

“Hybrid” 3D/VMAT technique for irradiation of patients with breast cancer and unfavorable anatomy

Preliminary dosimetric study

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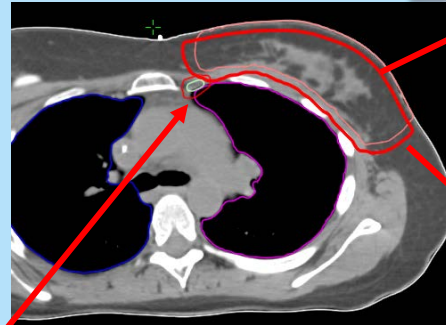
Introduction

- Breast cancer irradiation improves local control and survival
- Currently, there is a tendency towards an increase of full nodal irradiation (FNI) for high-risk patients
- Late toxicity should be minimized
- **Objective:** to perform a dosimetric comparison between 3D Conformal (field-in-field) and a “hybrid” 3D conformal combined with volumetric modulated arc technique (3D/VMAT) in the irradiation of high risk patients with breast cancer where FNI was indicated

Methods

5 patients: breast or chest wall RT and FNI

- Left side: 3
- 4DCT to evaluate movement
- Contouring: RTOG atlas
- 50 Gy in 25 fractions (4 patients)
- 50.4 Gy in 28 fractions (1 patient)
- 4 received 10 Gy boost (2Gy x 5)



PTV Evaluation: 5 mm
cropped from surface

PTV = CTV + 5mm

PTV margins IMN: 3-5mm





Methods

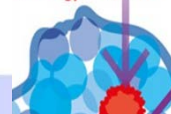
- Plan: 3DCRT with field-in-field



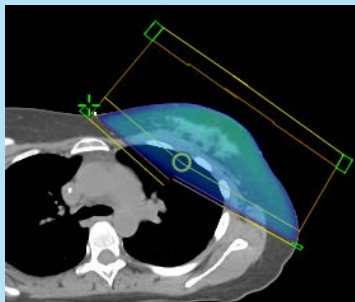
- Inadequate coverage of the Internal Mammary Nodes (IMN)
- OAR constraints not reached



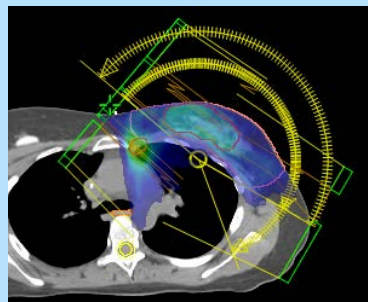
3D/VMAT



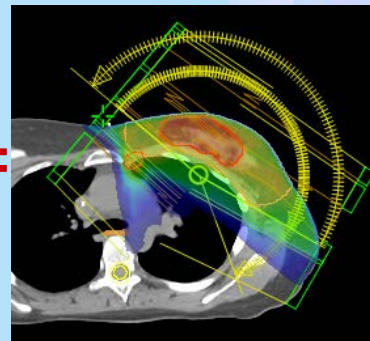
Methods



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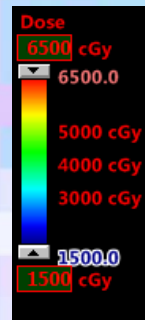
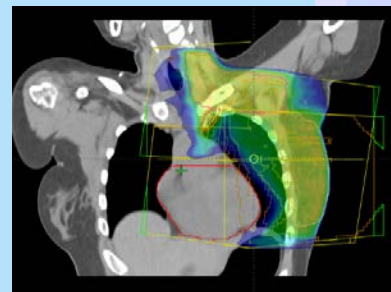
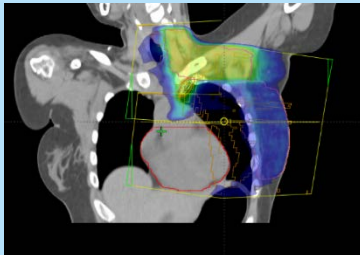
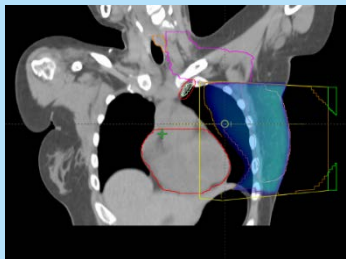
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3DCRT tangent fields
 ~50% dose: breast only

3 partial VMAT arcs

- IMN and FSC
- complement the breast





Results

Comparison of dosimetric parameters

Target coverage

OAR

Dosimetric parameters-		3D Field in Field	Hybrid 3D/VMAT	Relative difference (%)
PTV breast	D95	45.2 Gy	45.5 Gy	- 0.7
	D90	48.7 Gy	47.7 Gy	+ 2.1
	D2	61.6 Gy	60.8 Gy	+ 1.3
	Dmax	62.9 Gy	64.5 Gy	- 2.5
SCN	D95	45.6 Gy	49.3 Gy	- 7.5
	D90	46.9 Gy	50.4 Gy	- 6.9
	Dmax	48.6 Gy	50.8 Gy	- 4.3
IMN	D95	31.4 Gy	46.5 Gy	- 32.5
	D90	36.2 Gy	49.3 Gy	- 26.6
	Dmax	56.3 Gy	59.2 Gy	- 4.9

