Intraoperative radiotherapy in early breast cancer: innovative multi-institutional experience assisted by virtual treatment planning

Consorcio Hospitalario Provincial de Castellón

SaludMadrid

Hospital General Universitario Gregorio Marañón

Comunidad de Madrid

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Topics

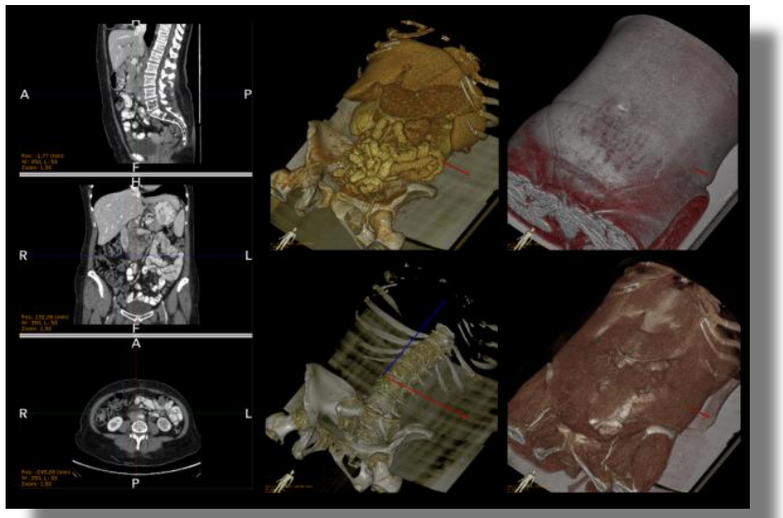
- Introduction
- Methods
- Results
- Conclusion

Introduction

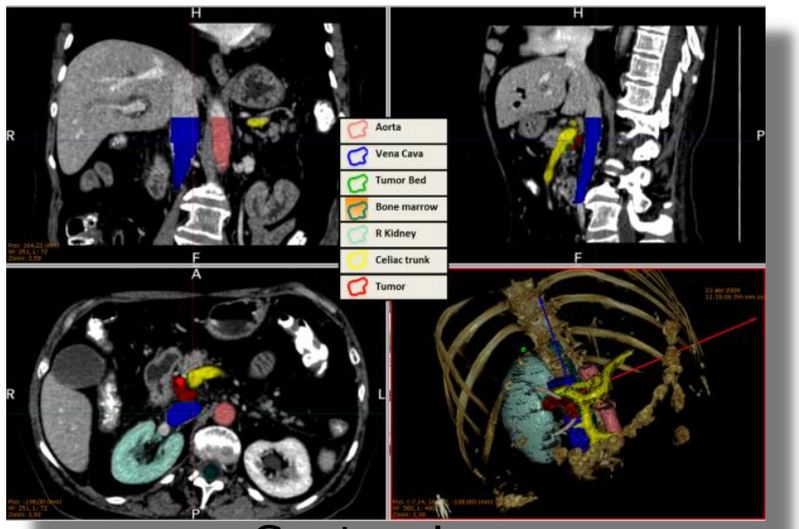
What is radiance?

An innovative virtual simulation and planning tool (“Radiance IORT simulation and planning tool") allows to define and evaluate different IORT parameters based in the use of electron beams (IOERT) and dosimetric profiles, implementing the selection of an optimized set of treatment parameters due to pre-planning testing in advance to the radio-surgical procedure.

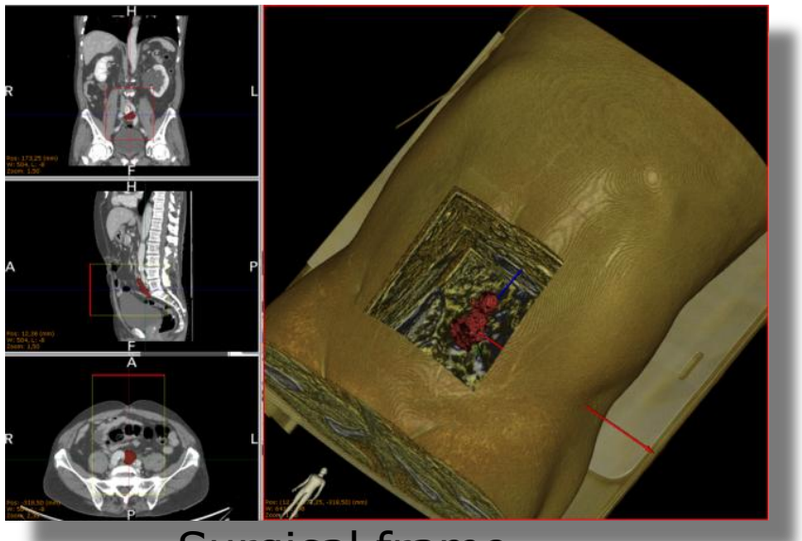
What is radiance?



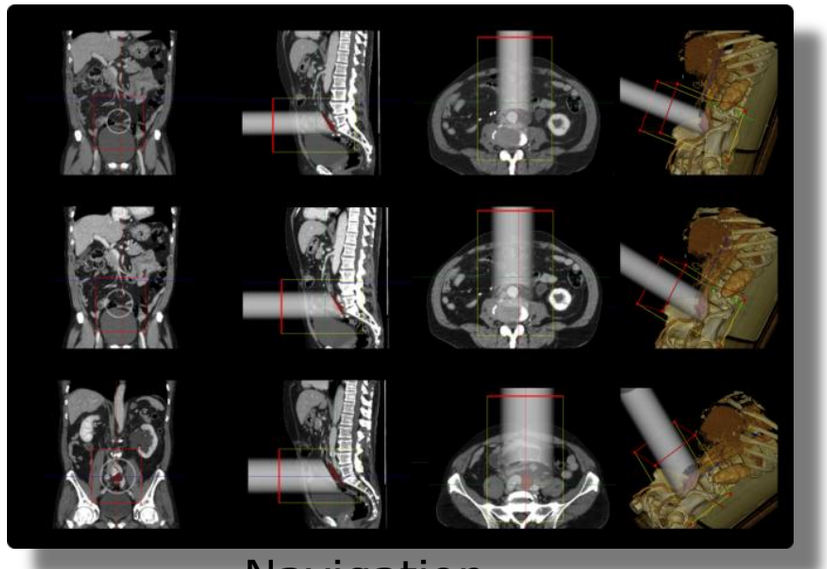
3D



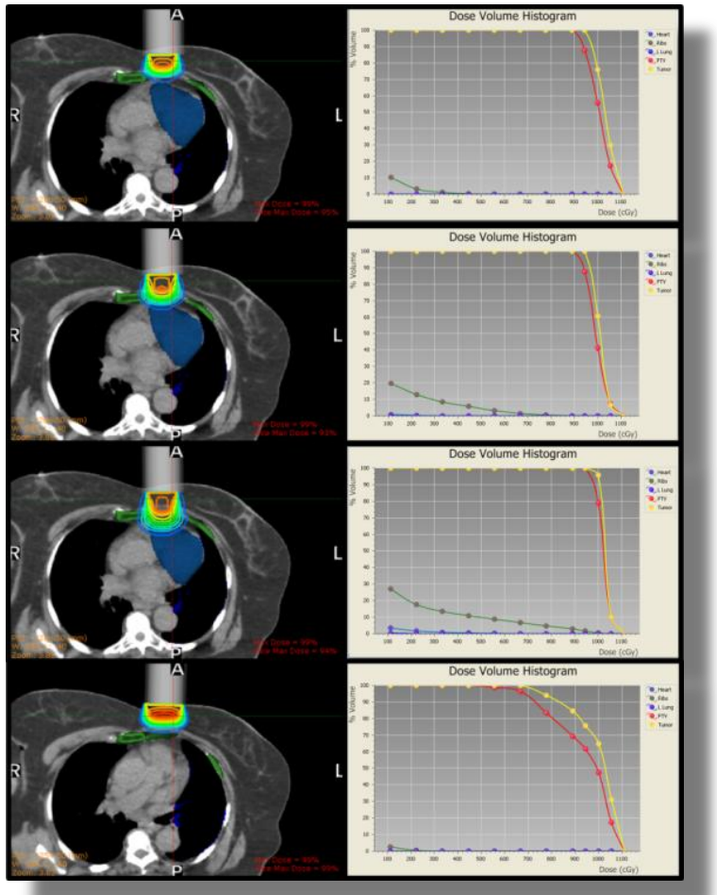
Contouring



Surgical frame



Navigation



HDV 's

Introduction

What we did?

A joint retrospective analysis of breast IORT prospectively collected data in order to describe and assess feasibility of Radiance and preliminar outcome results.

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Methods

Evaluation → BCS **+IORT**

Methods

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- 10Gy **+EBRT**
- 21Gy **no EBRT**

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→ adj. systemic treatment → *follow-up*

Methods

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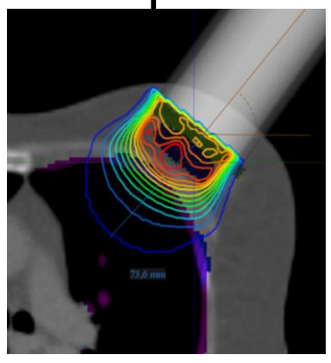
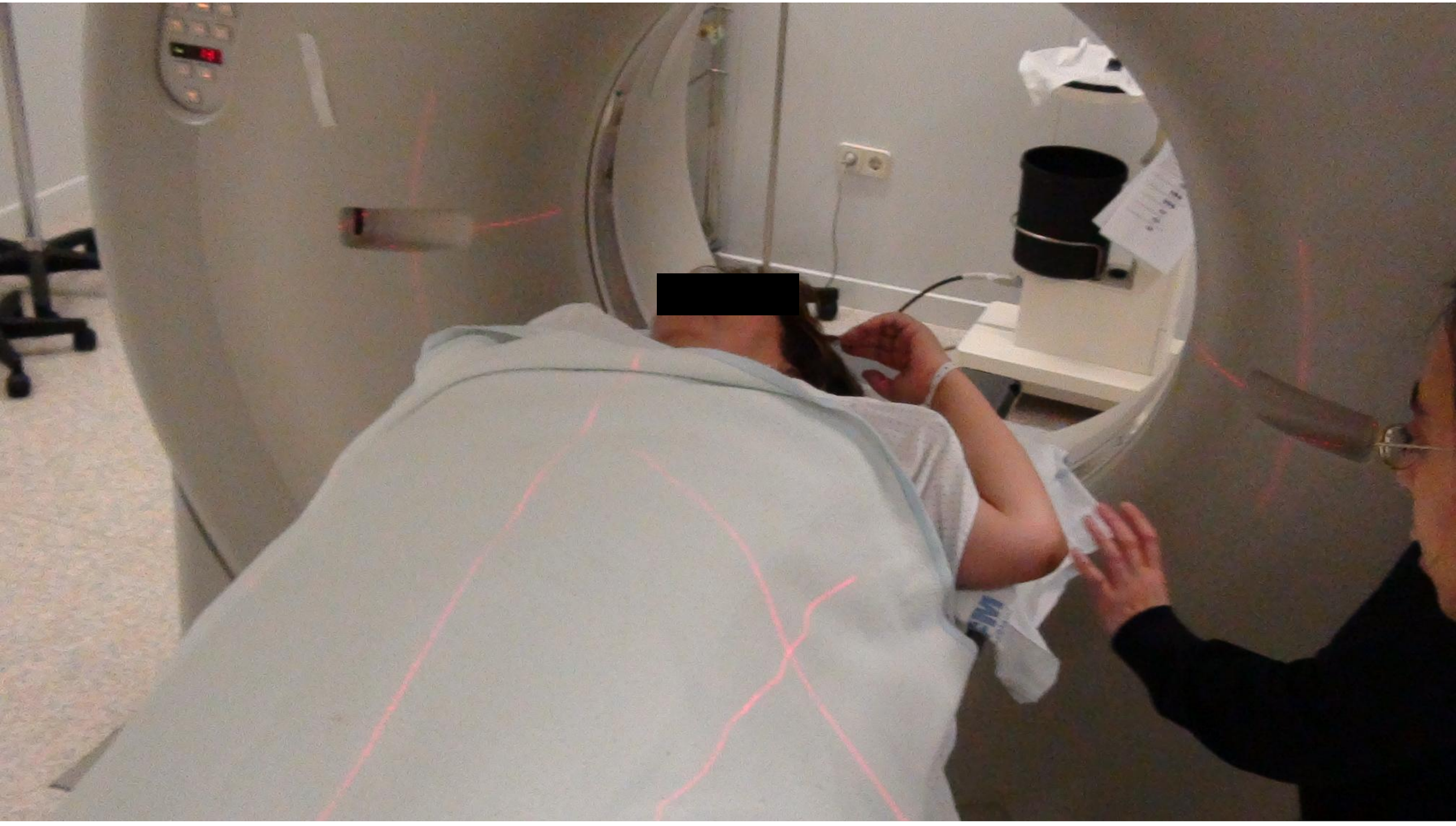
10Gy **+EBRT**

