Chapter 10

Formulating X-Ray Techniques

Learning Objectives

- Read and use an x-ray technique chart
- List methods for obtaining and/or creating an x-ray technique chart
- Accurately measure a body part using an x-ray caliper
- Compare fixed kilovolts peak (kVp) technique charts with variable kVp technique charts and state which is preferable

Learning Objectives (Cont'd)

- Explain what is meant by optimum kVp and how this value is determined
- Select an appropriate milliamperage station for a given set of circumstances
- Take appropriate steps when the technique chart fails to provide an appropriate exposure

Learning Objectives (Cont'd)

- Calculate exposure adjustments for changes in patient/part size
- Determine the technique change required when radiographs are too dark or too light
- Suggest appropriate technique changes for increasing or decreasing the scale of contrast
- Calculate technique changes for variation in source–image receptor distance

Technique Charts

- Contain information on:
  - Type of examination and projection
  - Patient measurement in cm
  - Digital exposure index
  - SID
  - kVp
  - mA
  - Exposure time
  - Grid usage

Technique Charts (Cont'd)

- Used to select exposure factors
- Each chart is unique to a particular x-ray machine
- Technique charts may be generated by
  - Film manufacturers
  - Technologists

Adjusting an Existing Technique Chart

- When the technique chart is not producing images with appropriate contrast and density:
  - Check x-ray machine calibration and digital processor systems
  - Ensure that all personnel are using the chart properly
  - Make changes to the technique chart only after ensuring all factors that could affect the techniques have been evaluated

Patient Measurement

- Use of a technique chart requires accurate patient measurement
  - Sandwich the body part between the lower and upper caliper jaws
  - Place the jaws directly against the body part
  - Do not compress the body part with the calipers
  - Measure the body part in the position that the exposure will be taken

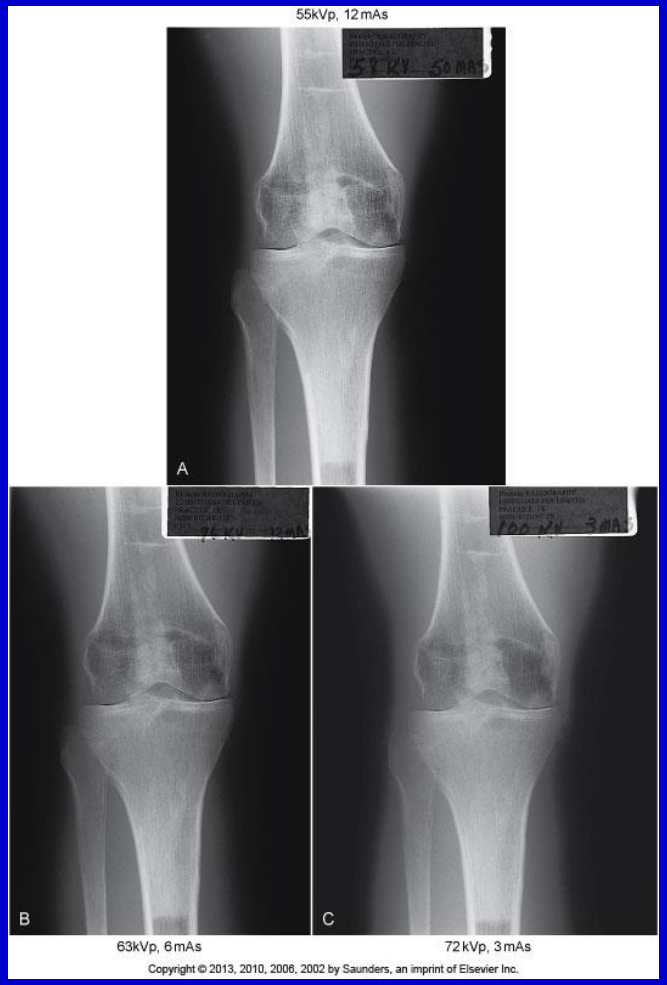
Ballinger PW, Frank ED: *Merrill's atlas of radiographic positions and radiologic procedures*, ed 10, St Louis, 2003, Mosby.

