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Aquilion CT Dose Management Tools

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Clinical Sciences Manager, CT
Clinical Collaborations

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Agenda

- Aquilion Family of CT Scanners
- Dose Safeguards
- Dose Management
- Dose Reduction
- Dose Measurement
- Dose Reporting
- Where to get more info…

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The Aquilion Family

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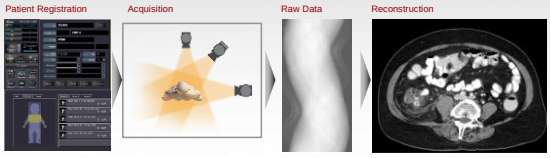
SURE Exposure: Integrated Dose Reduction

- Dose Safeguards
- Dose Management
- Dose Reduction



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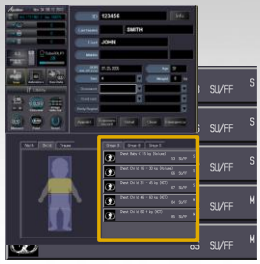
Integrated Dose Management

Integrated Optimized Workflow to Minimize Dose



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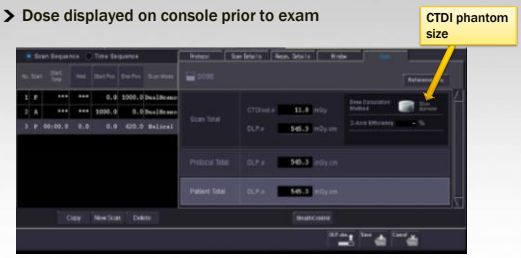
Scan Planning

- Real-time dose display
- Dose displayed on console prior to exam



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Scan Planning and Dose Safeguards

- NEMA Standard XR25 "Dose Check"
- The dose check standard contains two main components:
  - Dose Notification Feature
  - Dose Alert Feature
- Different dose levels can be set for pediatric patients
- Includes audit logs to more efficiently monitor patient dose management

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Dose Safeguards

- **DICOM SR - IHE Dose Report**
  - Dose information can be exported to PACS or a Dose Management System
  - Better monitor patient dose over repeat examinations and across multi-modalities
  - Build and share data bases of doses used for routine clinical examinations that could be compared locally, nationally or internationally
- **Protocol Password Protection**
  - System protocols can only be changed by specific individuals

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Scan Planning and Dose Safeguards

- NEMA Standard XR29 Smart Dose compliant
  1. DICOM Radiation Dose Structured Reporting (DICOM PS3.3-2011)
  2. NEMA XR-25 Dose Check
  3. Automatic Exposure Control
  4. Reference Preloaded Adult & Pediatric Protocols

Effective Jan 1, 2016:
For non-compliant providers Medicare reimbursements for CT procedures will be reduced by 5%; and on Jan 1, 2017 reduced by 15% more.

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PROTECT ™*

- PROTECT is a partnership designed to help Aquilion customers make CT safer for all patients.

PROTECT™

- PROTECT team will work closely with customer to evaluate, plan, and implement a strategy to lower dose, maintain image quality and meet the customers PROTECT goals.

*option

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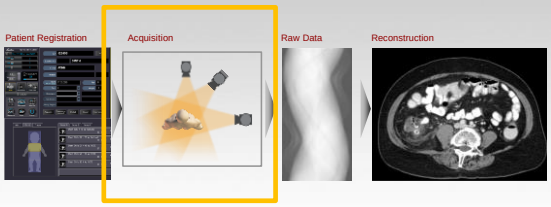
Dose Reduction Technologies



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Quantum Detector

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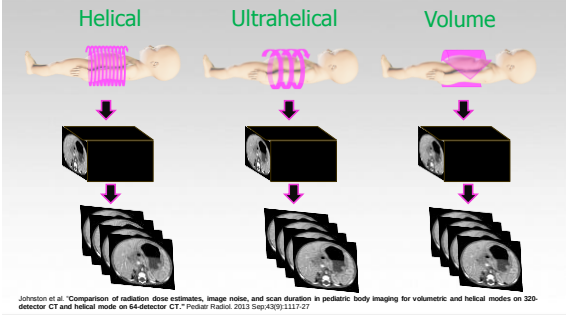
320-Row Volume CT Scan Modes



Johnston et al. "**Comparison of radiation dose estimates, image noise, and scan duration in pediatric body imaging for volumetric and helical modes on 320-detector CT and helical mode on 64-detector CT.**" Pediatr Radiol. 2013 Sep;43(9):1117-27