21Gy **no EBRT**

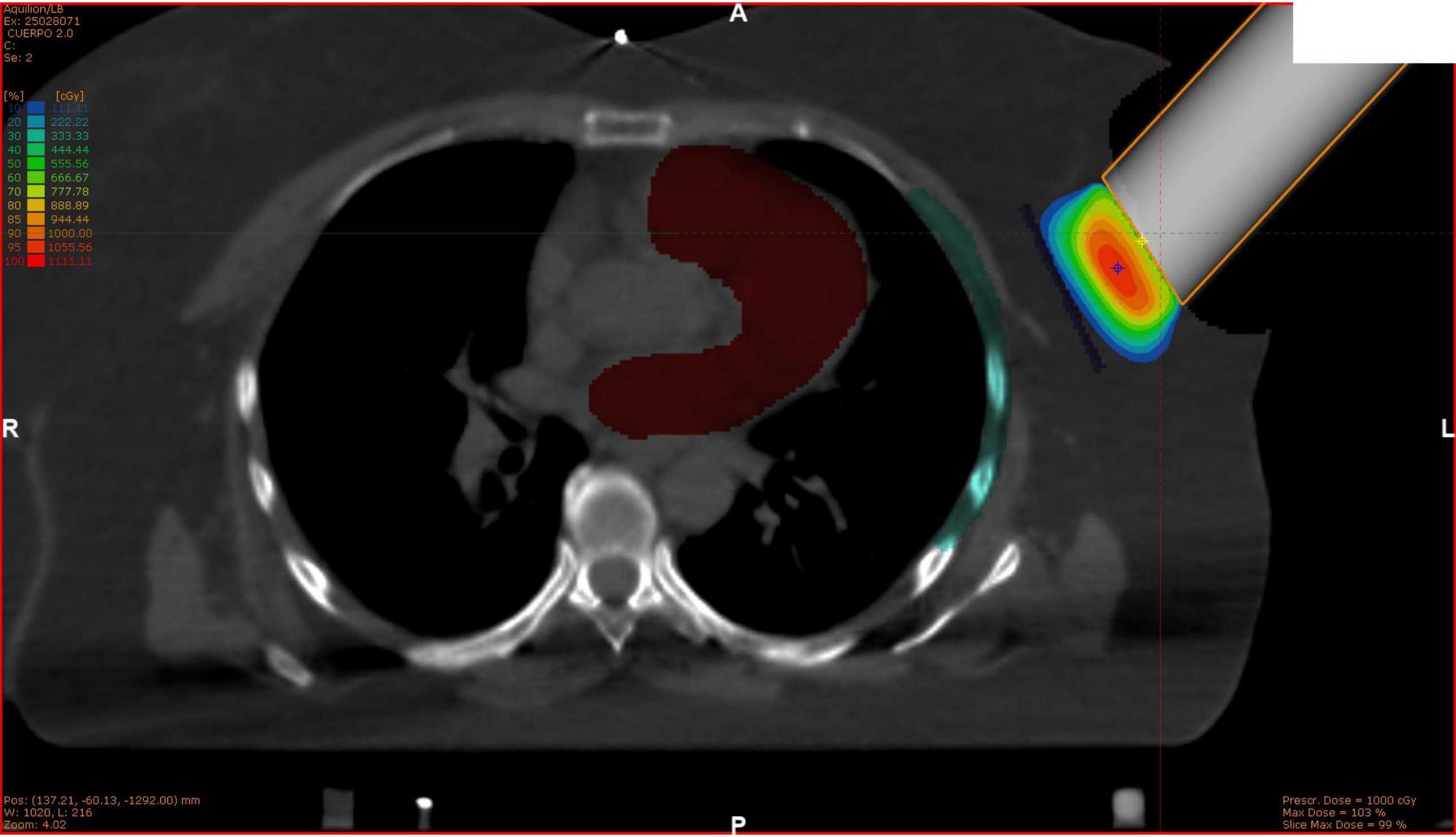
adj. systemic treatment → *follow-up*

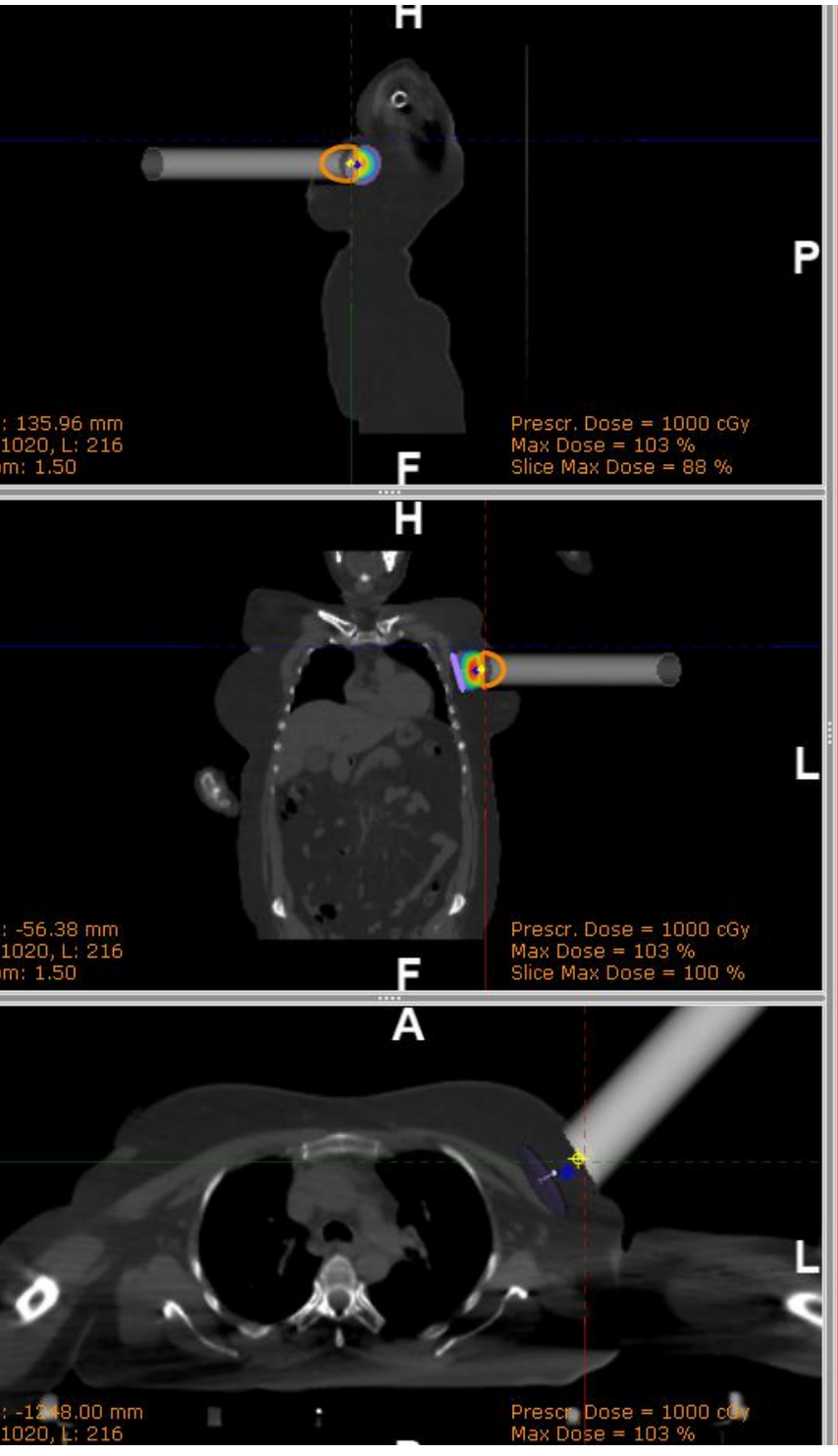


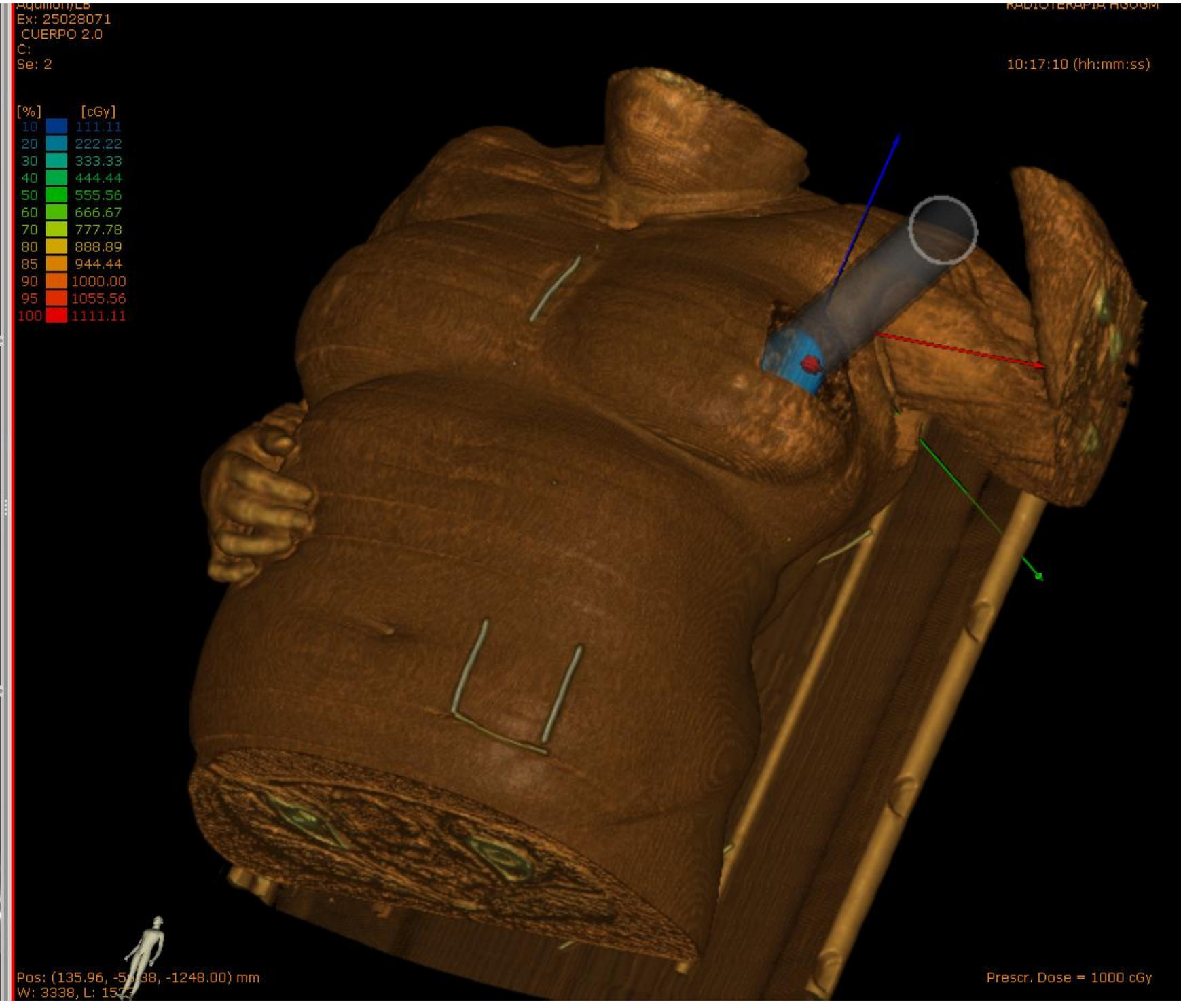
preoperative planning

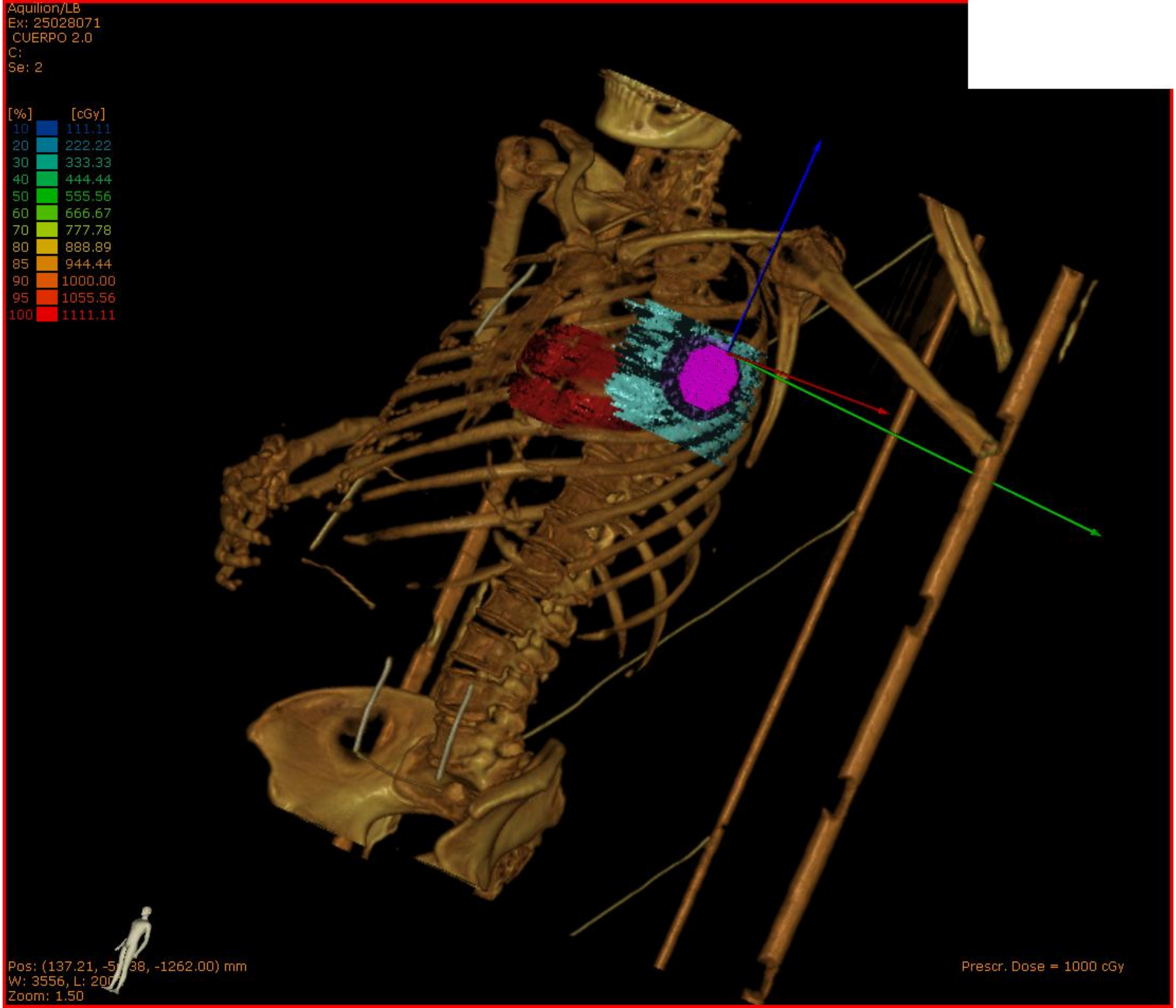



0.0
1
R
-570.0
WL= 38
WW= 110
F
1
H
0.0
WL= 170
WW= 250
PROTOCOLO
TECNICA
RECONSTRUCCION
art Pos.
End Pos.
Scan Mode


Aquilion/LB
Ex: 25028071
CUERPO 2.0
C:
Se: 2
[%] [cGy]
10 111.11
20 222.22
30 333.33
40 444.44
50 555.56
60 666.67
70 777.78
80 888.89
85 944.44
90 1000.00
95 1055.56
100 1111.11
A
R
L
P
Pos: (137.21, -60.13, -1292.00) mm
W: 1020, L: 216
Zoom: 4.02
Prescr. Dose = 1000 cGy
Max Dose = 103 %
Slice Max Dose = 99 %

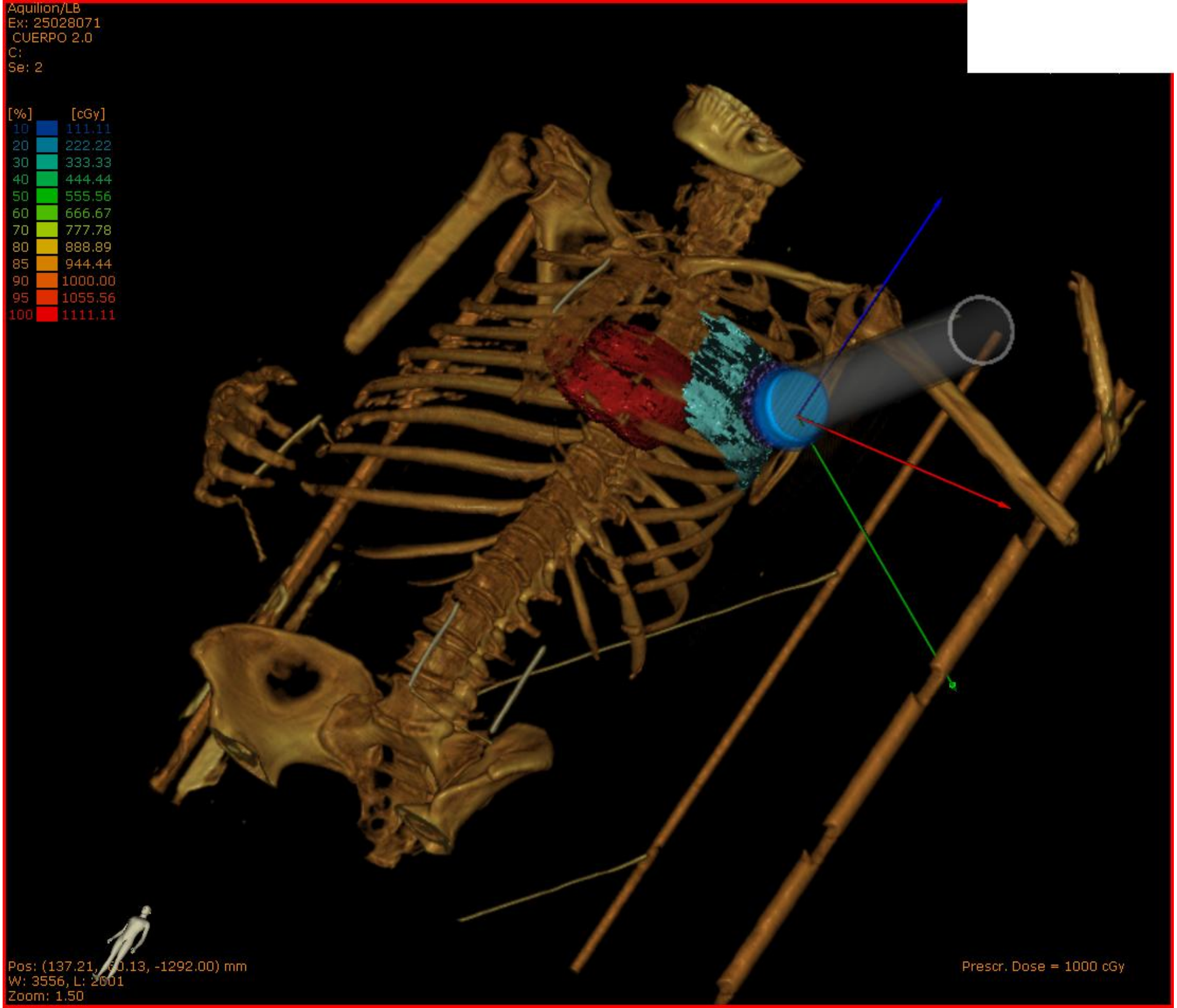

H
P
F
: 135.96 mm
1020, L: 216
m: 1.50
Prescr. Dose = 1000 cGy
Max Dose = 103 %
Slice Max Dose = 88 %
H
L
F
: -56.38 mm
