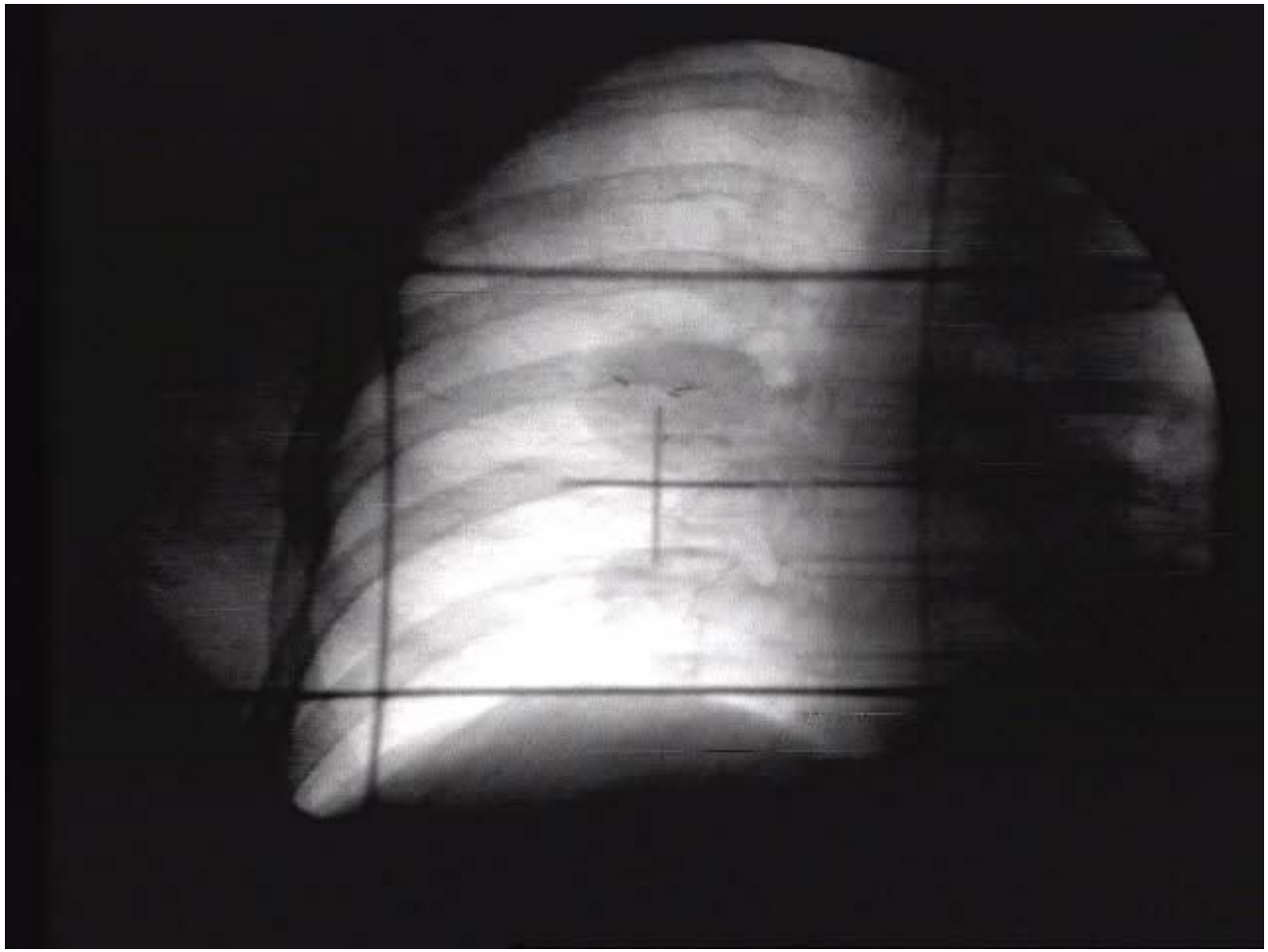
Image Guided Particle Therapy

What can we learn from conventional RT?

