Esperienza di stereotassia polmonare al Campus Bio-Medico: tecnica e risultati

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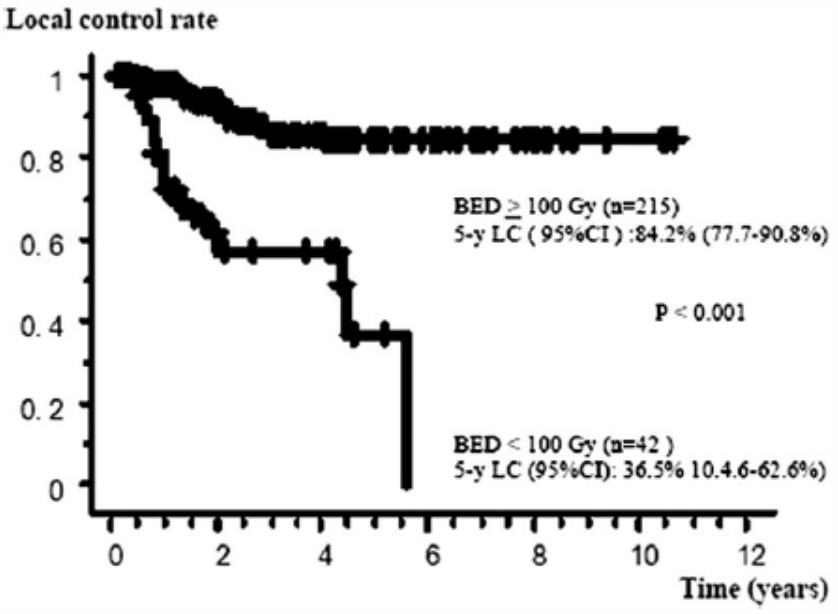
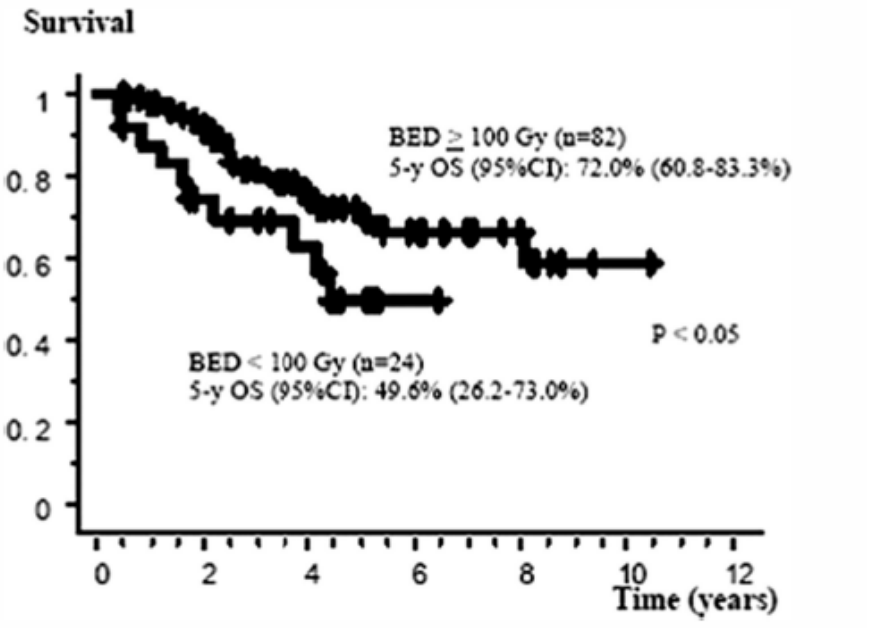
UNIVERSITÀ CAMPUS BIO-MEDICO DI ROMA

Background

$BED_{10} > 100$ Gy

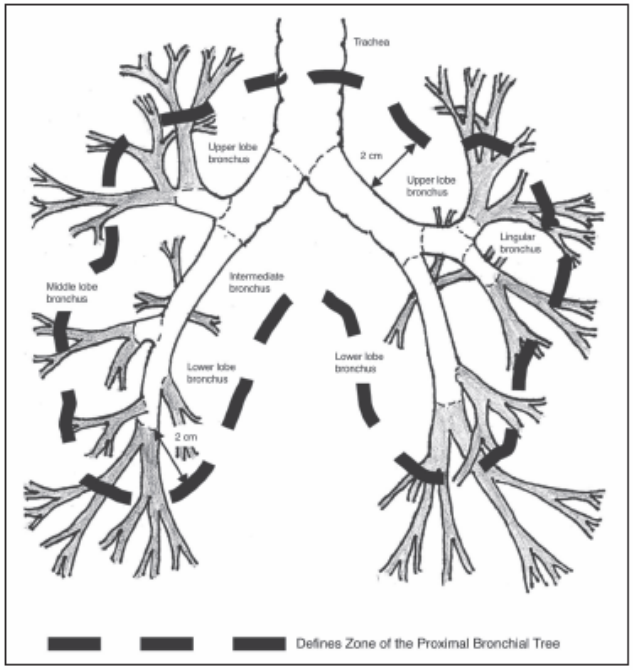




Onishi H et al, J Thorac Oncol 2007;2: Suppl 3, S94–S100

Background

Peripherally vs centrally located Tumors



Peripheral Lesions: 60 Gy in 3 fx

BED_{10}: 180 Gy

Centrally Located: 60 Gy in 8 fx

BED_{10}: 105 Gy

Timmerman M et al, J Clin Oncol 2006 Oct 20;24(30):4833-9.
Haasbeek CJ et al, J Thorac Oncol 2011 Dec;6(12):2036-43.

Open question

Simulation

Treatment Planning

Pre-treatment verification

Treatment

Post-treatment control

Open question

Simulation

Treatment Planning

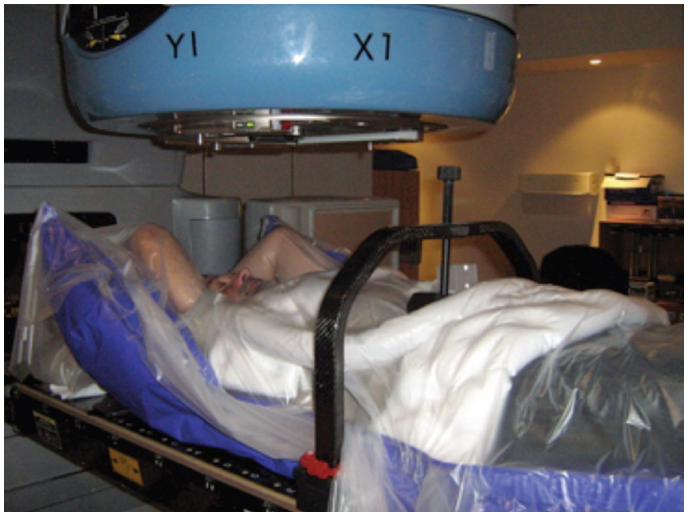
Pre-treatment verification

Treatment

Post-treatment control

Open question

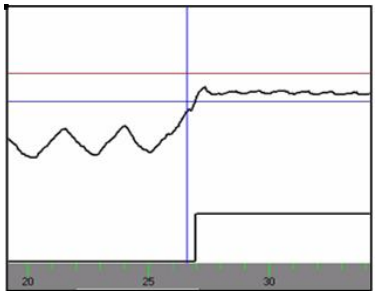
How to immobilize patient

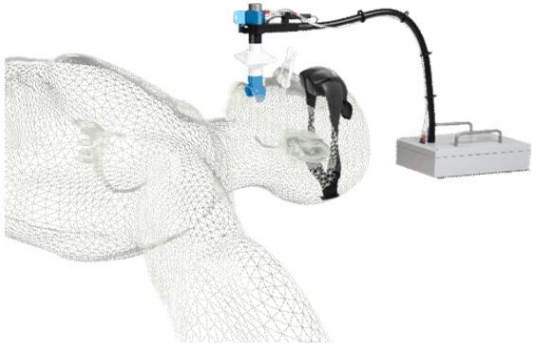


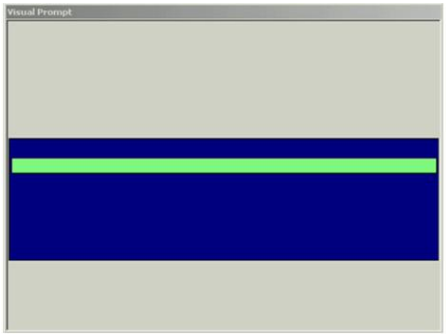
Open question

Breathing:

Free *vs.* Abdominal compression *vs.* Breath-hold vs. Coaching (audio/video)







Open question

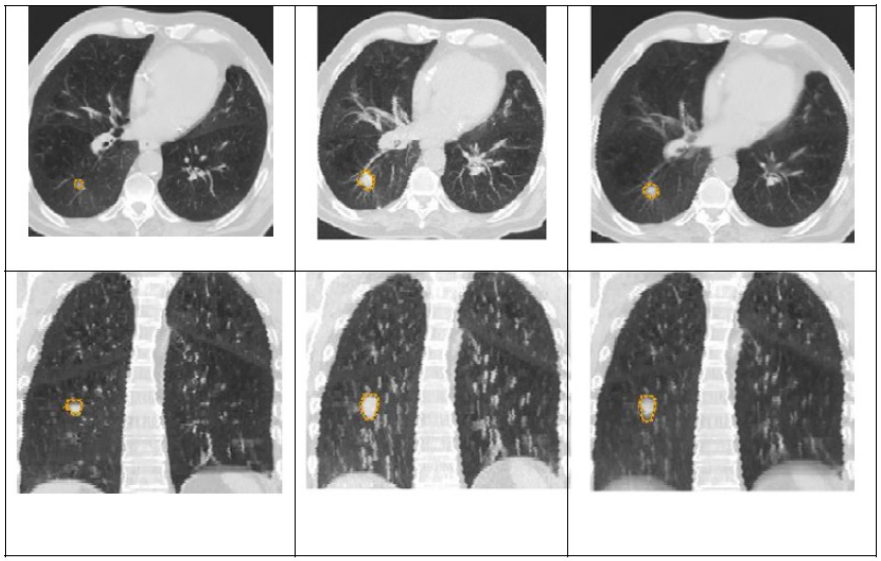
CT scanning (*i.e. ITV definition*):

Standard *vs.* Slow *vs.* 4D-scan (AIP vs MIP)