1020, L: 216
m: 1.50
Prescr. Dose = 1000 cGy
Max Dose = 103 %
Slice Max Dose = 100 %
A
L
: -1248.00 mm
1020, L: 216
Prescr. Dose = 1000 cGy
Max Dose = 103 %


Ex: 25028071
CUERPO 2.0
C:
Se: 2
[%] [cGy]
10 111.11
20 222.22
30 333.33
40 444.44
50 555.56
60 666.67
70 777.78
80 888.89
85 944.44
90 1000.00
95 1055.56
100 1111.11
10:17:10 (hh:mm:ss)
Pos: (135.96, -56.38, -1248.00) mm
Prescr. Dose = 1000 cGy


Aquilion/LB
Ex: 25028071
CUERPO 2.0
C:
Se: 2
[%] [cGy]
10 111.11
20 222.22
30 333.33
40 444.44
50 555.56
60 666.67
70 777.78
80 888.89
85 944.44
90 1000.00
95 1055.56
100 1111.11
Pos: (137.21, -5 38, -1262.00) mm
W: 3556, L: 20
Zoom: 1.50
Prescr. Dose = 1000 cGy

Aquilion/LB
Ex: 25028071
CUERPO 2.0
C:
Se: 2

[%]	[cGy]
10	111.11
20	222.22
30	333.33
40	444.44
50	555.56
60	666.67
70	777.78
80	888.89
85	944.44
90	1000.00
95	1055.56
100	1111.11



