

Review of risks to a radiologist's fingers during Interventional CT

Anne Davis – Portsmouth Hospitals NHS Trust

CTUG – November 2013





Radiologist's fingers
accidentally
irradiated during an
interventional CT
lung procedure.

Aims of this work

- Understand working practice
- Review the incident
- Establish the dose to the radiologist's fingers / hands
- Suggest ways to improve practice
- Review patient doses for interventional chest procedures

Background

Change of scanner used for interventional CT work

Previously

4 slice Siemens volume zoom



Staff usually left the room for exposures.
Predominantly sequential slices.
No use of CT fluoroscopy.

Now

128 slice Siemens Definition AS+



Better table side controls.
Staff in the room for parts of procedure.
Radiologists aware of CT fluoroscopy option.

Physics tests checked default biopsy settings to ensure patient doses would not be too high

What actually is interventional CT?

- Varies in complexity
- Biopsy (single or multiple lesions)
- Placing a catheter
- Aspiration (single or multiple lesions)
- Sclerotherapy – injection to shrink blood vessels (eg if supplying tumor)
- Ablation – removal of tissue (eg lung lesions)
- Drainage

Patient may be anaesthetized or awake,

Prone or supine depending on procedure

Features of Siemens Definition AS+

For Interventional CT work

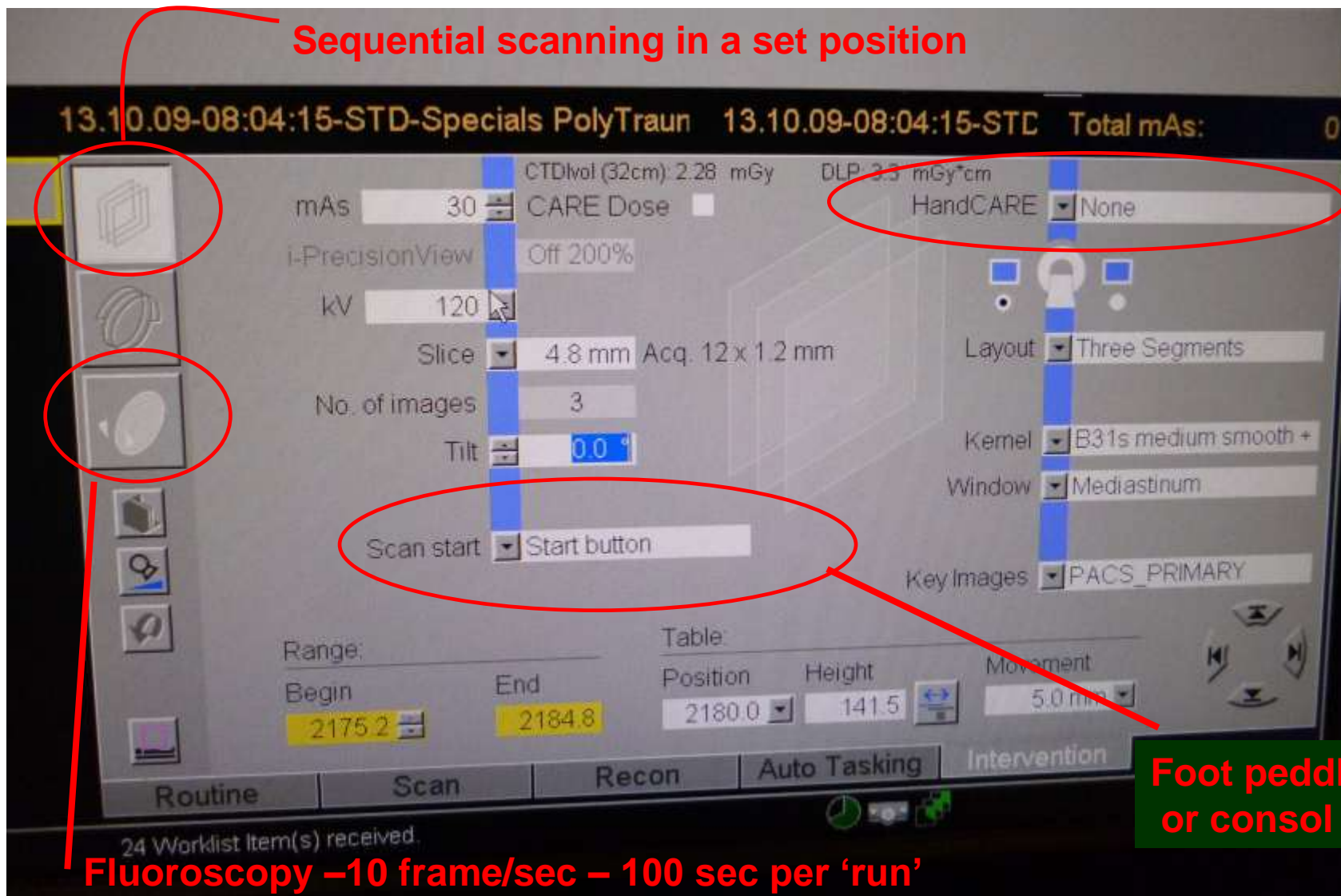


+
Foot peddle

From Siemens' website

Features of the Siemens Definition AS+

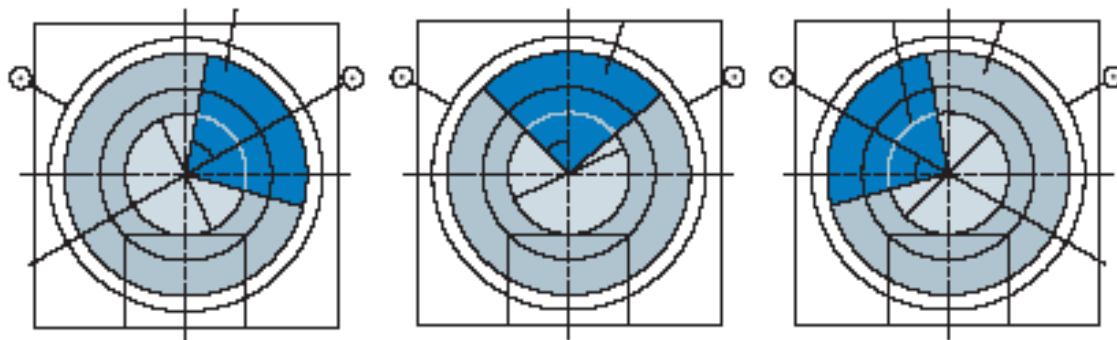
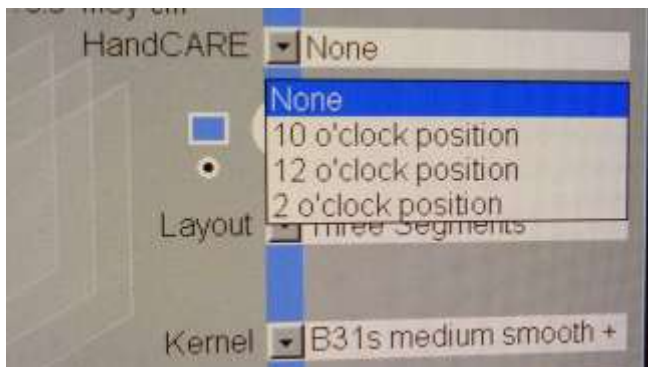
Sequential scanning in a set position



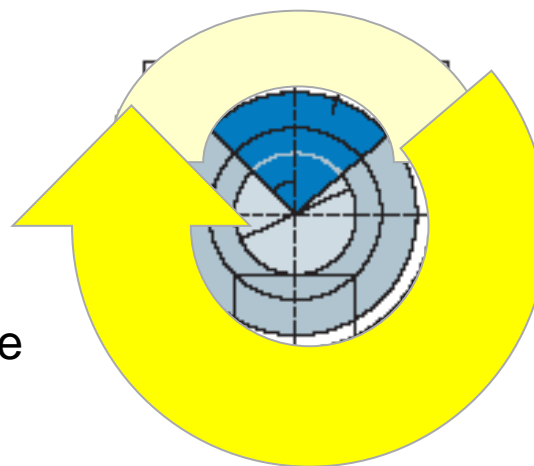
Foot peddle or consol button

Fluoroscopy -10 frame/sec - 100 sec per 'run'

