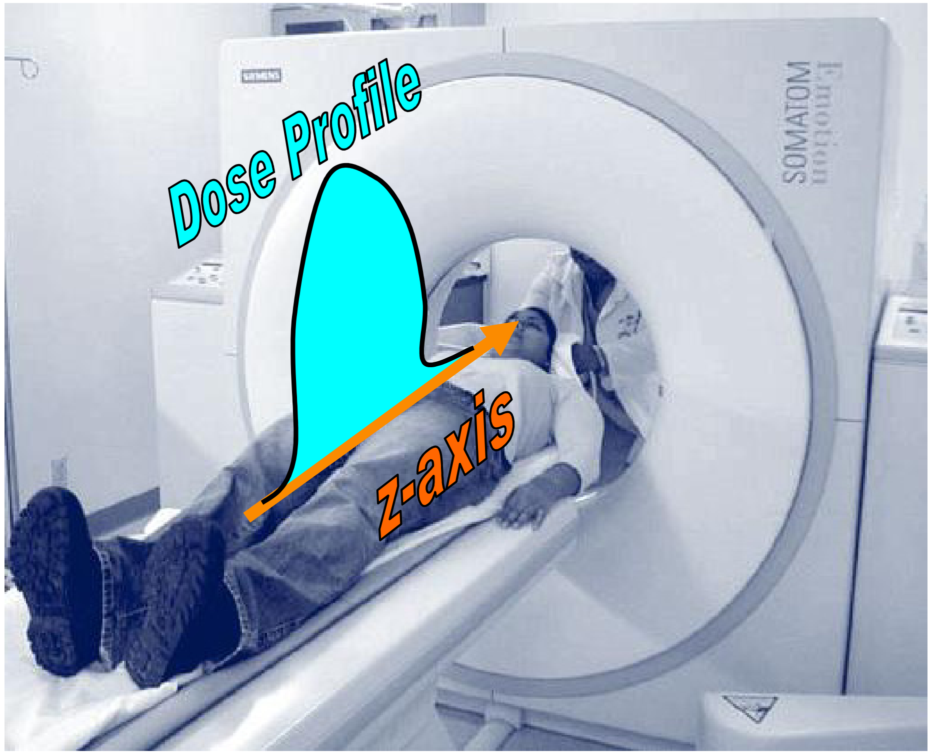
CT dose descriptors

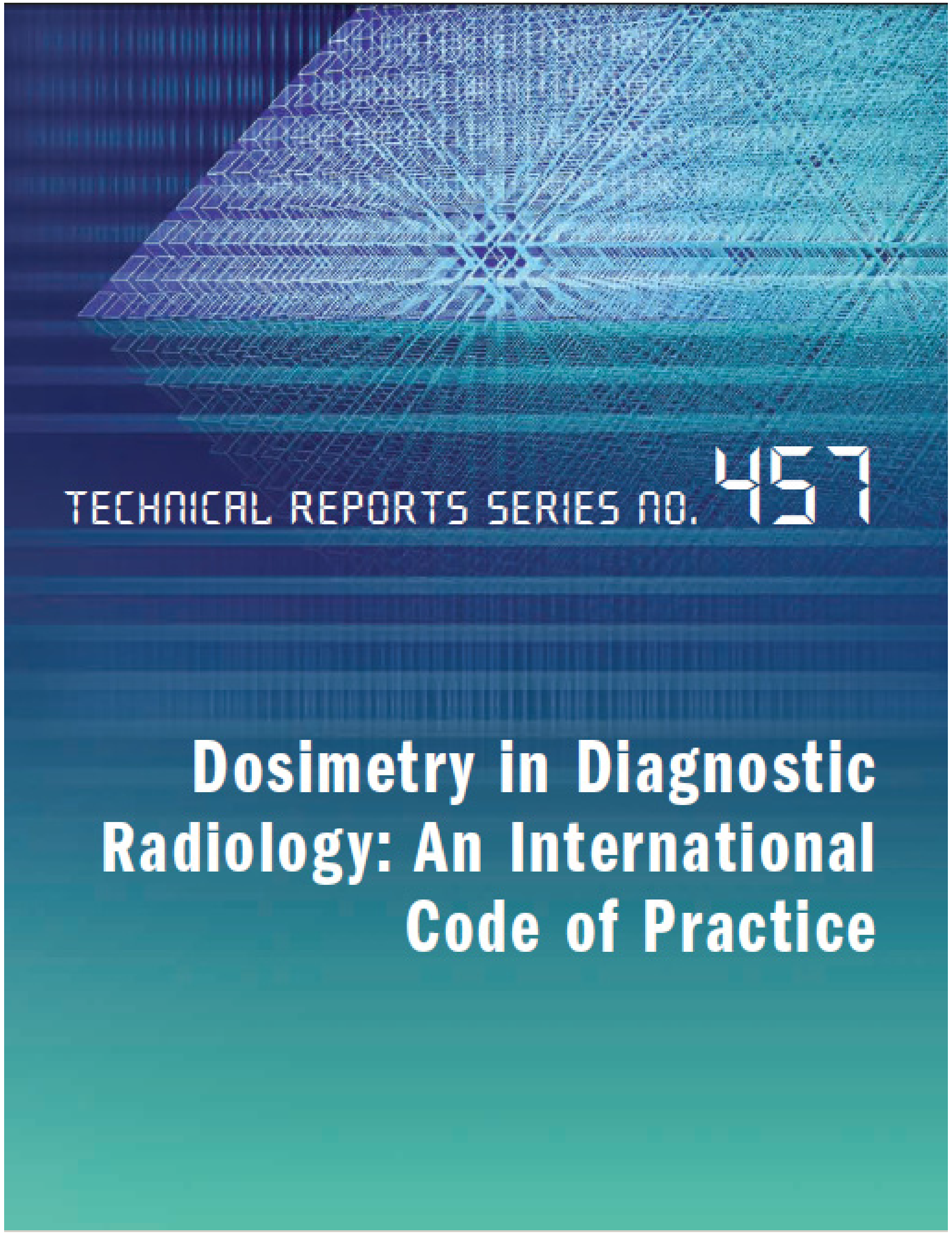
Katja Merimaa

Radiation dose in CT

- Basic quantities
  - DLP **D**ose **L**ength **P**roduct
  - CTDI **C**omputed **T**omography **D**ose **I**ndex

    (~MSAD Multiple Scan Average Dose)




TECHNICAL REPORTS SERIES NO. 457
Dosimetry in Diagnostic Radiology: An International Code of Practice

Air kerma-length product

(From IAEA TRS 457, 2007)

The air kerma–length product, P_{KL}, is the integral of the air kerma over a line of length, L, thus:

$$P_{KL} = \int_L K(z)\mathrm{d}z \qquad (3.10)$$

Unit: $\mathrm{J \cdot kg^{-1} \cdot m}$. If the special name gray is used, the unit of air kerma–length product is $\mathrm{Gy \cdot m}$.

In this Code of Practice, the air kerma–length product is applied to the dosimetry of CT and to the dosimetry of dental panoramic examinations.

3.2.7. Quantities for CT dosimetry

The CT air kerma index, $C_{a,100}$, measured free in air for a single rotation of a CT scanner is the quotient of the integral of the air kerma along a line parallel to the axis of rotation of the scanner over a length of 100 mm and the nominal slice thickness, T (see Glossary)[1]. The integration range is positioned symmetrically about the volume scanned, thus:

