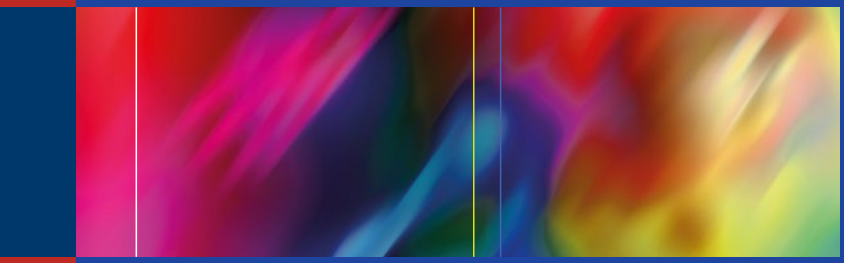
Daniel Purcell · Sneha A. Chinai
Brandon R. Allen · Moira Davenport
*Editors*



# Emergency Orthopedics Handbook

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# Dedication

***Daniel Purcell***

*Success is not the key to happiness. Happiness is the key to success. If you love what you are doing, you will be successful.*

–Albert Schweitzer

*This book is dedicated to all those involved in creating the ultimate reference manual depicting management of select musculoskeletal/orthopedic conditions in the emergency department. Without the sacrifice and tireless efforts of so many, this would not have been possible. Rejoice and celebrate, as we have created a masterpiece to be implemented by so many, fostering education and enhancing patient care for years to come. Special thanks to my wife Carmen, and my four children Cory, Miley, Aubrey, and Haley, who allowed me to follow my dreams and make this project a reality – I love you guys!*

***Sneha A. Chinai***

*This book is dedicated to all the providers who will use this guide to take better care of their patients with orthopedic complaints.*

***Brandon R. Allen***
*For my children, Nila and Owen, who continue to remind me what is important in life*

***Moira Davenport***
*Nobody said it's going to be easy. You have to dig into yourself. Think about your family. Think about the journey itself. THINK IN THE MOMENT.*
–Meb Keflezighi

*4× USA Olympic team member*
*2004 Olympic marathon silver medalist*
*2009 NYC Marathon Champion*
*2014 Boston Marathon Champion*
*This book is dedicated to those who care for musculoskeletal conditions in the emergency department and on the sidelines. It goes without saying that this work is also dedicated to those who sustain orthopedic injuries in the pursuit of better health and competitive aspirations. Lastly, huge thanks to my family for putting up with me on this crazy journey and for supporting me every step of the way! I would not be where I am today without JD, PD, MG, JJG, CPG, MAG, SMG, RE, and EDE. I think you have all earned honorary medical degrees by this point.*

# Foreword

It might be cliché, but it is true that Emergency Medicine providers are a "Jack of All Trades" and are required to know how to diagnose life- and limb-threatening diseases that cross all specialties. With the wide breadth of knowledge that Emergency Medicine providers must know, there is an increased need for textbooks that specifically address the needs of Emergency Medicine providers. Reading other specialty textbooks can lead to frustration as one tries to find the few nuggets of information that are pertinent to the emergency department. Ideally, Emergency Medicine textbooks are designed for quick reference, have great illustrations to be able to walk a provider through a rarely done procedure, and are focused on the life and limb threats.

Orthopedics is one area that many Emergency Medicine providers do not have a specialist readily available to take over the case, and there can be considerable sequalae if fractures, dislocations, and infections are not diagnosed and treated quickly. In fact, though missing an acute myocardial infarction is associated with large malpractice payouts, orthopedic injuries account for more medicolegal cases overall. It is imperative that Emergency Medicine providers have a good systematic approach to orthopedic cases to ensure good outcomes, and they must be familiar with multiple different reduction techniques in order to ensure a successful reduction.

This book, *Emergency Orthopedics Handbook*, ideally fits the needs of the busy Emergency Medicine provider. The text quickly gets to the pertinent information that is needed on a busy shift, while having great illustrations that can help

ensure a successful joint reduction, arthrocentesis, or application of a splint. Unsure how to measure compartment pressures, or what pressure is consistent with acute compartment pressure see Chap. 3, need help reducing a nursemaid's elbow see Chap. 5, and if you are worried about a septic ankle see Chap. 4 for detailed illustrations on how to approach the joint. This textbook will quickly become your handy resource for orthopedic emergencies and to confirm your treatment of the more common cases.