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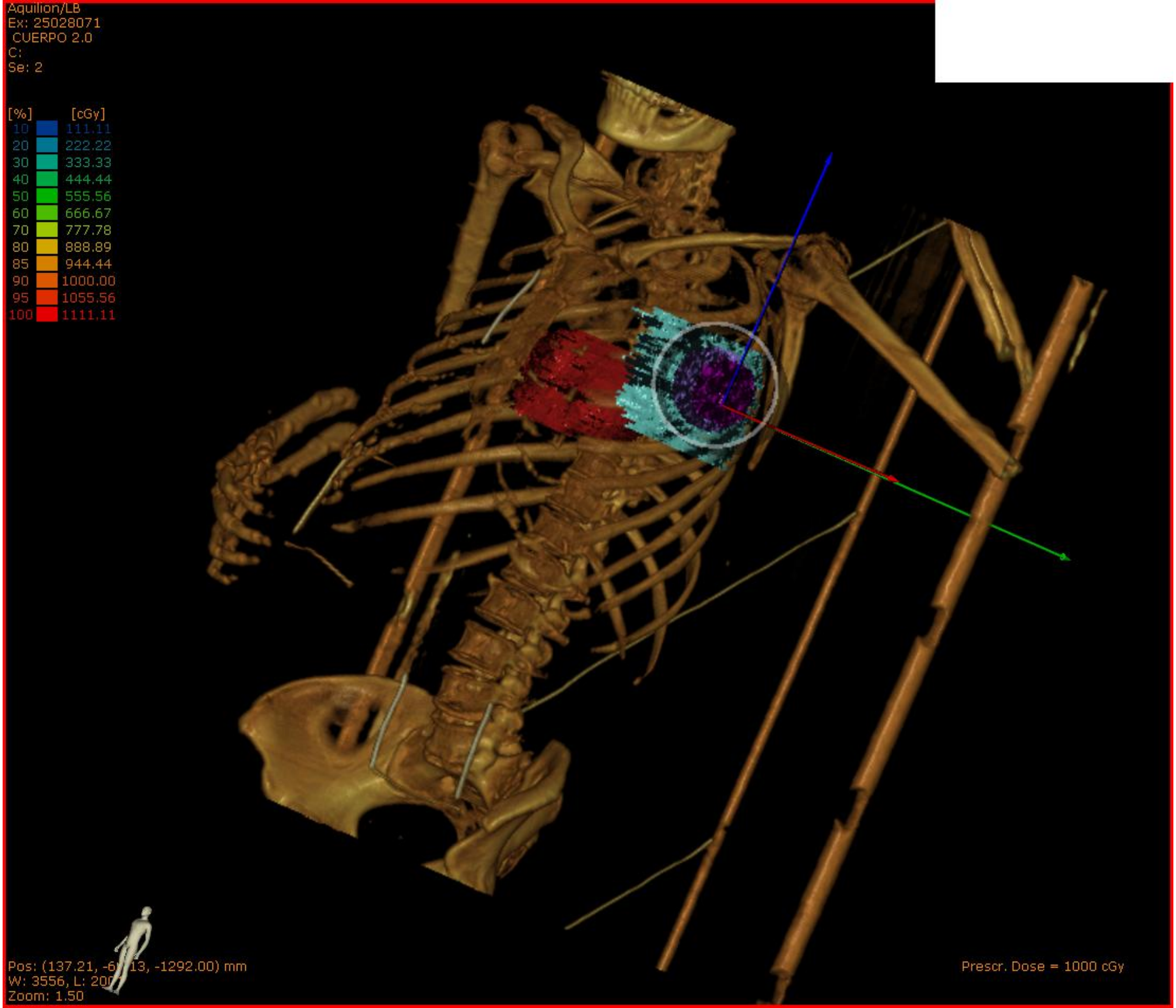
W: 3556, L: 2601
Zoom: 1.50

Prescr. Dose = 1000 cGy

Aquilion/LB
Ex: 25028071
CUERPO 2.0
C:
Se: 2

[%]	[cGy]
10	111.11
20	222.22
30	333.33
40	444.44
50	555.56
60	666.67
70	777.78
80	888.89
85	944.44
90	1000.00
95	1055.56
100	1111.11



Pos: (137.21, -6[illegible]13, -1292.00) mm
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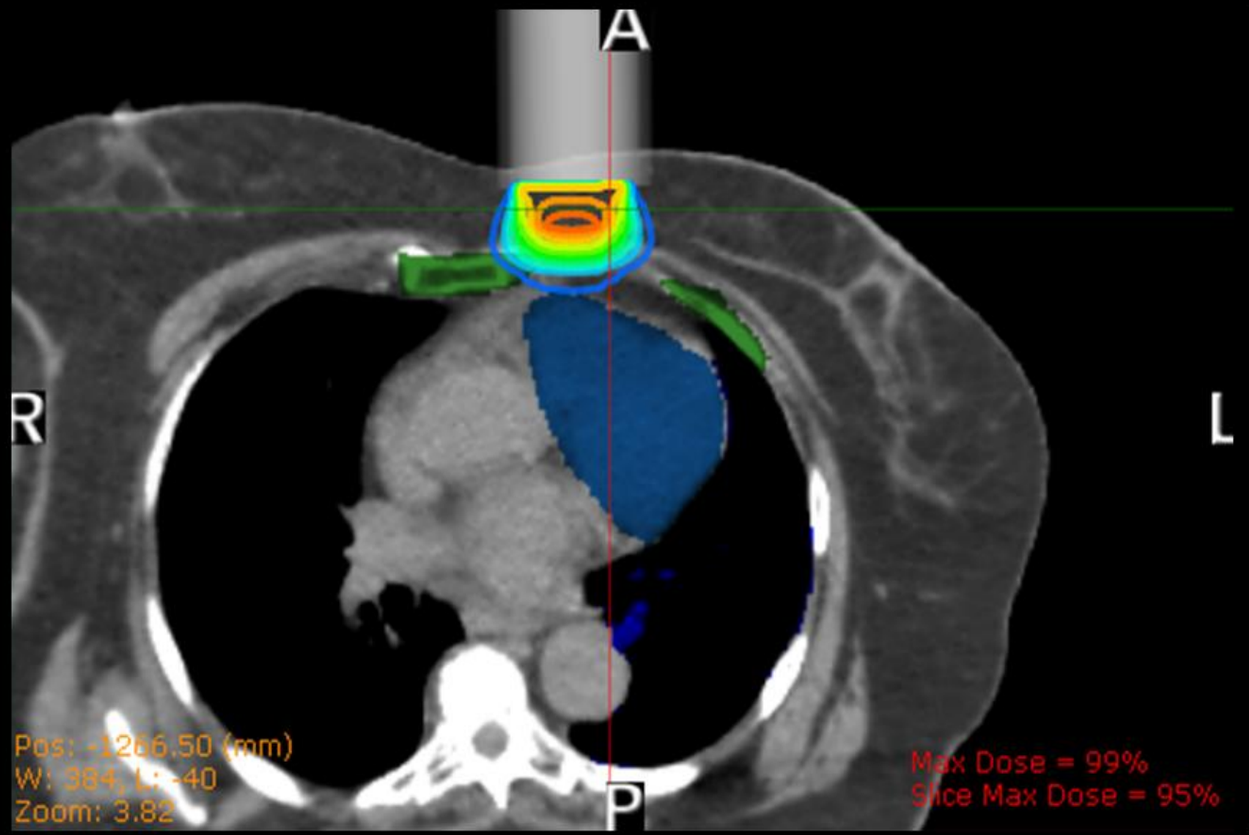
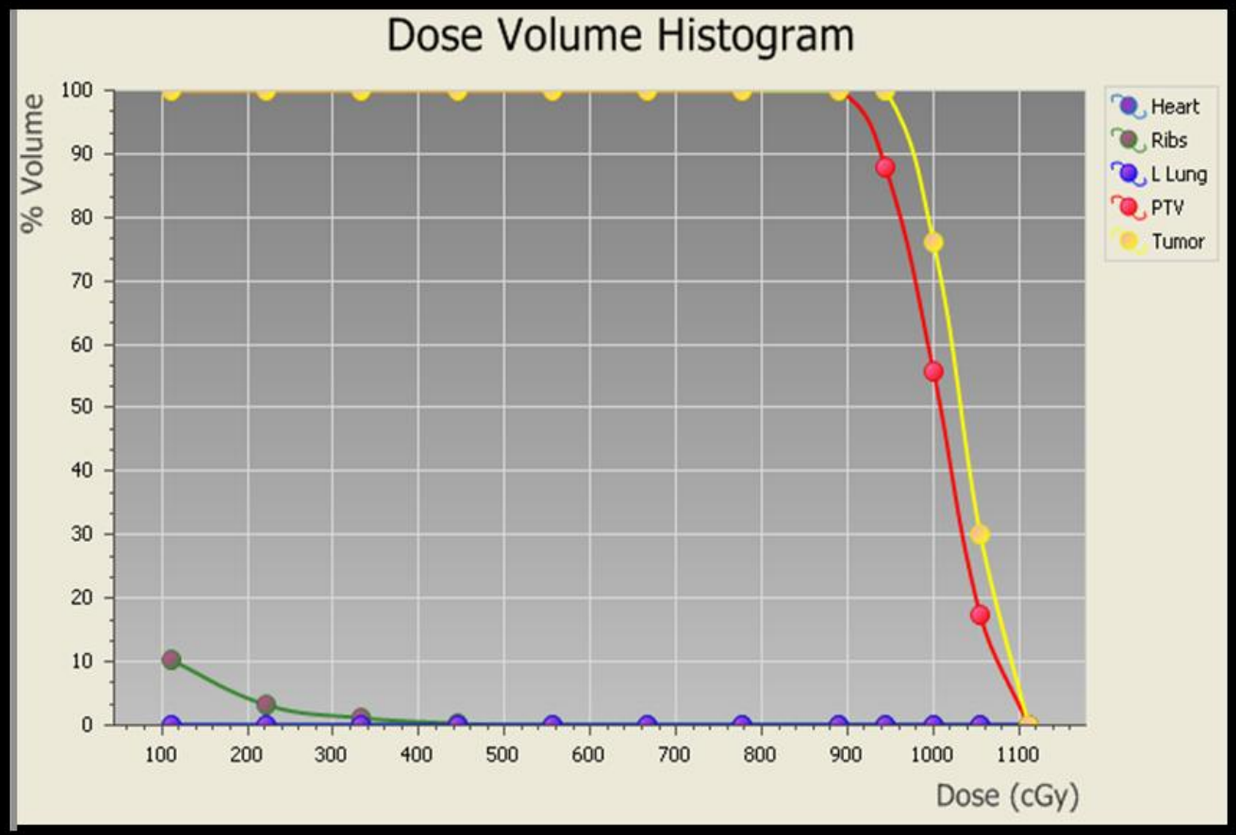
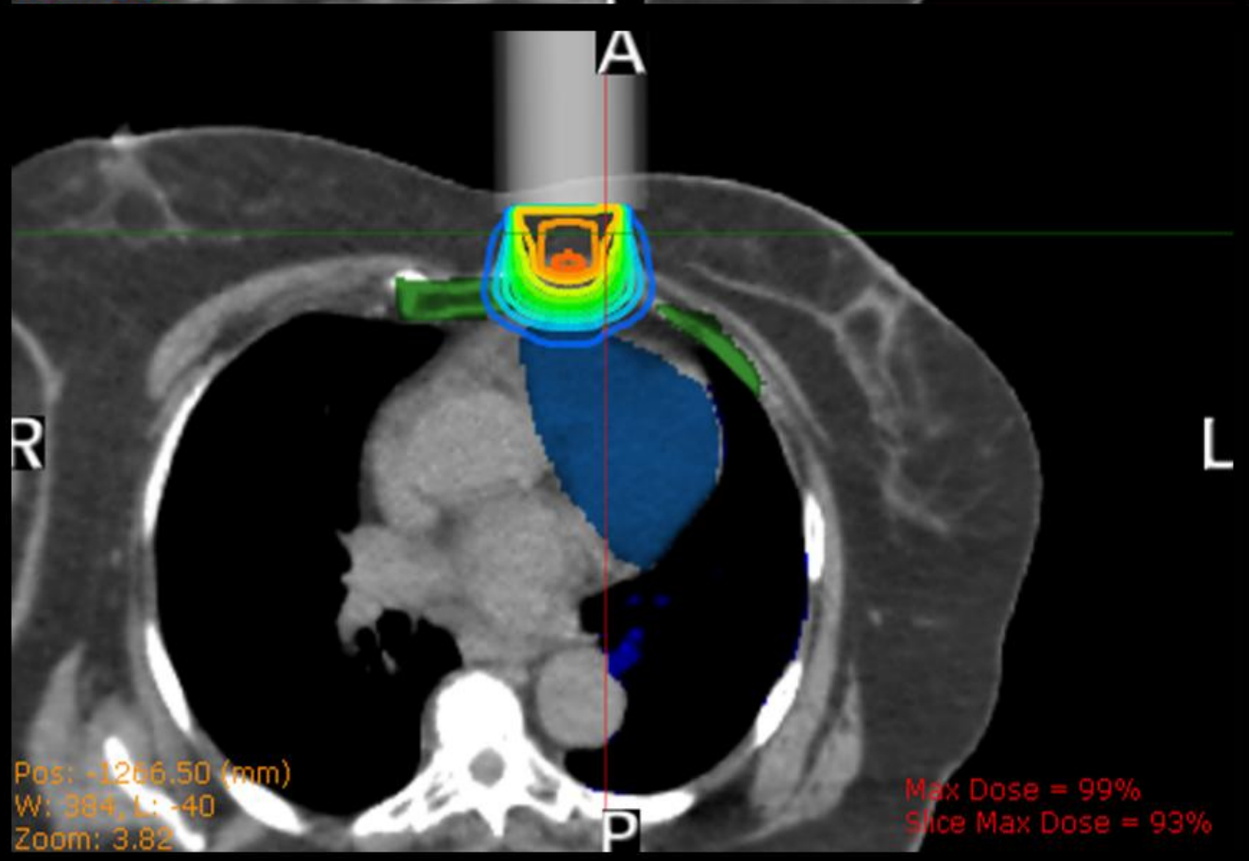
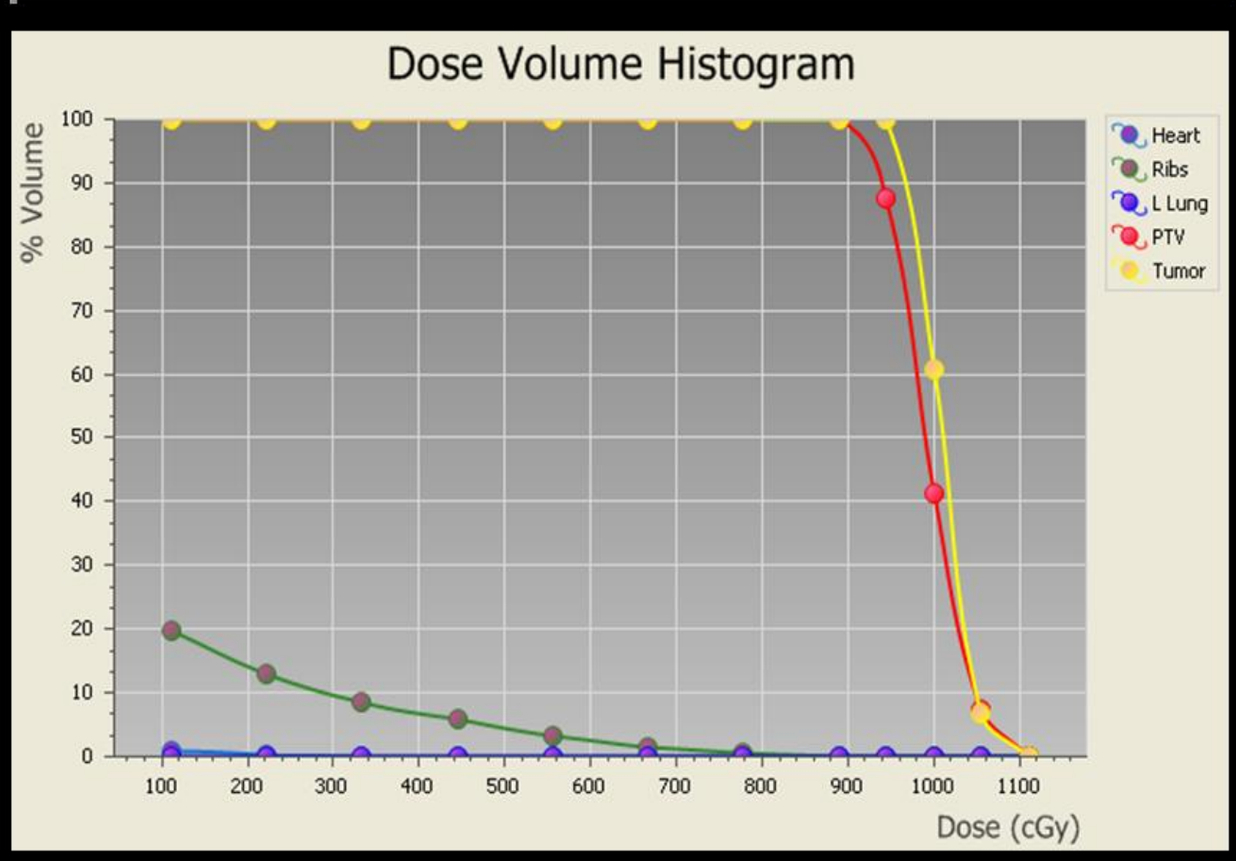
Zoom: 1.50