$$C_{a,100} = \frac{1}{T}\int_{-50}^{+50} K(z)\mathrm{d}z \qquad (3.11)$$

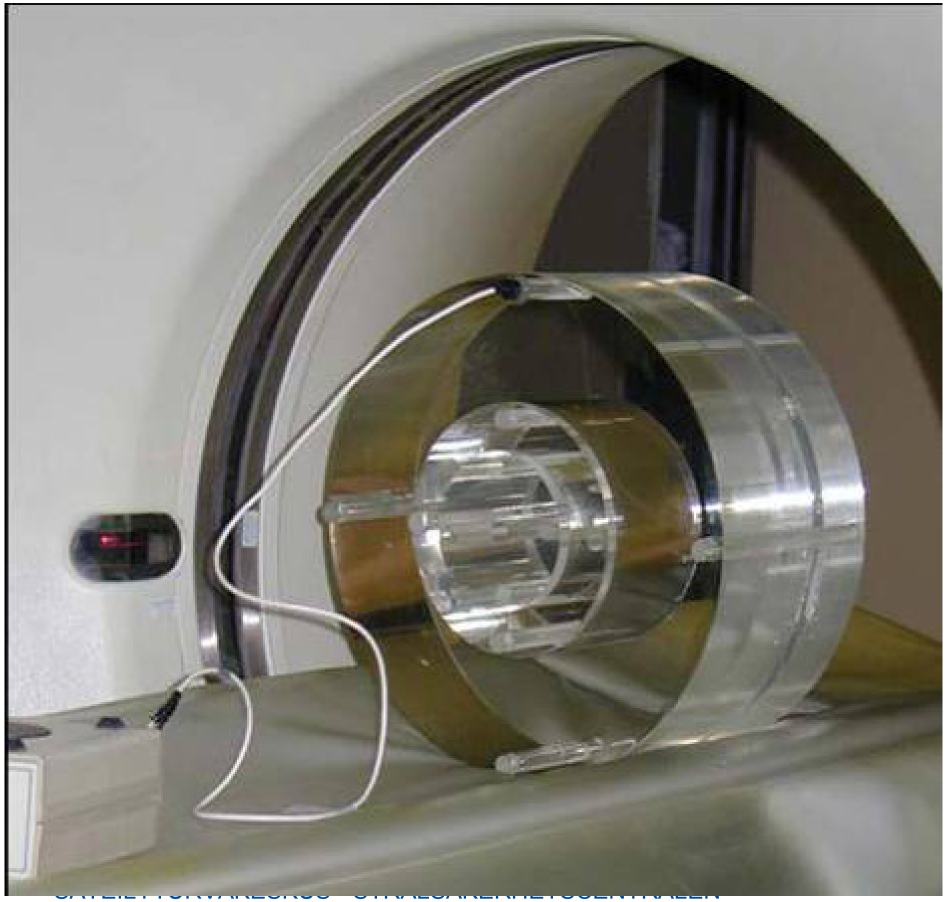
Unit: J/kg. The special name for the unit of CT air kerma index is gray (Gy).

For a multislice scanner with N simultaneously acquired slices of nominal thickness T (nominal width of irradiated beam NT), $C_{a,100}$ becomes:

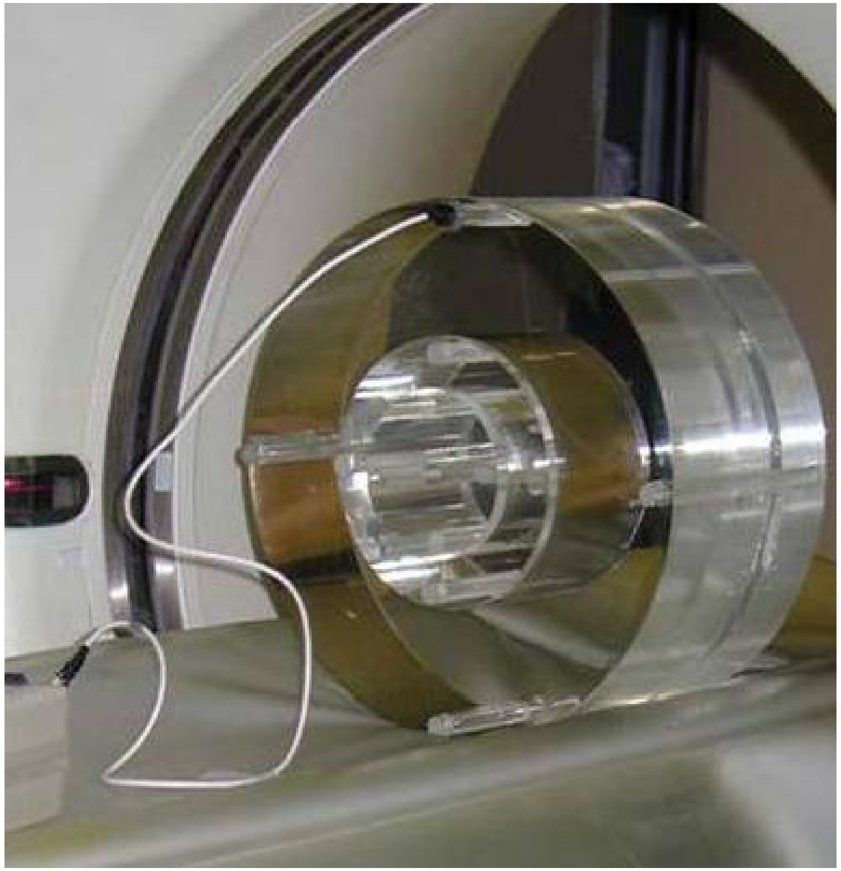
$$C_{a,100} = \frac{1}{NT}\int_{-50}^{+50} K(z)\mathrm{d}z \qquad (3.12)$$

