Knee & Patella Radiography

- Ltd Knee Series: A-P and Lateral
- Complete Knee: A-P, Lateral, Tunnel, may include Sunrise or Settegest & Oblique Views
- B/L Knees: A-P Weight-bearing & Both Laterals
Knee & Patella Radiography

• May be taken erect or recumbent.
• Lateral Views more difficult erect due to taper of the femur.
• Tunnel view very difficult erect.
• Weight-bearing good to access joint spaces.
• A B/L P-A Tunnel type view is best for joint assessment but difficult to set up.
Knee & Patella Radiography

• Some tube angulations is used for all knee views except for the erect lateral view.
• A 5 degrees cephalad angle is used for the A-P, P-A, Oblique and recumbent lateral views.
• Because of the density of the bone of the distal femur, views are taken Bucky.
A-P Knee

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16.2 Knee A-P

- **Measure**: A-P at patella
- **Protection**: recumbent: Apron; erect: Males: Bell; Females: Apron
- **SID**: 40” Bucky
- **Tube angle**: 5° cephalad
- **Film**: 8” x 10” I.D. up
Knee A-P


• Patient internally rotates leg 15° until the knee is in a true A-P position. Femur condyles parallel to film.
Knee A-P

- **Horizontal CR:** 1 cm distal to apex of patella
- **Vertical CR:** long axis of knee and femur.
- **Film centered to horizontal CR.**
- **Collimation Top to Bottom:** slightly less than film size
Knee A-P

- **Collimation Side to Side:**
  soft tissue of distal femur and proximal lower leg. Slightly less than film size.

- **Patient Instructions:**
  hold still.

- **Make exposure and let patient relax**
Knee A-P Film

- The joint space should be open.
- The patella should be midline.
- The adjacent soft tissues should be well visualized.
Medial Oblique Knee
16.3 Knee Medial Oblique

- **Measure:** A-P at patella
- **Protection:** Recumbent: apron; Erect: Male: Bell, Female: Apron
- **SID:** 40” Bucky
- **Tube Angle:** 5° cephalad
- **Film:** 8” x 10” Regular I.D. up
Knee Medial Oblique

- Patient lies supine on table with affected knee centered on table.
- Patient internally rotates lower leg as far as possible or until the femur condyles form a 40 to 45° angle to film. Avoid letting patient raise pelvis and increase object to film distance.
Knee Medial Oblique

- **Horizontal CR**: 1 cm distal to medial condyle.
- **Film centered to horizontal CR**.
- **Vertical CR**: long axis of femur.
- **Collimation Top to Bottom**: slightly less than film size.
Knee Medial Oblique

- **Collimation side to side:** soft tissue of knee region or slightly less than film size.
- **Patient instructions:** remain still
Knee Medial Oblique Film

- The fibular head will be clear of the tibia.
- The Knee joint space should be open.
- The soft tissue of the knee should be visualized.
- This view is useful in detecting loose bodies.
Lateral Oblique Knee
16.5 Knee Lateral Oblique

- **Measure:** A-P at patella
- **Protection:** Recumbent: Apron; Erect: Male: Bell; Females: Apron
- **SID:** 40” Bucky
- **Tube Angle:** 5° cephalad
- **Film:** 8” x 10” I.D. up
- **Accessories:** 45° sponge
Knee Lateral Oblique

- The patient lies supine on table or stands facing tube.
- The knee is externally or laterally rotated 40 to 45°.
- The 45°sponge may be used as a rest for the lateral side of the foot.
- The vertical long axis of the femur is centered to the Bucky or table center.
Knee Lateral Oblique

- **Horizontal CR:** 1 cm distal to medial condyle of femur or through the knee joint space.
- **Vertical CR:** centered to long axis of femur.
- **Collimation:** slightly less than film size or soft tissues of knee.
Knee Lateral Oblique

- **Patient Instructions:**
  Hold still
- **Make exposure and let patient relax**
- **Note:** It is easy to have too much rotation. The leg should not be turned more than 45 degrees measured at the condyles.
Knee Lateral Oblique Film

