Reducing Sedation and Anesthesia in Pediatric CT

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AAPM 2019 Annual Meeting SAM Session

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Learning Objectives

1. CT refresher: What determines speed?
1. Technical approaches to fast acquisition
2. Clinical examples

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1. CT refresher: What effects scan speed?

$$Scan\ speed = \frac{Detector\ collimation\ (\mathrm{N} \times \mathrm{T}) \cdot pitch}{Rotation\ time} = \frac{cm}{s}$$

$$Effective\ mAs = \frac{\mathrm{mA} \cdot \mathrm{s}}{pitch}$$

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A look back

	Canon	GE	Philips	Siemens
Model	Aquilion 64	VCT 64	Brilliance 64	Sensation 64
Year	2006	2004	2005	2004
Detector coverage (mm)	32 (64 × 0.5)	40 (64 × 0.625)	40 (64 × 0.625)	19.2 (32 × 0.6)
kV range	80-135	80-140	80-140	80-140
Rotation time (s)	0.4	0.4	0.4	0.33
Max speed (cm/s)	11	13.75	13.0	7.5
Reconstruction	FBP	FBP	FBP	FBP

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Today

	Canon	GE	Philips	Siemens
Model	Aquilion One GENESIS	Revolution CT	IQon Elite	SOMATOM Force
Detector coverage (mm)	160 (320 × 0.5) *Axial	160 (256 × 0.625) *Axial	40 (64 × 0.625)* *Dual-Energy	57.6 (2×96× 0.6)* *Dual Source
kV range	80 - 135	70-140	80-140	70-140
Rotation time (s)	0.275	0.25 s	0.27	0.25*
Max speed (mm/s)	16 cm /0.275 (Ax) 20 cm/s (H)	16 cm / 0.28 (Ax) 43.7 cm/s (H)	20 cm/s (DE)	73.7 cm/s *Limited FOV

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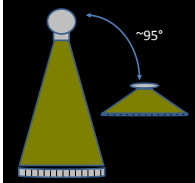
2. Technical approaches to fast acquisition

$$\text{Scan speed} = \frac{\text{Detector collimation (N} \times \text{T)} \cdot \text{pitch}}{\text{Rotation time}} = \frac{cm}{s}$$



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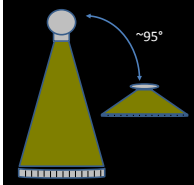

Benefits

*Single detector = 96 * 0.6 mm*

Max pitch = 3.2

Max speed = 73.7 cm/s

Clinical max = ~55

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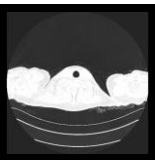

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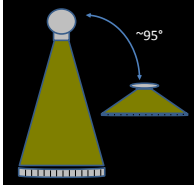

Limitations

5.76 cm Volumetric

FOV (pitch 3.2) = 32 cm

Max mA (80 kV) = 1300

No gantry tilt

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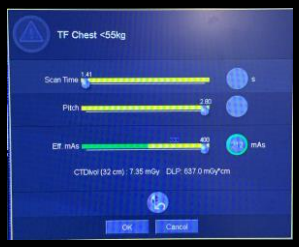
1. Technical approaches to fast acquisition



$$Effective\ mAs = \frac{mA \cdot s}{pitch}$$

Example:

Max Eff = 300

Pitch = 2.8 to 1.97

Scan time = 1.41 to 1.99 s

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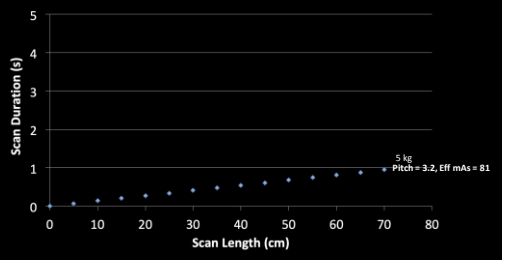