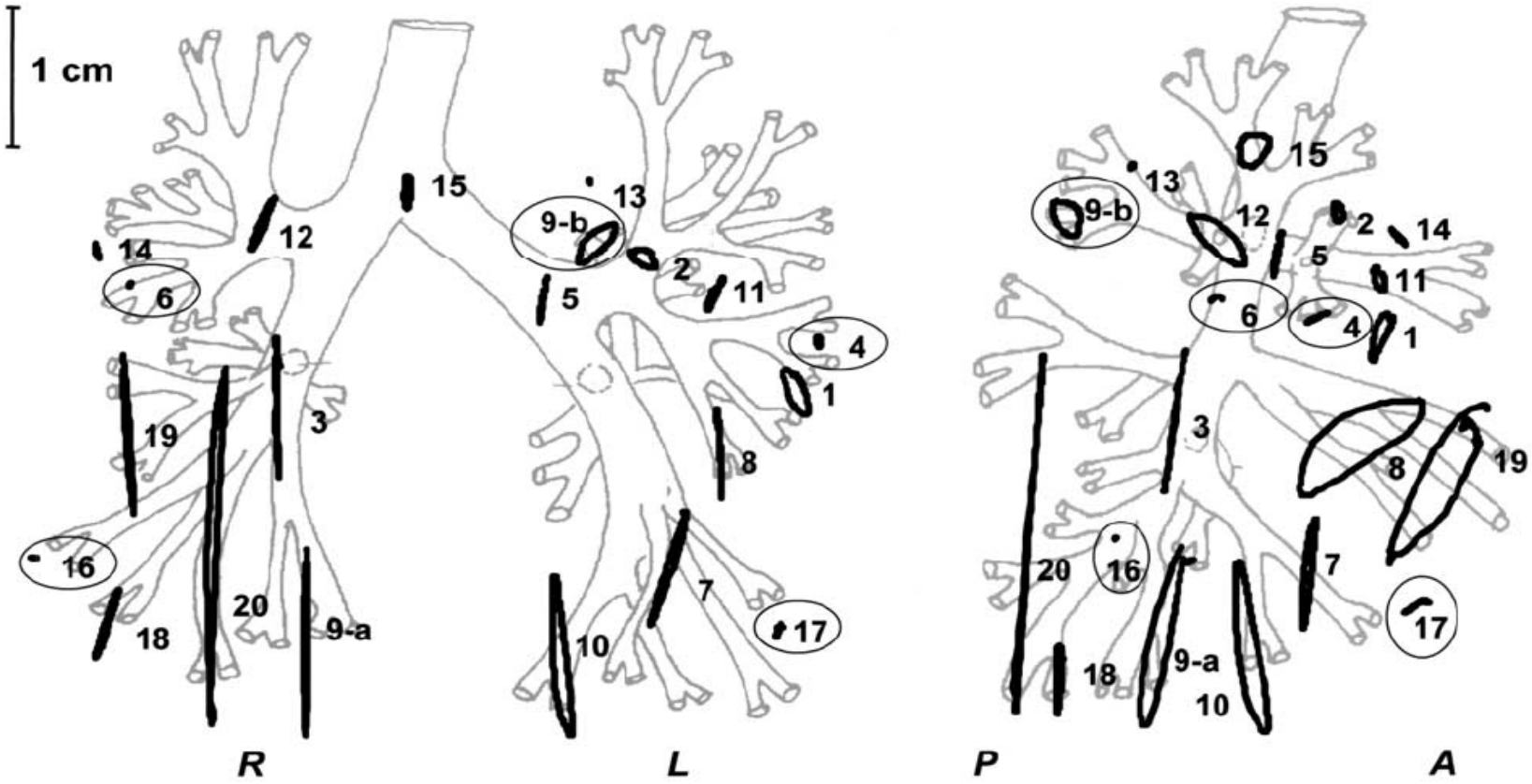
Håkan Nyström
Skandion, Uppsala, Sweden

Moving lung tumours

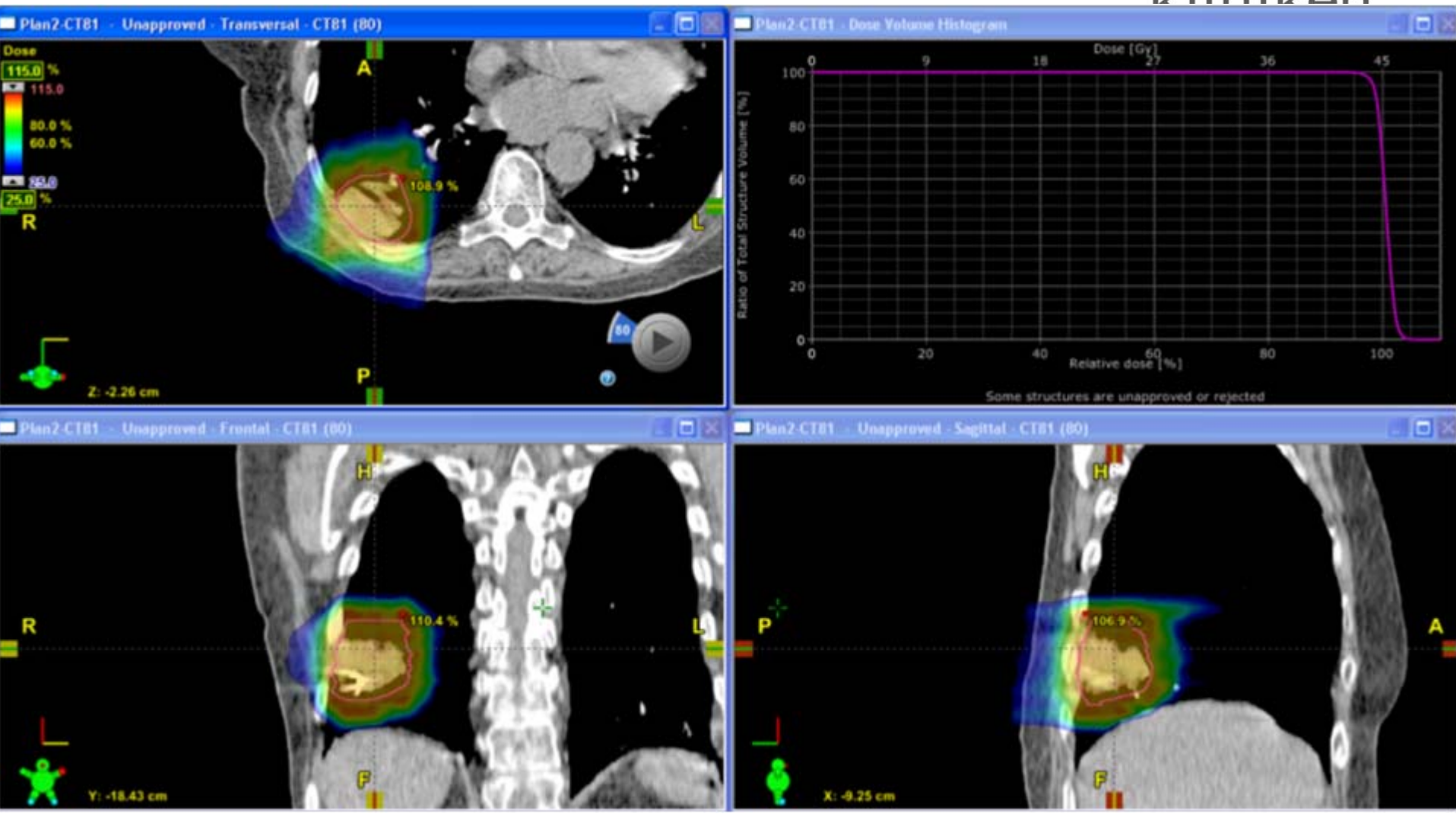
Skandion kliniken



Skandion kliniken



Seppenwoolde *et al,* IJROBP, 2002



Courtesy Per Munck af Rosenschöld, Copenhagen

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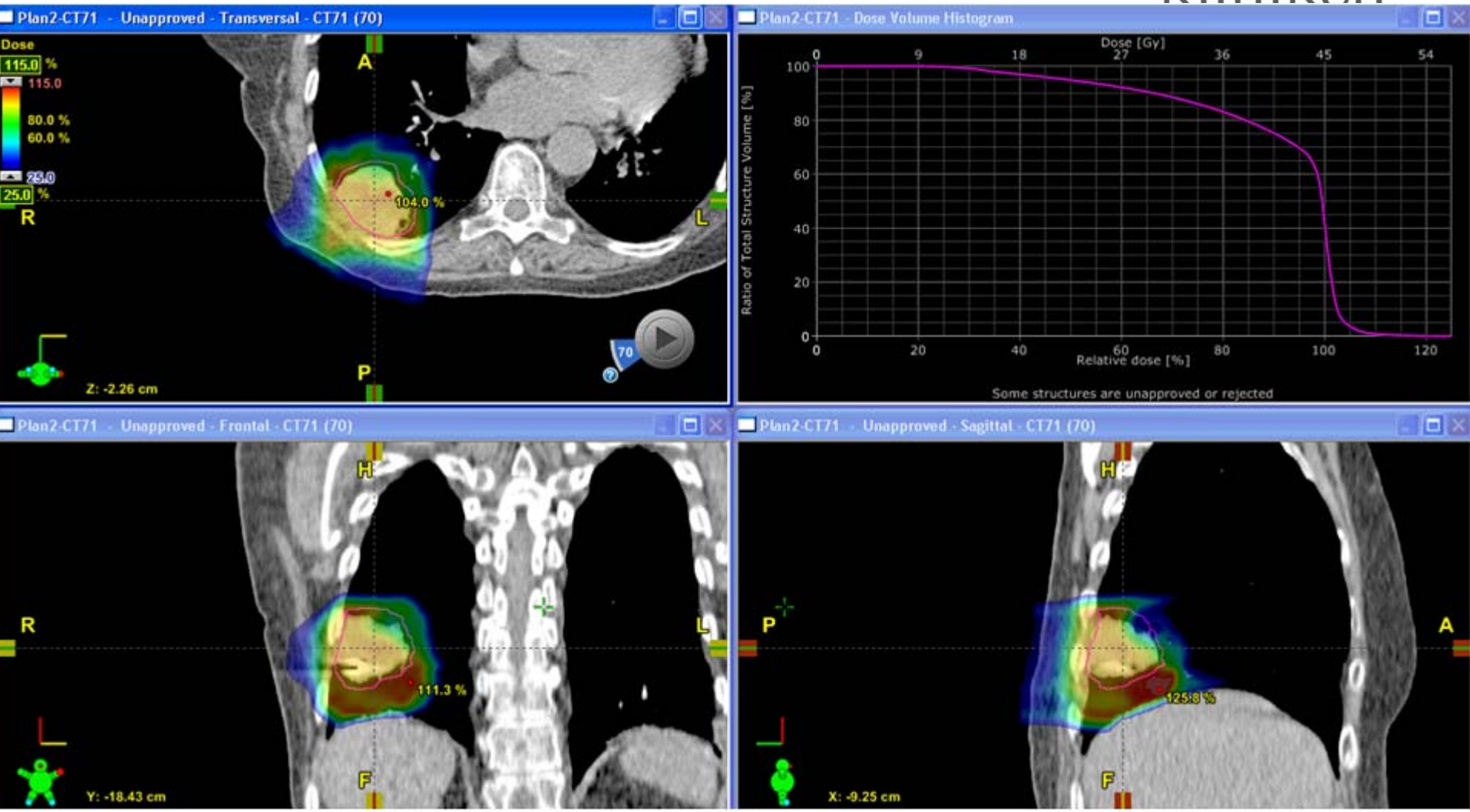

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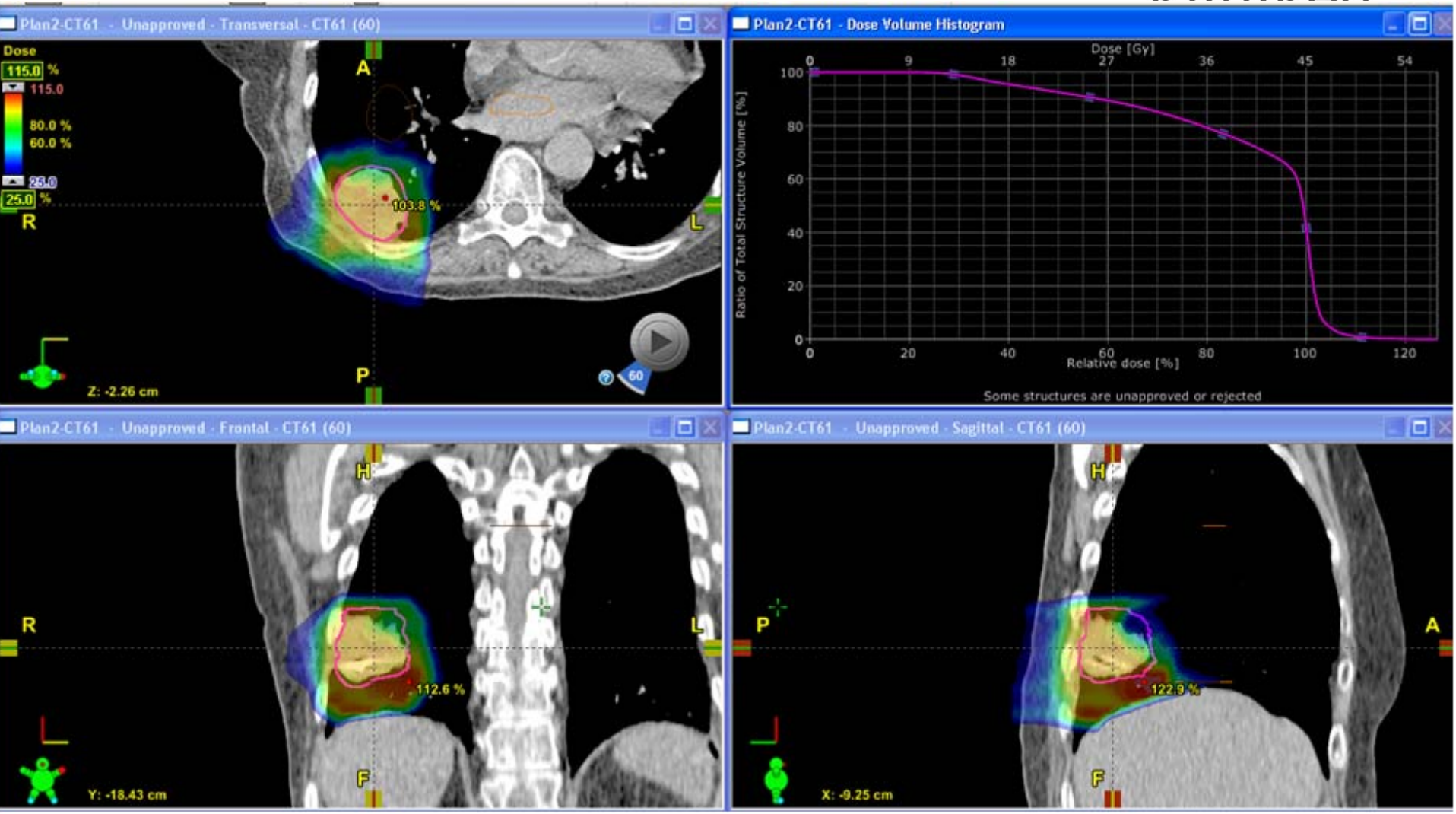

Courtesy Per Munck af Rosenschöld, Copenhagen

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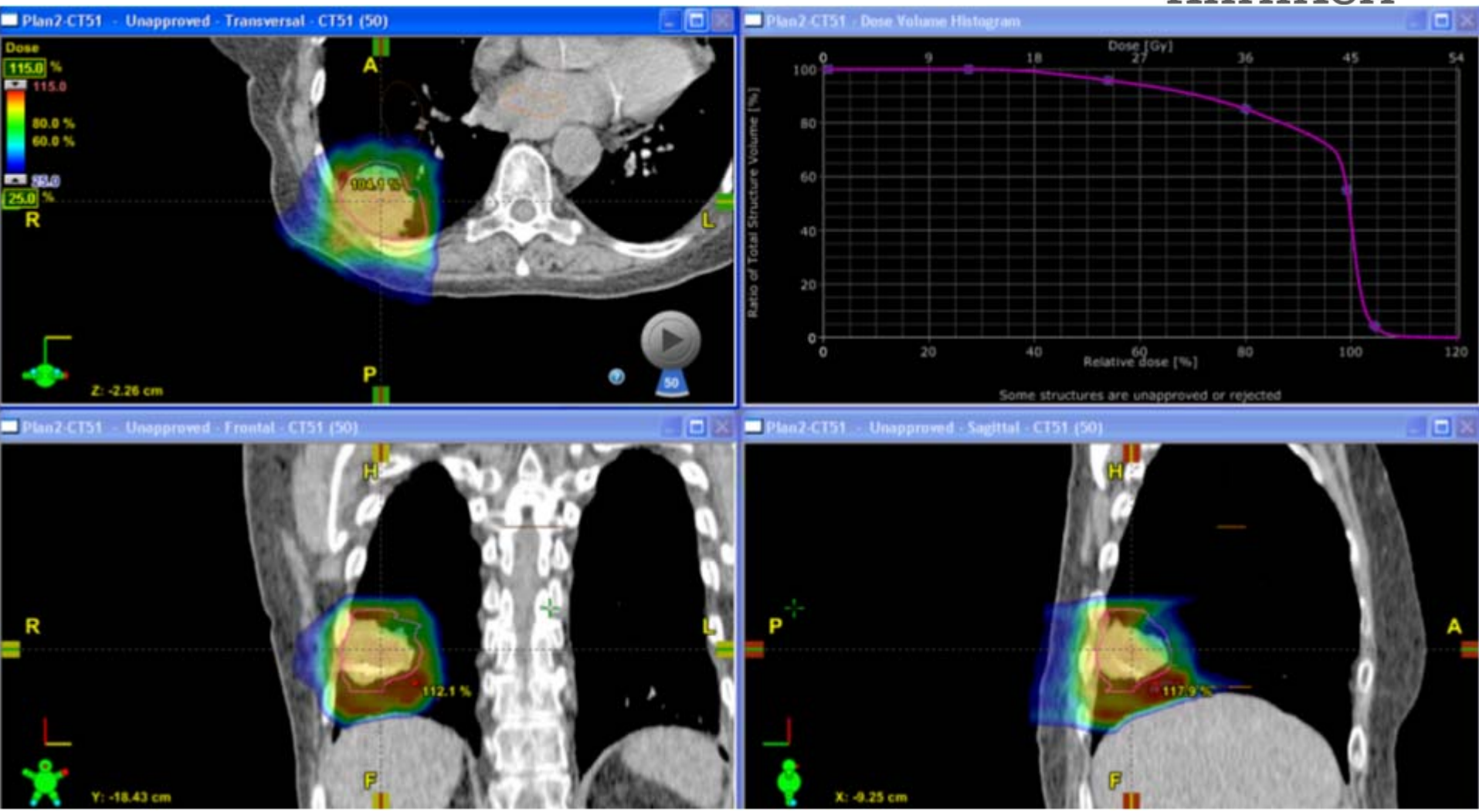

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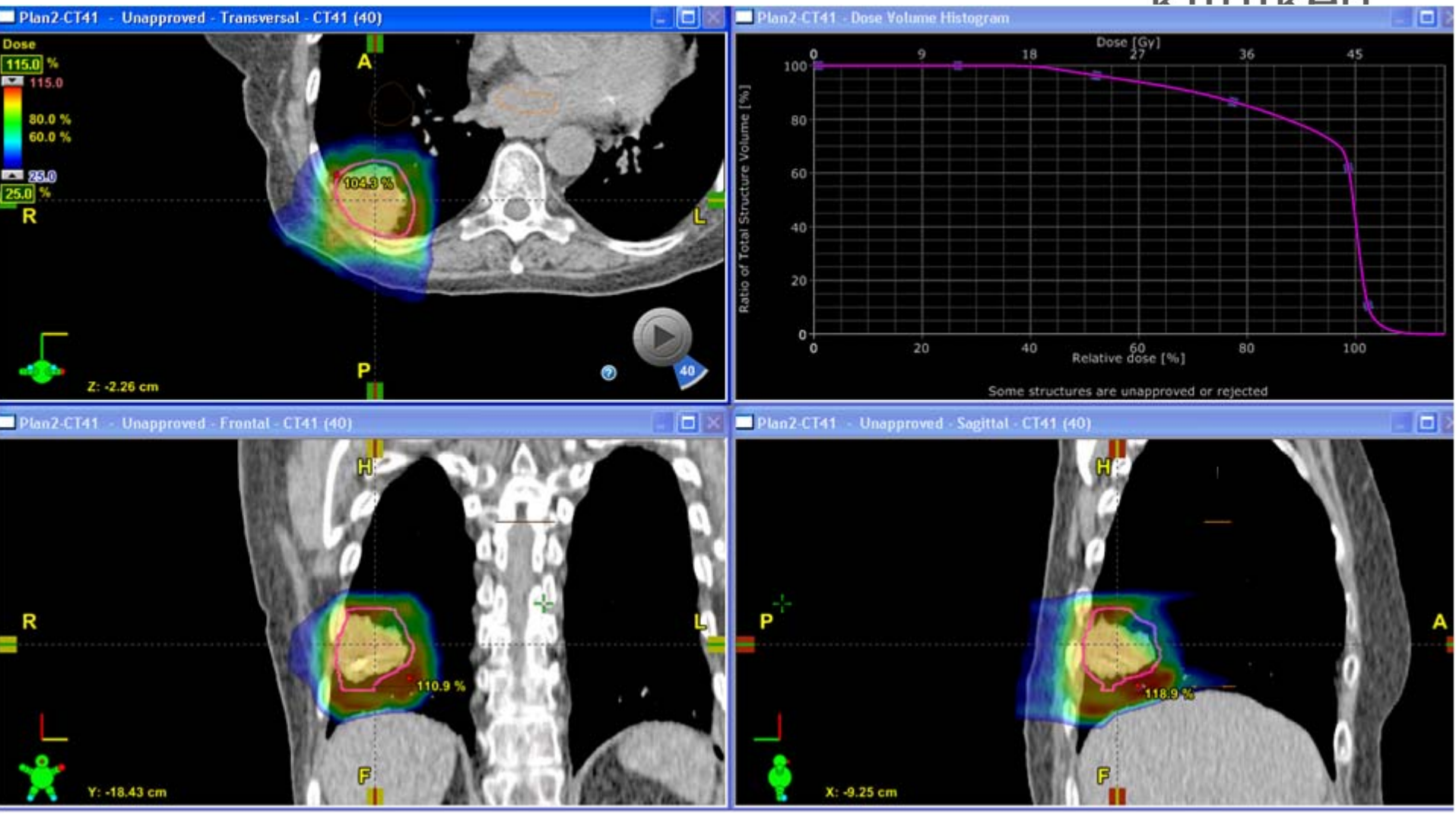

