THE ADVANTAGES OF USING AVERAGE ATTENUATION METRICS TO EXPRESS PATIENT SIZE IN COMPUTED TOMOGRAPHY DOSE OPTIMIZATION

IPOPORTO

S. Sarmento[1,2], B. Mendes[1,2], M. Gouvêa[3]

[1] Centro de Investigação, Instituto Português de Oncologia do Porto Francisco Gentil (IPOPFG), E.P.E, Porto, Portugal

[2] Serviço de Física Médica, IPOPFG E.P.E., Porto, Portugal

[3] Serviço de Radiologia, IPOPFG E.P.E., Porto, Portugal

THE ADVANTAGES OF USING AVERAGE ATTENUATION METRICS TO EXPRESS PATIENT SIZE IN COMPUTED TOMOGRAPHY DOSE OPTIMIZATION

S. Sarmento[1,2], B. Mendes[1,2], M. Gouvêa[3]

Introduction

Computed Tomography (CT) Dose Optimization

Comparison of exam doses is important

Diagnostic Reference Levels for standard-sized patients (70 kg)	Volume CT Dose Index (CTDIvol) expresses scanner output

Currently:

- Automatic Tube Current Modulation (ATCM) adapts scanner output according to patient size and anatomic region
- PACS + large-scale databases ⇒ dosimetric data for thousands of exams, but not patient biometric data
- Size Specific Dose Estimates (SSDE): estimate of patient dose at the centre of the scanned on (AAPM TG204)

[1] Centro de Investigação, Instituto Português de Oncologia do Porto Francisco Gentil (IPOPFG), E.P.E, Porto, Portugal
[2] Serviço de Física Médica, IPOPFG E.P.E., Porto, Portugal
[3] Serviço de Radiologia, IPOPFG E.P.E., Porto, Portugal

S. Sarmento[1,2], B. Mendes[1,2], M. Gouvêa[3]

Introduction

Computed Tomography (CT) Dose Optimization

AAPM TG204

SSDE is calculated from CTDIvol + conversion factor according to geometrical dimensions of the patient

Suggestions of AAPM TG220

Use of attenuation metrics: Water Equivalent Diameter (D_w)

D_w obtained from scout or full FOV CT images

D_w could be determined by CT scanner and included in DICOM header of CT images

1 EUROPEAN CONGRESS OF MEDICAL PHYSICS September 1-4, 2016 Eugenides Foundation Athens-Greece

[1] Centro de Investigação, Instituto Português de Oncologia do Porto Francisco Gentil (IPOPFG), E.P.E, Porto, Portugal
[2] Serviço de Física Médica, IPOPFG E.P.E., Porto, Portugal
[3] Serviço de Radiologia, IPOPFG E.P.E., Porto, Portugal

S. Sarmento[1,2], B. Mendes[1,2], M. Gouvêa[3]

Purpose

D_w Potential

To assess the potential of using the water equivalent diameter (Dw) instead of patient weight to quantify patient size when comparing exam doses.

1 EUROPEAN CONGRESS OF MEDICAL PHYSICS
September 1-4, 2016
Eugenides Foundation
Athens-Greece

[1] Centro de Investigação, Instituto Português de Oncologia do Porto Francisco Gentil (IPOPFG), E.P.E, Porto, Portugal
[2] Serviço de Física Médica, IPOPFG E.P.E., Porto, Portugal
[3] Serviço de Radiologia, IPOPFG E.P.E., Porto, Portugal

THE ADVANTAGES OF USING AVERAGE ATTENUATION METRICS TO EXPRESS PATIENT SIZE IN COMPUTED TOMOGRAPHY DOSE OPTIMIZATION

S. Sarmento[1,2], B. Mendes[1,2], M. Gouvêa[3]

Methods

Biometric Data

2 16-slice CT scanners:

- CT11 – GE Lightspeed
- CT14 - Toshiba Aquilion RXL

Protocol	CT scanner	# of patients	Age/years	Weight/kg	Height/cm
CHEST	CT11	31 (24 M; 7 F)	72 (33 - 89)	69 (45 - 105)	167 (150 - 183)
	CT14	49 (27 M; 22 F)	61 (21 - 82)	69 (43 - 117)	164 (147 - 183)
CAP	CT11	41 (22 M; 19 F)	60 (32 - 80)	65 (44 - 90)	163 (145 - 180)
	CT14	78 (38 M; 40 F)	63 (36 - 83)	70 (43 - 104)	163 (144 - 185)

•Total number of patients is indicated for each data set;
•M – Male;
•F – Female;
•Patient age, weight and height: average value + range in brackets.