- The medial condyle will be in profile.
- The fibular head, neck and shaft will be superimposed.
- Oblique view of the knee are useful in detecting loose bodies.
Lateral Knee no flexion
16.5 Knee Lateral View

- **Measure:** Lateral at Condyles
- **Protection:** Apron
- **SID:** 40” Bucky
- **Tube Angle:** 5° cephalad
- **Film:** 8” x 10” I.D. Up
Knee Lateral View

- **Recumbent**
- Patient lies on the affected side with femur aligned with vertical center line of table. The unaffected leg is brought in front of the body. The pelvis is lateral.
- Knee is bent 45 degrees.
- **Horizontal CR:** 1 cm distal to medial condyle.
Knee Lateral View

- **Film centered to horizontal CR.**
- **Vertical CR:** centered to medial condyle of femur
- **Collimation top to bottom:** Distal femur and patella to proximal tibia
- **Collimation side to side:** Soft tissues of knee
Knee Lateral View

• **Erect**
  • Patient stands with affected knee next to Bucky.
  • Place stool next to Bucky and have patient place foot on rung of stool.
  • Knee should not be flexed more than 90 degrees.
Knee Lateral View

- **Horizontal CR:** 1 cm distal to medial condyle. For large patients, through the joint space.
- **Vertical CR:** centered to tibia.
- Make sure the femur and tibia are parallel to film.
- **Film centered to horizontal CR.**
Knee Lateral View

- **Collimation side to side:** Soft tissue of patella to include distal femur.
- **Collimation top to bottom:** Soft tissue superior to femur to include distal tibia.
- **Either method**
  **Instructions:** Remain still
- **Make exposure**
Knee Lateral View Film

- Soft tissues surrounding knee should be well visualized.
- Femoral condyles should be superimposed.
- Patella should be in profile.
- Proximal Tibia and Fibula should be seen.
P-A Knee

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16.6 Knee Camp-Coventry or Tunnel View

- **Measure**: A-P at patella
- **Protection**: Apron
- **SID**: 40” Bucky
- **Tube Angle**: 30 to 35° Caudal or perpendicular to long axis of tibia
- **Film**: 8” X 10” I.D. up
Knee Camp-Coventry or Tunnel View

• The patient lies prone on table. The affected knee is centered to the table.
• A stool or similar device is placed on the table for the patient to rest their shin on.
• The knee is bent 30 to 35° and resting on the rung of the stool.
Knee Camp-Coventry or Tunnel View

- The tibia should be perpendicular to the beam
- **Horizontal CR:** centered through the intercondylar fossa.
- **Vertical CR:** long axis of femur.
- **Film centered to horizontal CR.**
Knee Camp-Coventry or Tunnel View

- **Collimation top to bottom:** slightly less than film size
- **Collimation side to side:** soft tissue of knee
- **Patient instructions:** Remain still
- **Make exposure and let patient relax.**
Knee Camp-Coventry or Tunnel Film

- The joint space should be open.
- The intercondylar fossa should be well visualized including the proximal and lateral surfaces free of rotation.
- The intercondyler eminence will be seen.
16.7 Knee A-P Bilateral W/B

- **Measure:** A-P at patella
- **Protection:**
  - Males: Bell;
  - Females: Apron
- **SID:** 40” Bucky
- **Tube angle:** 5° cephalad
- **Film:** 17” x 7” or
  17” x 14”I.D. up
Knee A-P Bilateral W/B

- Erect: Patient standing facing tube.
- Patient internally rotates leg 15° until the knee is in a true A-P position. The heels and toes should be touching.
- Femur condyles parallel to film.
Knee A-P Bilateral W/B

- **Horizontal CR:** 1 cm distal to apex of patella
- **Vertical CR:** long axis of knee and femur.
- **Film centered to horizontal CR.**
- **Collimation Top to Bottom:** slightly less than film size
Knee A-P Bilateral W/B