HandCARE for i-Fluoro or i-Seq



100 degree section where incident beam dose is reduced

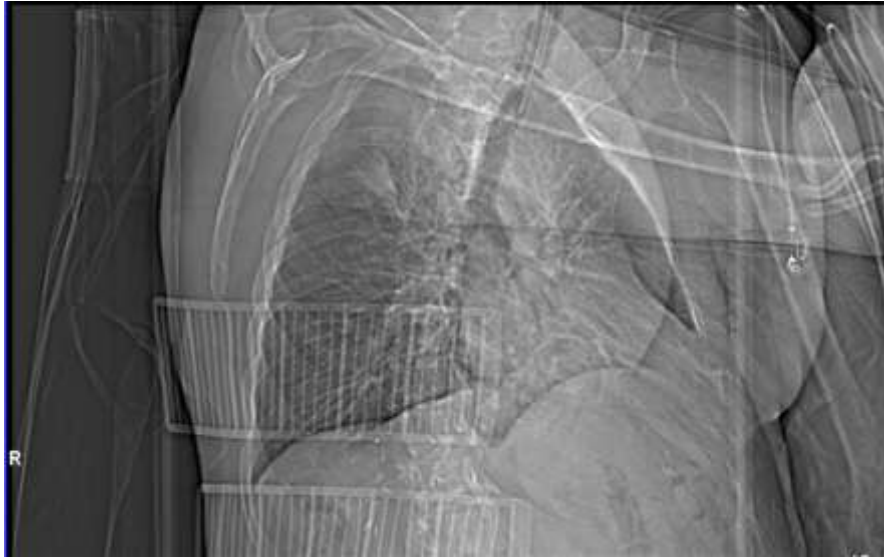


Must be switched on for each case

The case in question

- Lung procedure
- 3 lesions for microwave ablation
- Patient rotated to angle chest for ease of access





- **Topogram**
- **Spiral scan to find z-position**
- **Sequential scans / fluoro to advance needle / device into lesion**

Switched to fluoroscopy with a difficult lesion

Patient dose record

DLP (mGy.cm)

| | | | | | |
|-----------------------------------|---------------|-------|---------------|----------------|------------|
| Topogram | | | 120 kV | 36 mA | 4 |
| Location - Chest Spiral | | | 120 kV | 174 mAs | 420 |
| Lesion 1 Ablation - Seq | 10 exp | 14 mm | 120 kV | 30 mAs | 33 |
| Lesion 2 Ablation - Seq | 4 exp | 38 mm | 120 kV | 30 mAs | 30 |
| Lesion 3 Ablation - Fluoro | * | 14 mm | 120 kV | 30 mAs | 614 |
| - Seq | 9 exp | 38 mm | 120 kV | 30 mAs | 69 |
| Check - Chest Spiral | | | 120 kV | 177 mAs | 403 |

*** 67 sec of fluoro**

Estimation of dose to fingers

i- fluoro
120 kV
30 mAs

12x1.2 mm
(14.4 mm
Beam width)



CT ion chamber



Stack of TLDs in a thin tube

Fingers in beam for 10s
of CT fluoroscopy



HandCare OFF & then ON (10 o'clock position)

Estimation of dose to fingers (10 secs)