Fixed and Variable kVp Technique Charts

- Fixed kVp
  - Optimum kVp for each projection is determined and remains constant
  - mAs is adjusted according to patient thickness
  - Results in greater exposure latitude
- Variable kVp
  - mAs for each body part remains the same
  - Adjustments of 2 to 3 kVp for each cm change in patient size
  - Results in lower image contrast

Optimum kVp

- Refers to the kVp that produces appropriate image contrast
- Determined by taking a series of phantom images in which kVp and mAs are varied
  - Adjust kVp using the 15% rule
  - When kVp is decreased by 15%, double the mAs to maintain density

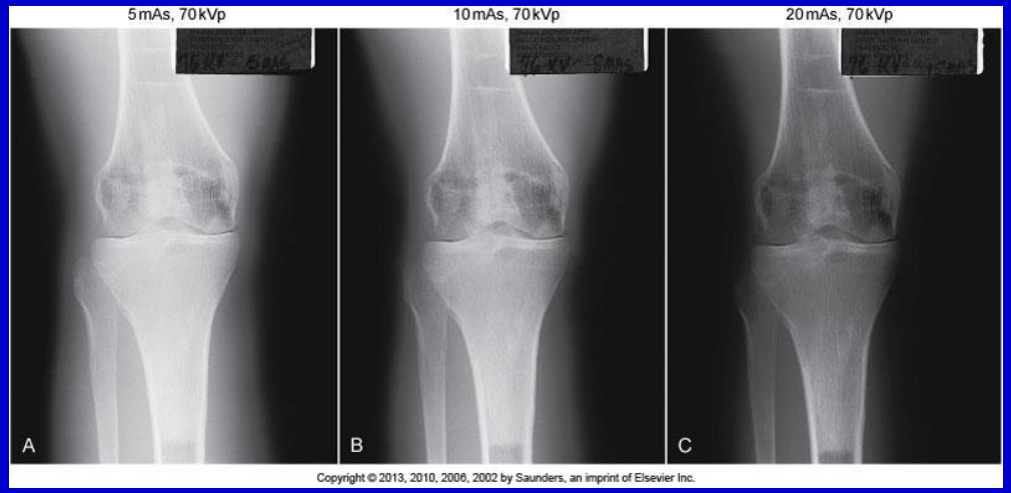


Milliamperage Selection

- Different mA and time combinations may produce the same mAs
  - Example: 300 mA × 0.1 sec = 30 mAs
    150 mA × 0.2 sec = 30 mAs
- Choice of mA depends on
  - Tube rating
  - Focal spot size
  - Exposure time
  - Available mA settings

