Tailoring CT Protocols to the Patient's Age, Size and Clinical Scenario

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Presentations

- A Brief Introduction to the Effects of Size On Dose and Image Quality in CT (D. Bakalyar)
- CT Protocol Optimization over the Range of Patient Age & Size and for Different CT Scanner Types: Recommendations & Misconceptions (F. Ranallo)
- Meeting the Imaging Needs of the Pediatric Radiologist: The Effect of Patient Size, Age and Clinical Circumstance On Optimizing the CT Image (K. Applegate)

A Brief Introduction to the Effects of Size On Dose and Image Quality in CT

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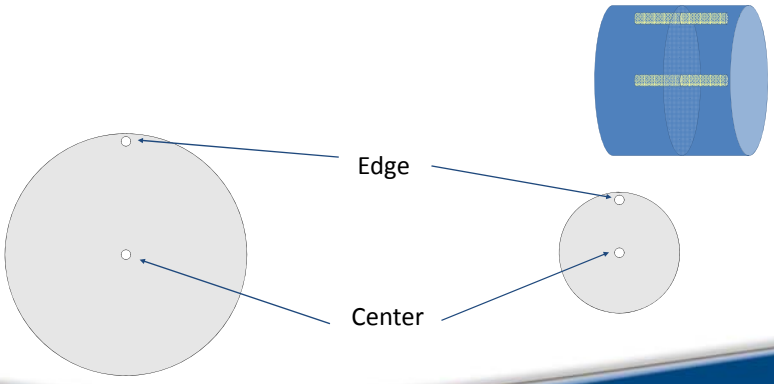
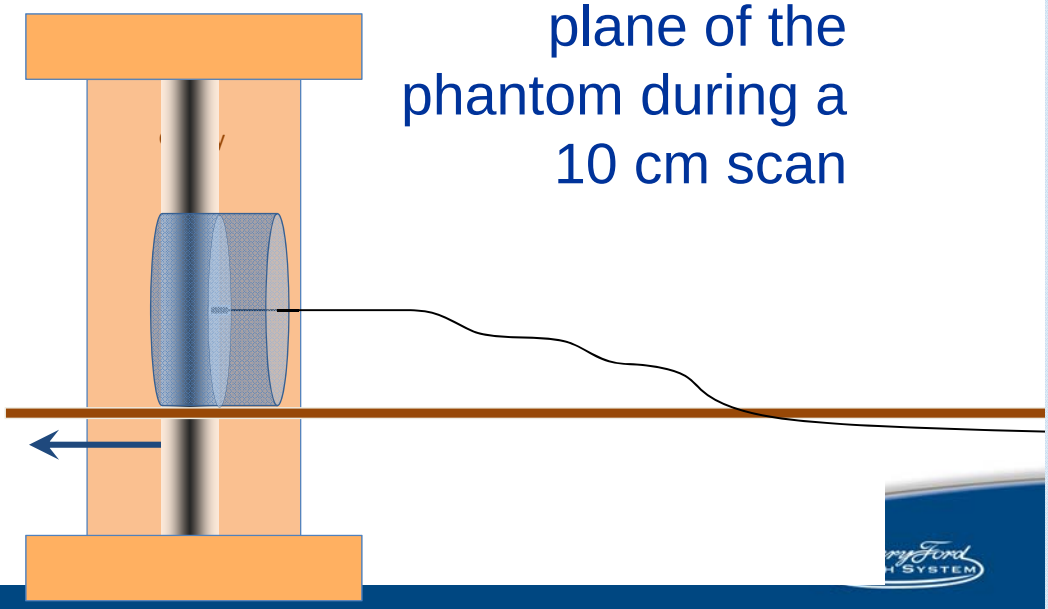
- Interpreting $CTDI_{Vol}$ and SSDE
- How dose should scale with size
- Is a child a small adult?

Patient Size: $CTDI_{vol}$ for the two standard phantom sizes



Accumulating dose in the central plane of the phantom during a 10 cm scan



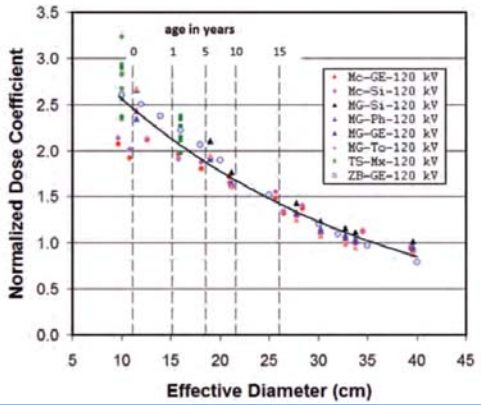
Two different phantoms

- Traditionally, two sizes of phantoms constructed of PMMA are used,
  - Head: 16 cm diameter, 15 cm long
  - Body: 32 cm diameter, 15 cm long
- Using the same scanning parameters *and filtration*, the head $CTDI_{vol}$ is about double the body $CTDI_{vol}$