[1] Centro de Investigação, Instituto Português de Oncologia do Porto Francisco Gentil (IPOPFG), E.P.E, Porto, Portugal
[2] Serviço de Física Médica, IPOPFG E.P.E., Porto, Portugal
[3] Serviço de Radiologia, IPOPFG E.P.E., Porto, Portugal

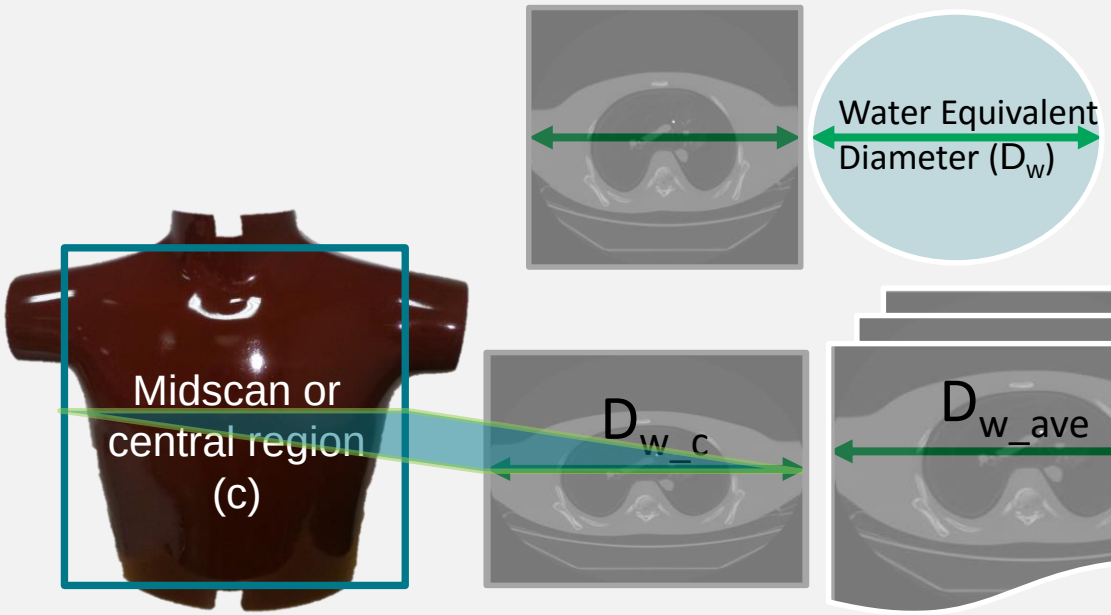
THE ADVANTAGES OF USING AVERAGE ATTENUATION METRICS TO EXPRESS PATIENT SIZE IN COMPUTED TOMOGRAPHY DOSE OPTIMIZATION

S. Sarmento[1,2], B. Mendes[1,2], M. Gouvêa[3]

Methods

Water Equivalent Diameter (Dw)

Dw calculated from PACS-stored images



Average (ave) of Dw for all images in sequence

D_{w_c}	D_{w_ave}

SSDE calculated using $CTDI_{vol}$ and D_{w_c}, according to definition

[1] Centro de Investigação, Instituto Português de Oncologia do Porto Francisco Gentil (IPOPFG), E.P.E, Porto, Portugal
[2] Serviço de Física Médica, IPOPFG E.P.E., Porto, Portugal
[3] Serviço de Radiologia, IPOPFG E.P.E., Porto, Portugal