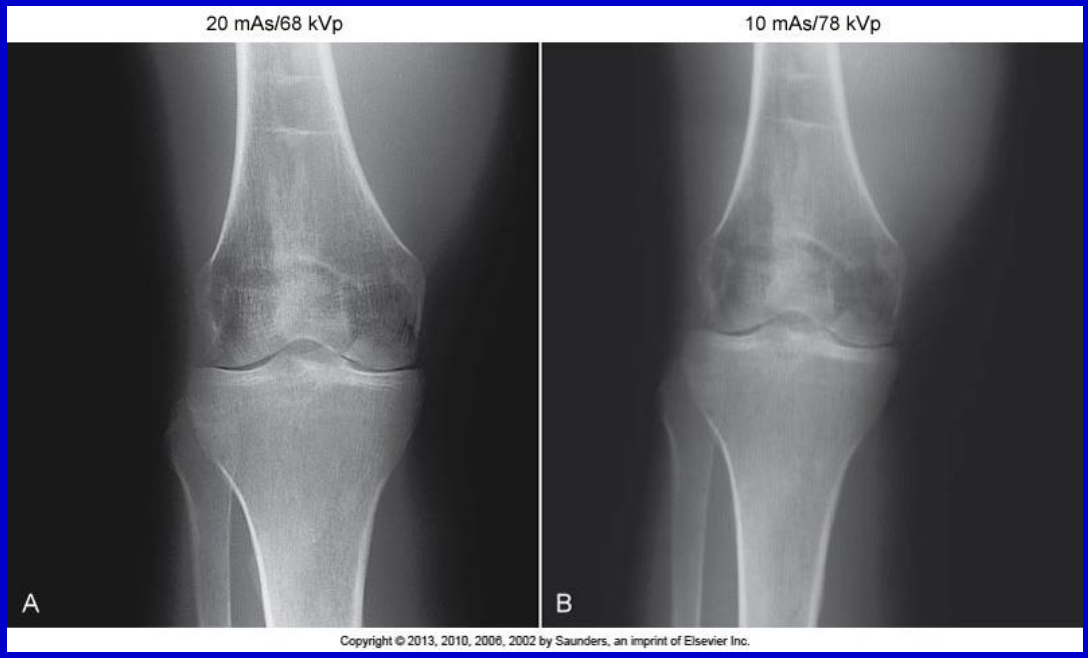
Technique Adjustment

- Patient Size
  - Increase mAs 30% for each 2-cm increase
  - Decrease mAs 20% for each 2-cm decrease
- Insufficient and Excessive Density
  - Increase mAs 100% when density is insufficient
  - Decrease mAs 50% when density is excessive



Technique Adjustment (Cont'd)

- Contrast Too Low
  - Decrease kVp by 15% and increase mAs by 100% to maintain density
- Contrast Too High
  - Increase kVp by 15% and decrease mAs by 50% to maintain density



Technique Adjustment (Cont'd)

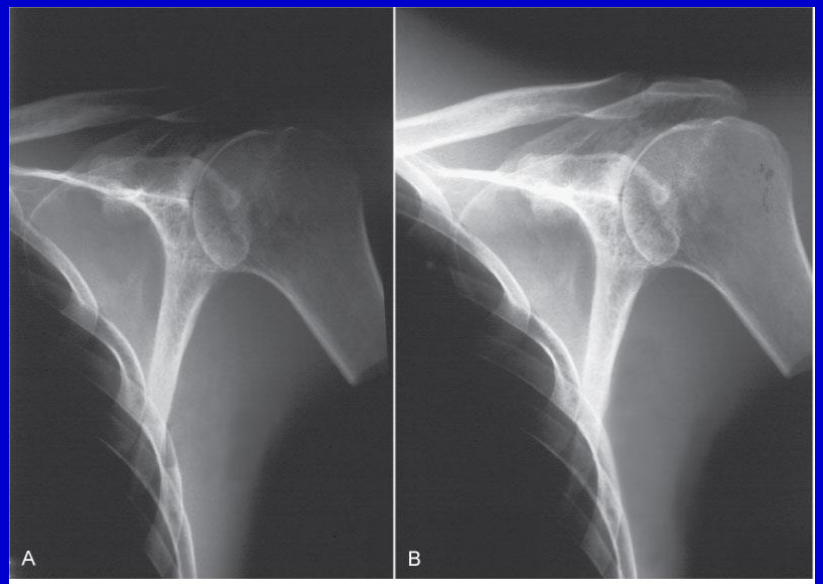
- Variations in SID affect density
- Use formula to
  - Increase mAs when SID is increased
  - Decrease mAs when SID is decreased

$$\frac{mAs_1}{mAs_2} = \frac{(SID_1)^2}{(SID_2)^2}$$

mAs_1 = Original mAs
mAs_2 = New mAs
SID_1 = Original distance
SID_2 = New distance