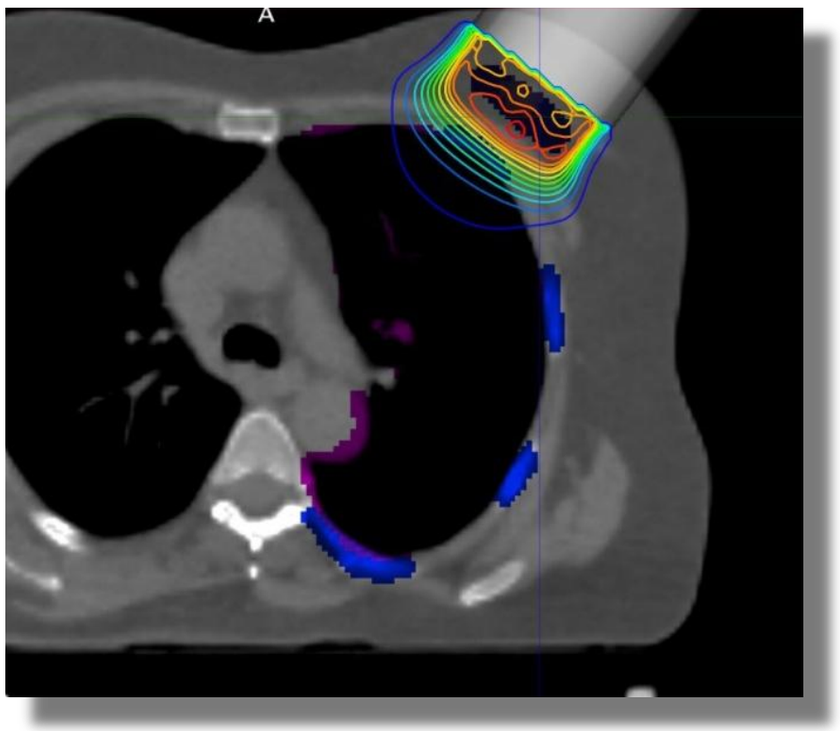
Prescr. Dose = 1000 cGy

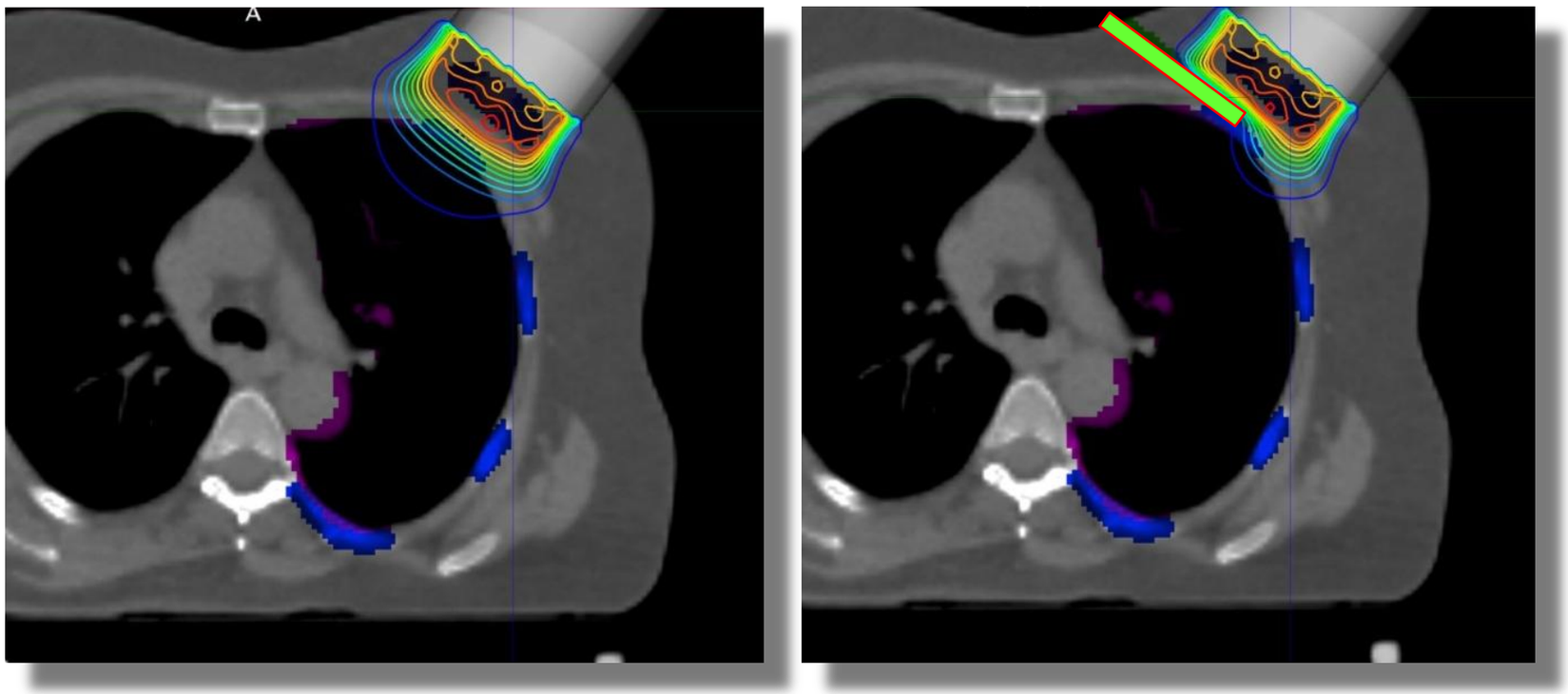

A
R
L
P
Pos: -1266.50 (mm)
W: 384, L: -40
Zoom: 3.82
Max Dose = 99%
Slice Max Dose = 95%

