Trauma & Mobile Radiography

By

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Imaging Procedures 362

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Mobile and Trauma Radiography

- Mobile (portable) chest procedure
- Trauma patient on stretcher

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Terminology: Dislocation or Luxation
Displacement of a bone from a joint

- Shoulder dislocation
- Thumb dislocation
Terminology: Subluxation
Partial dislocation of a joint

- Subluxation of C-spine (C5 vertebra displaced posteriorly)
1. **Sprain:** Forced wrenching or twisting of a joint resulting in a partial rupture or tearing of supporting ligaments

2. **Fracture:** A break in the bone

3. **Contusion:** A "bruise" type injury without a fracture or break in the skin
Fracture Alignment Terminology

Apposition: Relationship of the long axes of fracture fragments

Types of apposition
1. Anatomical apposition
2. Lack of apposition
3. Bayonet apposition

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Fracture Alignment Terminology

Angulation:
Loss of alignment

1. Apex angulation
   Describes the direction or angle of the apex of the fracture

2. Varus (lateral apex)

3. Valgus (medial apex)
Types of Fractures

1. Simple fracture
   - Bone does not break through skin (closed fracture)

2. Compound fracture
   - Bone protrudes through skin (an open fracture)

3. Incomplete fracture
   - Fracture does not traverse through entire bone
   Examples:
   - Torus fx
   - Greenstick fx
   - Plastic fx

Compound fx

Incomplete fx
- Greenstick fx

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General Types of Fractures

- Complete fractures (two pieces)
  - Transverse fx
  - Oblique fx
  - Spiral fx

- Comminuted fractures (two or more fragments)
  - Segmental fx (double type fracture)
  - Butterfly fx (two fragments)
  - Splintered fx (thin, sharp fragments)
General Types of Fractures

- Impacted fracture
  - One fragment driven into another
    (ends of bones)
Named Fractures

- Colles' fracture
  - Posterior displacement of distal radius

- Reverse Colles' fracture?
  - Anterior displacement

Colles' fx (radius)
Named Fractures

- Monteggia's fracture
  - Proximal ulna along with dislocation of radial head

- Pott's fracture
  - Ankle fx of distal fibula with frequent fx of medial malleolus
Additional Fracture Types

- Compression fracture
  - Vertebral body collapses or is crushed
Additional Fracture Types

- Stellate fracture
  - Fracture lines radiate from a center point of injury

- Tuft fracture
  - Comminuted fx of distal phalanx
Open and Closed Reductions

- Closed reduction
  - By manipulation, no surgery
  - Minimum 2 projections

- Open reduction
  - With surgery
  - Minimum 2 projections

- C-arm fluoroscopy
  - Mobile fluoroscopy with both open and closed reductions
Trauma Adaptation Positioning

- Principle One: Two projections, 90° from each other (often with no patient movement)

- Requires adaptation of CR angle and IR placement
Examples of Principle One

- Two projections 90° from each other (Adapt CR angles and IR placement to minimize further injury or discomfort to patient)
- AP foot (adaptation of CR and IR alignment)
- Lateral foot (horizontal beam to minimize movement)
Principle One Exceptions

- Barriers to true AP and lateral (splints, traction bars, etc.)
- Exceptions to true CR-part-IR alignment

- Trauma oblique C-spine exception, IR not perpendicular
Trauma Principle Two:

- Initial long bone studies require both joints be demonstrated for each projection.
- Follow-up studies usually only require the joint nearest the injury.
Horizontal Beam Projections

- Divergency of x-ray beam
- Ensure body part is not projected off IR
Grids

- Body parts greater than 10 cm
- Lead strips run parallel to centerline
- Absorbs scatter radiation which improves visibility of detail
- 6:1 to 8:1 grid ratio
Grid Use Rules

1. CR centering to near centerline
2. CR angle along length of lead strips
3. Grid focal range for SID
   - Medium portable grid, 34-46 in. (86-117 cm)
   - Long-focus portable grid, 48-72 in. (122-183 cm)
Mobile (Portable) X-Ray Equipment – Three Types

1. Battery powered
2. 110V capacitor discharge
3. C-arm digital mobile fluoroscopy
Mobile (Portable) X-Ray Equipment

Type 1: Battery powered, battery driven
- 10-16 rechargeable 12V batteries
- Speed 2.5 to 3 mph (maximum incline 7°)
- Recharged with 110 or 120V source
- 8 hours to charge if fully discharged
Mobile (Portable) X-Ray Equipment

Type 2: Standard power source (110 or 120V) and capacitor discharge
- Much lighter, usually not motor driven
- Stores electrical charge for greater electrical power upon making exposure
Siemens Mobilett Plus

- An example of dual power source, battery and/or standard power with capacitor discharge
Mobile (Portable) X-Ray Equipment