The weighted CT air kerma index, C_W, combines values of $C_{PMMA,100}$ measured at the centre and periphery of a standard CT dosimetry phantom [3.5–3.8]. It is given by:

$$C_W = \frac{1}{3}\left(C_{PMMA,100,c} + 2C_{PMMA,100,p}\right) \quad (3.13)$$



$$C_{VOL} = C_W \frac{NT}{l} = \frac{C_W}{p};$$



?

Size-Specific dose estimate

- CT displays show dose to 16 cm or 32 standard phantom
- CT scanner's dose display values (DLP/CTDI) gives information of the radiation output
- New devices tell which phantom, older ones might not
- If tube-current modulation is used

  -> is the dose value based on average on maximum current? (IEC standard is changing max. mA -> average, at the moment Toshiba shows max. others average)

AAPM Report No. 204

Size-Specific Dose Estimates (SSDE) in Pediatric and Adult Body CT Examinations

Report of AAPM Task Group 204, developed in collaboration with the International Commission on Radiation Units and Measurements (ICRU) and the Image Gently campaign of the Alliance for Radiation Safety in Pediatric Imaging

Definitions: Size related parameters

Figure 2. The anterior posterior (AP) and lateral dimension, along with effective diameter are illustrated in this figure. The lateral dimension can be determined from a PA or AP CT radiograph, and the AP dimension can be determined by a lateral CT radiograph. The effective diameter corresponds to a circle having an area equal to that of the patient's cross section on a CT image. Some investigators have also used patient perimeter (circumference) as a metric of patient size.