Six phases of a 4D-CT data set

Average intensity projection

Maximum intensity projection



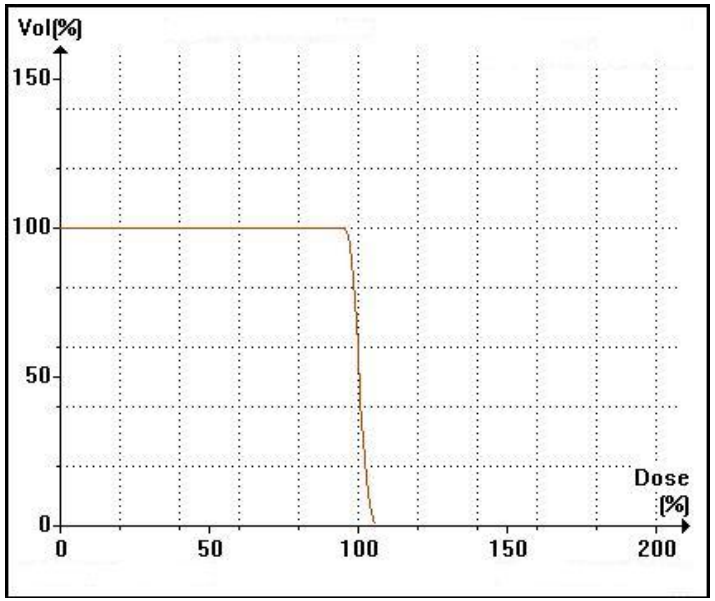
Helical MIP Averaged Intensity

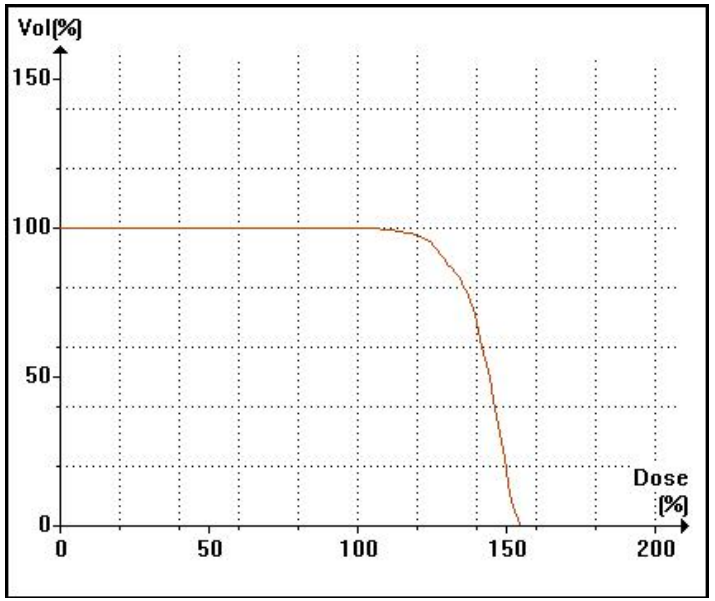
Open question

Treatment planning

Dose heterogeneity to PTV:

Homogeneity *vs.* Dose Gradient





Open question

Treatment planning

Dose heterogeneity to PTV:

- Homogeneity *vs.* Dose Gradient

Field distribution:

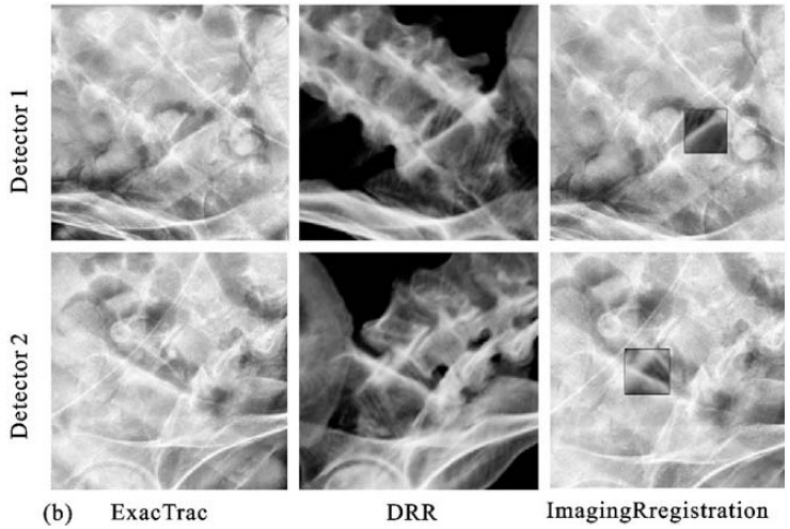
- Static *vs.* Arc *vs.* Volumetric
- # of beams

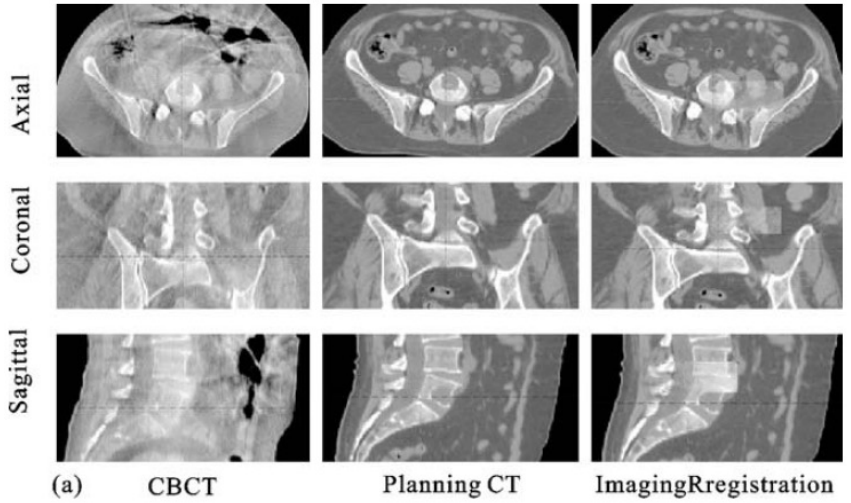
Open question

Pre-treatment verification

Type of identification:

2D (MV *vs.* KeV) *vs.* Cone-Beam CT





Open question

Pre-treatment verification

Tumor location:

Invasive (seeds) *vs.* Non-invasive

Patient rotation:

No adjust *vs.* Manual *vs.* Robotic table

Open question

Treatment

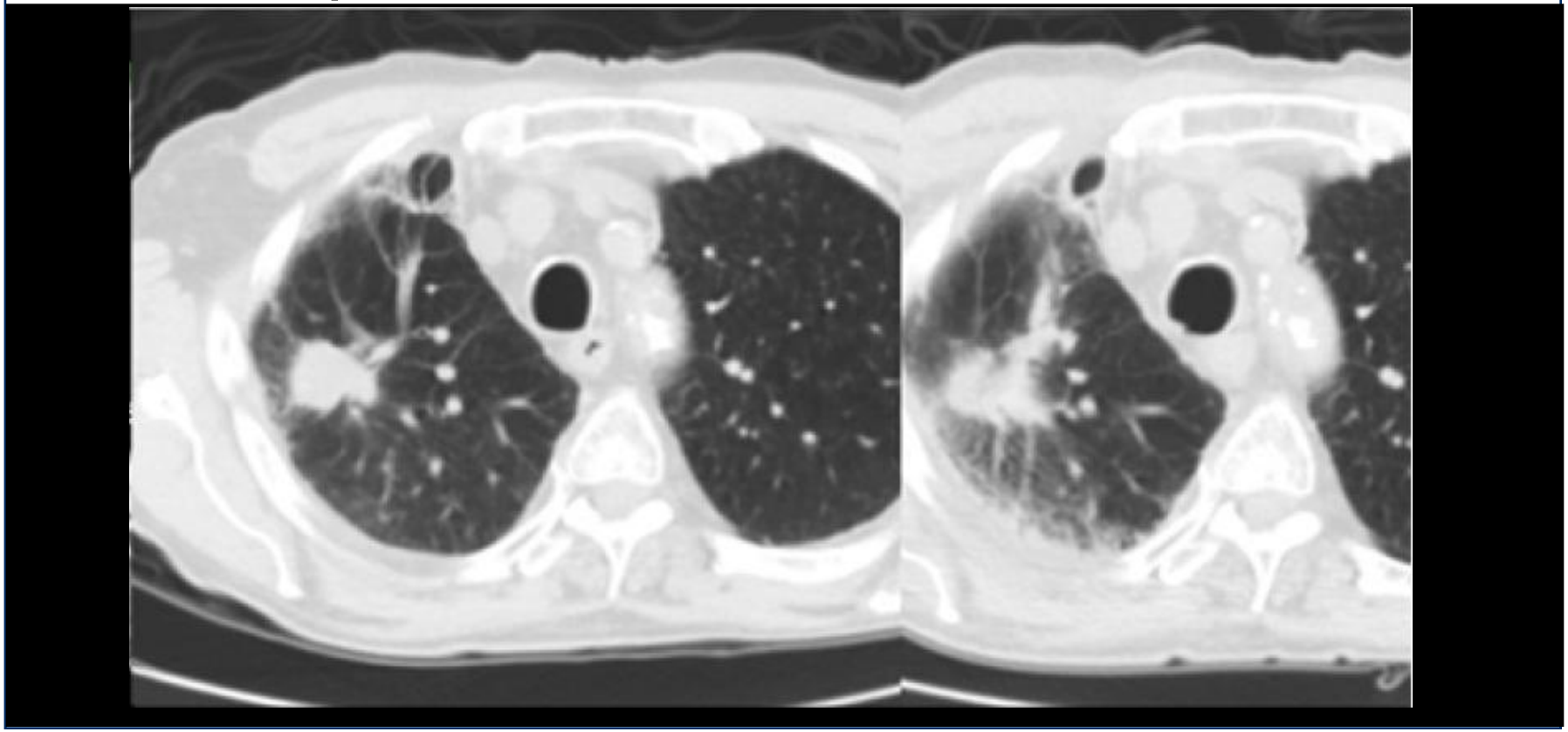
Overall treatment time:

Consecutive *vs.* Every other day *vs.* 1.5-2 weeks

Open question

Post-treatment verification

Follow-up: Tumor *vs.* Fibrosis



One among several answers

In the next few minutes we want to share

Technical solutions

Results according these solutions

Facilities @ UCBM

Siemens CT scan

BrainLab ExacTrack

Brainscan

Varian cLinac 2100 C/D

Technical issues

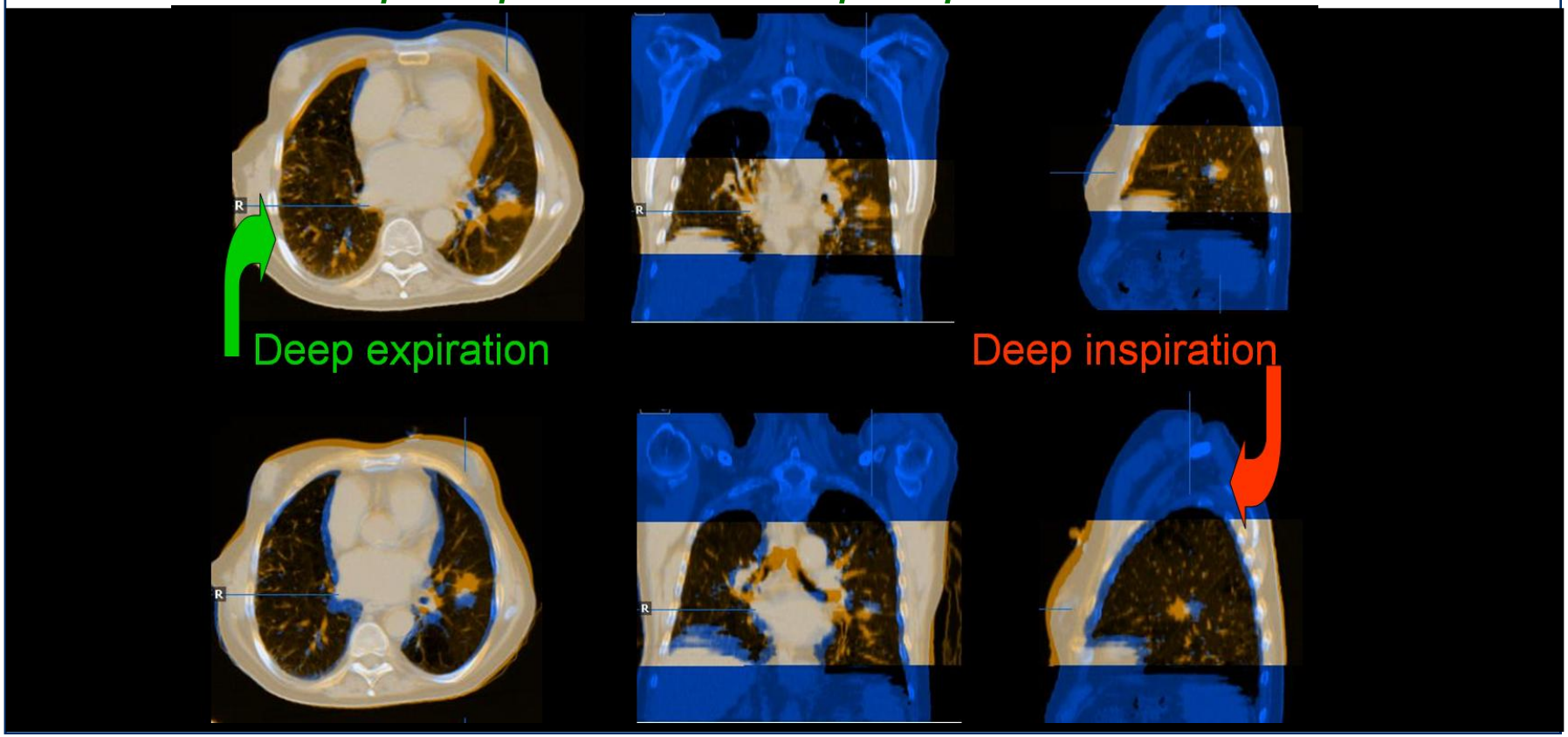
Patient Simulation:

Supine, Vac-Lock, Optical Marker, Free breating

Technical issues

ITV definition by 3 CT scans:

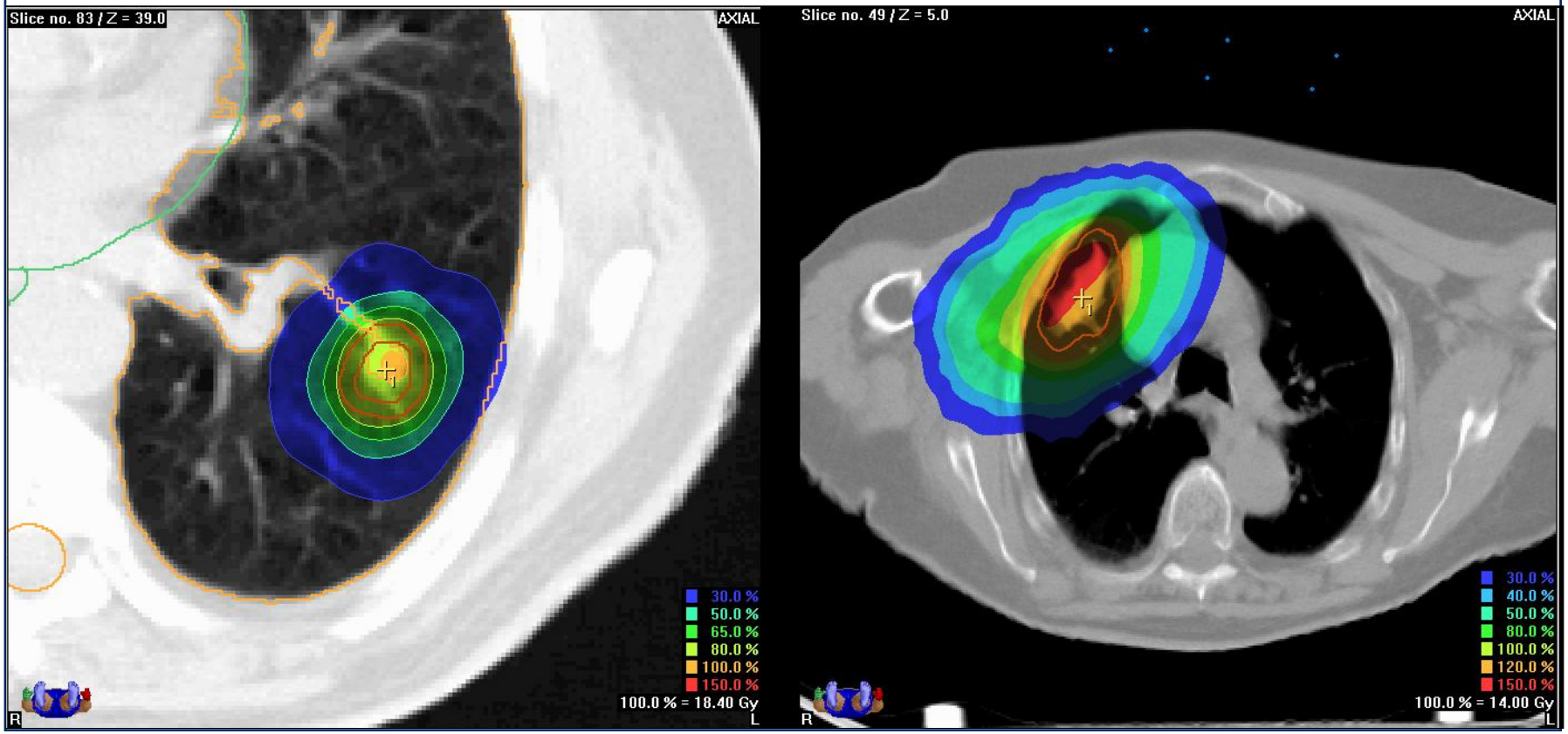
Free + deep inspiration + deep expiration



Technical issues

Treatment Plan:

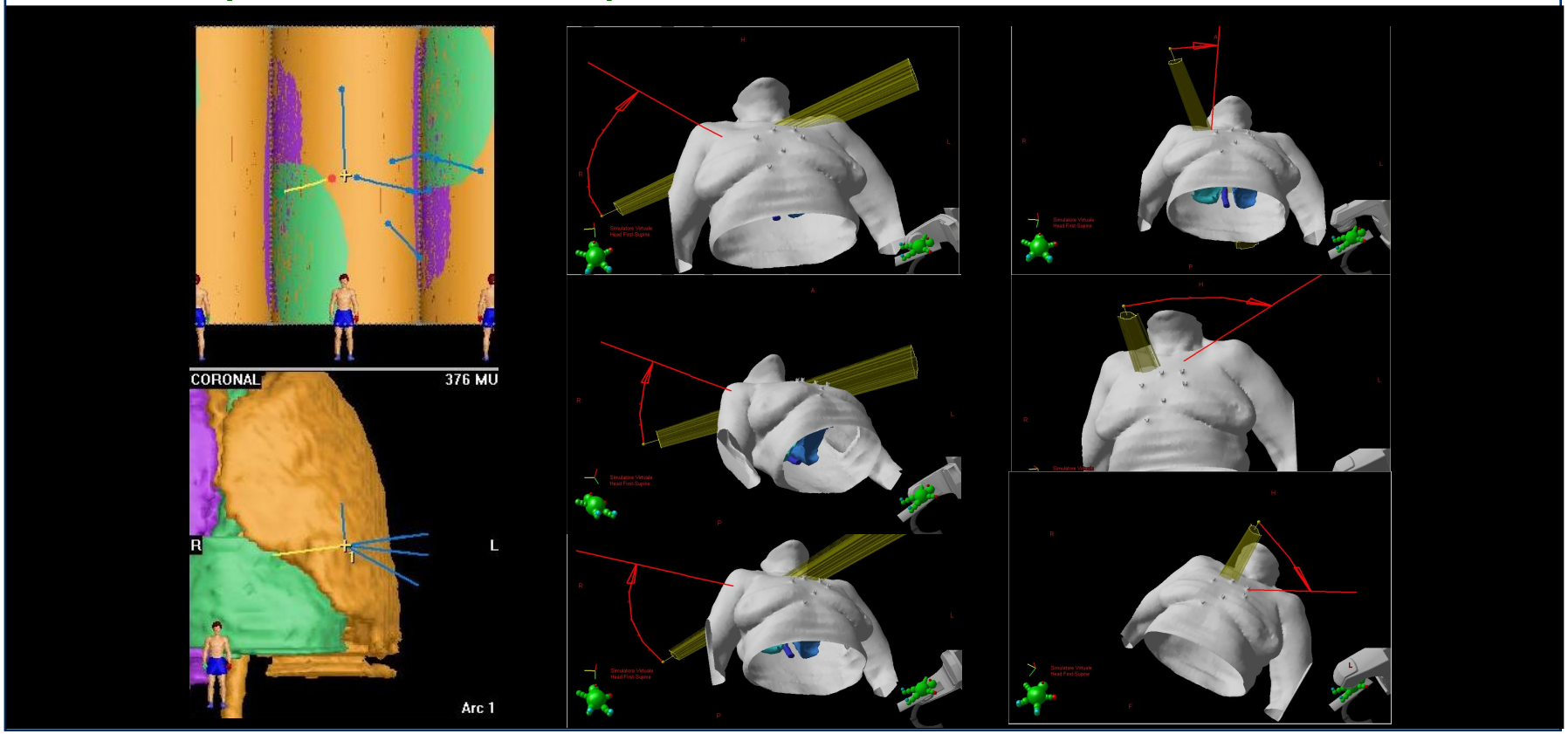
20 Gy @ isocenter with 65% isodose covering whole PTV



Technical issues

Field distribution:

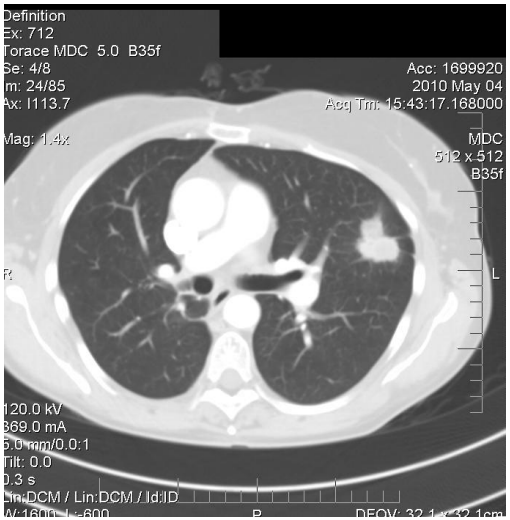
Multiple arcs technique

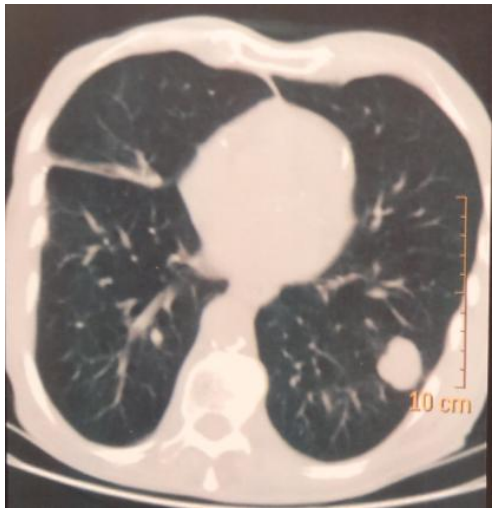


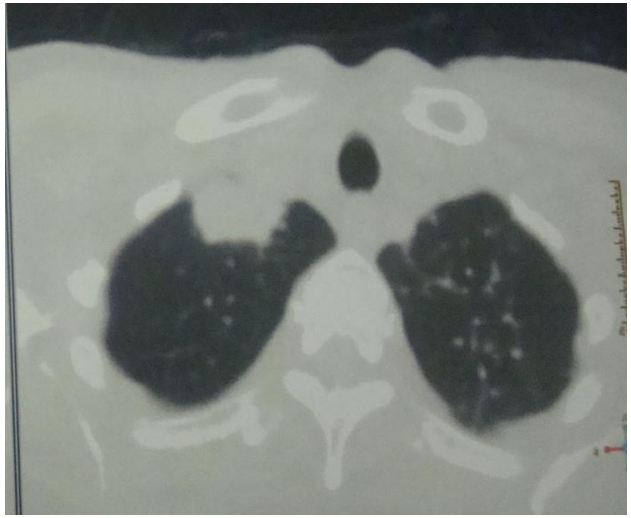
Technical issues

Dose distribution:

According to site ?



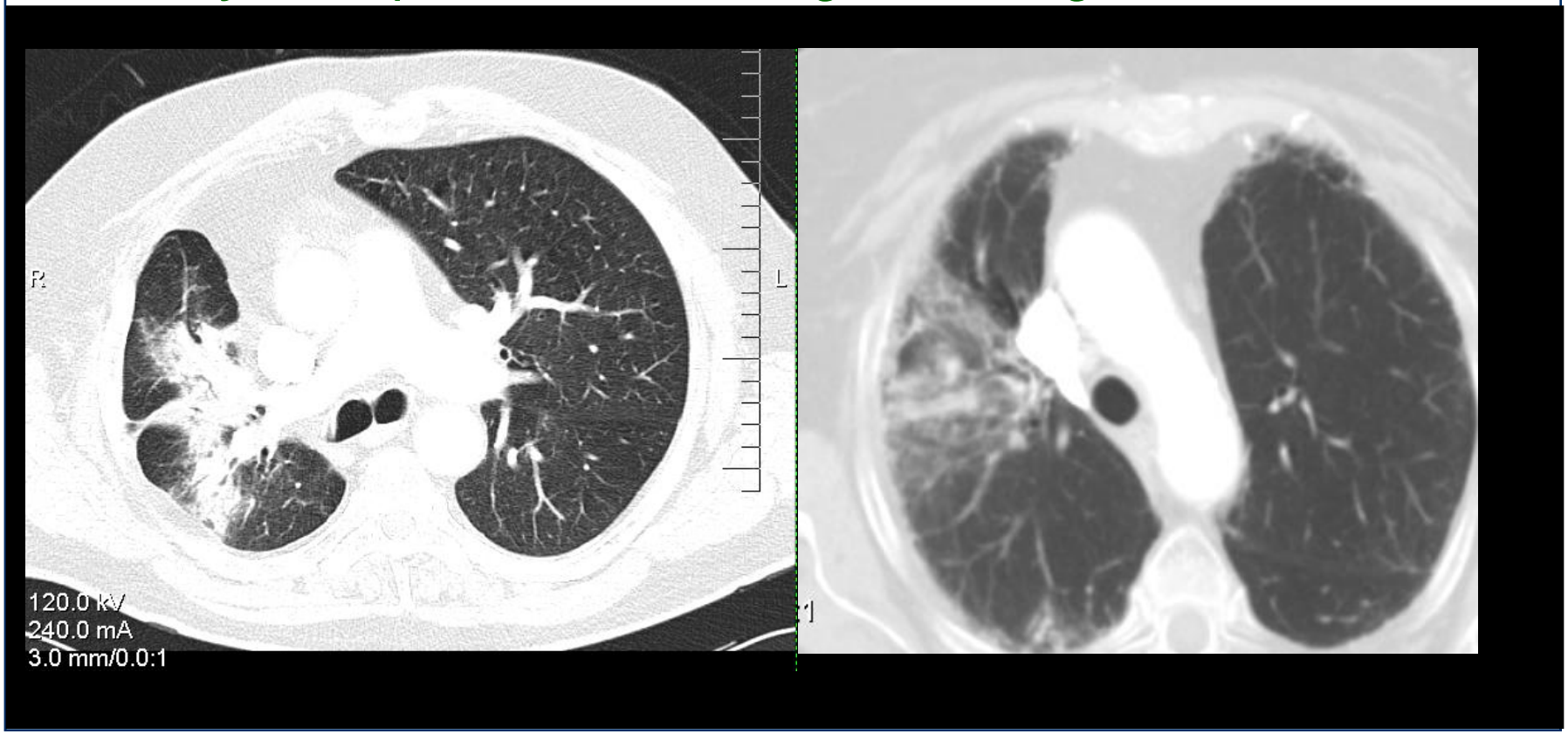




Technical issues

Dose distribution:

Analysis of pattern of radiological changes



Technical issues

Dose distribution:

Evaluation of DVH, 21 Grade 1 lung reaction on 96 treated lesions (21.8%)

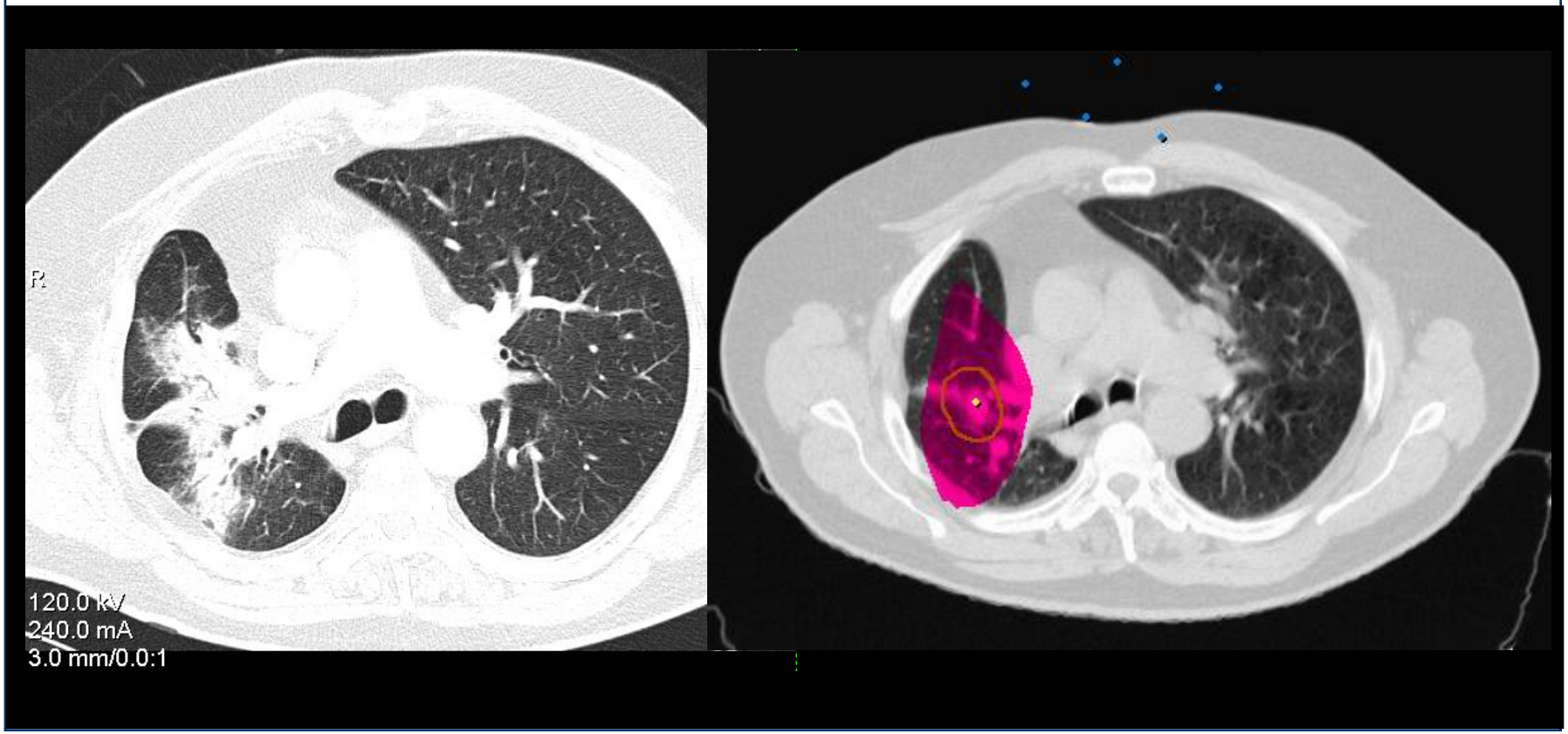
	V-Lung		
	V12*	**V15***	**V18***
Presente	>18%	>15%	>10%
Assente	<10%	<7%	<5%

*Biological Equivalent Dose for α/β=3; 3 fx
BED2= 15, 20, 30 Gy

Technical issues

Dose distribution:

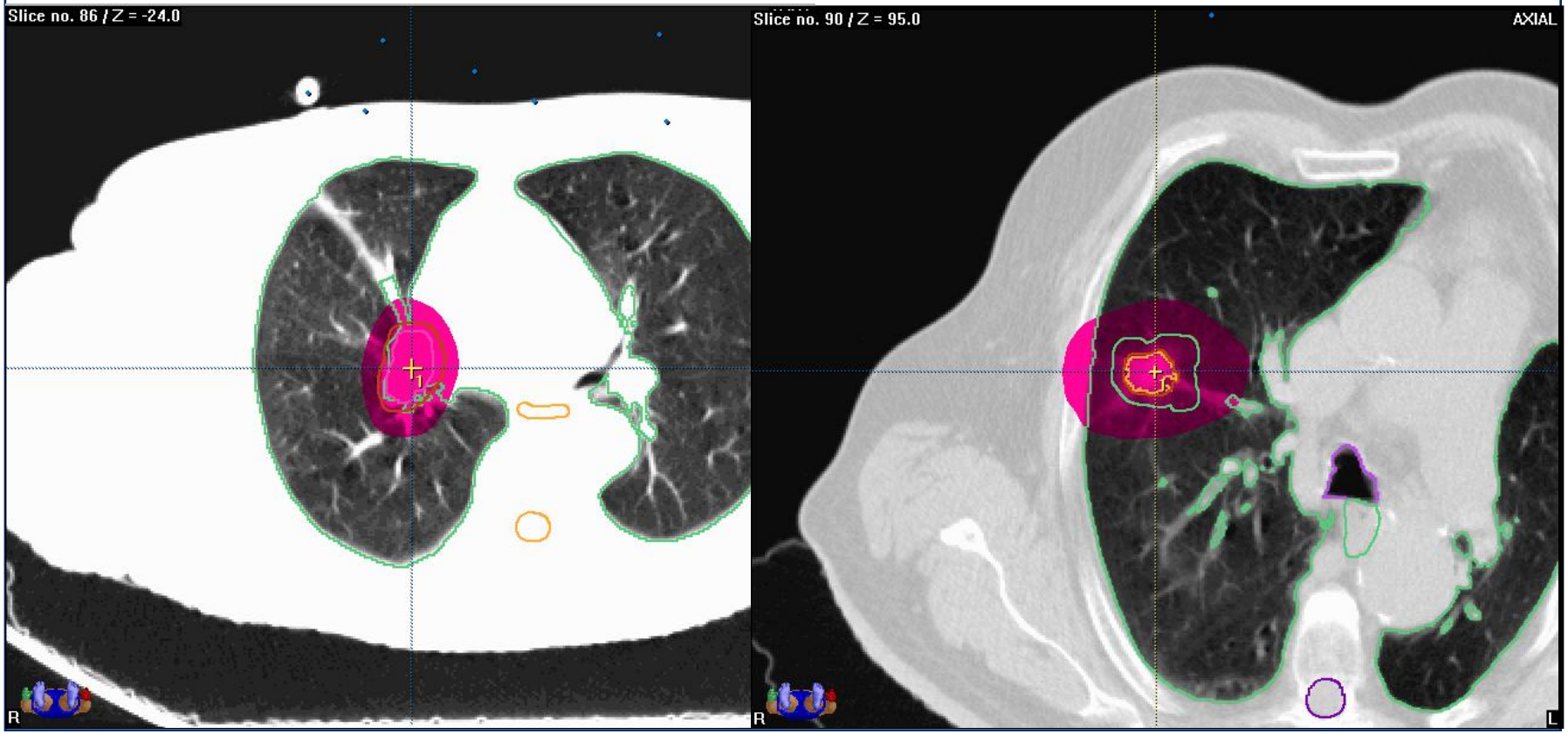
Evaluation of dose distribution



Technical issues

Dose distribution:

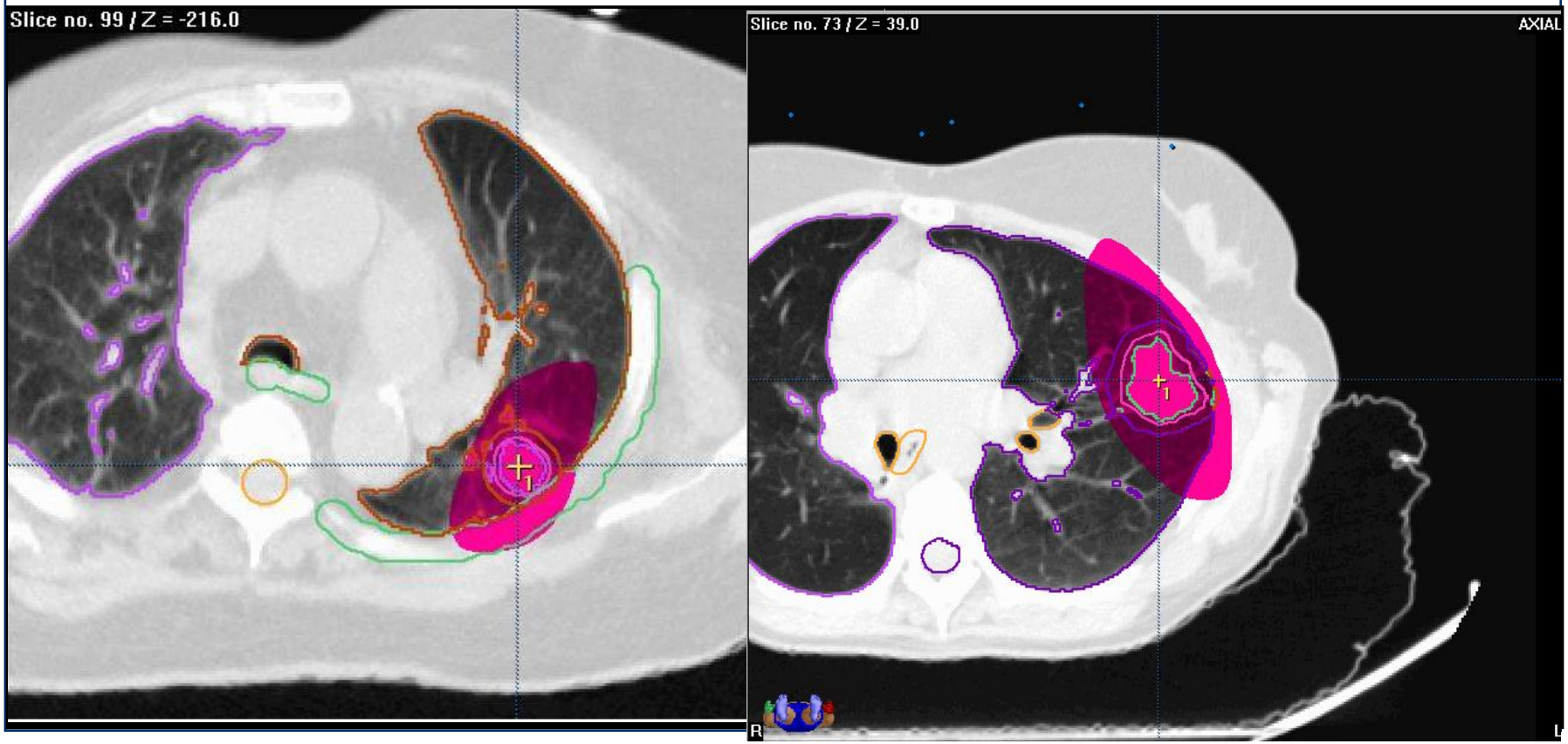
Evaluation of dose distribution



Technical issues

Dose distribution:

Evaluation of dose distribution



Technical issues

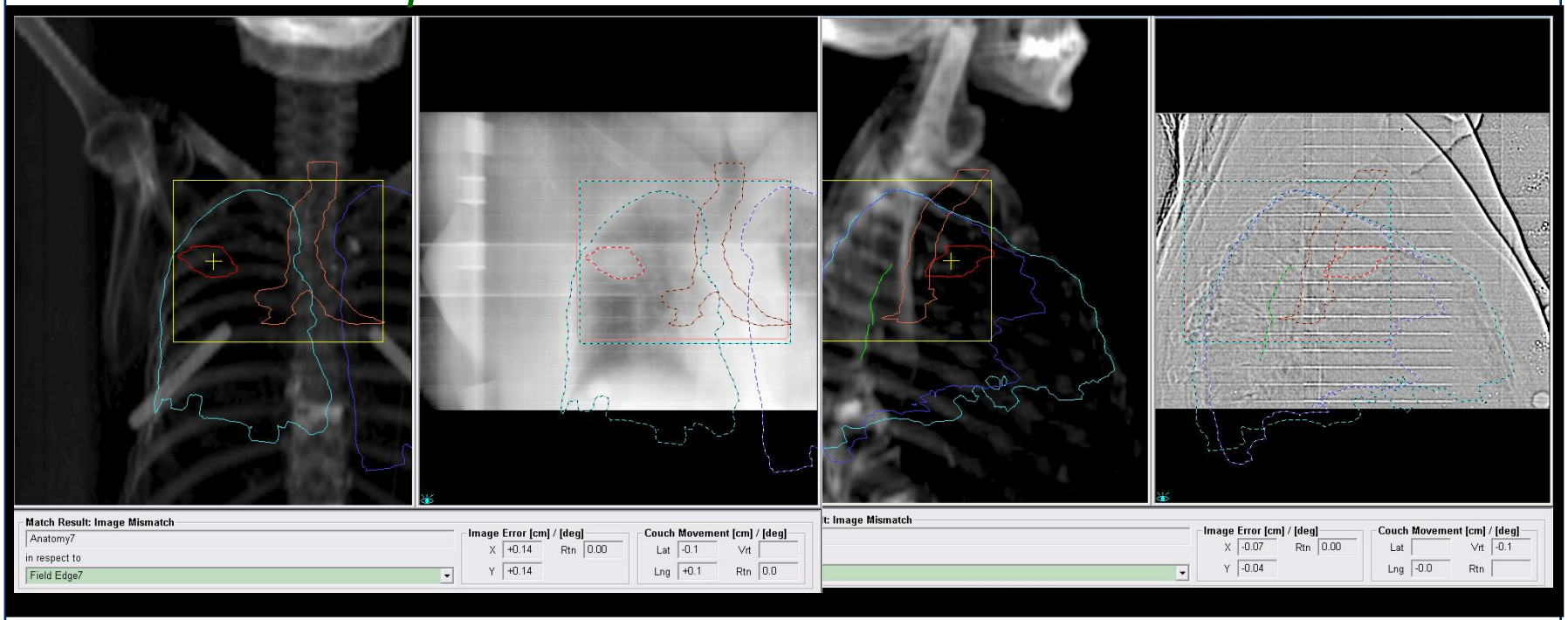
Pre-treatment verification:

Exactrac with manual tilt adjustment

Technical issues

Pre-treatment verification:

Exac-Track plus verification



Treatment:

On 3 consecutive days

Results

From January 2007 to December 2011

Patients treated: 78

Number of lesions: 96

2007-09: 48 lesions; 2010-11: 48 lesions

Median age: 72 yrs (range: 43-88)

Male:Female ratio: 47:31

Primary lung cancer: 40 patients

Lung metastases: 56 (lung: 27, colon: 15, others: 14)

