Technique Still Matters

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Objectives

- The goal of good technique is to penetrate the anatomy correctly and deliver the appropriate quantity of radiation to the image receptor.

- The characteristics of the equipment that determine the technique to be used.

- Image quality problems that occur when the wrong kVp and mAs are used.

- Make a technique chart.
The x-ray producing equipment has been tested by a qualified expert.

- The kVp must be accurate:
  - If you set 80 kVp, the average energy will be 80 kVp.
- The exposure must be linear:
  - 200 mA will produce twice as much radiation as 100 mA.
- Exposures must be reproducible:
  - 80 kVp @ 10 mAs must produce the same quantity of radiation time after time on that machine.
  - The Automatic Exposure Control (AEC) must produce the same quantity of radiation exposure after exposure.
Before you develop techniques

- Perform QC recommended by the manufacture
- Make sure your IR and plate reader have been calibrated by the service engineer
1. The goal of good technique is to penetrate the anatomy correctly and deliver the appropriate quantity of radiation to the image receptor.
Penetrate the Anatomy

- kVp controls the penetrating ability of the beam
- Higher kVp higher energy x-rays
- Higher energy shorter wavelengths
- Shorter wavelength more penetrating

26 kVp

110 kVp
Penetrate the Anatomy

26 kVp

110 kVp
The best kVp for the average person is not optimum for everyone.
Testing the effect of changes in kVp

Aluminum step wedge with a spinning top
Lower kVp can under penetrate the anatomy. This will produce images that do not show all there is.
Appropriate quantity of radiation

With film we know an image is over exposed. It is too dark.
Now we have the exposure index

The exposure index roughly tells us the quantity of radiation striking the image receptor

Manufacturers give us a range to target for the best images and patient dose
Variation

- With everything exactly the same there can be variation in the EI.
- Fuji will vary $\pm 20\%$
Exposure latitude

- **Exposure latitude**: the range of exposures over which a diagnostic image can be produced.

- **Film has a narrow latitude**
  - If you doubled exposure the film would be too dark
  - If you cut the exposure in half the film would be too light

- **Digital systems have a wide exposure latitude.**
  - Range is 0.01 mR to 10 mR on the IR
The right mAs

- When the mAs is too high you are over exposing the patient to unnecessary radiation.
- If the mAs is too low you will get noisy images.
Slightly over exposed

Gross under exposure
Appropriate quantity of radiation

- mAs controls the quantity of radiation
  \[ \frac{mAs_1}{mAs_2} = \frac{mR_1}{mR_2} \]

- kVp also controls the quantity of radiation
  \[ \frac{kVp_1^2}{kVp_2^2} = \frac{mR_1}{mR_2} \]
Digital image receptors have a wide latitude of exposures

Fuji has a range of exposure index values of 100 S to 400 S

This is a range of exposure of 4 times

Let’s say you shoot an abdomen 80kVp @ 40 mAs and get 100 S.

You can cut to 10 mAs and get 400 S.
You are still in the acceptable range but you have cut the patient dose to $\frac{1}{4}$ of the original amount.
Choose your own range

- When you make your technique chart choose your target exposure index.
- Choose a target that is on the low radiation side of the range.
- If you have a Fuji system set your target at 300 S.
- Show the images to the radiologist for approval
- Make your chart based on the technique you used.
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Technique conversion

- Convert the technique

\[
\frac{\text{mAs}_1}{\text{mAs}_2} = \frac{S_2}{S_1}
\]

- Old mAs = New S

- New mAs = Old S

- \(40 \text{ mAs} = \text{New 400 S}\)

- \(\text{New mAs} = \text{Old 100 S}\)
Making a fixed kVp chart

- Once you have a good technique
- Measure the patient or the phantom
- When the thickness measurement increases 6 cm double the mAs

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With a Supertech calculator you can make a technique chart with only one good technique.

Caution: Same grid, same tube, same SID, same IR
Each x-ray unit with have a unique technique chart

- X-ray generators have a wide variety of designs.
- With the same technique high efficacy generators produce x-ray exposures with more radiation and higher quality radiation. You can’t use the same technique in Room 1 as Room 2.
- The grid in the bucky can vary greatly in the quantity of radiation absorbed.
The design of the image receptor will determine the efficiency of absorbing and using the radiation present.

If you change the IR system, you may need to modify the chart.
Test the chart yourself for a while to be sure it works before turning it over to everyone.

If you have anatomic programing save the new techniques

Communicate
We use AEC for everything!

- The service engineer can adjust the AEC to give you an exposure at your target EI value.

- Use a phantom for this process.
- Shoot and adjust
- If you don’t have a phantom borough one from the radiology school
Adjustments to the chambers to increase or decrease radiation levels.
S value Indicates the quantity of radiation striking the image receptor
Higher mAs exposures

Higher patient dose

Lower chance of noise
Don’t start a technique chart until you are sure the equipment is in calibrated and QC is within limits.
Where do I start?

- Start with procedures that are the most frequently performed
When you make the technique chart be sure the technical factors are selectable on the operator’s consol.

Don’t use 81 kVp @ 3.2 mAs, 72” SID if that is not available on the controls.
Long exposure times
To reduce the chance of motion

- Use a shorter exposure time.
- 100 mA @ 0.5 sec = 50 mAs
- 400 mA @ 0.125 sec = 50 mAs
- Both these exposures will produce the same quantity of radiation.
To use breathing technique choose a lower mA station and keep the mAs constant. This will produce a longer exposure time.

200 mA at 0.5 sec. (100 mAs) is not blurring the ribs

Go to a lower mA station like 50 mA, keep the mAs the same and find the new time.

100 mAs/50 mA = 2 sec.
That technique didn’t work!

Don’t throw out the chart if it is off for one patient.

- It might be the patient.
That technique didn’t work!

- If your technique chart has been working for months and suddenly you are getting exposure indicator values that are off…
- There is a system change somewhere.
- Check the plate reader. The signal output from the PM tube can drift. This produces an EI that indicates low radiation levels when that is not the case.
- The radiation output on the x-ray machine may need calibrated.
“The best practice is to select the appropriate exposure technique factors for the patient’s size and condition, based on a planned exposure system designed in collaboration with radiologists, to determine adequate image quality for diagnosis.”
Recommended reading

- Learn more on digital imaging
- Overview of Digital Detector Technology
- ASRT White Paper
- Best Practices in Digital Radiography