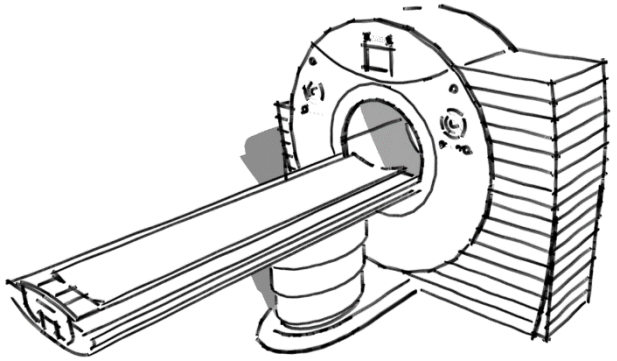

Vliv centrace pacienta na kvalitu obrazu a dávku na CT

Lucie Súkupová, Daniel Vedlich
Institut klinické a experimentální medicíny, Praha

16. 4. 2019

Konference ČSFM, Harrachov

Phys Med. 2012 Jul;28(3):191-9. doi: 10.1016/j.ejmp.2011.06.002. Epub 2011 Jul 8.

Impact of miscentering on patient dose and image noise in : clinical studies.

Habibzadeh MA[1], Ay MR, Asl AR, Ghadiri H, Zaidi H.

Author information

Universal Journal of Medical Science 4(3): 102-107, 2016
DOI: 10.13189/ujmsj.2016.040304

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Consequences Radiation Dose

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Prevalence and Severity Observations From 57,621 and/or Pelvis

Oladunni O. Akin-Akintayo, MD,
Elizabeth A. Krupinksi, PhD, Xia
William C. Small, MD PhD, Cour
Department of Radiology and Imaging Sciences, Emory

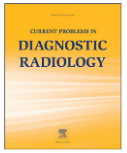
Purpose: To determine distances between patie
differences based on patient gender, scan regio
Materials and Methods: A water phantom and a
centered positions. Additionally, data from 57,
analysis of variance using the centroid-to-isoce
Results: The majority of patient acquisitions (83.7% (4827/5762)) were performed with the patient's centroid positioned
below isocenter (SD 1.8 cm); range 12.1 cm below to 7.8 cm above isocenter). Off-centering in the x-axis was less severe (
(SD 1.6 cm)). Distance between centroid and isocenter in the y-axis did not differ as a function of sex but did differ based on
and gantry aperture.
Conclusion: Off-centering is common during CT imaging and has been previously demonstrated to impact dose and image

patients.

Effect of Patient Centering on in

Current Problems in Diagnostic Radiology 45 (2016) 265–270

Current Problems in Diagnostic Radiology
journal homepage: www.cpdrjournal.com



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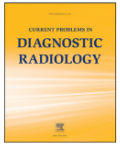
Current Problems in Diagnostic Radiology 000 (2019) 1–8

ELSEVIER
Current Problems in Diagnostic Radiology
journal homepage: www.cpdrjournal.com



Effect of CT Localizer Radiographs on Radiation Dose Associated With Automatic Tube Current Modulation: A Multivendor Study

Fabio Paolicchi, RT, PhD[a,*], Luca Bastiani, PhD[b], Jacopo Negri, RT[c], Davide Caramella, MD[a]

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[b] Institute of Clinical Physiology, National Research Council, Pisa, Italy
[c] Department of Radiology, Macerata General Hospital, Macerata, Italy

Objectives: To assess the influence of the CT localizer radiograph on the automatic tube current modulation system of 7 CT scanners produced by 4 different CT manufacturers.
Methods: The influence of the localizer orientation, table height, tube current and tube potential values on the radiation dose of the related CT scan were evaluated. Images were acquired by using an anthropomorphic phantom positioned in the CT gantry isocenter as well as from -6 cm to +6 cm vertically to the isocenter.
Results: Vertical movement of the CT table height affected the radiation dose in all scanners using anterior-posterior or a posterior-anterior localizer orientation albeit differently, depending on the manufacturer; only in 1/7 scanner no influence was observed. The latero-lateral localizer orientation proved to be more effective in limiting the influence of the vertical miscentering in all scanners. Changing localizer's tube voltage influenced the scan radiation dose in scanners produced by two manufacturers, while no significant effect was observed in scanners produced by the other two manufacturers. No significant dose variation was observed in 6/7 scanners when changing the localizer's tube current.
Conclusion: Localizer radiograph shows a significant influence on the radiation exposure but with different outcomes depending on the manufacturer of the CT scanner. Radiologists and radiographers should have a thorough understanding of these differences to assure patients the best examination in terms of radiation dose and image quality.