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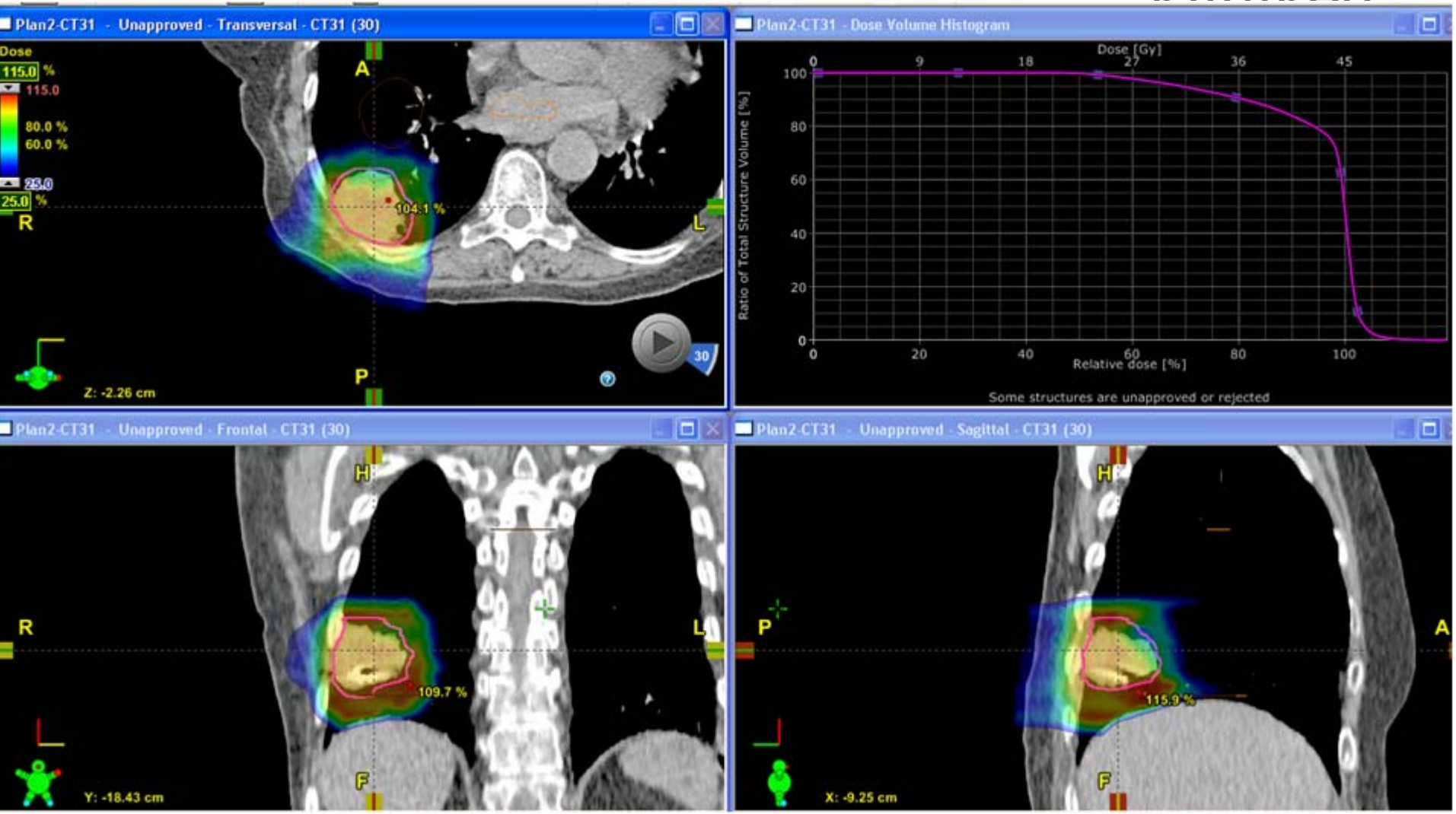

Courtesy Per Munck af Rosenschöld, Copenhagen

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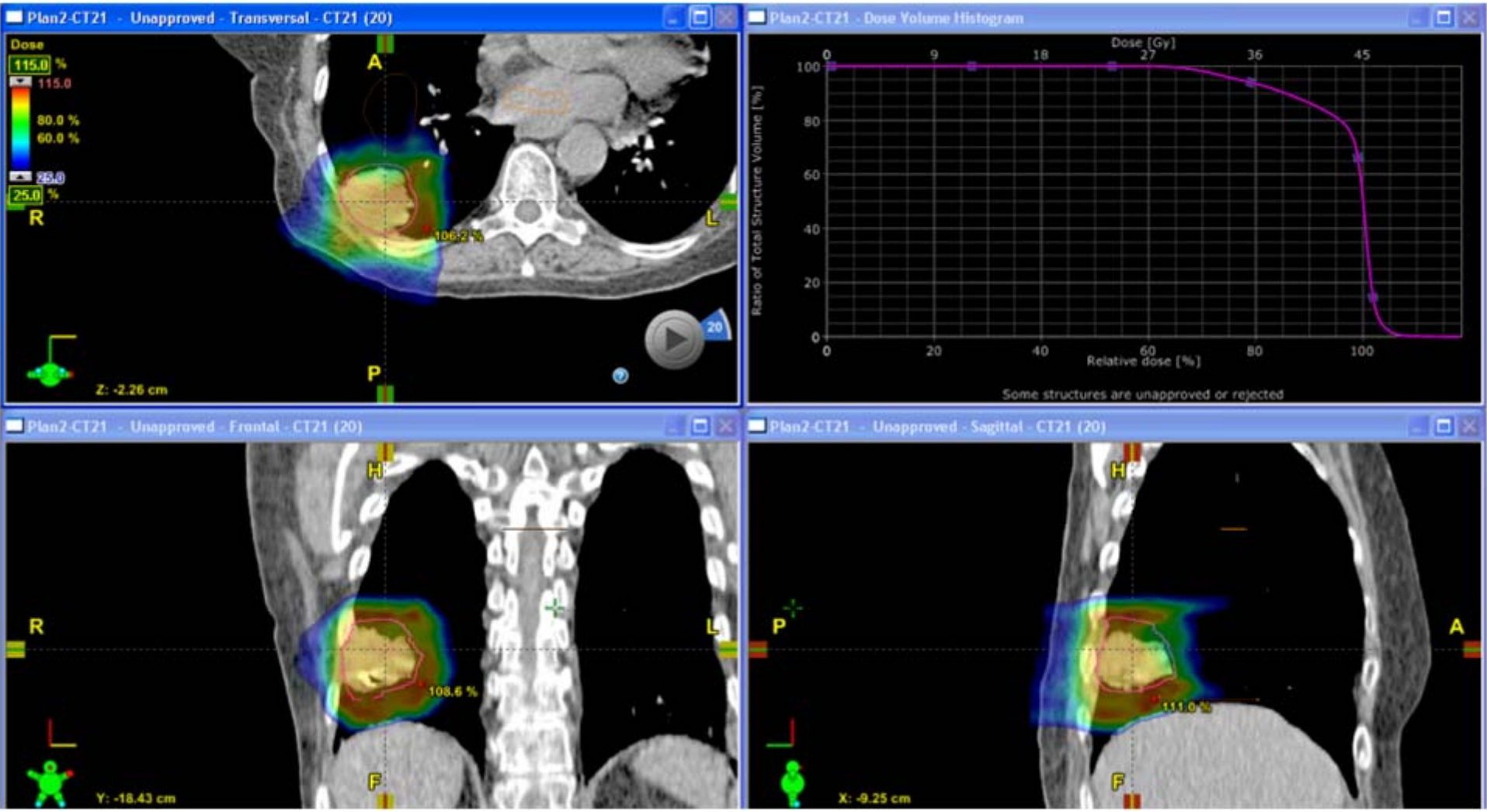
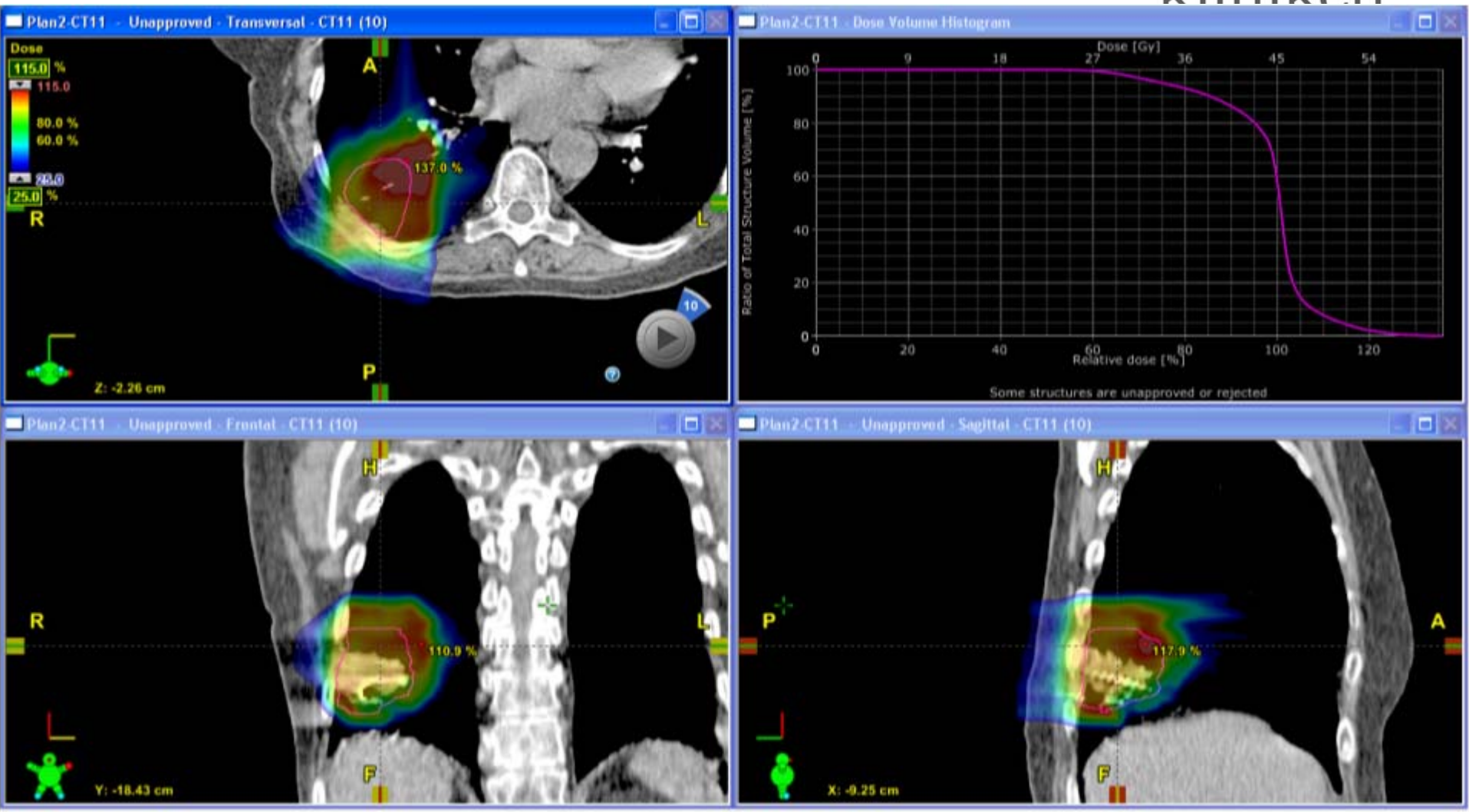


