Forearm Fractures
Trevor J. Mills

**KEY POINTS**

- The goal of treatment of forearm fractures is to restore length, correct angulation, and ideally, achieve normal function.
- Radiographs of the proximal and distal joints of patients with a forearm fracture should always be considered to rule out concurrent dislocations (i.e., Monteggia fracture).

**EPIDEMIOLOGY**

Injury is a leading cause of mortality, morbidity, and lost days of work. The annual health care cost of injuries exceeds $9.2 billion. Traumatic injuries result in more than 34 million emergency department (ED) visits each year. The highest rate of injuries occurs in persons between the ages of 15 and 24 years. Likewise, forearm fractures are commonly seen in young adults but have a bimodal distribution, with a second increased incidence in the elderly.

**PATHOPHYSIOLOGY**

The bones of the forearm consist of the radius and ulna. These two bones lie in parallel and are connected by joint capsules at the elbow and at the wrist, whereas the shafts are interlocked by a fibrous interosseus membrane. Most forearm fractures are caused by a sudden force, such as a fall on an outstretched arm. Because of the interlocking joint capsules, interosseus membrane, and contraction of the forearm muscles, multiple fractures, displaced fragments, and concurrent dislocations may be present. Alternatively, forearm fractures may be due to smaller repetitive injuries, which result in a stress fracture over time. Any pathophysiologic process that reduces the integrity of the bone, such as osteopenia, osteomyelitis, and bone metastasis, increases the likelihood of fracture, even with normal external stress.

**PRESENTING SIGNS AND SYMPTOMS**

Symptoms of forearm fractures include pain, forearm edema, forearm ecchymosis, abnormal or reduced mobility from the wrist through the elbow, and complaints of neurovascular compromise. Findings on physical examination can include obvious bony deformity; shortening of the forearm; crepitus; tenderness to palpation of the forearm; joint effusions; abnormal mobility of the wrist, forearm, or elbow; and neurologic and vascular deficits of the forearm, wrist, or hand.

**Box 88.1 Signs and Symptoms of Fractures and Complications That Suggest Serious Injury**

- **Open Fracture**
  - Open wounds in proximity to the fracture, bone fragments protruding from the skin
  - Skin tenting may indicate a high potential for progression to an open fracture

- **Fracture-Dislocation**
  - In patients with intraarticular fractures and displaced fractures, additional radiographs above and below the injury may reveal concurrent dislocations
  - Physical examination should include the joints above and below the fracture site

- **Vascular Compromise**
  - Loss or reduction of pulses distal to the injury
  - Reduced capillary refill
  - Skin pallor; patient complaints of a “cold” extremity or pain out of proportion to the injury

- **Neurologic Compromise**
  - Loss of strength, sensation, reflexes, or two-point discrimination distal to the injury
  - Complaints of paresthesias or pain distal to the injury

- **Compartment Syndrome**
  - Tense forearm
  - Neurologic or vascular compromise distal to the injury

**PEDIATRIC FRACTURES**

Forearm fractures in the pediatric population include several additional entities because children have a plastic bone matrix and active growth plates, both of which contribute to unique fractures (Table 88.2). In children, when an external force bends a long bone, one side of the cortex may be disrupted while the other side remains intact (greenstick fracture).
Alternatively, a deformity of the bone may occur without an obvious fracture line (plastic deformity). With compression, buckling of the cortex may be seen (torus fracture). Depending on the age of the child, fractures through the various growth plates of the elbow and wrist may also occur (Salter-Harris fractures).

**DIFFERENTIAL DIAGNOSIS AND MEDICAL DECISION MAKING**

The differential diagnosis for forearm fractures includes any soft tissue injury to the forearm, in addition to acute skin, soft tissue, and joint infections (Box 88.2). Some clinical aspects of acute arterial occlusion, as well as venous thrombosis, may mimic forearm fractures. Any acute neurologic change, including paresthesias, weakness, and functional loss, should be considered along with forearm fractures. Two normal variants sometimes mistaken for forearm fractures on radiographs are normal growth plates in children and nutrient vessels.

The orthopedic literature often recommends radiographs of a suspected fracture and additional films of the joints above and below the injury (Fig. 88.2; Table 88.3). This is true for forearm fractures if they are close to the joint (either elbow or wrist) or are suspected of having a concurrent dislocation (Fig. 88.3).
Disruption of the radioulnar joint must be suspected in patients with a fracture of the ulnar styloid, shortening of the radius (5 mm), or widening of the radioulnar joint (2 mm). ORIF will probably be required.

Additional films are not usually necessary with uncomplicated shaft fractures (one bone, nondisplaced). If the fracture is intraarticular, additional radiographic views or computed tomography or magnetic resonance imaging may be suggested (Table 88.4).

A Colles fracture is probably unstable if the fracture is comminuted and exhibits ulnar styloid displacement, loss of radial height of 2 mm or greater, intraarticular displacement of more than 1 mm, or dorsal angulation greater than 20 degrees.

Although most forearm fractures are evident on plain radiographs, occult fractures of the elbow may be difficult to interpret. One indication of an elbow fracture is the fat pad or sail sign, which indicates hemarthrosis of the elbow joint and thus a fracture.6

The fracture is probably unstable if it is comminuted.