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r.com/locate/ejmp

t, patient size, and localizer

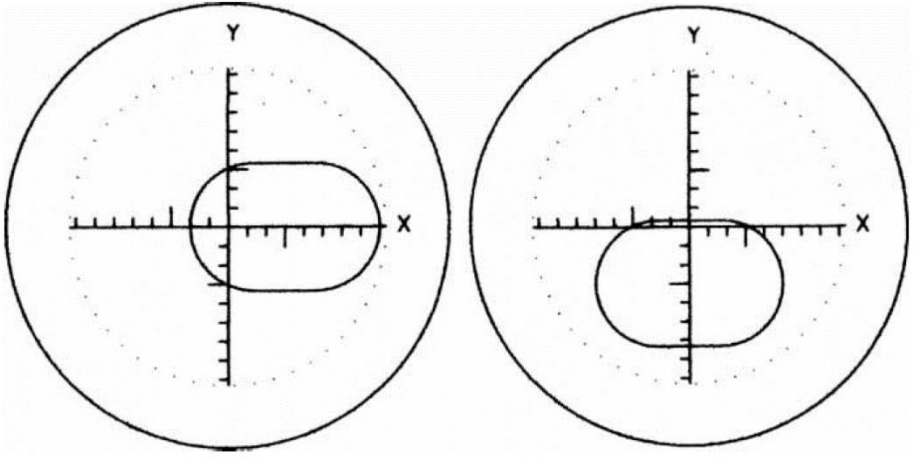
rylic sheets, and an anthropomorphic phantom. A lateral (LAT) and a a MDCT scanner (GE Discovery CT750 HD). AEC scan acquisitions were prescribed for each combination of phantom, localizer orientation, and table height ± 4 cm with the center position; the displayed $CTDI_{vol}$ was recorded. Based on the institutional dose monitoring program, the relationship between change in $CTDI_{vol}$ and change in table height were studied for LAT and AP localizers for clinical exams.

Results: For all phantom scans based on the PA localizer, the percent change in ranged between −18% and 42% for table heights 4 cm below and above proper centering; while for the LAT localizer, the percent change in $CTDI_{vol}$ from ideal were no greater than 12% different for ± 4 cm differences in table height. Change in $CTDI_{vol}$ and change in table height displayed a strong linear relationship for AP localizer exams ($P = 0.002$), and weak correlation for LAT localizer exams ($P = 0.12$).

Conclusions: Since uncertainty in vertical patient positioning is inherently greater than lateral positioning, the LAT localizer should be utilized to precisely and reproducibly deliver the intended amount of radiation prescribed by CT protocols.

Centrace pacienta na CT

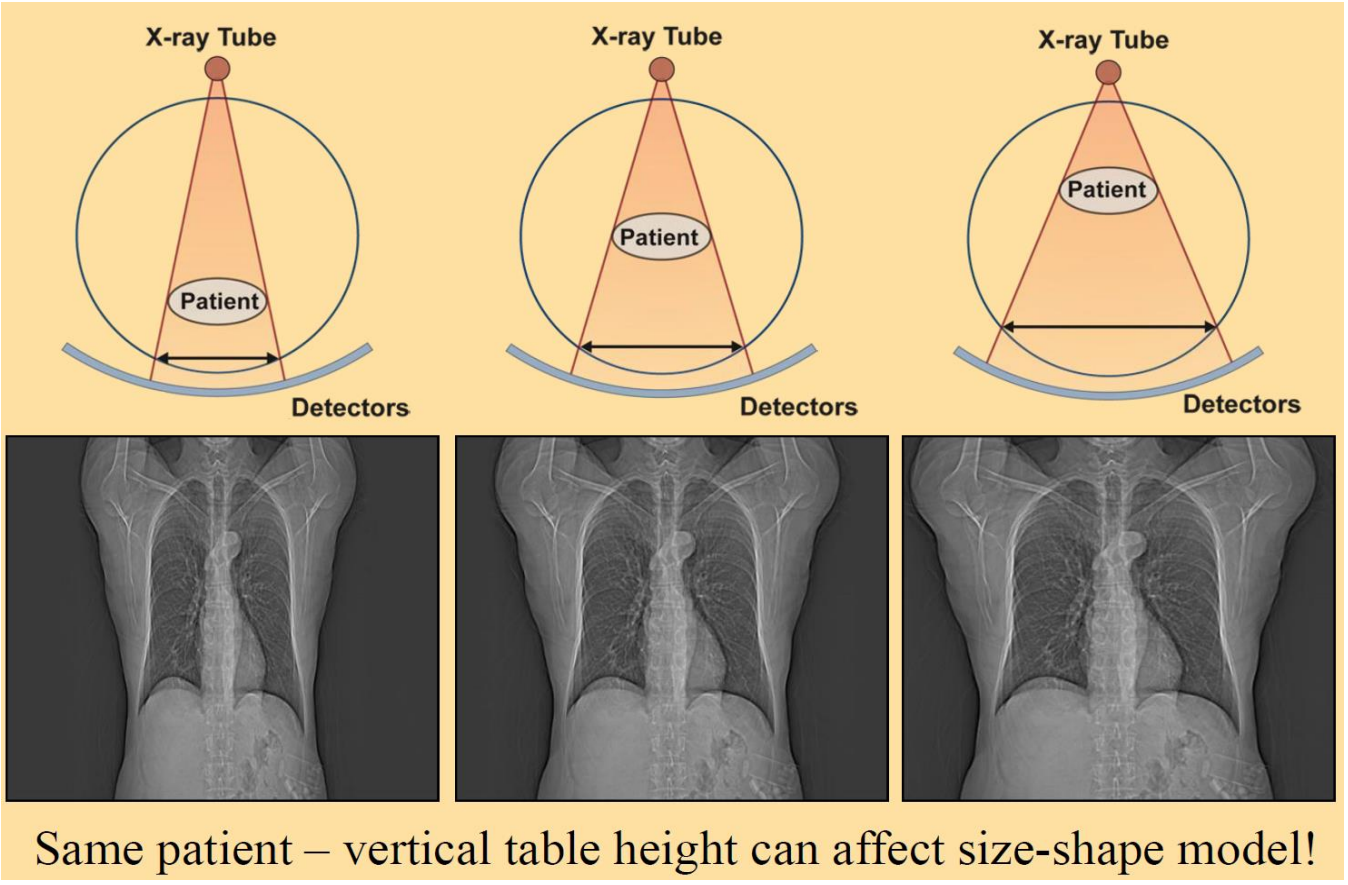
- Centrace pacienta ve vertikálním i horizontálním směru
- **Horizontální centrace** není problematická (RA zvládají)
- **Vertikální centrace** je problematická – zaměříme se na ni



IK+E M

Gudjonsdottir J. et al. *Efficient use of automatic exposure control systems in Computed Tomography requires correct patient positioning*. Acta Radiologica 2009; 9: 1035-1041.