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Dynamic Volume CT: Lower Dose Volume Scanning

- Why is volume acquisition lower dose than helical?
  - No helical overranging
  - Only one rotation of overbeam/penumbra
  - No low pitch overlap for gated studies

ONE Aquilion

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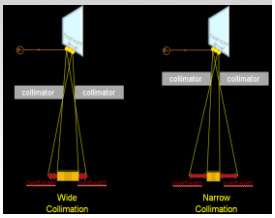
Overbeaming

- Overbeaming is the excess radiation exposure beyond the collimated beam in z-direction
  - "penumbra"
- Wider collimation decreases relative penumbra
- Decrease # of gantry rotations inherently decreases this effect



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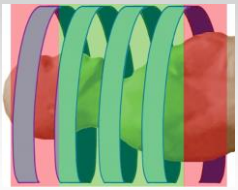
Overranging

- Helical scanning requires raw data on either end of planned scan length for reconstruction
- Unnecessary radiation exposure to tissue beyond desired view
- Accounts for higher percentage of total exposure with smaller scan lengths (cardiac, neuro, pediatric)
- Active collimation reduces
- Does not occur with true axial volume scanning
  - It's just a really thick axial slice



Schilham A et al. Radiographics 2010;30:1057-1067

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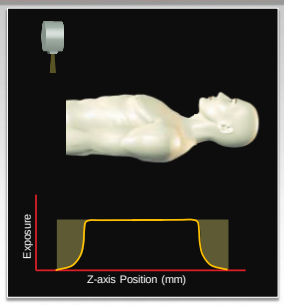
Active Collimation

- Helical overranging minimized for lower dose image acquisition



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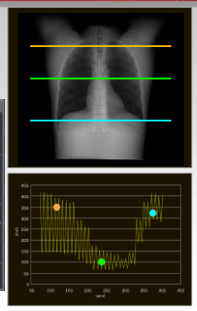
SureExposure Tube Current Modulation

- XYZ mA modulation
- Dual Scanogram based
- Automatic dose savings



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Tech Assist Lateral Slide

- 8.4 cm's of Lateral Table Movement
- Assist Technologist in Positioning/Moving Patient
- Center Patient in CT Bore, Improved mA Modulation (Dose) and Image Quality

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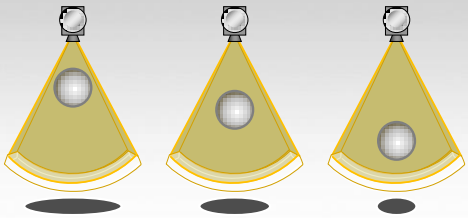
Auto Couch Height Compensation

- SURE Exposure uses patient size for exposure calculation
- Incorrect positioning causes errors in patient size calculation



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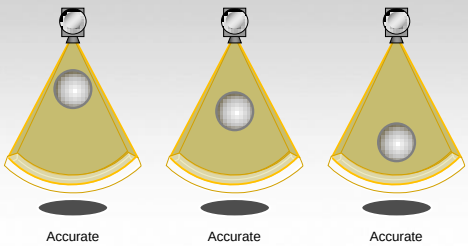
Auto Couch Height Compensation

- SURE Exposure will compensate for incorrect patient positioning to ensure accurate body size calculation and exposure dose



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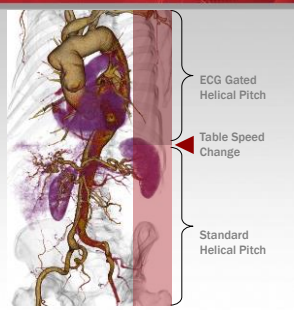
Variable Helical Pitch vHp

- Changing table speeds within the same exam saves time, dose and cost
- Combining ECG and non ECG gated scans into one makes excellent use of contrast media with significant dose reduction



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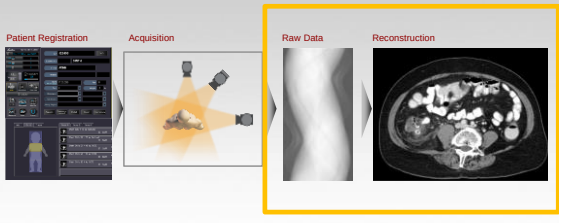
Dose Reduction Technologies



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AIDR 3D Dose reduction

AIDR 3D *integrated*

- **Integrated**
  Preset in CT protocol
- **Automated**
  Increase clinical workflow
- **Adaptive**
  Personalized dose reduction

Dose Reduction Simplified

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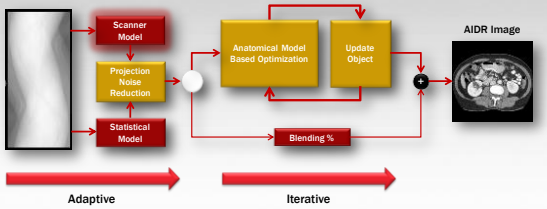
Adaptive Iterative Dose Reduction (AIDR) 3D

AIDR 3D is the latest evolution and Toshiba's 3rd generation of iterative reconstruction technology that has been fully integrated in to the imaging chain.