- **Collimation Side to Side:** soft tissue of distal femur and proximal lower leg of both knees.
- **Collimation Top to Bottom:** Slightly less than film size.
- **Patient Instructions:** hold still.
- **Make exposure and let patient relax**
Knee A-P Bilateral Film

- The joint space should be open.
- The patella should be midline.
- The adjacent soft tissues should be well visualized.
16.8 Patella P-A

- **Measure:** A-P at the Patella
- **Protection:** Apron
- **SID:** 40” Bucky
- **Tube Angle:** 5° cephalad
- **Film:** 8” x 10” I.D. up
Patella P-A

- Patient lies prone on table or stands facing Bucky.
- The affected knee is aligned with the center line of the table or Bucky.
- The limb is internally rotated until it is in a true P-A position.
Patella P-A

- **Horizontal CR:** mid patella
- **Vertical CR:** centered to middle of knee and patella
- **Film centered to Horizontal CR**
- **Collimation Top to Bottom:** 5” or to include patella or slightly less than film size.
Patella P-A

- **Collimation side to side:** soft tissue of distal femur
- **Patient Instructions:** remain still
- **Make exposure and let patient relax.**
Patella P-A Film

- There should be no rotation.
- The knee joint and patella should be well visualized.
- Soft tissue adjacent to patella should be seen.
- Note collimation side to side is too tight.
16.9 Patella Lateral

- **Measure:** Lateral at condyles
- **Protection:** Lead apron draped over pelvis
- **SID:** 40” table top
- **Tube Angle:** 5° cephalad
- **Film:** 8” x 10” Extremity or Detail Cassette I.D. up
Patella Lateral

- Patient lies on affected side with knee flexed 10 to 15°. Lower leg will be in a lateral position.
- Extremity cassette placed under affected knee.
- **Horizontal CR:** centered to patella.
- Film may be centered to Horizontal CR.
Patella Lateral

- **Vertical CR:** through the femoral condyle and patella joint space.
- **Collimation top to bottom:** 5” or to include patella
- **Collimation side to side:** anterior femur and patella
- **Note:** the entire knee need not be visualized.
Patella Lateral Film

- The patella and anterior knee should be in a true lateral position.
- The distal femur may appear under exposed.
16.10 Settegest or Sunrise View

- **Measure:** A-P at patella
- **Protection:** Apron draped over patient
- **SID:** 40” Table Top
- **Tube Angle:** 20° cephalad
- **Film:** 8” x 10” Extremity or Detail Cassette
Settegest or Sunrise View

• Patient lies prone on table.
• Patient bends knee about 110°.
• The belt used for the gonad shield or Velcro may be used to assist patient hold position. Wrapping belt around ankle and giving other end to patient to hold.
Settegest or Sunrise View

- The leg should be in a true P-A position, internally rotated 15°.
- Place extremity cassette under leg.
- **Horizontal CR:** through the patella-femoral joint space.
- **Film centered to Horizontal CR.**
Settegest or Sunrise View

- **Vertical CR:** long axis of femur or mid patella
- **Collimation:** 5” x 5”
- **Instructions:** Remain still
- **Make exposure and let patient relax**
Settegest or Sunrise Film

- The patella will be visualized. The patella-femoral joint space will be seen but the view cannot be used to diagnose a tracking problem due to the extreme flexion.
- Lauren or Merchants Views are used to evaluate tracking.
16.11 Lauren Views of Interpatellar Fossa

- **Measure**: A-P at mid patella
- **Protection**: None is practical
- **SID**: 60” non-Bucky
- **Tube Angle**: varies with amount of knee flexion
- 1. Knee flexed 30°: 30° cephalad tube angle
Lauren Views of Interpatellar Fossa

- 2. Knee flexed 45°: 45° cephalad tube angle
- **Film:** 17” x 7” Regular Speed with I.D. to unaffected side.
- Patient is seated on table with legs over side.
Lauren Views of Interpatellar Fossa

- The thighs and lower legs are strapped together to prevent external rotation of femur.
- Patient flexes knee to form a 30° angle. The tube is angled 30° cephalad.
- **Horizontal CR:** through the patella-femoral joint space.
Lauren Views of Interpatellar Fossa