Vertikální centrace

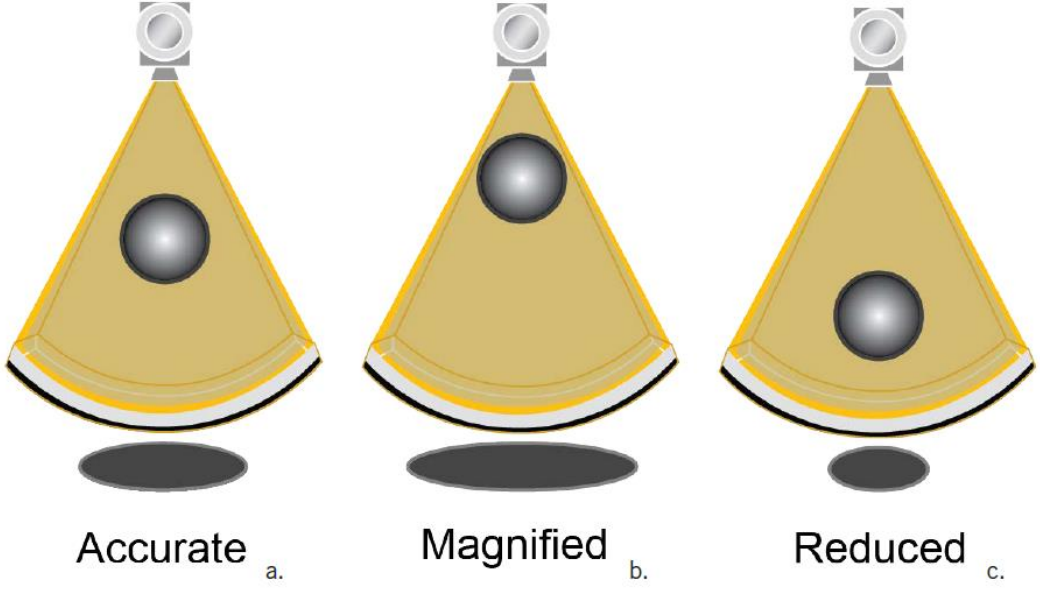


Courtesy of
Jim Kofler, PhD.

https://www.aapm.org/meetings/2011cts/documents/mcnitt-graytubecurrentmodulationv4.pdf

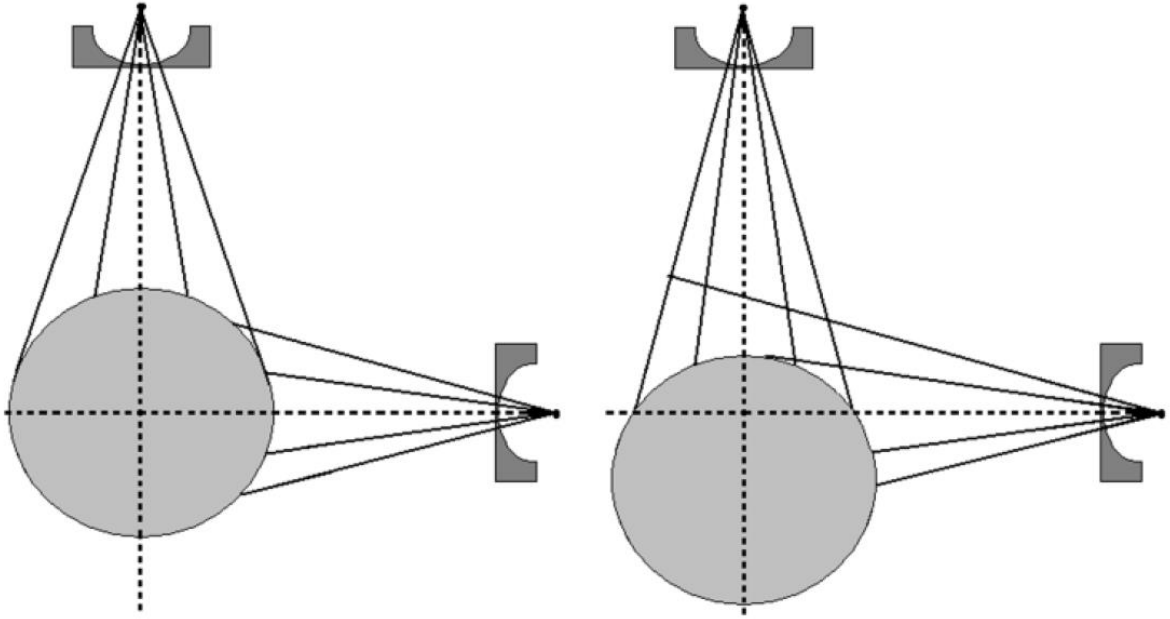
Vertikální centrace

- Centrace pacienta ovlivňuje „vzhled“ lokalizačního skenu neboli jak se pacient jeví velikostí ⟹ ovlivňuje fungování automatické modulace proudu