Courtesy Per Munck af Rosenschöld, Copenhagen



Courtesy Per Munck af Rosenschöld, Copenhagen

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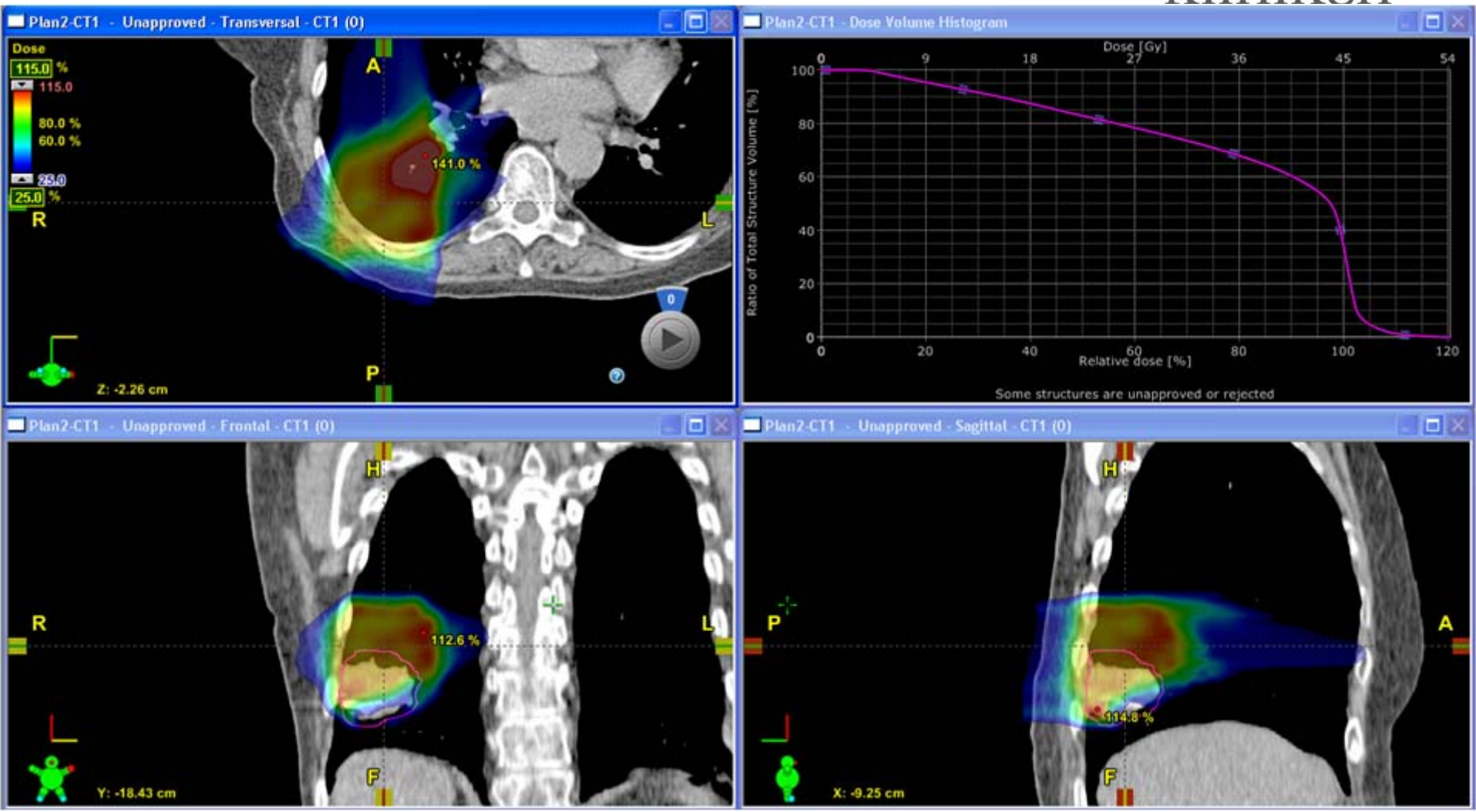

Courtesy Per Munck af Rosenschöld, Copenhagen

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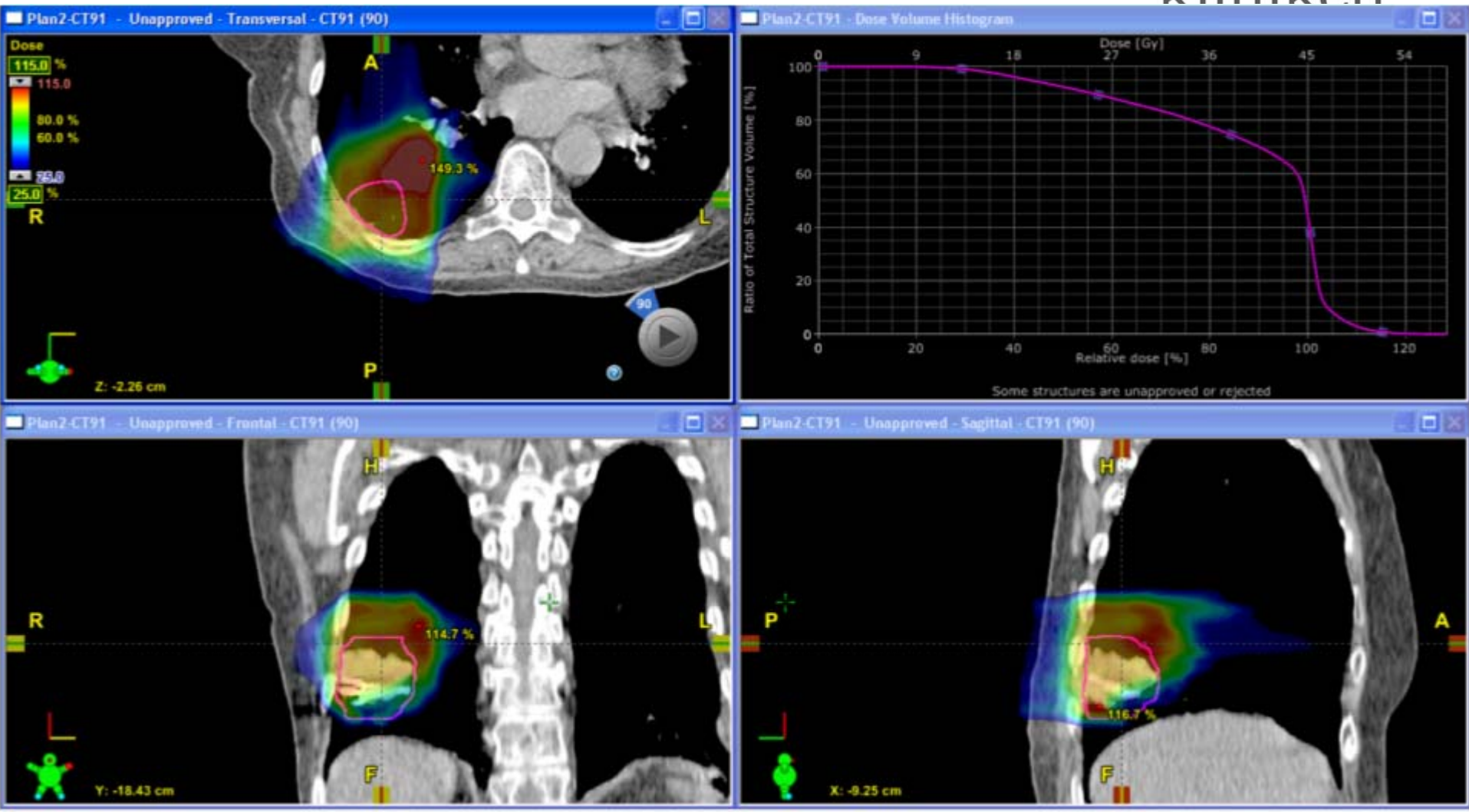

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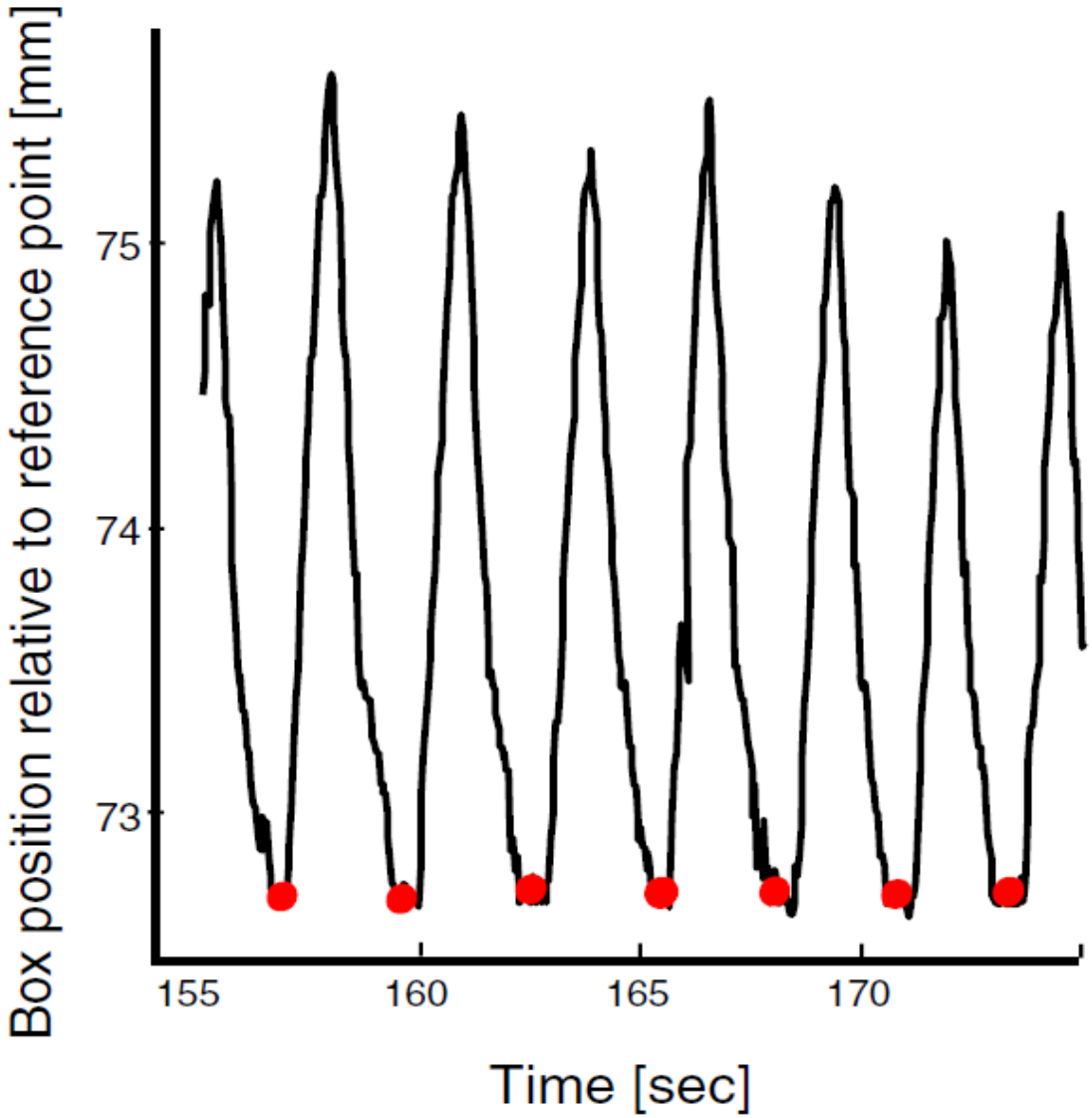
Which breathing manoeuvre should be used ?

a Stable exhale point level

Skandion kliniken



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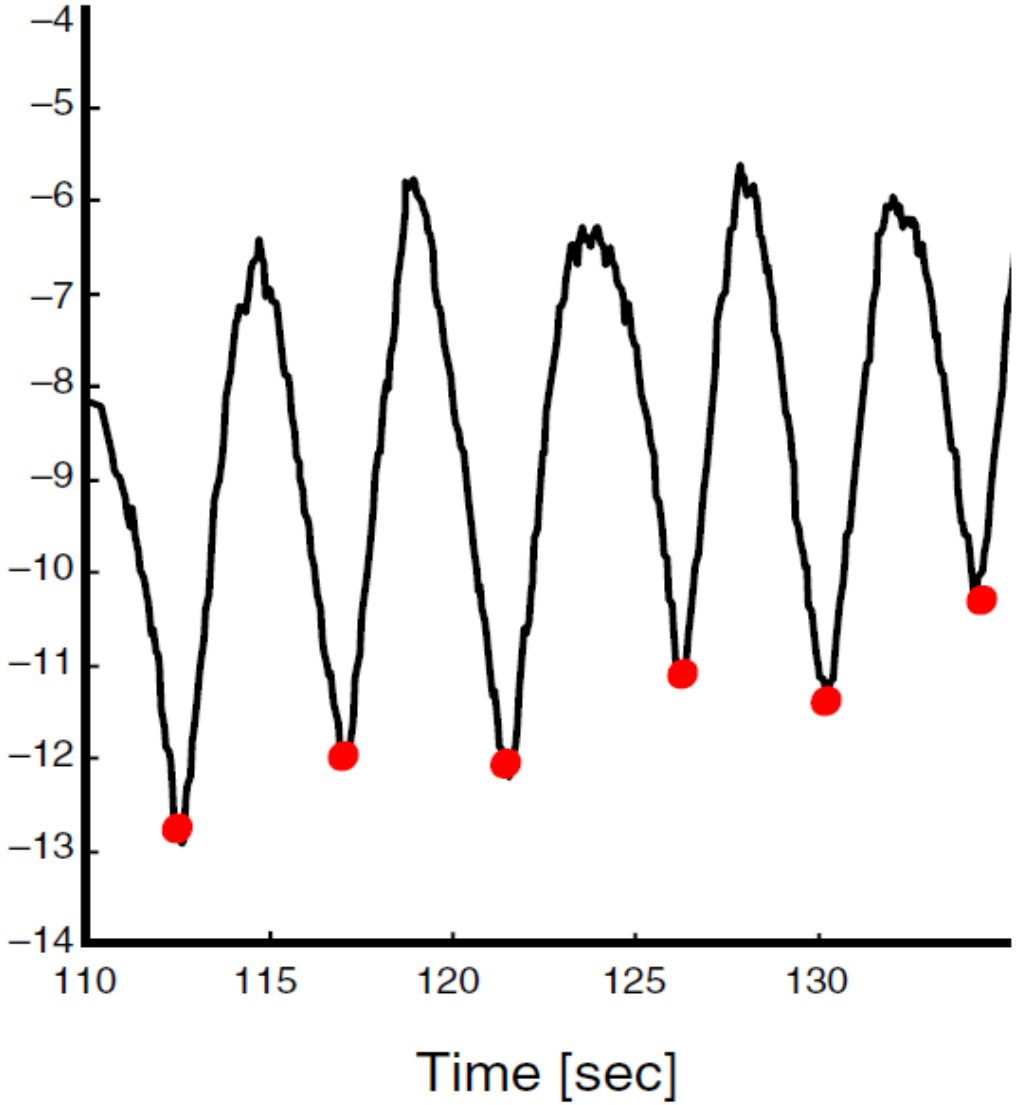
b Systematic increase in exhale point level