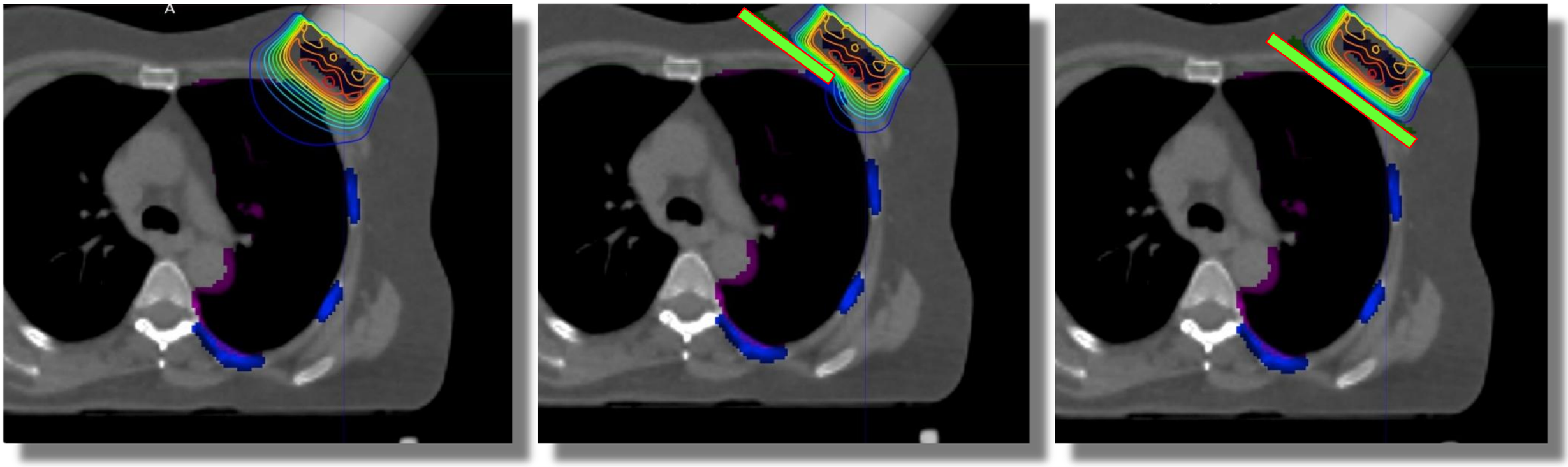

Dose Volume Histogram
% Volume
100
90
80
70
60
50
40
30
20
10
0
100
200
300
400
500
600
700
800
900
1000
1100
Dose (cGy)
Heart
Ribs
L Lung
PTV
Tumor

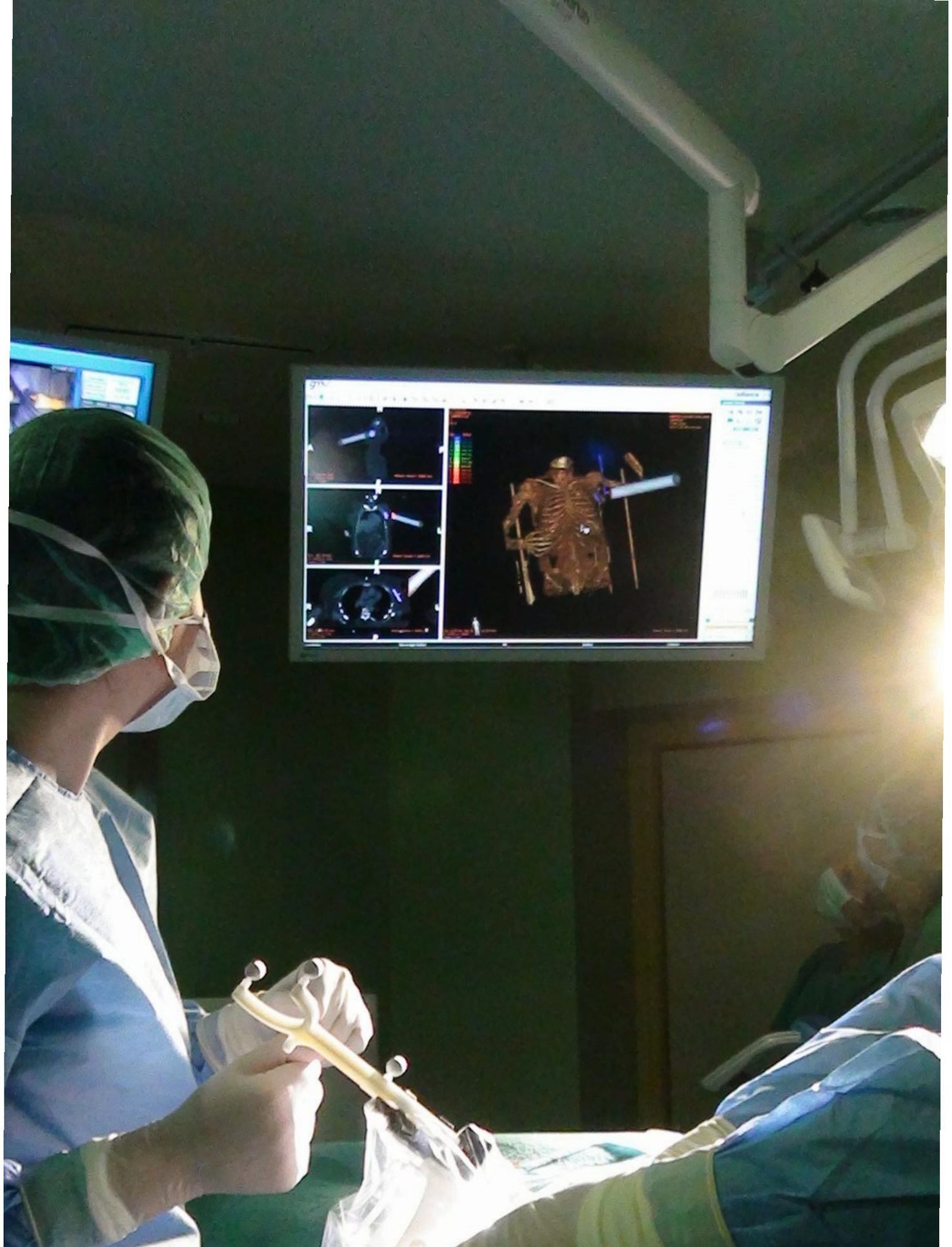

A
R
L
P
Pos: -1266.50 (mm)
W: 384, L: -40
Zoom: 3.82
Max Dose = 99%
Slice Max Dose = 93%


Dose Volume Histogram
% Volume
100
90
80
70
60
50
40
30
20
10
0
100
200
300
400
500
600
700
800
900
1000
1100
Dose (cGy)
Heart
Ribs
L Lung
PTV
Tumor

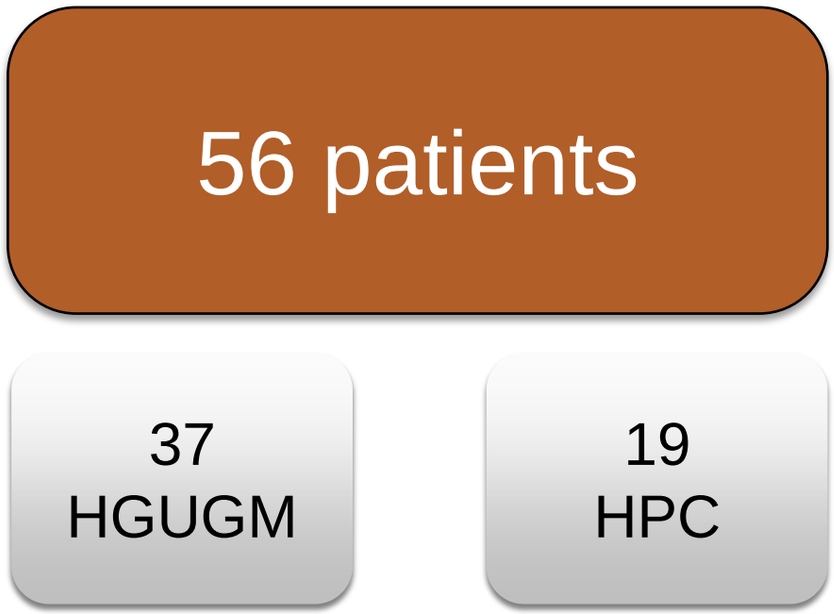

A


A


A



Results



Follow-up	37m (6-67m)
Age (median)	65y
Menstrual status	Postmenopausal 95%

Clinical characteristics

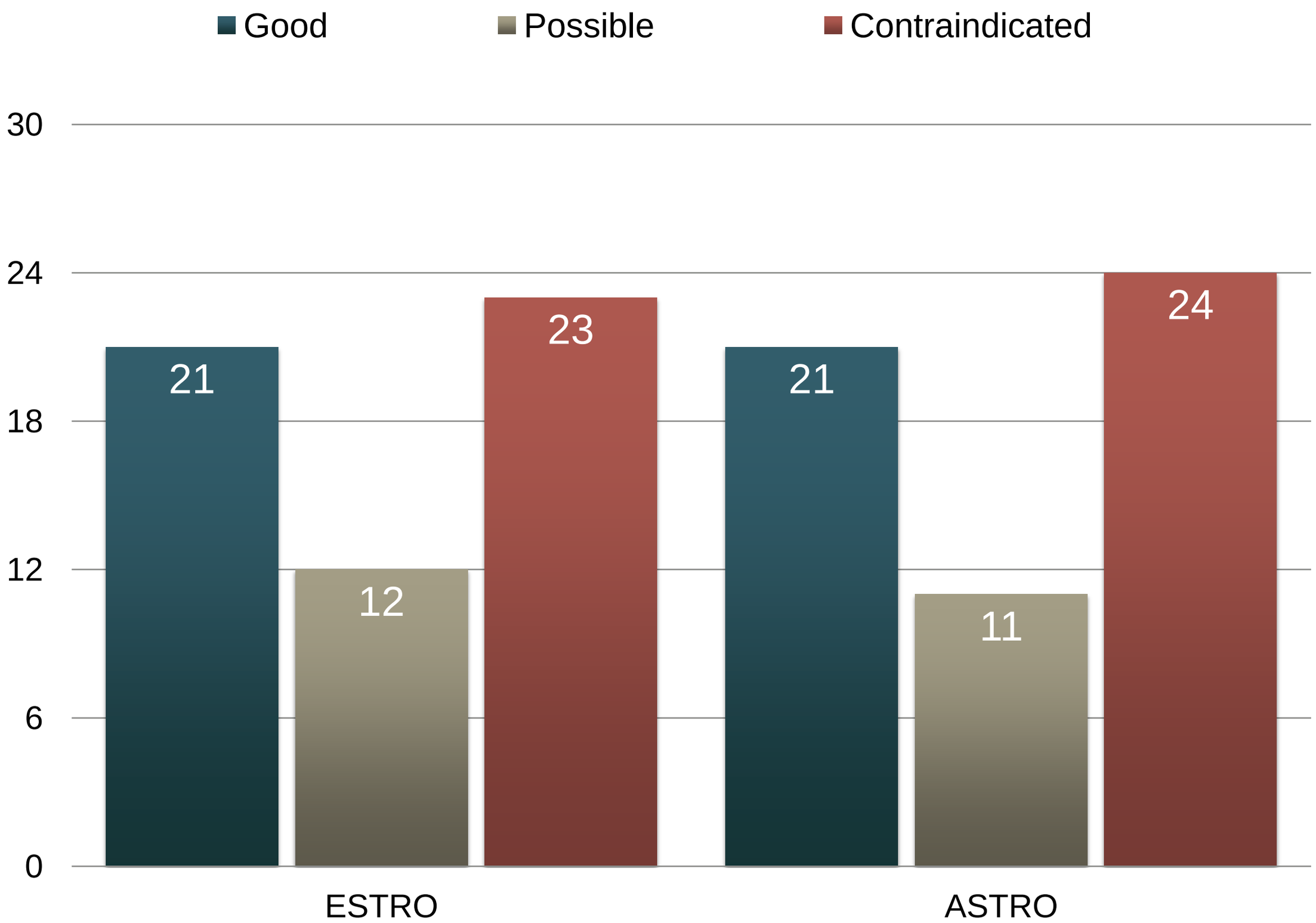
Breast	Left 59%
Localization	UOQ 21 (37%)
Unicentric	89%
cT1-2	100%
cN0	89%