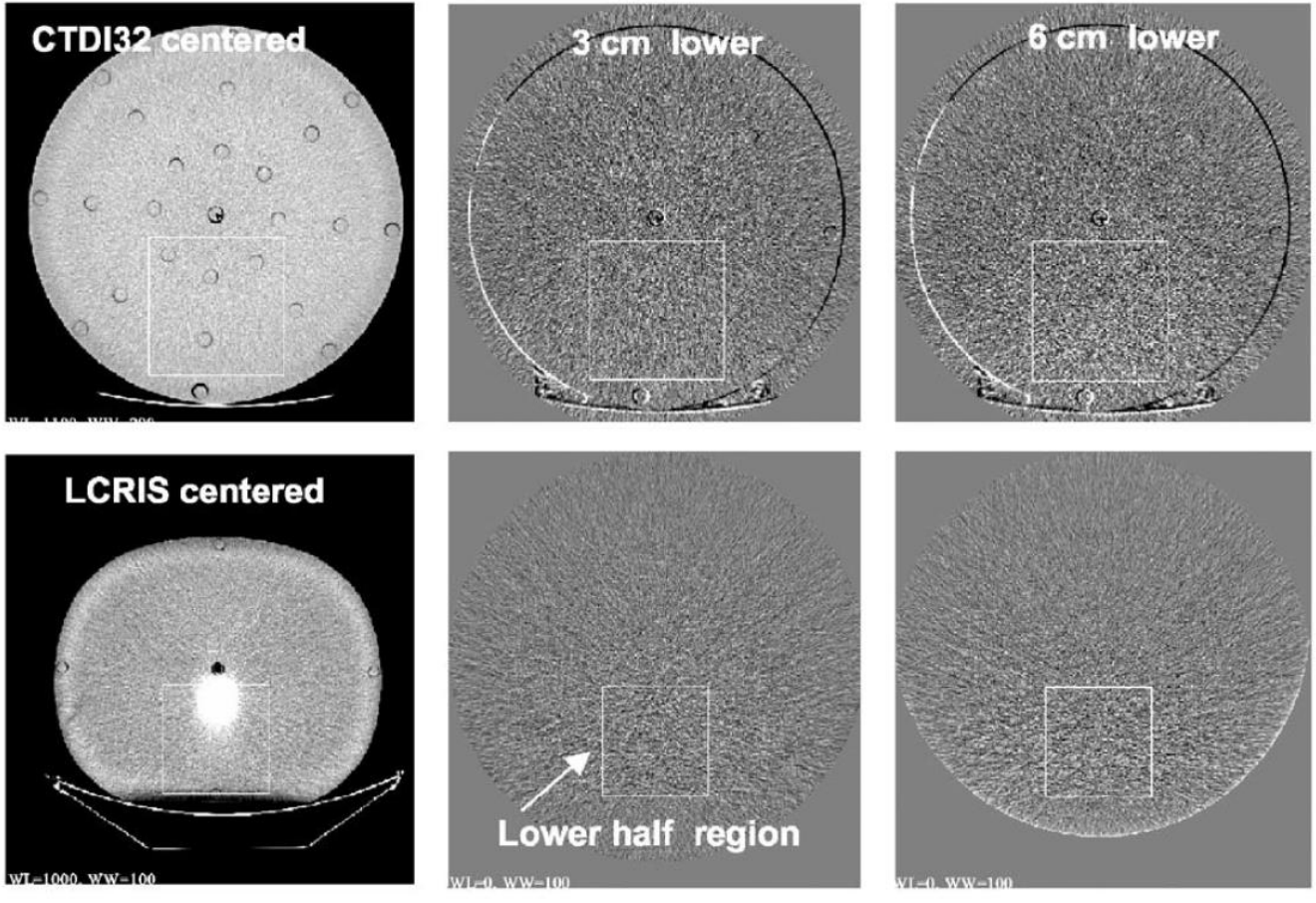
Vertikální centrace

- Centrace pacienta ovlivňuje i fungování bow-tie filtru



Sukupova L. et al. *Consequences of the patient's mis-centering on the radiation dose and image quality in CT imaging – Phantom and clinical study*. Universal Journal of Medical Science 2016; 4(3): 102-107.