Type 3: Mobile C-Arm Fluoroscopy

Includes
- C-arm with x-ray tube and image intensifier
- TV monitors (2)

Features
- Digital imaging and storage
- Image hold feature
- Image enhancement, masking, and subtraction

C-arm setup for surgical and interventional procedures
Mobile C-Arm Fluoroscopy

- Maneuverability is an advantage
- Uses include surgical procedures and interventional studies

One example of horizontal C-arm lateral hip setup in surgery

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C-arm ready for lateral hip projection for hip pinning
Mobile C-Arm Fluoroscopy

C-arm setup for AP projection (patient prone)

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Mobile C-Arm Fluoroscopy

- Controls and operation modes
  - Mag mode
  - Pulse mode
  - Snapshot or digital spot mode
  - Automatic/manual exposure control
  - Foot pedal
  - Roadmapping
Mobile C-Arm Fluoroscopy

- IR mode
  - Standard screen-grid cassettes

Cassette holder attachment
Three Cardinal Principles of Radiation Protection

Especially important during C-arm procedure

1. Distance
2. Time
3. Shielding
C-Arm Orientation and Exposure Patterns

- Vertical PA
  - Least exposure to operator
C-Arm Orientation and Exposure Patterns

- 30° C-arm tilt
  - Increased exposure to face and neck by a factor of four

- Horizontal
  - Increased exposure at x-ray tube end

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C-Arm Orientation and Exposure Patterns

- Vertical AP orientation
  - Should be avoided, increased exposure to head and neck

Do NOT use as vertical AP with tube on top

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Part II
Trauma and Mobile Radiographic Positioning

AP Chest

- AP supine
- AP semi-erect
Lateral Decubitus Chest

- Radiolucent pads under shoulders and hips
- Arms above head
AP Oblique Sternum

- 15-20° mediolateral angle (right to left cross angle)
- Grid crosswise
Lateral Sternum

- Horizontal beam, to mid sternum
- Arms down by side
AP Ribs

- AP above diaphragm
- AP below diaphragm
AP Oblique Ribs
(if patient cannot be rotated)

- 30-40° mediolateral angle
- Grid crosswise

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AP Abdomen

- CR at iliac crest
Left Lateral Decubitus

- Support board or sufficient pads
- CR 1-2 in. (2.5-5 cm) above iliac crest
Dorsal Decubitus (Lateral) Projection

- Useful projection to rule out possible abdominal aortic aneurysm
AP Hand and/or Fingers

- AP hand and proximal fingers
- AP mid and distal phalanges
AP, Oblique, and Lateral Hand and Wrist

AP

Oblique

Lateral

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PA and Lateral Thumb

- PA thumb
- Lateral thumb
PA and Lateral Wrist and Distal Forearm
(In Splint)
PA and Lateral Distal Forearm (In Cast)
PA Elbow

- CR perpendicular to interepicondylar plane

Lateral Elbow

- CR parallel to interepicondylar plane

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Trauma Axiolateral Projections of Elbow

- Projection for radial head – CR angled 45° towards shoulder
- Projection for coronoid process – CR angled 45° away from shoulder
AP and Lateral Humerus

- CR perpendicular to epicondyles
- Include both joints
- CR parallel to epicondyles

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- Horizontal CR to surgical neck and centerline of grid
AP Shoulder and Scapula

- CR perpendicular to shoulder joint
- CR perpendicular to mid scapula
Lateral Scapular Y

- Palpate scapular borders
- CR cross angled if required
- Grid crosswise
AP Clavicle

- CR perpendicular to mid clavicle

AP Axial Clavicle

- CR 15-20° cephalad
- Grid lengthwise
AP Foot

- CR perpendicular to IR

Lateral Foot

- CR to base of metatarsals
Oblique Foot – Optional

- CR 30-40° mediolateral
**AP Ankle**
- CR midway between malleoli
- CR perpendicular to long axis of foot

**AP Mortise**
- CR 15-20° lateromedial

**Lateral**
- CR to lateral to malleolus

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AP and Lateral Lower Leg

- Include both joints
- CR parallel to long axis of foot

- CR horizontal to mid shaft

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AP and Lateral Knee

- No CR angle for average patient
- Horizontal CR parallel to epicondyles
Medial Oblique Knee

- Optional trauma knee projection
- CR angled 45° lateromedially
- IR perpendicular to CR
AP and Lateral Mid-Distal Femur

- Grid lines vertical for CR centering
AP Pelvis
(Initial projection)

- Top of cassette 1 in. (2.5 cm) above crest
- CR perpendicular to center of IR

AP Hip

- CR perpendicular to hip
- Rotate leg 15° internally if hip fracture is ruled out

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Inferosuperior Lateral Hip
(Danelius-Miller Method)

- Horizontal CR perpendicular to femoral neck
Mediolateral Hip (Sanderson Method)