Biopsy

Histology	ductal 82%
Nuclear grade	grade 1: 5% grade 2: 81% grade 3: 14%
ER+	96%
PR+	88%
HER-2 negative	93%

Surgical and pathology features

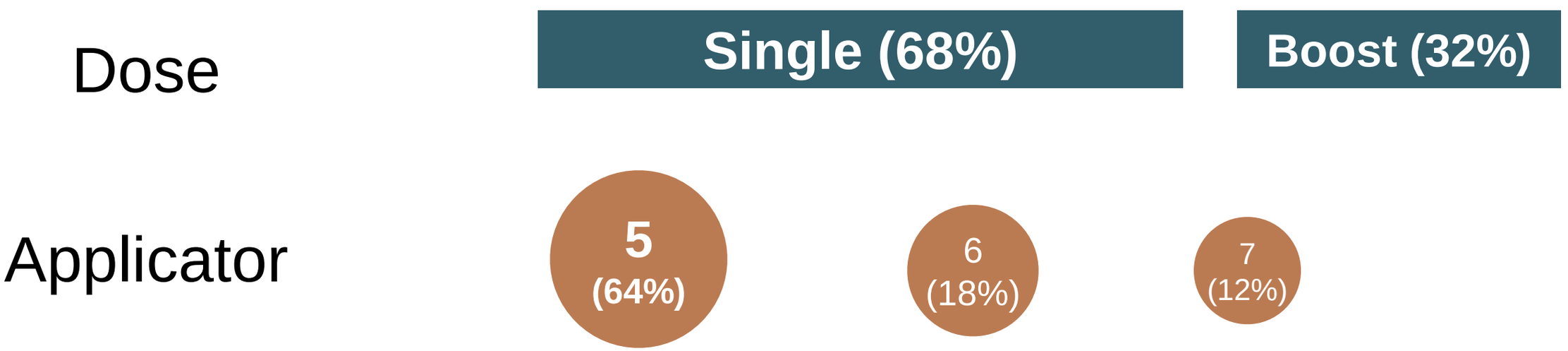
Type of sugery	BCS
Sentinel nodal status	negative 57% positive 31% not performed 12%
<pT1c	80%
pN+	34%
Surgical margins	negative 73%
Lymphovascular invasion	9%
Perineural invasion	2%