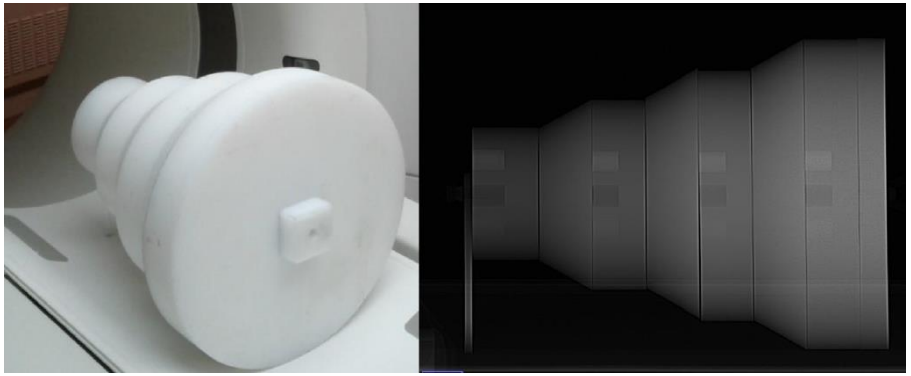
Kvalita obrazu

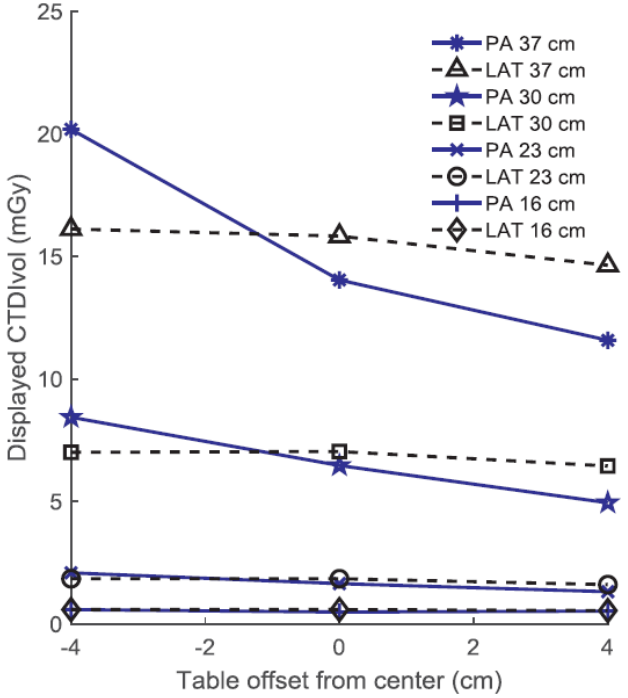


Toth T. et al. *The influence of patient centering on CT dose and image noise*. Med. Phys. 2007; 34(3093).

Výsledky (1)

- Nárůst $CTDI_{vol}$ při centraci nad izocentrum a pokles při centraci pod izocentrum





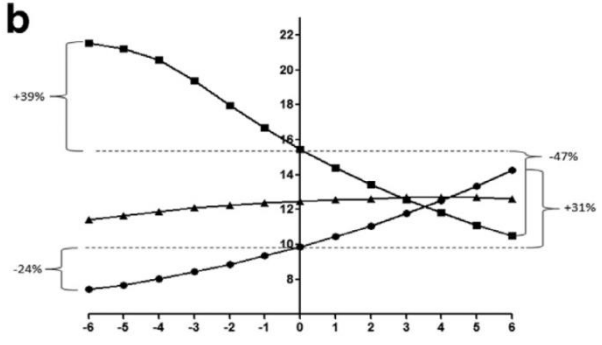
Winslow J. et al. *Dependency of prescribed CT dose on table height, patient size, and localizer acquisition for one clinical MDCT*. Physica Medica 2018; 55: 56-60.

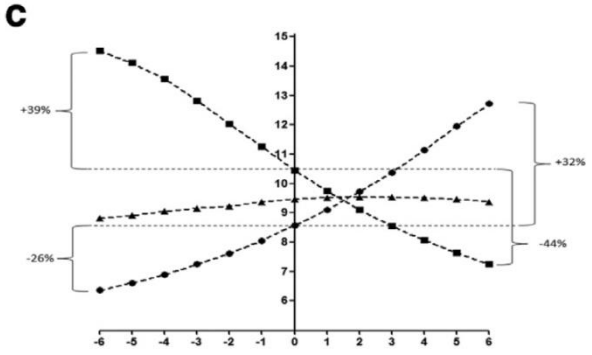
Výsledky (2)

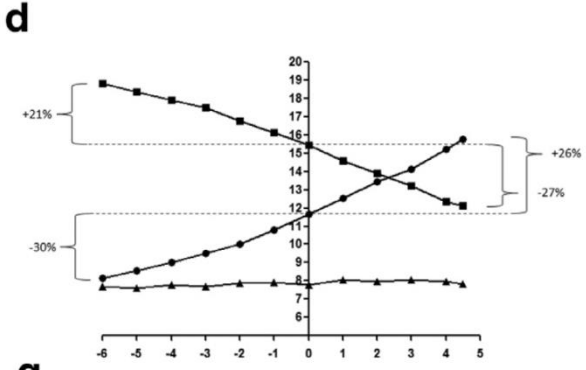
AP PA LL

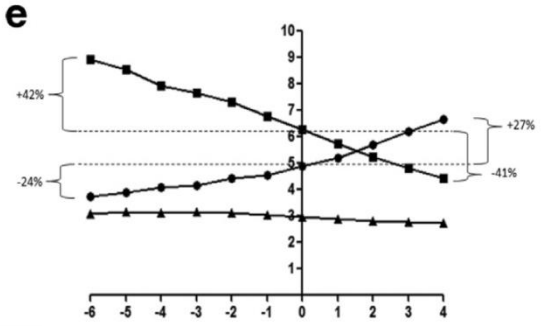
b) GE Lightspeed VCT 64
c) GE Discovery 750 HD
d) Siemens Somatom 64
e) Siemens Biograph 40
f) Philips iCT 256
g) Toshiba Aquilion 16

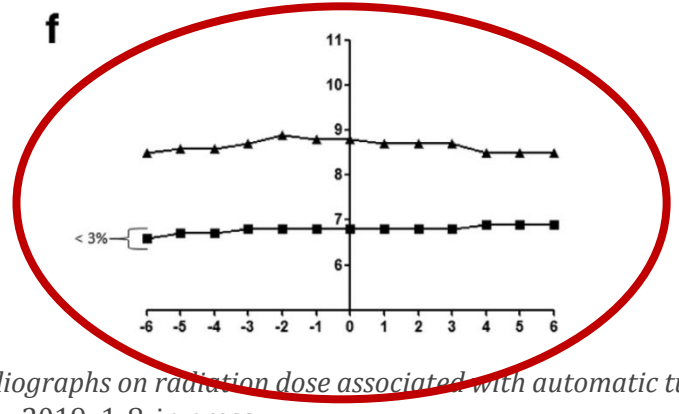
- Výsledky se lišily pro různé CT skenery