Compensating Filters

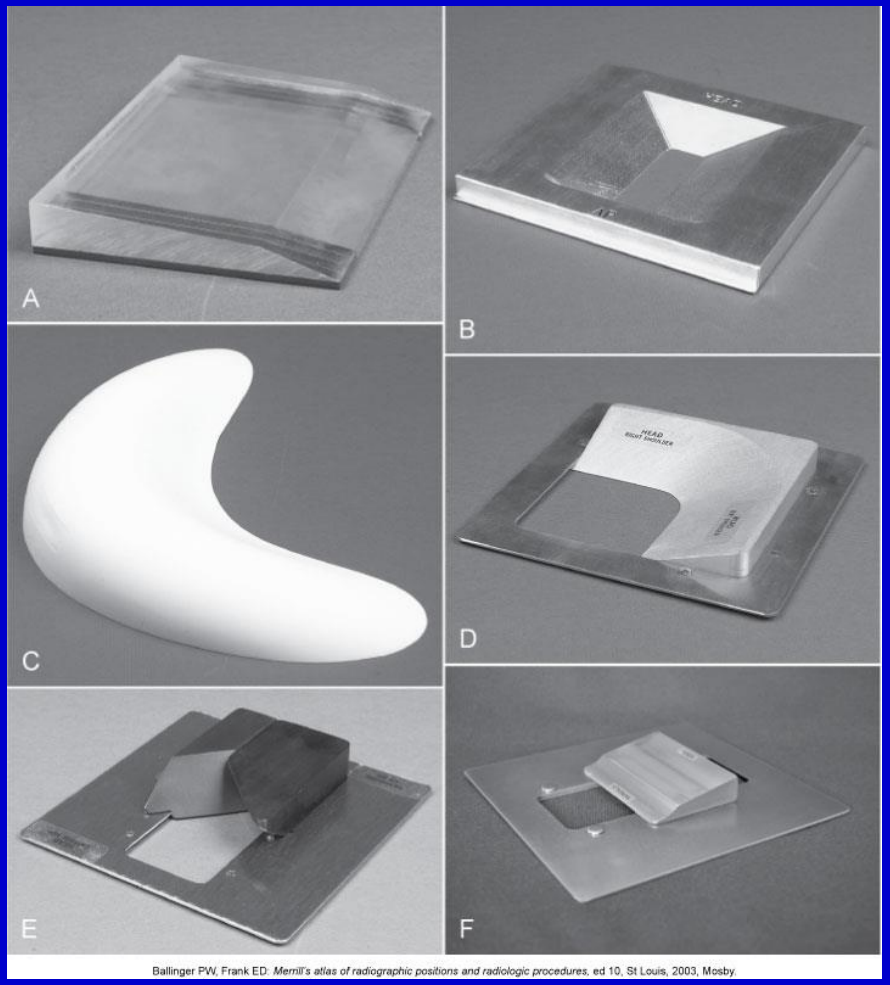
- Placed between the x-ray tube and patient to achieve consistent radiographic density for body parts that vary in thickness, such as the thoracic spine



Ballinger PW, Frank ED: *Merrill's atlas of radiographic positions and radiologic procedures*, ed 10, St Louis, 2003, Mosby. Ferlic Filter Company, LLC, White Bear Lake, Minn.

Compensating Filters (Cont'd)

- Types of filters
  - Wedge
  - Trough
  - Boomerang
  - Ferlic for shoulder
  - Ferlic for cervicothoracic region



Ballinger PW, Frank ED: *Merrill's atlas of radiographic positions and radiologic procedures*, ed 10, St Louis, 2003, Mosby.

Summary

- Technique charts provide sets of exposure factors according to body part and patient size
- Make changes to the technique chart only after ensuring all factors that could affect the techniques have been evaluated
- Measurements needed to create technique charts are obtained using calipers

Summary (Cont'd)

- Technique charts are either fixed or variable kVp
- For any type of technique chart, the optimum kVp or the kVp that will produce appropriate image contrast must be determined
- mA selection depends on tube rating, focal spot size, exposure time, and available mA settings

Summary (Cont'd)

- Exposure time affects density and can be calculated by dividing the mA by the mAs
- Increase mAs when patient size increases or the density is insufficient
- Decrease mAs when patient size decreases or the density is excessive
- Decrease kVp to obtain a shorter scale or higher contrast

Summary (Cont'd)

- Increase kVp to obtain a lower or longer scale of contrast
- To maintain density when SID is increased, increase mAs
- Compensating filters are placed between the x-ray tube and patient to achieve consistent radiographic density for body parts that vary in thickness