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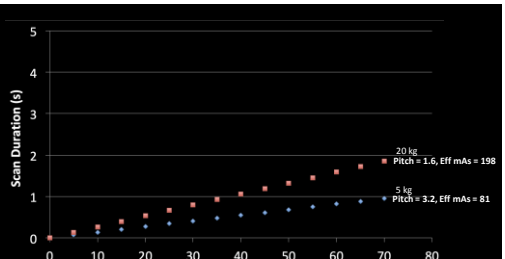

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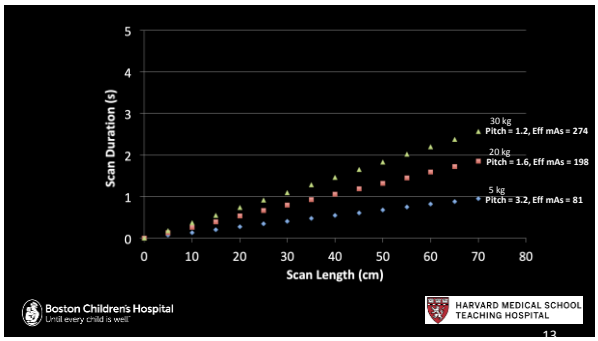
Scan Duration (s)
Scan Length (cm)
30 kg
Pitch = 1.2, Eff mAs = 274
20 kg
Pitch = 1.6, Eff mAs = 198
5 kg
Pitch = 3.2, Eff mAs = 81
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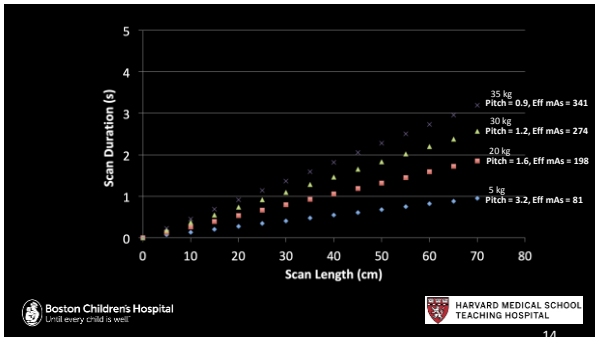
Scan Duration (s)
Scan Length (cm)
35 kg
Pitch = 0.9, Eff mAs = 341
30 kg
Pitch = 1.2, Eff mAs = 274
20 kg
Pitch = 1.6, Eff mAs = 198
5 kg
Pitch = 3.2, Eff mAs = 81
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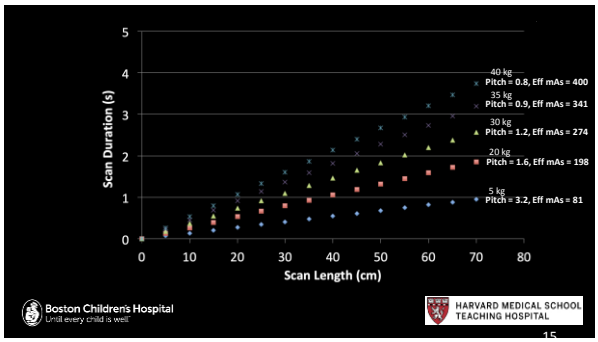
Scan Duration (s)
Scan Length (cm)
40 kg
Pitch = 0.8, Eff mAs = 400
35 kg
Pitch = 0.9, Eff mAs = 341
30 kg
Pitch = 1.2, Eff mAs = 274
20 kg
Pitch = 1.6, Eff mAs = 198
5 kg
Pitch = 3.2, Eff mAs = 81
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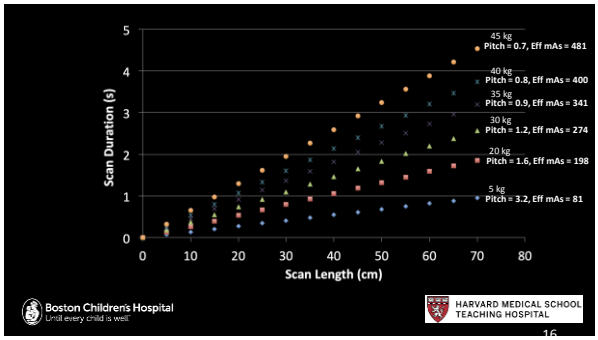