Good
Possible
Contraindicated
30
24
18
12
6
0
21
12
23
21
11
24
ESTRO
ASTRO

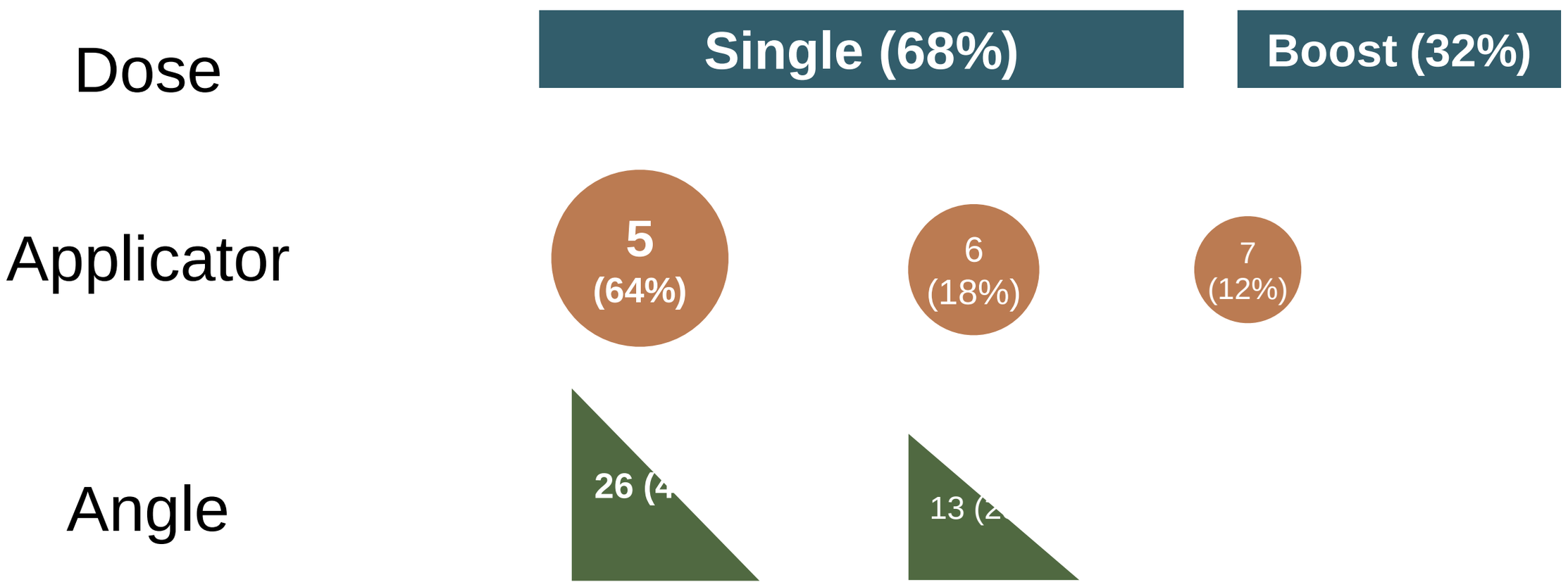
IOERT

Dose

IOERT



IOERT



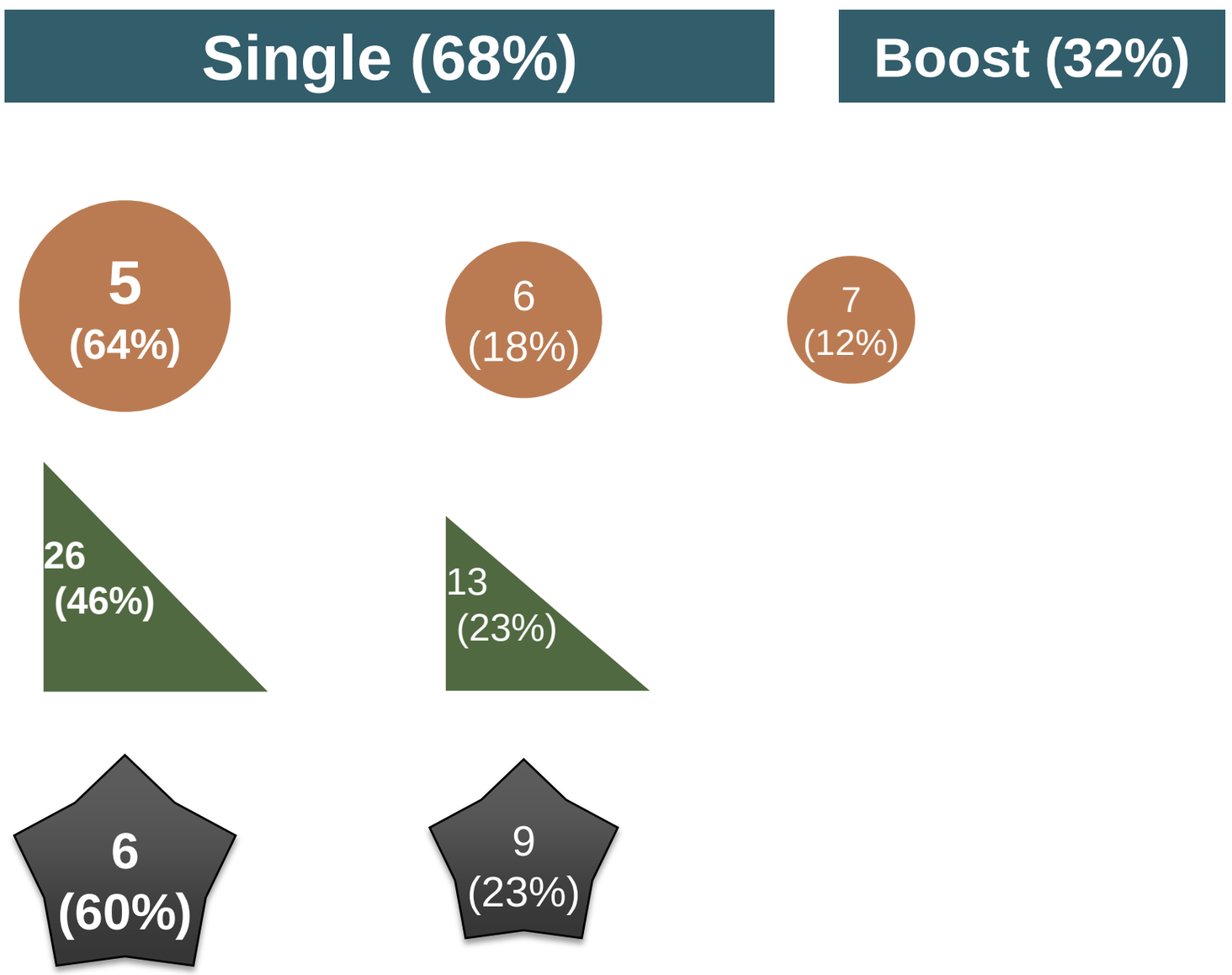
IOERT

Dose

Applicator

Angle

Energy



IOERT

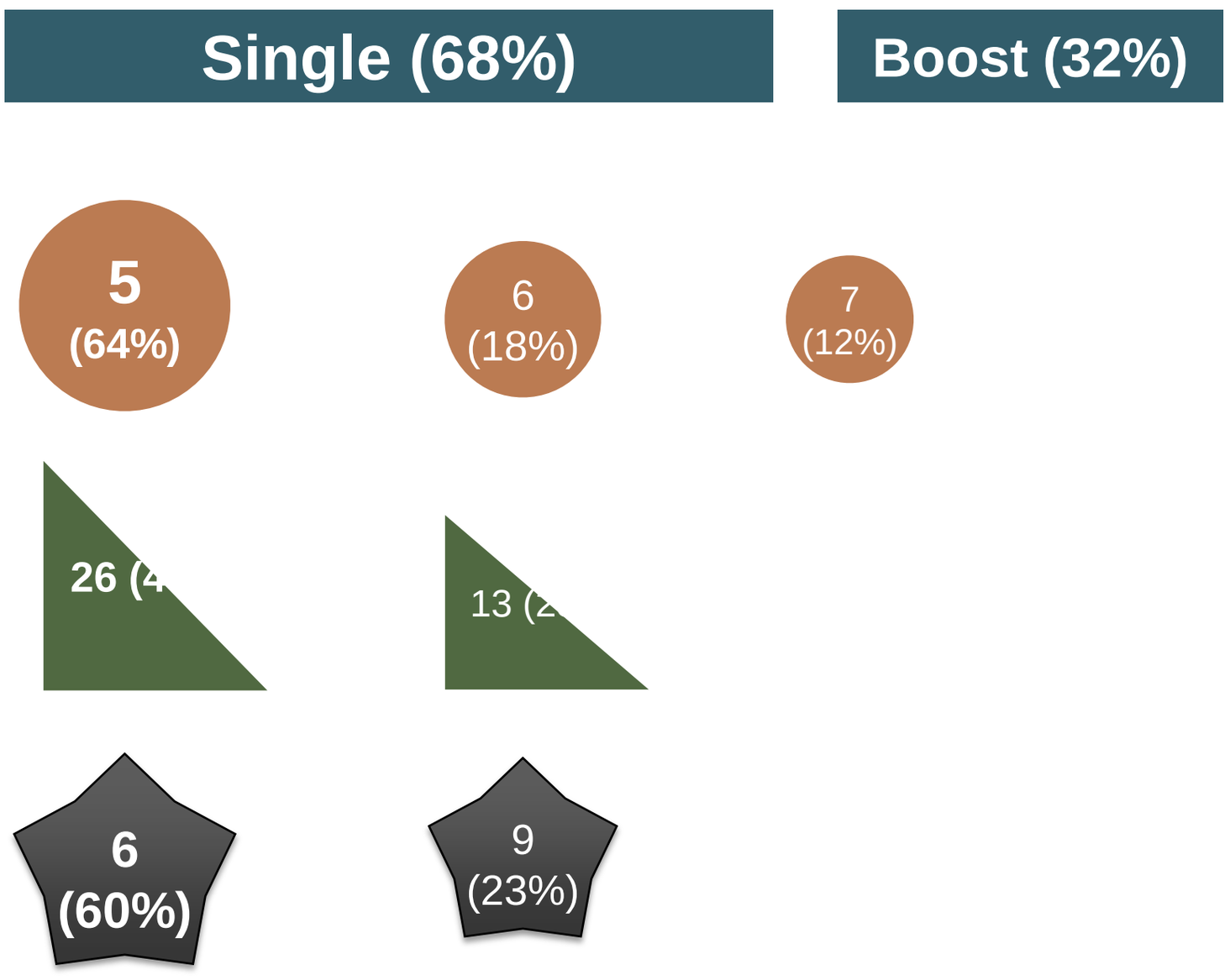
Dose

Applicator

Angle

Energy

Protection



Toxicity and cosmesis

3 grade 3+ skin toxicity

Toxicity and cosmesis

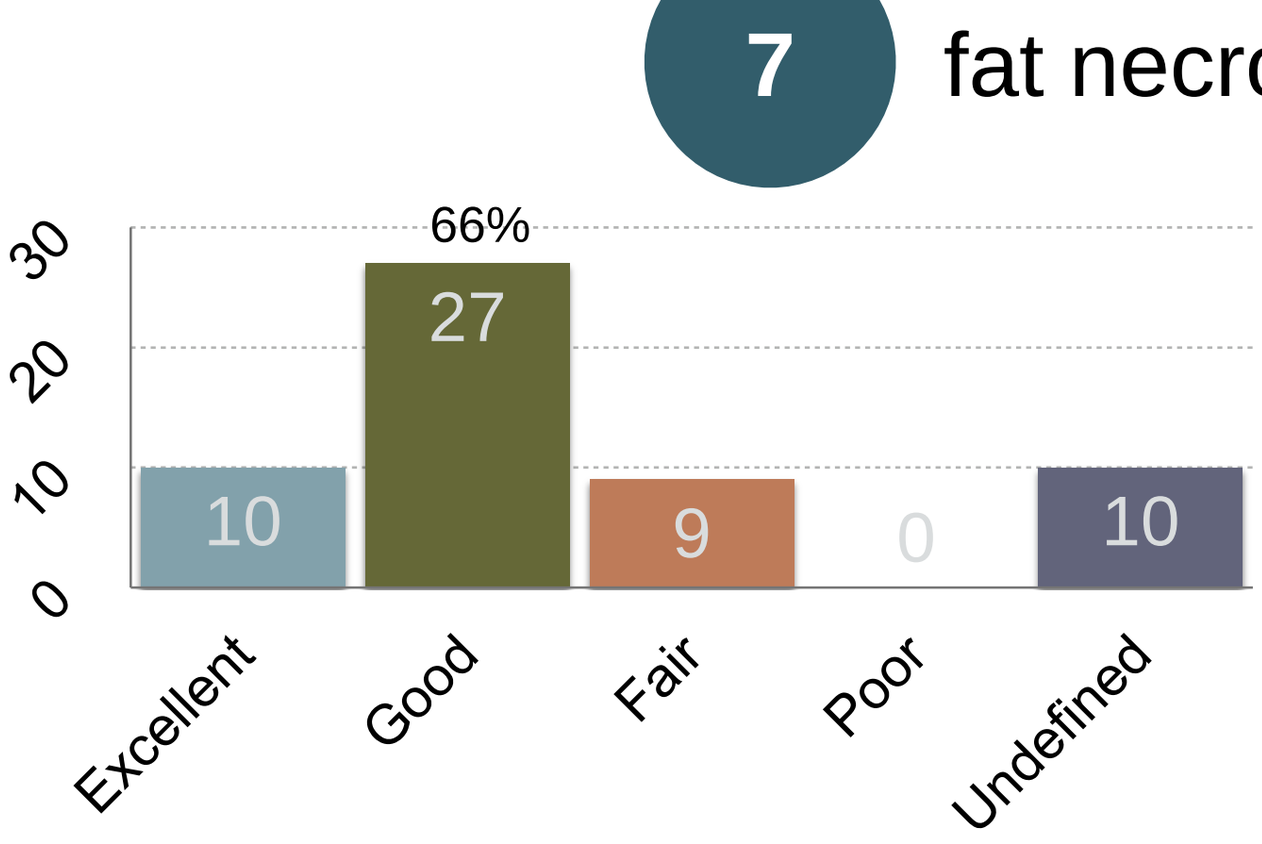
3 grade 3+ skin toxicity

7 fat necrosis

Toxicity and cosmesis

3 grade 3+ skin toxicity

7 fat necrosis



NSABP/RTOG
Breast Cosmetis Grading Scale

Status

51 alive without disease

2 alive with disease

1 dead with disease

2 dead without disease

Status

51 alive without disease

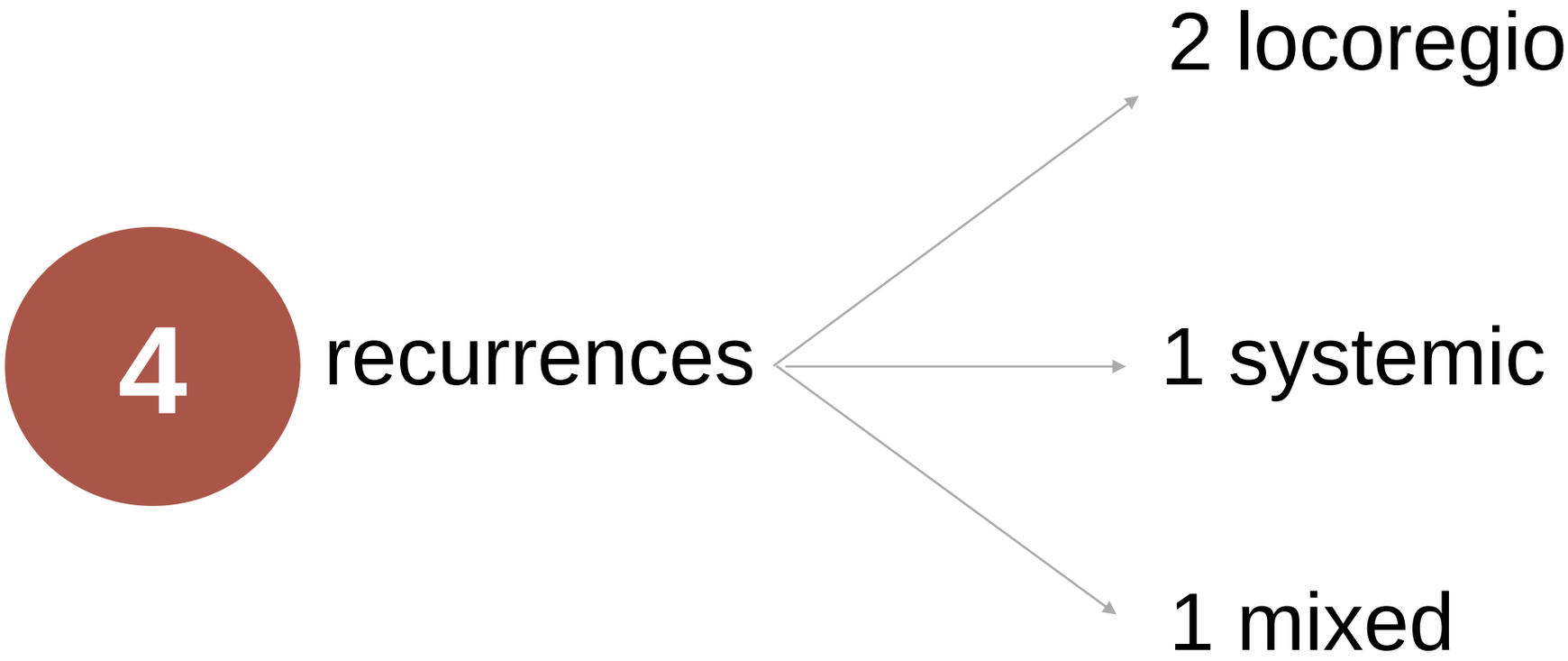
2 alive with disease

1 dead with disease

2 dead without disease

4 recurrences

Status



Recidives

Time to recidive	Type	IORT dose	Age	pT	pN	IHQ	Borders	Adj Tx	Salv tx	Status
35	Local (axilla)	21Gy	63	**T2**	**N0**	HR+ Her2- Ki67 40%	**+**	Chem	Chem+RT	AWoD
58	Local (breast)	21Gy	78	**T2**	**N0**	HR+ Her2- Ki67?	**+**	-	Surg	AWD
33	Systemic (bone)	9Gy	43	**T2**	**N0**	HR 40% Her2- Ki67?	**+**	Chem, RT	Chem	AWD
28	Mixed (breast, non-regional nodes)	21Gy	74	**T2**	**N0**	HR- Her2+ Ki 67 50%	**+**	-	None	DWD

None in-field or in-quadrant

All left sided

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None in-field or in-quadrant

All left sided

Recidives

95%

local control

Patient	Time to recidive	Type	IORT dose	Age	pT	pN	HR	Her-2	Ki67	Borders	Adj Tx	Status
1	35	Local (axilla)	21 Gy	63	**T2**	**N0**	+	-	**40 %**	**+**	Chem	AWoD
2	58	Local (breast)	21 Gy	78	**T2**	**N0**	+	-	**?**	**+**	-	AWD
3	33	Systemic (bone)	9Gy	43	**T2**	**N0**	40 %	-	**?**	**+**	Chem, RT	AWD
4	28	Mixt (breast, non-regional nodes)	21 Gy	74	**T2**	**N0**	-	+	**50 %**	**+**	-	DWD

Recidives

Patient	Time to recidive	Type	IORT dose	Age	pT	pN	HR	Her-2	Ki67	Borders	Adj Tx	Status
1	35	Local (axilla)	21 Gy	63	**T2**	**N0**	+	-	**40 %**	**+**	Chem	AWoD
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3	33	Systemic (bone)	9Gy	43	**T2**	**N0**	40 %	-	**?**	**+**	Chem, RT	AWD
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95% local control

100% in-field local control

Recidives

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95% local control

100% in-field local control

100% local control for ASTRO suitable or ESTRO good candidates

There were no statistically significant difference in clinical or pathological characteristics between treatment modality or cosmetic result.

Conclusions

- The low local and systemic recurrence rates and the excellent toxicity profile in our joint experience support the efficacy and safety of IORT as single modality or boost for patients with early stage breast cancer.

- The use of Radiance IORT simulation and planning tool is feasible to introduce in clinical practice and allows a pre-procedure selection of treatment parameters.

- Further studies regarding concordance between pre and post procedure parameters together with topography of cancer control are ongoing research projects.

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BiG

BIOMEDICAL
IMAGING AND
INSTRUMENTATION
GROUP

SaludMadrid

Hospital General Universitario
Gregorio Marañón

Comunidad de Madrid

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