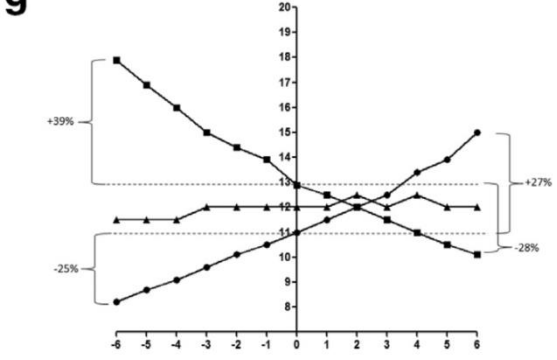








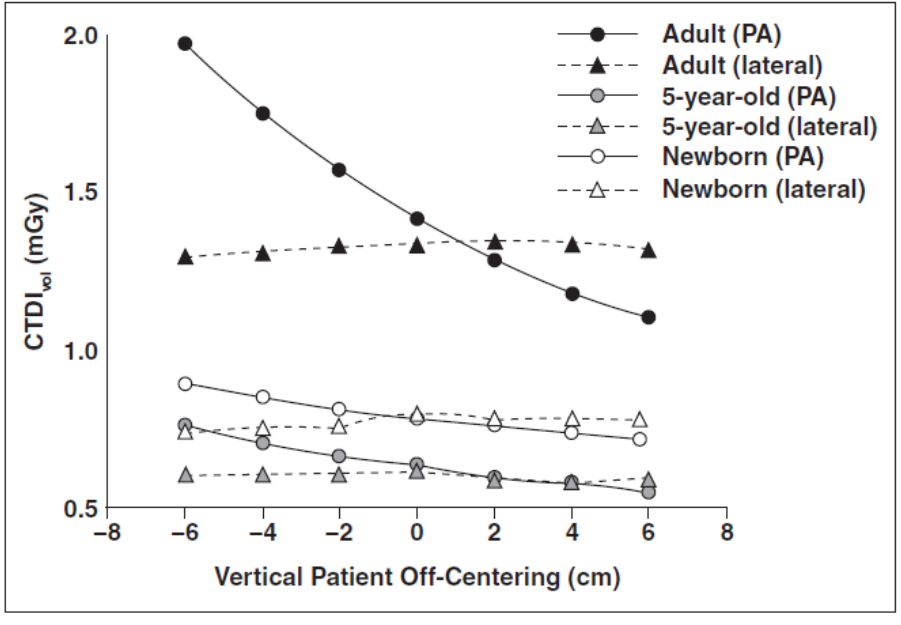




Paolicchi F. et al. *Effect of CT localizer radiographs on radiation dose associated with automatic tube current modulation: A multivendor study.* Current Problems in Diagnostic Radiology 2019; 1-8, in press.

Výsledky (3)

- Nárůst $CTDI_{vol}$ při centraci nad izocentrum a pokles při centraci pod izocentrum (pro CT hrudníku)

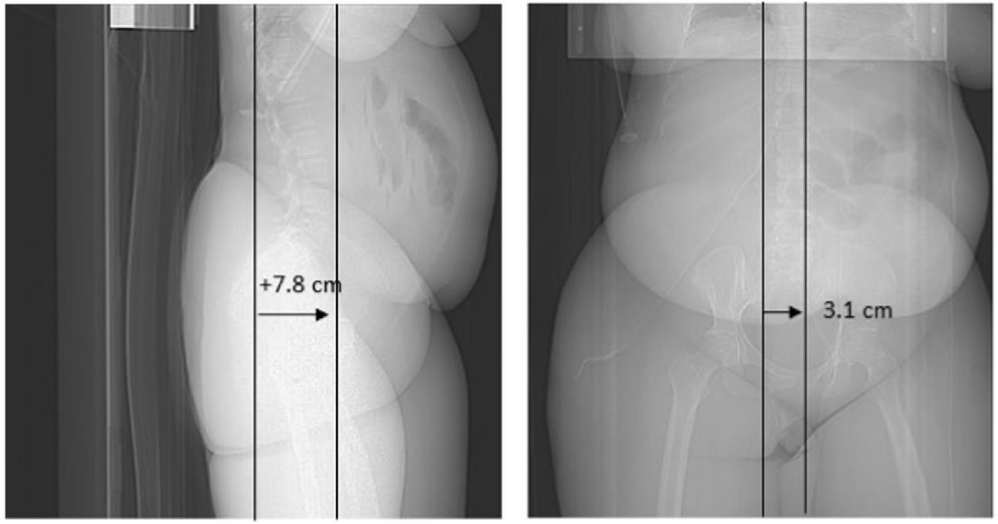


IKEM

Kaasalainen T. et al. *Effect of patient centering on patient dose and image noise in chest CT*. AJR. 2014; 203: 123-130.