Dosimetric parameters		3D Field in Field	Hybrid 3D/VMAT	Relative difference (%)
Ipsilateral lung	V5	53.1 %	93.1 %	- 43.0
	V10	50.2 %	59.1 %	- 15.0
	V20	42.6 %	30.3 %	40.6
	Dm	21.0 Gy	15.9 Gy	32.1
Heart	V10	7.4 %	2.8 %	164.3
	V20	4.8 %	12.8 %	- 62.5
	Dm	4.7 %	5.5 %	- 14.5
CL breast	Dmax	36.9 Gy	18.6 Gy	98.4
CL lung	V5	0.1 %	37.5 %	- 99.7
Both lungs	V20	20.8 %	13.6 %	52.9

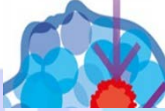
Discussion

- Patients with unfavourable anatomy may achieve benefits due to this approach
- Less than 5% breast cancer patients in 1 year
- The classical opposed tangents technique associated with VMAT was used in order to reduce uncertainties associated with moving targets, assigning more robustness to the technique

Conclusions

- Both techniques achieved adequate coverage of the breast or chest wall and supraclavicular and axillary nodes
- IMN were better covered with hybrid 3D/VMAT
- OAR dose constraints not achieved with 3D field-in-field were reached with the combined technique
- Hybrid 3D/VMAT may be an option for better coverage of the IMN when FNI is indicated in patients with unfavorable anatomy





Breast: 25 x 200 cGy

PTV's Coverage Evaluation

PTVeval	D95% > 45 Gy	
	D90% > 47.5 Gy	
	Hot Spot	Acceptable
	D30% < 53 Gy	55 Gy
	D2% < 57.5 Gy	
D _{max} < 57.5 Gy	60 Gy	

SCFeval	D90% > 45 Gy	
	Hot Spot	Acceptable
	D2% < 57.5 Gy	
	D _{max} < 57.5 Gy	60 Gy

BOOSTeval	D90% > 9 Gy	
	Hot Spot	
	5x200cGy D30% < 11 Gy	
	D _{max} < 11.5 Gy	

Dose Evaluation at OR

		<i>Breast</i>		<i>Breast + SCF</i>	
		Ideal	Acceptable	Ideal	Acceptable
Ipsilateral	V20 Gy	<12%	<15%	<30%	<30%
Lung	V10 Gy	<16%	<35%	<40%	<50%
	V5 Gy	<25%	<50%	<50%	<65%
	D _{avg}	<7 Gy	<12 Gy	<15 Gy	

		<i>R Breast</i>		<i>L Breast</i>	
		Ideal	Acceptable	Ideal	Acceptable
Heart	V20 Gy	0%	0%	<4%	<5%
	V10 Gy	0%	<10%	<6%	<30%
	D _{avg}	<1.5 Gy		<4 Gy	

		<i>Breast</i>		<i>Breast + SCF</i>	
		Ideal	Acceptable	Ideal	Acceptable
CL Lung	V5 Gy	<0%		<1%	<10%

		<i>Breast</i>		<i>Breast + SCF</i>	
		Ideal	Acceptable	Ideal	Acceptable
CL Breast	D _{max}	<3 Gy	<10 Gy	<3 Gy	<12 Gy

		<i>Breast</i>		<i>Breast + SCF</i>	
		Ideal	Acceptable	Ideal	Acceptable
Summed					
Lungs	V20 Gy	<7%		<15%	<20%

Plexus	V40 Gy	<12 cc
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Breast: 15 x 267 cGy

PTV's Coverage Evaluation

	D95% >	36 Gy	
	D90% >	38 Gy	
PTVeval	Hot Spot	Acceptable	
	D30% <	42 Gy	44.1 Gy
	D2% <	42.5 Gy	45.7 Gy
	D _{máx} <	43.5 Gy	47.5 Gy

	D90% >	36 Gy	
SCFeval	Hot Spot	Acceptable	
	D2% <	42.5 Gy	45.7 Gy
	D _{máx} <	43.5 Gy	47.5 Gy

	D90% >	7.2 Gy	
BOOSTeval	Hot Spot		
3x267cGy	D30% <	8.5 Gy	
	D _{máx} <	8.9 Gy	

Dose Evaluation at OR

		<u>Breast</u>		<u>Breast + SCF</u>	
		Ideal	Acceptable	Ideal	Acceptable
Ipsilateral	V16.8 Gy	<12%	<15%	<30%	
Lung	V8.8 Gy	<16%	<35%	<38%	<50%
	V4.5 Gy	<23%	<50%	<50%	<65%
	D _{avg}	<6 Gy	<10.4 Gy	<10.4 Gy	

		<u>R Breast</u>		<u>L breast</u>	
		Ideal	Acceptable	Ideal	Acceptable
Heart	V16.8 Gy	0%	0	<2%	<5%
	V8.8 Gy	0%	<10%	<3%	<30%
	D _{avg}	-	<1.5 Gy	<3.6 Gy	-

		<u>Breast</u>		<u>Breast + SCF</u>	
		Ideal	Acceptable	Ideal	Acceptable
CL Lung	V4.5 Gy	<1%		<1%	<10%

		<u>Breast</u>		<u>Breast + SCF</u>	
		Ideal	Acceptable	Ideal	Acceptable
CL breast	D _{máx}	<2.8 Gy	<7.5 Gy	<2.8 Gy	<2.8 Gy

		<u>Breast</u>		<u>Breast + SCF</u>	
		Ideal	Acceptable	Ideal	Acceptable
Summed					
Lungs	V16.8 Gy	<6%		<17%	<20%