HandCare ON

HandCare OFF

CT Chamber

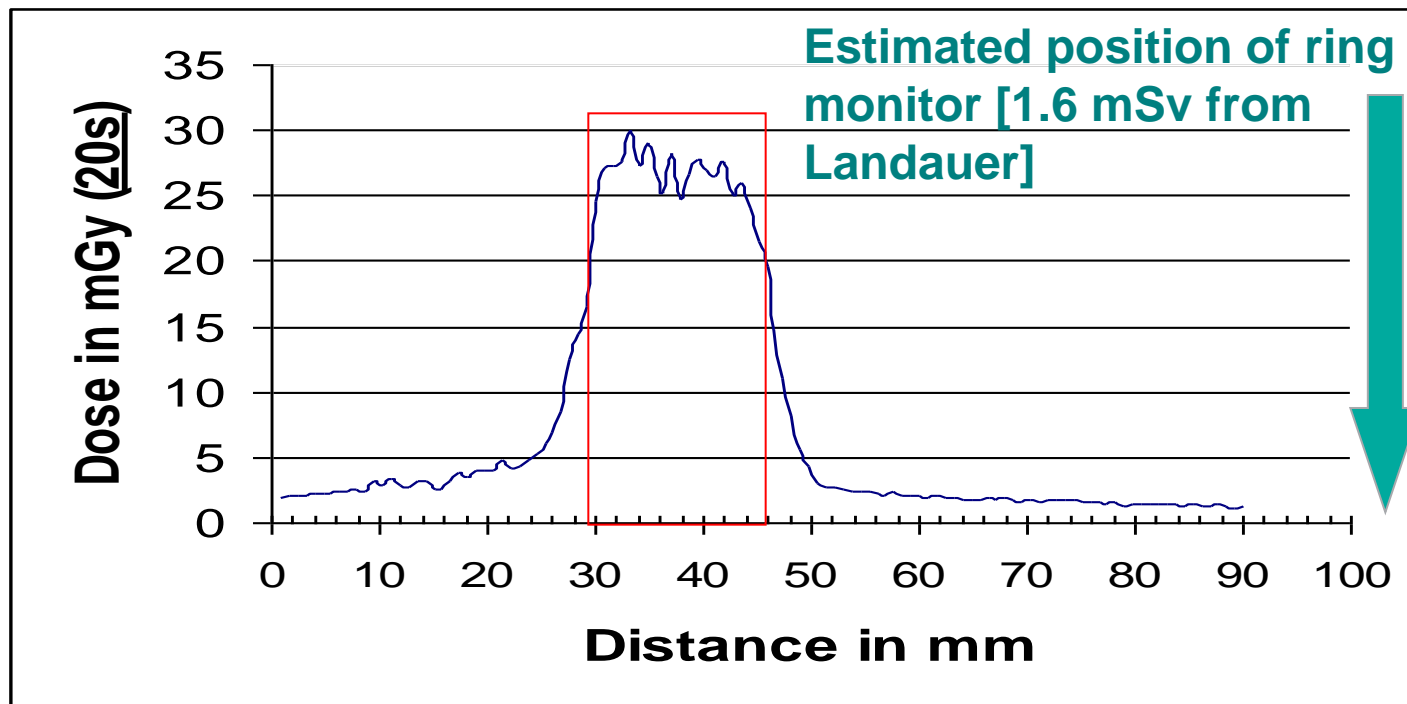
30 mGy [3 mGy/s]

84 mGy [8.4 mGy/s]

TLDs

23 mGy [2.3 mGy/s]

Dose profile across the TLDs



Estimation of dose to radiologist's eyes, trunk & hands

When standing close to scanner aperture (not allowing for PPE)

120 kV
30 mAs

12x1.2 mm
(14.4 mm
Beam width)
Handcare ON

Eyes
75cm from phantom



i-fluoro

3 uGy/s

For 67s : 201 uGy

Trunk
~60cm from phantom



4 uGy/s

268 uGy

Hands
15cm from phantom



42 uGy/s

2814 uGy

i-seq
(1 exposure)

1.8 uGy

2.2 uGy

Hands pulled
right back

In practice stands further away than this for sequential

Options for finger dose reduction – Needle holders



**Yoshimatsu,
Yamagami et al
(BJR)**



**Dean & Gharib
(Thyroid disease
manager)**

Local solution – low cost - forceps



**Surgical needle
holder**



Radiation protection training session with the radiologist

- Explained source of risks
- X-ray beam width (could be 30 mm) and extent
- Functioning of HandCare and protection given
- Practice session with the needle holder

Since then

- **No use of CT fluoroscopy in last 6 months by anyone**
- **Anyone who is going to use it must be properly trained**
- **Updating the risk assessment**

NHS Trust fined after radiologist exposed to radiation



Health and Safety
Executive

Date:

7 October 2013

Release No:

HSE/M/236/13

From
www.hse.gov.uk/press

United Lincolnshire Hospitals NHS Trust has been fined after an interventional radiologist was exposed to significant amounts of ionizing radiation.

Boston Magistrates' Court today (7 October) heard that an interventional radiologist working with a CT scanner at Pilgrim Hospital, Boston, received more than double the annual dose limit for skin exposure in just over three months.

As an interventional radiologist his work involved the insertion of biopsy needles into patients, which he carried out using the CT scanner operating in continuous "fluoroscopy" mode, giving "real time" x-ray images which he observed whilst standing next to the scanner.

The scanner, which the trust had bought in 2009, was used by a number of other consultants for the same purpose but they used the conventional "step and shoot" method which required them to leave the room when the CT scanner was generating x-rays.

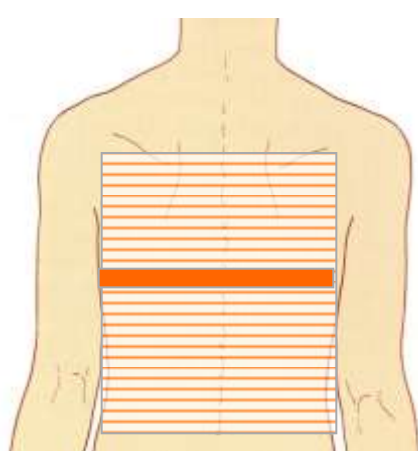
However, when the interventional radiologist arrived at the hospital in August 2011 he favoured the fluoroscopy mode, operating the x-rays for periods of up to 30

**Radiologist's fingers repeatedly in the beam.
No prior risk assessment and estimated to have received twice the annual dose limit.**

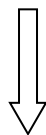
£30,000 fine and costs of £15,128

Patient doses – chest biopsy procedure

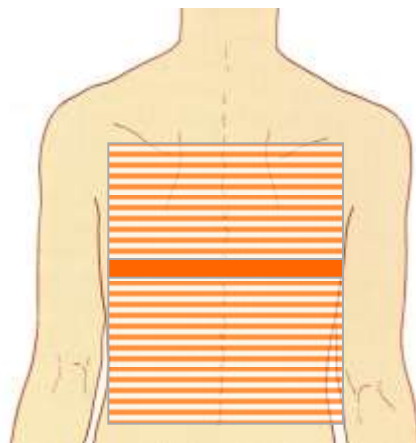
Different techniques according to radiologist preference



**Spiral,
Sequentials for biopsy**



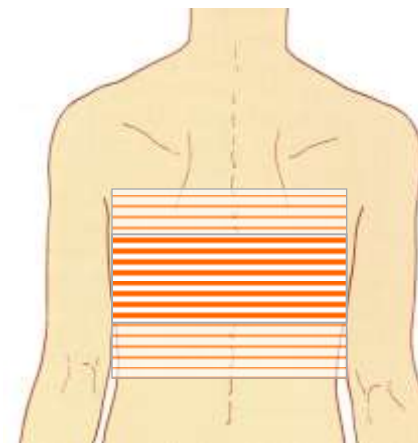
DLP range: 100 to 350 mGy.cm



**Spiral,
Sequentials for biopsy,
Spiral**



230 to 530 mGy.cm



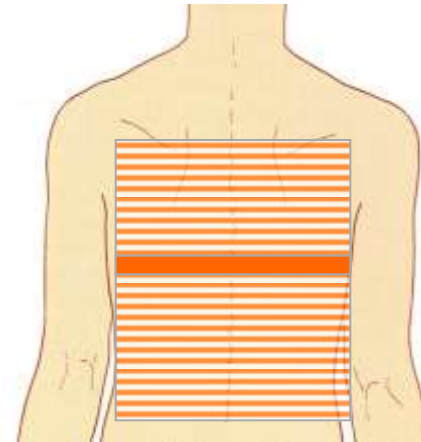
**Spiral,
Lots of short spirals**



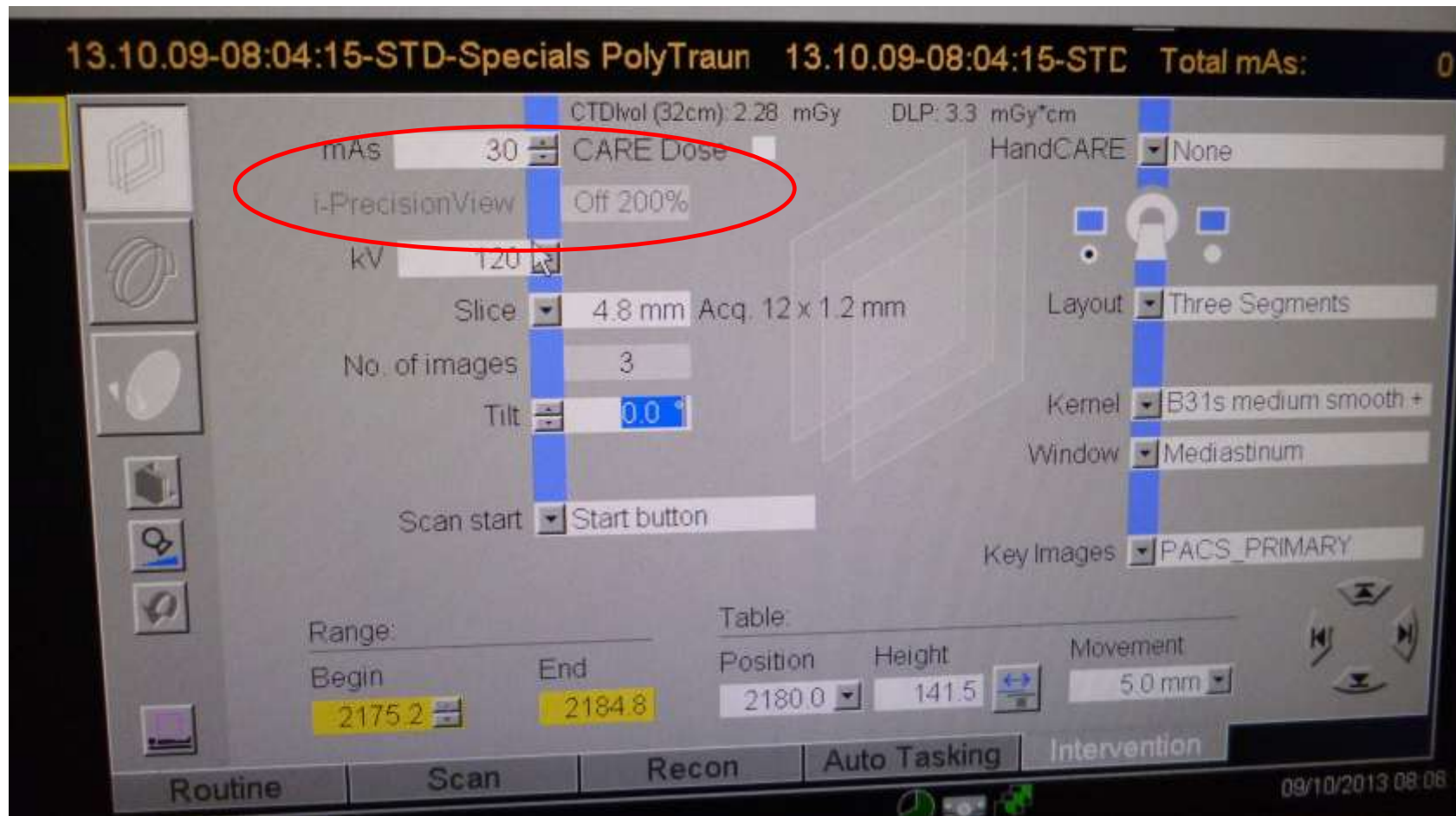
(Small data samples)

Patient doses – chest biopsy procedure – Optimisation

- Can scan length be reduced?
- Can mAs be reduced?
- Are all the spirals necessary?
- Is there a role for i-Precision view?



i-Precision view



The % increase or reduction of mAs for (only the) NEXT scan compared to default value. Deselected after the next scan is completed.

Lessons learnt

- Radiologist's training is essential.
- Extremity monitoring of limited usefulness (false reassurance?).
- Experienced CT radiographers should support these procedures and know what to do to minimise patient & doctor doses.
- Appropriate use of HandCare is effective at reducing operator dose.
- Patient dose data review can be useful – but no comparison data.
 - Must review clinical procedures and techniques.
 - Understand the clinical risks to the patient.
 - Look at the whole procedure not just the interventional part.
- Remind CT departments that new techniques must have a PRIOR risk assessment.