2. Technical approaches to fast acquisition

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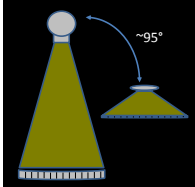

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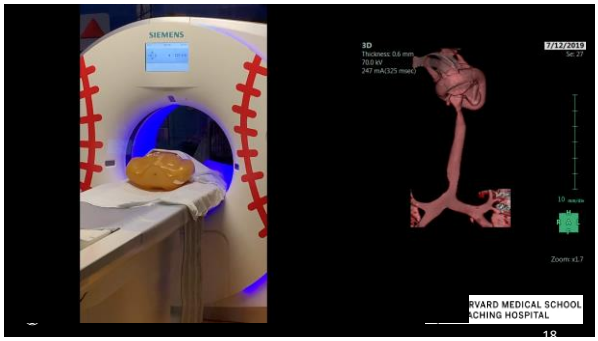

1. Technical approaches to fast acquisition

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1. Technical approaches to fast acquisition

$$\text{Scan speed} = \frac{\text{Detector collimation } (N \times T) \cdot \text{pitch}}{\text{Rotation time}} = \frac{cm}{s}$$

Benefits

*320 * 0.5 mm / 256 * 0.625*
16 cm Volumetric
4-8 cm Helical

<16 cm

16cm/0.275 = 58 cm/s

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Images courtesy of Canon Medical Systems USA

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1. Technical approaches to fast acquisition

$$\text{Scan speed} = \frac{\text{Detector collimation (N} \times \text{T)} \cdot \text{pitch}}{\text{Rotation time}} = \frac{cm}{s}$$

Limitations

No AEC in Axial
Increased scatter

4-8 cm Helical

>16 cm

mAx = 20 - 43.7 cm/s

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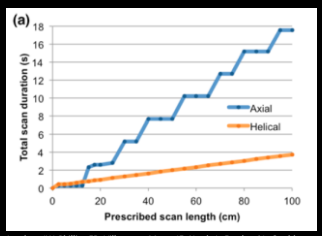

Lambert JW, Phillips ED, Villanueva-Meyer JE, Nardo L, Facchetti L, Gould RG. Axial or Helical? Considerations for wide collimation CT scanners capable of volumetric imaging in both modes. Med Phys. John Wiley and Sons Ltd.; 2017;44(11):5718–5725.

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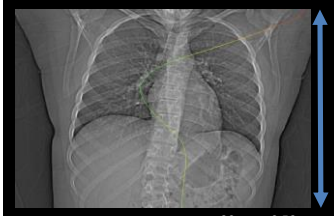
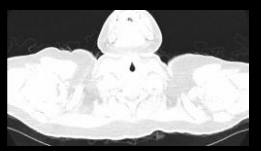
3. Clinical examples

$$\text{Scan speed} = \frac{\text{Detector collimation (N} \times \text{T)} \cdot \text{pitch}}{\text{Rotation time}} = \frac{cm}{s}$$

=96*0.6*2.45/0.25 = 56 cm/s





30 cm = 0.53 s

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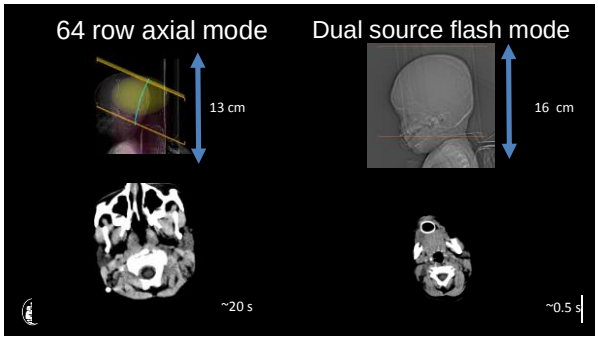

Thank you!

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