- Elevate hip 20-30°
- Cassette tilted 45°

CR perpendicular to long axis of foot
Horizontal Beam Lateral C-Spine

- Horizontal CR to C4 and centerline of grid
- No head or neck manipulation
AP Trauma Cervical Spine

- CR 15-20° cephalad
- CR to lower thyroid cartilage
AP C1-2 (Open Mouth)

- CR parallel to lower upper incisors-base of skull

Alternate AP Axial

- CR 35-40° cephalad (tip of mandible-base of skull)

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Swimmer's Lateral

- Horizontal CR centered to C7-T1
Trauma Cervical Obliques

Method One:

- IR remains flat on table
- CR angled 45°
Method Two:
- CR 45° medial and 15° cephalad
- 72 in. (183 cm) SID
  (due to increased OID)
Method One

- Cassette flat on table top, not perpendicular to CR

Method Two

- Cassette at 45°, perpendicular to CR
AP and Lateral Thoracic Spine

- CR at level of T7
- Horizontal beam, CR to T7
AP and Lateral Lumbar Spine

- CR at level of L3
- Horizontal beam, CR to level of L3
Trauma Lateral Skull

- CR 2 in. (5 cm) superior to EAM
- No tilt or rotation

- Without head manipulation
Trauma Lateral Skull
(Horizontal Beam Lateral)

- No rotation or tilt of skull
- Entire skull demonstrated
**AP 0°**
- CR parallel to OML
- CR to glabella

**AP "Reverse Caldwell"**
- CR 15° cephalad to OML
- CR to nasion
AP vs. PA Caldwell Projections

<table>
<thead>
<tr>
<th></th>
<th>cm</th>
<th>kV</th>
<th>mAs</th>
<th>Sk</th>
<th>ML</th>
<th>Thyroid</th>
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<tr>
<td>PA</td>
<td>20</td>
<td>80</td>
<td>22</td>
<td>271</td>
<td>46</td>
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</tr>
<tr>
<td>AP</td>
<td>20</td>
<td>80</td>
<td>22</td>
<td>252</td>
<td>64</td>
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</tbody>
</table>

A

B

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AP Axial Skull

- CR 30° caudad to OML
- CR to level of EAMs

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Trauma AP Axial Projections

- 30° caudad to OML
- <30° angle to OML
Lateral Facial Bones

- CR midway between outer canthus and EAM
AP Reverse Waters (Acanthioparietal)

- CR parallel to MML
- CR enters acanthion
- Petrous ridges just below maxillary sinuses
Modified AP Waters
(Acanthioparietal)

- CR parallel to LML
- CR enters acanthion

- Petrous ridges in mid aspect of maxillary sinuses
- Best demonstrates floor of orbits and entire orbital rims

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AP Axial Mandible

- 35-40° caudad to OML
- CR 2 in. (5 cm) anterior to EAMs
AP Mandible

- CR parallel to OML
- CR to lips

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Axiolateral Oblique Mandible

- Rotate skull appropriate amount
- CR angle 25-30° cephalad
Axiolateral Oblique Mandible

- CR enters 2 in. (5 cm) inferior to gonion
Gift time.....

• Answer the abnormalities listed in the next three slides.....
# Additional Named Fractures

<table>
<thead>
<tr>
<th>Fracture Description</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Baseball (Mallet) fx</td>
<td>?</td>
</tr>
<tr>
<td>Barton’s fx</td>
<td>?</td>
</tr>
<tr>
<td>Bennet fx</td>
<td>?</td>
</tr>
<tr>
<td>Boxers fx</td>
<td>?</td>
</tr>
<tr>
<td>Hangman’s fx</td>
<td>?</td>
</tr>
<tr>
<td>Hutchinson’s (Chauffeur’s) fx</td>
<td>?</td>
</tr>
<tr>
<td>Nursemaid’s elbow (jerked elbow) (common pediatric condition—not a fracture)</td>
<td>?</td>
</tr>
</tbody>
</table>
## Fracture Terminology Review

1. An indented fx of the skull
2. Fx due to a disease process
3. Fx of pedicles of C2
4. Fx of the distal 5th metacarpal
5a. Fx of distal radius with posterior dislocation
5b. Fx of distal radius with anterior dislocation
<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Fx of lat., med., and post. malleoli</td>
<td>?</td>
</tr>
<tr>
<td>2.</td>
<td>Fx of bone separated by tendon</td>
<td>?</td>
</tr>
<tr>
<td>3.</td>
<td>Fx through epiphyseal plate</td>
<td>?</td>
</tr>
<tr>
<td>4.</td>
<td>Fx of maxilla due to direct blow to orbit</td>
<td>?</td>
</tr>
<tr>
<td>5.</td>
<td>A type of pathological fracture that is non-traumatic in origin, usually to midshafts of metatarsals</td>
<td>?</td>
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</tbody>
</table>