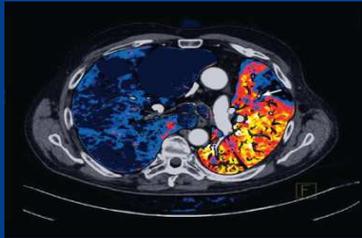




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The influence of Slice collimation in CT on $n\text{CTDI}_w$ using ImPACT data

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Introduction



Tomography is a central task of the devices in medical diagnosis, which provides high-quality photographs of cross sections in the body. CT contributes over 34% of collective dose from diagnostic X-Ray examinations in the world.

Measuring radiation dose of patients in computed tomography ($CTDI_w$ Computed Tomography Dose Index, and normalized Computed Tomography Dose Index $_nCTDI_w$) is highly affected by scan parameters (such as tube current (mA), scan (rotation) time (s), tube voltage (kV), beam (slice) width (mm), helical pitch and number of slices/tube rotations (scan length)).



Purpose



This work focused on investigating the relationship between slice collimation width and radiation dose ($_n\text{CTDI}_w$) in 16 CT scanners of 4 different manufacturers (Toshiba, GE, Philips and Siemens) 7 of them are single and 9 are multi slice. The results are obtained using ImPACT software version 1.0.2



Materials and Methods



The normalized CTDI (${}_n\text{CTDI}_w$) is obtained by dividing the CTDI_w value by the mAs that was used to measure CTDI_w :

$${}_n\text{CTDI}_w = \frac{\text{CTDI}_w}{\text{mAs}}$$

It is worthwhile (and indeed necessary) to note that the ${}_n\text{CTDI}_w$ is a characteristic quantity for scanner (dose rate coefficient) which simply represents the capacity of a scanner in terms of output and which conveys absolutely nothing about patient dose.



Materials and Methods



Tables 1 to 16 are obtained from ImPACT database then plotted curve slice collimation versus n_{CTDI_w} at 100 mAs for 16 CT scanner models. The ImPACT column in the tables 1, 16 express to ImPACT factor to normalize all slice collimations values to 10mm.



Results



The results indicates that the relationship between collimation width and $n\text{CTDI}_w$ for all scanner of Toshiba, Philips and GE seems to be exponential whereas for Siemens, GE (HiSpeed ZX/i) and Philips (Secura) (the correlation coefficient of these models was very low and the data were not conclusive enough to get to the same conclusion. The doses at the same width of 10mm for all scanners were presented.

Chart 1 presents comparison 16 CT scanner models and normalized CTDI_w at 100mAs, 10mm



[Table 1] Manufacturers and models in comparison with radiation dose ($nCTDI_w$) at 100 mAs, 10 mm



[Table 17] Manufacturers and models in comparison with radiation dose ($nCTDI_w$) at 100 mAs, 10 mm

| Manufacturer | Model | Maximum collimation width | Max $nCTDI_w$ - Min $nCTDI_w$ | kV | $nCTDI_w$ @10mm mGy/100 mAs |
|----------------|-------------------------------|---------------------------|-------------------------------|-----|--------------------------------|
| | | mm | mGy | | |
| TOSHIBA | X Press- GX (Asteion) | 10 | 5.0 | 120 | 6 |
| | Asteion Dual | 20 | 36.8 | 120 | 15 |
| | Asteion Multi (CXB-400C tube) | 32 | 14.4 | 120 | 13 |
| | Aquilion 16 | 32 | 34.9 | 120 | 14.3 |
| GE | Pace, Sytec | 10 | 2.8 | 120 | 10.9 |
| | HiSpeed ZX/i | 20 | 0.8 | 120 | 6.6 |
| | Light Speed Pro 16 | 20 | 2.9 | 120 | 9.9 |
| | Light Speed VCT | 40 | 7.3 | 120 | 12.2 |
| PHILIPS | M / EG | 10 | 3 | 120 | 29.8 |
| | Secura | 10 | 3.4 | 120 | 7.6 |
| | Aura | 10 | 13 | 120 | 12 |
| | Brilliance 16 | 24 | 5 | 120 | 7.9 |
| SIEMENS | Siemens Balance, Emotion | 10 | 3.2 | 130 | 12.6 |
| | Somatom AR-C, AR-SP, AR-T | 10 | 11.5 | 130 | 13.6 |
| | Sensation 16 | 24 | 3 | 120 | 6.8 |
| | Sensation 64 | 29 | 1.9 | 120 | 5.8 |



