Transferring protocols from a GE LS16 to a Siemens Definition Flash

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Aim

– To set up mA-modulated protocols on a new Siemens Definition Flash to give comparable doses to well established protocols on a GE LightSpeed 16.

– Furthermore:

  – to get it right first time

  – for patients of all sizes!

GE LightSpeed16

- mA modulation: Smart mA / Auto mA

- mA modulation parameter: **noise index**

- Single TCM strength setting (system aim is for constant noise with patient size)

- Workhorse diagnostic CT scanner on Sutton site.

- Installed in 2003. 8 replacement tubes to date.

Siemens Definition Flash

- mA modulation: CareDose / CareDose 4D

- mA modulation parameter: **quality reference mAs** (75 kg)

- 5 user-selectable TCM strength settings

- TCM response is different for different body parts (protocol dependent).

- RMH's first Siemens CT scanner, installed February 2012 at the Sutton site

Image Siemens: Somatom Definition Flash product brochure

General Comparison

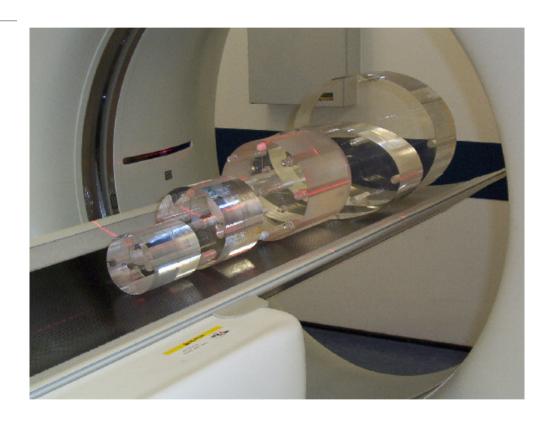| Feature	LightSpeed 16	Definition Flash
Simultaneous row acquisition	16 ×	64 ×
Min. slice width	0.625 mm	0.6 mm
Min. rotation time	0.50 s	0.28 s
Max tube mA	440	2 × 714
Max tube power	53 kW	2 × 100 kW
Max table feed	100 mm/s	430 mm/s
Pitch range (spiral)	0.56 – 1.75	0. 17 – 3.2
Beam Filters	Body, head	Head, body, paed/cardiac, DE
Gantry aperture size	700 mm	780 mm

Matching protocols using scan CTDIvol:

- Reported CTDIvol :
  - Refers to a 32 cm phantom (adult **and child** body protocols)
  - Refers to a 16 cm phantom (**head** protocols only)
- Happily the same for both scanners.

- FLASH: nominal protocol CTDIvol will be approximately correct for a standard 75 kg patient
- Match this to GE LS16 CTDIvol for 75 kg pt found from dose audit.

- **What about patients of other sizes?**

TCM phantoms

We scanned our family of phantoms with auto-mA protocol on the LightSpeed 16:

• Head: 16 × 16 cm

• Shoulders: 16 × 30 cm
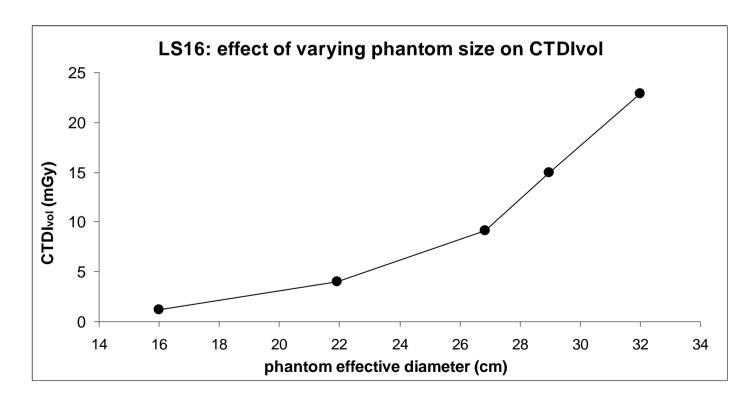
• Abdomen: 24 × 30 cm

• Chest: 28 × 30 cm

• Large body: 32 × 32 cm

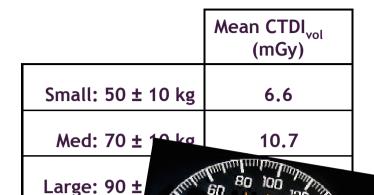We recorded how scan CTDIvol changed with phantom size.