Results

Primary lung cancer

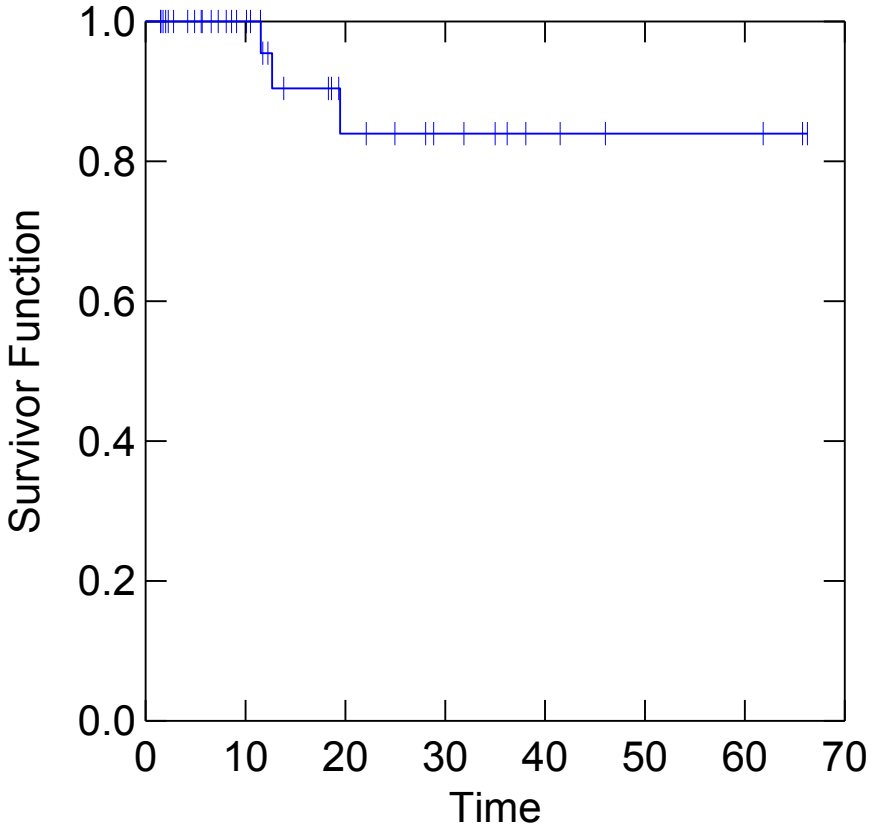
Histology:

Adenocarcinoma:	17 (42.5%)
Squamous cell:	10 (25%)
NSCLCs:	4 (10%)
Undefined:	9 (22.5%)

Mean GTV volume: 9cc (5-32 cc)

Results

3 years Local control: 84%



Failures: 21 patients (52.5%)

Local: 3 (7.5%)

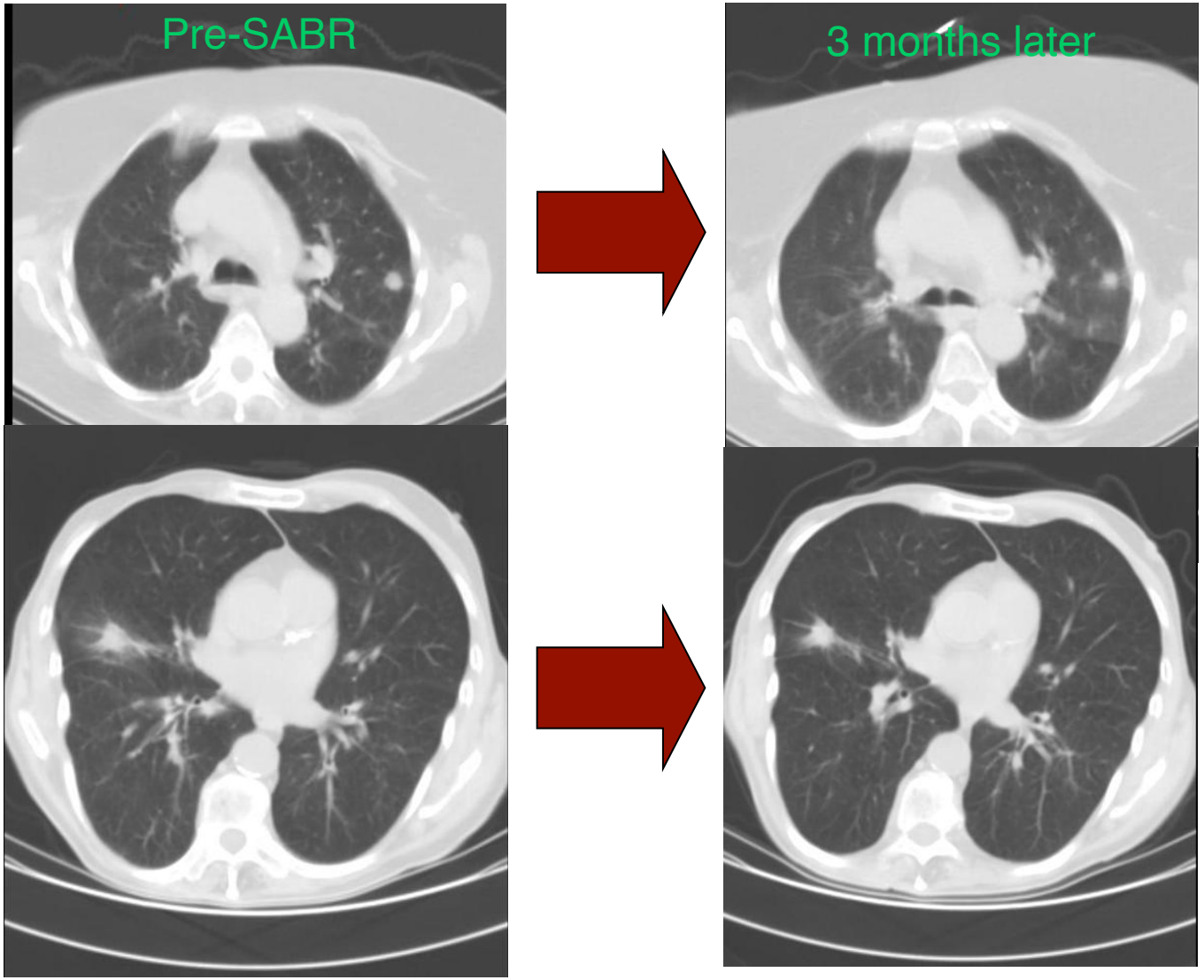
Nodal: 8 (20%)

Distant: 10 (25%)