Wishing you all the best in your care of patients with orthopedic emergencies.

Michael C. Bond, MD, FACEP, FAAEM
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# Preface

Musculoskeletal disorders are among the most common presenting complaints to the emergency department. Pathology may encompass acute traumatic injury, exacerbation of a chronic condition, and in extreme instances, limb and/or life threatening events. Knowledge of their management not only directly impacts results of immediate care, but also long-term patient outcomes. Preparation for success involves a favorable combination of advanced education, skillful experience, and associated technical expertise. Creation of a reference source that combines scholarly activity and innovative visual demonstration would thus be an invaluable tool to facilitate this effect.

The purpose of this publication was to formulate a comprehensive, yet pertinent compilation of various musculoskeletal conditions evaluated and remedied by assorted "emergency care" providers. It is intended to educate the novice practitioner in an expedient and adept manner, while also communicating advanced instruction to the isolated community provider. Our goal is to support enhanced recognition, as well as implementation of expert care for a multitude of receiving musculoskeletal conditions.

This anthology resulted from collaboration among multiple contributors and is directly reflected within its organization and content. We suspect Emergency Medicine Orthopedics will have an immediate and extensive impact upon the care of countless patient circumstances, immeasurably heightening the functional quality of their lives.

The authors would like to extend a sincere appreciation regarding consideration of this resource within your respective

treatment domains and are confident its delineated content will categorically optimize future musculoskeletal patient encounters. Thank you for your support and please contact us with any questions and/or feedback. Good luck!

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Gainesville, FL, USA — Brandon R. Allen, MD
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# Contents

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# Chapter 1
# Key Motor and Sensory Exam

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Table 1.1 Key physical exam findings: upper extremity

| Nerve lesion | Mechanism of injury | Sensory deficit(s) | Motor deficit(s) | Classic presentation |
|---|---|---|---|---|
| Axillary (C5, C6) | Humeral head dislocation (anterior MC)<br>Proximal humerus fracture (surgical neck-head/shaft transition)<br>Quadrilateral space syndrome (axillary nerve/posterior humeral circumflex artery) | Superolateral upper arm (area over deltoid insertion) | Active abduction of the shoulder >20° (supraspinatus initiates abduction ~0–20°) | Acute: anterior dislocation-"squared off" shoulder<br>Chronic: deltoid muscle atrophy |
| Radial (C5, C6, C7, C8) | Mid-shaft humerus fracture<br>Compression in axilla crutch usage, arm draped over couch/bench ("Saturday night palsy")<br>Radial head dislocation/ subluxation (Monteggia fracture, "Nursemaid's" elbow) | **Superficial branch:** anatomic snuffbox<br>Dorsal 1st web space<br>Lateral 1/2 dorsum hand, up to level of proximal phalanx (median nerve innervates distal region) | **Radial nerve (proper)/deep branch:** forearm extension (triceps)<br>**PIN:** forearm supination (supinator muscle), extension of wrist and fingers at MCP joints<br>PIN-only motor component, no sensory component ("PIN = no pain") | **Radial**: inability to extend forearm against gravity<br>Absent/decreased triceps reflex<br>**PIN:** wrist drop<br>No extensor pollicis longus function ("Thumbs up")<br>Absent/decreased brachioradialis reflex<br>Ulnar deviation of wrist (See Fig.1.1) |

| Nerve lesion | Mechanism of injury | Sensory deficit(s) | Motor deficit(s) | Classic presentation |
|---|---|---|---|---|
| Median (C6, C7, C8, T1) | **Proximal injury**: supracondylar humerus fracture | Thenar eminence. Lateral 3.5 digits | "OK" sign<br>Flexion of wrist<br>Flexion of thumb (FPL), 2nd/3rd digit DIPJ (FDP).<br>**Anterior Interosseous nerve**: forearm pronation | "Hand of benediction"/"Pope's blessing"<br>Absent function of lateral ½ FDP/lumbricals with unopposed digital extensor function: cannot close index/middle fingers when make fist<br>Ulnar deviation of wrist (unopposed FCU)<br>(See Fig. 1.2) |
| | **Distal injury**: carpal tunnel syndrome/ acute CTS (radio-carpal dislocation/distal radius fracture)<br>Lunate/peri-lunate dislocation | Lateral 3.5 digits | Thumb opposition | "Ape" hand/"simian" hand<br>Thumb/index finger paralyzed in adduction and hyperextension<br>Carpal tunnel syndrome: thenar muscle atrophy ("wasting")<br>*****ACTS requires immediate surgical decompression***** |