LS16 TCM characterisation

- – Used standard TAP protocol
- – Scanned head, shoulders, abdomen and chest phantoms
- – Plotted CTDI$_{vol}$ against phantom effective diameter (geometric mean of AP and lateral dimensions)

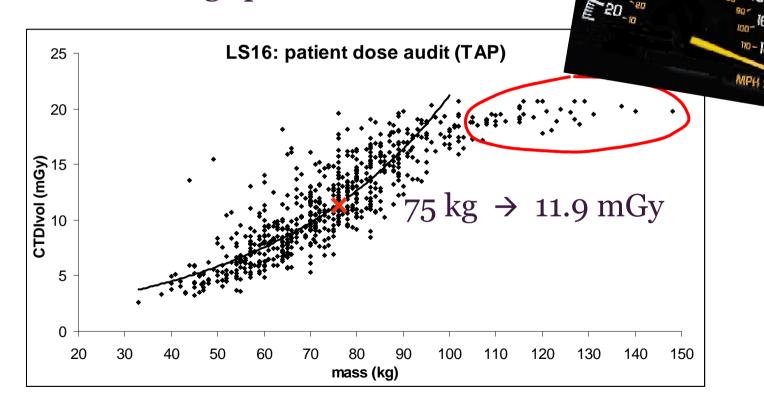**LS16: effect of varying phantom size on CTDIvol**

Y-axis: **CTDIvol (mGy)** (0 to 25)
X-axis: **phantom effective diameter (cm)** (14 to 34)

LS16 dose audit

- Automatically collected dose data for range of exams including TAPs
- Plateau for large patients

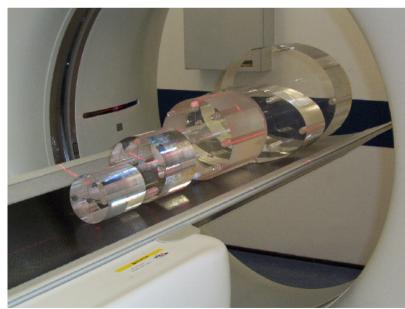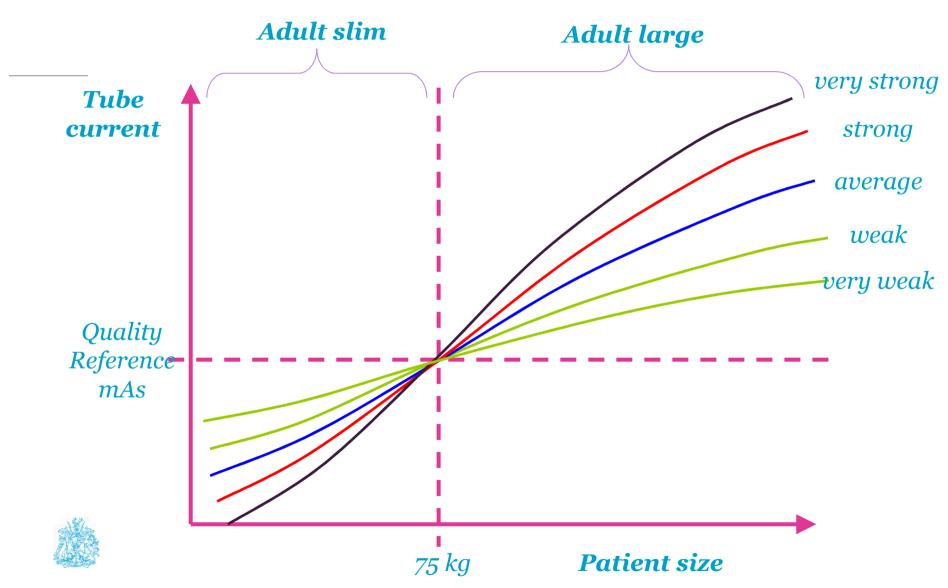|	Mean CTDI$_{vol}$ (mGy)
Small: 50 ± 10 kg	6.6
Med: 70 ± 10 kg	10.7
Large: 90 ±	

LS16: patient dose audit (TAP)

75 kg → 11.9 mGy

Flash TCM characterisation

– Scanned standard head, shoulders, abdomen, chest and body phantoms

– Used Siemens standard abdomen protocol with default quality reference effective mAs