Skandion kliniken



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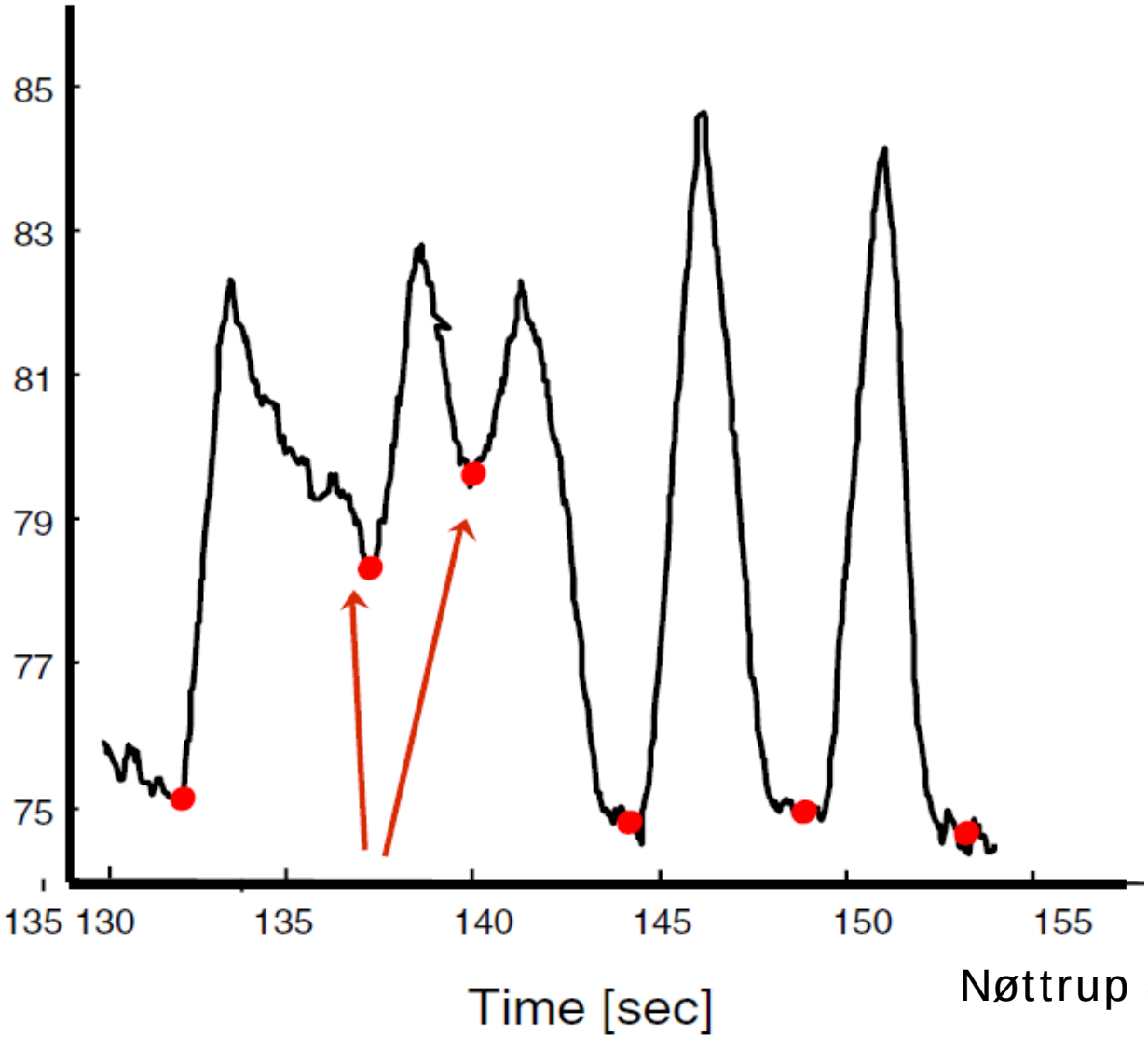
C Sudden shift in exhale point level

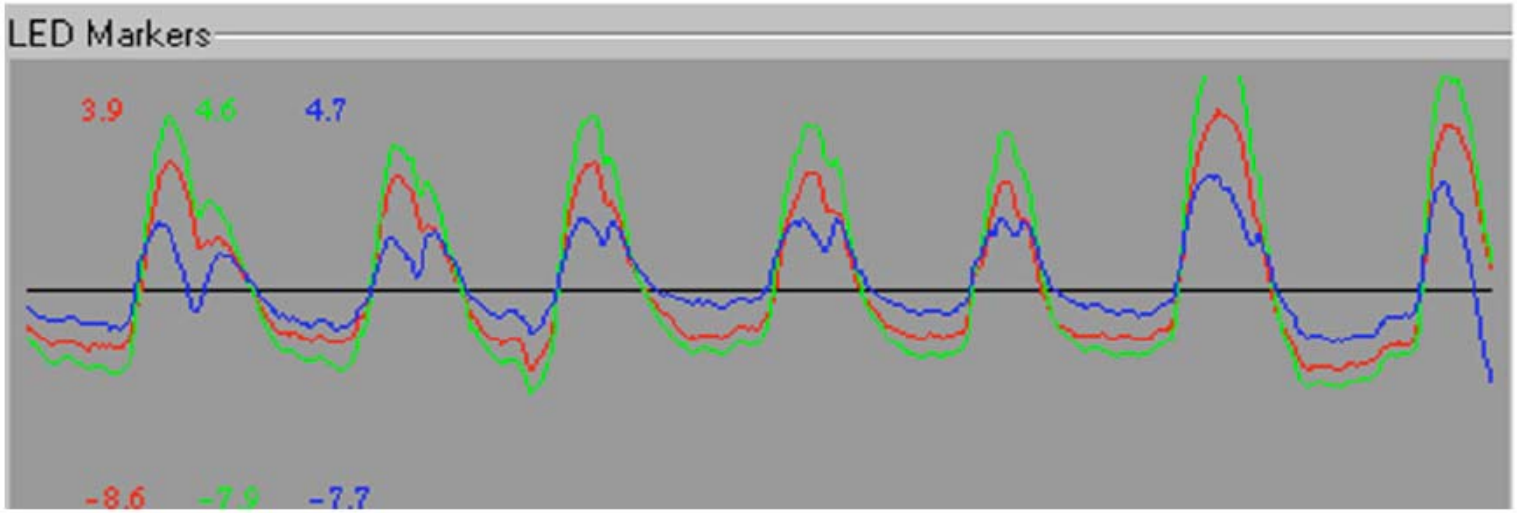
Skandion kliniken



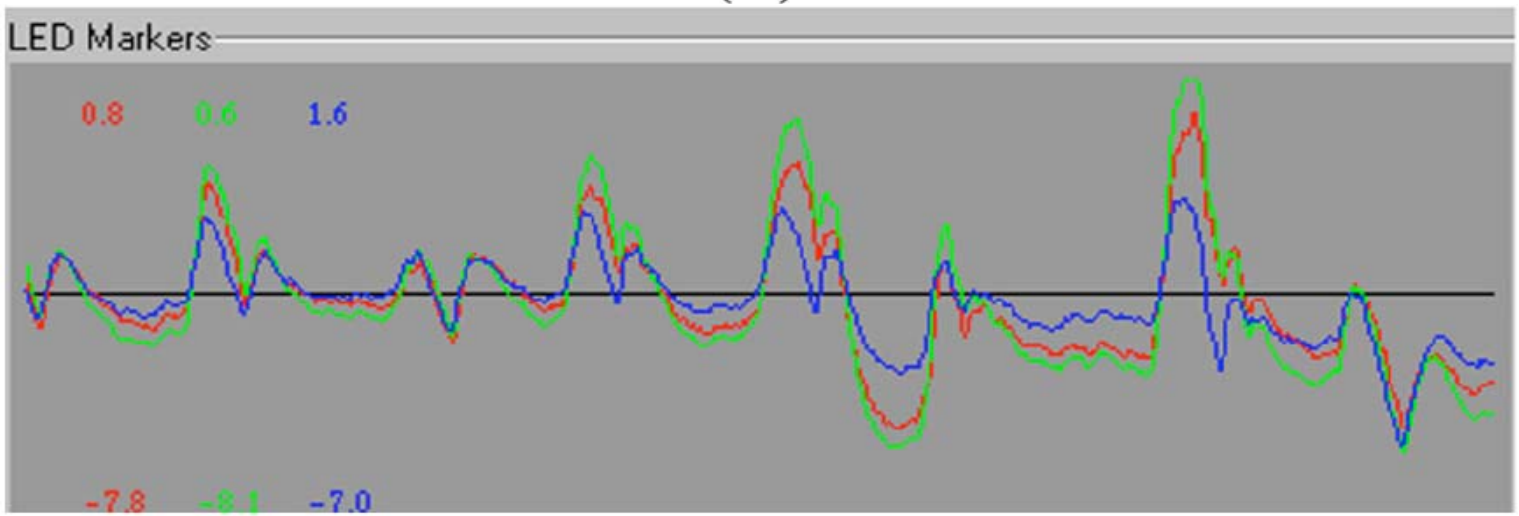
Nøttrup *et al* 2008

4D PET/CT


Coronal2 Volume 2/Volume 1
Ex: 3944
Se:
A: 41.0
S 114
RIGSHOSP
F 57 AW448141119.64.1100105673
Nov 02 2004
DFOV 50.0cm
21.6
R
2
5
0
0.0
L
2
5
0
50 % PET
3.9/
4.2mm /4.2sp
04:22:18 PM
m=0.0 M=21.6 kBq/ml
I 386
V=1.26



(a)



(b)

Patient surface motion, AAPM TG 76, 2006

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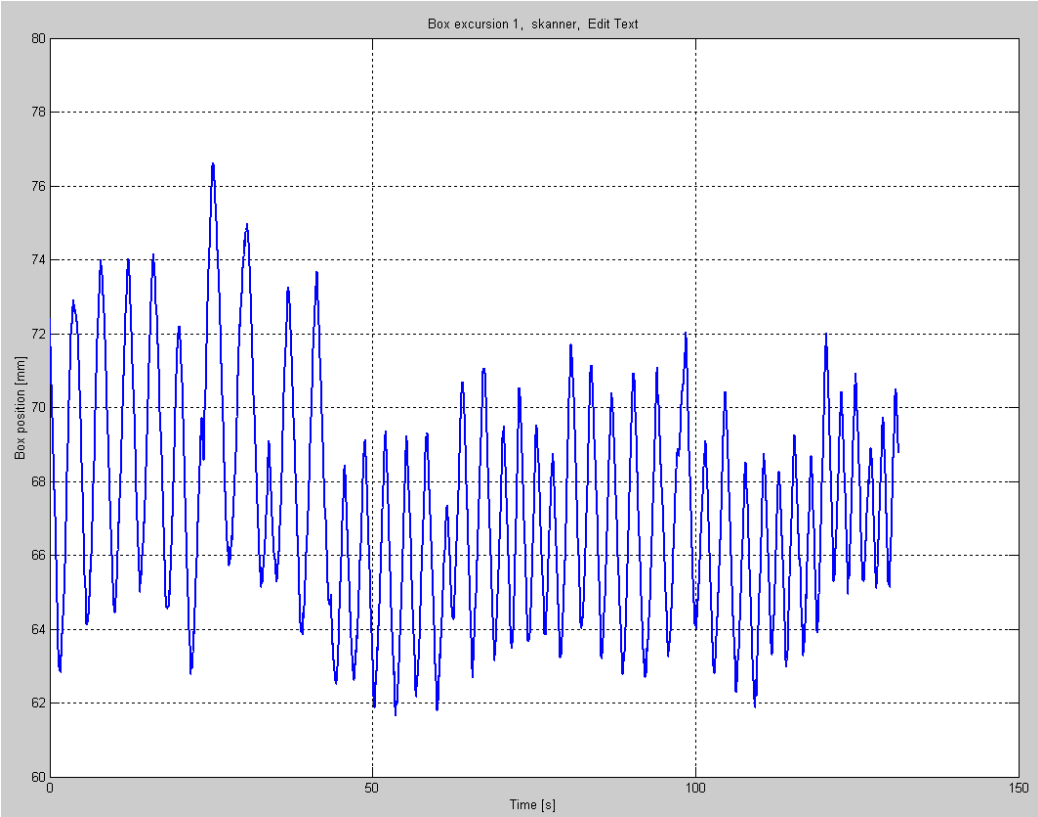
What about coaching?

