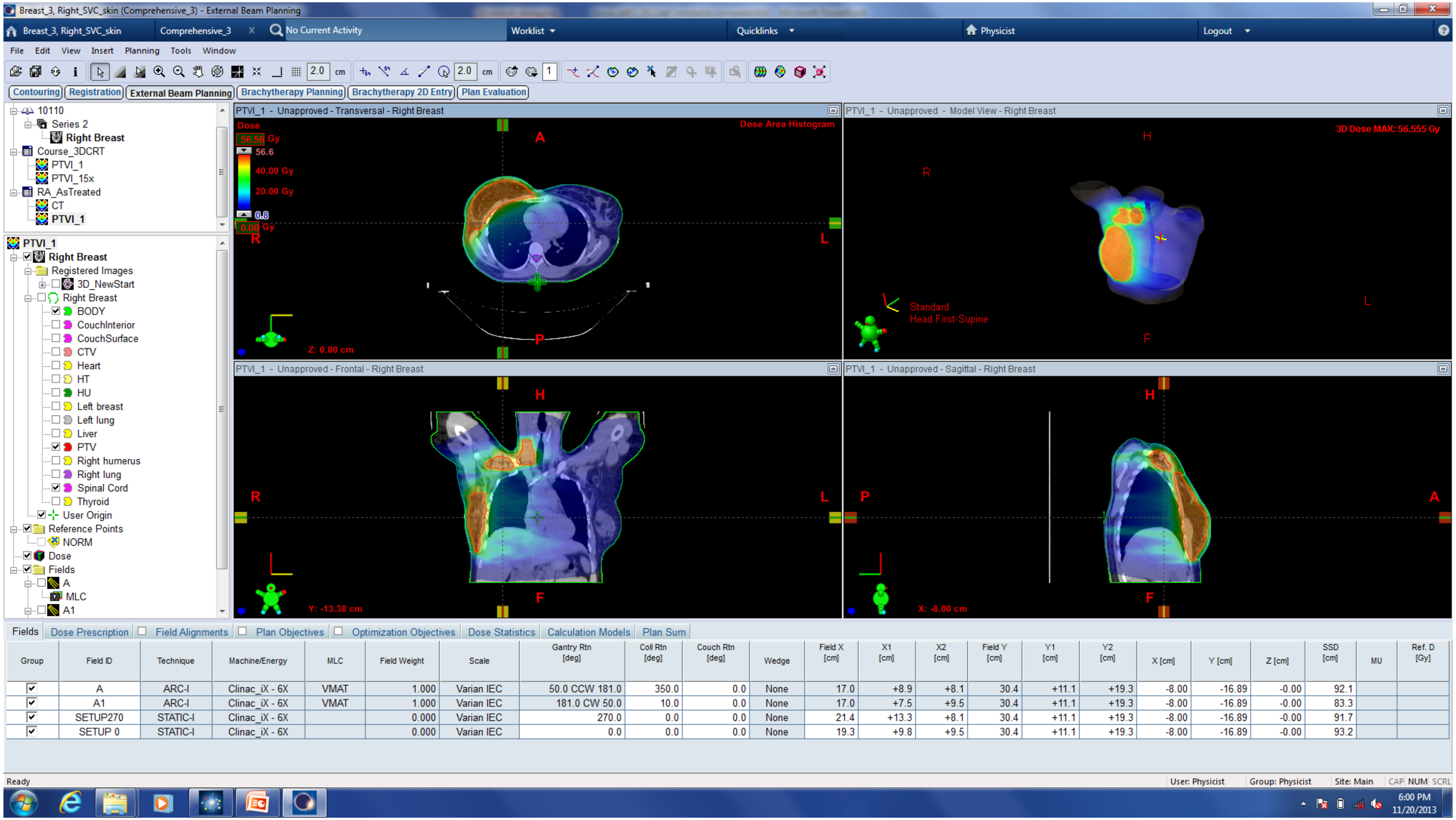
PTV RapidArc ▲ 3DCRT 15MV●

Hearth

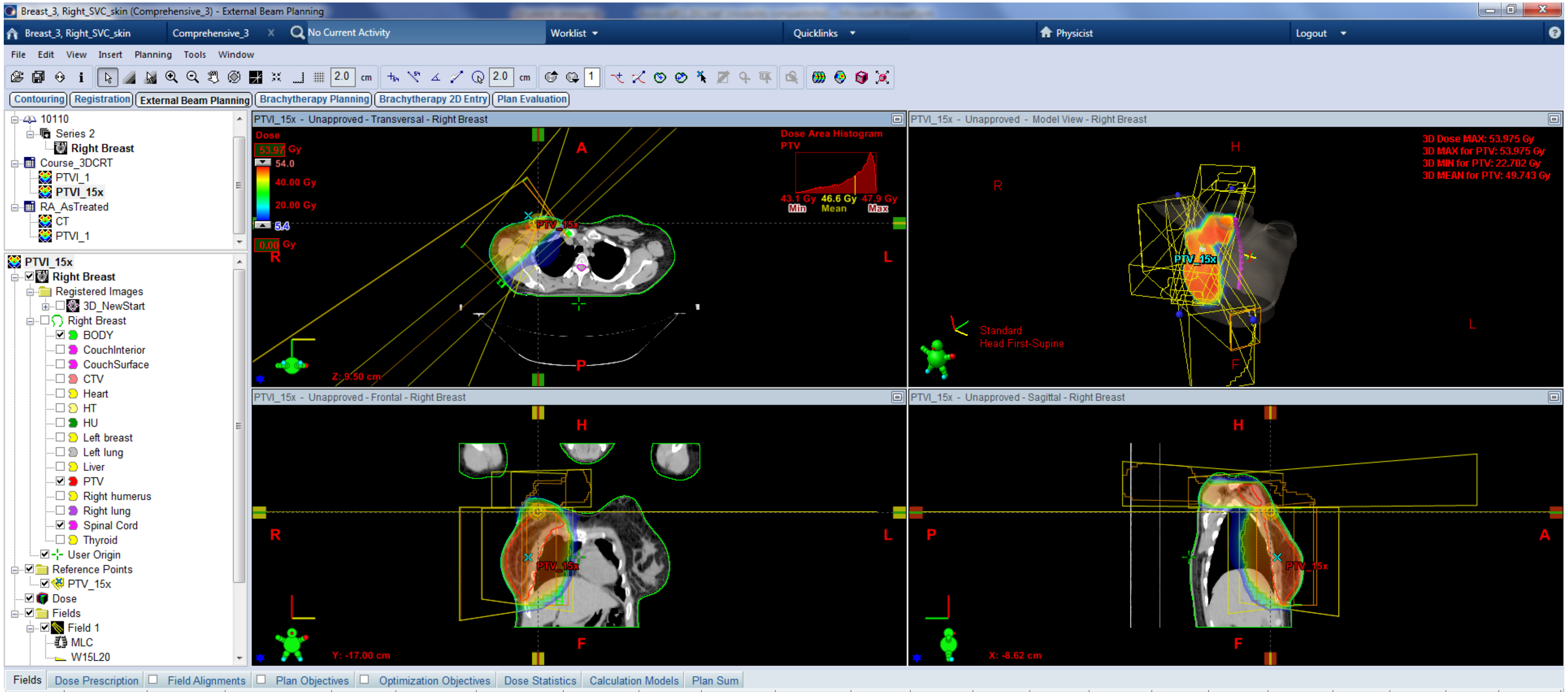
Controlateral breast

Thyroid

Spinal cord



Group	Field ID	Technique	Machine/Energy	MLC	Field Weight	Scale	Gantry Rtn [deg]	Coll Rtn [deg]	Couch Rtn [deg]	Wedge	Field X [cm]	X1 [cm]	X2 [cm]	Field Y [cm]	Y1 [cm]	Y2 [cm]	X [cm]	Y [cm]	Z [cm]	SSD [cm]	MU	Ref. D [Gy]
☑	A	ARC-I	Clinac_iX - 6X	VMAT	1.000	Varian IEC	50.0 CCW 181.0	350.0	0.0	None	17.0	+8.9	+8.1	30.4	+11.1	+19.3	-8.00	-16.89	-0.00	92.1		
☑	A1	ARC-I	Clinac_iX - 6X	VMAT	1.000	Varian IEC	181.0 CW 50.0	10.0	0.0	None	17.0	+7.5	+9.5	30.4	+11.1	+19.3	-8.00	-16.89	-0.00	83.3		
☑	SETUP270	STATIC-I	Clinac_iX - 6X		0.000	Varian IEC	270.0	0.0	0.0	None	21.4	+13.3	+8.1	30.4	+11.1	+19.3	-8.00	-16.89	-0.00	91.7		
☑	SETUP 0	STATIC-I	Clinac_iX - 6X		0.000	Varian IEC	0.0	0.0	0.0	None	19.3	+9.8	+9.5	30.4	+11.1	+19.3	-8.00	-16.89	-0.00	93.2		