### Table 88.3 Radiographs Useful in the Differential Diagnosis of Forearm Fractures

<table>
<thead>
<tr>
<th>SUSPECTED INJURY</th>
<th>VIEWS</th>
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<tbody>
<tr>
<td>Proximal forearm fracture</td>
<td>Elbow series (AP and lateral) and forearm series (AP and lateral forearm)</td>
</tr>
<tr>
<td>Shaft fracture</td>
<td>Forearm series</td>
</tr>
<tr>
<td>Distal forearm fracture</td>
<td>Wrist series (AP and lateral wrist) and forearm series</td>
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AP, Anteroposterior.
TREATMENT

Prehospital treatment includes immobilization to reduce the development of further injury and help control pain. The mainstays of ED treatment include pain control, reduction of further injury, immobilization, and appropriate disposition. Pain control should include elevation of the arm and cooling via ice packs. Oral or parenteral pain medications are usually indicated, depending on the age and size of the patient and the amount of pain.

Reduction of further injury depends on the fracture. Patients with open fractures and suspected open fractures should be given early parenteral antibiotic therapy and tetanus prophylaxis (if indicated). Displaced fractures and fractures with associated dislocations require early relocation, either by the emergency physician in consultation with an orthopedic surgeon or, if the patient’s condition is unstable, by an orthopedic surgeon in the ED.

The preferred method of fracture immobilization in the ED is splinting rather than casting because fracture edema will tend to increase in size over the first 24 hours. Specific splints for particular fractures are listed in Table 88.5.

Table 88.5 Immobilization of Forearm Fractures

<table>
<thead>
<tr>
<th>FRACTURE</th>
<th>IMMOBILIZATION</th>
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<tbody>
<tr>
<td>Proximal forearm fracture—olecranon</td>
<td>Long arm posterior splint</td>
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<tr>
<td>Shaft fracture without displacement</td>
<td>Long arm posterior splint</td>
</tr>
<tr>
<td>Shaft fracture with displacement</td>
<td>Long arm posterior splint with urgent orthopedic referral for surgical reduction</td>
</tr>
<tr>
<td>Shaft fracture with concurrent dislocations</td>
<td>Reduction and long arm posterior splint</td>
</tr>
<tr>
<td>Distal fracture—Colles, Smith, shaft</td>
<td>Reduction in the emergency department and sugar-tong splint</td>
</tr>
<tr>
<td>Hutchinson</td>
<td>Short dorsal forearm splint (reduction)</td>
</tr>
<tr>
<td>Barton</td>
<td>Short volar forearm splint (reduction)</td>
</tr>
</tbody>
</table>

FOLLOW-UP, NEXT STEPS IN CARE, AND PATIENT EDUCATION

Patients with forearm fractures can be classified into three categories: those who need immobilization with routine orthopedic follow-up, those who need interventions in the ED with very close follow-up, and those who should be admitted to the hospital.

Admission criteria include all open fractures, fractures with suspected compartment syndrome or neurovascular compromise, and fractures (or fracture-dislocations) that cannot be...
adequately reduced in the ED. Patients who have difficulty with pain control or social issues that reduce their ability to take care of their injuries may also require admission. Any suspicion of child abuse, interpersonal violence, or elder abuse may also necessitate admission.

Forearm injuries that require urgent orthopedic referral include unstable fractures, fractures that can be reduced and splinted but need further internal fixation, and dislocations that are reduced.

**TIPS AND TRICKS**

**Splinting Procedure**
Use extra padding on the elbow and wrist.
Cast padding should be smooth to avoid pressure points.
To avoid irregularities, use constant pressure (palms, not fingers) to shape the splint.
Always repeat the distal neurovascular examination after the splint dries.
If in doubt, splint joints in the position of use and avoid flexion contractures.

**PRIORITY ACTIONS**

**History:** Elucidate mechanisms with a high potential for open fractures.

**Physical examination:** Check the joints above and below the injury, examine the skin for open wounds, and evaluate and reevaluate neurovascular status distal to the injury.

**Radiography:** Always look for a second fracture or associated dislocation.

**Treatment:** Antibiotic therapy is needed for patients with open fractures; early reduction of dislocations and displaced fractures is essential.

**DOCUMENTATION**

**History**
Details of the mechanism and circumstances (fall, penetrating trauma, motor vehicle collision)
Timing of the event; time elapsed before arrival at the emergency department
Concurrent medications, drugs, or alcohol use; allergies; last meal; immunizations
Past orthopedic injuries or surgeries; other surgeries

**Physical Examination**
Initial examination, including evaluation of motor, neurologic, and vascular function
Reexamination over time, including after any intervention (e.g., splinting)

**Diagnostic Studies**
Emergency department interpretation of radiographs, computed tomography scans, magnetic resonance images, and angiograms

**Medical Decision Making**
Indications for studies and choice of consultant
Discussion with the consultant and mutual care plan decisions

**Procedures**
Details of each procedure, including the type of splint or immobilization device used

**Patient Instructions**
Discussion of injuries and potential outcomes with the patient, family, or both
Discussion of splint care with the patient, family, or both
Documentation of pain medications prescribed or the recommended plan for breakthrough pain

**SUGGESTED READINGS**


**REFERENCES**

References can be found on Expert Consult @ www.expertconsult.com.
REFERENCES