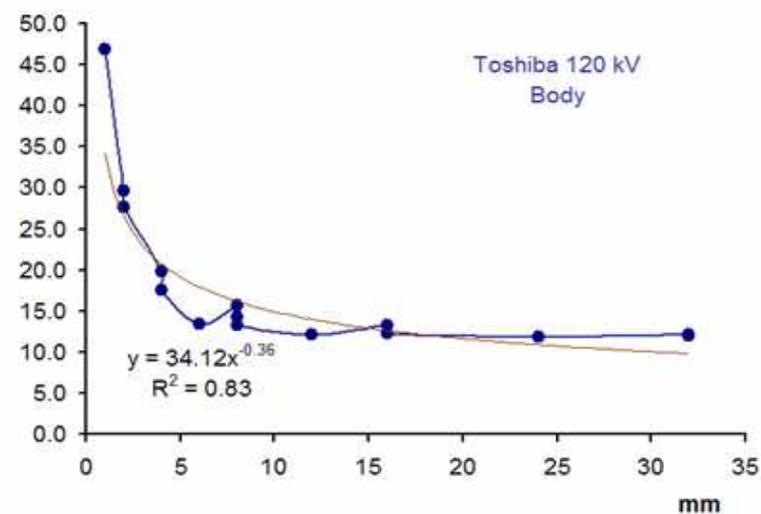
Toshiba 120 kV multi slice

Model: Aquilion 16

| mm | ImPACT | mGy/100 mAs |
|-----------------|----------|-------------|
| 4 x 8 | 32 | 0.86 |
| 16 x 2 | 32 | 0.84 |
| | 24 | 0.85 |
| 4 x 4 | 16 | 0.83 |
| 16 x 1 | 16 | 0.86 |
| | 12 | 0.93 |
| 1 x 8 | 8 | 0.85 |
| 4 x 2 | 8 | 0.93 |
| 16 x 0.5 | 8 | 1 |
| | 6 | 1.1 |
| 1 x 4 | 4 | 0.94 |
| 4 x 1 | 4 | 1.23 |
| 1 x 2 | 2 | 1.38 |
| 4 x 0.5 | 2 | 1.93 |
| | 1 | 2.07 |

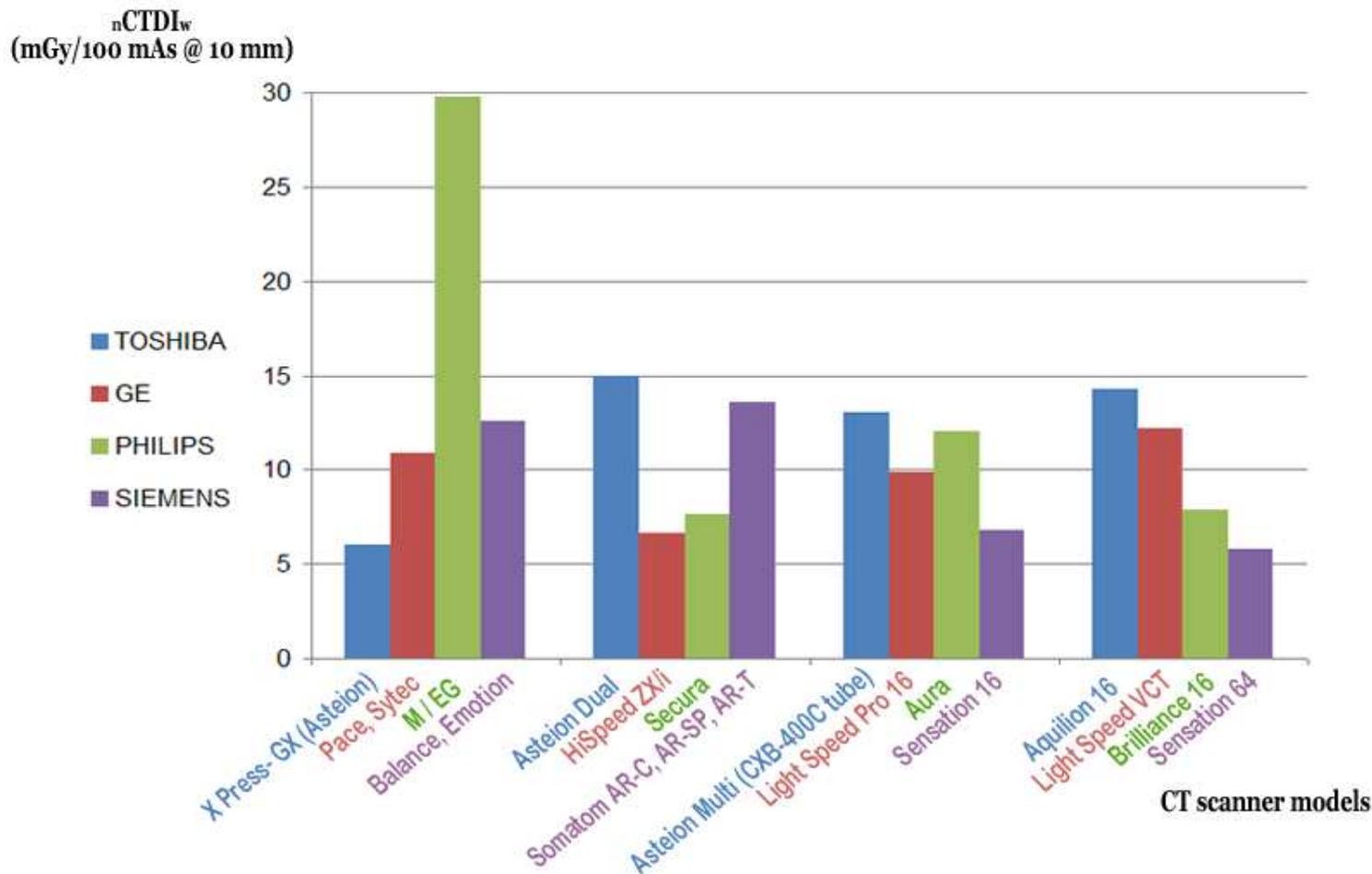
mGy/100mAs

nCTDI vs mm





[Chart 1] Comparison CT scanner models and normalized CTDI_w at 100mAs, 10mm





Conclusion



Radiation dose of CT scanner $n\text{CTDI}_w$ (mGy/100mAs) increases with the decrease of slice collimation using the same parameters of kVp and mAs.

Relationship between $n\text{CTDI}_w$ and slice collimation width was found to be exponential in most cases (single and multi slice).