Radius and ulnar shaft fractures

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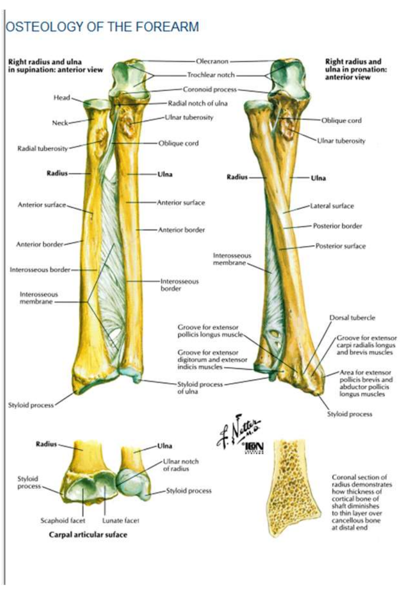
Epidemiology

Diaphyseal forearm fractures are relatively common. The incidence of diaphyseal fracture of the radius, ulna, or both is reported to be approximately 1 to 10 per 10,000 persons per year. There is a bimodal distribution with the highest incidence among young males aged 10 to 20 years and females over age 60 years old.

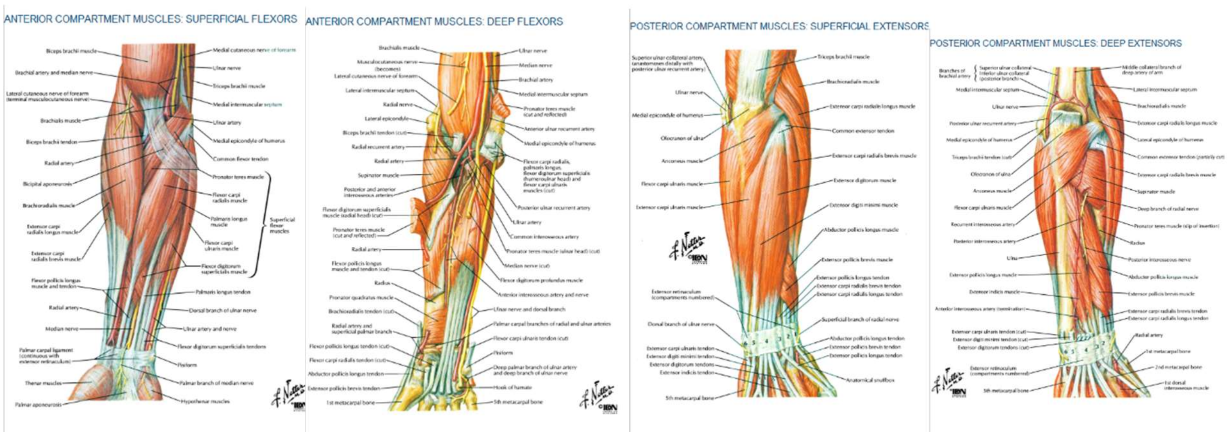
Both bone forearm fractures are often the result of high energy trauma in young individuals, such as motor vehicular accidents and falls from height. Risk factors for forearm fractures include high contact/impact sports participation such as football and wrestling, postmenopausal status, and osteoporosis. There is an increased risk for forearm fractures in highly active individuals compared to the average population.

Anatomy

The forearm is the region between the elbow and the wrist joints. It consists of 2 bones, the radius and ulna which forms proximal and distal articulations namely the proximal radioulnar and distal radioulnar joints. In between the two articulations, and interosseous membrane connects the bones. Proximally, the radial head articulates with the capitellum of the distal humerus and articulates with radial notch of the proximal ulna. There is a normal radial bow of the radial shaft which is important in the motions of the forearm. The radial shaft widens distally to form the triangular distal radius which ends with the radial styloid process. The distal radius articulates with the scaphoid and lunate carpal bones to form the wrist joint. Proximally the ulna forms into the olecranon that articulates with the trochlea of the humerus. The shaft of the ulna is straight compared to the radius and distally it ends with the ulnar head and ulnar styloid.



The forearm contains many muscles, including the volar wrist and finger flexors, dorsal wrist and finger extensors, elbow flexors (brachioradialis), pronator, and supinator muscles.

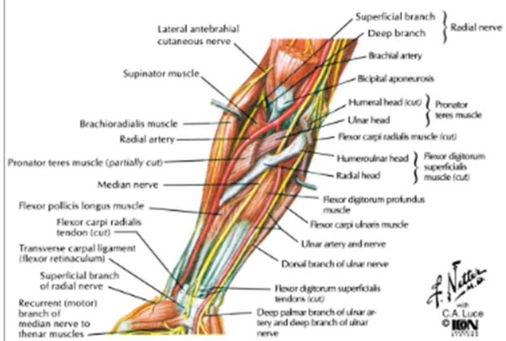


The radial nerve innervates the brachioradialis, extensor carpi radialis longus (ECRL), and extensor carpi radialis brevis (ECRB). Distally from the elbow after piercing the supinator, the radial nerve gives rise to the posterior interosseous nerve that supplies the supinator and the rest of the wrist and finger extensors. The superficial radial sensory branch is responsible for the sensation of the dorsal forearm and radial dorsal 1/3 of the hand.