– Repeated for all **5** strength settings (very weak to very strong)

– Plotted $CTDI_{vol}$ against phantom effective diameter
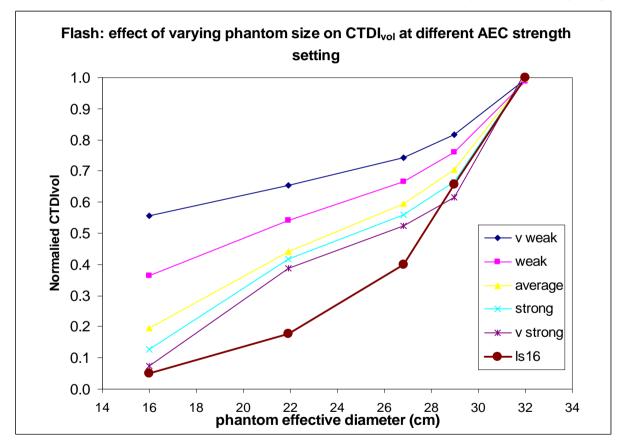
Flash mA modulation strengths

Flash TCM characterisation

Flash: effect of varying phantom size on CTDI$_{vol}$ at different AEC strength setting

- CTDIvol equal for all strength settings for the 32 cm phantom: point where delivered mAs is equal to the target mAs.

- We can deduce that Siemens have chosen the 32 cm phantom (or equivalent) to be the 75 kg reference patient **for this protocol body part (abdomen).**

- Measurements done with a **thorax** protocol indicate that the 75 kg reference patient is closer to our 24 × 30 cm phantom.

- Our phantoms only go up to 75 kg equivalent for the abdo protocol– unable to test into the "obese adult" range

Chart axes:
- Y-axis: CTDIvol (mGy), values 0, 10, 20, 30, 40, 50
- X-axis: phantom effective diameter (cm), values 16, 18, 20, 22, 24, 26, 28, 30, 32, 34

Legend:
- very weak
- weak
- average
- strong
- very strong

Choosing the Flash TCM strength

- – Which Flash curve is most similar to the LS16 curve?

Flash: effect of varying phantom size on $CTDI_{vol}$ at different AEC strength setting
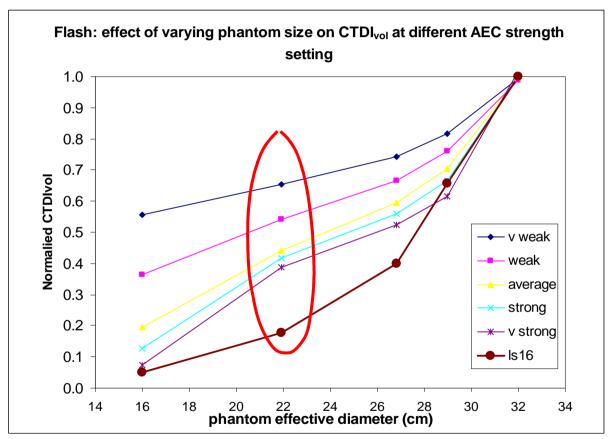
- – Compare normalised CTDIvol: Siemens default protocols have higher CTDIvol than optimised LS16 protocols (approx ×2).

Choosing the Flash TCM strength

– Which Flash curve is most similar to the LS16 curve?

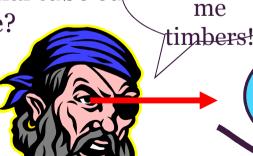**Flash: effect of varying phantom size on CTDI$_{vol}$ at different AEC strength setting**

– **Very Strong** response on the Flash gives most similar response to the LightSpeed 16 tube current modulation (with exception of 16 × 30 cm phantom) for this range of phantom sizes.

An aside on the 16 × 30 cm phantom results

- They don't really fit expected curve…
- This is the most elliptical phantom
- LightSpeed 16 measurements:
  - Performed a lateral and then AP scout before scan
- Flash measurements:
  - Performed only an AP scout.
- Different baseline mA chosen at start of scan?
- Difference in rotational tube cumodulation response?