Klinické výsledky (1)

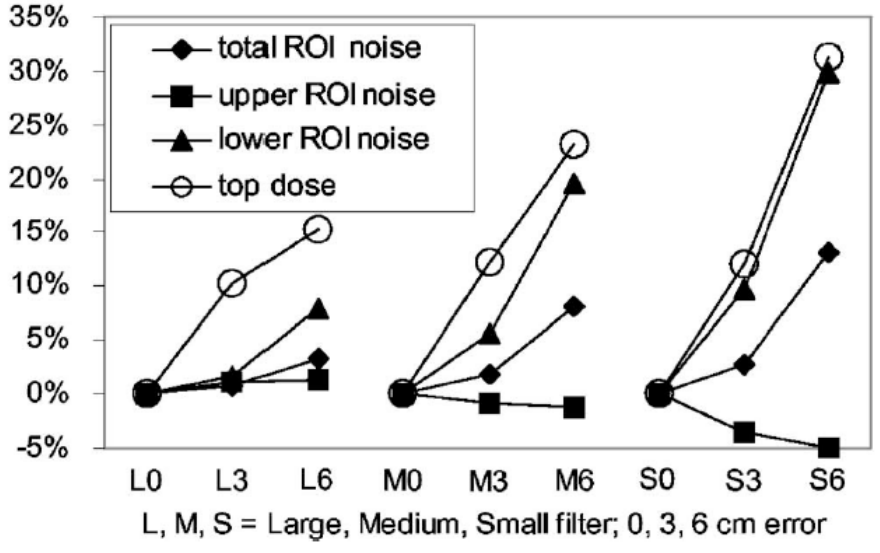
- Studie 1: 57 621 CT skenů hrudníku, břicha a/nebo pánve
  - 84 % pacientů centrováno pod izocentrum
  - Průměrná hodnota špatné centrace -17 mm (pod izocentrem)
  - Rozsah -121 mm až +78 mm



Akin-Akintayo OO. et al. *Prevalence and severity of off-centering during diagnostic CT: Observations from 57621 CT scans of the chest, abdomen, and/or pelvis.* Current Problems in Diagnostic Radiology. 2018; in press.

Klinické výsledky (2)

- Studie 2: 549 CT skenů břicha
  - 74 % pacientů centrováno pod izocentrum
  - Průměrná hodnota špatné centrace -23 mm (pod izocentrem)
  - Rozsah -66 mm až +34 mm
  - S centrací pod izocentrum roste šum a dávka na povrchu do pacienta

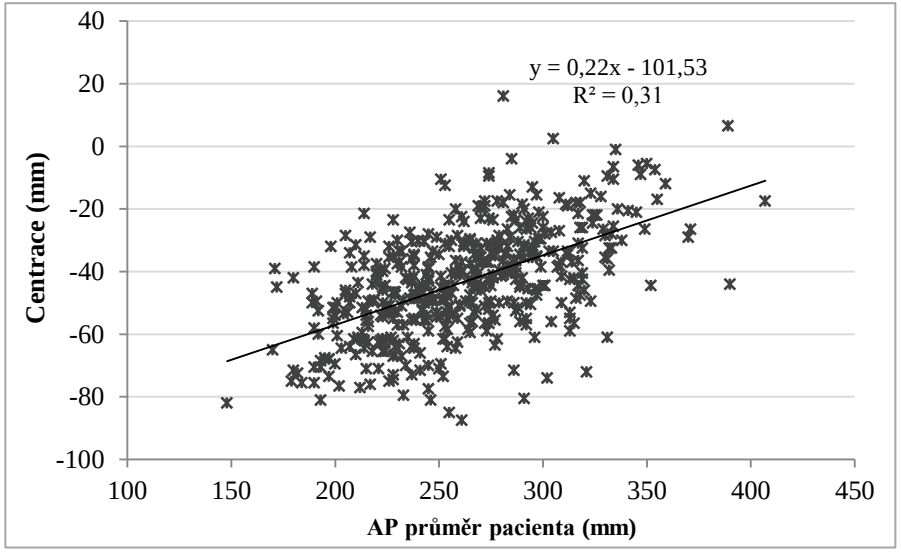


IKEM

Toth T. et al. *The influence of patient centering on CT dose and image noise.* Med. Phys. 2007: 34(3093).

Klinické výsledky (3)

- Studie 3: 473 CT skenů břicha
  - 99 % pacientů centrováno pod izocentrum
  - Průměrná hodnota špatné centrace -43 mm (pod izocentrem)
  - Rozsah -88 mm až +16 mm



Sukupova L. et al. *Consequences of the patient's mis-centering on the radiation dose and image quality in CT imaging – Phantom and clinical study.* Universal Journal of Medical Science 2016; 4(3): 102-107.

Řešení pro správnou centraci

- Obeznámit RA s touto skutečností!