- **Vertical CR**: mid-sagittal plane of patient.
- Patient holds film perpendicular to central ray.
- **Collimation**: slightly less than film size or to soft tissue around patella.
- **Instructions**: Remain still
Lauren Views of Interpatellar Fossa

- Get new film and proceed with the 45° flexion view and if needed the 60° flexion views.
- The tube angle is set so the central ray is parallel with the long axis of the patella at the varied degrees of flexion.
Lauren Views of Interpatellar Fossa Film

• Both patella-femoral joint spaces must be seen on all views.
• Legs must be strapped together to diagnose, a low lateral condyle.
Lauren Views of Interpatellar Fossa Film

- Flexion more than 60° will reduce an otherwise subluxed patella and distort the depth of the sulcus.
- The Settegest View is of little value in evaluation of the extensor mechanics of the knee or anterior knee pain.
22.1 Radiographic Quality Control

Variables in Radiographic Equipment
• kVp Calibration
• mA Calibration
• Timer accuracy
• Collimator accuracy
• Beam Alignment
• Grid Centering
• Focal Spot

• Impacts technique
• Impacts technique
• Impacts Technique
• Impacts Collimation
• Impacts Grid Cut off
• Impacts Grid Cut Off
• Impacts Resolution
Radiographic Quality Assurance

• Begins with the Acceptance Tests to set baseline values and assure proper operation.
• Periodic monitoring to assure continued compliance. Annual or Semiannual
• After major component repair or replacement
Radiographic Performance Standards

- kVp Accuracy
- mA, Timer, mAs
- Collimator
- Beam Alignment
- Grid Centering
- Exposure Reproducibility

- ± 5%; ± 2 between 60 and 100 kVp
- ± 5%
- ±2% of SID
- ± 2°
- ± 2°
- ± 5%
22.2 Collimator Accuracy and Beam Alignment

• **Tools needed:**
  - 9 pennies or
  - Collimator alignment tool
  - Beam perpendicularity test tool

• **Standard:** Must be within 2% of SID or 0.8” at 40” SID
Collimator Accuracy and Beam Alignment

• **Procedure:**
  • Set SID @ 40” to Bucky
  • Place 8”X10 Cassette in Bucky
  • Center beam to film center
  • Collimate to 5” square
  • Mark borders with pennies taped to Bucky
  • Make exposure and process film.
Collimator Accuracy and Beam Alignment

- **Procedure:**
  - mark center and horizontal and vertical axis of beam
  - The exposure should be to the outer edges of the pennies.
  - Must be within the diameter of the pennies to pass the test.
Collimator Accuracy and Beam Alignment

- **Procedure:**
- mark center and horizontal and vertical axis of beam
- The exposure should be to the outer edges of the pennies.
- Must be within the diameter of the pennies to pass the test.
Collimator Accuracy and Beam Alignment

- **Frequency:** semiannual or after replacement of collimator light bulb or tube replacement.
- You should hold the x-ray machine supplier to a much higher standard.
- **The beam and light fields should match!**
Collimator Accuracy and Beam Alignment

- **Procedure with beam alignment test tool:**
  - Set SID to 40” to Bucky
  - Center 8” x 10” film to Beam
  - Tape collimator test tool to Bucky centered to light field.
  - Collimate to marked borders on tool (5” x 7”)

![Collimator test tool](image)
Collimator Accuracy and Beam Alignment

- **Procedure with beam alignment test tool:**
  - Tape the beam perpendicularly test tool to the collimation tool with the metal ball centered to center of tool.
  - Make exposure and process the film
Collimator Accuracy and Beam Alignment

- Viewing of test film
- The both small balls must be within the first circle to be in proper alignment.
- Collimation should match borders of test tool.
- **Frequency**: semiannual or after tube or Bucky replacement or repair
22.3 Grid Cut Off and Perpendicularly Testing

- If the tube is not perpendicular to the Bucky, Grid Cut-Off will result.
- If the grid focus is not correct, grid cut off will also result.
- The left knee is under exposed compared to the right. This is grid cut off.
Grid Cut Off and Perpendicularity Testing