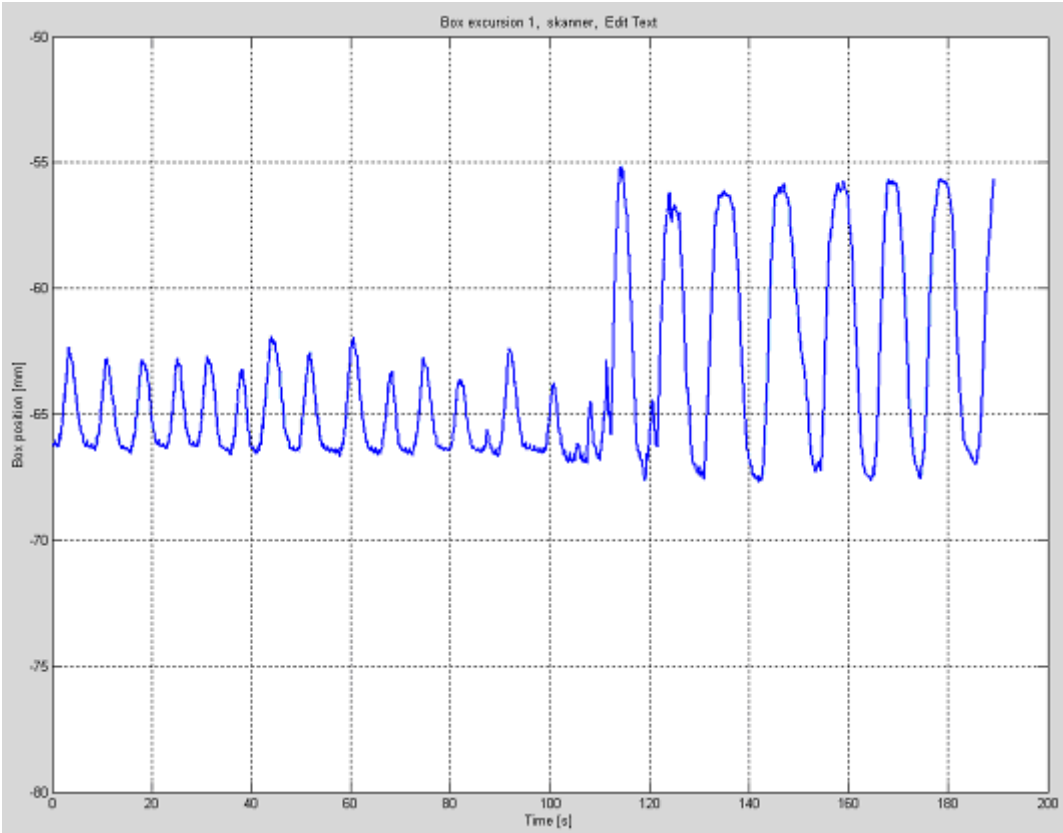
Is coaching necessary?

Spontaneous respiration



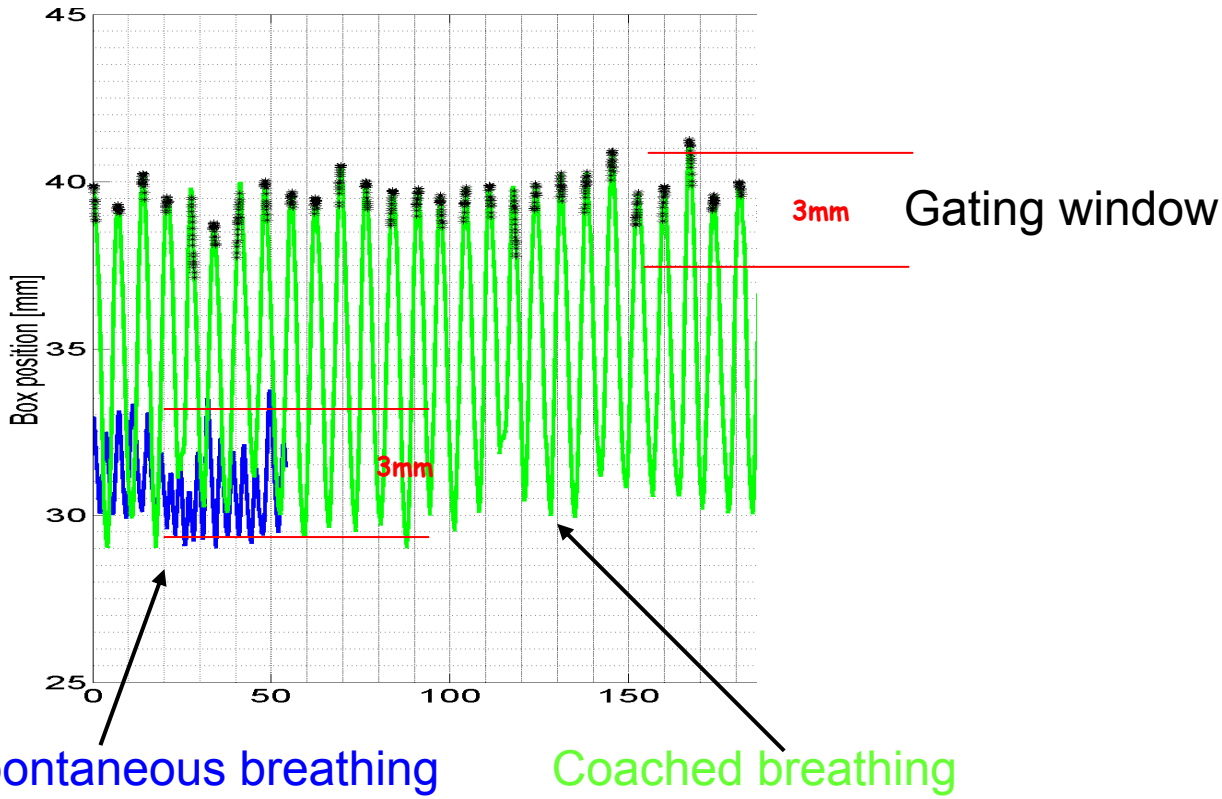
Comparison: free breathing vs. coaching

Typical breathing curves without and with coaching

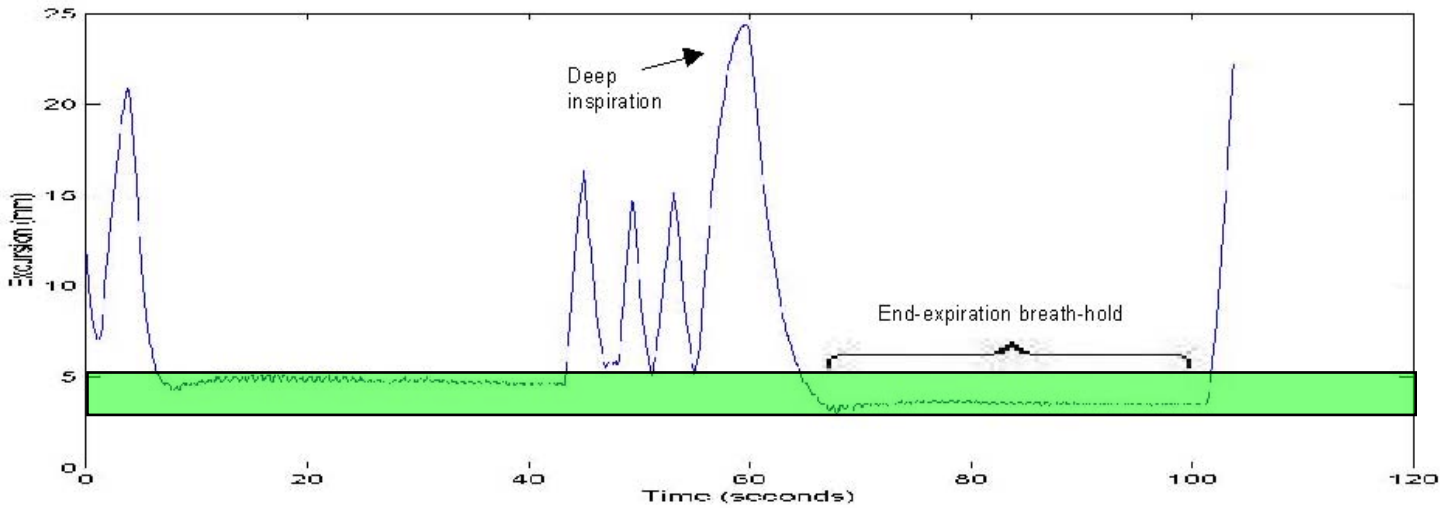


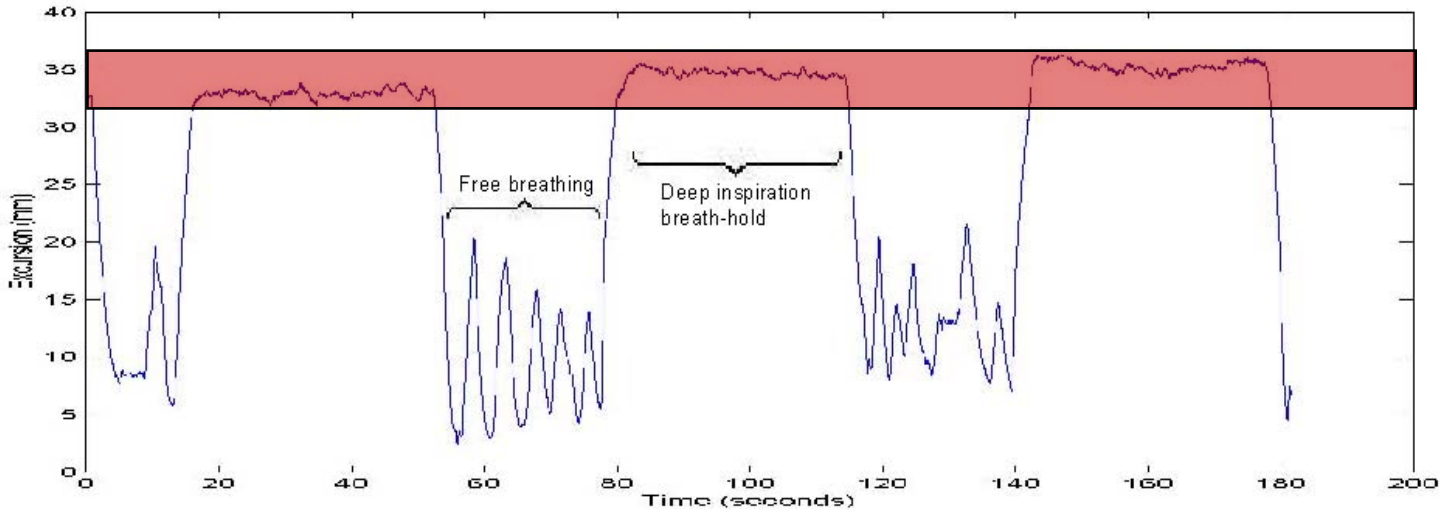
→ increased breathing amplitude

Typical respiratory pattern with and without coaching



Breath-hold techniques:





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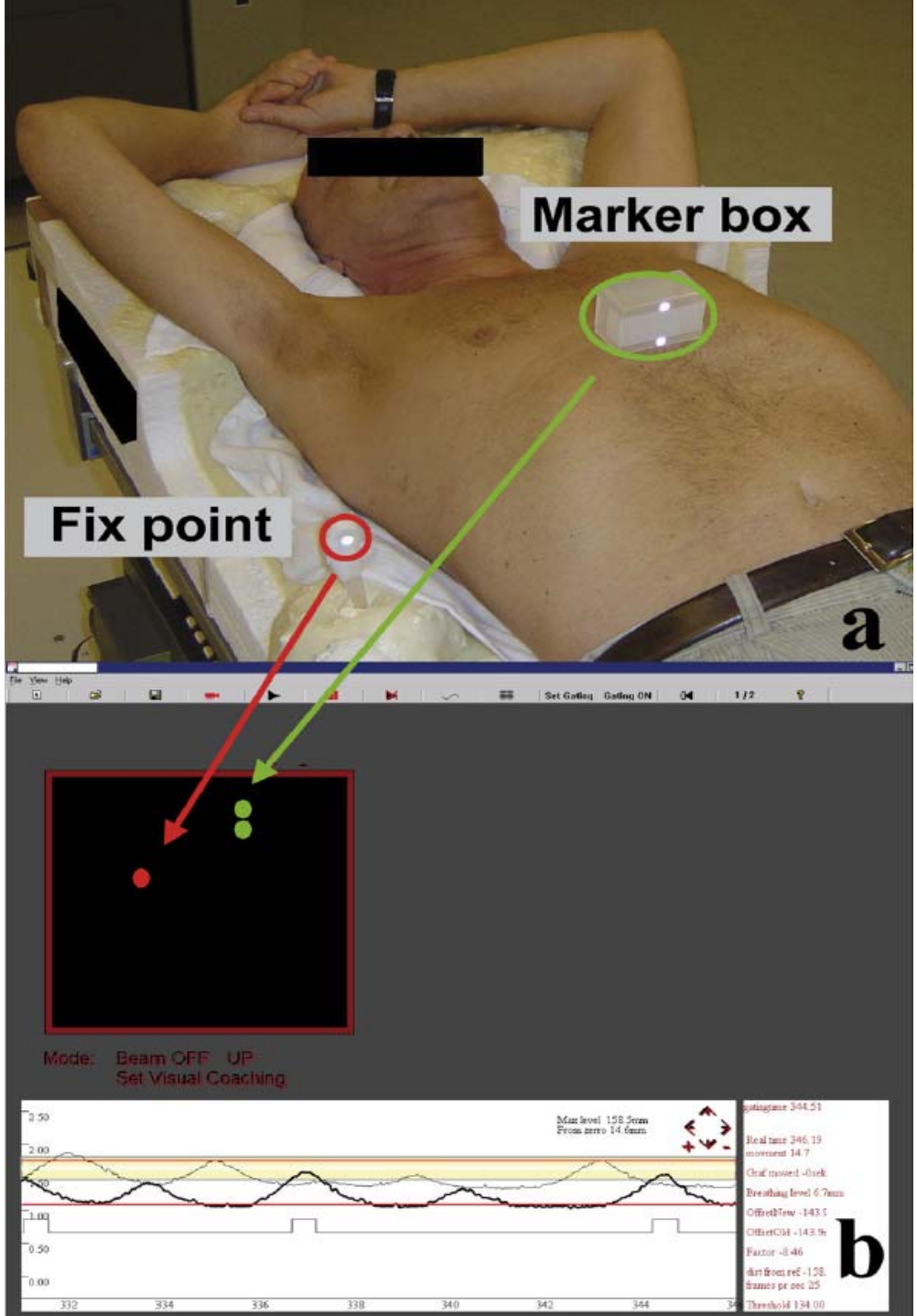

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Intrafraction and interfraction variations

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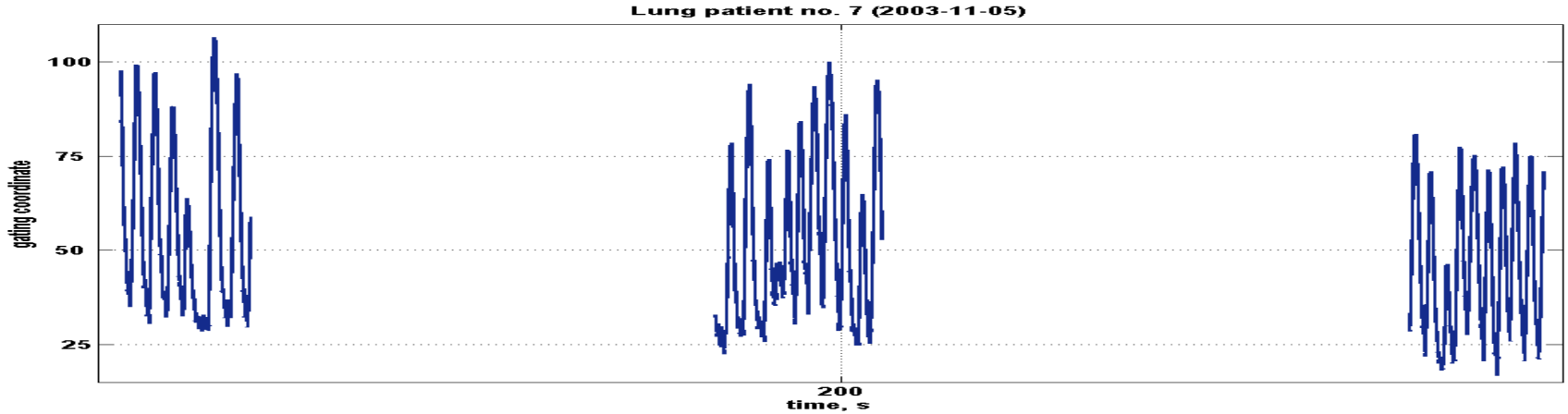

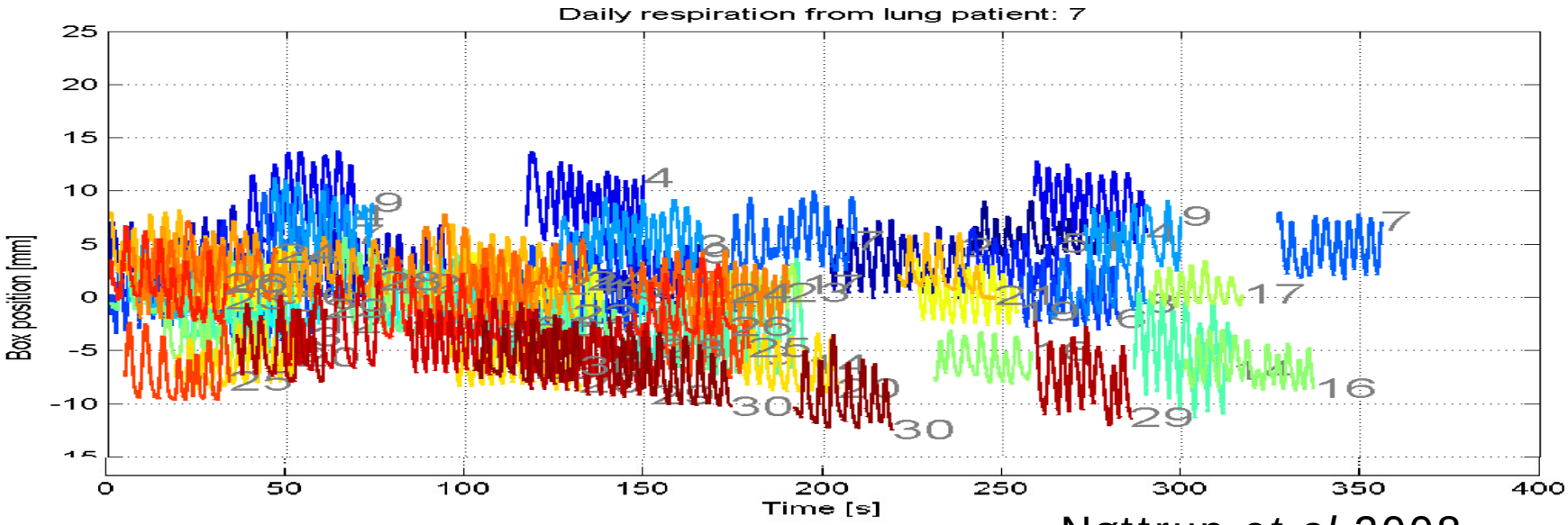

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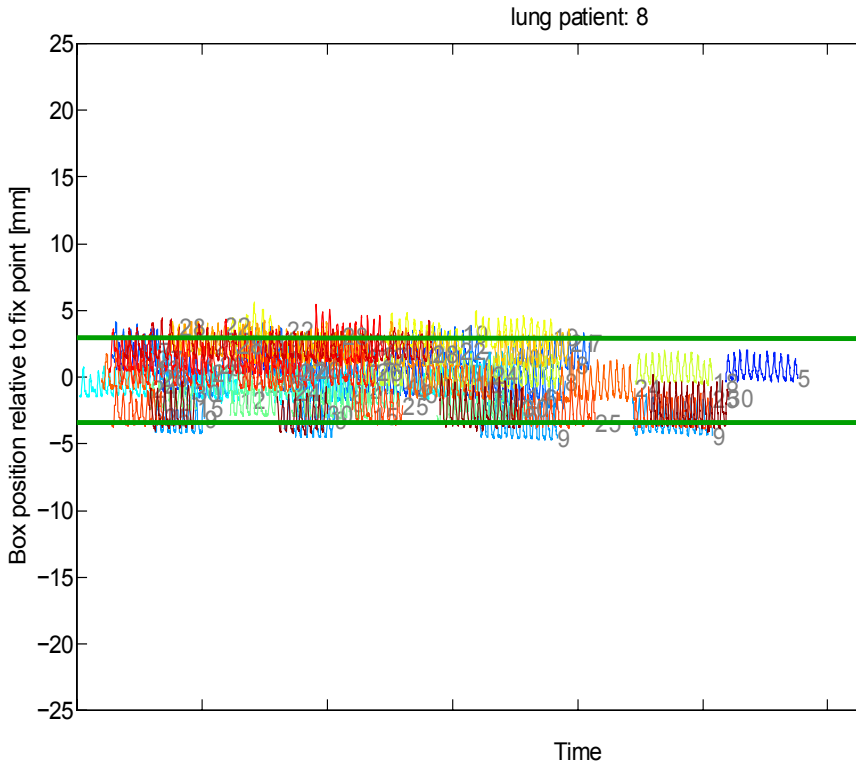
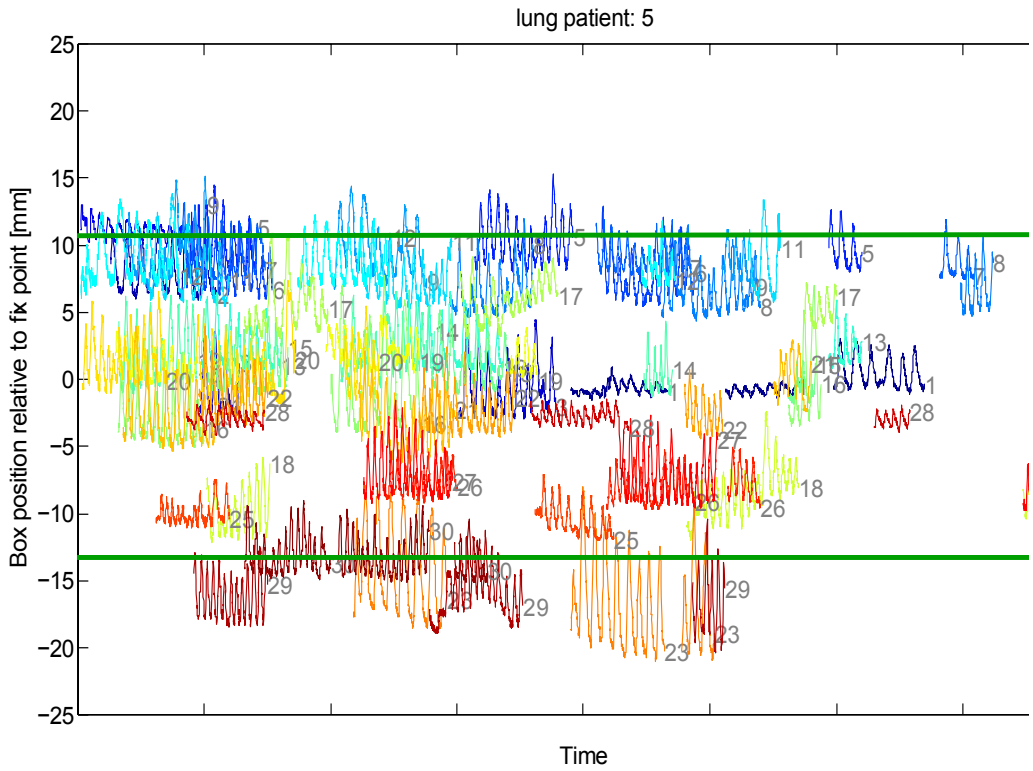
Interfraction variations





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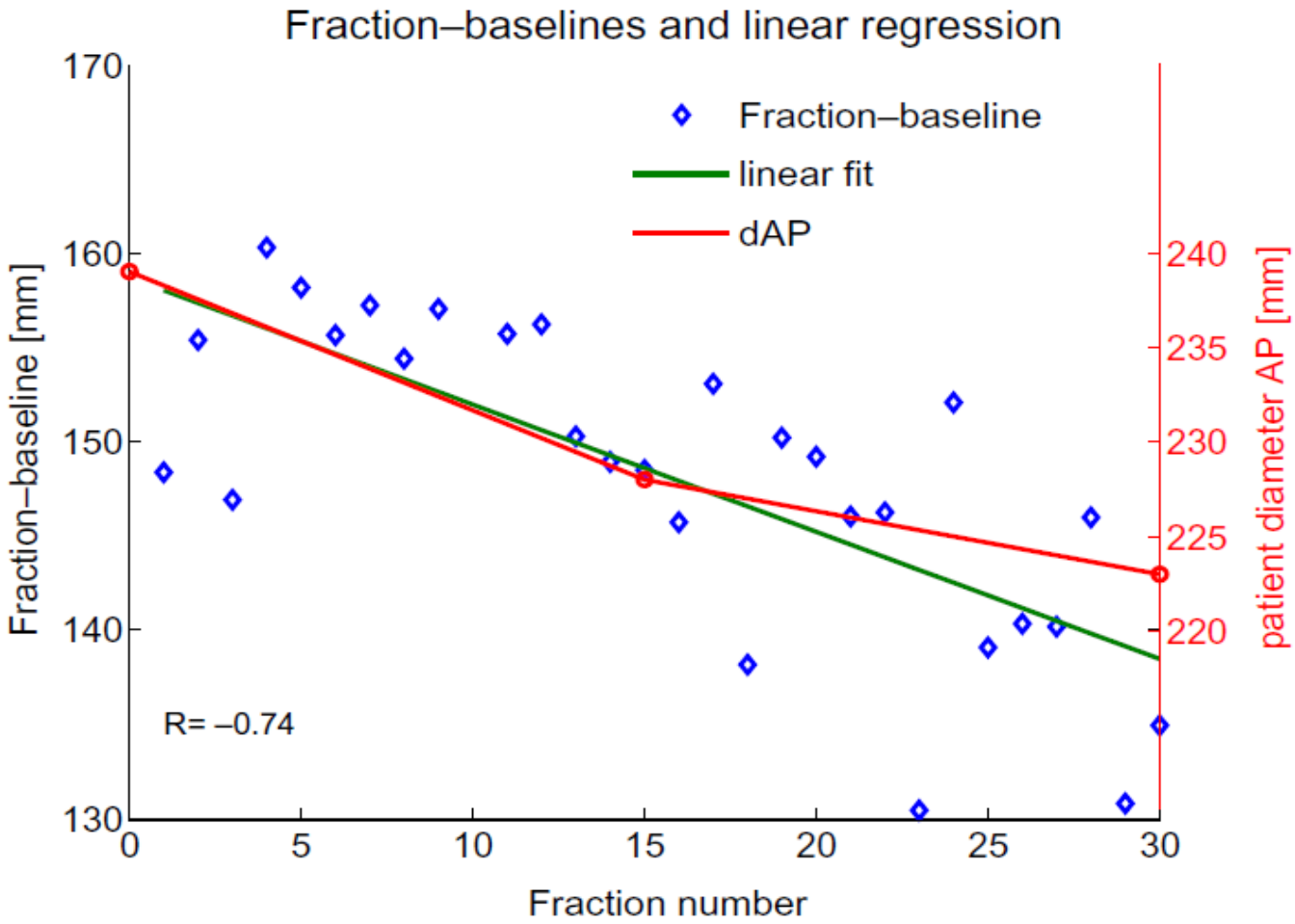

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Intrafraction and interfraction variations

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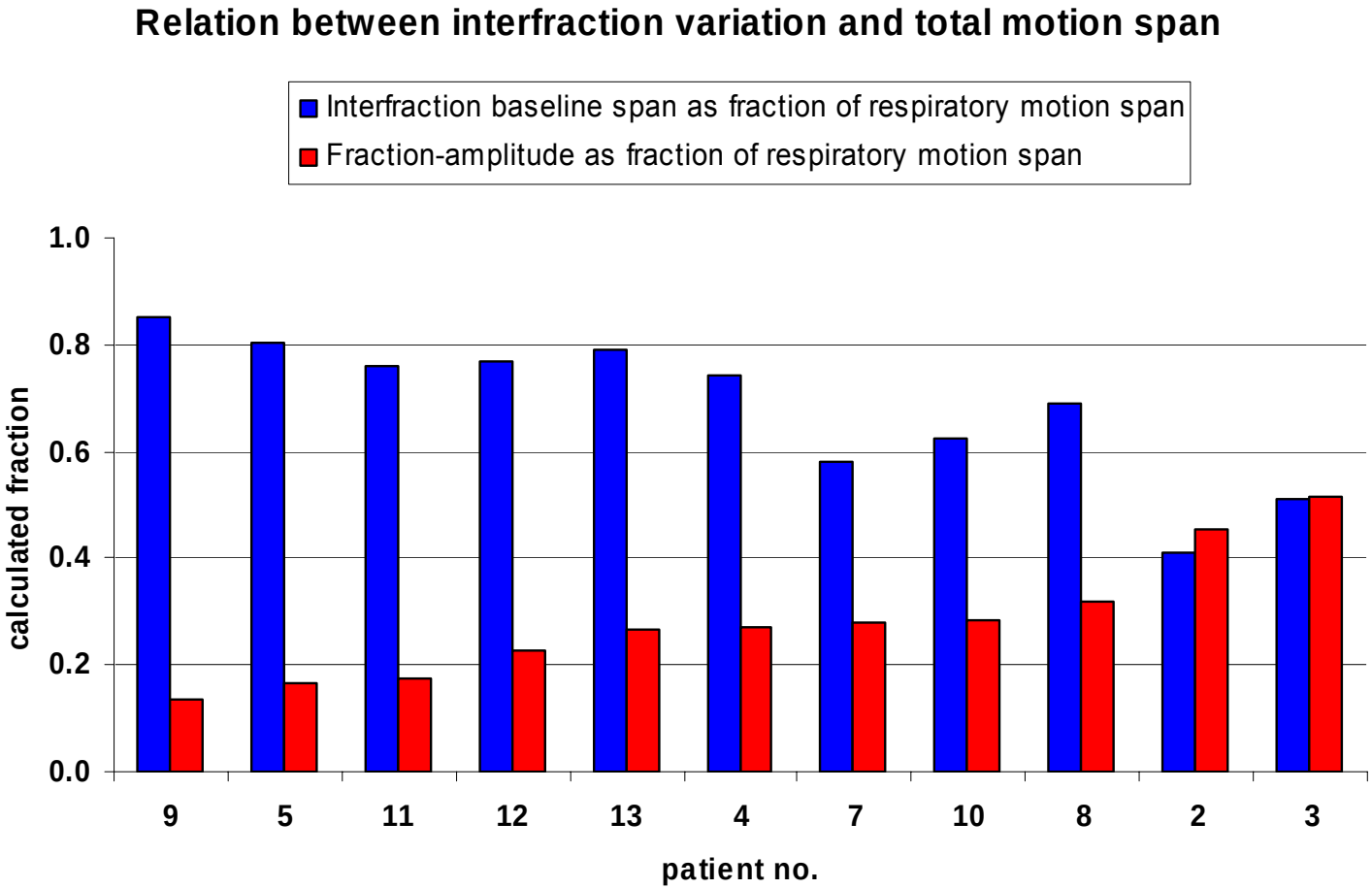

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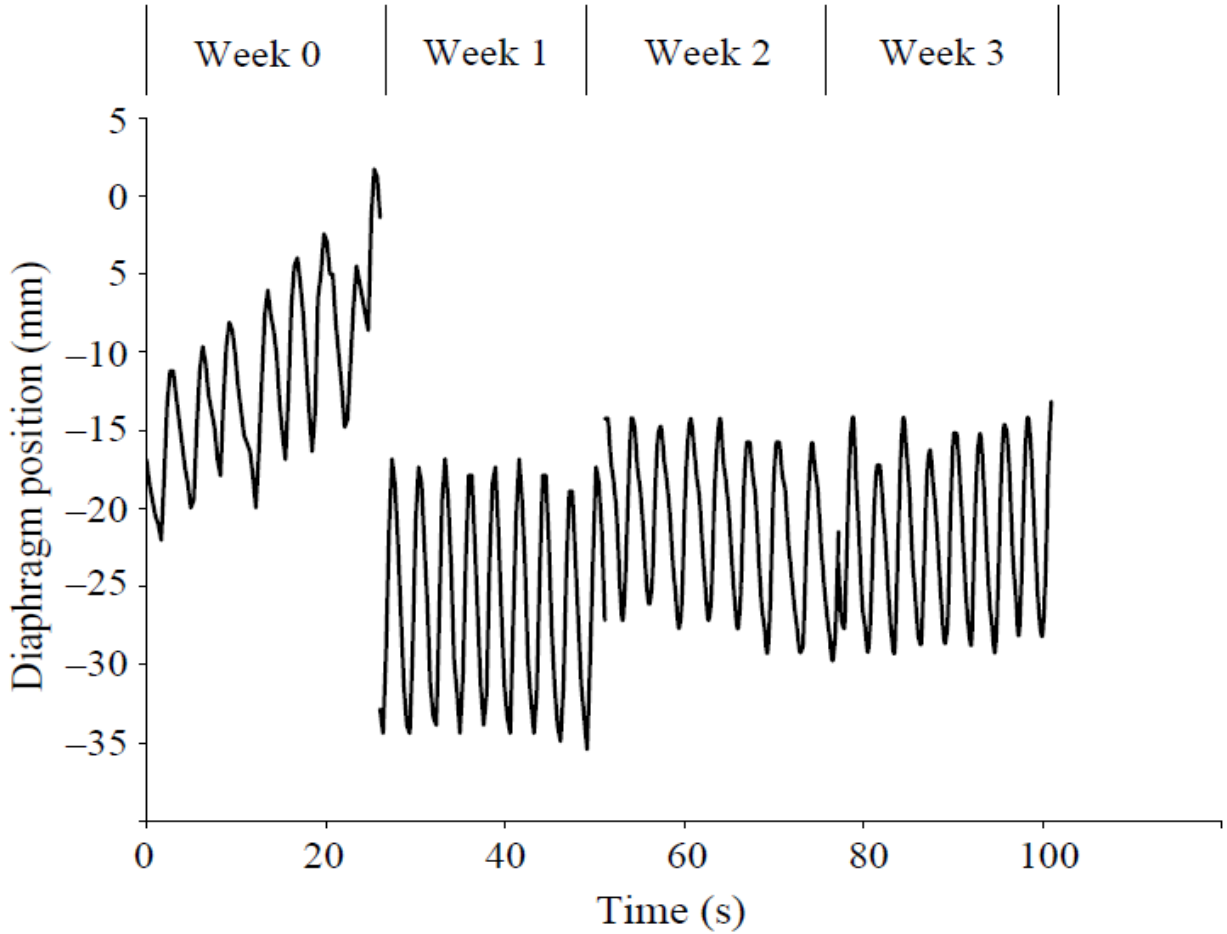

Fig. 3. Diaphragm position as a function of time for patient 7. Four separate daily sessions, one from each treatment week, are displayed. The reference trace (week 0) exhibited a time trend over the course of fluoroscopic recording. Subsequent sessions did not demonstrate the same trend.

Hugo *et al*, R&O 78 (2006) 326

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EFFECTS OF INTERFRACTIONAL MOTION AND ANATOMIC CHANGES ON PROTON THERAPY DOSE DISTRIBUTION IN LUNG CANCER

ZHOUGUANG HUI, M.D.,* XIAODONG ZHANG, PH.D.,* GEORGE STARKSCHALL, PH.D.,* YUPENG LI, M.S.,* RADHE MOHAN, PH.D.,* RITSUKO KOMAKI, M.D.,† JAMES D. COX, M.D.,† AND JOE Y. CHANG, M.D., PH.D.†

sideration during the original proton therapy planning. This finding indicates that imaging during the original 4D-CT simulation can predict the pattern of tumor motion during the course of radiation therapy. However, in 1 case (Fig. 3),

Int. J. Radiation Oncology Biol. Phys., Vol. 72, No. 5, pp. 1385–1395, 2008

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In conclusion – the problem of protons for lung targets is not solved by:

- Proper selection of non-moving tumours
- Treatment planning based on 4D-CT
- Re-design of margins
- Audio-coaching of the patient

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Probably a combination of many things is needed:

- Repeated (daily?) imaging
- Adaptive planning (plan of the day?)
- Advanced audio-visual coaching
- Gating (or breath hold techniques?)

- Apnea during anaesthesia?

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THANK YOU FOR YOUR ATTENTION!

Can audio coached 4D CT emulate free breathing during the treatment course?

GITTE F. PERSSON[1], DITTE F. [illegible]
TRINE JUHLER [illegible]

Radiotherapy and Oncology 84 (2007) 40–48
www.thegreenjournal.com

Target delineation

Intra- and interfraction breathing variations during curative radiotherapy for lung cancer

Trine Juhler Nøttrup*, Stine Sofia Korreman, Anders Navrsted Pedersen, Lasse Rye Aarup, Håkan Nyström, Mikael Olsen, Lena Specht

Department of Radiation Oncology, Rigshospitalet, Copenhagen, Denmark

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