The scanner model analyzes the physical properties of the CT system at the time of the acquisition.

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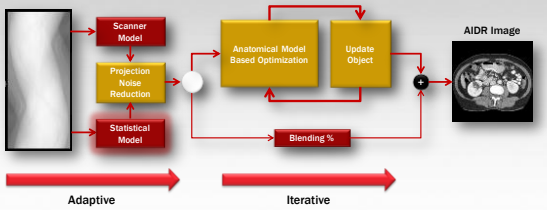

The statistical modeling characterizes both electronic and quantum noise patterns in projection space.

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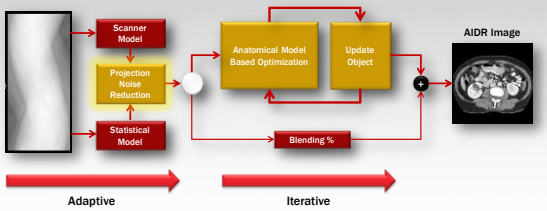

Adaptive processing in the raw domain based on the measured scanner and statistical modeling that reduces noise and artifacts.

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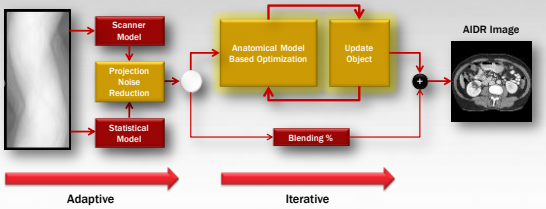

A sophisticated iterative technique that optimizes reconstructions for the particular body region being scanned, dramatically reducing noise while preserving spatial resolution and image texture.

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Adaptive Iterative Dose Reduction (AIDR) 3D

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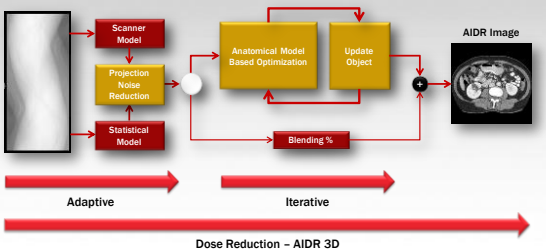

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AIDR 3D Key Features - Integrated

- Integrated
  - When AIDR 3D is used in a protocol, SUREExposure automatically lowers the tube current prior to imaging the patient adjusting for the expected noise reduction from AIDR 3D. Thus dose reduction is achieved without the need to manually adjust those protocols to achieve lower doses than FBP.

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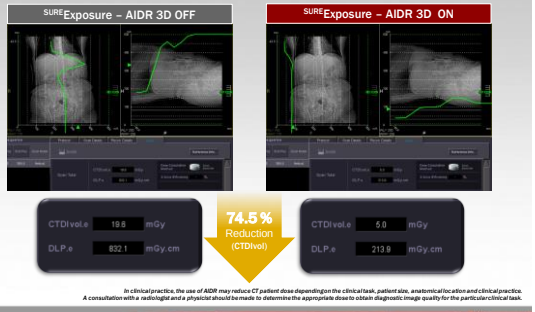
AIDR 3D Key Features - Integrated



In clinical practice, the use of AIDR may reduce CT patient dose depending on the clinical task, patient size, anatomical location and clinical practice. A consultation with a radiologist and a physicist should be made to determine the appropriate dose to obtain diagnostic image quality for the particular clinical task.

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AIDR 3D Key Features - Automated

- Automated
  - AIDR 3D is pre-set in the protocol
  - No need for an extra post processing step
  - No extra steps
  - Implementing AIDR 3D on-site is virtually invisible to the technologists with exception of lower doses and/or improved IQ. No additional training necessary.