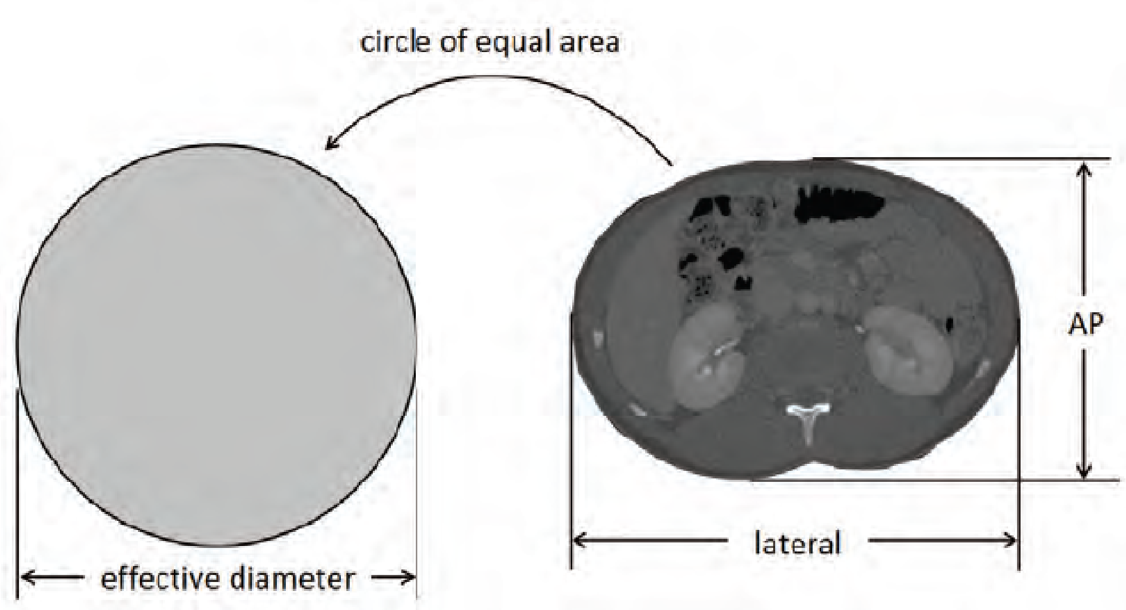
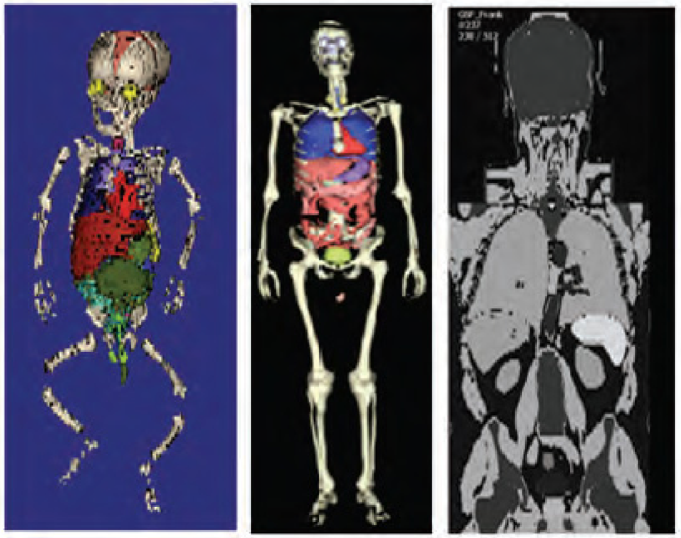


Figure 2 illustrates several of the parameters discussed in this section. The CT radiograph is the scanned projection radiography used in CT to prescribe the scan range (also called Scout™, Topogram™ and Scanogram™ by various manufacturers).

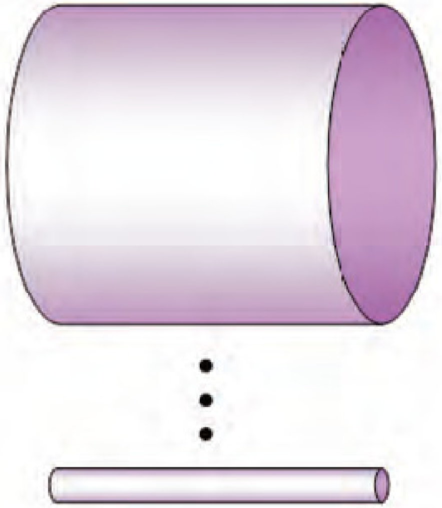
$$\text{Effective diameter} = \sqrt{(AP*LAT)}$$