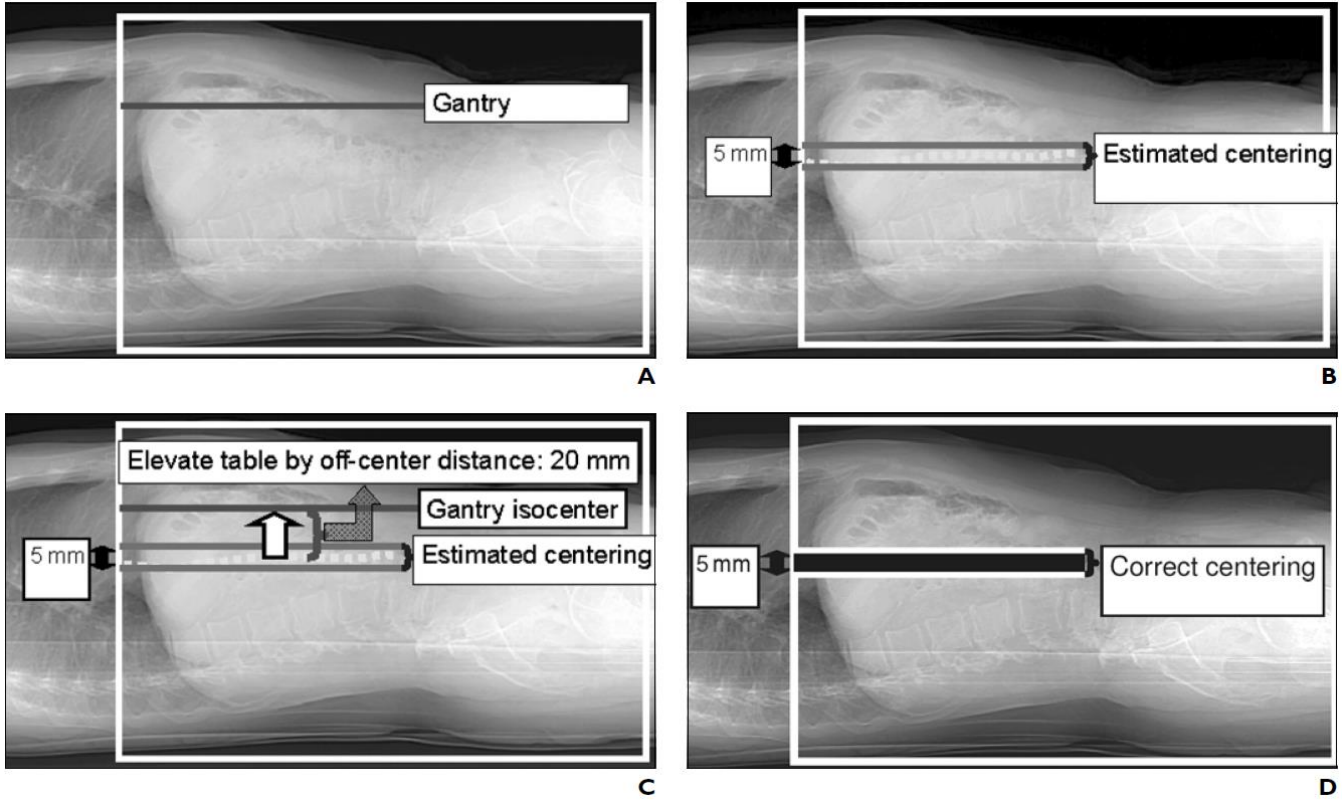
- AP (PA) i LAT lokalizační sken
- Po skenu upravit pozici pacienta

- Softwarové a hardwarové funkce na CT skenerech – Canon, Siemens

IK+E M

Řešení pro správnou centraci

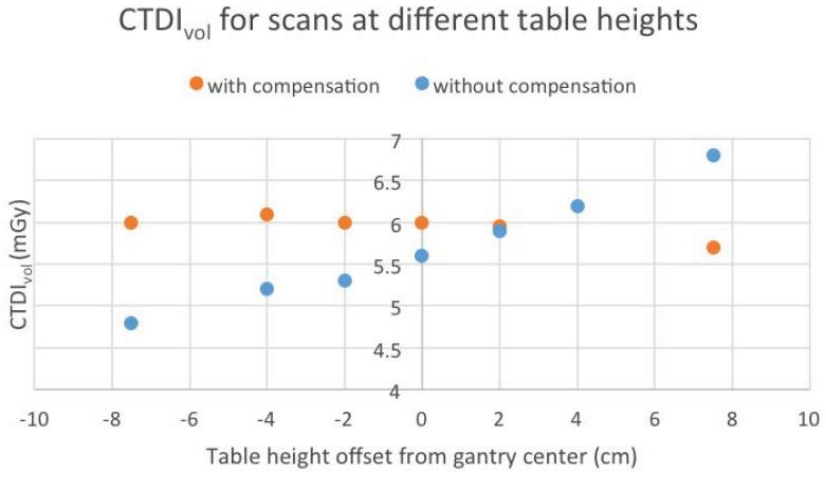
- Softwarové řešení



Li J. et al. *Automatic patient centering for MDCT: Effect on radiation dose*. AJR. 2007; 188: 547-552.

Řešení pro správnou centraci

- Softwarové řešení
- Auto Couch Height Positioning Compensation ve vertikálním směru (Canon Aquilion Precision)



- Hardwarové řešení
- FAST 3D camera (Siemens Somatom Force)

https://de.medical.canon/wp-content/uploads/sites/2/2015/01/Auto-Couch-Height-Positioning-2014-aquilion.pdf
https://static.healthcare.siemens.com/siemens_hwem-hwem_ssxa_websites-context-root/wcm/idc/groups/public/@global/@imaging/@ct/documents/download/mda4/ndqx/~edisp/di_ct_brochure_somatom_force_brochure_07-2018-05556644.pdf

Závěr (1)

- Snahou RF i RA je dostát optimalizaci, tj. získat dostatečnou kvalitu obrazu za nejnižší dávky

- Existují možnosti, jak snížit dávky a stále mít dostatečnou kvalitu obrazu (iterativní rekonstrukce, nižší napětí…), ale počítá se se správnou centrací pacienta

- Při špatné centraci se zvyšuje šum (a klesá $CTDI_{vol}$) nebo roste $CTDI_{vol}$ (i kvalita obrazu, ale my to téměř nepoznáme)

IKEM

Závěr (2)

- Ze studií vyplynulo, že pacienti jsou centrováni převážně pod izocentrum (ve vertikálním směru), tj. RA vnímají pacienta jako většího, než ve skutečnosti je

- Odchylka od izocentra 60 mm směrem k rentgence – nárůst dávky o cca 35 %, 60 mm směrem od rentgenky – pokles o 30 %

- Centrace pacienta ovlivňuje fungování automatické volby napětí – podobně jako při modulaci proudu

IKEM

Děkuji za pozornost.