- Tools Needed:
  - A homogenous phantom that will produce some density on the film. This can be: A lead apron or piece of Lucite 14”x17”x2”
  - Densitometer
  - 14” x 17” Cassette
Grid Cut Off and Perpendicularly Testing

- Procedure:
- Set the SID at 40” Bucky
- Drape Apron over Bucky or
- Place Lucite in stool in front of Bucky
- Place cassette in Bucky Tray and center tube to film.
Grid Cut Off and Perpendicularity Testing

- Procedure:
  - Collimate to film size and make exposure.
  - Process film
  - Repeat test at 72” SID.
  - Process Film
Grid Cut Off and Perpendicularity Testing

- Standard: There should be not more than ± 0.10 OD change from center of image to sides of image.
- If 40” or 72” test passes and the other fails, the focal range of the grid may be wrong.
- If both fail, the grid is misaligned.
Grid Cut Off and Perpendicularly Testing

- Grid misalignment can be common with new installations.
- If the Bucky crashes to the floor, the grid can be knocked out of alignment.
- **Frequency of test:** Semiannual
22.4 Linearity Of Exposure

• “The same mAs should produce the same exposure each time.”
• This will be true if the mA and Timer are accurately calibrated.
• The kVp must be the same.
Linearity Of Exposure

• **Tools needed:**
  – Aluminum Step wedge
  – Lead Blockers
  – 14” x17” Cassette
  – Densitometer

• **Standard:** Exposure should be within ± 5% across the mA, Time and mAs settings
22.4 Linearity Of Exposure

- Procedure:
- Set SID to 40” table top
- Place cassette on table
- Step wedge is placed on cassette.
- Collimation set to size of step wedge.
- Lead blockers cover the area around exposure.
Linearity Of Exposure

• Procedure:
• Set a baseline technique and initiate first exposure
• Cover exposed section of film and prepare for second exposure.
• Change control setting and put back to original setting.
• Make exposure.
Linearity Of Exposure

• Procedure:
  • Continue process with changes in power level or mA setting, Focal Spot settings and time settings.
  • Make sure that the exposed areas of the cassette are covered by the lead blockers.
  • Process the film.
Linearity Of Exposure

- This is an example of poor calibration of the x-ray generator.
- The small and large focal spot mA setting are not calibrated.
- This was a new unit that the service engineer failed to calibrate.
Linearity Of Exposure

- This is an example of proper calibration of the machine.
- Each exposure is virtually identical. If you need to adjust a technique on this machine, you can do it reliably.
22.5 Focal Spot Testing

• Test Tools:
  – RMI Focal Spot Test Tool or
  – Pin Hole Camera or
  – NEMA Star Pattern Test Tool
  – Extremity Cassette
  – Lead Blocker
Focal Spot Testing

- **Procedure:**
  - Place Extremity Cassette or Card Board Film Holder on Table.
  - Cover half of cassette with Lead Blocker
  - Set SID to 40” Table Top
  - Place test tool on cassette with rivets aligned with the anode and cathode.
Focal Spot Testing

- **Procedure:**
  - Collimate to size of test tool.
  - Set technique and make exposure on small focal spot.
  - Cover exposed section of cassette.
  - Set tool on unexposed section of cassette.
Focal Spot Testing

- **Procedure:**
  - Place “L” on film and make exposure with large focal spot.
  - Process the film.
Focal Spot Testing

• Interpretation of film:
• Compare vertical and horizontal three bars.
• 1.0mm Focal spot will resolve 11 line pairs/mm.
• 2.0mm focal spot will resolve 5 to 6 line pairs/mm.
• If you cannot see this far, the tube may be bad.
Focal Spot Test Film Passed
Focal Spot Testing

- While the focal spot passes the test, the exposure is different between the large and small focal spots.
- This was the first clue that the calibration of the machine was wrong.
Focal Spot Test Film

• Both exposures are at the same mAs and kVp
• Resolution: Passed
• Exposure: Fail