The median nerve is responsible for innervation of the flexor digitorum superficialis, flexor carpi radialis, and palmaris longus. The anterior interosseous nerve, which is the branch of the median nerve, supplies the flexor pollicis longus, lateral half of the flexor digitorum profundus, and pronator quadratus. Sensation at the radial volar aspect of the forearm is from the median nerve. Prior to the wrist joint, the median nerve gives off the palmar cutaneous nerve which is responsible for sensation in the thenar eminence and central palmar areas. In the hand it provides sensation to the volar radial half of the ring, middle, and index fingers, and in the thumb

The ulnar nerve supplies the flexor carpi ulnaris and the ulnar half of the flexor digitorum profundus muscles. Majority of its innervated muscles are the intrinsic muscles of the hand. Ulnar nerve supplies sensation in the ulnar half of the volar forearm, hypothenar area, and ulnar volar half of the ring and small fingers.

The two main arteries in the forearm are the radial and ulnar arteries.



Mechanism of Injury

The most common mechanism is still trauma, typically from an axial load like falling on an outstretched hand, direct blow to the forearm, and motor vehicular accidents.

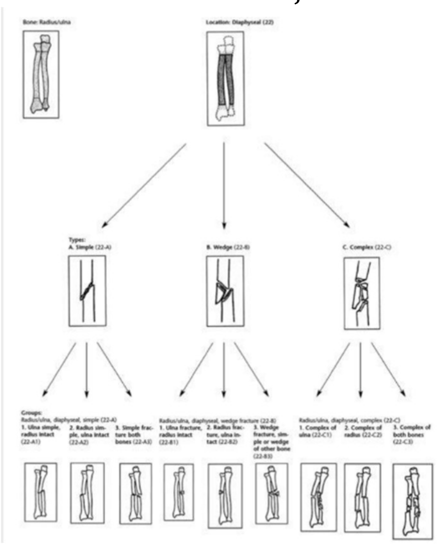
Physical Examination

Both bone forearm fractures are unstable injuries and patients will present with a grossly deformed forearm with loss of function and movement. Wounds should be identified and evaluated for possible open fractures. Integrity of the musculo-tendinous units of the forearm needs to be checked in the presence of lacerations. In high velocity injuries and comminuted both bone fractures, compartment syndrome should be ruled out and the neurovascular status of the limb should be regularly monitored.

Evaluation

Orthogonal radiographic AP and Lateral views of the forearm should be requested. The elbow and wrist joints should be visualized in the radiographic images. As a rule, radiographs should be obtained with supervision from the orthopaedic surgeon to prevent inadvertent pain and poorly taken radiographs. The classification used for forearm fractures is the Arbeitsgemeinschaft fur Osteosynthesefragen (AO) and Orthopaedic Trauma Association (OTA) which group the fracture depending on the fracture configuration and degree of comminution. Simple fracture configurations are labeled as 2A and comminuted ones as 2C.
There are 3 special fracture patterns in the forearm which necessitates surgical management for best outcomes. First is the Galeazzi fracture which involves a distal third radius fracture with an associated distal radioulnar joint dislocation. Second is the Monteggia fracture which is a proximal

3rd ulnar shaft fracture with an associated radial head dislocation. Third is the Essex-Lopresti fracture which is a fracture of the radial head with disruption of the interosseous membrane and dislocation of the distal radioulnar joint.



Management

Pediatric forearm fractures could be treated non-surgically if an acceptable reduction could be maintained and is dependent on the patient’s age. Younger patients have more remodeling potential therefore more leeway in the acceptable fracture displacement and angulations.

Table of Acceptable Reduction (Tolerances) *			
	Angle	*Malrotation (°)*	*Bayonet Apposition*
0-10 years	<15	<45	Yes, if <1cm short
≥10 years	<10	<30	No
Approaching skeletal maturity (<2y growth remaining)	0	0	No
An acceptable reduction is also driven by patient age and location of fracture with younger patients having more remodeling potential and proximal fractures having lower tolerances.			

Unlike pediatric forearm fractures, adult forearm fractures are almost always treated surgically for best functional outcomes. Nonsurgical management is usually reserved for the truly nondisplaced fractures, isolated ulnar shaft fractures with <50% displacement and <10 degrees angulation, and moribund patients. The goal of the surgery is to restore the proper length, axis, rotation, and anatomy of the radius and ulna. Another goal of the surgery is the early resumption of range of motion of the forearm to prevent stiffness and loss of function of the extremity.

Options for fixation includes external fixators, intramedullary nails, and plates. External fixators are reserved for open fractures and serve as a temporary stabilizing fixator (damage control orthopaedics) prior to definitive management. Intramedullary nailing of the radius and ulna is not commonly used because compared to plates it lacks rotational stability and the radial bow is difficult to maintain. It is reserved to those patients with poor soft tissue integrity. The standard fixation method is the use of plates, specifically mini dynamic compression plates (mini DCP). In non-comminuted fractures, absolute stability and anatomic reduction can be achieved with the use of the plates and screws allowing early range of motion and quicker functional recovery.