Thus

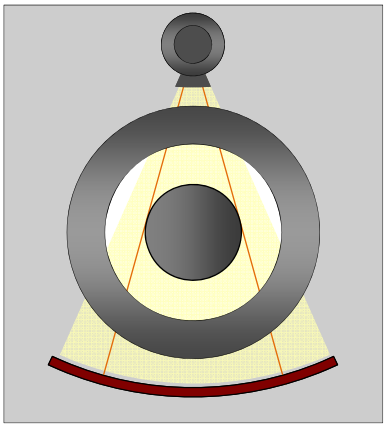
- One must always know *which* phantom is being referenced—not always obvious but should always be indicated
- Since the ratio is always about the same, it suggests that measuring $CTDI_{vol}$ for only one size may suffice (Careful!).
- …leading to Size Specific Dose Estimate or SSDE.

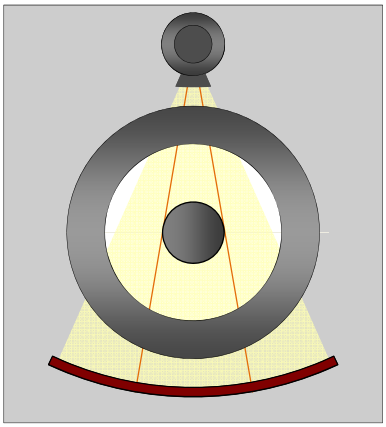
AAPM Report 204 and SSDE (Size Specific Dose Measurement—further refinements in AAPM Report 220)



The normalized dose coefficient for the 32 cm PMMA $CTDI_{vol}$ phantom is shown as a function of effective diameter. The individual data points correspond to four independent research groups, as indicated in the key. (Mc=McCollough, MG=McNitt-Gray, TS=Toth/Strauss, ZB=Zhou/Boone). Scanners represented are also indicated in the key (GE=General Electric, Si=Siemens, Ph=Phillips, To=Toshiba, Mx=Mixed Scanner manufacturers).

Magnification, FOV and noise: What needs to happen here?
Scaling dose to size



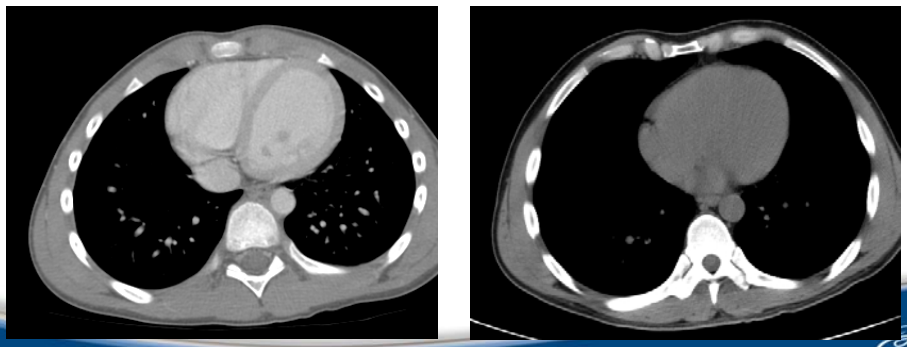


Based on size alone…

- for the same apparent noise, the dose to the detector must *increase* as the patient size *decreases*.
- for a smaller patient, due to less attenuation *less* patient dose is required to achieve the *same* dose to the detector
- These effects counter each other resulting in the recommendation of equating SSDE for patients of different size.

Pediatrics: Is a child a small adult?

Child and adult: Which is which?



However…

As we will see in the following presentations, there are often opportunities to reduce the dose further in pediatric patients. This is because the diagnostic task facing the pediatric radiologist may permit more noise.

So, how does this affect patient dose in a child?

- Magnification requires a higher detector dose but lower attenuation allows us to reduce dose.
- Goske, Strauss et al. suggest equating SSDE as a starting point but that in many cases due to other differences in children, we can reduce the dose in children even further. Dr. Applegate will provide us with more detail on this point.
- (What about slice thickness? Stay tuned for following presentations.)

M. J. Goske, K. J. Strauss et al., "Diagnostic Reference Ranges for Pediatric Abdominal CT," Radiology 268(1), 208-218 (2013).

Thank you