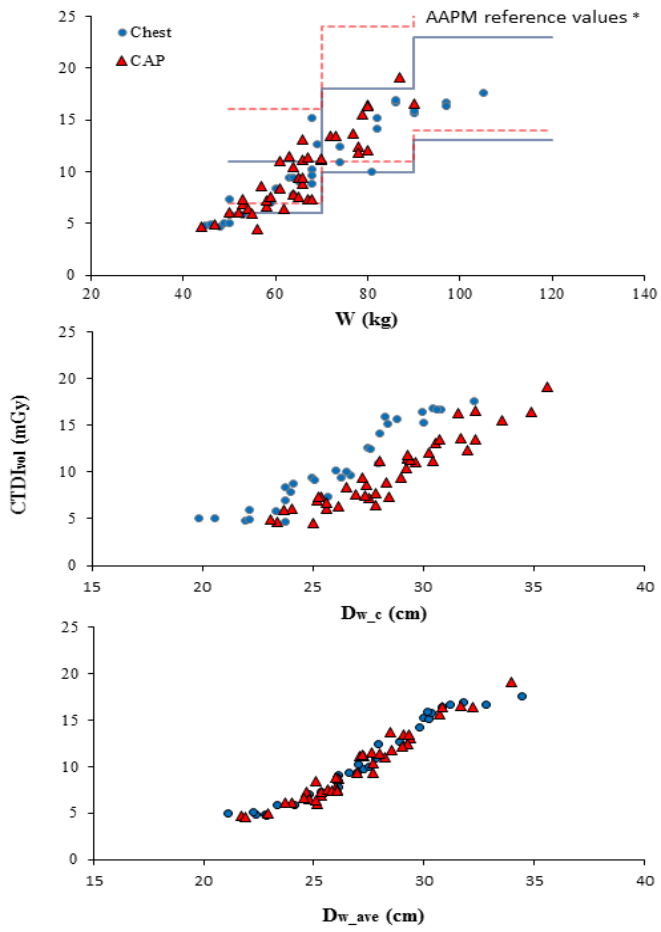
THE ADVANTAGES OF USING AVERAGE ATTENUATION METRICS TO EXPRESS PATIENT SIZE IN COMPUTED TOMOGRAPHY DOSE OPTIMIZATION

S. Sarmento[1,2], B. Mendes[1,2], M. Gouvêa[3]

Results

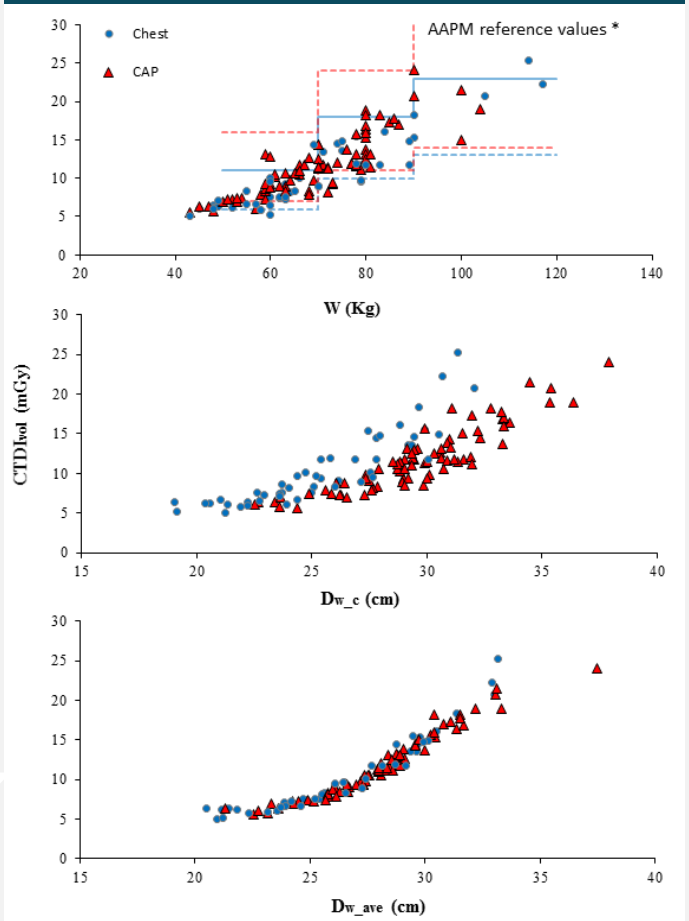
Use of D_{w_ave}

GE LightSpeed



Use of D_{w_ave} reduces data dispersion

Toshiba Aquilion



*http://www.aapm.org/pubs/CTProtocols

[1] Centro de Investigação, Instituto Português de Oncologia do Porto Francisco Gentil (IPOPFG), E.P.E, Porto, Portugal
[2] Serviço de Física Médica, IPOPFG E.P.E., Porto, Portugal
[3] Serviço de Radiologia, IPOPFG E.P.E., Porto, Portugal