Local control progression: any increase on CT scan

PT#1

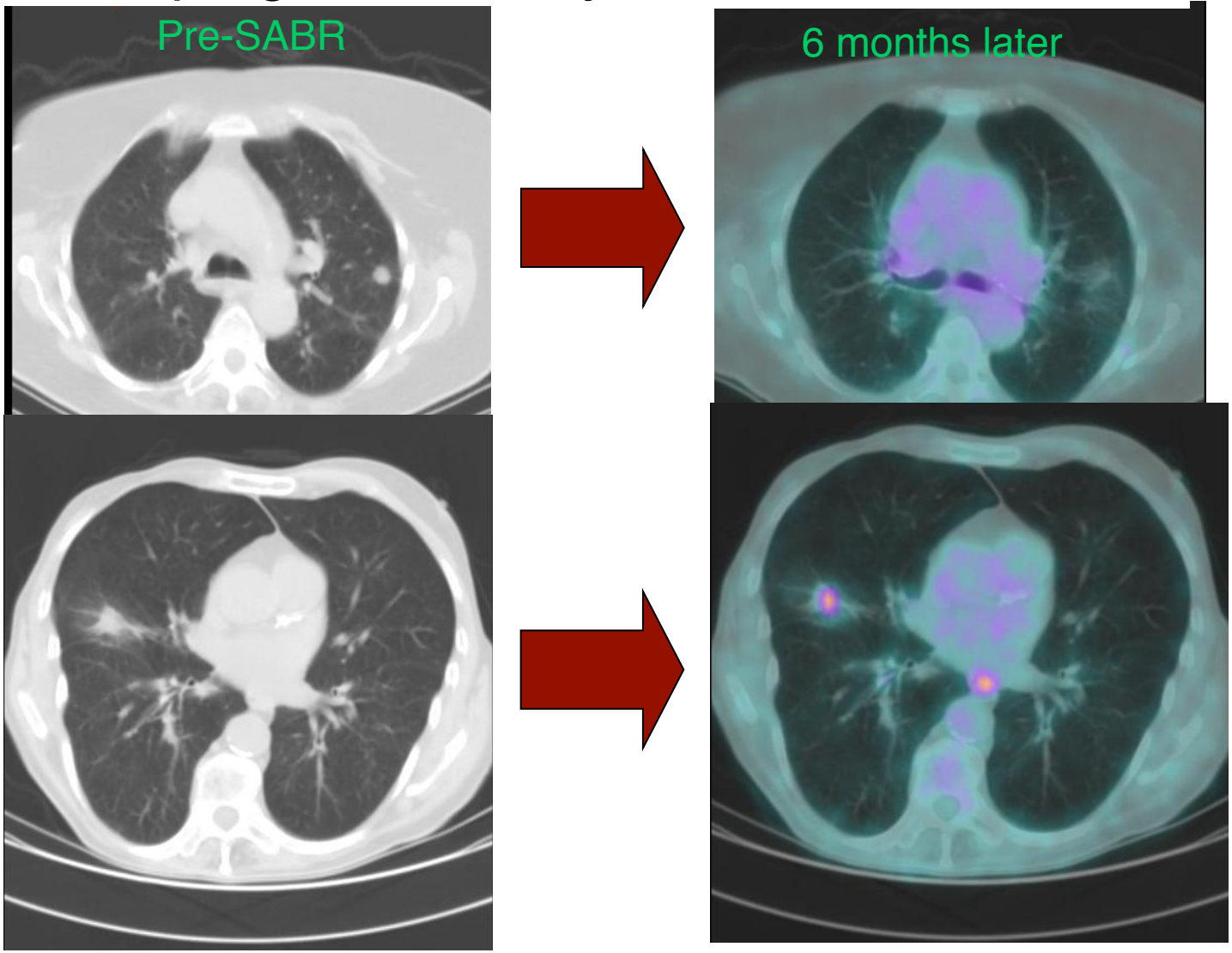
PT#2

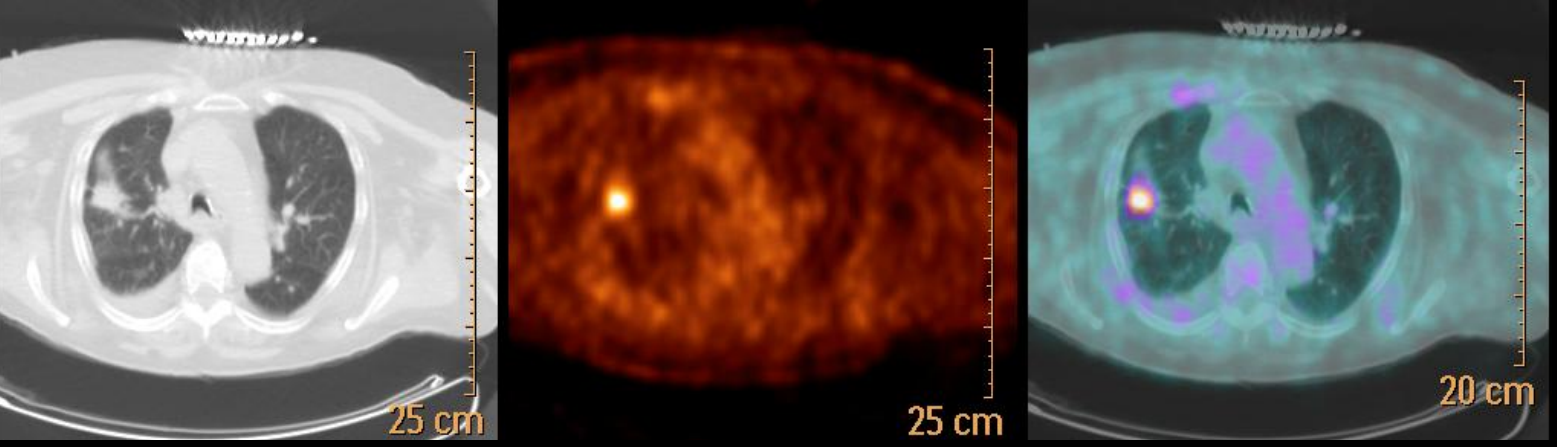


Local control progression: any increase on CT scan

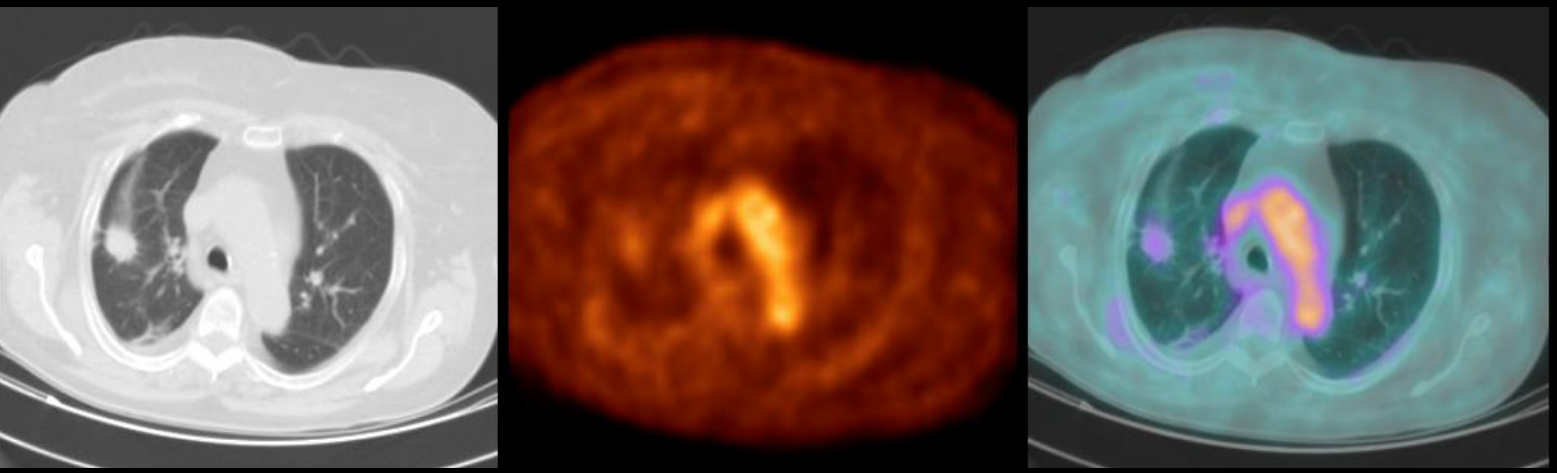
PT#1

PT#2

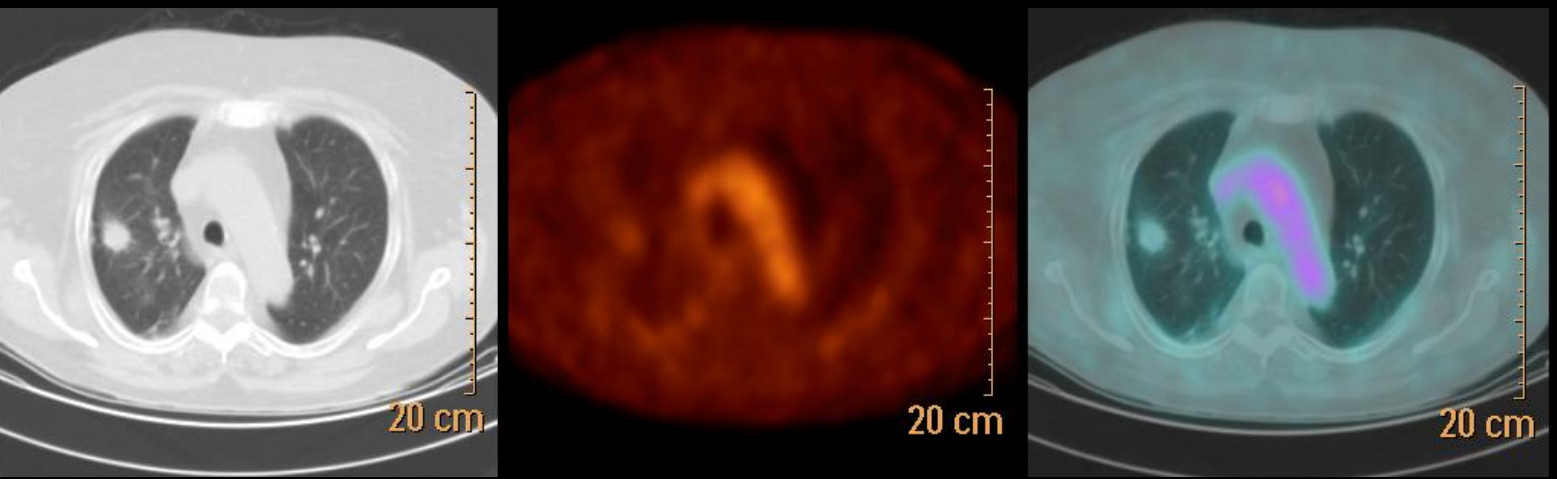




Pre-SABR
SUV= 7.6



Post-SABR@3
SUV= 2.5



Post-SABR@6
SUV= 1.6

Follow-up

PET/CT scan:

17 patients with PET/CT scan

Time point: pre-SABR, 3 and 6 months after

PET/CT evaluation:

SUVmax

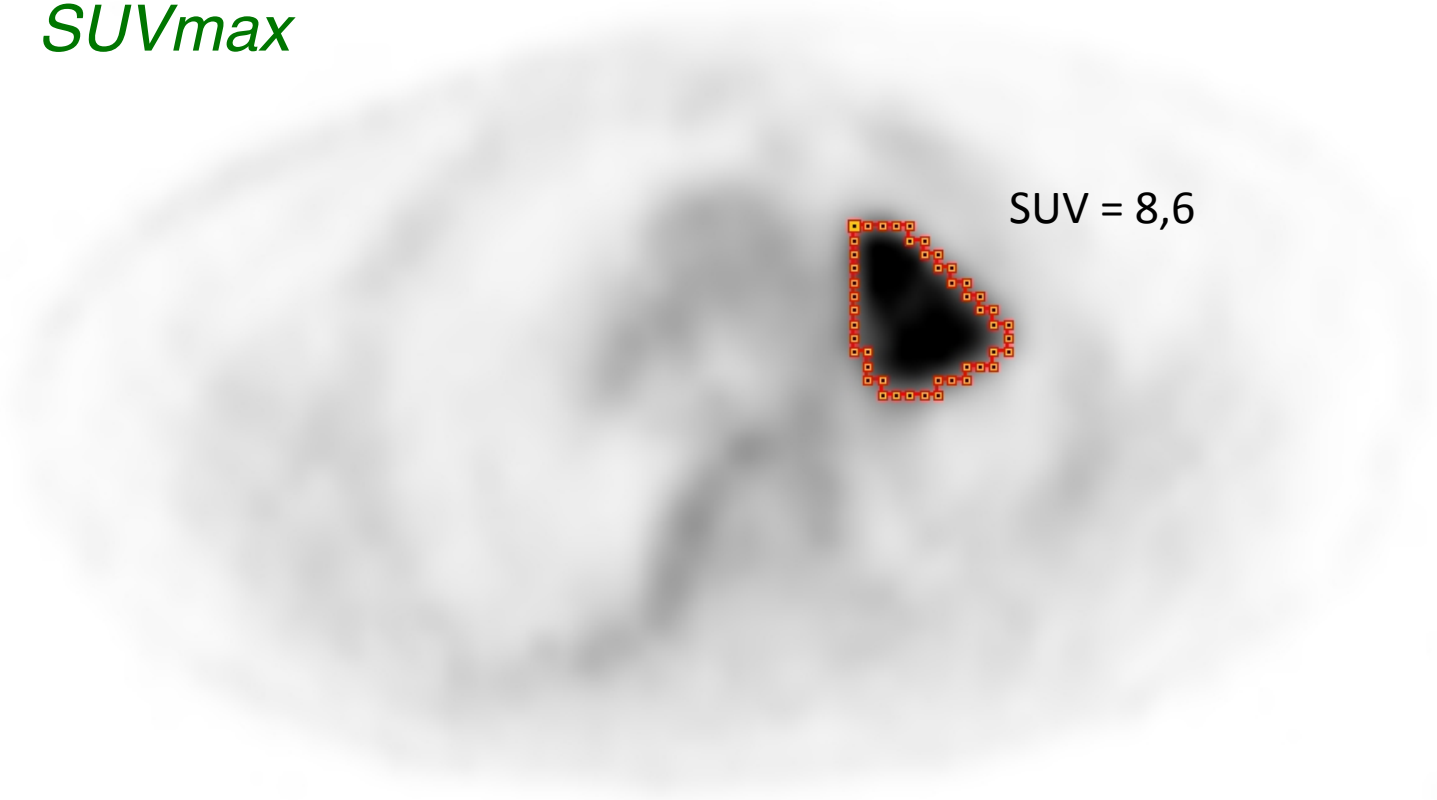
Tumor-to-Background Ratio

Metabolic Tumor Volume

18F-FDG PET/CT scan in Follow-up

PET/CT evaluation:

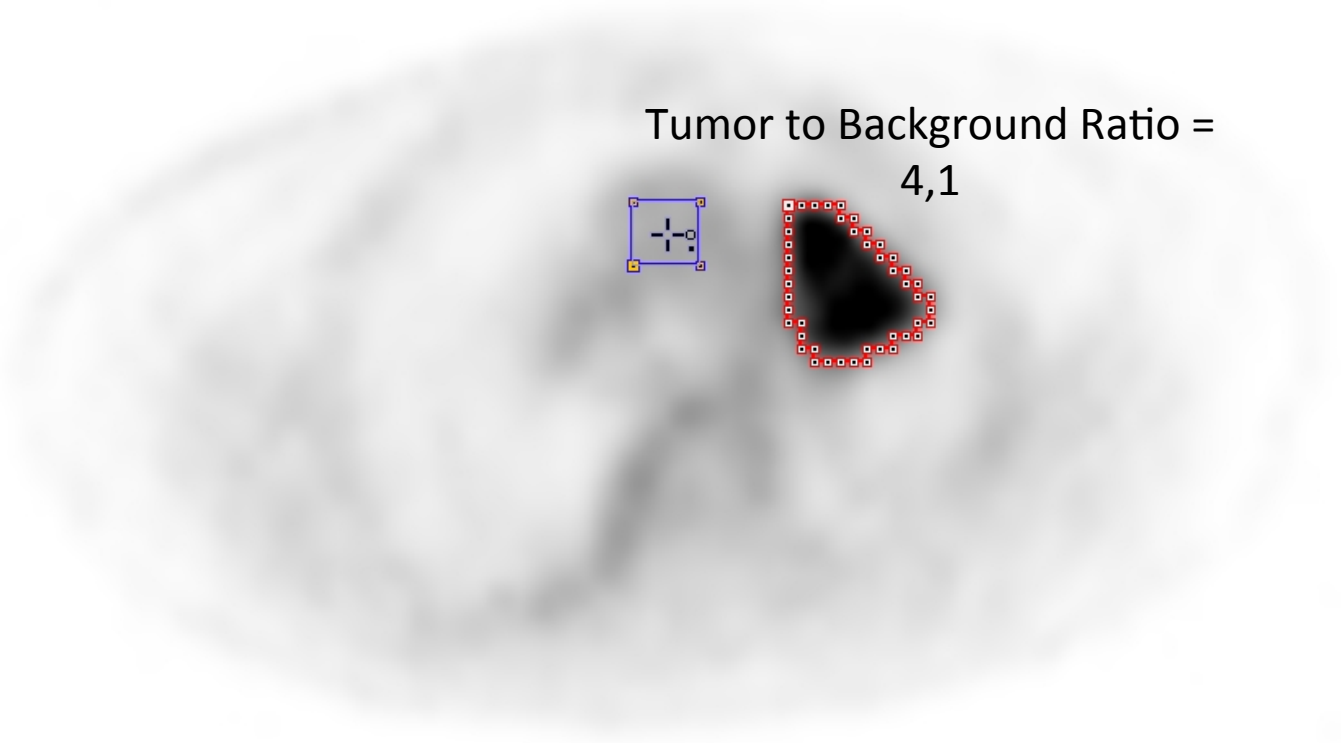
SUVmax



18F-FDG PET/CT scan in Follow-up

PET/CT evaluation:

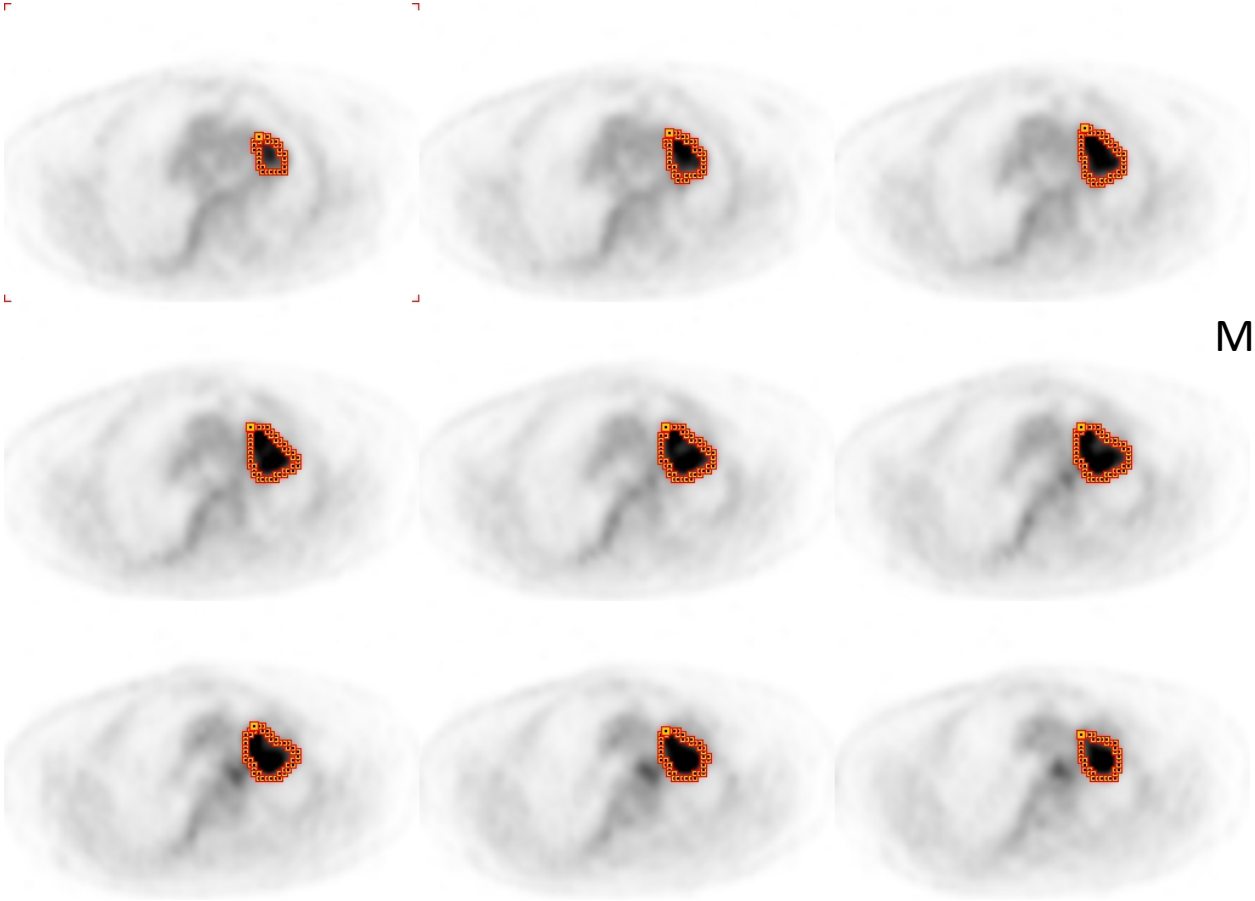
Tumor-to-Background Ratio



18F-FDG PET/CT scan in Follow-up

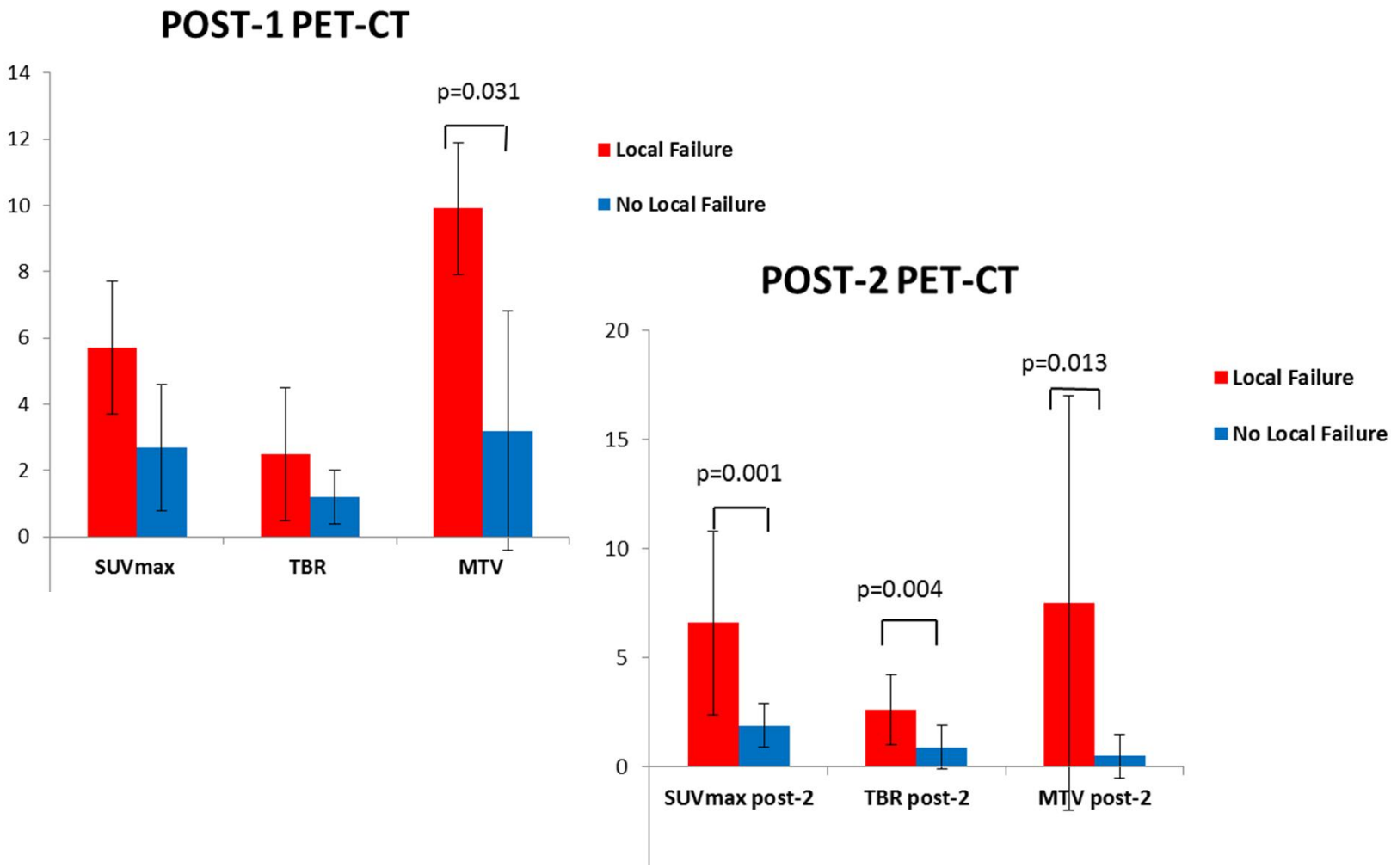
PET/CT evaluation:

Metabolic Tumor Volume



MTV = 53 cc

Follow-up


POST-1 PET-CT
14
12
10
8
6
4
2
0
p=0.031
Local Failure
No Local Failure
SUVmax
TBR
MTV
POST-2 PET-CT
20
15
10
5
0
p=0.001
p=0.004
p=0.013
Local Failure
No Local Failure
SUVmax post-2
TBR post-2
MTV post-2

Conclusion

Several solutions are available for SABR in clinical practice.

BrainLab facilities with Exactrack is suitable and consistent for SABR treatment

Improving technique could reserve better clinical performance and indication

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