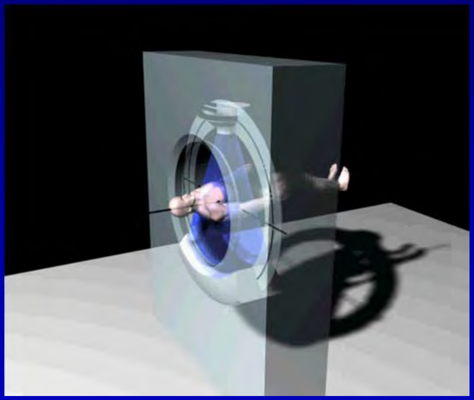
CT Protocol Optimization over the Range of CT Scanner Types: Recommendations & Misconceptions



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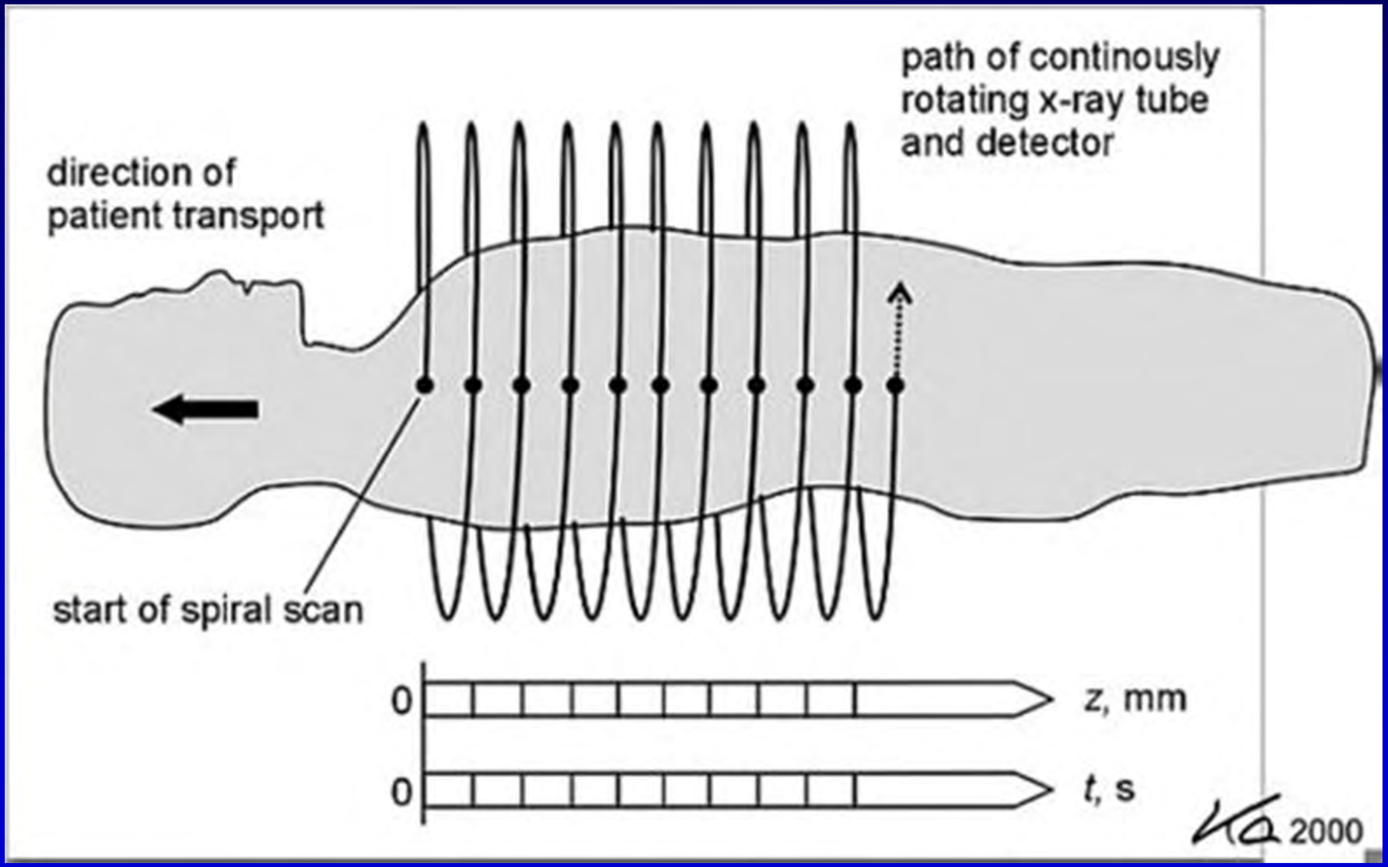
TOPICS:

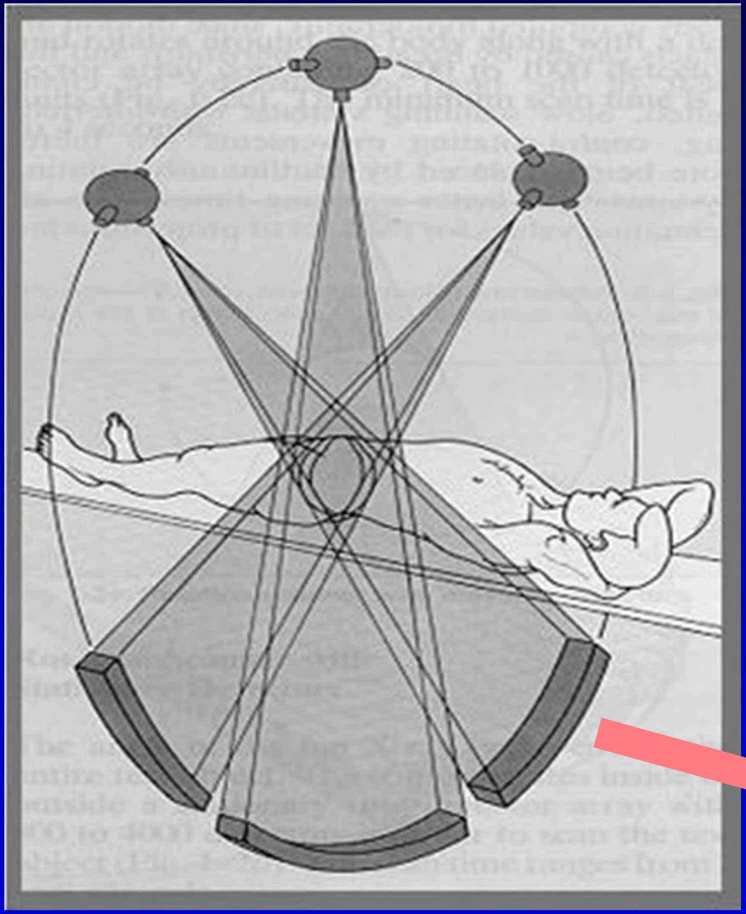
- Quick Overview
  - Modern Computed Tomography
  - CT Dosimetry
- CT Image Quality & Dose
- Optimization of CT Scan Techniques for Dose & Image Quality

Evolution to Helical/ Spiral CT Scanners

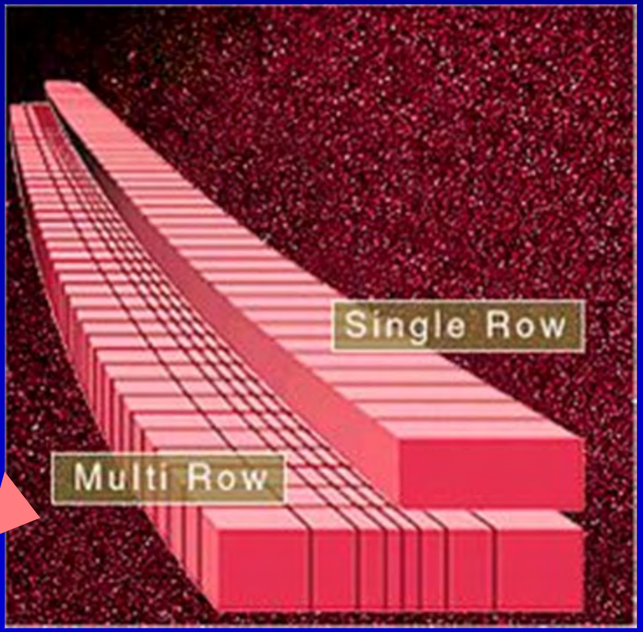
Single Slice Helical/ Spiral CT



Evolution to Multislice Scanners
2, 4, 8, 16, 64, … ?



Data Acquisition



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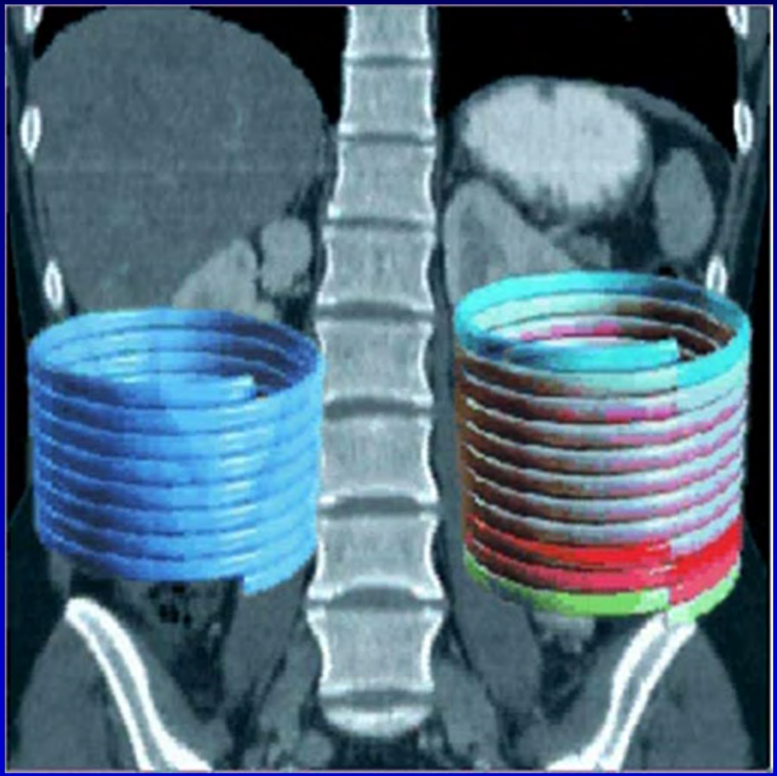


Evolution to Multislice Scanners 2, 4, 8, 16, 64, … ?

Definition of Pitch for Single-slice Helical / Spiral Scanning:

$$\text{Pitch} = \frac{\text{Table travel per 360° tube rotation}}{\text{Nominal Slice Thickness}}$$

Definition of Pitch for Multi-slice Helical / Spiral Scanning:

$$\text{Pitch} = \frac{\text{Table travel per 360° tube rotation}}{\text{Total collimation width of all simultaneously collected slices}}$$

Dose in Computed Tomography

CT Dose

- $CTDI_w$ is a weighted value of $CTDI_{100}$ measurements, at the center and the surface of the 16cm or 32cm diameter CTDI phantom, that attempts to give the average dose throughout the volume of the phantom (for contiguous axial slices or for helical scanning at a pitch of 1). It is defined as:

$$CTDI_w = 1/3\ CTDI_{100}\ (\text{center}) + 2/3\ CTDI_{100}\ (\text{surface})$$

CT Dose

- $CTDI_{vol}$
  - If you then take into account the effect of pitch on dose for a helical/ spiral scan then you have another version of CTDI:

$$CTDI_{vol} = CTDI_w / Pitch$$

  - This is an approximation of the dose averaged over the volume of the phantom.

CT Dose

- DLP
  - A final dosimetry measure is the Dose Length Product (DLP) which is defined as:

$$DLP = CTDI_{vol} \times \text{Scan Length}$$

and has units of mGy • cm

- $CTDI_{vol}$ and DLP are the CT dose units provided by the CT Scanner.

CT Dose

- DLP
  - Estimates of an “average” size patient’s effective dose (E) can be derived from the values of DLP for an examination. Use the following equation containing a coefficient E_{DLP} appropriate to the examination:

$$E = E_{DLP} \times DLP$$

CT Dose

- DLP
  - Values of E_{DLP} for Adult scans:

Region of Body	E_{DLP} (mSv / mGy•cm)		Phantom
Head	0.0023	0.0021	16 cm
Head & Neck		0.0031	16 cm
Neck	0.0054	0.0059	32 cm
Chest	0.017	0.014	32 cm
Abdomen	0.015	0.015	32 cm
Pelvis	0.019	0.015	32 cm

⇑ Two different sources ⇑

CT Dose

- **Converting DLP to Effective Dose for Adults**

  Quick method of getting the effective dose in mSv from the DLP in mGy•cm using previous table:

  - **Take the DLP and divide it by 100**
    - **For the Body, then multiply by 1.5**
    - **For the Head, then divide by 4**

Image Quality in Computed Tomography

Image Quality and Dose:

Artifacts

Dose

Image Sharpness

Image Noise

Modulation Transfer Function – MTF (visibility of small high contrast objects)

visibility of smaller, lower contrast clinical objects

Low Contrast Detectability (visibility of large low contrast objects)

Image Reconstruction Filters, Algorithms, or Kernels

Below are the measured MTF functions for the reconstruction algorithms available on a GE scanner. The algorithms that do not have a "hump" in the MTF are: soft, standard, detail, bone, and edge in order of increasing sharpness. A hump in the MTF indicates a form of edge enhancement of the image; these are evident in the lung reconstruction and the bone plus reconstruction.

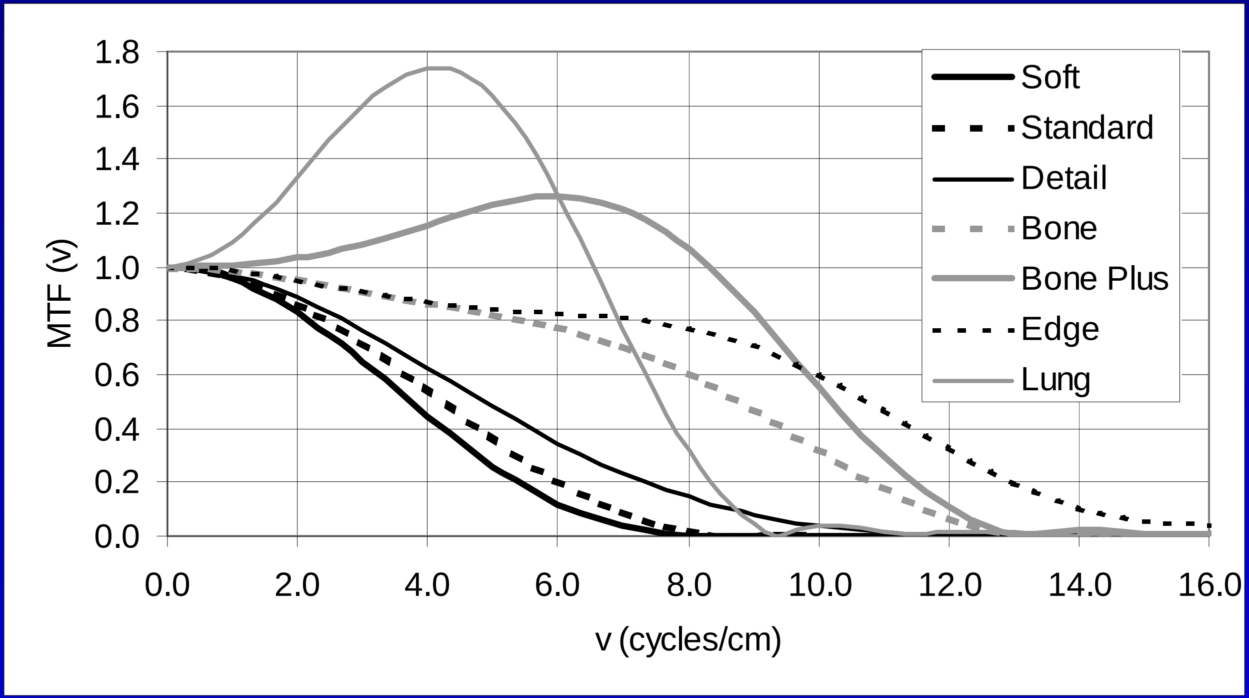


Image Reconstruction Filters, Algorithms, or Kernels (Siemens)

Kernel names have 4 positions. Example: B31s.

Pos.1: kernel type (B=body, C=child head, H=head, U=ultra high resolution, S=special kernel, T=topo.)

Pos. 2: resolution (1,...,9. Higher number -> higher resolution)

Pos. 3: version (0,...,9)

Pos. 4: scan mode (f=fast (no j-FFS , no UHR comb), s=standard (with j-FFS , no UHR comb), h=highres (with j-FFS, no UHR comb), u=ultrahighres (with j-FFS, with UHR comb))

The use of z-FFS is not coded to the kernel name.

B10f, B18f, B19f, B20f, B25f, B29f, B30f, B31f, B35f, B36f, B39f, B40f, B41f, B45f, B46f, B47f, B50f, B60f, B65f, B70f, B75f, B80f,

B08s, B10s, B18s, B19s, B20s, B25s, B29s, B30s, B31s, B35s, B39s, B40s, B41s, B45s, B46s, B47s, B50s, B60s, B65s, B70s, B75h, B80s.

B30m/B40m (m=f,s) are standard kernels,
B20m/B10m are more smooth.
Br1m (r=3,4) have about the same visual sharpness as Br0m, but a finer noise structure (better image impression, improved LC).
B25m correspond to kernels B30m with ASA.
B35m is designed for Ca-scoring and quantitative analysis,
B36f is a sharper version of B35f,
B45m has intermediate resolution.
B46m is for investigations of patency of stents and for quantitative investigations.
B47m have resolution between B46m and B50m.
B50m, B60m, B70m are sharper kernels (for cervical spine, shoulder, extremities, thorax).
B65m is a special lungHR-kernel for quantitative evaluations.
B80m is a special lungHR-kernel (corresponding to HCE with B40m); not as sharp as B70m.
B18m are the kernels B10m with stronger de-ringing.
Br9m (r=1,2,3) are the PET/SPECT versions of Br0m.
B75m (m=f,h) are lungHR kernels with less overshooting at edges.

H10f, H19f, H20f, H21f, H22f, H23f, H29f, H30f, H31f, H32f, H37f, H39f, H40f, H41f, H42f, H45f, H47f, H48f, H50f, H60f,

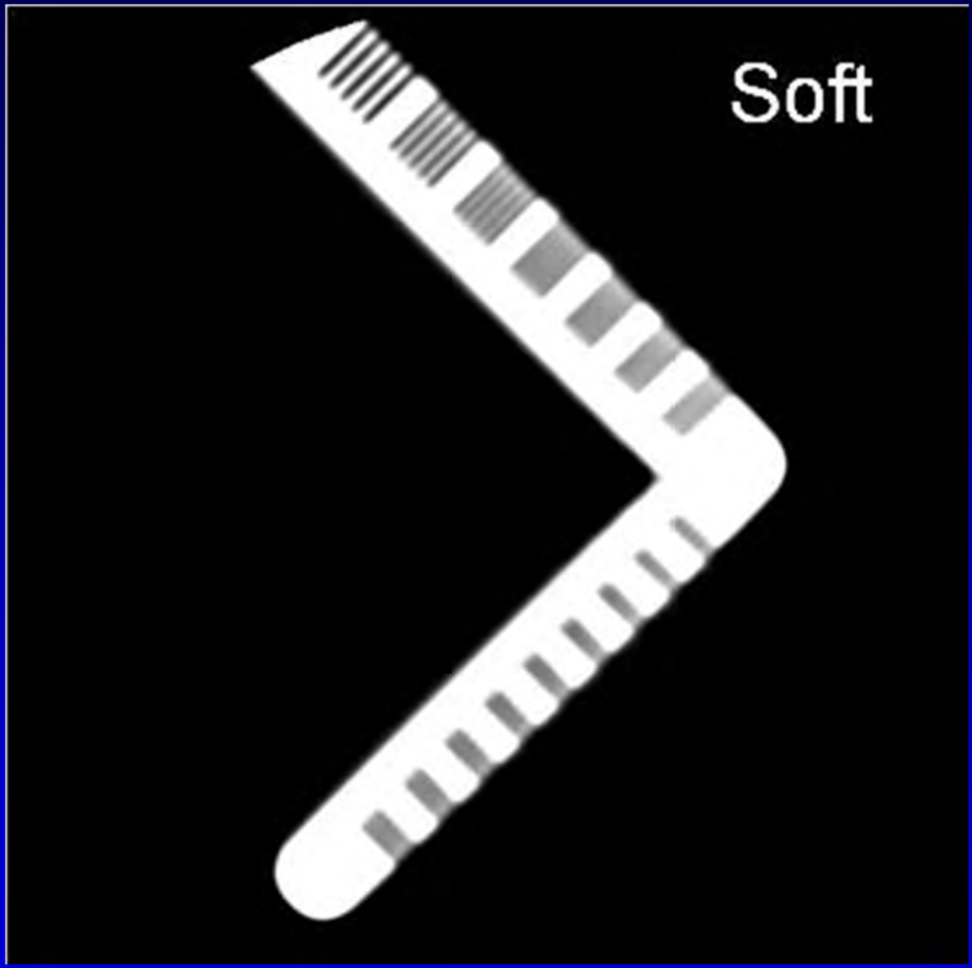
H10s, H19s, H20s, H21s, H22s, H23s, H29s, H30s, H31s, H32s, H37s, H39s, H40s, H41s, H42s, H45s, H47s, H48s, H50s, H60s,

H70h, H80h (Open only).

H40m (m=f, s) is the standard kernel,
H30m, H20m or H10m lead to softer images.
Hr1m (r=2,3,4) yield the same visual sharpness as Hr0m, but have a finer noise structure (better image impression, improved LC).
Therefore Hr1m are used in standard protocols.
Hr2m are the kernels Hr0m without PFO.
H23m serves for Neuro PBV.
H37m, H47m, H48m are alternative kernels with different noise impression.
H45m serve for intermediate resolution,
H50m, H60m are sharper kernels.
Hr9m (r=1,2,3) are the PET/SPECT versions of Hr0m.
H70h gives highest resolution without comb.
H80h gives the hires specification for Sensation Open.

Image Sharpness:

Images of a resolution pattern made with different Image Reconstruction Algorithms



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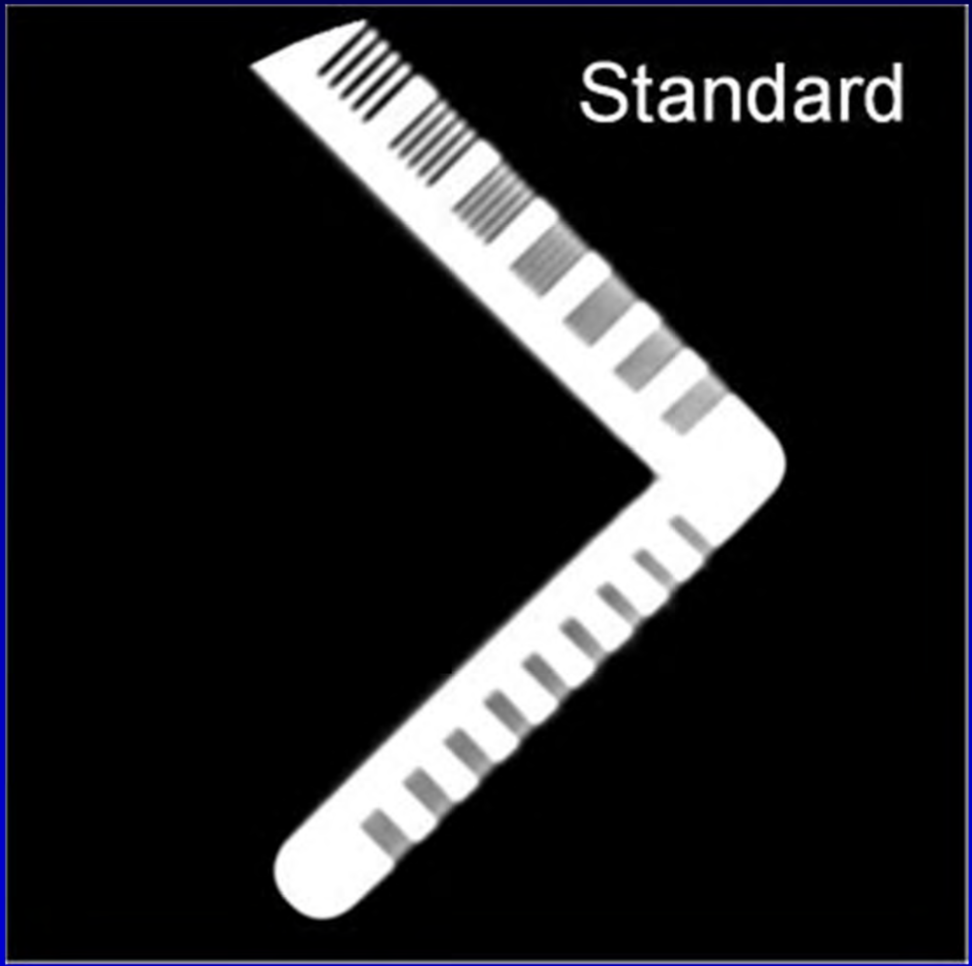

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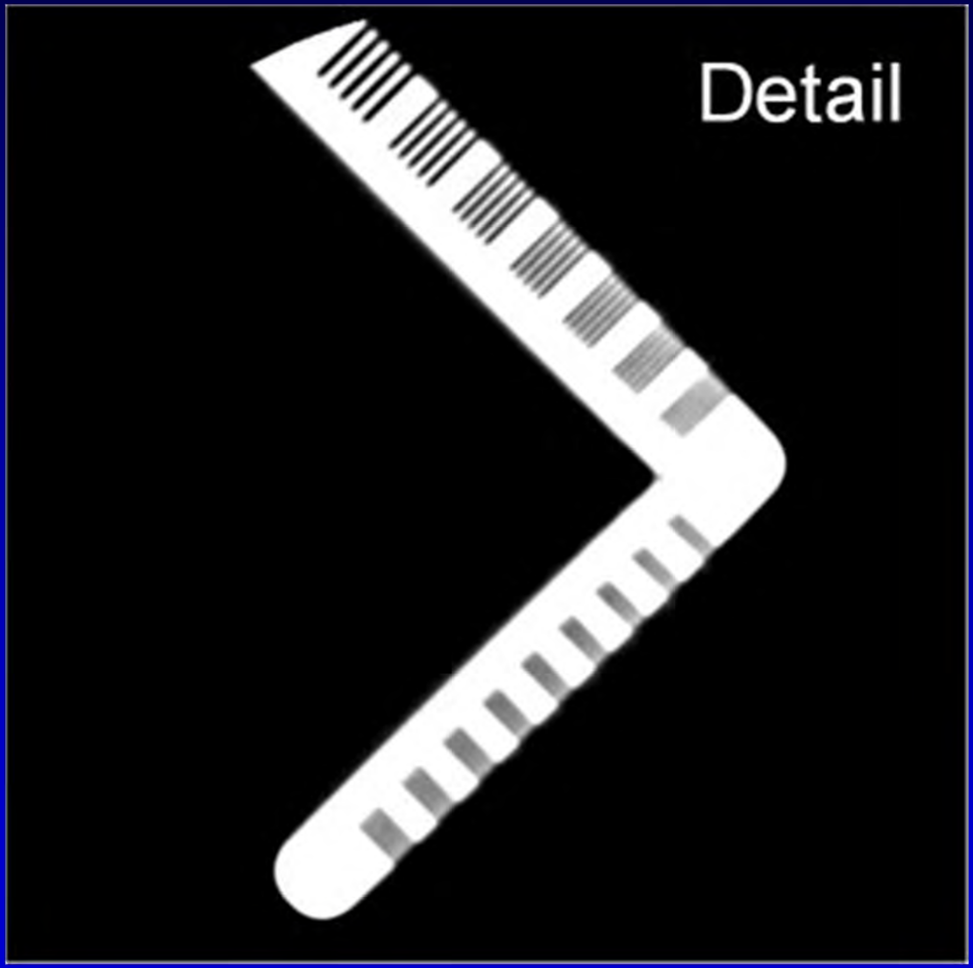

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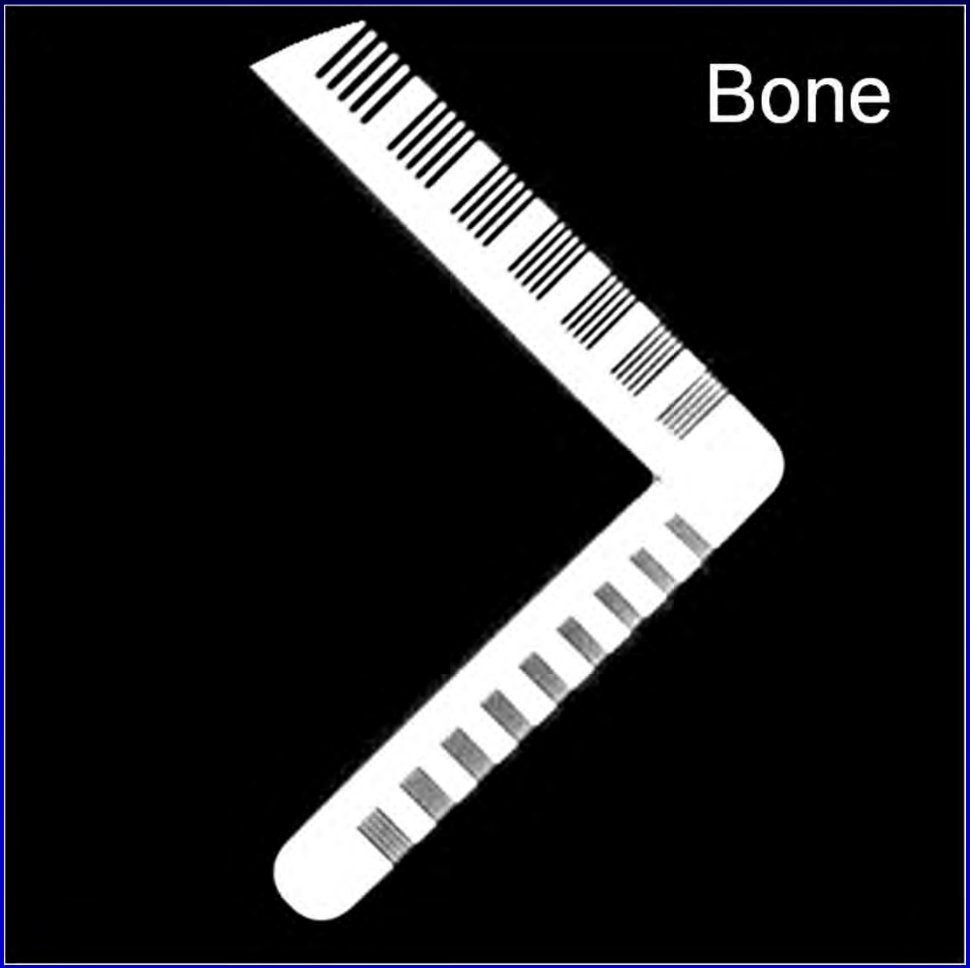

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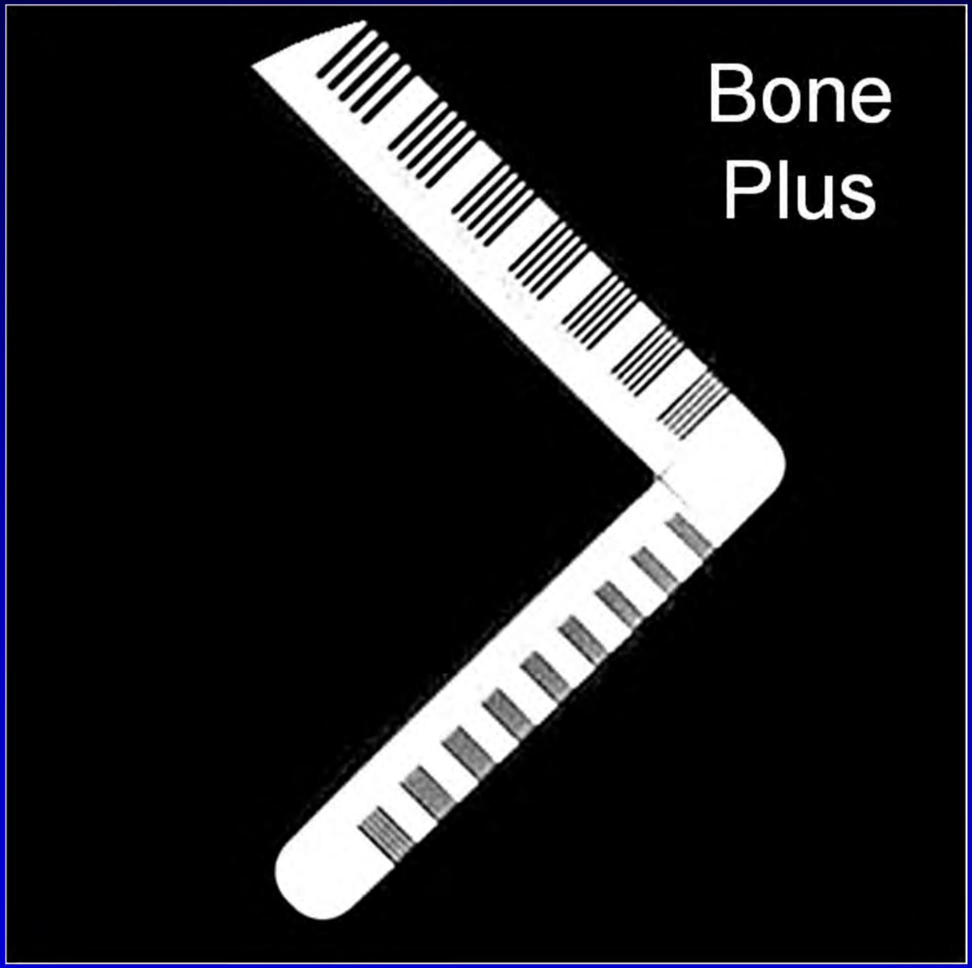

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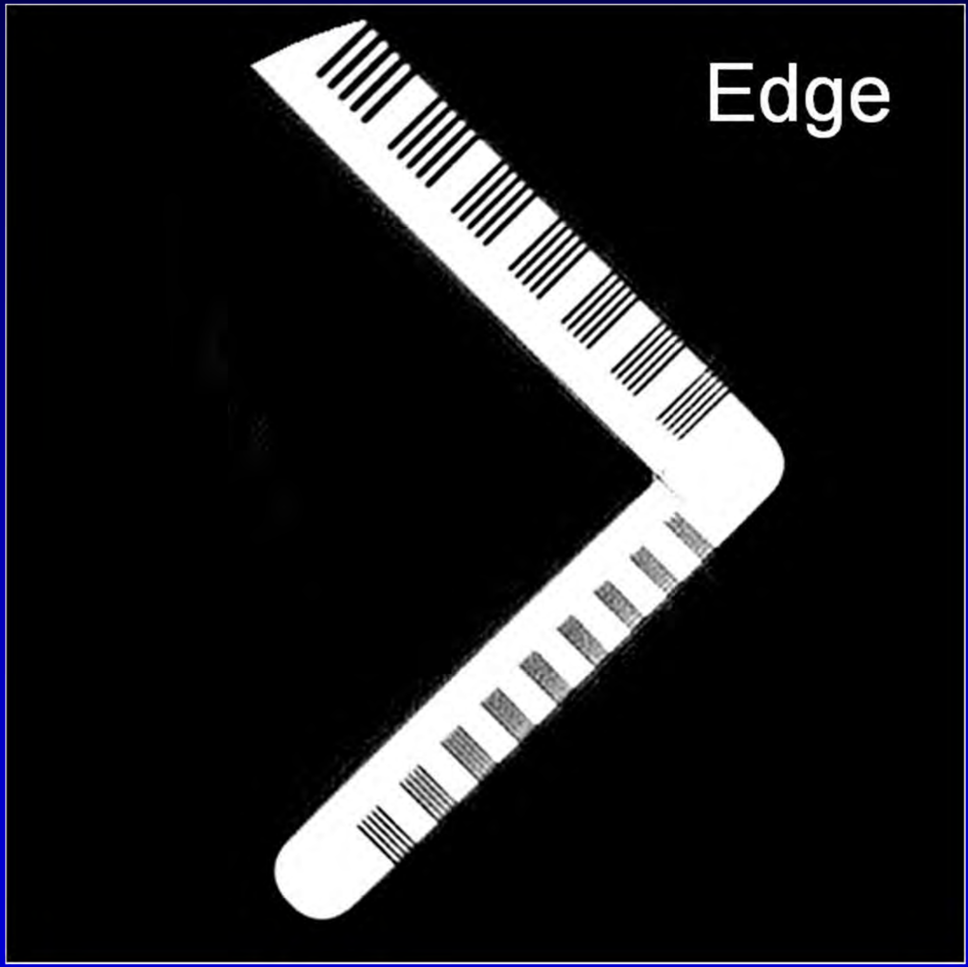

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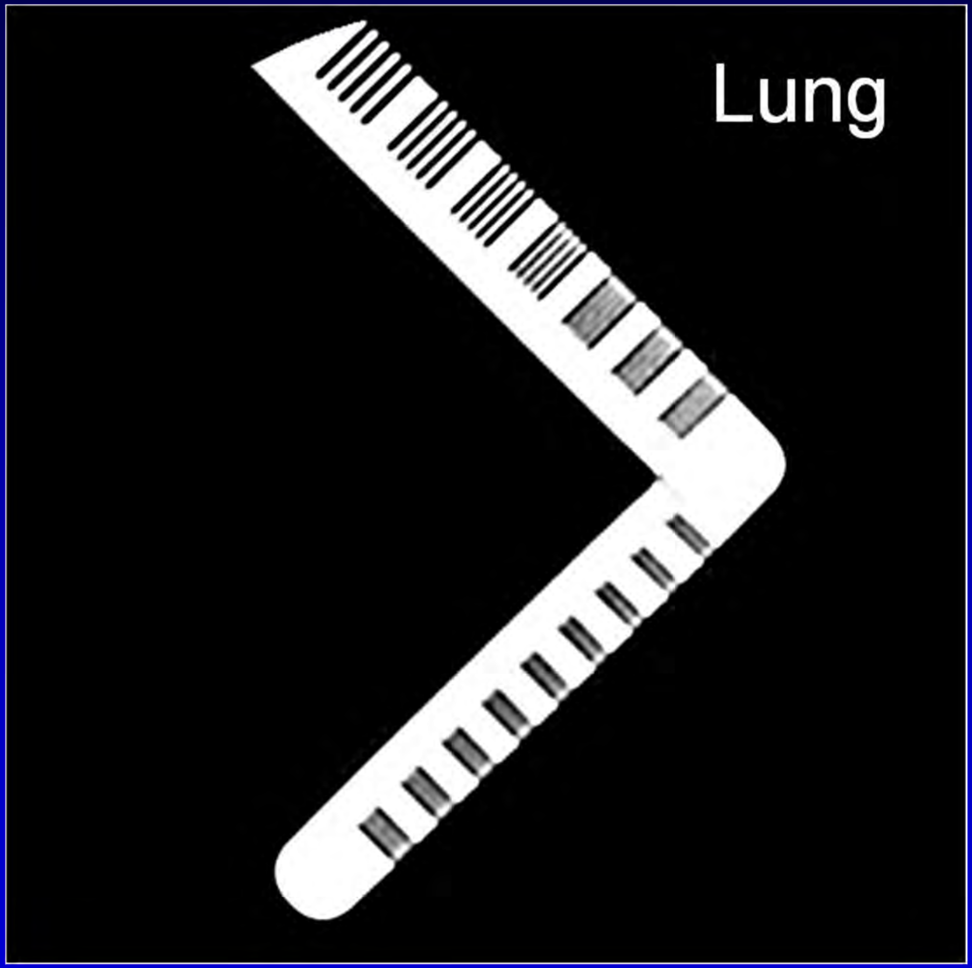


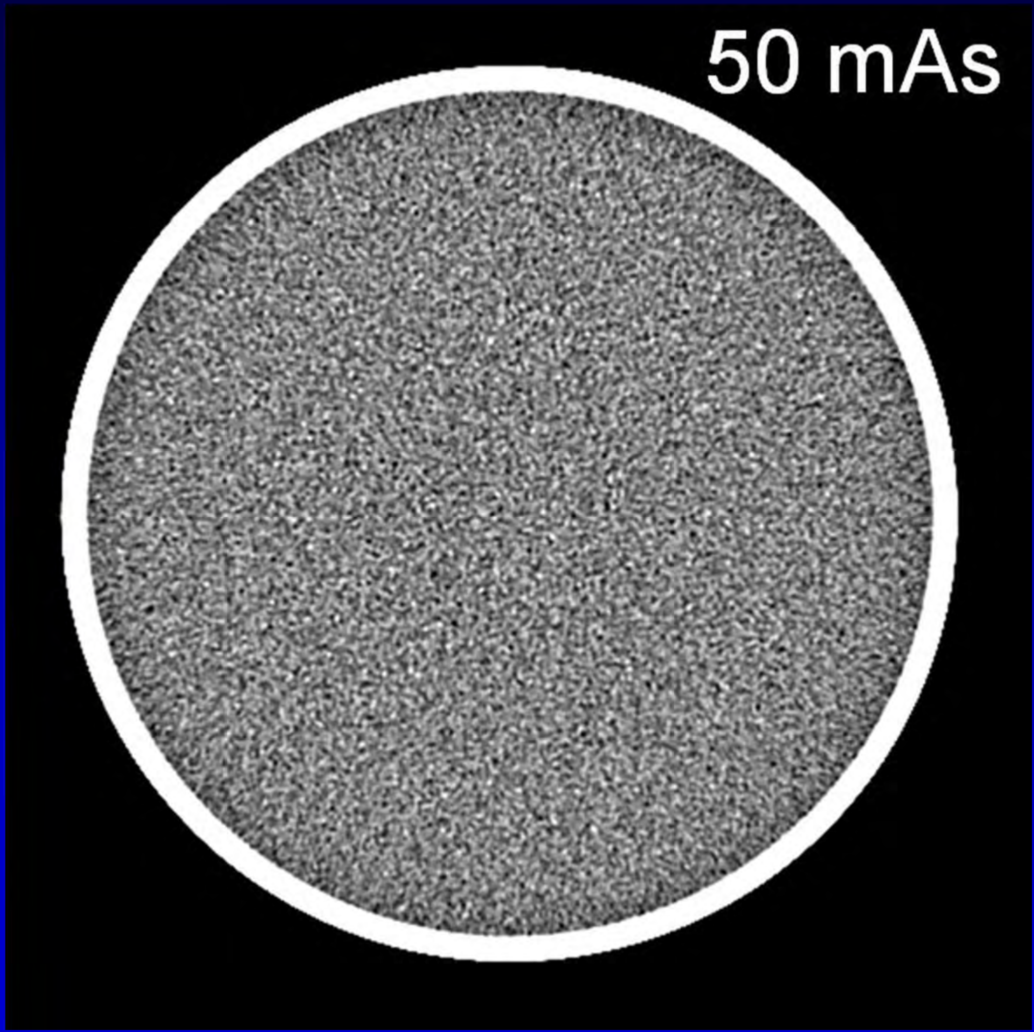
Image Sharpness:

Increasing the image sharpness

- Positive effects:
  - Allows visualization of finer detail
- Negative effects:
  - Increases the image noise
  - Increases image artifacts

Image Noise:

Images of a uniform water pattern imaged using mAs values incrementing by a factor of 2, from 50 mAs to 800 mAs.



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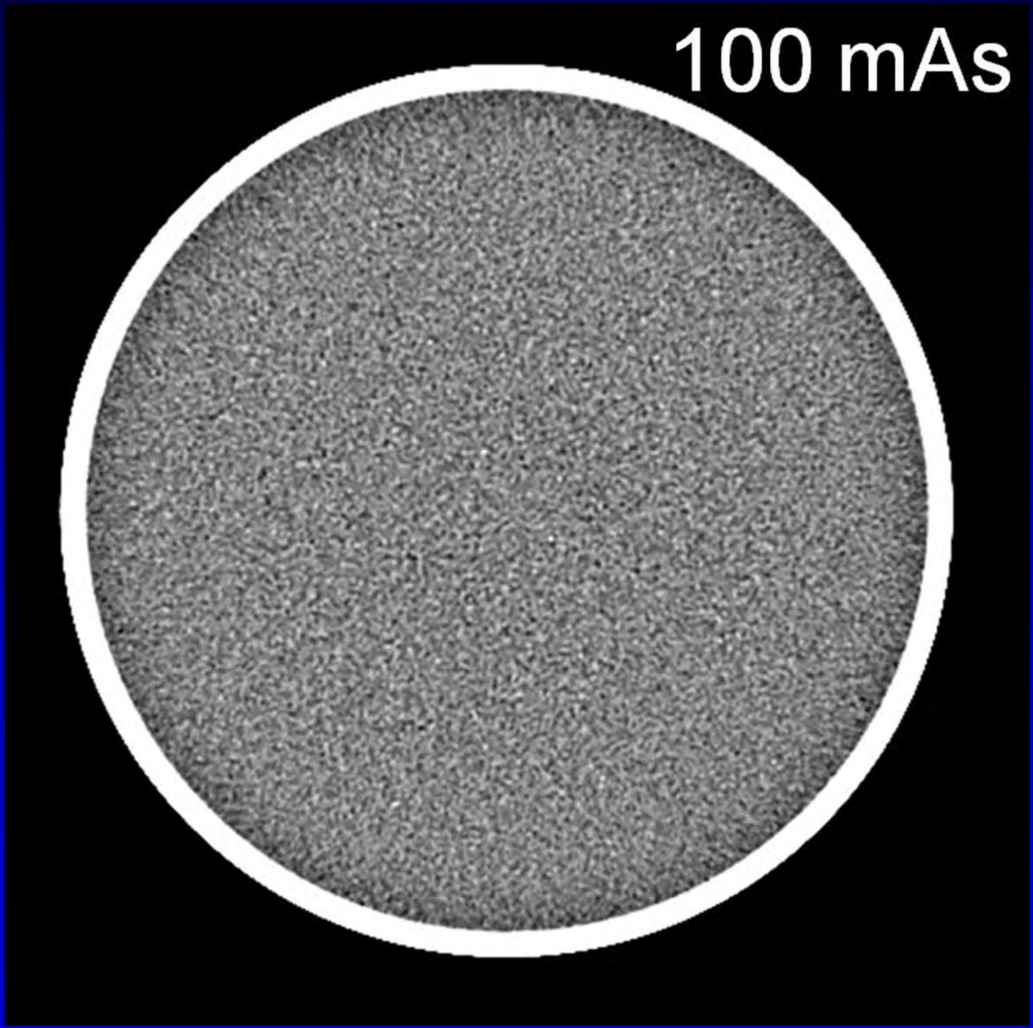

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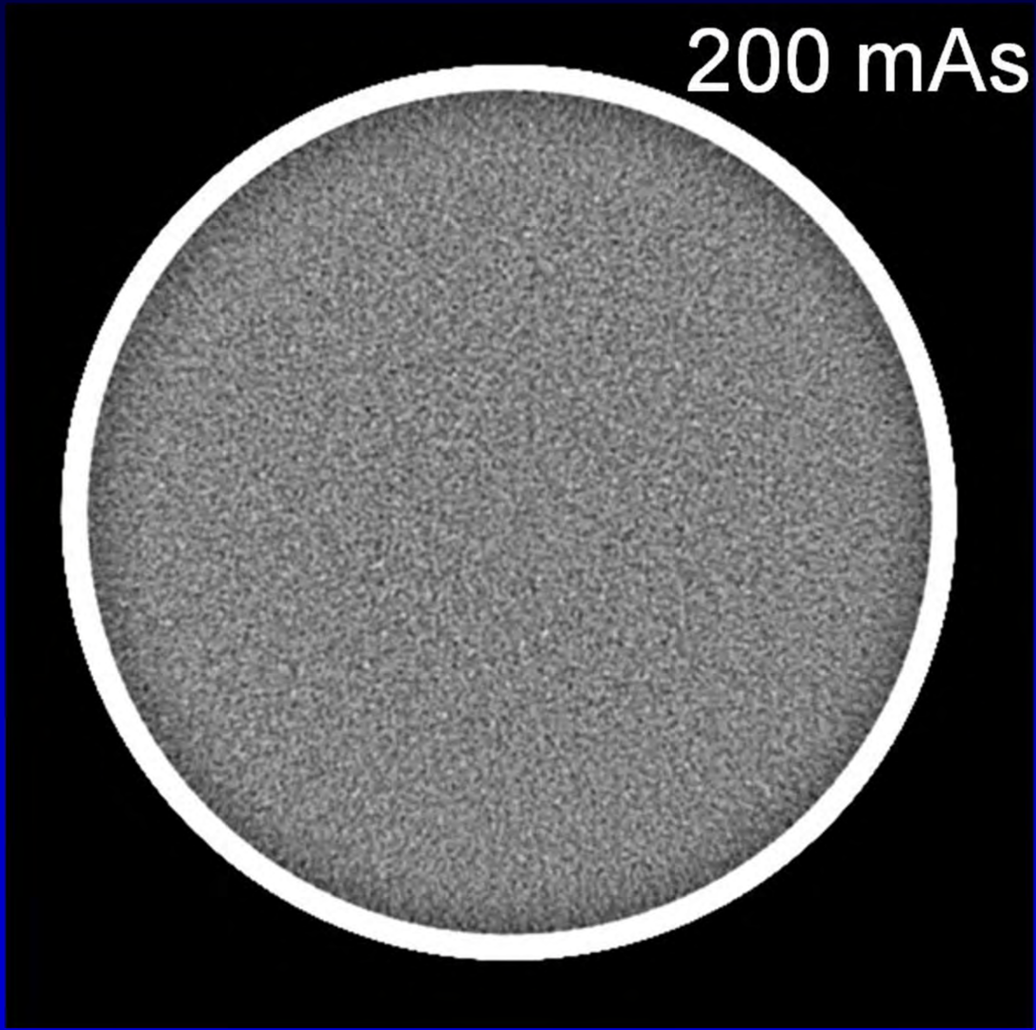

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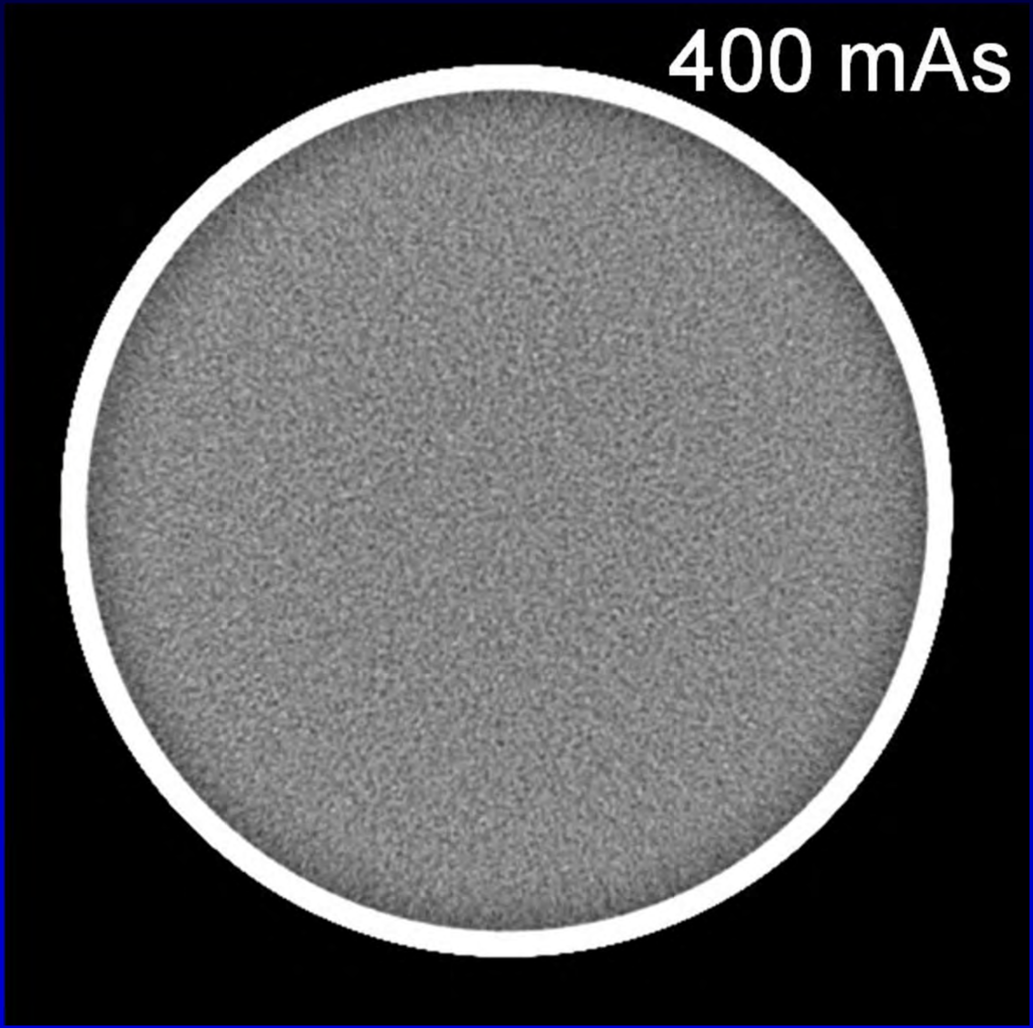

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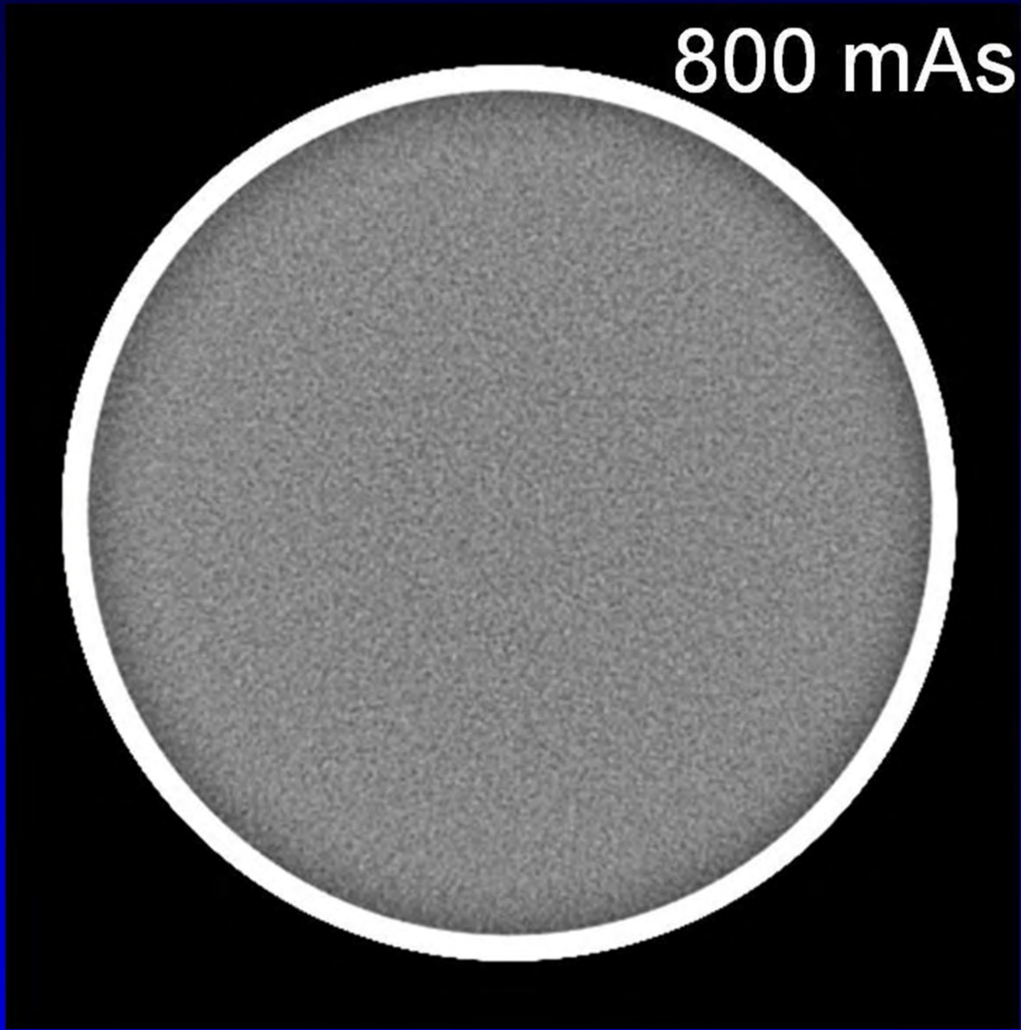

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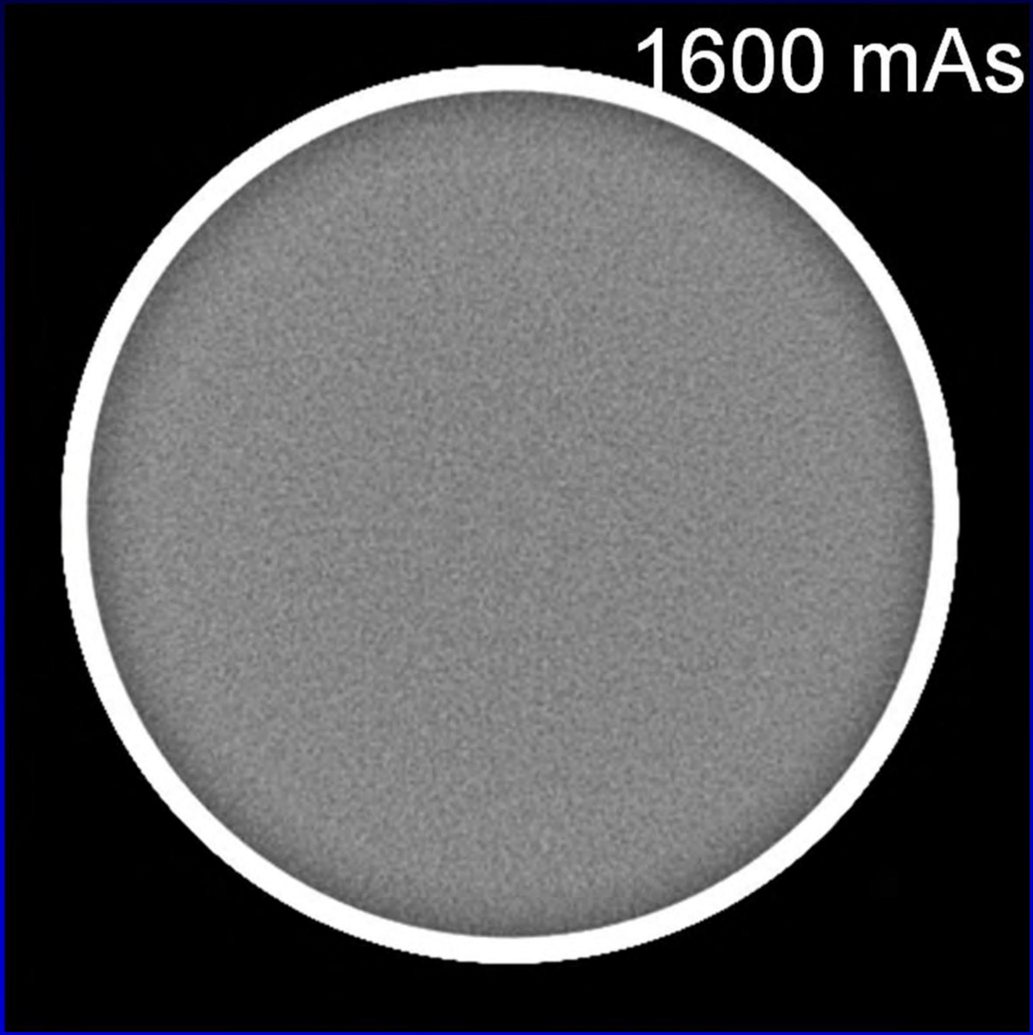


Image Noise:

Image noise is reduced by:

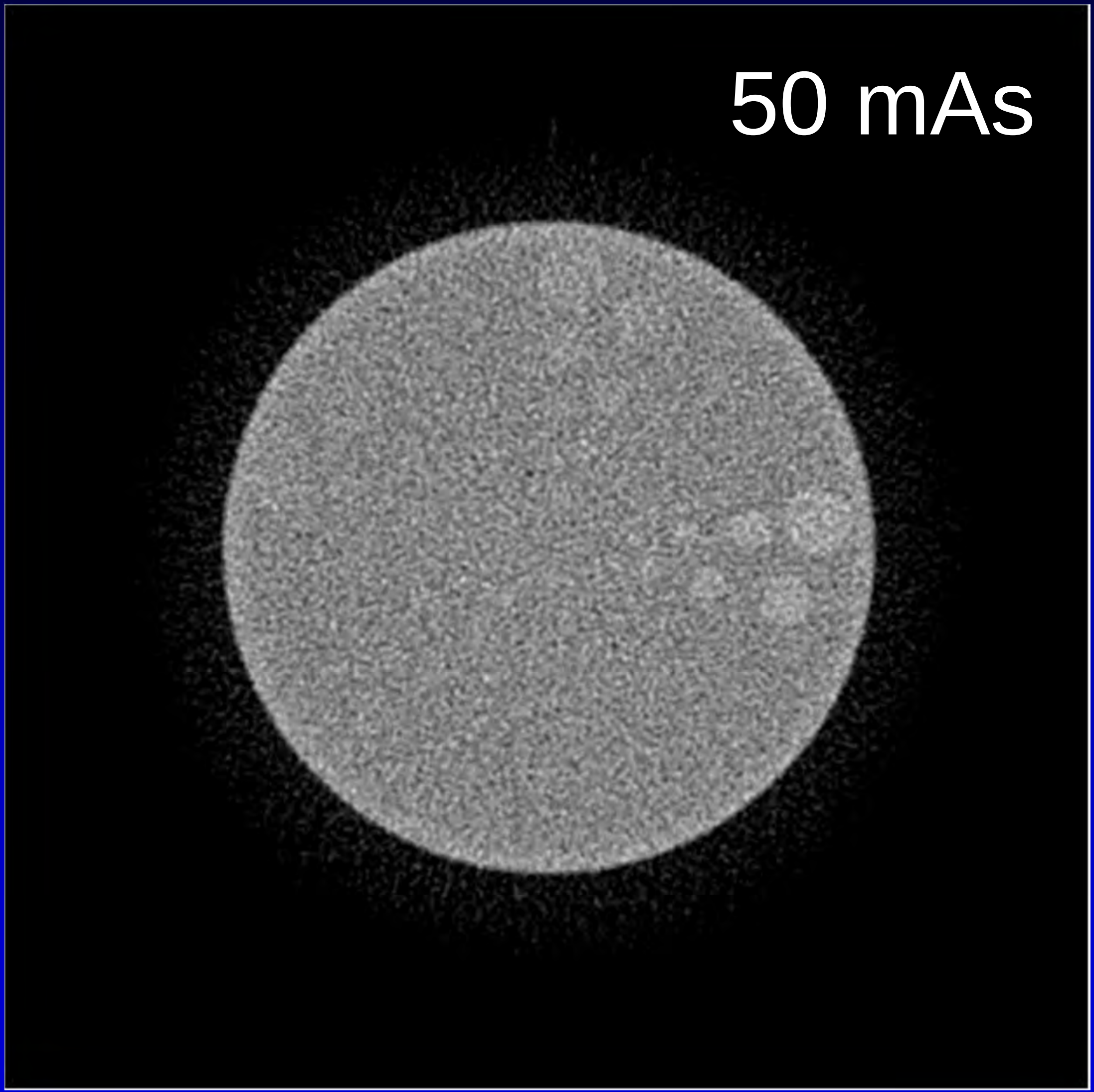
- **Using a less sharp or "softer" image reconstruction algorithm**
- **Increasing the dose to the detectors used in reconstructing the image slice.**

$$\text{Noise} \propto 1/\sqrt{\text{Dose}}$$

  - **To reduce noise by a factor of 2, increase the effective mAs by a factor of 4.**
  - **Increasing the slice thickness by a factor of 4 decreases the noise by a factor of 2.**

Low Contrast Detectability:

Images of a low contrast detectability pattern imaged using mAs values incrementing by a factor of 2, from 50 mAs to 800 mAs.



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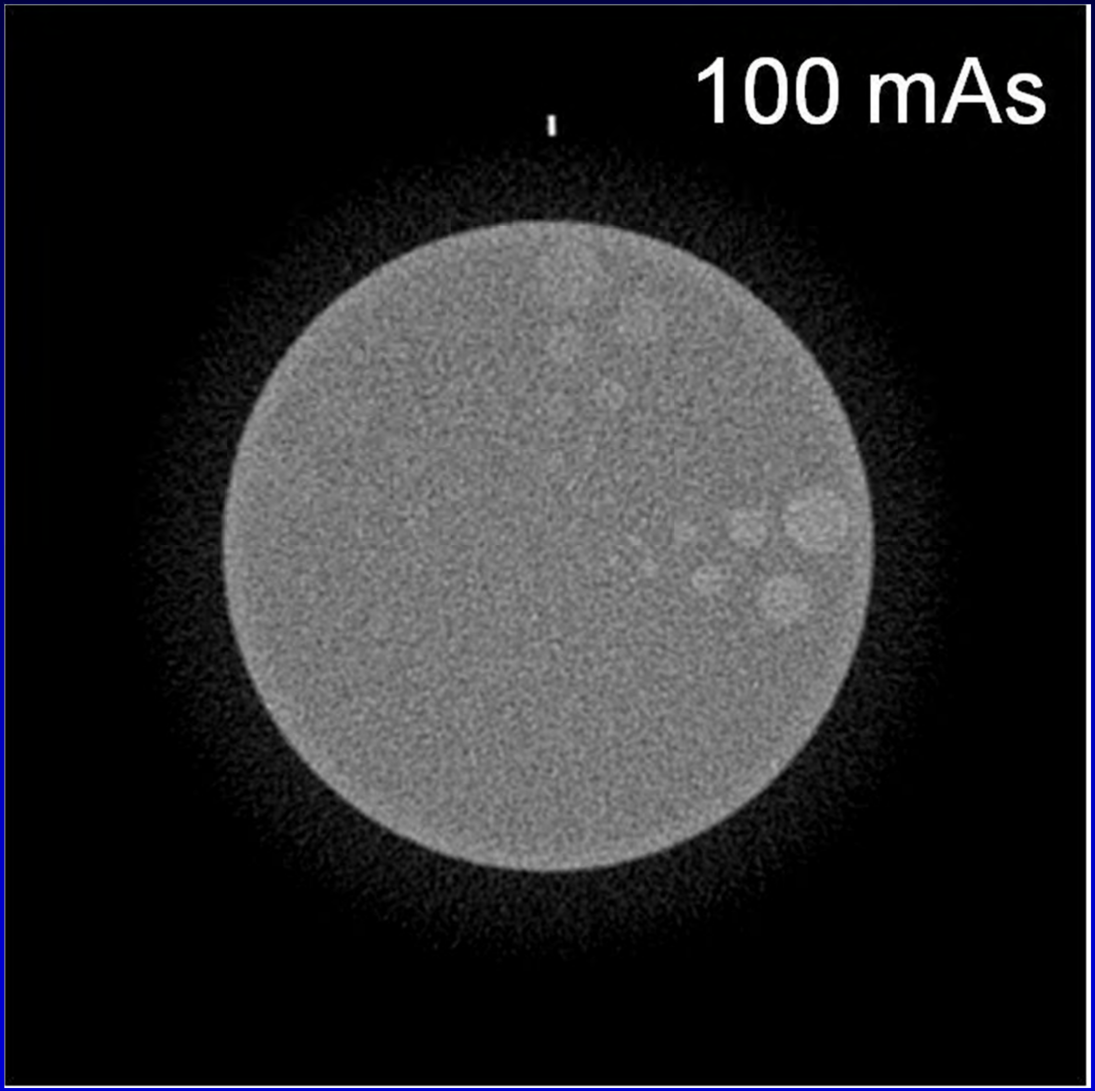

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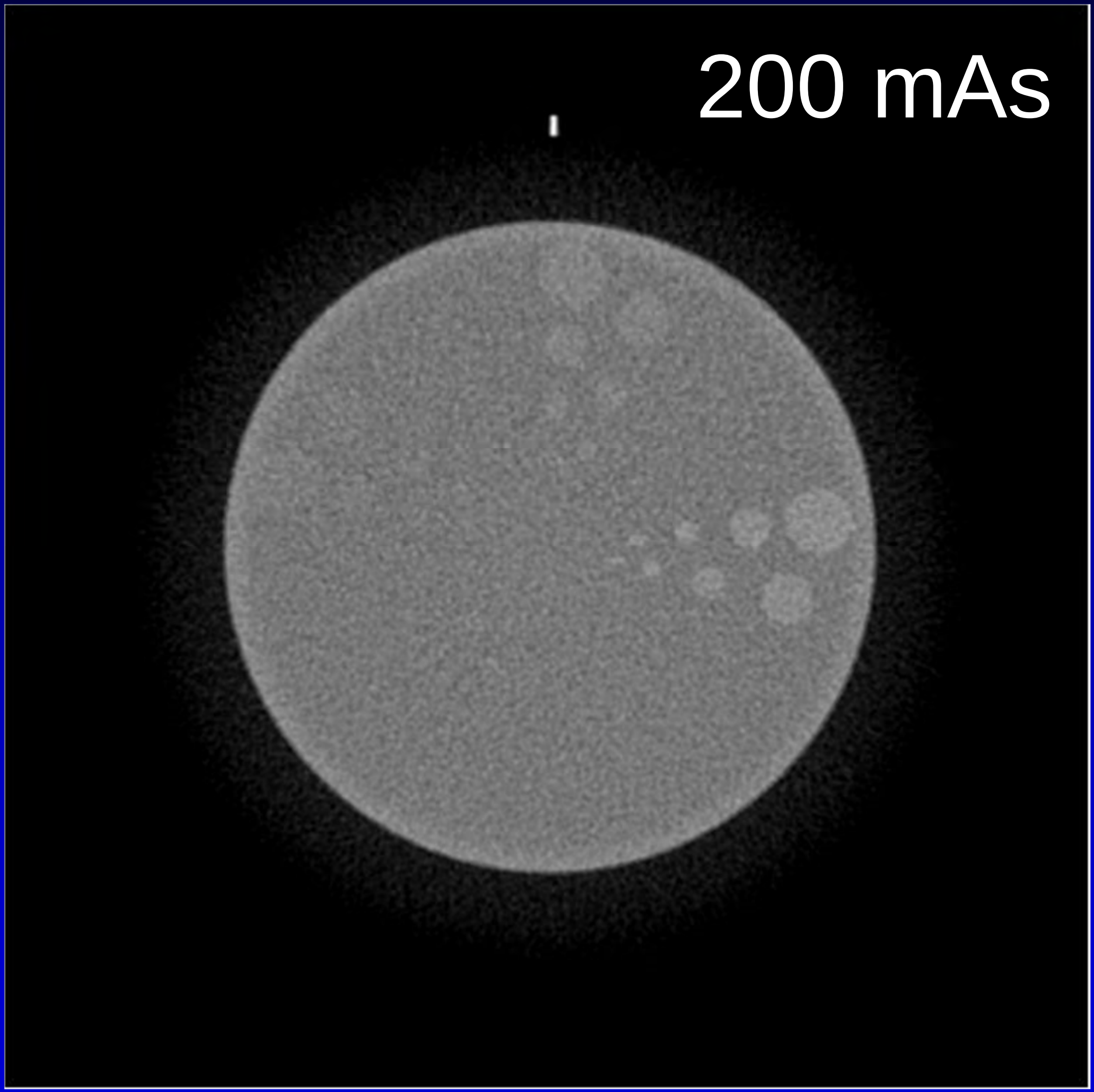

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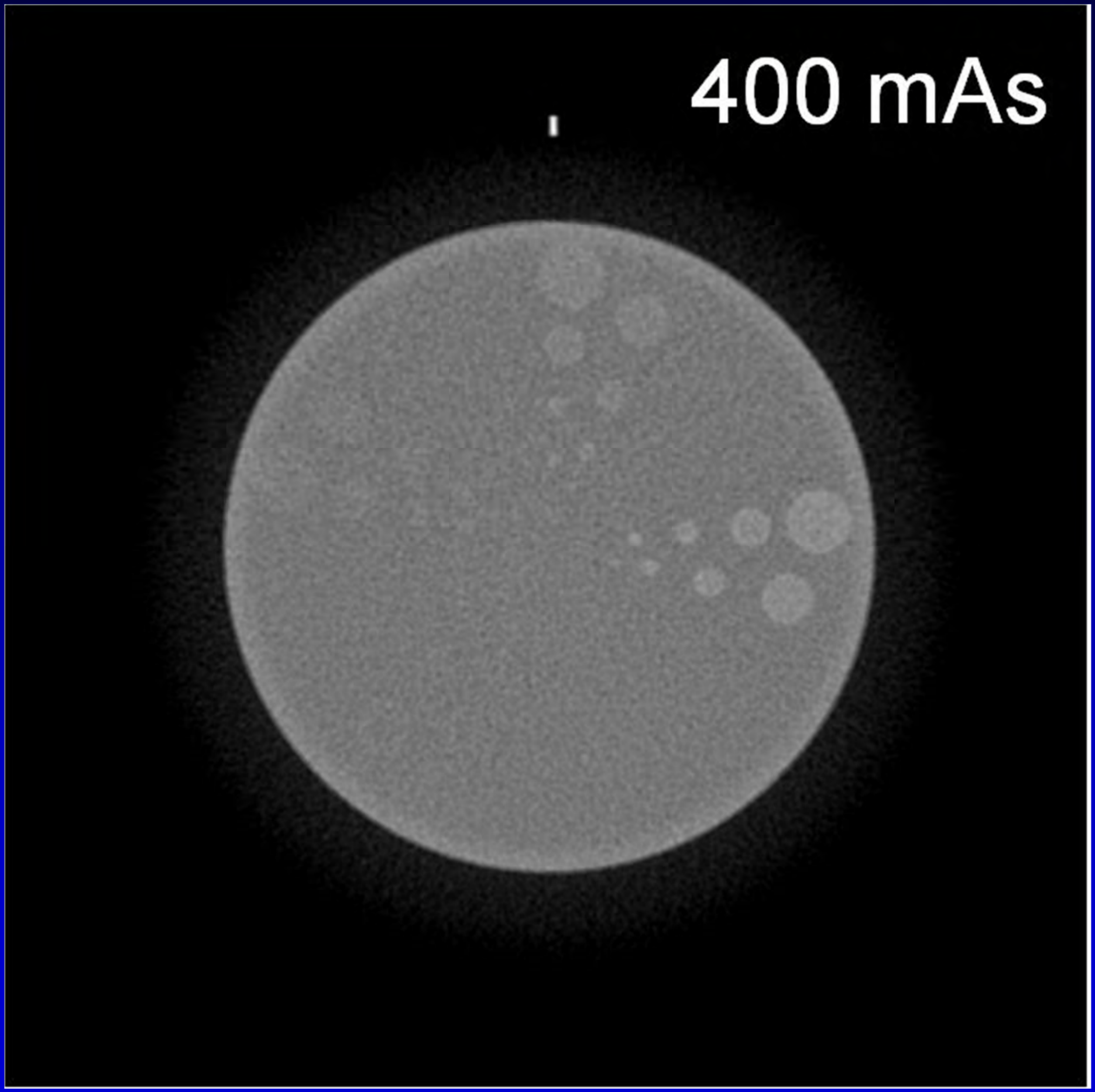

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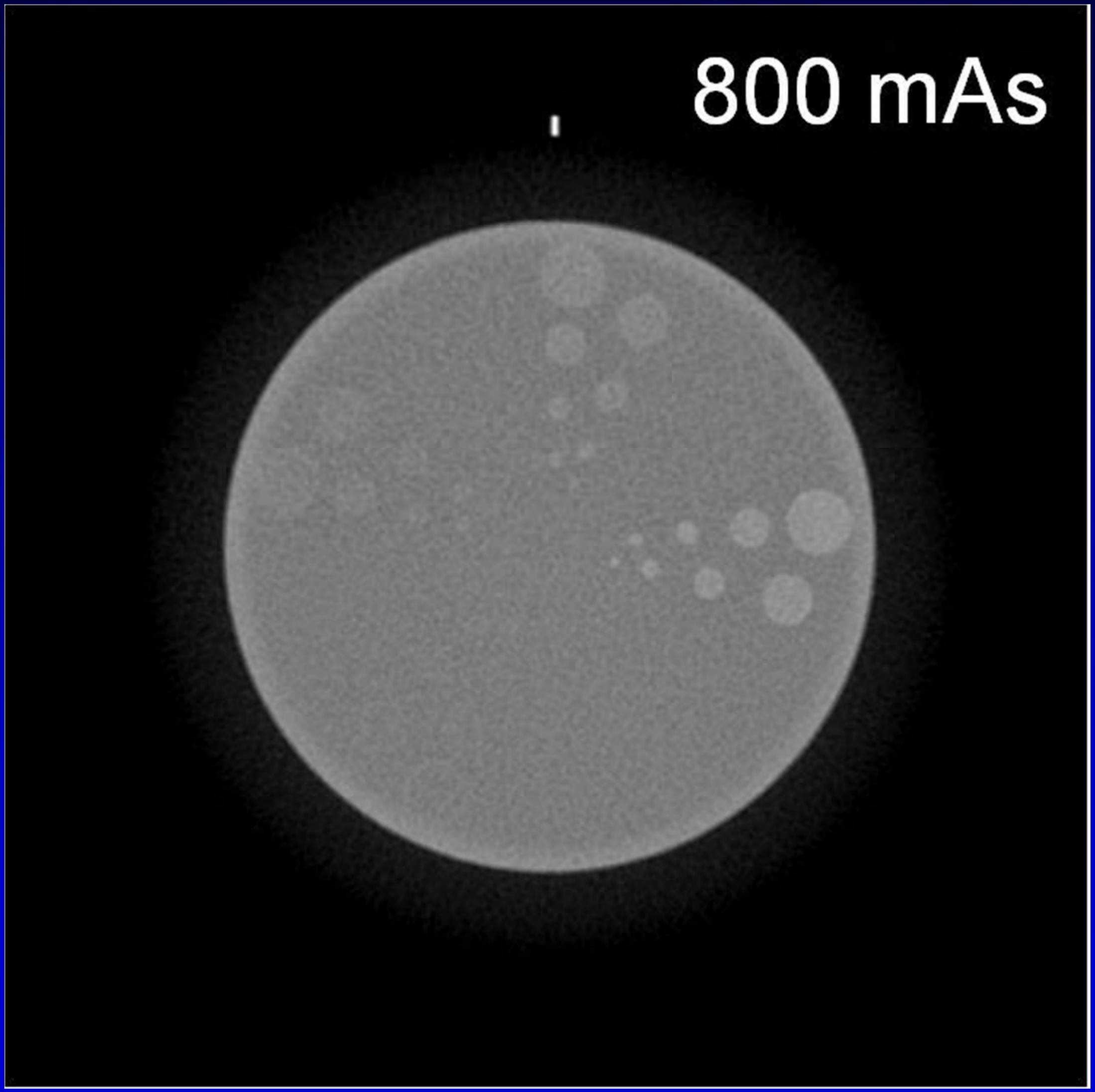
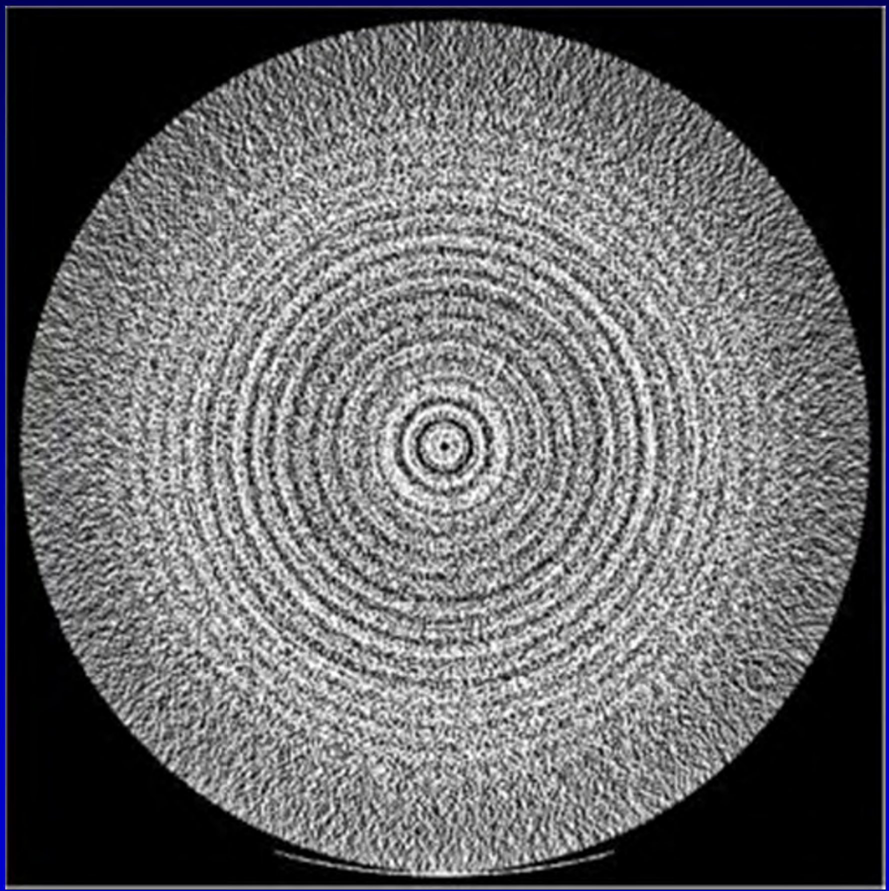


Artifacts from Data Acquisition Problems

- **Ring Artifacts**



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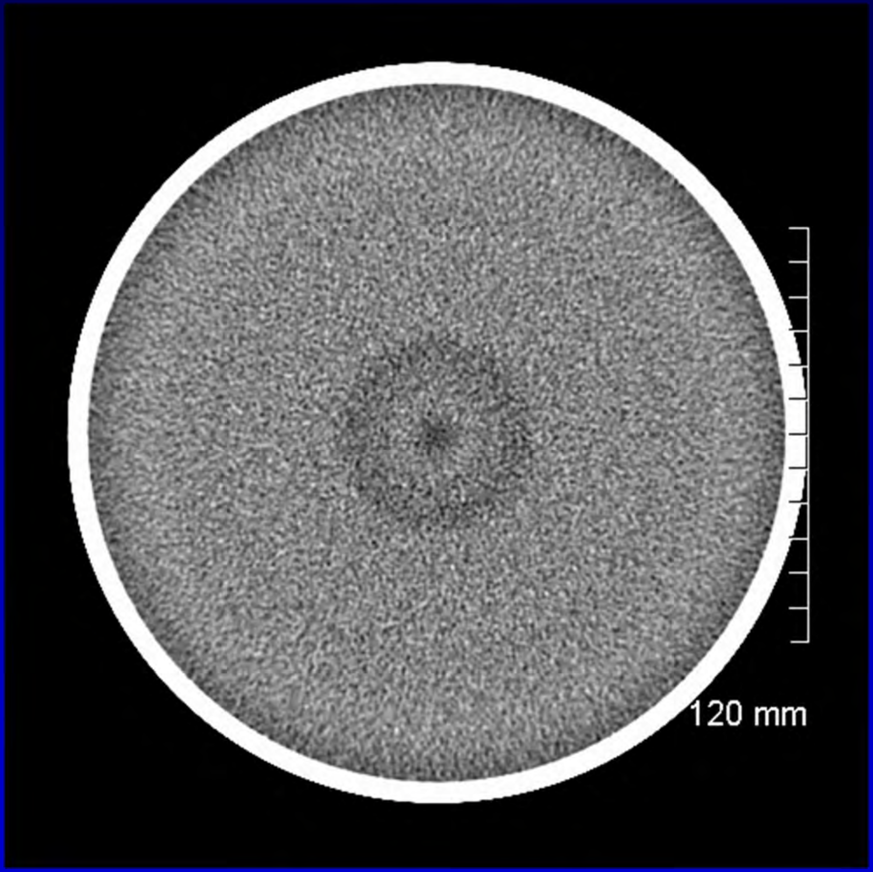

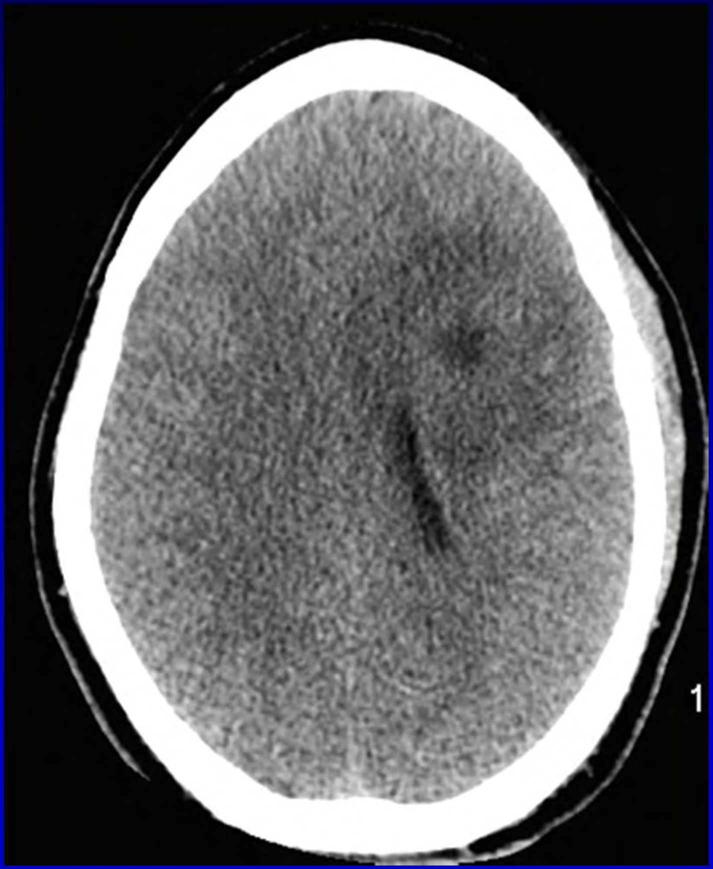

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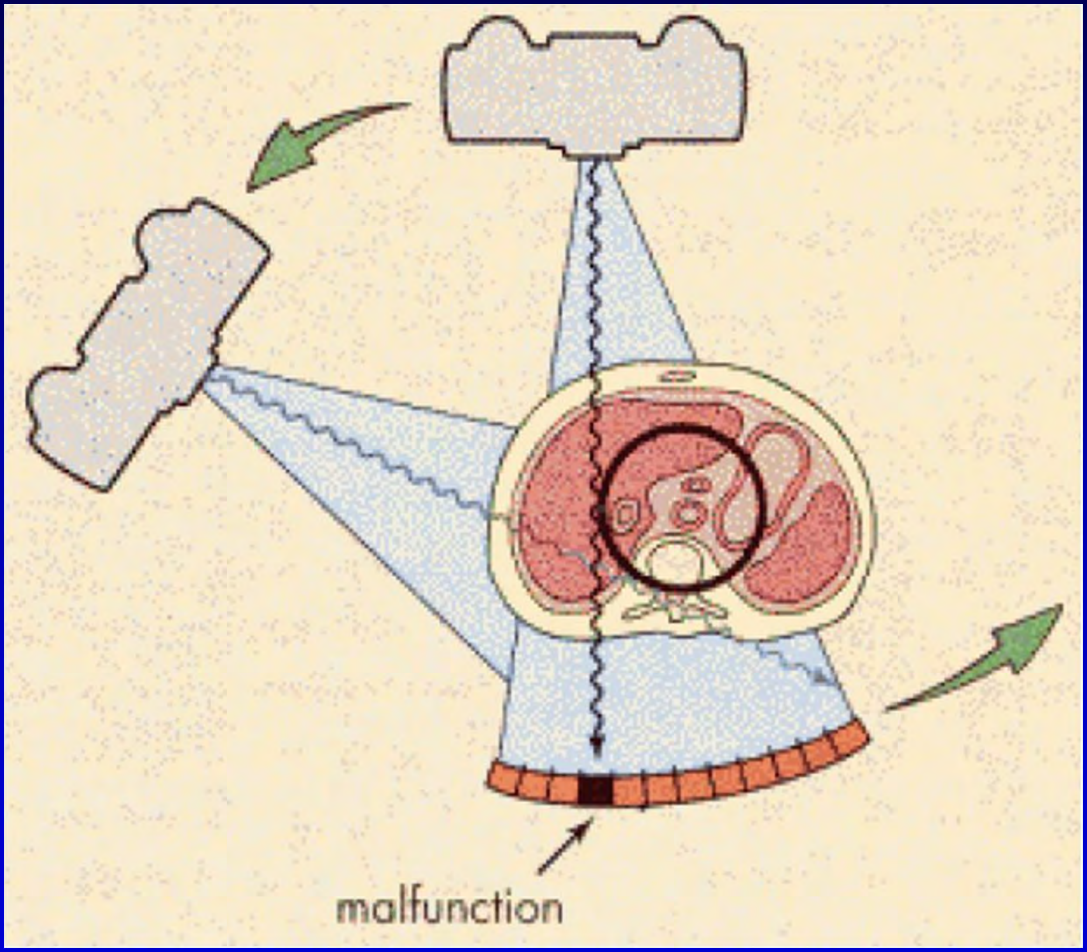
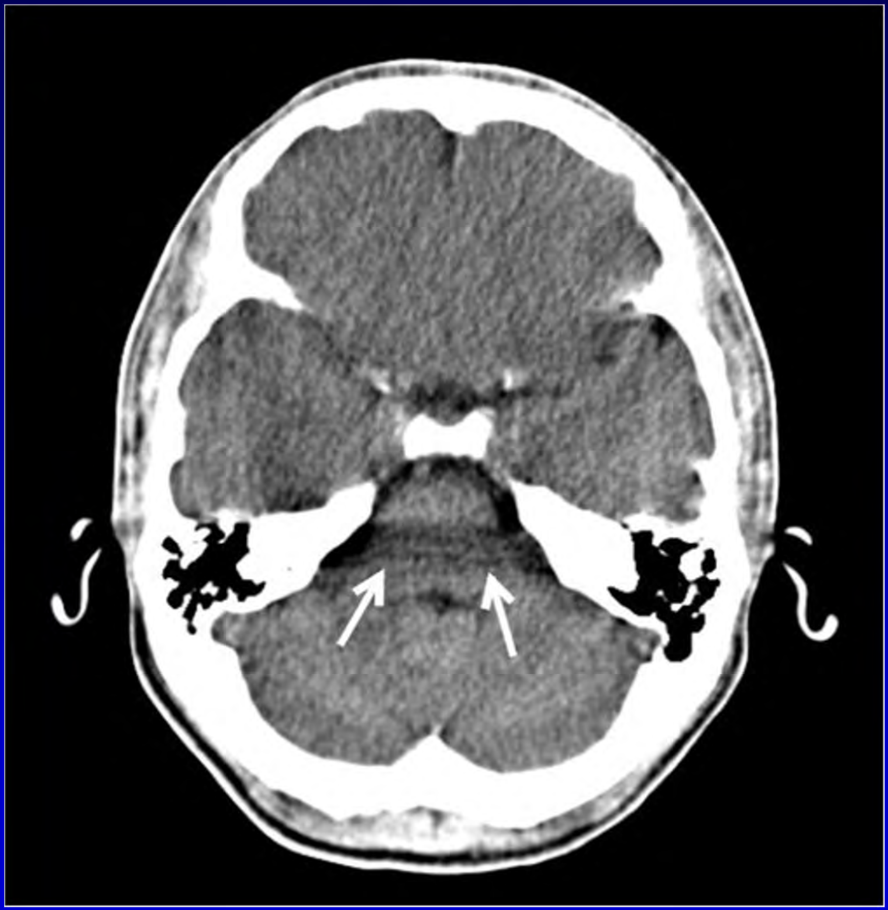


Beam Hardening & Partial Volume Artifacts



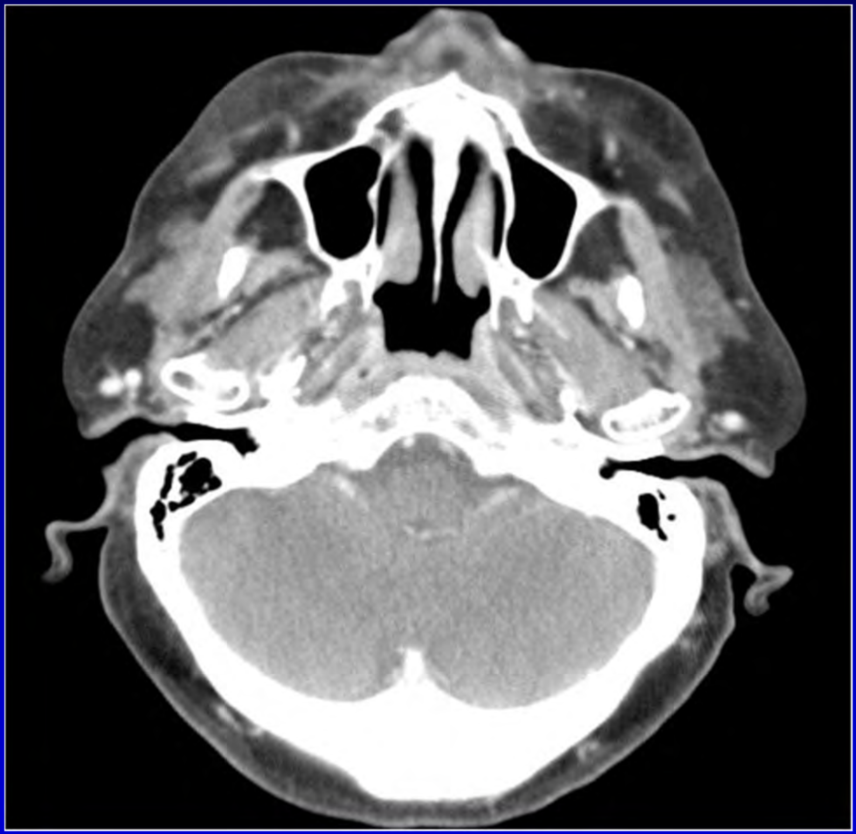
Beam Hardening & Partial Volume Artifacts

Reconstruction without iterative beam hardening correction

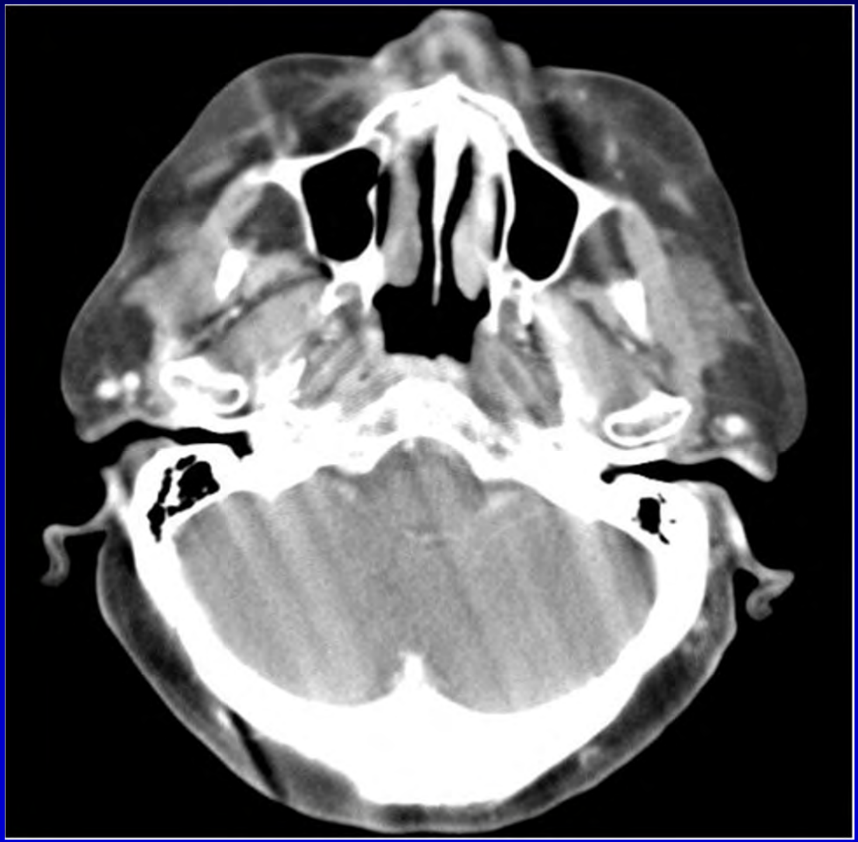
Reconstruction with iterative beam hardening correction

Motion Artifacts

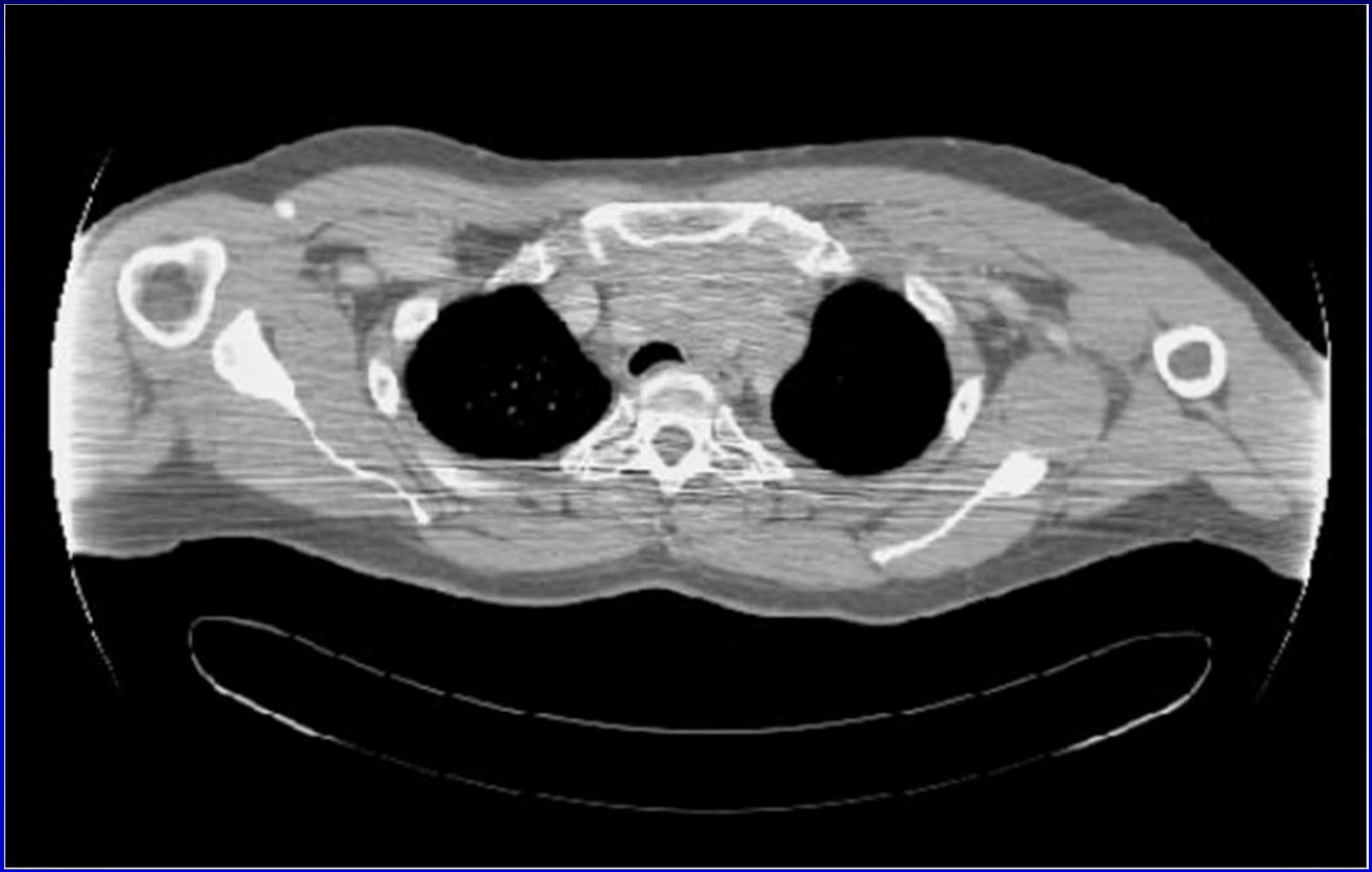
No Motion



With Motion



Artifact due to the patient extending outside the Scan Field of View; ALSO "Stringy" noise artifact



Effect of CT Protocols on Image Quality and Dose

Axial Scan Techniques Affecting Image Quality & Dose

- kV
- mAs – mA & rotation time
- Slice thickness

Helical Scan Techniques Affecting Image Quality & Dose

- kV
- mAs – mA & rotation time
- Slice thickness
- Pitch

Helical Scan Techniques Affecting Image Quality & Dose

Definition of Pitch for Multislice Helical / Spiral Scanning:

$$\text{Pitch}_{coll} = \frac{\text{Table travel per 360° tube rotation}}{\text{Total collimation width of all simultaneously collected slices}}$$

Helical Scan Techniques Affecting Image Quality & Dose

- **The image noise and patient dose for helical scanning is generally a function of mA x rotation time / pitch which is often referred to as "Effective mAs":**

Effective mAs = mAs / pitch

- **This is analogous to the use of $CTDI_{vol}$:**

$$CTDI_{vol} = CTDI_w / pitch$$

Helical Scan Techniques Affecting Image Quality & Dose

Effective mAs = mAs / pitch

- **Siemens and Toshiba scanners use the term "Effective mAs" in their scan techniques.**
- **Phillips uses the term "mAs/ slice", which means the same as effective mAs.**

Helical Scan Techniques Affecting Image Quality & Dose

Effective mAs = mAs / pitch

- **You may change the mA, rotation time, or pitch values, but if the effective mAs remains constant, so does the $CTDI_{vol}$ and the patient dose.**
- **If the effective mAs remains constant the image noise will also remain constant or nearly so.**

Manual vs. Automatic Exposure

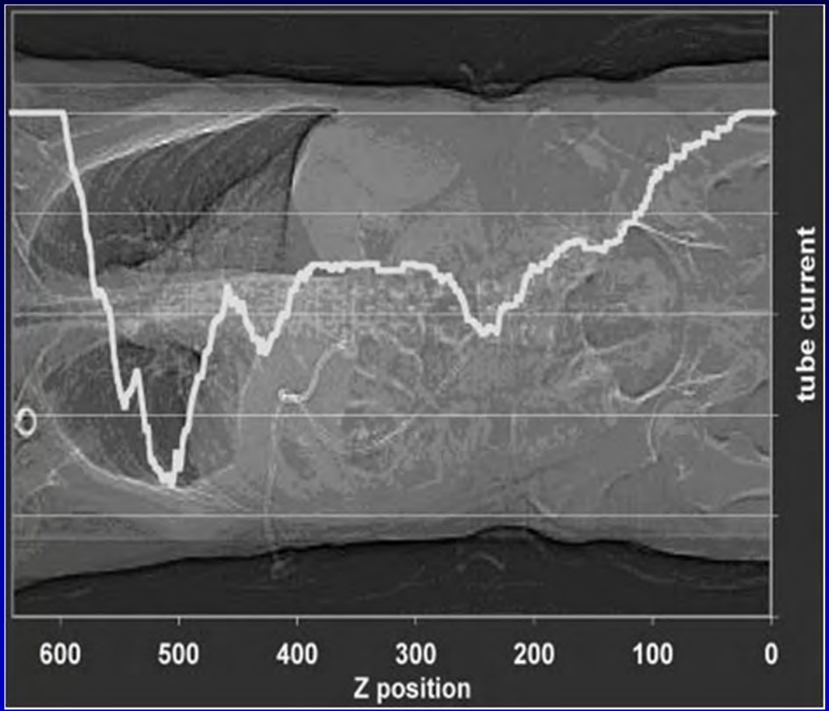
One deficiency of CT Scanners before 2001

- **They did not contain any type of "phototimer" or automatic exposure control (AEC) to assure a proper patient dose.**
- **Therefore, manual technique charts were needed for different patient sizes.**
- **Usually this was not done → so that techniques more suited for larger patients were used on all patients resulting in unneeded radiation exposure.**

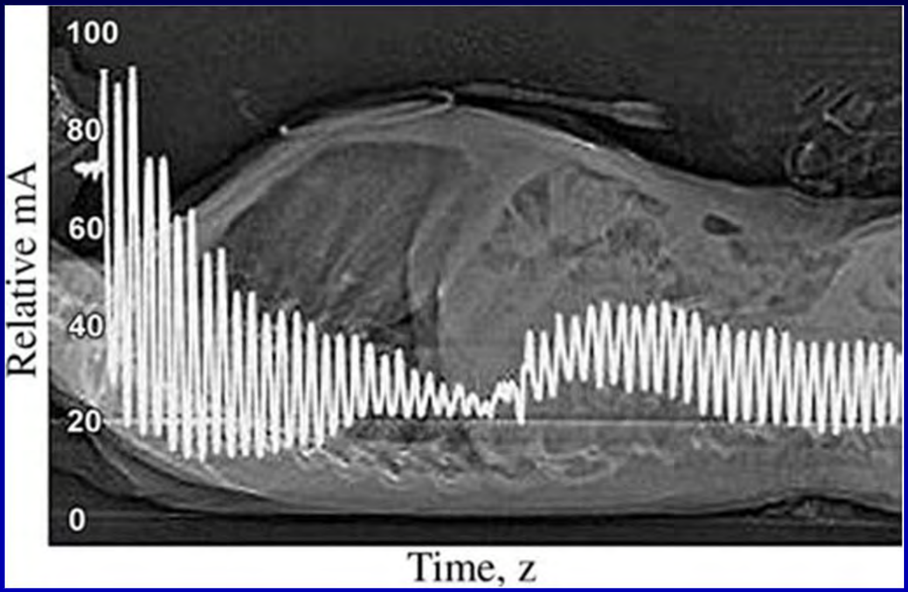
Automatic Exposure Control in CT Scanners

- Modern CT scanners have some type of automatic exposure control (AEC) that changes the mA during the scan.
- There are two basic types of AEC that can be used separately or together:
  - The scanner varies the mA at different axial positions of the patient.
  - The scanner varies the mA as the tube rotates around the patient.
- It is optimal to use both types together if the scanner allows it (Most do allow it).

Automatic Exposure Control in CT Scanners



The scanner varies the mA at different axial positions of the patient.



The scanner varies the mA at different axial positions of the patient and also varies the mA as the tube rotates around the patient.

Automatic Exposure Control in CT Scanners

- **Caution: The methods used by different manufacturers to perform AEC in CT are very different and may achieve very different clinical results.**

Automatic Exposure Control in CT Scanners

- Some scanners (GE, Toshiba) try to keep the image noise constant as patient size increases: the automatic exposure control is adjusted by selecting the amount of noise that you wish in the image. This is done by selecting a **"Noise Index"** or **"SD"** (standard deviation).
  - Typical values of Noise Index are **2.5 to 3.5** for a standard adult head scan and **12 to 20** for the body (for a 5 mm slice thickness).
  - The scanner attempts to keep the image noise constant by adjusting the mA within set limits.

Automatic Exposure Control in CT Scanners

- For scanners that use a "Noise Index" or "SD" for AEC:
  - The dose for a scan depends both on the "Noise Index" or "SD" **AND** the **slice thickness** selected for the **first** image reconstruction.
  - Let's say you want to view reconstructed slice thicknesses of both 5 mm and 1.25 mm:

    Suppose the first image reconstruction has a slice thickness of 5 mm with a Noise Index of 12. If the first image reconstruction is switched to a slice thickness of 1.25 mm, the Noise Index needs to be changed to 24 to keep the dose constant.

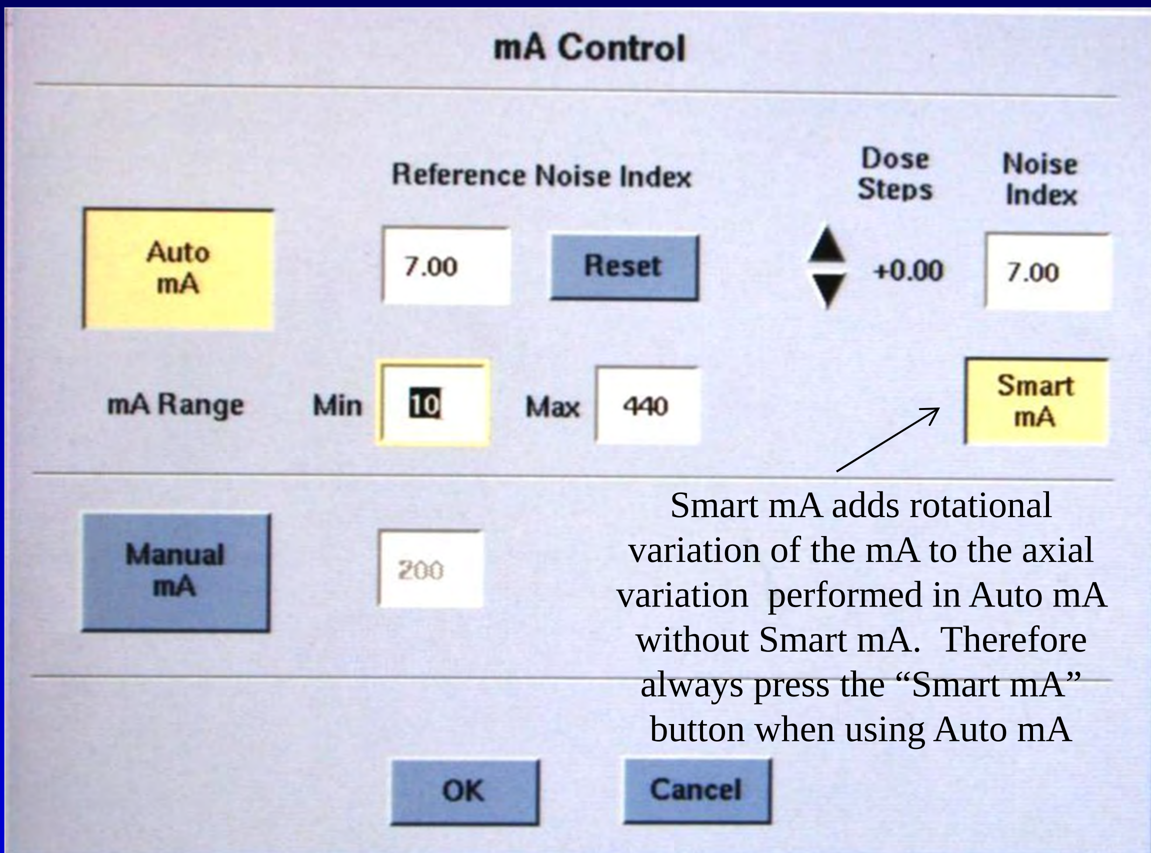
Automatic Exposure Control in CT Scanners

- For scanners that use a "Noise Index" or "SD" for AEC:
  - Example:
  - The same mA values and the same patient dose will result from the following settings:

Noise Index or SD	Slice Thickness
12	**5.0**
17 = 12 x $\sqrt{2}$	**2.5**
24 = 12 x 2	**1.25**

Automatic Exposure Control in CT Scanners

GE Example:



Smart mA adds rotational variation of the mA to the axial variation performed in Auto mA without Smart mA. Therefore always press the "Smart mA" button when using Auto mA

With GE scanners you must select whether you will be using manual techniques "Manual mA" or AEC techniques "Auto mA".

"Manual mA" uses an actual mA setting, "Auto mA" uses a Noise Index setting.

Having one set correctly in a protocol does nothing to insure the other is properly set.

Automatic Exposure Control in CT Scanners

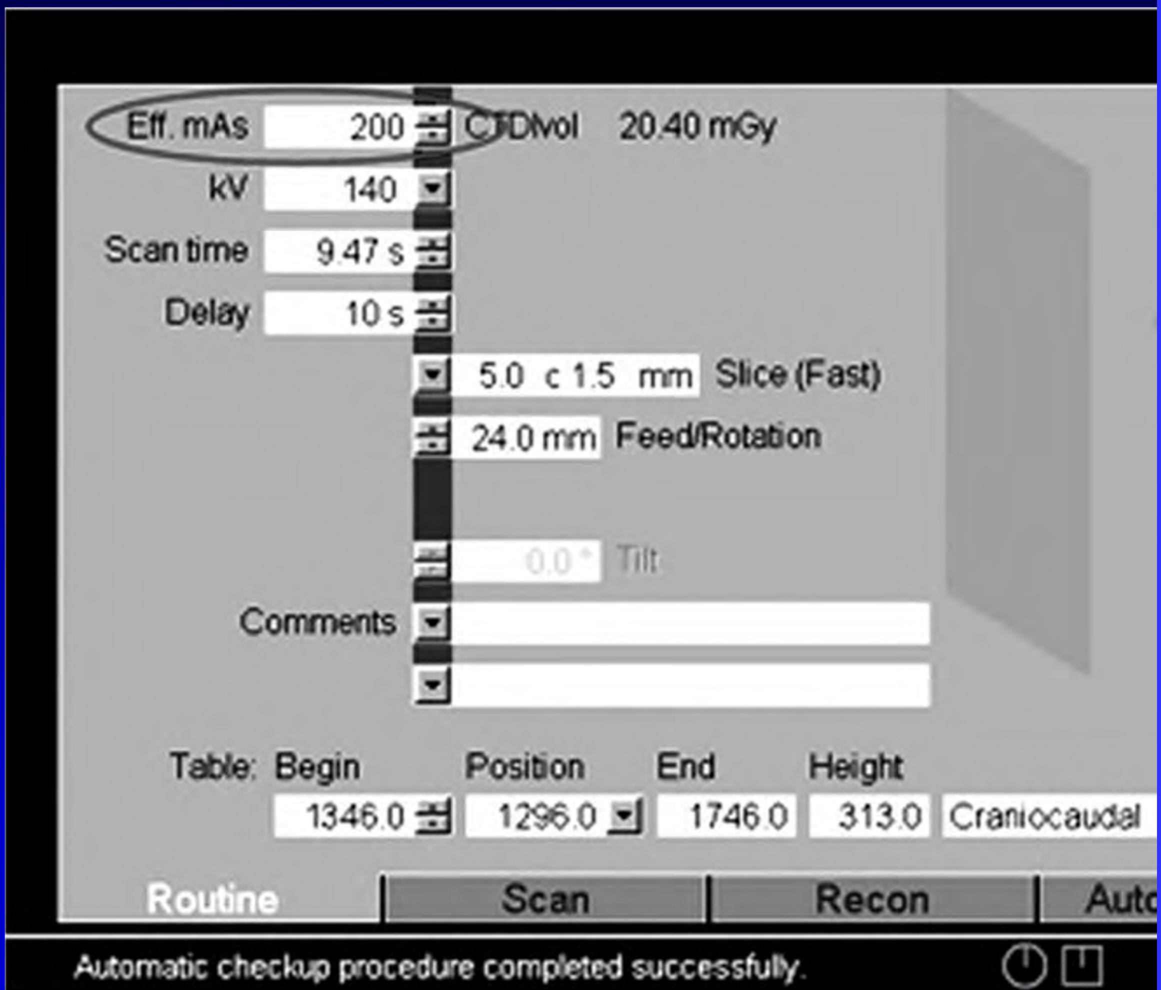
- Other scanners (Siemens, Philips) allow you to select the **"mAs"**, **"Effective mAs"**, or the **"mAs/ slice"** that you would use for an "reference" size patient. For Siemens scanners this selection is called the **"Quality reference mAs".**

- In AEC mode the scanner then automatically increases or decreases the effective mAs for larger or smaller patients. This is done by varying the mA.

Effective mAs
mAs/ slice **= (mA x rotation time) / pitch**

Automatic Exposure Control in CT Scanners

Siemens:



With Siemens scanners you select the "Eff. mAs" whether you will be using manual techniques OR AEC techniques.

In manual mode this is the actual eff. mAs used and in AEC mode it is the eff. mAs that you would desire for an "reference" size patient.

There is not the use of 2 different parameters for manual & AEC mode.

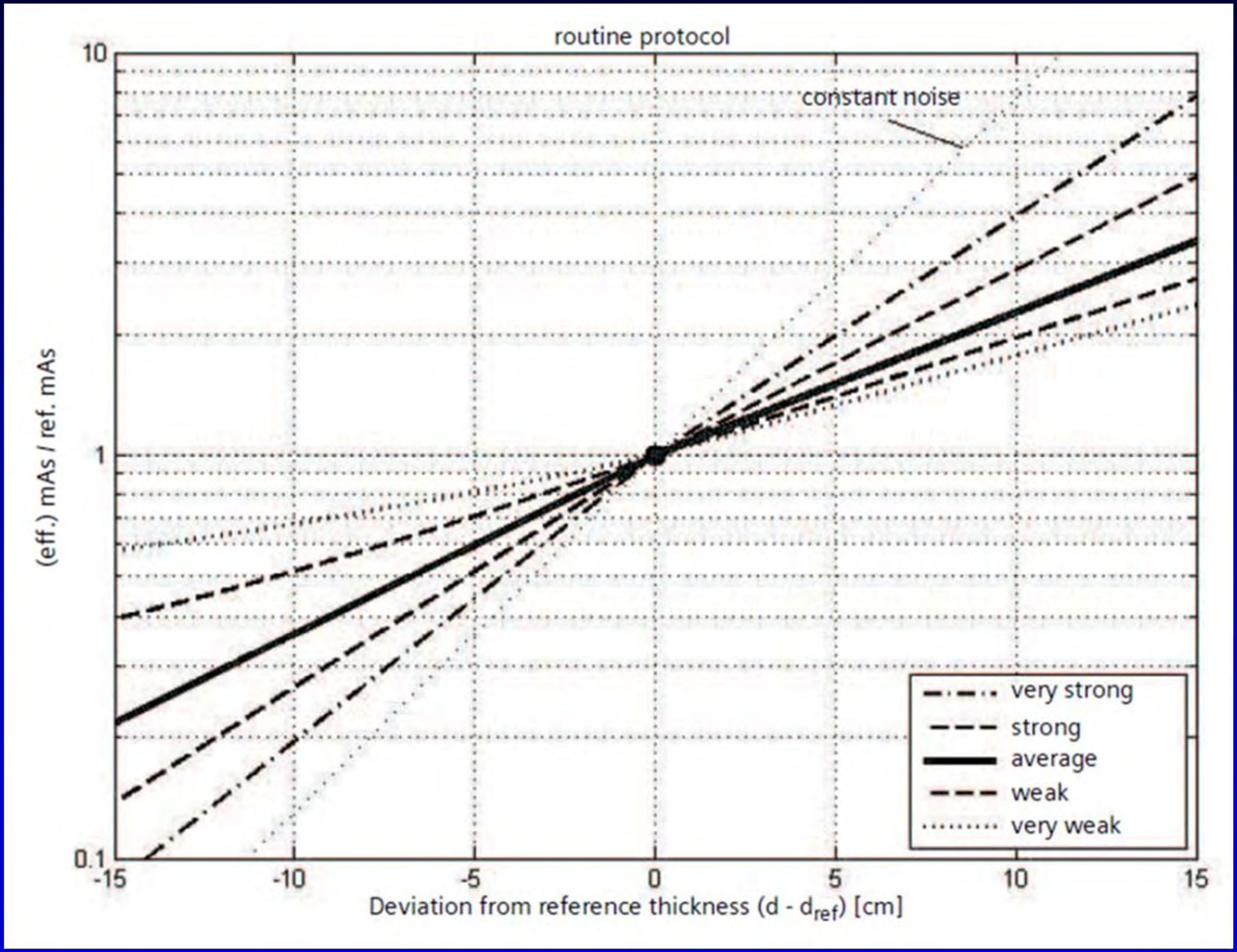
Automatic Exposure Control in CT Scanners

- Scanners that try to keep the image noise constant have the problem that they can quickly reach the maximum mA "ceiling" before getting to very large patients.

- Scanners that use a reference mAs setting will generally allow the mA to increase only modestly with increased patient size, allowing the image noise to increase substantially for large patients.

- What is needed is a new AEC approach and the use of higher kV for larger patients.

Automatic Exposure Control in CT Scanners



Automatic Exposure Control in CT Scanners

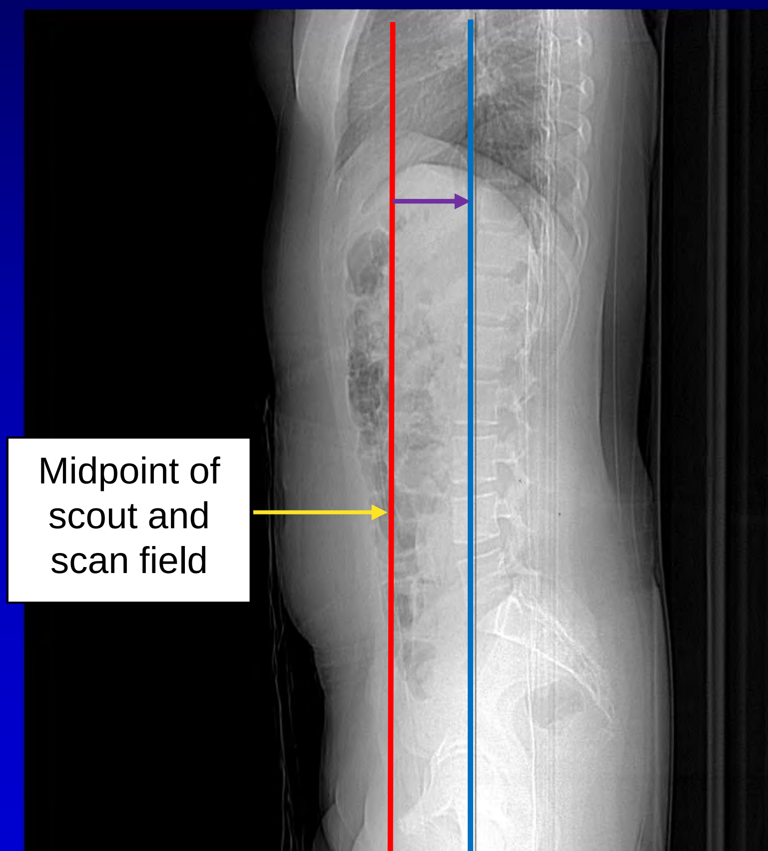
A Concern with All CT Scanner:

- Proper centering of the patient is very important for the proper operation of the AEC system.
- A common problem is mis-centering the patient too low in the scan field.

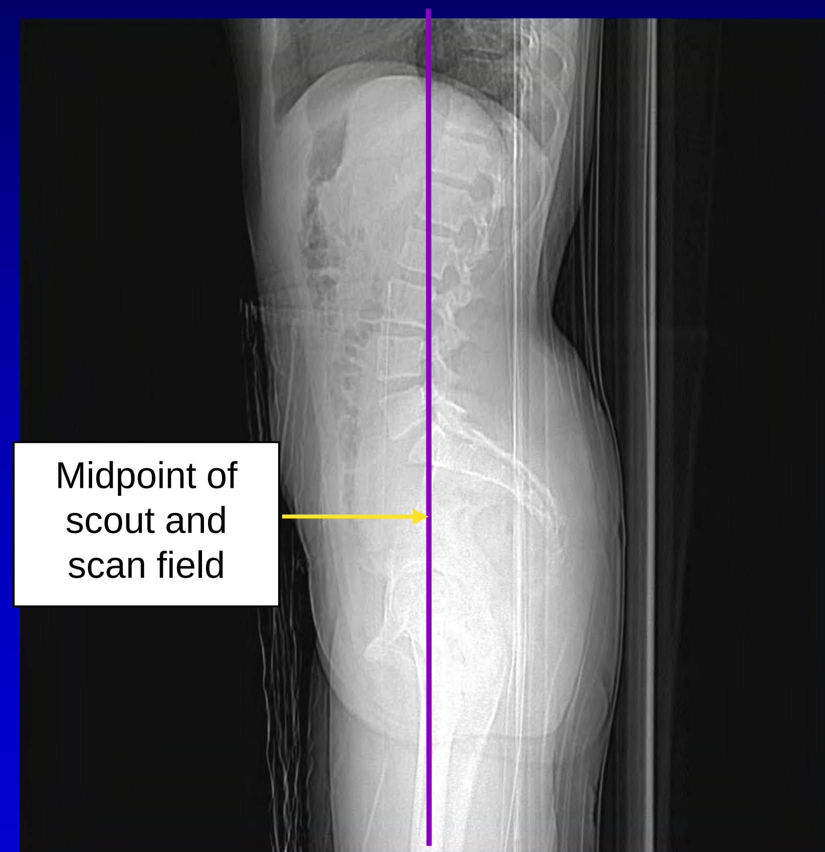
Automatic Exposure Control in CT Scanners

A Concern with All CT Scanner:

Patient positioned 6 cm too low



Patient positioned properly



Automatic Exposure Control in CT Scanners

A Concern with Older Siemens Scanners:

- **After performing the topo scan, Siemens scanners warn you if the available effective mAs is lower than the effective mAs requested by the AEC system, which would result in unacceptable image quality.**
- **However the scanner does not let you increase the kV, for example, from 120 to 140 which could solve the problem!**
- **This means a "work-around" is required: temporarily reduce the Quality Ref mAs to a very low value. You can then raise the kV to 140. Then increase the Quality Ref mAs to at least ½ of its original value, if possible.**

Automatic Exposure Control in CT Scanners

A Concern with GE and Toshiba Scanners:

- Since the GE and Toshiba scanners require two separate parameters for determining the mA in manual and AEC mode, one must understand the proper use of the "Noise Index" or "SD" parameter when using AEC.
- When switching from manual to AEC mode or from AEC to manual mode one must be sure that the exposure parameter of "manual mA" or "Noise Index/ SD" is properly adjusted. When one of these modes is the manufacturer's "default" mode, one should not assume that correct settings will result when switching modes.

Manual vs. Automatic Exposure - kV Adjustment -

- Increasing the kV will have different effects when using manual exposure mode and different types of automatic exposure modes.

Manual vs. Automatic Exposure - kV Adjustment -

- **For all CT scanners:**
  - **In a manual mode increasing the kV will always increase the patient dose, if all other scan parameters are kept constant.**

Manual vs. Automatic Exposure - kV Adjustment -

In AEC Mode:

- **With GE and Toshiba scanners, increasing the kV will decrease the patient dose, if all other adjustable scan parameters are kept constant (mA will decrease)**

- **With Siemens and Philips scanners, increasing the kV will increase the patient dose, if all other adjustable scan parameters are kept constant (mA will remain nearly constant)**

Optimizing CT Protocols:

Misconceptions

and

Recommendations

for

Scan and Imaging Parameters

kV

Misconceptions:

- **Scanning at 140 kV will reduce patient dose for any type of CT scan: head, body, adult or pediatric.**
- **For head scans, 140 kV should be used through the posterior fossa region to reduce image artifacts from bone.**

kV

Recommendations:

- **If we ignore beam hardening artifact limitations and CT scanner power limitations:**
  - **The theoretical optimal kV, for any CT imaging, is the kV that will give the highest ratio of contrast to noise at a given patient dose.**

kV

Recommendations:

- **For all Head CT scans and all Head or Body Pediatric scans this "theoretical optimal" would be close to 80 kV.**

- **For Adult Body CT scans this "theoretical optimal" will range from 80 kV up to 140 kV.**

kV

Recommendations:

- Modern CT scanners now have higher x-ray power & much more efficient use of this power through multi-slice design.

  They also have improved beam hardening/ bone correction algorithms.

  These improvements allow you to use lower kV settings – closer to the theoretical optimal.

Optimal kV Technique Setting for Axial or Helical Scanning

kV - Head CT – Peds and Adult

- Use **80 kV** for Peds Head 0 - 2y w/wo IV contrast.
- Use **80 kV** for Peds Head 2 - 6y w IV contrast.
- Use **100 kV** for Peds Head 2 - 6y wo IV contrast.
- Use **100 kV** for Adult Head w IV contrast.
- Use **120 kV** for Adult Head w/o IV contrast.

Optimal kV Technique Setting for Axial or Helical Scanning

kV – Body CT - Peds

- Use **80 kV** for Peds Body for whom the sum of lateral and AP dimensions is less than 44 cm.
- Use **100 kV** for Peds Body for whom the sum of lateral and AP dimensions is between 44 - 55 cm.
- Use Adult protocols for larger patients.

Optimal Technique Setting for Axial or Helical Scanning

kV – Body CT – Adults – wo IV contrast

- Use **100 kV** for Small Adults for whom the sum of lateral and AP dimensions is less than 55 cm.
- Use **120 kV** for Medium Size Adults.
- Use **140 kV** for Large Adults for whom the sum of lateral and AP dimensions is greater than 75 cm.
  - **140 kV** for Large Adults reduces image noise and provides better image quality without large exposure increases.

Optimal Technique Setting for Axial or Helical Scanning

kV – Body CT – Adults – w IV contrast

- Use **80 kV** for Small Adults for whom the sum of lateral and AP dimensions is less than 55 cm.
- Use **100 kV** for Medium Size Adults.
- Use **120 kV** for Large Adults for whom the sum of lateral and AP dimensions is greater than 80 cm.
  - Note: the use of lower kV produces a significant increase in the contrast of iodine, with better optimization of contrast to noise.

kV

Recommendations:

- For scanning the neck or upper thorax, the amount of lateral attenuation through the shoulders is a serious problem.
- It will cause some degree of horizontal streaking artifact through the shoulder, which is actually a noise effect.

kV

Recommendations:

- **Here the solution is to *increase* the kV from 120 kV to 140 kV to reduce the amount of lateral attenuation through the shoulders as much as possible and thus reduce this “noise” streaking artifact.**

kV and Pitch - Pediatric

Misconceptions:

- **Using 140 kV for children to reduce dose.**

  On the contrary this will generally raise the dose for equal image quality and is not recommended.

- **Using a pitch greater than 1.0 for children is often strongly recommended to reduce radiation dose.**

  This is usually totally misguided, as we will see shortly.

Pitch

Misconceptions

- **Scanning at higher pitch should be used as a strategy to reduce adult or pediatric patient dose and is the best way to reduce scan time and motion artifact and blur.**

WRONG!!!

Pitch

Misconceptions:

- A pitch of less than one over-irradiates the patient due to scanning overlap, and thus wastes radiation dose.
- Thus one should avoid using a pitch less than one, particularly in pediatric scans.

WRONG!!!

Pitch

Recommendations:

- Changing the pitch from 1.0 to 0.5 increases the patient dose by a factor of 2 but also decreases image noise.
- The effects on dose and noise are the same as increasing the mA or the rotation time by a factor of 2, but with the added advantage of decreasing helical artifacts.

Pitch

Recommendations:

- The effect of increased dose at lower pitch is easily countered by reducing the rotation time or mA in manual mode.
- There is NO increase in dose when decreasing pitch in AEC mode since the AEC mode in all scanners will keep the dose constant.

Pitch

Recommendations:

- **Lowering the pitch and decreasing the exposure time by the same factor will keep the patient dose and exam time constant, but provide better image quality – *you get something for nothing!***

Pitch

Recommendations:

Example:

- ***Change a 1.0 sec rotation time and a pitch of 1.6 to***

  a 0.5 sec rotation time and a pitch of 0.8

Pitch

Recommendations:

- **For head scanning ALWAYS use a pitch of less than 1.0 to minimize helical artifact.**
- **Best results are usually obtained with a pitch just above 0.5: 1 .**

Pitch

Recommendations:

- For body scanning use a pitch of **less than 1.0** whenever possible to minimize helical artifact and allow more radiation for the adequate imaging of larger patients.
- When decreasing pitch in body scans, you need to be aware of breath hold limitations and contrast considerations .

Dose Reduction

Recommendations:

- **Instead of increasing pitch, the proper dose reduction strategy is:**

  1. Reduce the rotation time (will reduce dose in manual mode and is the first step in AEC mode).

  2. Reduce the effective mAs (in manual or AEC mode); reduce the mA (in manual mode); or increase the noise index or SD (in AEC mode).

  3. Only then increase pitch if required to reduce total exam time.

Axial vs. Helical Scanning

Misconceptions:

- Heads should always be scanned using the axial rather than the helical mode or you will get a lower quality image.

Axial vs. Helical Scanning

Recommendations:

- Helical scanning will almost always allow an exam with equal or better image quality than an axial scan if you have a CT scanner with 16 or more slices and select proper scan techniques.
- Axial scanning is still useful if required for positioning of the patient to avoid artifacts, since tilting the gantry is not allowed with helical scanning.

Axial vs. Helical Scanning and slice reconstruction interval

Recommendations:

Advantages of Helical scanning:

- Shorter total scan time with less chance for patient motion during the scan.
- The ability to reconstruct slices at intervals less than the slice thickness.

VERY IMPORTANT!

Axial vs. Helical Scanning and slice reconstruction interval

Recommendations:

- With axial scanning, the slice reconstruction incrementation is normally equal to the slice thickness.

Axial vs. Helical Scanning and slice reconstruction interval

Recommendations:

- **With helical scanning, the slice reconstruction incrementation can be set at any value. The best z-resolution is obtained by reconstructing at intervals ½ of the actual slice thickness – this particularly helps with multiplanar reformatting.**
- **This is a significant advantage of helical scanning that is often not utilized.**

Axial vs. Helical Scanning and slice reconstruction interval

Recommendations:

- When creating slices for reformating of axial images to a modified axial plane, or for sagittal or coronal images, ALWAYS use thin slices as the source images, if this is not done automatically by the scanner. DO NOT USE 5 mm slices!
- For soft tissue recons use 1.0 to 1.5 mm slice thickness.
- For bone or high res recons use 0.5 to 0.75 mm slice thickness.

Detector Configuration

Misconceptions:

- The acquisition slice width (acquisition detector configuration) can be equal to the reconstructed slice thickness without causing image degradation.

Detector Configuration

Recommendations:

- Streaking artifacts off of bone and air are due to both beam hardening and partial volume artifacts.
- Thus it is important to use scan techniques to reduce partial volume artifacts.

Detector Configuration

Recommendations:

- **To minimize partial volume artifacts in head scans always use the smallest detector width in acquiring the scan data, *regardless* of the imaged slice thickness.**
- **You may be restricted in some body scans since using the smallest detector width can also reduce the total beam width and increase the exam time.**

Detector Configuration

Recommendations:

- For head scans this means using 16 x 0.5 mm, 16 x 0.6 mm, or 16 x 0.625 mm for a 16 slice scanner and using 32, 40, or 64 x 0.5, 0.6, or 0.625 mm for 32 to 64 slice scanners.
- Do not use 2.5 mm or 5 mm acquisition for example.

Detector Configuration

Recommendations:

- With a GE 16 slice scanner you can use a 16 x 0.625 acquisition for the best quality in the head, but this only gives you a 10 mm beam width.
- In the body you may need to go to a 16 x 1.25 acquisition which provides a 20 mm beam width and allows you to scan at twice the speed.

Detector Configuration

Recommendations:

- **However the 16 slice GE scanner also allows you to use it in an 8 slice mode: 8 x 1.25 mm or 8 x 2.5 mm - which should NEVER BE USED.**
- **Likewise the GE 8 slice scanner can also be used in a 4 slice mode - which again should NEVER BE USED.**

CT Protocols

Abdomen/ Pelvis **--Medium Adult--**

From Recon 2: Sa & Co Reformat: Ave., 5.0 mm thick 2.5 mm interval

	CT 1	CT 2	CT 3	CT 4 &	East & RP CT
Scanner	GE Opt CT580W	GE LS 16	GE LS 16 Pro	GE LS VCT 64	GE LS 8
Scan Type	Helical	Helical	Helical	Helical	Helical
Detector Coverage (mm) Beam Collimation (mm)	20	20	20	40	10
Detector Rows	16	16	16	64	8
Detector Configuration	16 x 1.25	16 x 1.25	16 x 1.25	64 x 0.625	8 x 1.25
Scan FOV	Large	Large	Large	Large Body	Large
Pitch	0.938	0.938	0.938	0.516	1.35
Speed (mm/rot)	18.75	18.75	18.75	20.64	13.5
Rotation Time (sec)	0.7	0.7	0.6	0.4	0.6
kV	120	120	120	120	120
Smart/ Auto mA or Manual mA	Smart mA	Auto mA	Smart mA	Smart mA	Auto mA
Smart mA/ Auto mA Range	60-660	50-440	60-660	50-400	80-440
Noise Index	**12**	**12**	**12**	**15**	**12**
(Manual mA)	(470)	(380)	(440)	(330)	(440)
% Dose Reduction (ASiR)				None	
Slice Thickness (mm)	5.0	5.0	5.0	5.0	5.0
Interval (mm)	3.0	3.0	3.0	3.0	3.0

CT Protocols

Recon 1:					
DFOV	36	36	36	36	36
Recon Type	Standard	Standard	Standard	Standard	Standard
WW/ WL	325/15	325/15	325/15	325/15	325/15
Recon Option	Plus	Plus	Plus	Plus	Plus
ASiR Setup				**Slice 40%**	
Recon 2:					
DFOV	36	36	36	36	36
Recon Type	Standard	Standard	Standard	Standard	Standard
WW/ WL	325/15	325/15	325/15	325/15	325/15
Recon Option	Plus	Plus	Plus	Plus	Plus
Recon Option				IQ Enhance	
ASiR Setup				**Slice 40%**	
Slice Thickness (mm)	1.25	1.25	1.25	1.25	1.25
Interval (mm)	0.625	0.625	0.625	0.625	0.625