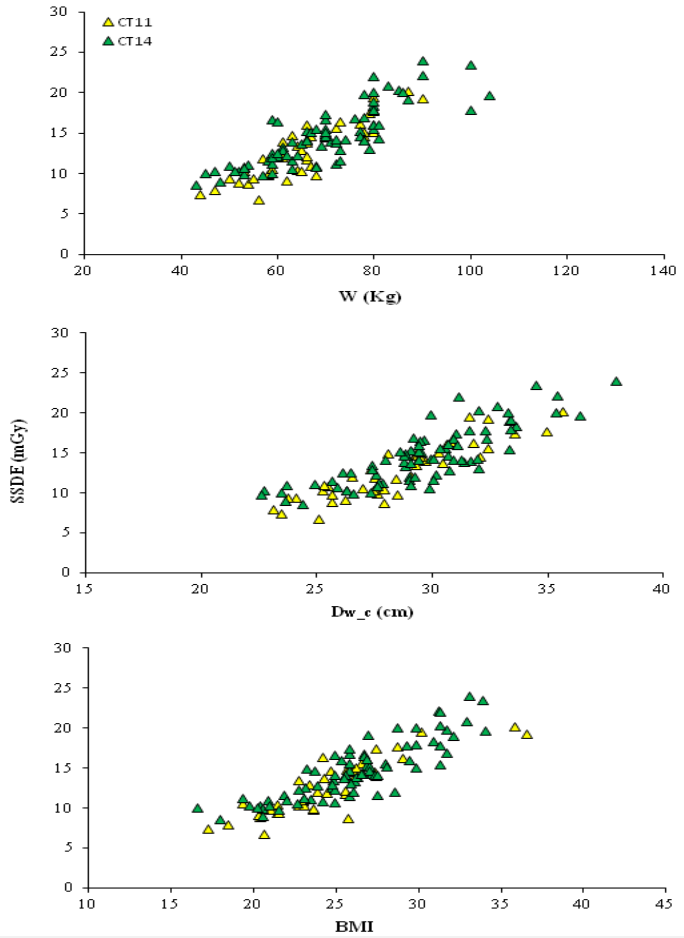
THE ADVANTAGES OF USING AVERAGE ATTENUATION METRICS TO EXPRESS PATIENT SIZE IN COMPUTED TOMOGRAPHY DOSE OPTIMIZATION