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AIDR 3D Key Features - Adaptive

- Adaptive
  - No need to select levels
  - AIDR 3D adapts to the body region/imaging category
  - Several parameters within AIDR 3D are automatically adapted such as:
    - Blending level
    - Number of iterations,
    - Considers edge detail and noise sensitivity
    - Strength of signal at detectors
- A note on adaptive
  - Although AIDR 3D is fully adaptive, it is equipped with three strengths ("mild", "standard", and "strong") primarily for research
  - The "standard" setting is used for majority of protocols. The "strong" setting is used for the less texture-sensitive task of body perfusion.

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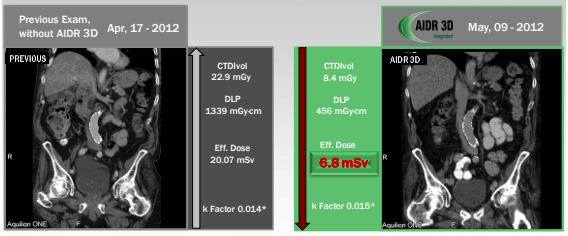
AIDR 3D - Automated



Same patient scanned before and after AIDR 3D implementation

* AAPM Report 96

Courtesy St. Elizabeth's Medical Center, USA

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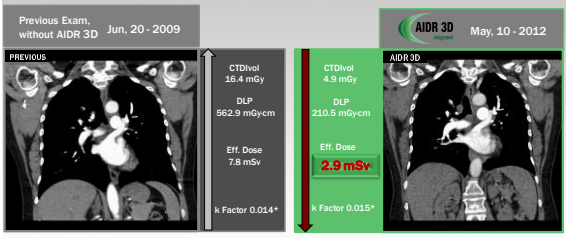
AIDR 3D - Automated



Same patient scanned before and after AIDR 3D implementation

* AAPM Report 96

Courtesy St. Elizabeth's Medical Center, USA

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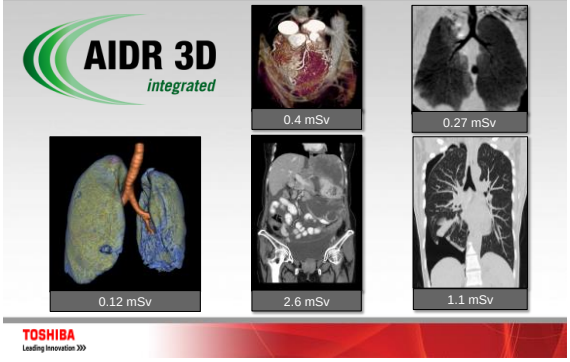
AIDR 3D is Universal (all imaging tasks)



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AIDR 3D for Install Base

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Dose Measurement and Reporting

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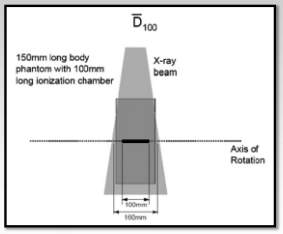
Measuring CTDI for Volume CT scanners

- Use same phantom and ion chamber as MDCT scanners



J. Geleijns et al. "Computed tomography dose assessment for a 160 mm wide, 320 detector row, cone beam CT scanner." Phys Med Biol. 2009 May 21;54(10):3141-59

According to IEC 60601-2-44.ed3

$$CTDI_{100} = \frac{1}{\min\{N \times T,\ 100mm\}} \int_{-50mm}^{+50mm} D(z)dz$$

International Atomic Energy Agency (IAEA). "Status of computed tomography dosimetry for wide cone beam CT scanners": IAEHuman Health Reports No. 5. Vienna, Austria: IAEA, 2011

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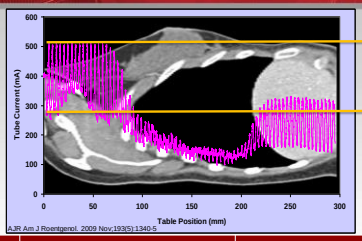
Dose Reporting



AJR Am J Roentgenol. 2009 Nov;193(5):1340-5.

Software Version	$CTDI_{vol}$	DLP
3.0 – 4.62	Based on maximum mA	Based on average mA
4.63 and later	Based on average mA	Based on average mA

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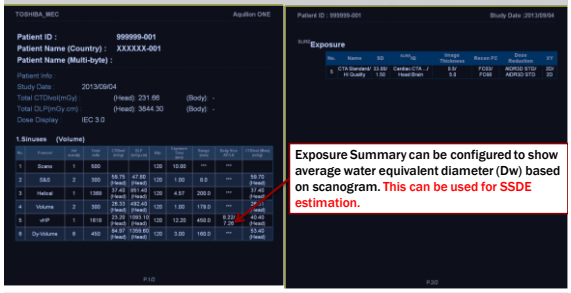
Sample Exposure Record (software v6.0)



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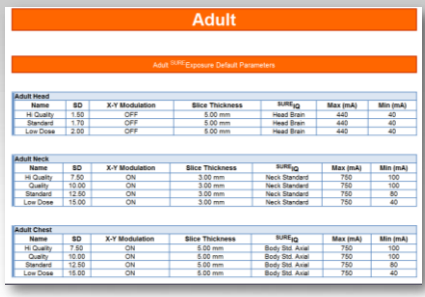
Protocol Print-Out for Protocol Auditing



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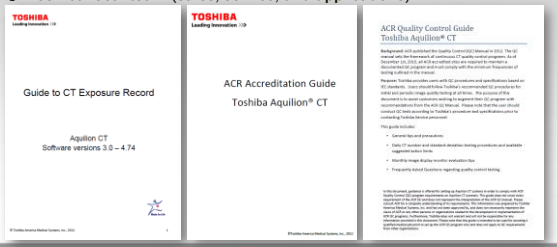
More info for Medical Physicists…

- Toshiba Assist Line: 1-800-521-1968
- ToshibaLearningCenter.com
- Toshiba local team (sales, service, and applications)



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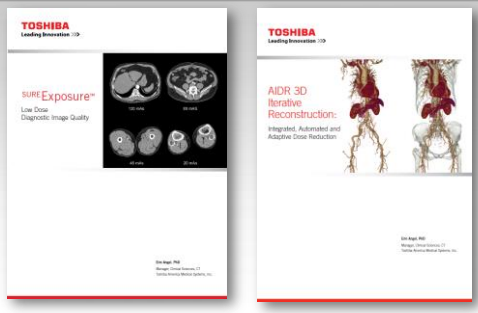
Whitepapers



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Aquilion CT

- Ultra Low Dose, **Safe**
- Fast Workflow, **Efficient**
- Advanced Applications, **Accurate**
- Uncompromised Performance and Value

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Thank You

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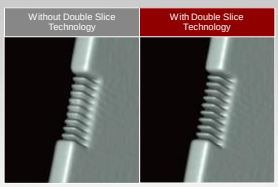
Aquilion CT, Double Slice Technology

- Reconstruct double the slices per rotation
- Up to 0.5 mm x 320 detector row
- Up to 640 slice reconstruction
- 3D image quality improvement
- Partial volume effects minimized
- Data acquired as a volume



No Additional Dose

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Aquilion CT, Double Slice Technology

No Additional Dose

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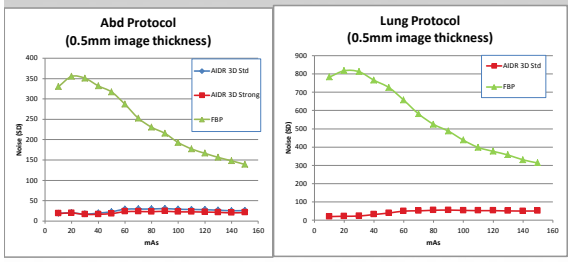
Noise Reduction

- Volume Mode, 40 cm water phantom, 120 kVp, LFOV, 80x0.5 mm



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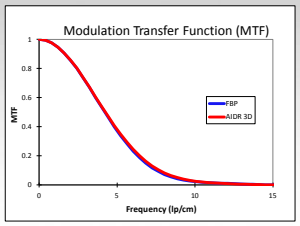
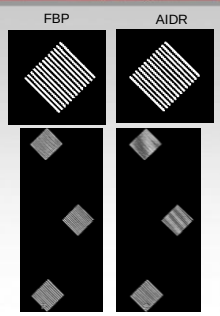
Spatial Resolution

- Abdomen Protocol, 120 kVp





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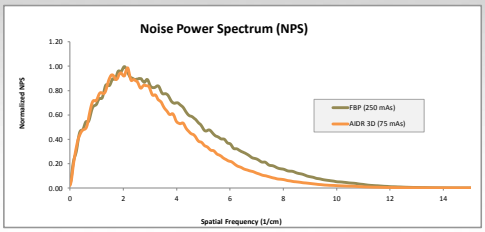
Texture Preservation

- Abdomen protocol, 250 mAs for FBP and 75 mAs for AIDR 3D (70% dose difference)



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