Group	Field ID	Technique	Machine/Energy	MLC	Field Weight	Scale	Gantry Rtn [deg]	Coll Rtn [deg]	Couch Rtn [deg]	Wedge	Field X [cm]	X1 [cm]	X2 [cm]	Field Y [cm]	Y1 [cm]	Y2 [cm]	X [cm]	Y [cm]	Z [cm]	SSD [cm]	MU	Ref. D [Gy]
☑	Field 1	STATIC-I	Clinac_iX - 15X	Static	1.050	Varian IEC	51.0	0.0	0.0	W15L20	15.7	+9.1	+6.6	20.9	+20.0	+0.9	-8.62	-17.00	9.50	98.0	130	1.132
☑	Field 2	STATIC-I	Clinac_iX - 15X	Static	0.600	Varian IEC	224.8	0.0	0.0	None	13.9	+4.9	+9.0	20.6	+19.7	+0.9	-8.62	-17.00	9.50	87.1	75	1.008
☑	Field up 1	STATIC-I	Clinac_iX - 6X	Static	1.300	Varian IEC	23.0	0.0	0.0	None	14.4	+5.0	+9.4	7.2	-1.0	+8.2	-8.62	-17.00	9.50	98.7	107	
☑	Field up 2	STATIC-I	Clinac_iX - 15X	Static	0.650	Varian IEC	198.0	0.0	0.0	None	19.6	+10.2	+9.4	7.6	-1.0	+8.6	-8.62	-17.00	9.50	84.6	76	

...and thank you for your attention

European Cancer Care Certification
The Requirements of a Specialist Breast Unit 2010
Certification n° ES010 / 2011 - 3

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