S. Sarmento[1,2], B. Mendes[1,2], M. Gouvêa[3]

Results

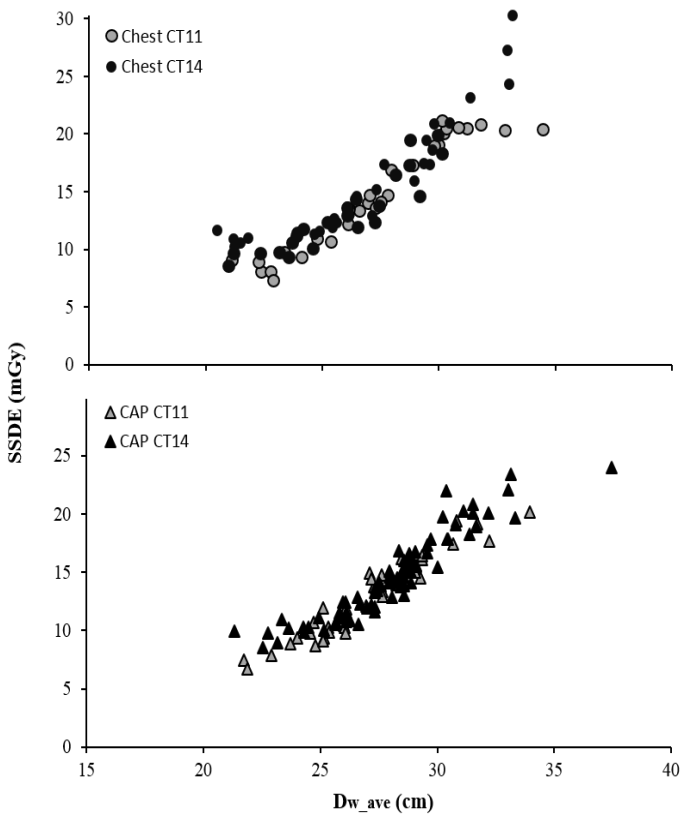
SSDE

CAP Exams



Use of Dw_ave reduces data dispersion

SSDE vs D_{w_ave}



1 EUROPEAN CONGRESS OF MEDICAL PHYSICS
September 1-4, 2016
Eugenides Foundation
Athens-Greece

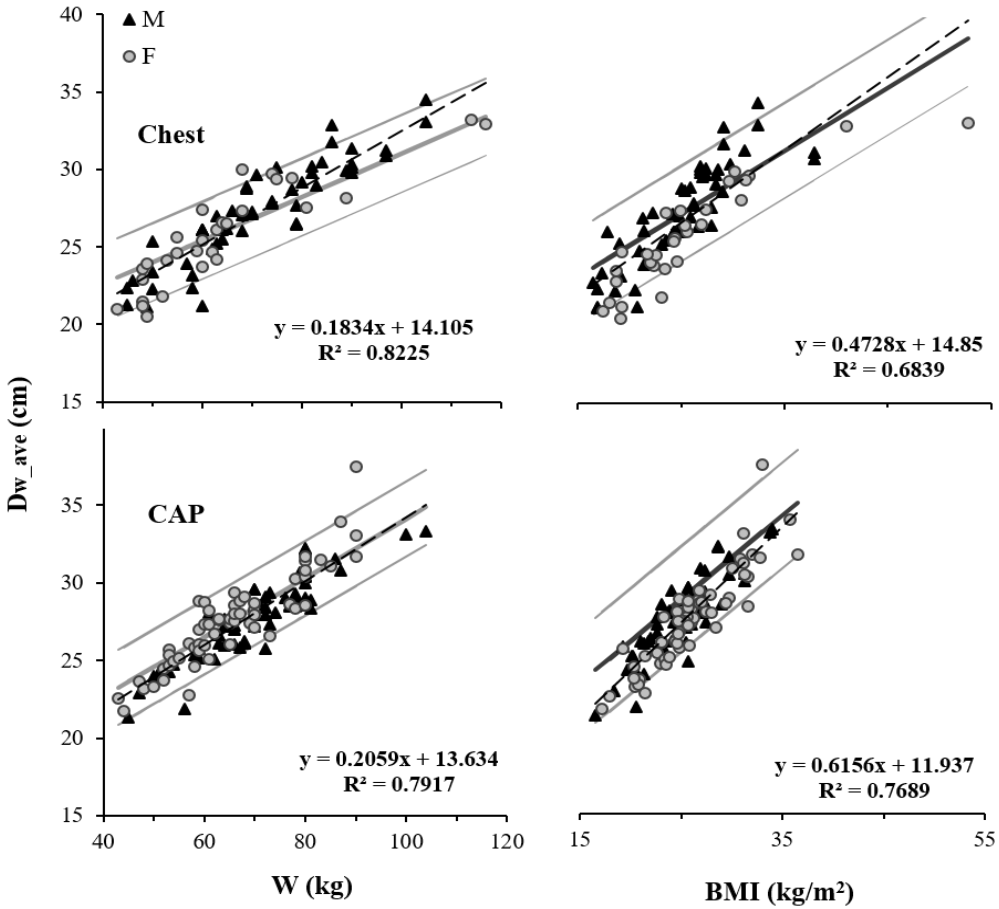
[1] Centro de Investigação, Instituto Português de Oncologia do Porto Francisco Gentil (IPOPFG), E.P.E, Porto, Portugal
[2] Serviço de Física Médica, IPOPFG E.P.E., Porto, Portugal
[3] Serviço de Radiologia, IPOPFG E.P.E., Porto, Portugal

THE ADVANTAGES OF USING AVERAGE ATTENUATION METRICS TO EXPRESS PATIENT SIZE IN COMPUTED TOMOGRAPHY DOSE OPTIMIZATION

S. Sarmento[1,2], B. Mendes[1,2], M. Gouvêa[3]

Results

D_{w_ave}



Broken line: fits to data, no separation of male/female patients

Light grey lines: fit and 95% prediction limits for chest and abdominal CT data from previous study by Menke for different patient population (Radiology 2005;236:565–71)

[1] Centro de Investigação, Instituto Português de Oncologia do Porto Francisco Gentil (IPOPFG), E.P.E, Porto, Portugal
[2] Serviço de Física Médica, IPOPFG E.P.E., Porto, Portugal
[3] Serviço de Radiologia, IPOPFG E.P.E., Porto, Portugal

S. Sarmento[1,2], B. Mendes[1,2], M. Gouvêa[3]

Conclusions

Expressing Patient Size in CT

- $CTDI_{vol}$ and SSDE present a stronger correlation with D_{w_ave} than with D_{w_c}, BMI or weight
- D_{w_c} reflects localized anatomy characteristics, like abdominal obesity or large breasts in some female patients
- D_{w_ave} is a good metric for patient size which can be used with small and large data sets
- Good agreement with data from previous study by Menke for different patient population (Radiology 2005;236:565–71) for D_{w_ave} vs weight relation

[1] Centro de Investigação, Instituto Português de Oncologia do Porto Francisco Gentil (IPOPFG), E.P.E, Porto, Portugal
[2] Serviço de Física Médica, IPOPFG E.P.E., Porto, Portugal
[3] Serviço de Radiologia, IPOPFG E.P.E., Porto, Portugal