A. Physical Anthropomorphic Phantoms
(McCollough and collaborators, Mc)

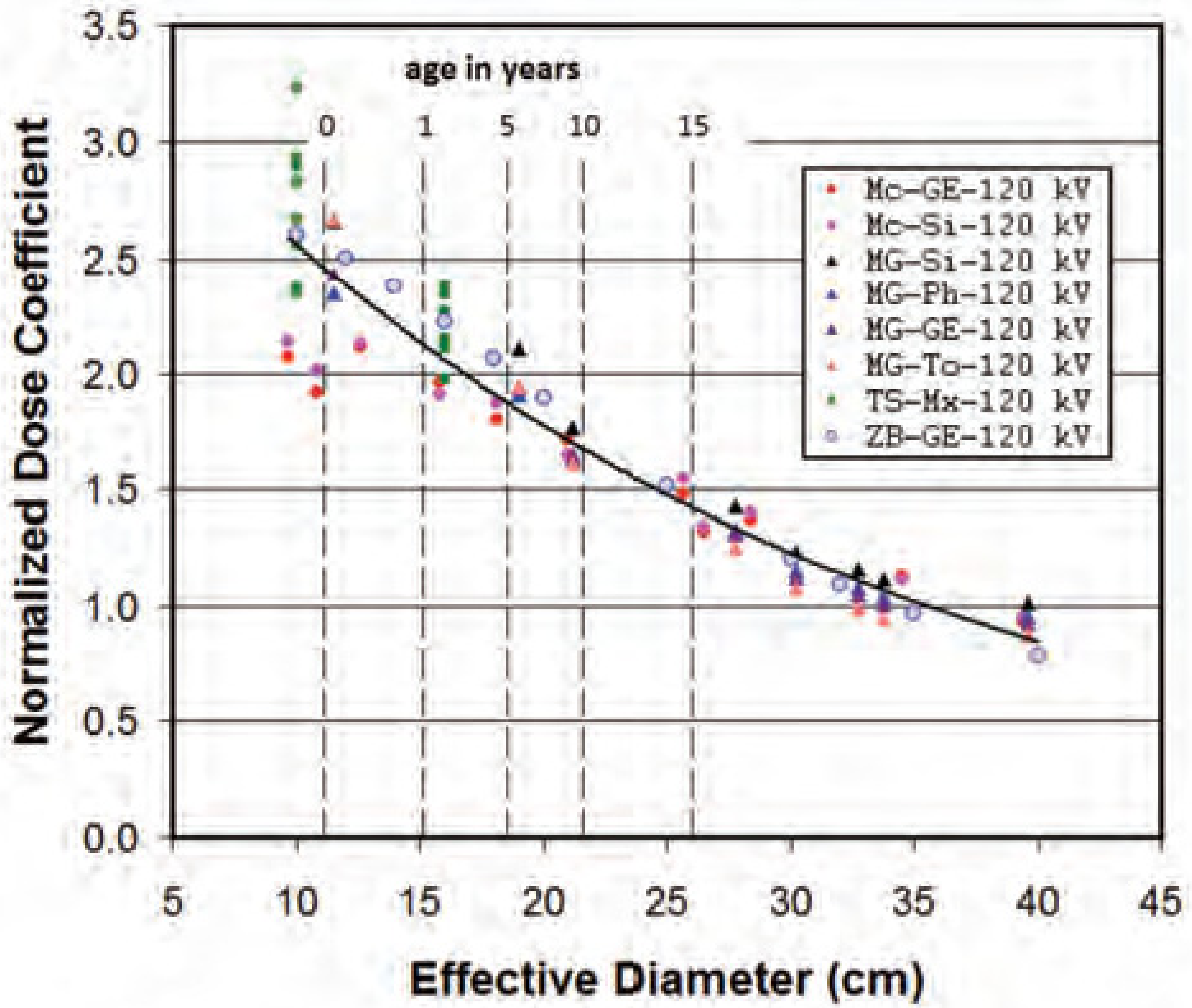
B. Cylindrical PMMA phantoms
(Toth and Strauss, TS)



C. Monte Carlo Voxelized Phantoms
(McNitt-Gray and collaborators, MG)



D. Monte Carlo Mathematical Cylinders
(Boone and collaborators, ZB)


age in years
0
1
5
10
15
Mc-GE-120 kV
Mc-Si-120 kV
MG-Si-120 kV
MG-Ph-120 kV
MG-GE-120 kV
MG-To-120 kV
TS-Mx-120 kV
ZB-GE-120 kV
Normalized Dose Coefficient
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
5
10
15
20
25
30
35
40
45
Effective Diameter (cm)

- Conversion factors for different size patients for 16 cm and 32 cm phantom doses
- AP+LAT, AP, LAT or effective diameter