Shiver me timbers!
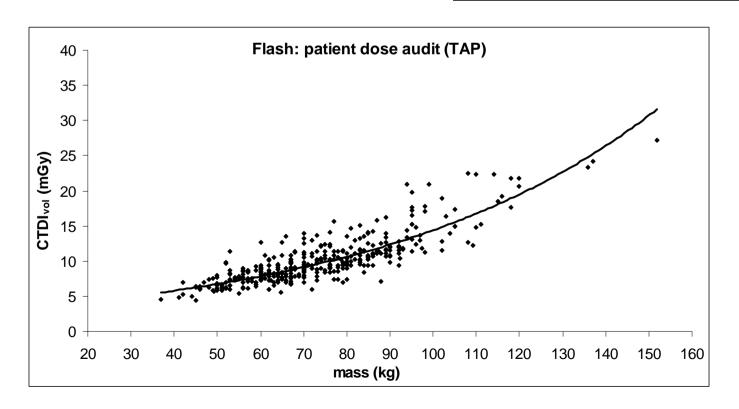
Setting up Flash clinical protocols

- Our MPE worked with the CT superintendent.
- They used an anthropomorphic Rando phantom.
- Set quality reference effective mAs on Flash to give the same $CTDI_{vol}$ to that of 75 kg patient scanned on the LS16.
- Use the **very strong** TCM curve for adult slim setting (patients up to 75 kg).
- Use default **average** TCM curve for adult obese setting (patients over 75 kg).

- Important to use the correct body part for each protocol!

- Doses should now match…. Let's check!

Confirmation of protocol matching: Flash dose audit

	Mean CTDI$_{vol}$ (mGy)
Small: 50 ± 10 kg	7.0
Med: 70 ± 10 kg	9.7
Large: 90 ± 10 kg	12.2

– Automatically collected dose data for Flash TAPs

– No plateau for large patients

Flash: patient dose audit (TAP)

Results

	LS16: Mean CTDIvol	Flash: Mean CTDIvol	% difference
Small: 50 ± 10 kg	6.6	7.0	+ 7 %
Med: 70 ± 10 kg	10.7	9.7	- 10 %
Large: 90 ± 10 kg	15.4	12.2	- 21 %

Flash and LS16: patient dose audit (TAP)

Results

- Doses matched fairly well for medium patients

- Siemens "Very strong" AEC response is not strong enough for decreasing patient weight!

- Can increase the response strength for patients > 75 kg.

Flash and LS16: patient dose audit (TAP)

Discussion

- Many set up options on Flash: 5 strength settings and large number of body part settings.
- Important to build protocols from the correct body part.
- No plateau on Flash because tubes operate at higher maximum mA.
- We were unable to test above 75 kg because our phantoms are not big enough.

- Paeds? Work in progress. Siemens reference patient has changed from 20 kg to 75 kg...

Conclusion

- Dose audit results show that this process has worked well to achieve matched scan CTDIvols between the scanners.
- Automated dose audit is a useful tool in optimisation!
- Match not perfect because:
    - Constant cross-section perspex phantoms are not equivalent to patients.
    - Even the very strong Siemens AEC setting is not as strong as the GE LS16 response.
    - Can't compare match for heaviest patients: LS16 capped at ~400 mA, Flash at ~700 mA.
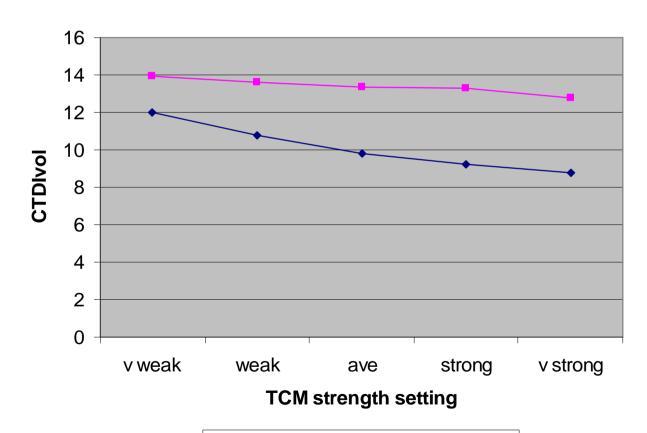
Thanks for listening!

– Comments?

– Questions?

Affect of body part on scan CTDIvol:

– 30 × 24 phantom scanned with 2 identical protocols,
  – One built from default abdo, one from default thorax: