# Mastering Digital Radiography

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WHITE PAPER

# Best Practices in Digital Radiography

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asrt

American Society of Radiologic Technologists

**Published in 2012**

# ASRT Best Practices in Digital Radiography

- Radiographers need to take responsibility for understanding and appropriately performing digital radiography procedures because it is their professional duty and **an essential component of the radiographers' practice standards and code of ethics.**

# A few of the 25 Best Practices Discussed

- Optimum kVp
- Technique charts
- Using Exposure Index (EI) numbers
- Post collimation/shuttering
- Grids
- Using the AEC
- Shielding
- Using anatomic side markers

The following slides show a hand phantom exposed from 50 to 100 kV to demonstrate the minute differences visualized on an image using higher kV and lower mAs with DR.

# DR 50 kV

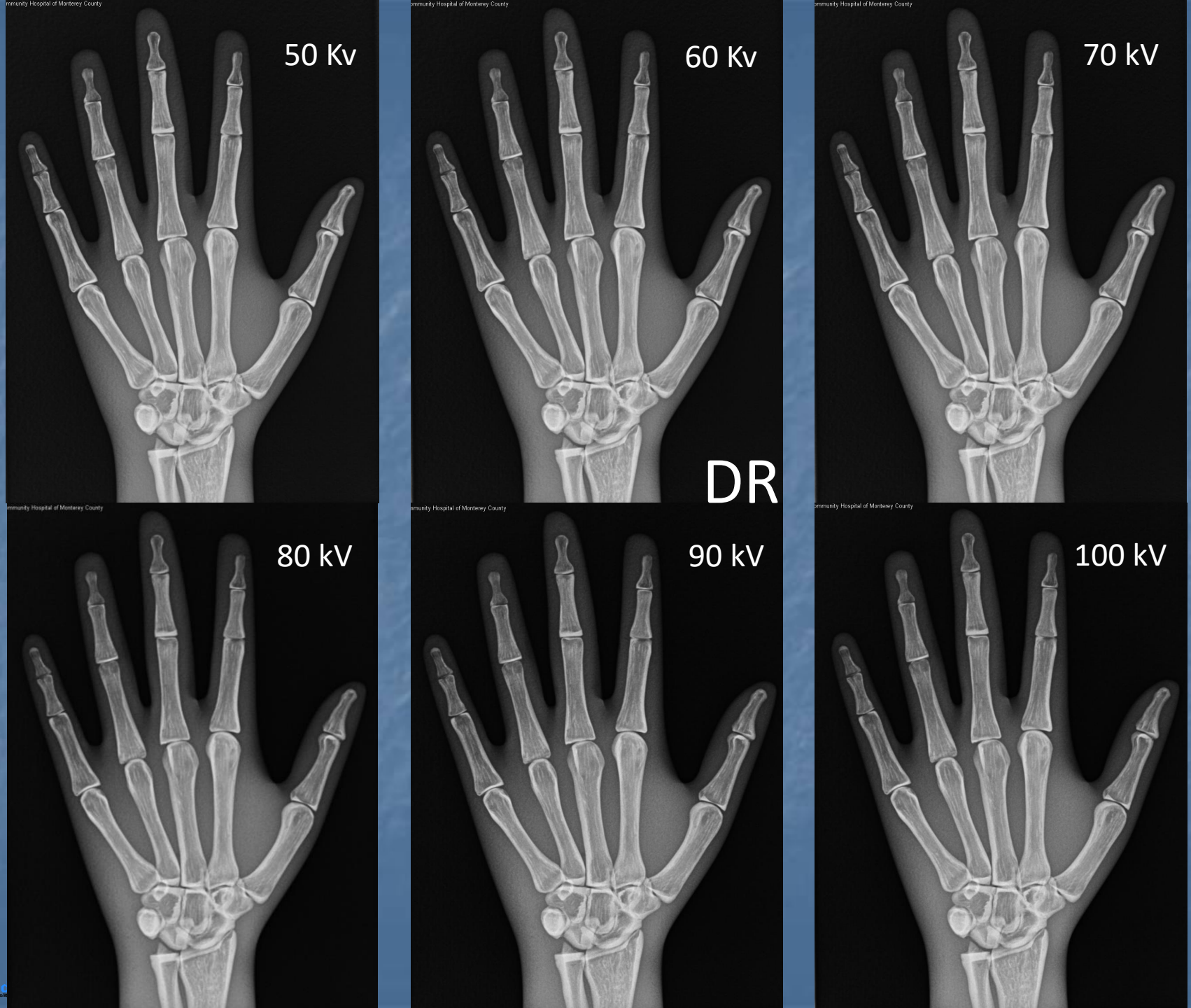
# DR 60 kV

# DR 70 kV

# DR 80 kV

# DR 90 kV

# DR 100 kV


50 Kv
60 Kv
70 kV
DR
80 kV
90 kV
100 kV

# These are the 15-20 kV (higher than film) digital optimum kVs developed by Barry Burns

| DIGITAL OPTIMUM kV | |
|---|---|
| **Body Part** | **kV** |
| Chest (Bucky/Grid) | **117-125** |
| Chest (Non Grid) | **85-95 (105)** |
| Abdomen | **85-95** |
| Abdomen (Iodine) | **75-80** |
| Extremities (Table Top) | **65-75** |
| Extremities (Grid) | **70-80** |
| Extremities (Bucky) | **75-85** |
| AP Spines | **85-95** |
| C-Spine Lateral | **85-100** |
| T-Spine Lateral | **85-100** |
| L-Spine Lateral | **85-100** |
| Ribs (Upper and Lower) | **80-90** |
| Skull | **80-90** |
| BE – (Regular) | **110-120** |
| BE – (Air Contrast) | **100-110** |
| **Pediatric:** | |
| Infant Extremities | **50-65** |
| Pediatric Chest (Non Grid) | **70-85** |

# ASRT Best Practices concerning kVp

- Use the highest kVp within the optimal range for the position and part coupled with the lowest amount of mAs as needed to provide an ***adequate*** **exposure to the image receptor**.
- CHOMP radiologist's want to see a little "diagnostic" or "acceptable" mottle.

# Universal CR Technique Chart

## 100% More mAs

**UNIVERSAL CR TECHNIQUE CHART** **Least mAs (450 Speed)**

| Part | View | Small | | Medium | | Large | |
|---|---|---|---|---|---|---|---|
| All techniques are male patients. If female, subract 10 lbs. | | 120-160 lbs. | | 160-200 lbs. | | 200-240 lbs. | |
| | | kV | mAs | kV | mAs | kV | mAs |
| Abdomen **(33% More)** | AP (grid -40") | 85 | 18 | 85 | 20 | 85 | 32 |
| Ankle | AP | 70 | 1.8 | 70 | 2.1 | 70 | 2.4 |
| Ankle | Lat | 70 | 1.5 | 70 | 1.8 | 70 | 2.1 |
| Chest -Adult | AP (grid) | 120 | 1.5 | 120 | 2.2 | 120 | 3 |
| Chest -Adult | AP (non grid) | 85 | 1.6 | 85 | 2.4 | 85 | 3.1 |
| Chest (2-9 lb) | AP (non grid - 40") | 75 | 0.9 | 75 | 1.2 | 75 | 1.5 |
| Chest (2-9 lb) | Lat (non grid - 40") | 77 | 1.2 | 77 | 1.5 | 77 | 1.8 |
| Chest (10-20 lb) | PA (non grid - 72") | 80 | 0.75 | 80 | 1 | 80 | 1.2 |
| Chest (10-20 lb) | Lat (non grid - 72") | 83 | 1 | 83 | 1.2 | 83 | 1.4 |
| Chest (25-35 lb) | PA (non grid - 72") | 82 | 1 | 82 | 1.2 | 82 | 1.4 |
| Chest (25-35 lb) | Lat (non grid - 72") | 85 | 1.2 | 85 | 1.4 | 85 | 1.6 |
| C-Spine | AP (grid - 40") | 85 | 2.8 | 85 | 3.6 | 85 | 4.5 |
| C-Spine | AP (non grid - 40") | 70 | 2.2 | 70 | 3 | 70 | 3.9 |
| C-Spine | Odontoid (grid - 40") | 85 | 3.6 | 85 | 4.5 | 85 | 5.4 |
| C-Spine | Lat (grid - 72") | 85 | 8.2 | 85 | 9.9 | 85 | 12.9 |
| C-Spine | Lat (non grid - 72") | 70 | 6 | 70 | 7.8 | 70 | 10.2 |
| C-Spine | Swimmers (grid - 40") | 95 | 24 | 95 | 39 | 95 | 54 |
| Elbow | AP | 70 | 1.3 | 70 | 1.5 | 70 | 1.8 |
| Elbow | Oblique/Lateral | 70 | 1.4 | 70 | 1.6 | 70 | 1.9 |
| Finger | All Views | 66 | 0.6 | 66 | 0.75 | 66 | 0.9 |
| Foot | AP | 70 | 1.2 | 70 | 1.5 | 70 | 1.8 |
| Foot | Lat | 70 | 1.8 | 70 | 2.1 | 70 | 2.4 |
| Forearm | AP/Lat | 70 | 1.1 | 70 | 1.3 | 70 | 1.6 |
| Hand | PA | 66 | 0.7 | 66 | 0.9 | 66 | 1.1 |
| Hand | Lat | 70 | 1.1 | 70 | 1.3 | 70 | 1.6 |
| Hip | AP (grid ) | 85 | 6.3 | 85 | 9.4 | 85 | 11.7 |
| Hip | AP ( non grid ) | 75 | 3.9 | 75 | 4.8 | 75 | 6 |
| Hip | X-Table Lat (grid) | 90 | 30 | 90 | 45 | 90 | 60 |
| Humerus | AP (grid) | 77 | 2.8 | 77 | 3.3 | 77 | 3.8 |
| Humerus | AP ( non grid ) | 70 | 2.1 | 70 | 2.4 | 70 | 2.7 |

# Universal CR Technique Chart
# 100% More mAs (Page 2)

**UNIVERSAL CR TECHNIQUE CHART 100% More mAs (225 Speed)**

| Part | View | Small | | Medium | | Large | |
|---|---|---|---|---|---|---|---|
| All techniques are male patients. If female, subract 10 lbs. | | 120-160 lbs. | | 160-200 lbs. | | 200-240 lbs. | |
| | | kV | mAs | kV | mAs | kV | mAs |
| Knee | AP/Lat (grid) | 85 | 7.5 | 85 | 9 | 85 | 10.5 |
| Knee | AP/Lat (non grid) | 70 | 6 | 70 | 7.5 | 70 | 9 |
| Knee | Sunrise (non grid) | 70 | 7.5 | 70 | 9 | 70 | 10.5 |
| L-Spine | AP (grid) | 90 | 21 | 90 | 30 | 90 | 42 |
| L-Spine | Oblique (grid) | 90 | 33 | 90 | 48 | 90 | 66 |
| L-Spine | X-Table Lat (grid) | 95 | 48 | 95 | 66 | 95 | 90 |
| Mandible | PA (grid) | 85 | 9 | 85 | 12 | 85 | 15 |
| Mandible | Obl (grid - 40") | 81 | 6.9 | 81 | 9.6 | 81 | 12.3 |
| Mandible | Obl (non grid - 40") | 70 | 6 | 70 | 8.4 | 70 | 10.8 |
| Nasal Bones | Lateral (non grid) | 70 | 4.5 | 70 | 5.7 | 70 | 6.9 |
| Pelvis | AP (grid) | 85 | 18 | 85 | 27 | 85 | 36 |
| Ribs | PA Upper (72") | 85 | 18 | 85 | 24 | 85 | 30 |
| Ribs | Obl Upper (72") | 85 | 27 | 85 | 36 | 85 | 45 |
| Ribs | AP Lower (40") | 85 | 18 | 85 | 27 | 85 | 36 |
| Shoulder | AP (grid) | 85 | 9.3 | 85 | 13.5 | 85 | 18 |
| Shoulder | AP (non grid) | 70 | 6 | 70 | 8.1 | 70 | 9.9 |
| Shoulder | Y View (grid) | 85 | 25 | 85 | 34 | 85 | 48 |
| Shoulder | Axillary (non grid) | 70 | 6 | 70 | 8.4 | 70 | 10.5 |
| Sinus | Caldwell | 85 | 10.5 | 85 | 13.2 | 85 | 16 |
| Sinus | Waters | 85 | 12 | 85 | 15 | 85 | 18 |
| Sinus | Lateral | 85 | 5.4 | 85 | 7 | 85 | 8.7 |
| Skull | PA | 85 | 10 | 85 | 12.6 | 85 | 15.3 |
| Skull | Lat (grid) | 85 | 7.5 | 85 | 9 | 85 | 10.5 |
| Tib-Fib | AP/Lat (non grid) | 70 | 4.2 | 70 | 5.5 | 70 | 7.1 |
| Toe | All Views | 66 | 1.5 | 66 | 1.8 | 66 | 2.1 |
| T-Spine | AP | 85 | 16.5 | 85 | 22.5 | 85 | 28.5 |
| T-Spine | Lat (breathing) | 90 | 39 | 90 | 54 | 90 | 69 |
| Wrist | PA | 66 | 1.8 | 66 | 2.4 | 66 | 3 |
| Wrist | Lat | 70 | 2.4 | 70 | 3 | 70 | 3.6 |
| Zygomatic Arch | AP Axial - Townes | 80 | 7.8 | 80 | 9.6 | 80 | 10.8 |
| Zygomatic Arch | SMV (grid) | 80 | 7.5 | 80 | 9.3 | 80 | 11.1 |
| Zygomatic Arch | SMV (non grid) | 70 | 6.3 | 70 | 8 | 70 | 10 |

# DR **Obese** Technique Chart – Least mAs

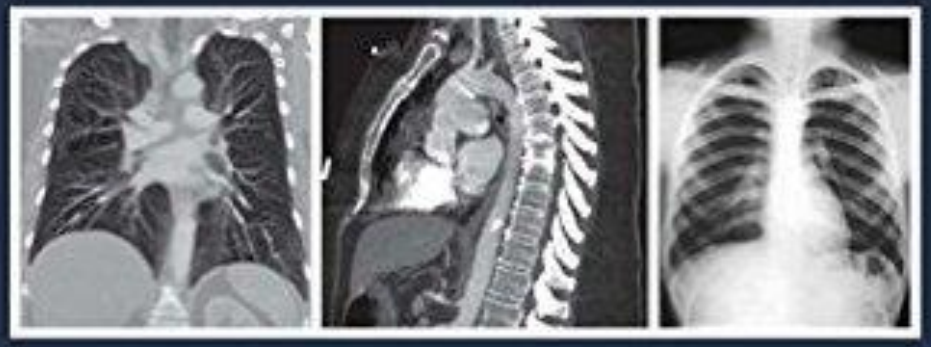
| X-Large and XX-Large DR TECHNIQUE CHART Least mAs | | | | | |
|---|---|---|---|---|---|
| | | X-Large 240-280 lbs | | XX-Large **(Obese)** 280-330 lbs | |
| **Part** | **Projection** | | | | |
| | (ng = non grid) | **kV** | **mAs** | **kV** | **mAs** |
| Abdomen | AP (grid - 40") | 85 | 30 | 85 | 60 |
| Ankle | AP (ng) | 70 | 2.4 | 70 | 3.6 |
| Chest | AP (grid) | 120 | 4 | 120 | 6 |
| C-Spine | AP (grid - 72") | 90 | 16 | 90 | 25 |
| C-Spine | Lat (grid - 72") | 90 | 20 | 90 | 30 |
| C-Spine | Swimmers (grid - 40") | 95 | 80 | 95 | 130 |
| Elbow | AP (ng) | 70 | 2 | 70 | 3 |
| Finger | All Views | 68 | 1.2 | 68 | 1.8 |
| Foot | AP (ng) | 70 | 2 | 70 | 3 |
| Forearm | AP (ng) | 70 | 2 | 70 | 3 |
| Hand | PA (ng) | 68 | 1.2 | 68 | 1.8 |
| Hip | AP | 85 | 20 | 85 | 40 |
| Hip | X-Table Lat (grid - 40") | 90 | 100 | 90 | 200 |
| Humerus | AP (grid) | 80 | 6 | 80 | 12 |
| Humerus | Transthoracic Lat | 90 | 60 | 90 | 120 |
| Knee | AP/Lat (grid - 40") | 85 | 6 | 85 | 10 |
| L-Spine | AP | 90 | 40 | 90 | 80 |
| L-Spine | X-Table Lat (grid - 40") | 95 | 80 | 95 | 160 |
| Mandible | PA | 85 | 7.5 | 85 | 11 |
| Mandible | Obl | 85 | 6 | 85 | 10 |
| Pelvis | AP | 85 | 30 | 85 | 60 |
| Ribs | PA Upper | 85 | 25 | 85 | 50 |
| Ribs | AP Lower (grid - 40") | 85 | 30 | 85 | 80 |
| Shoulder | AP | 85 | 15 | 85 | 28 |
| Shoulder | Y View | 85 | 32 | 85 | 50 |
| Skull | PA | 85 | 8 | 85 | 12 |
| Skull | Lat | 85 | 5 | 85 | 7 |
| Tib-Fib | AP/Lat (grid) | 80 | 6 | 80 | 10 |
| Toe | All Views (ng) | 66 | 2 | 66 | 2 |
| T-Spine | AP | 85 | 25 | 85 | 50 |
| T-Spine | Lat (breathing) | 90 | 50 | 90 | 75 |
| Wrist | PA (ng) | 68 | 1.8 | 68 | 2.6 |

| XXX-Large & XXXX-Large DR TECHNIQUE CHART Least mAs | | | | | |
|---|---|---|---|---|---|
| | | XXX-Large 330-380 lbs | | XXXX-Large **(Morbidly Obese)** 380-440 lbs. | |
| **Part** | **Projection** | | | | |
| | (ng = non grid) | **kV** | **mAs** | **kV** | **mAs** |
| Abdomen | AP (grid - 40") | 85 | 90 | 85 | 130 |
| Ankle | AP (ng) | 70 | 5 | 70 | 6.4 |
| Chest | AP (grid) | 120 | 8 | 120 | 10 |
| C-Spine | AP (grid - 72") | 90 | 32 | 90 | 40 |
| C-Spine | Lat (grid - 72") | 90 | 40 | 90 | 50 |
| C-Spine | Swimmers (grid - 40") | 95 | 180 | 95 | 240 |
| Elbow | AP (ng) | 70 | 4 | 70 | 5 |
| Finger | All Views | 68 | 2.4 | 68 | 2.8 |
| Foot | AP (ng) | 70 | 4 | 70 | 5 |
| Forearm | AP (ng) | 70 | 4 | 70 | 5 |
| Hand | PA (ng) | 68 | 2.5 | 68 | 3.2 |
| Hip | 75 | 85 | 60 | 85 | 80 |
| Hip | X-Table Lat (grid - 40") | 90 | 300 | 90 | 440 |
| Humerus | AP (grid) | 80 | 18 | 80 | 24 |
| Humerus | Transthoracic Lat | 90 | 180 | 90 | 240 |
| Knee | AP/Lat (grid - 40") | 85 | 14 | 85 | 18 |
| L-Spine | AP | 90 | 120 | 90 | 160 |
| L-Spine | X-Table Lat (grid - 40") | 95 | 320 | 95 | 440 |
| Mandible | PA | 85 | 15 | 85 | 20 |
| Mandible | Obl | 85 | 14 | 85 | 18 |
| Pelvis | AP | 85 | 90 | 85 | 120 |
| Ribs | PA Upper | 85 | 75 | 85 | 100 |
| Ribs | AP Lower | 85 | 120 | 85 | 180 |
| Shoulder | AP | 85 | 40 | 85 | 50 |
| Shoulder | Y View | 85 | 75 | 85 | 75 |
| Skull | PA | 85 | 18 | 85 | 22 |
| Skull | Lat | 85 | 10 | 85 | 14 |
| Tib-Fib | AP/Lat (grid) | 80 | 15 | 80 | 20 |
| Toe | All Views (ng) | 66 | 2.5 | 66 | 3 |
| T-Spine | AP | 85 | 75 | 85 | 100 |
| T-Spine | Lat (breathing) | 90 | 100 | 90 | 150 |
| Wrist | PA (ng) | 68 | 3.6 | 68 | 4.4 |

# Contestants from The Biggest Loser


THIRTEENTH EDITION | VOLUME TWO

# MERRILL'S ATLAS OF RADIOGRAPHIC POSITIONING & PROCEDURES



Bruce W. Long
Jeannean Hall Rollins
Barbara J. Smith

ELSEVIER

# Merrill's Atlas of Radiographic Positioning and Procedures

- In mid 2013 Bruce Long, First Author of Merrill's hired me to create the first digital technique charts for the Merrill's Atlas.
- In it's 50+ year history they have always had film/screen techniques.
- In the 13th edition, which was released in early 2015, there are almost 250 digital techniques included (half CR and half DR).
- Each technique also has the Entrance Dose (ESE).

# ASRT Best Practices concerning Exposure Technique Charts

- Use exposure technique charts that are continuously improved and applicable to a wide range of patient ages and sizes.

# What does mAs do in the digital world?

- Not what it did in the film world, that's for sure!!
- To a huge extent, mAs does not really control density/brightness any more.
- Brightness is now mainly controlled by processing algorithms.

# What does mAs do? (continued)

- You just need enough mAs or your image will have noise.
- The goal is to use the least amount possible to get a *diagnostic image*.
- As the ASRT states: “Provide an **adequate** exposure to the Image Receptor”.

# Exposure Index numbers

- Dose Exposure, Exposure Index/Indicator numbers. (S, LgM, EI, EI_s, ReX, EXI, DEI, DI) are how you tell if your technique was correct.
- The Exposure Index/Indicator - EI (what we will call it from now on) number is best if the centering and collimation are very good.
- My goal is to get from the best dose EI number to 50% “more” than that number.

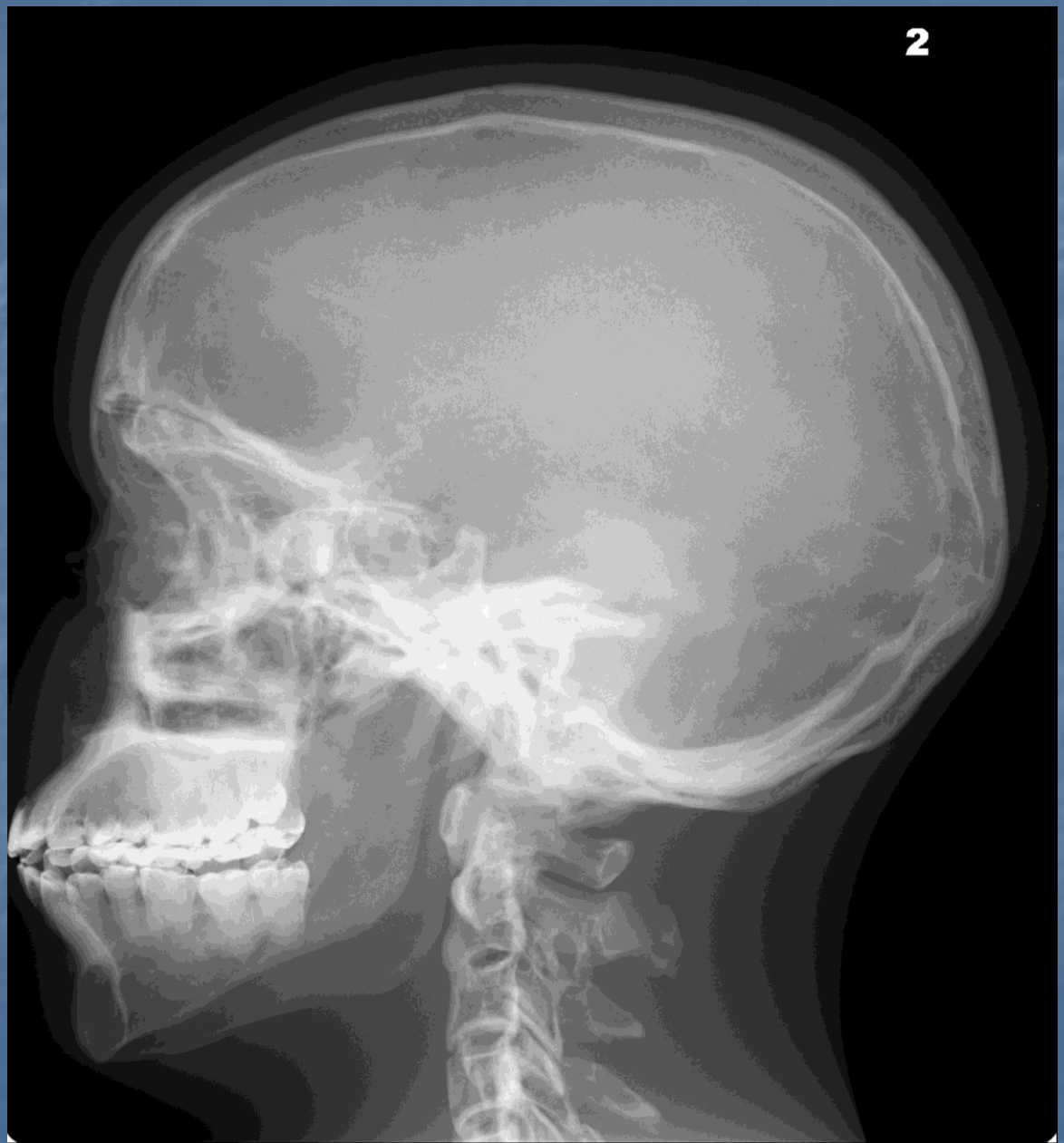
# Critiquing digital images

- The EI numbers are the number 1 way to critique your image.
- You should definitely use the magnification mode to check for noise and burn.
- You should always be able to Level and Window and make your image look well penetrated and contrasty.

# Critiquing digital images (continued)

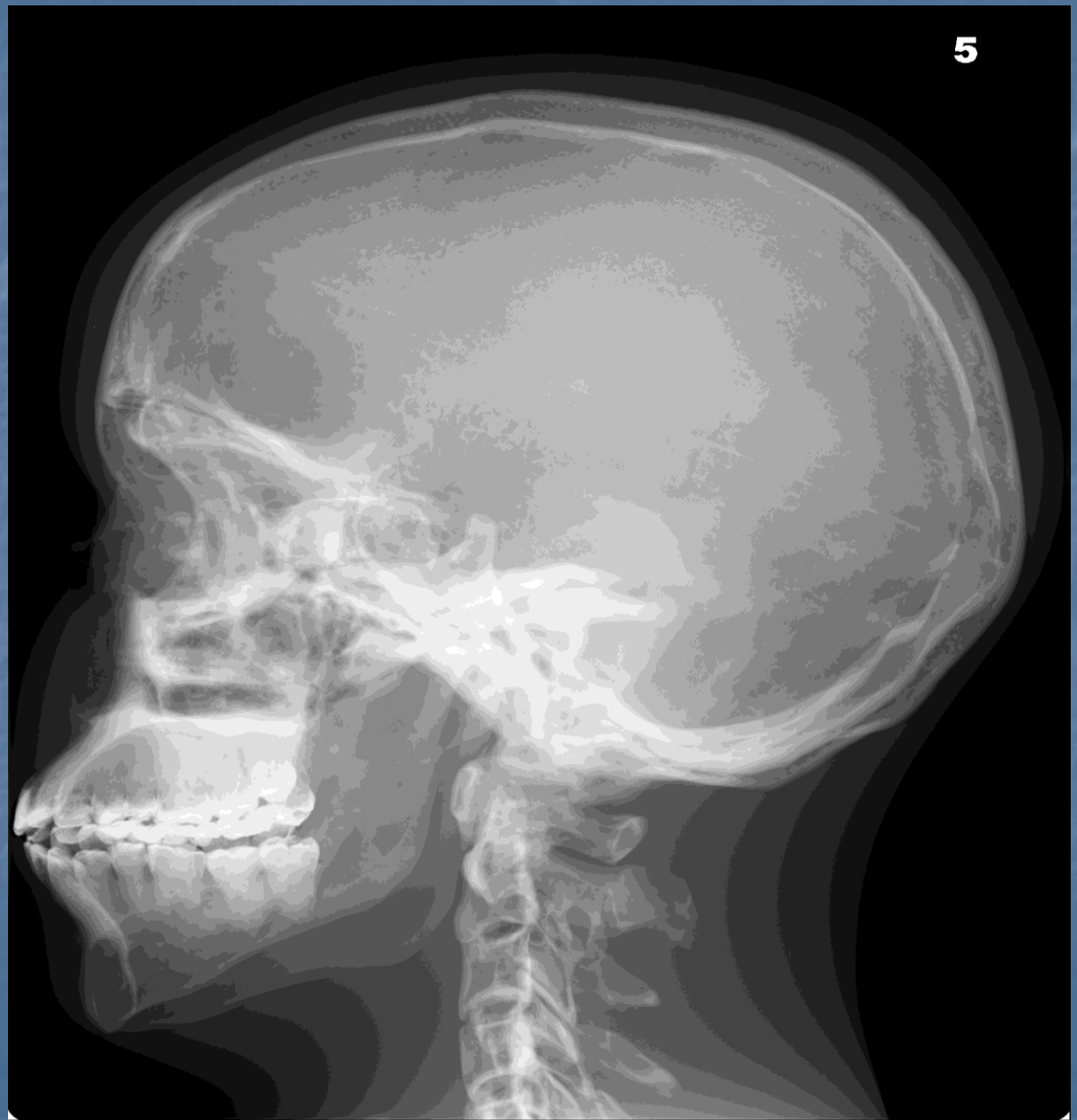
- Because of automatic rescaling it's ***impossible*** to prove you used the *correct* technique if your only gauge is what the finished image looks like.

# Fuji 85 kV @ 4 mAs - S# 357

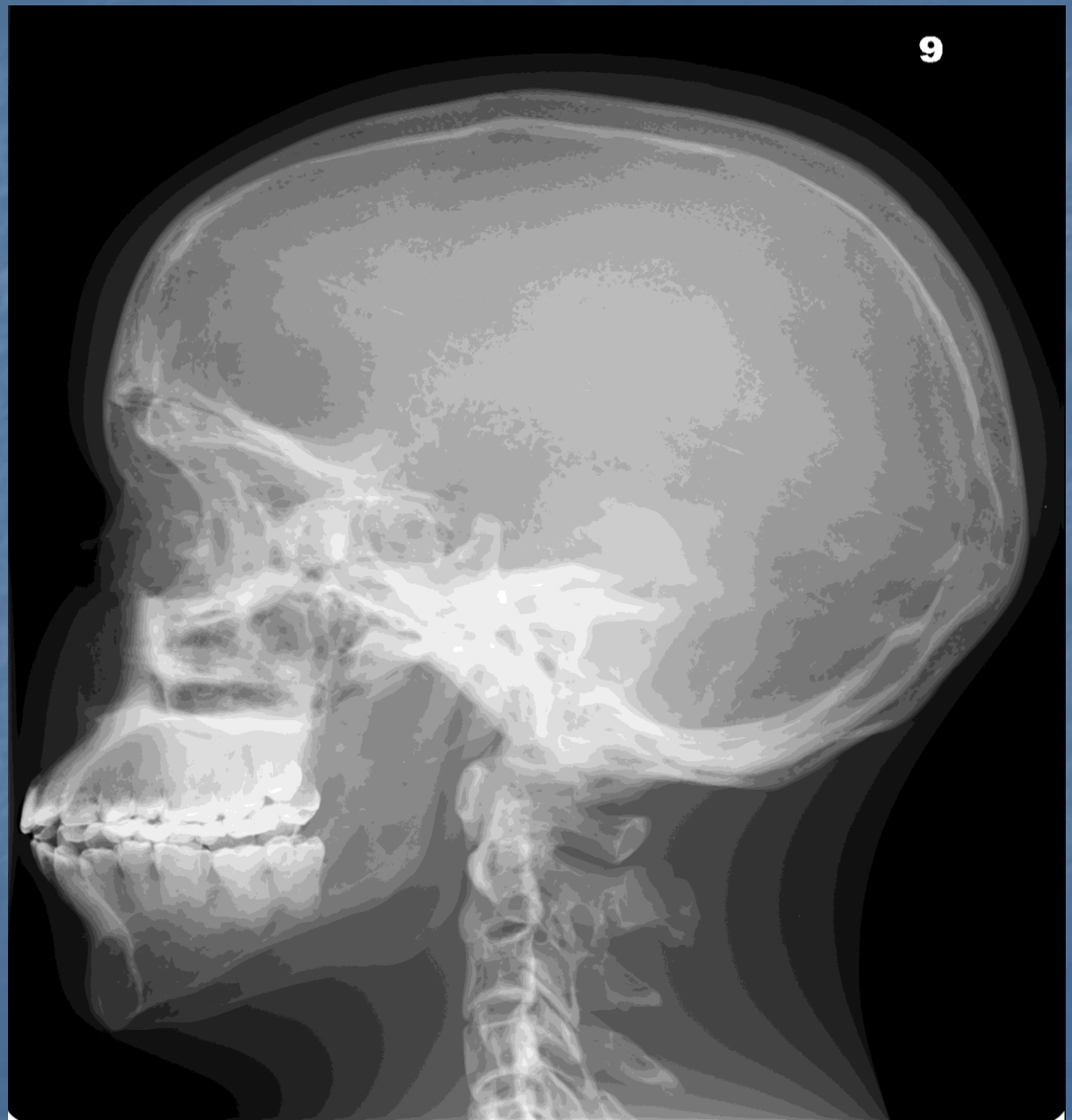


# 85 kV @ 8 mAs - S# 171

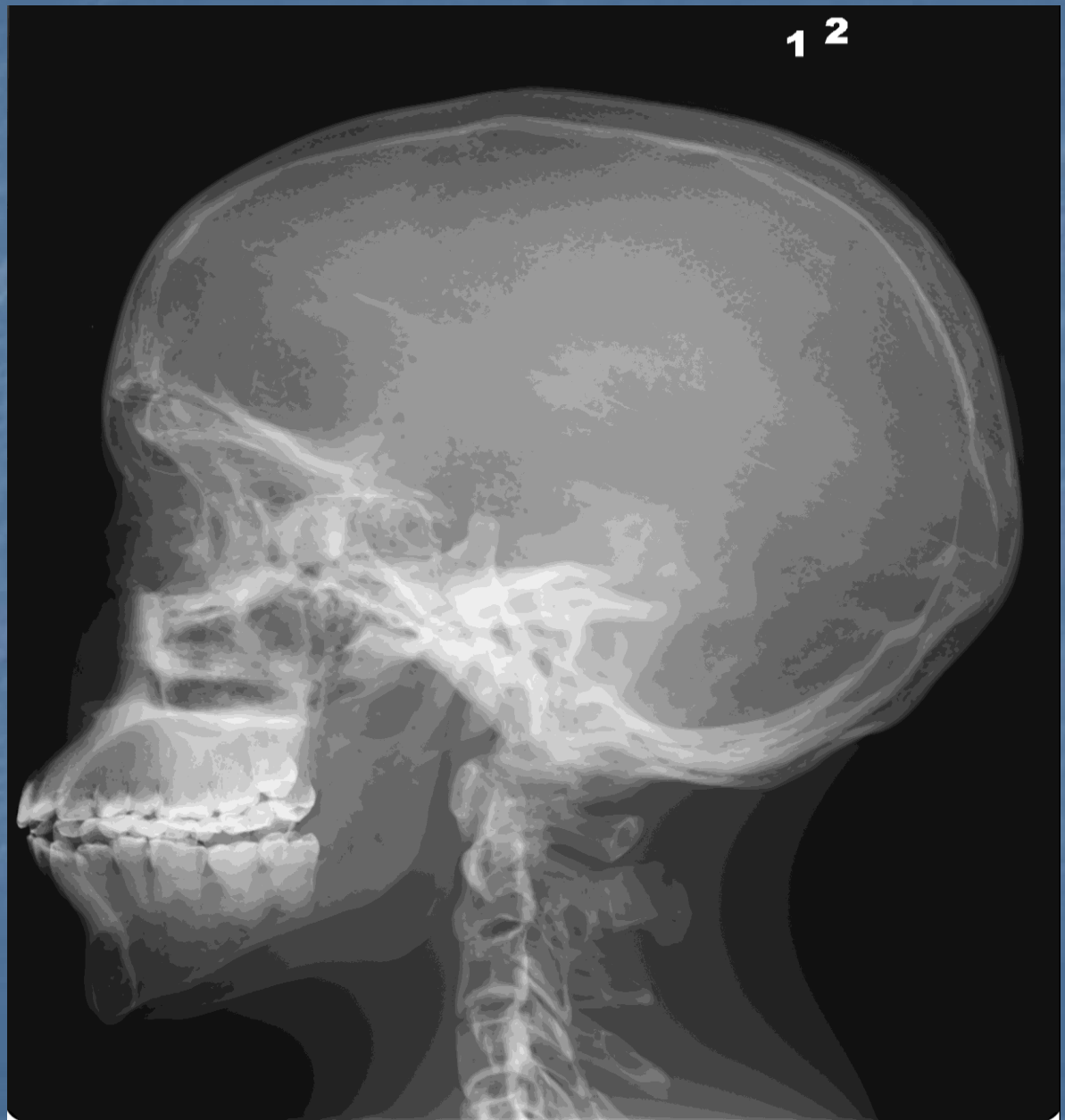
# 85 kV @ 32 mAs - S# 38



# 85 kV @ 200 mAs - S# 6



# 85 kV @ 400 mAs - S# 3



# Carestream Portable Detector
# 85 kV @ 2 mAs EI 1385

# 85 kV @ 4 mAs EI 1682

# 85 kV @ 8 mAs  EI 1966

# 85 kV @ 16 mAs EI 2257

# 85 kV @ 32 mAs EI 2517

# 85 kV @ 45 mAs  EI 2405

# How much can you overexpose for CR and DR?

- For all CR (except Agfa) you can use a minimum of 50 times, and probably closer to 100 times, too much mAs and have a perfectly diagnostic/passable image.
- For most DR you can use about 10-15 times too much mAs.

# Universal Cesium DR Chart Least mAs

**CESIUM DR TECHNIQUE CHART** **Least mAs (600 Speed)**

| Part | View | Small | | Medium | | Large | |
|---|---|---|---|---|---|---|---|
| All techniques are male patients. If female, subract 10 lbs. | | 120-160 lbs. | | 160-200 lbs. | | 200-240 lbs. | |
| | | kV | mAs | kV | mAs | kV | mAs |
| Abdomen | AP (grid -40") | 85 | 6.5 | 85 | 10 | 85 | 16 |
| Ankle | AP | 70 | 1.2 | 70 | 1.4 | 70 | 1.6 |
| Ankle | Lat | 70 | 1 | 70 | 1.2 | 70 | 1.4 |
| Chest -Adult | AP (grid) | 120 | 1 | 117 | 1.5 | 117 | 2 |
| Chest -Adult | AP (non grid) | 105 | 1.1 | 105 | 1.6 | 105 | 2.1 |
| Chest (2-9 lb) | AP (non grid - 40") | 75 | 0.6 | 75 | 0.8 | 75 | 1 |
| Chest (2-9 lb) | Lat (non grid - 40") | 77 | 0.8 | 77 | 1 | 77 | 1.2 |
| Chest (10-20 lb) | PA (non grid - 72") | 80 | 0.5 | 80 | 0.65 | 80 | 0.8 |
| Chest (10-20 lb) | Lat (non grid - 72") | 83 | 0.65 | 83 | 0.8 | 83 | 0.95 |
| Chest (25-35 lb) | PA (non grid - 72") | 82 | 0.65 | 82 | 0.8 | 82 | 0.95 |
| Chest (25-35 lb) | Lat (non grid - 72") | 85 | 0.8 | 85 | 0.95 | 85 | 1.1 |
| C-Spine | AP (grid - 40") | 85 | 1.9 | 85 | 2.4 | 85 | 3 |
| C-Spine | AP (non grid - 40") | 70 | 1.5 | 70 | 2 | 70 | 2.6 |
| C-Spine | Odontoid (grid - 40") | 85 | 2.4 | 85 | 3 | 85 | 3.6 |
| C-Spine | Lat (grid - 72") | 85 | 5.5 | 85 | 6.6 | 85 | 8.6 |
| C-Spine | Lat (non grid - 72") | 70 | 4 | 70 | 5.2 | 70 | 6.8 |
| C-Spine | Swimmers (grid - 40") | 95 | 16 | 95 | 26 | 95 | 36 |
| Elbow | AP | 70 | 0.85 | 70 | 1 | 70 | 1.2 |
| Elbow | Oblique/Lateral | 70 | 0.95 | 70 | 1.1 | 70 | 1.3 |
| Finger | All Views | 66 | 0.4 | 66 | 0.5 | 66 | 0.6 |
| Foot | AP | 70 | 0.8 | 70 | 1 | 70 | 1.2 |
| Foot | Lat | 70 | 1.2 | 70 | 1.4 | 70 | 1.6 |
| Forearm | AP/Lat | 70 | 0.75 | 70 | 0.9 | 70 | 1.05 |
| Hand | PA | 66 | 0.5 | 66 | 0.6 | 66 | 0.75 |
| Hand | Lat | 70 | 0.75 | 70 | 0.9 | 70 | 1.1 |
| Hip | AP (grid ) | 85 | 4.2 | 85 | 6.3 | 85 | 7.8 |
| Hip | AP ( non grid ) | 75 | 2.6 | 75 | 3.2 | 75 | 4 |
| Hip | X-Table Lat (grid) | 90 | 20 | 90 | 30 | 90 | 40 |
| Humerus | AP (grid) | 77 | 1.9 | 77 | 2.2 | 77 | 2.5 |
| Humerus | AP ( non grid ) | 70 | 1.4 | 70 | 1.6 | 70 | 2 |
| Humerus | Transthoracic Lat | 90 | 14 | 90 | 20 | 90 | 26 |

# Universal Cesium DR Chart Least mAs (page 2)

**CESIUM DR TECHNIQUE CHART** **Least mAs (600 Speed)**

| Part | View | Small | | Medium | | Large | |
|---|---|---|---|---|---|---|---|
| All techniques are male patients. If female, subract 10 lbs. | | 120-160 lbs. | | 160-200 lbs. | | 200-240 lbs. | |
| | | kV | mAs | kV | mAs | kV | mAs |
| Knee | AP/Lat (grid) | 85 | 2.5 | 85 | 3 | 85 | 3.5 |
| Knee | AP/Lat (non grid) | 70 | 2 | 70 | 2.5 | 70 | 3 |
| Knee | Sunrise (non grid) | 70 | 2.5 | 70 | 3 | 70 | 3.5 |
| L-Spine | AP (grid) | 90 | 7 | 90 | 10 | 90 | 14 |
| L-Spine | Oblique (grid) | 90 | 11 | 90 | 16 | 90 | 22 |
| L-Spine | X-Table Lat (grid) | 95 | 16 | 95 | 22 | 95 | 30 |
| Mandible | PA (grid) | 85 | 3 | 85 | 4 | 85 | 5 |
| Mandible | Obl (grid - 40") | 81 | 2.3 | 81 | 3.2 | 81 | 4.1 |
| Mandible | Obl (non grid - 40") | 70 | 2 | 70 | 2.8 | 70 | 3.6 |
| Nasal Bones | Lateral (non grid) | 70 | 1.5 | 70 | 1.9 | 70 | 2.3 |
| Pelvis | AP (grid) | 85 | 6 | 85 | 9 | 85 | 12 |
| Ribs | PA Upper (72") | 85 | 6 | 85 | 8 | 85 | 10 |
| Ribs | Obl Upper (72") | 85 | 9 | 85 | 12 | 85 | 15 |
| Ribs | AP Lower (40") | 85 | 6 | 85 | 9 | 85 | 12 |
| Shoulder | AP (grid) | 85 | 3.1 | 85 | 4.5 | 85 | 6 |
| Shoulder | AP (non grid) | 70 | 2 | 70 | 2.7 | 70 | 3.3 |
| Shoulder | Y View (grid) | 85 | 8.5 | 85 | 11.5 | 85 | 16 |
| Shoulder | Axillary (non grid) | 70 | 2 | 70 | 2.8 | 70 | 3.5 |
| Sinus | Caldwell | 85 | 3.5 | 85 | 4.4 | 85 | 5.3 |
| Sinus | Waters | 85 | 4 | 85 | 5 | 85 | 6 |
| Sinus | Lateral | 85 | 1.8 | 85 | 2.3 | 85 | 2.9 |
| Skull | PA | 85 | 3.3 | 85 | 4.2 | 85 | 5.1 |
| Skull | Lat (grid) | 85 | 2.5 | 85 | 3 | 85 | 3.5 |
| Tib-Fib | AP/Lat (non grid) | 70 | 1.4 | 70 | 1.8 | 70 | 2.3 |
| Toe | All Views | 66 | 0.5 | 66 | 0.6 | 66 | 0.7 |
| T-Spine | AP | 85 | 5.5 | 85 | 7.5 | 85 | 9.5 |
| T-Spine | Lat (breathing) | 90 | 13 | 90 | 18 | 90 | 23 |
| Wrist | PA | 66 | 0.6 | 66 | 0.8 | 66 | 1 |
| Wrist | Lat | 70 | 0.8 | 70 | 1 | 70 | 1.2 |
| Zygomatic Arch | AP Axial - Townes | 80 | 2.6 | 80 | 3.2 | 80 | 3.6 |
| Zygomatic Arch | SMV (grid) | 80 | 2.5 | 80 | 3.1 | 80 | 3.7 |

# Differences of the Least mAs to 100% More mAs technique charts

- The Least mAs chart uses the smallest mAs of all the charts (least dose to patient, most chance of noise).
- The 33% More mAs chart uses 33% more mAs/dose than the Least mAs chart.
- The 66% More mAs chart uses 66% more mAs/dose than the Least mAs chart.
- The 100% More mAs chart uses 100% (double) more mAs/dose than the Least mAs chart.

# How to use these four charts

- **Begin** with the "**100% More mAs**" because this has the least chance of noise.
- If you have a diagnostic image and the EI numbers show you can use less mAs, go to the **"66% More mAs"** chart.
- If again you have a diagnostic image and the EI numbers show you can use less mAs, go to the **"33% More mAs"** chart.
- Finally, if you have a diagnostic image and the EI numbers show you can still drop the mAs, go to the **"Least mAs"** chart.

# Difference between all charts

| Difference Between All Technique Charts (in Speed and mAs) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DR Cesium Least mAs | DR Cesium 33% More | DR Cesium 66% More | DR Cesium 100% More | DR Gado-linium | CR Least mAs | CR 33% More | CR 66% More | CR 100% More |
| 600 Speed | 500 Speed | 400 Speed | 300 Speed | 450 Speed | 450 Speed | 375 Speed | 300 Speed | 225 Speed |
| 10 mAs | 13.3 mAs | 16.6 mAs | 20 mAs | 15 mAs | 15 mAs | 20 mAs | 25 mAs | 30 mAs |

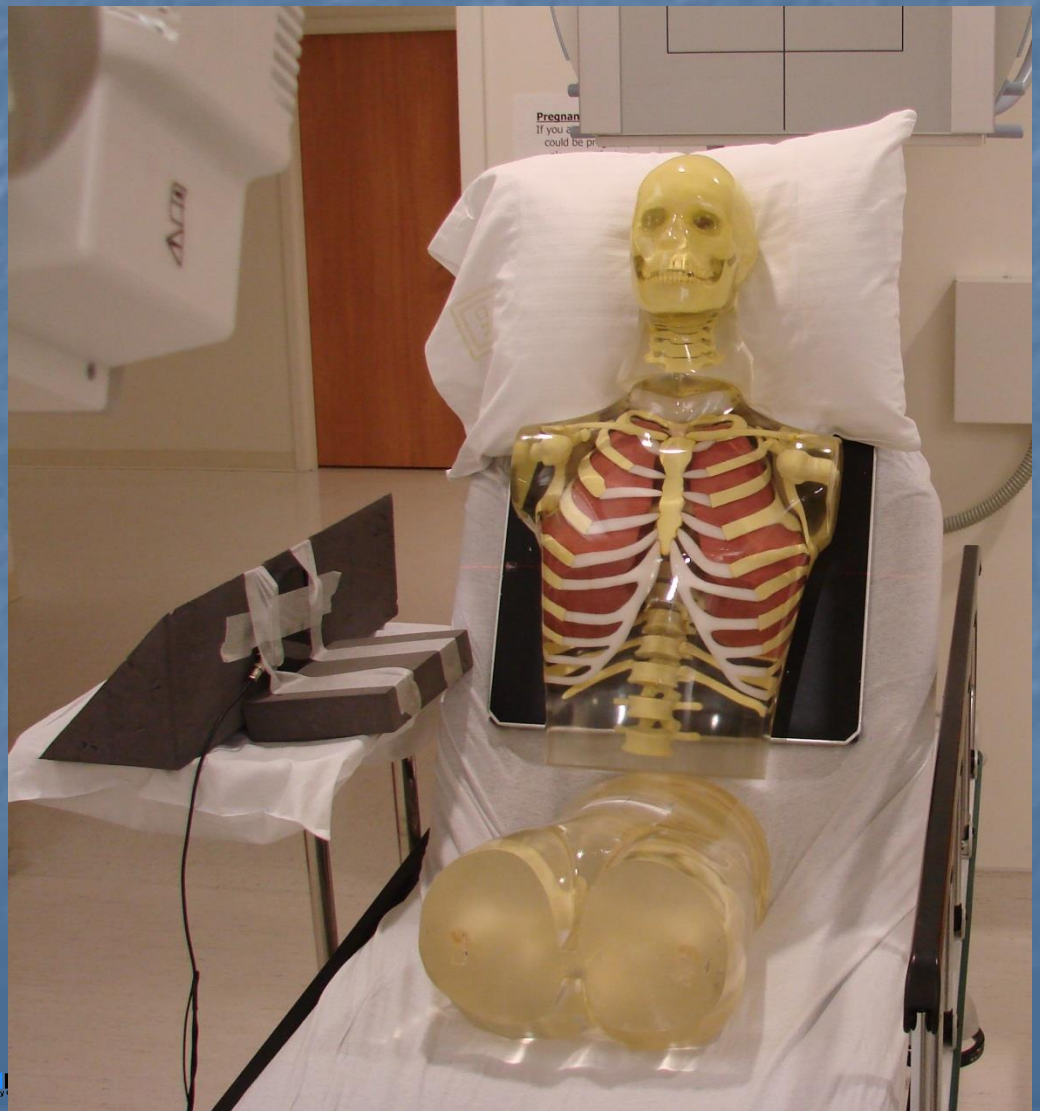
# Here is how much dose you save your patient when you increase the kV and decrease the mAs at a 72” SID.

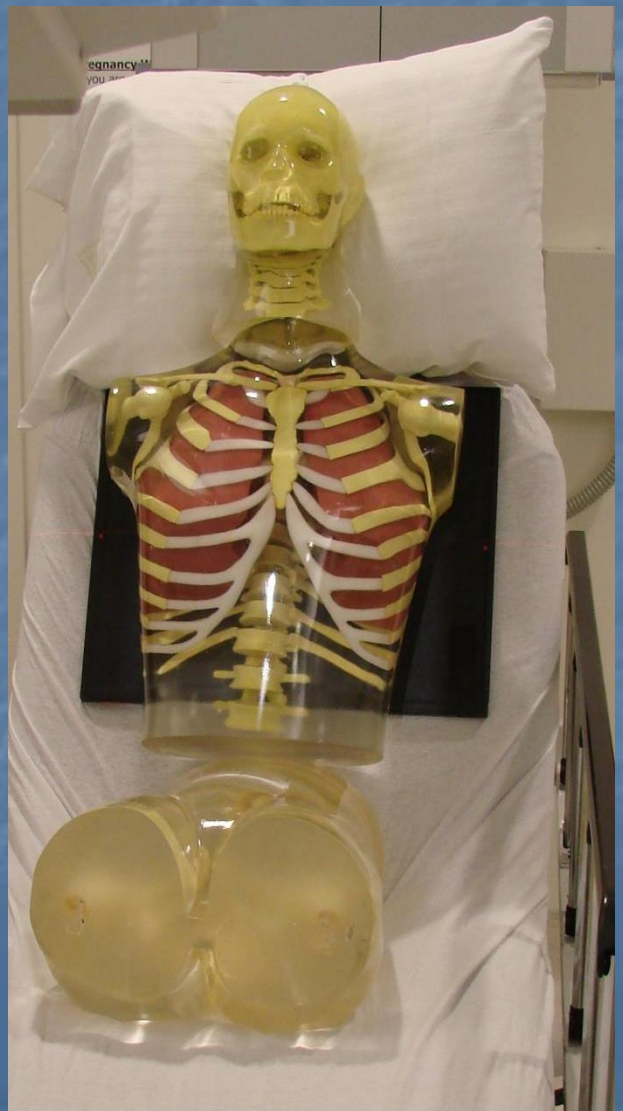
## Radiation Dose Saved

| SID | kV | mAs | ESE Dose (mR) | Radiation Saved (%) | 50% EI Decrease (mAs) | 50% EI Dose (mR) | Total Dose Reduction (%) |
|---|---|---|---|---|---|---|---|
| 72" | 70 | 20 | 33.0 | | | | |
| 72" | 81 | 10 | 22.1 | 33.0% | 5.0 | 11.1 | 66.5% |
| 72" | 85 | 8 | 19.4 | 41.3% | 4.0 | 9.7 | 70.7% |
| 72" | 90 | 6.3 | 17.0 | 48.5% | 3.2 | 8.5 | 74.2% |
| 72" | 96 | 4 | 12.2 | 63.1% | 2.0 | 6.1 | 81.6% |

# How much scatter radiation occurs during an AP chest?

We did this experiment many times with and without grids, at 115 and 85 kV, and at 3 different angles. This one is taken at 90 degrees to the patient.





# This one is taken at 45 degrees to the patient.

# And this one we are calling 0 degrees.


Fluoro

# Natural Background Radiation - 2006

- 1r =1 rad
- 1 milliR (mR) = 1/1000 of a rad
- 1 microR (µR) = 1/1000 of a mR
- **Natural Radiation** = 304 milliR/year
- 304 milliR = 304,000 microR
- 304,000 microR/year = **844 microR/day**

# Here are all the doses for 0, 45 and 90 degrees (arrows at 6') 85@3.2 and 115@4

## Dose exposure due to scatter from Portable Chest Xrays

| Angle of Chamber (Deg) | Distance (ft) | Dose #1 (microR) | Dose #2 (microR) | Average Dose (microR) |
|---|---|---|---|---|
| 90 | 1 | 96.0 | 94.6 | 95.3 |
| 90 | 2 | 42.7 | 42.0 | 42.4 |
| 90 | 3 | 21.1 | 22.0 | 21.6 |
| 90 | 4 | 13.3 | 12.7 | 13.0 |
| 90 | 5 | 10.6 | 9.0 | 9.8 |
| 90 | 6 | 6.9 | 6.1 | 6.5 |
| 45 | 1 | 195.5 | 196.2 | 195.9 |
| 45 | 2 | 79.3 | 80.7 | 80.0 |
| 45 | 3 | 38.3 | 39.2 | 38.8 |
| 45 | 4 | 24.3 | 23.8 | 24.1 |
| 45 | 5 | 16.2 | 17.9 | 17.1 |
| 45 | 6 | 11.6 | 12.0 | 11.8 |
| 45 | 7 | 9.4 | 9.1 | 9.3 |
| 45 | 8 | 7.1 | 6.4 | 6.8 |
| 0 | 6 | 34.0 | 33.1 | 33.6 |
| 0 | 7 | 24.5 | 23.0 | 23.8 |
| 0 | 8 | 17.4 | 16.0 | 16.7 |
| 0 | 9 | 14.0 | 14.2 | 14.1 |
| 0 | 10 | 10.5 | 11.6 | 11.1 |
| 0 | 11 | 8.4 | 8.9 | 8.7 |
| 0 | 12 | 6.3 | 7.5 | 6.9 |
| 0 | 13 | 5.3 | 6.4 | 5.9 |
| 0 | 14 | 0.0 | 0.0 | 0.0 |
| 0 | 15 | 0.0 | 0.0 | 0.0 |
| 0 | 16 | 0.0 | 0.0 | 0.0 |

Chest technique of 85@3.2 was used for all exposures. Ionization Chamber angle is measured from mid sagittal plane.

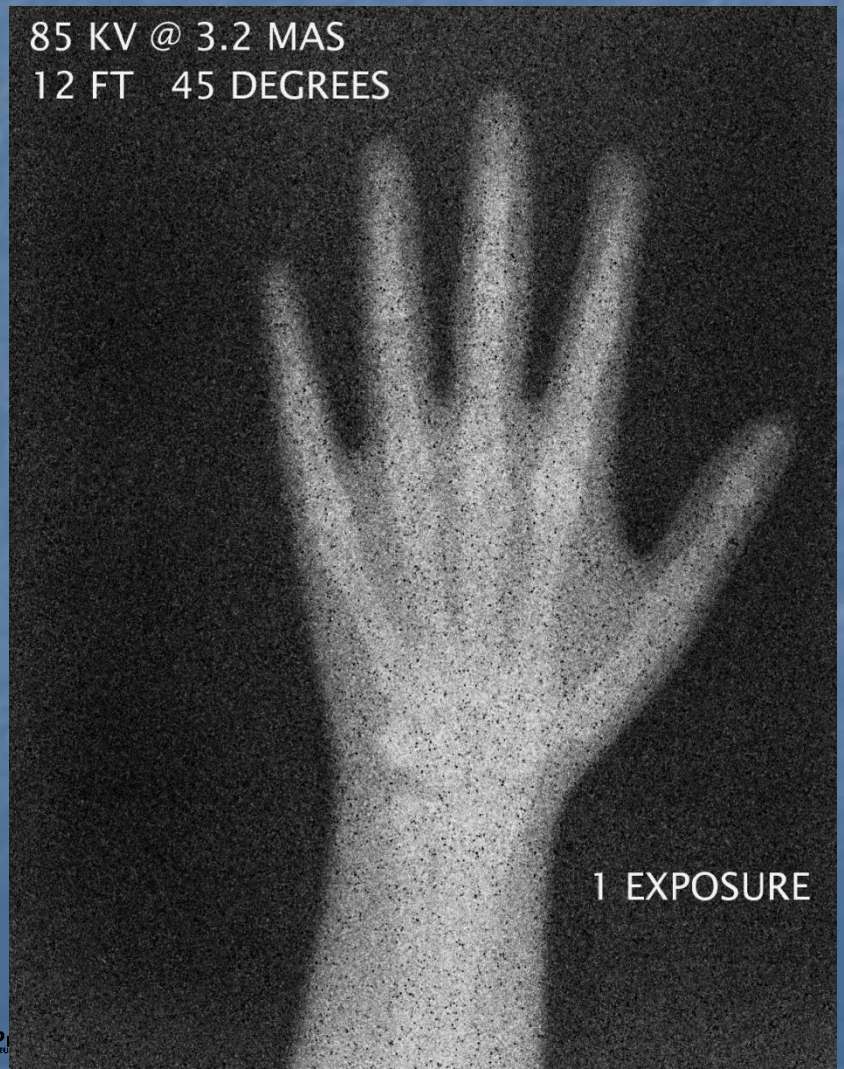
## Dose exposure due to scatter from Portable Chest Xrays

| Angle of Chamber (Deg) | Distance (ft) | Dose #1 (microR) | Dose #2 (microR) | Average Dose (microR) |
|---|---|---|---|---|
| 90 | 1 | 316.0 | 320.0 | 318.0 |
| 90 | 2 | 125.8 | 127.2 | 126.5 |
| 90 | 3 | 68.3 | 67.6 | 68.0 |
| 90 | 4 | 42.2 | 41.0 | 41.6 |
| 90 | 5 | 27.1 | 28.3 | 27.7 |
| 90 | 6 | 19.7 | 19.7 | 19.7 |
| 45 | 1 | 744.0 | 778.0 | 761.0 |
| 45 | 2 | 295.0 | 295.0 | 295.0 |
| 45 | 3 | 150.7 | 151.2 | 151.0 |
| 45 | 4 | 98.3 | 97.6 | 98.0 |
| 45 | 5 | 66.2 | 65.2 | 65.7 |
| 45 | 6 | 48.6 | 47.4 | 48.0 |
| 45 | 7 | 33.6 | 32.7 | 33.2 |
| 45 | 8 | 27.6 | 27.5 | 27.6 |
| 0 | 6 | 76.0 | 75.1 | 75.6 |
| 0 | 7 | 50.5 | 51.8 | 51.2 |
| 0 | 8 | 39.3 | 39.8 | 39.6 |
| 0 | 9 | 32.3 | 31.9 | 32.1 |
| 0 | 10 | 25.4 | 27.0 | 26.2 |
| 0 | 11 | 22.4 | 21.8 | 22.1 |
| 0 | 12 | 17.0 | 16.9 | 17.0 |
| 0 | 13 | 14.3 | 14.4 | 14.4 |
| 0 | 14 | 12.6 | 12.5 | 12.6 |
| 0 | 15 | 10.2 | 9.9 | 10.1 |
| 0 | 16 | 8.3 | 8.2 | 8.3 |

Chest technique of 115@4 was used for all exposures. Ionization Chamber angle is measured from mid sagittal plane.

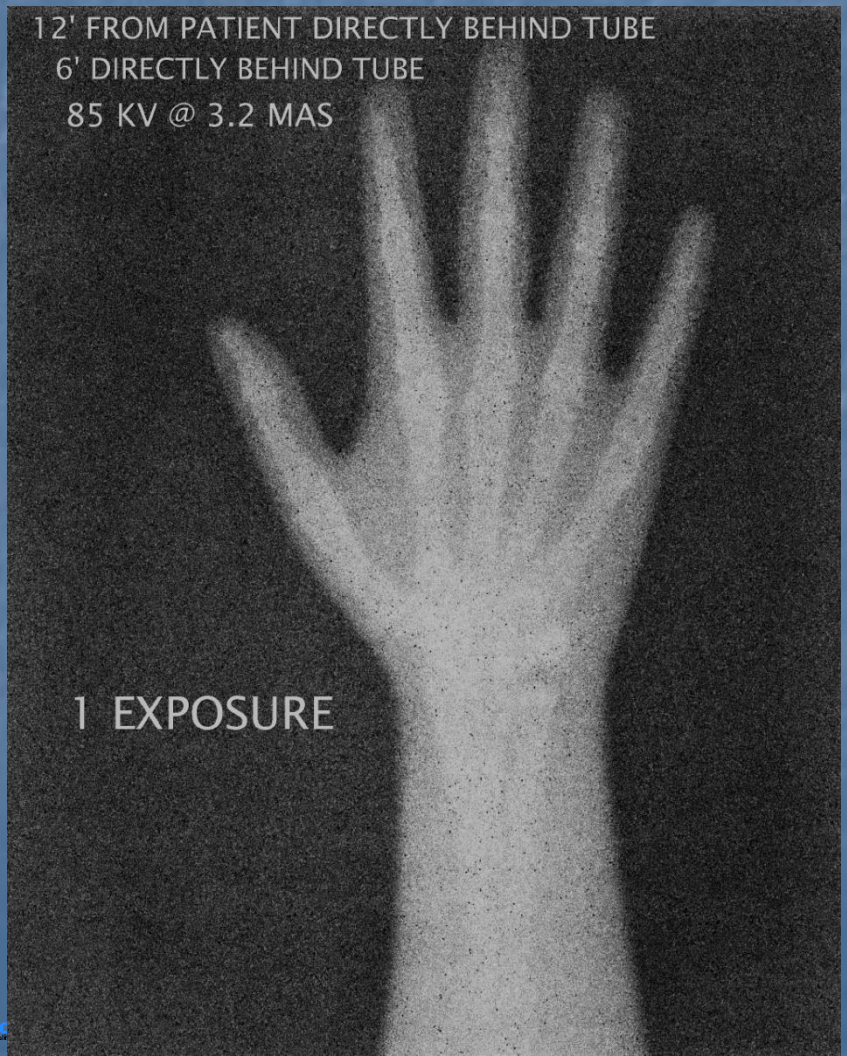
This experiment used the arm/hand phantom and a 10x12 CR cassette. We set it up where many techs stand when making a PCXR exposure. This photo and the following image have the cassette at:
45 degrees and 12 feet from the patient **(1200 speed).**

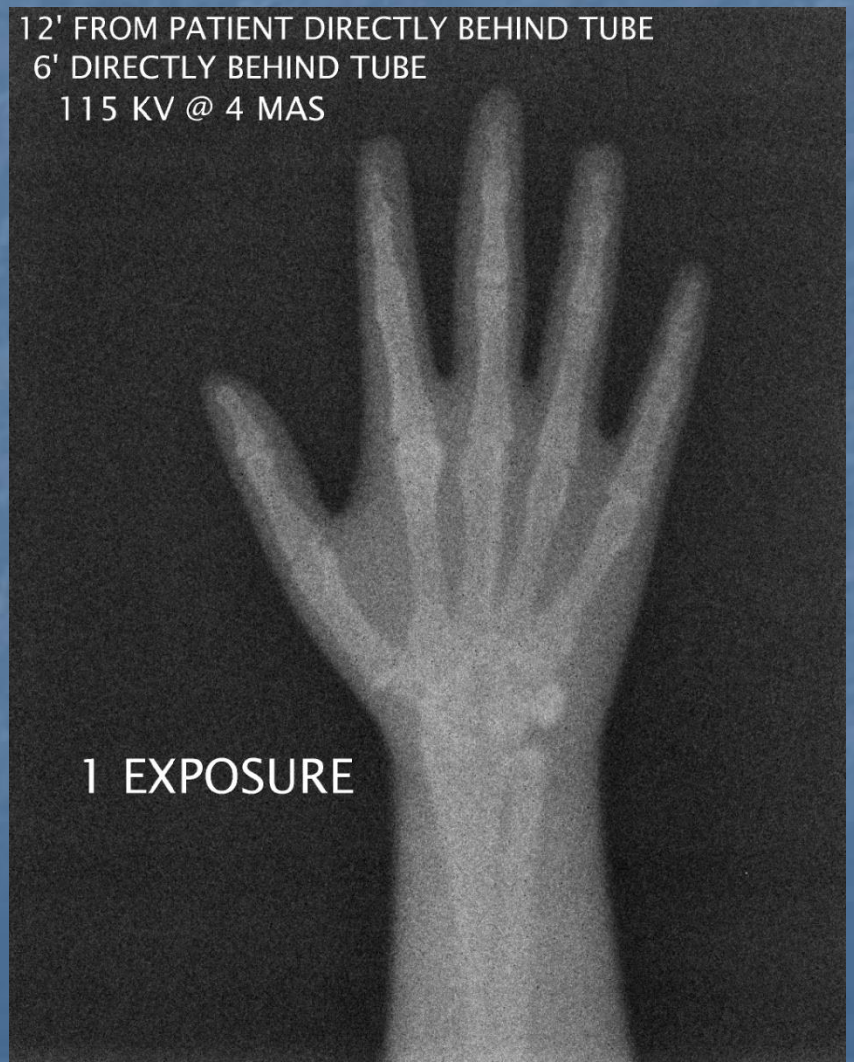
# An image cannot lie. Even though the scatter dose is way down in the micro R's, there is enough radiation to make this image – with 1 exposure!!




This photo and the following image was taken with the phantom/cassette 12 feet from the patient directly behind the tube (which is 6 feet from the patient).

# The 85 kV image had 6.0 microR and the 115kv image had 17 microR.

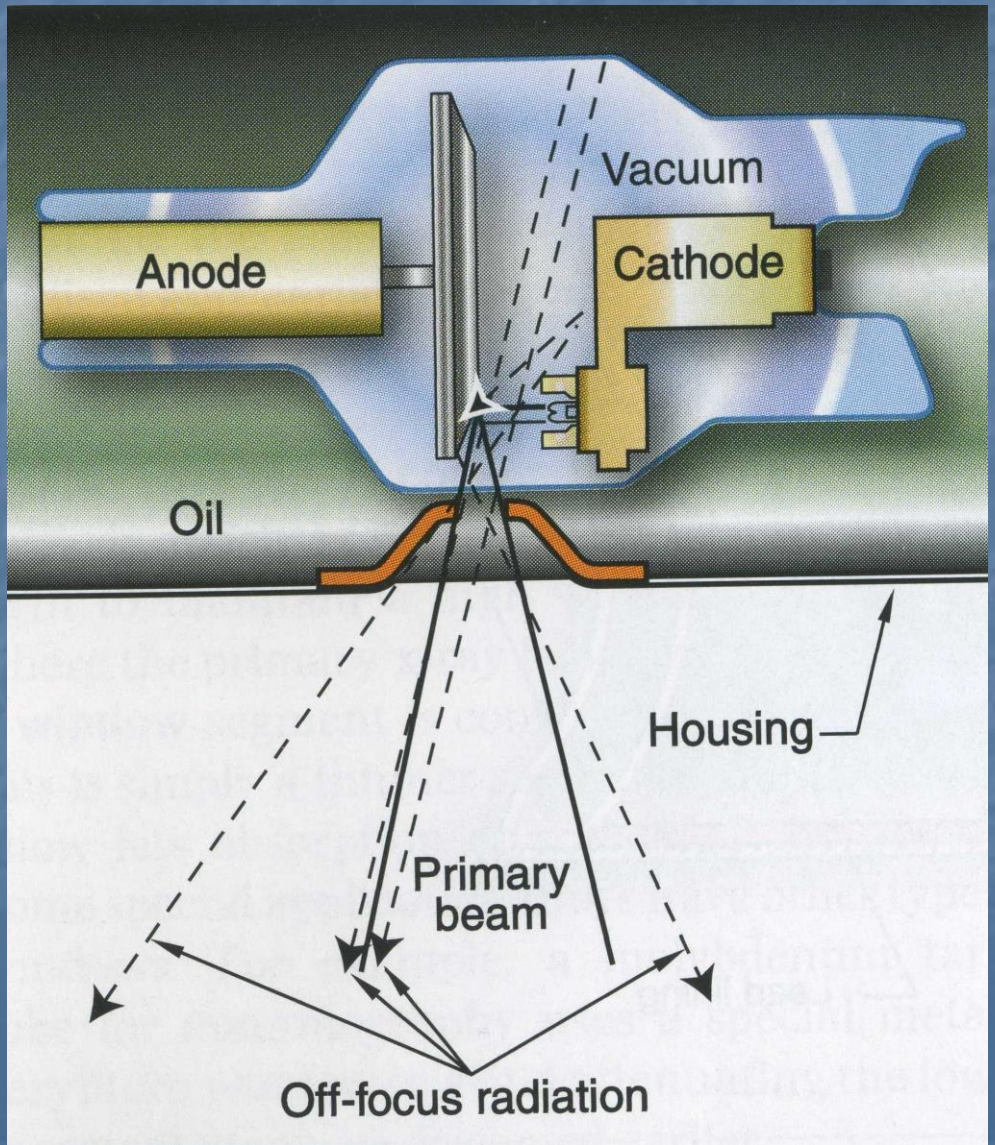


The perfect place to stand when making an exposure is directly behind the tower. You lean your head out while giving the breathing instructions, then move your head back behind the tower while making the exposure.

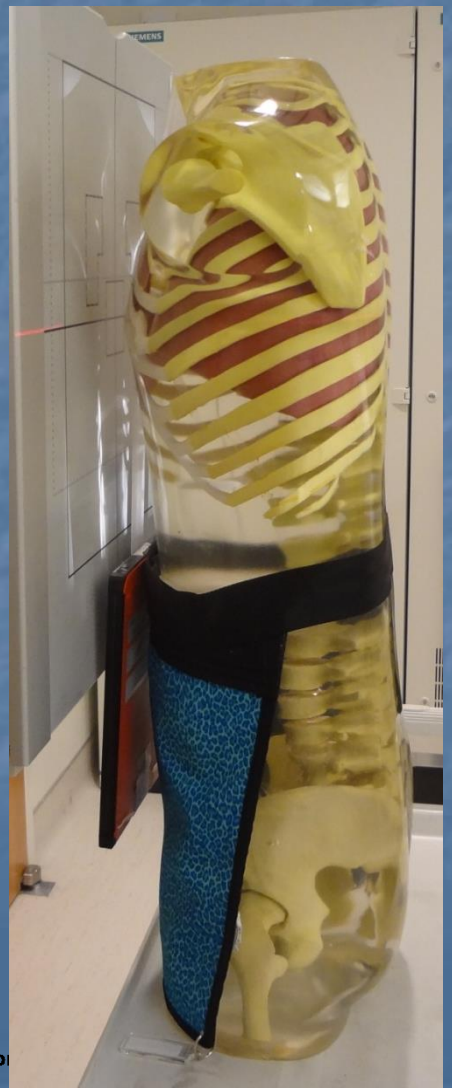
# I’m on the “good” side

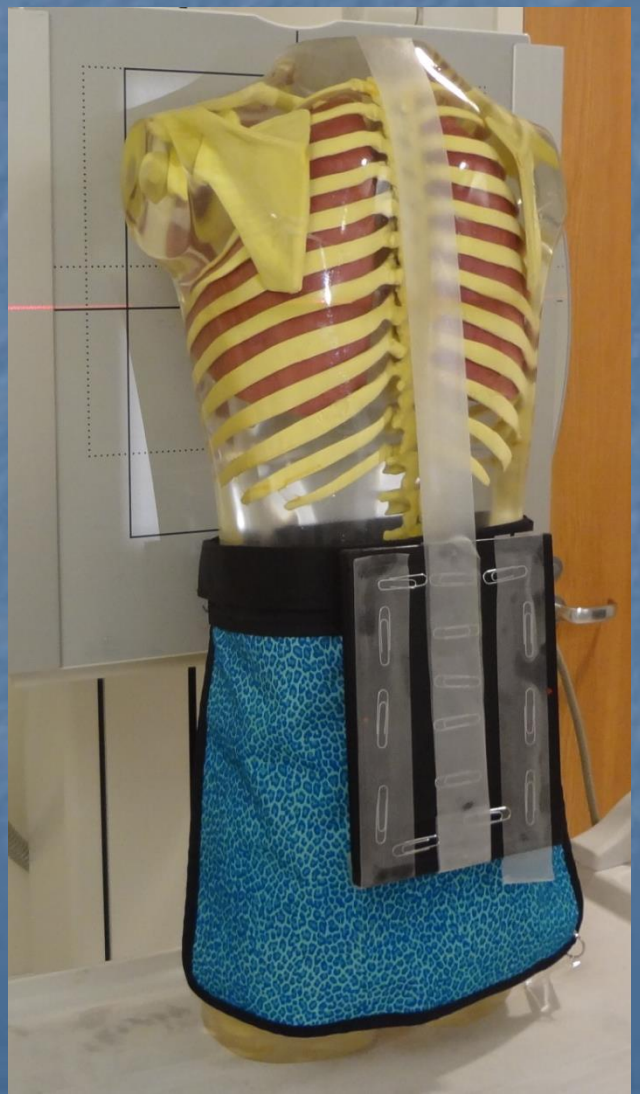
# Off-Focus Radiation

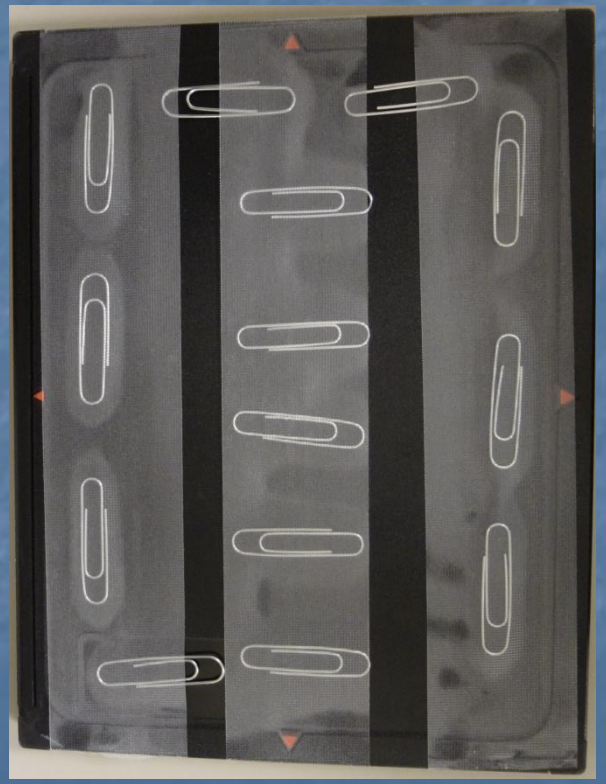



Art courtesy of "Principles of Radiographic Imaging" by Rick Carlton

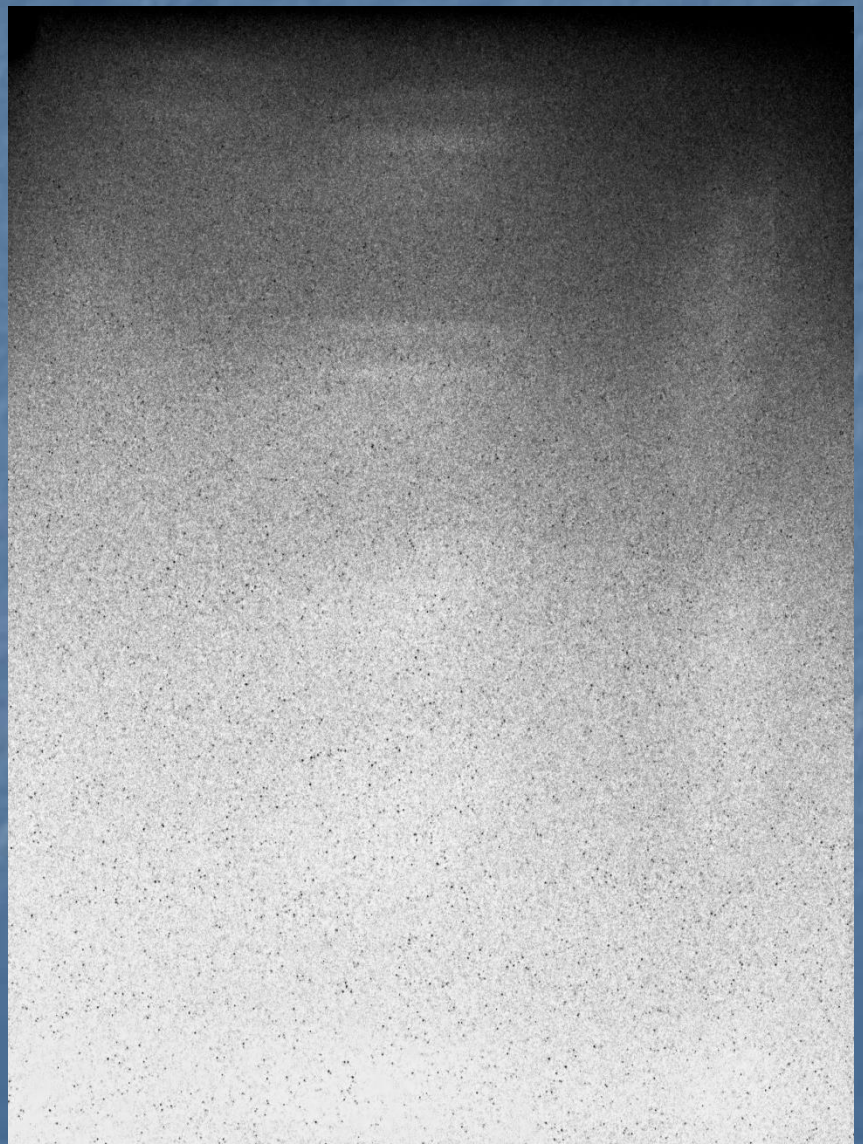
# Checking to see if it is wiser to shield a patient in the front or the back for a PA chest x-ray. Collimated to 14x17 with shield and cassette below primary beam.



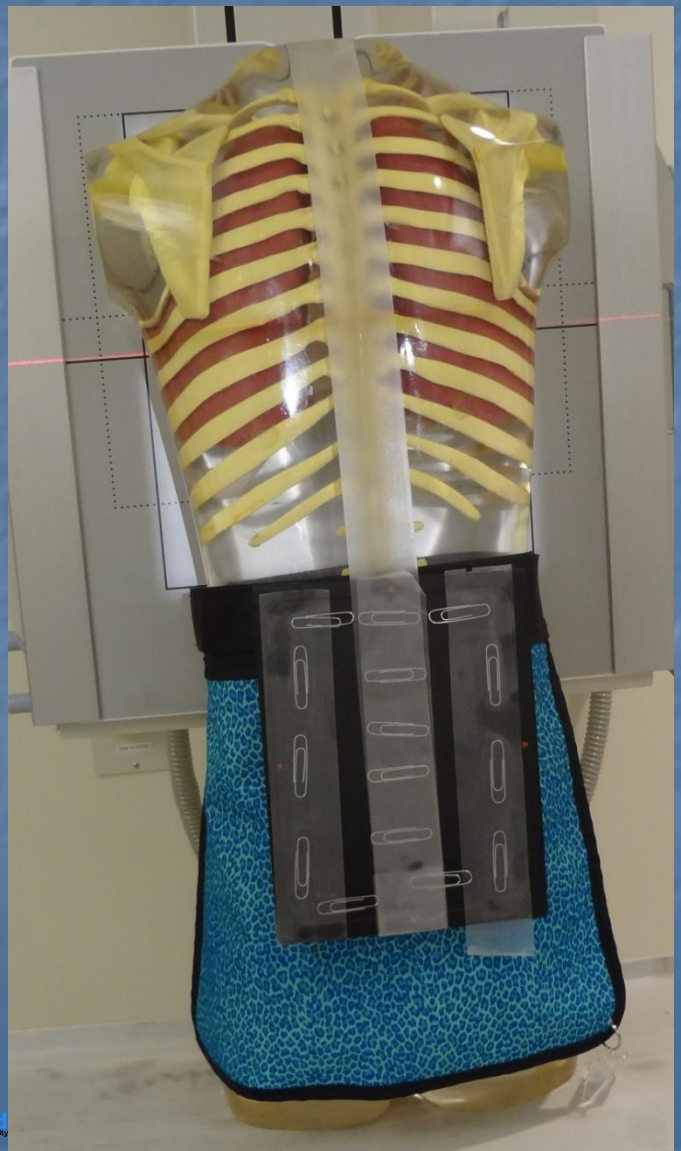


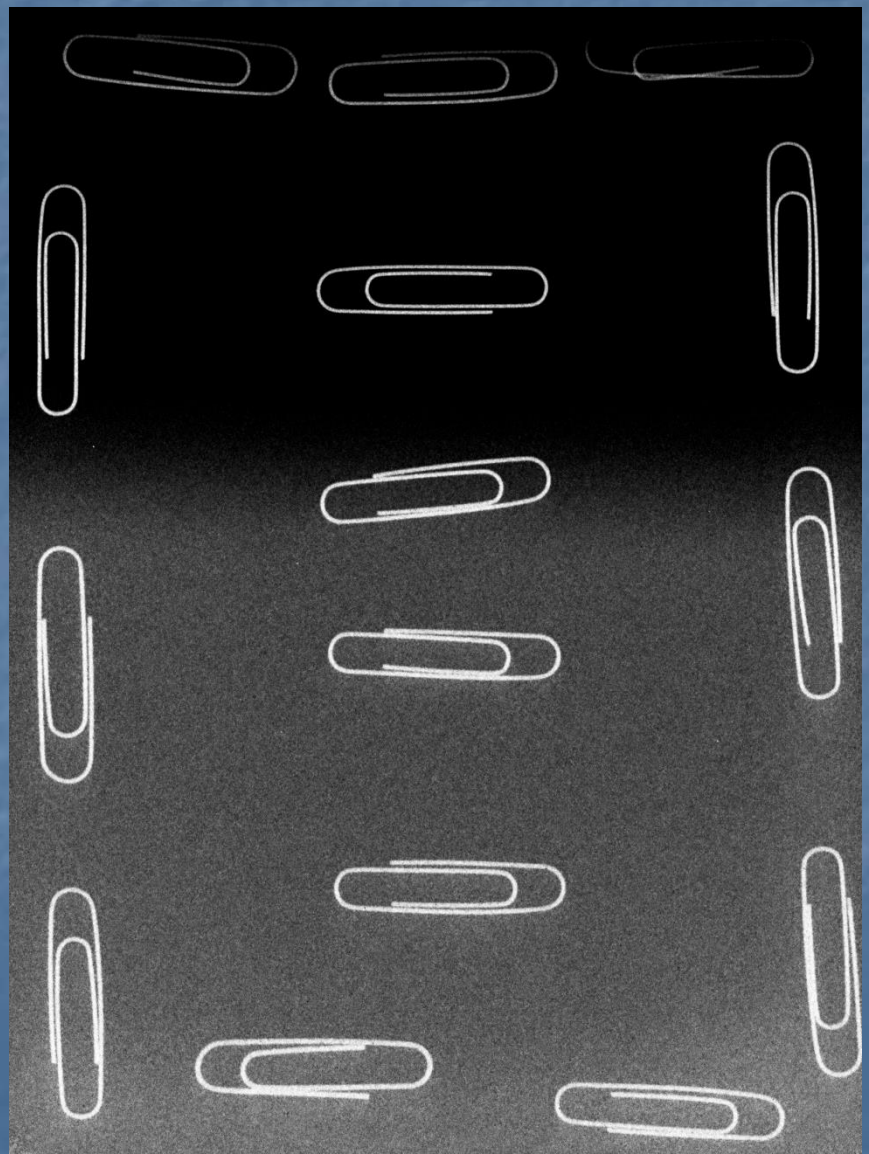


# Shield and cassette in front.
# 117 kV @ 2.5 mAs  LgM .540

# Shield and cassette in back.
# 117 kV @ 2.5 mAs  LgM 1.53





CR cassette with paper clips spaced every inch, bottom of 14x17 lightfield just above the cassette. None of the primary beam is exposing the cassette.

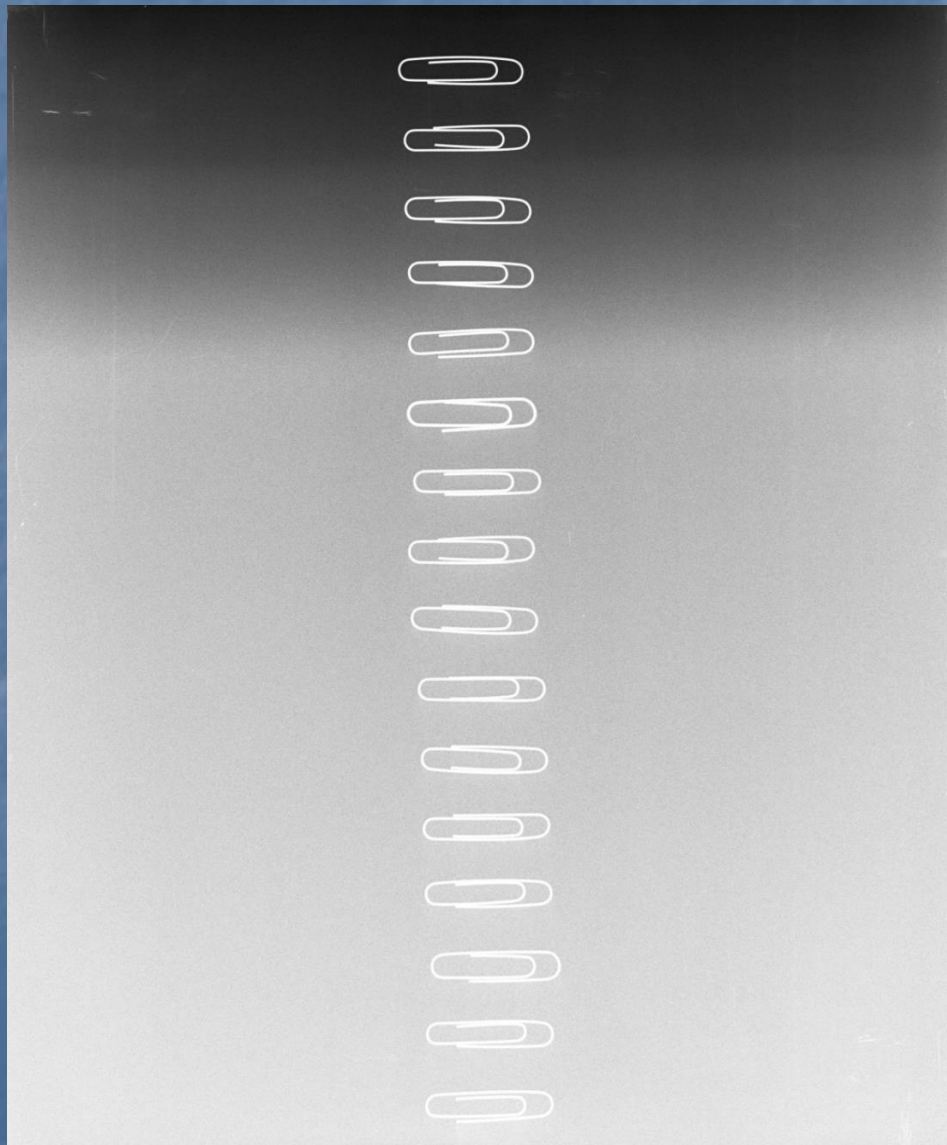
117 kV @ 2.5 mAs

LgM 1.23

(1200 Speed)

72 kV @ 20 mAs

LgM 1.69



# Cassette blocked with a .5mm lead apron.

## 117 kV @ 2.5 mAs LgM 0.511

1200 Speed

# Off-Focus experiment with the dosimeter. Ion chamber 36” off floor. Tube 40” and 72” SID. Collimated to 14”x17”.

# Started with bottom of light field just above the top of the ion chamber.

# Tube 27” higher (maxed out)

# Here are the doses from all three experiments.

| Leakage Radiation Through Collimators | | | |
|---|---|---|---|
| Height above ion chamber in inches | 85 kV@ 3.2 mAs 72" SID MicroR's (µR) | 115 kV@ 4 mAs 72" SID MicroR's (µR) | 85 kV@ 16 mAs 40" SID MicroR's (µR) |
| **0** | 96.0 | 239.0 | 1035.8 |
| **1** | 72.0 | 166.1 | 615.4 |
| **2** | 52.0 | 117.9 | 432.8 |
| **3** | 39.3 | 90.5 | 391.6 |
| **4** | 31.1 | 71.1 | 321 |
| **5** | 27.6 | 59.4 | 296.8 |
| **6** | 21.8 | 50.9 | 244.6 |
| **7** | 18.0 | 42.8 | 218.6 |
| **8** | 15.6 | 36.7 | 180.6 |
| **9** | 13.0 | 31.0 | 164.2 |
| **10** | 11.2 | 27.1 | 148.5 |
| **11** | 9.9 | 23.3 | 133.1 |
| **12** | 8.6 | 20.8 | 125 |
| **13** | 7.4 | 18.7 | 111.7 |
| **14** | 0.0 | 17.3 | 105.5 |
| **15** | 0.0 | 15.8 | 101.1 |
| **16** | 0.0 | 14.6 | 97.7 |
| **17** | 0.0 | 13.8 | 96.2 |
| **18** | 0.0 | 12.8 | 95.1 |
| **19** | 0.0 | 12.6 | 94.1 |
| **20** | 0.0 | 12.4 | 90.8 |
| **21** | 0.0 | 12.4 | 86.9 |
| **22** | 0.0 | 12.2 | 82.5 |
| **23** | 0.0 | 11.6 | 78 |
| **24** | 0.0 | 11.5 | 74.2 |
| **25** | 0.0 | 11.0 | 72.4 |
| **26** | 0.0 | 11.2 | 70.3 |
| **27** | 0.0 | 10.7 | 66.8 |

# Because of Off-Focus Radiation, the shield needs to be placed on the side of the tube

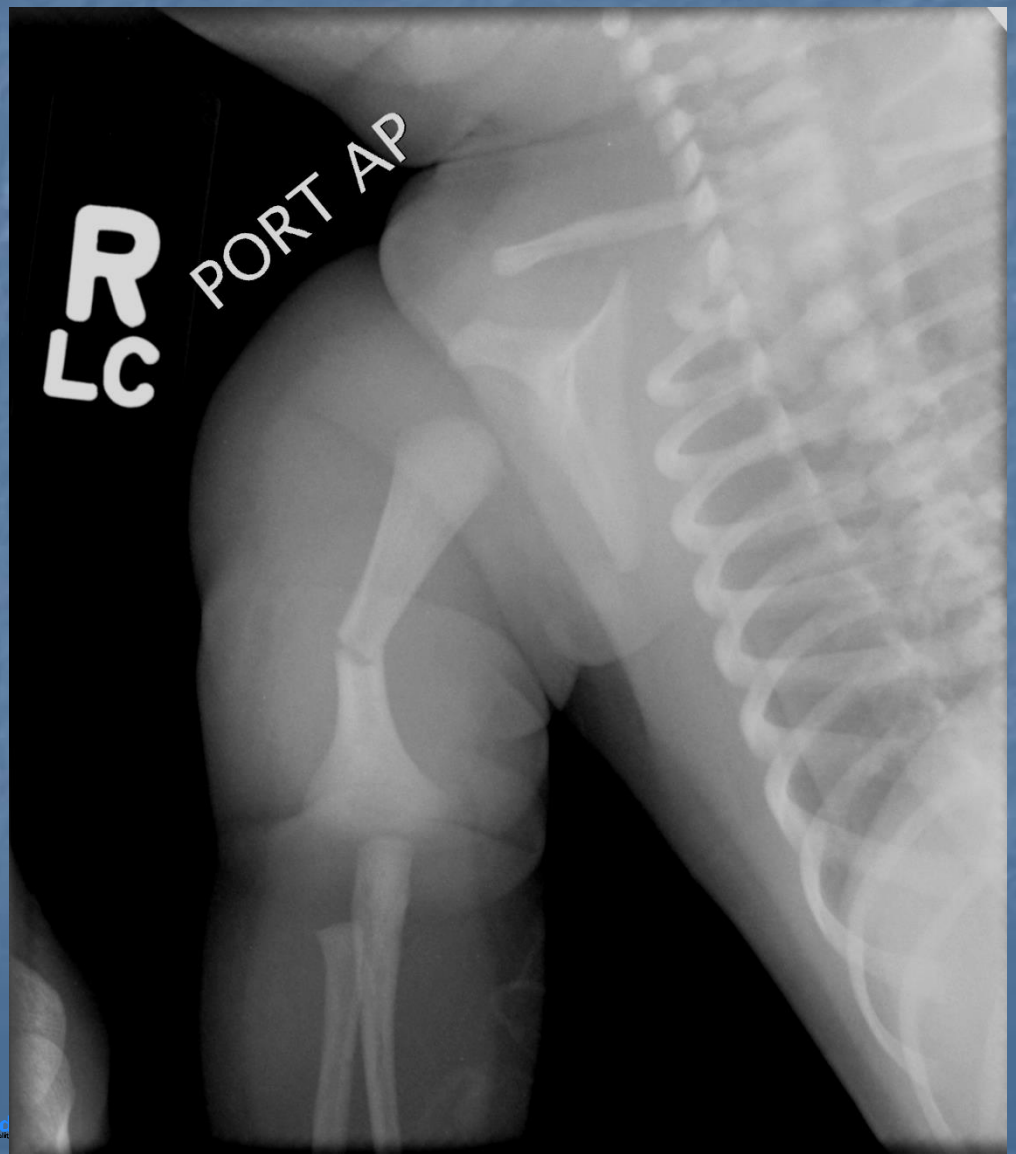
With our new “double lead” roller shield, we only need to put on a wrap around apron in the front for patient’s that are pregnant.

# At CHOMP, because of the off-focus radiation, all of our upright abdomens are now taken PA.

# Legal issue – Post Collimation

- "Also coming" *will be* a lawsuit for post collimation (shuttering).
- Gag order story.
- ***All*** radiologists are legally responsible for everything that is on the original image.

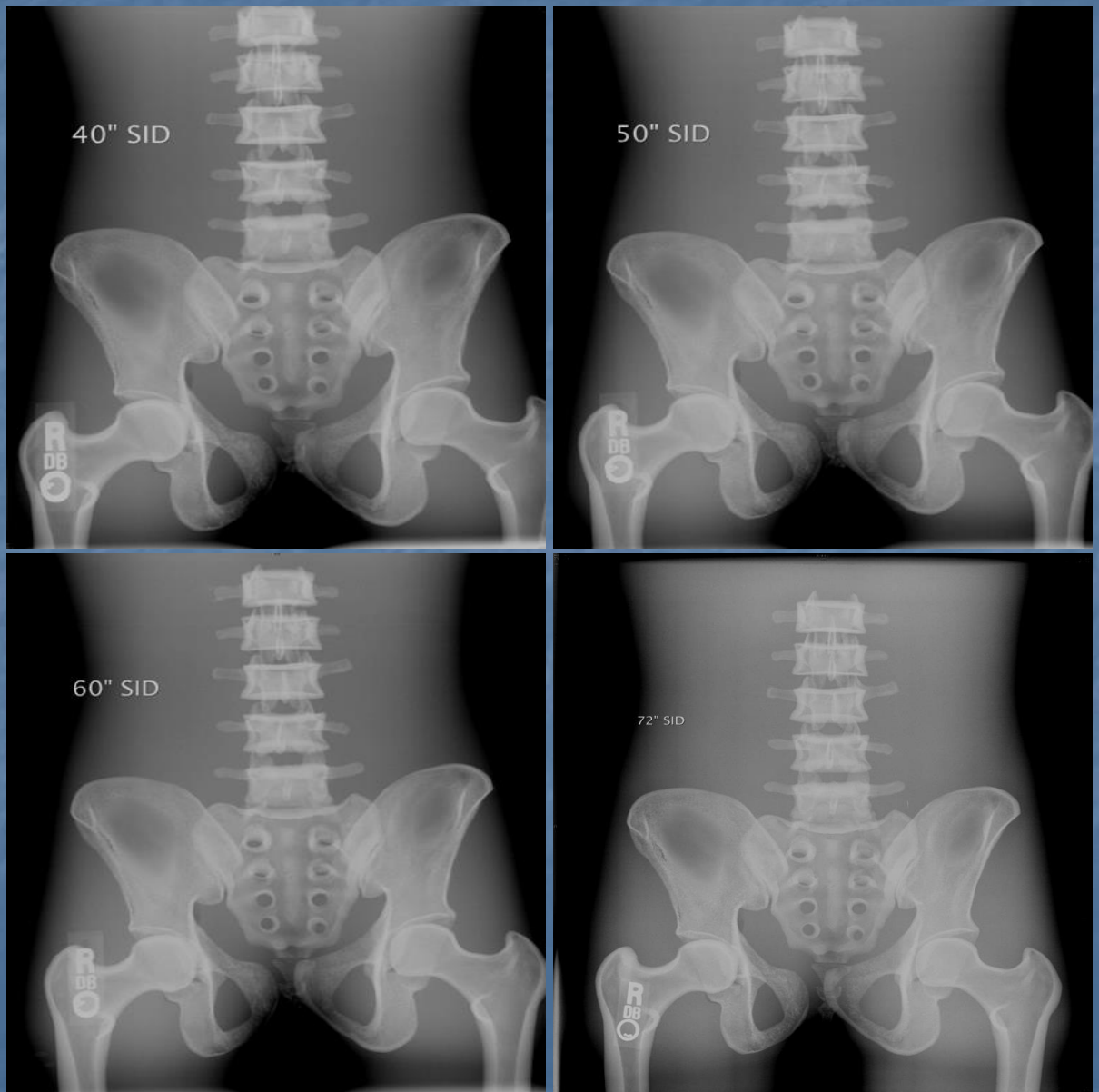
# Here's a portable humerus on a newborn. The tech could have shuttered like this.




# Digital Image Cropping or Masking in Radiography

- It is the position of the American Society of Radiologic Technologists that a **digital image should not be cropped or masked such that it eliminates areas of exposure from the image** that is presented for interpretation. Pre-exposure collimation of the x-ray beam is necessary to comply with the principle of as low as reasonably achievable (ALARA). **To determine that exposed anatomy on an image is not significant or of diagnostic value is a medical decision and is therefore outside of the scope of practice for a radiologic technologist.**
- http://www.asrt.org/docs/default-source/governance/2014-house-of-delegates-minutesdbfbfed00c826490b755ff0000d82291.pdf?sfvrsn=0

# How much more anatomy can be seen on an abdomen when the SID is increased



# 72” is the new 40”(SID)!!

- In the Jan/Feb 2015 Peer Reviewed article of the ASRT Radiologic Technology Journal: “Increasing Source-to-Image Distance to Reduce Radiation Dose From Digital Radiography Pelvic Examinations”
- Increasing SID will decrease patient dose

Entrance surface dose, including backscatter was reduced by 39% and effective dose by 41% when the SID was increased from 100 cm (40”) to 140 cm (55”).

- In addition, the image quality is increased because the magnification and geometric unsharpness are reduced (because there is less elongation).

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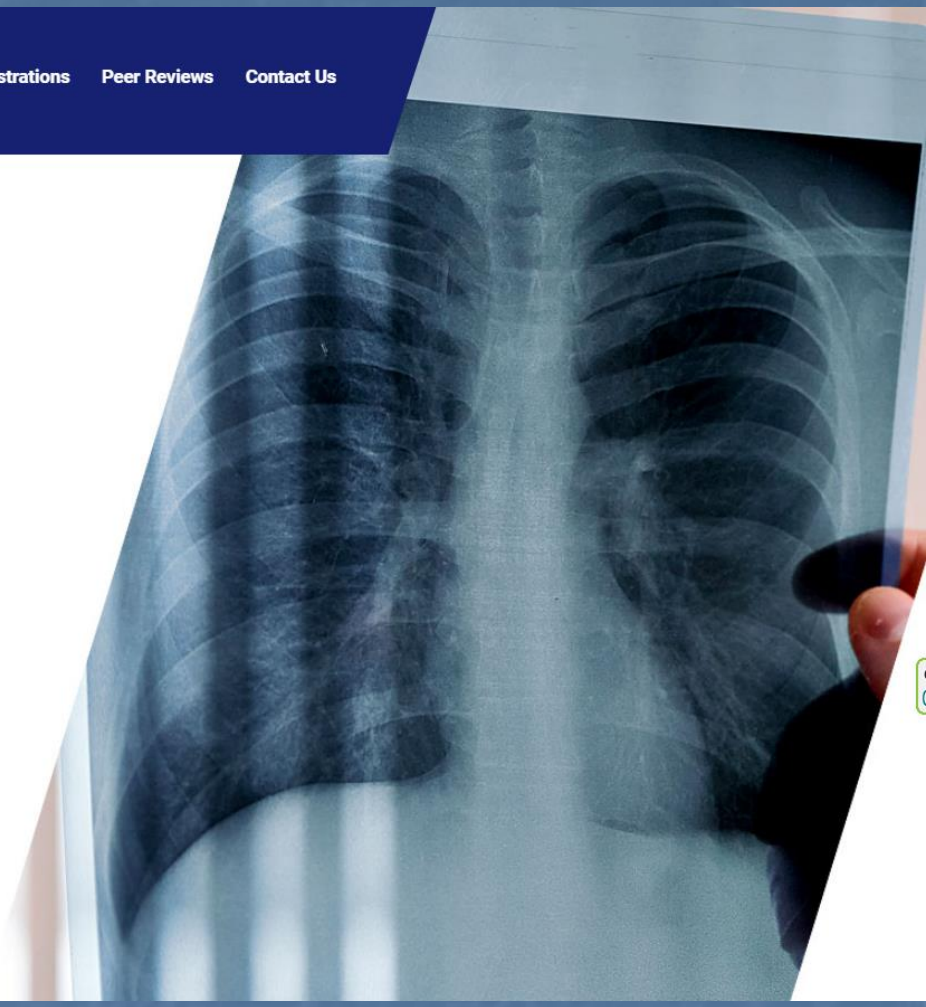
# This website was created again

so I could continue to have all of my low dose DR and CR digital technique charts, and radiation protection experiments and demonstrations, available for free.

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