(continued)

Table 1.1 (continued)

| Nerve lesion | Mechanism of injury | Sensory deficit(s) | Motor deficit(s) | Classic presentation |
|---|---|---|---|---|
| Ulnar (C8, T1) | **Proximal injury**:<br>Humeral medial epicondyle fracture<br>Clavicle fracture<br>Cubital tunnel syndrome<br>Supracondylar humeral fracture (peds) | Medial forearm (medial antebrachial cutaneous nerve)<br>Hypothenar eminence<br>Medial 1.5 digits | Flexion of medial fingers<br>Flexion/ulnar deviation at wrist | Radial deviation of the wrist<br>Volkmann's ischemic contracture (forearm compartment syndrome post-supracondylar humeral fracture) |
| | **Distal injury**:<br>Hook of hamate fracture<br>Entrapment in Guyon's canal<br>Ulnar artery thrombosis | Medial 1.5 digits | Adduction/ abduction fingers (interosseus muscles)<br>Adduction of thumb (adductor pollicis)<br>Extension of fingers (lumbricals) | "Claw" hand-hyperextension MCPJ/ flexion PIPJ, DIPJ of ring/ little fingers (See Fig. 1.3).<br>Dorsal IO atrophy (permanent atrophy between the thumb and forefinger) |
| Musculocu-taneous (C5, C6, C7) | Brachial plexus upper trunk/lateral cord injury<br>Bicipital aponeurosis (lacertus fibrosus) compression | Lateral forearm (lateral antebrachial cutaneous nerve) | Forearm flexion/ supination | Absent/decreased biceps reflex<br>Decreased flexion and/or supination strength (latter more affected) |

FIGURE 1.1 Wrist drop

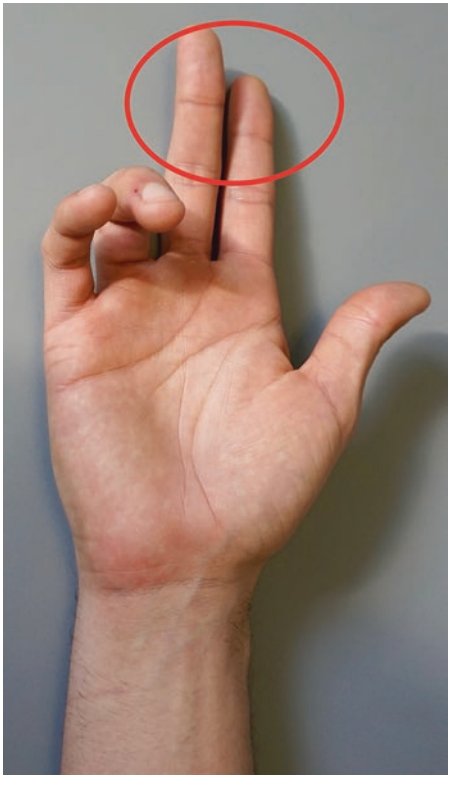

FIGURE 1.2 Proximal median nerve injury – cannot flex second and third fingers

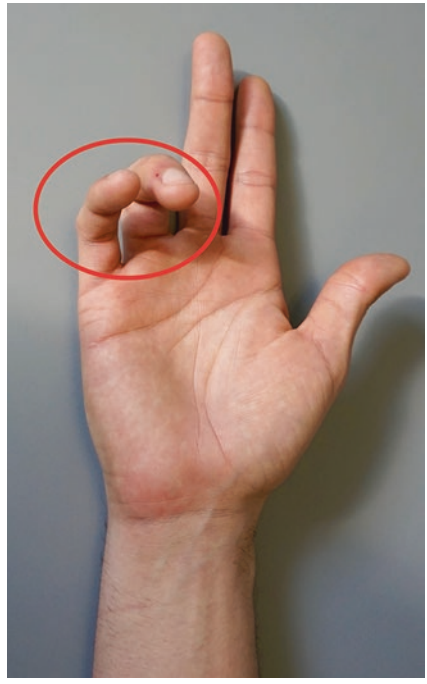

FIGURE 1.3 Distal ulnar nerve injury – cannot extend fourth and fifth digits

Figure 1.4

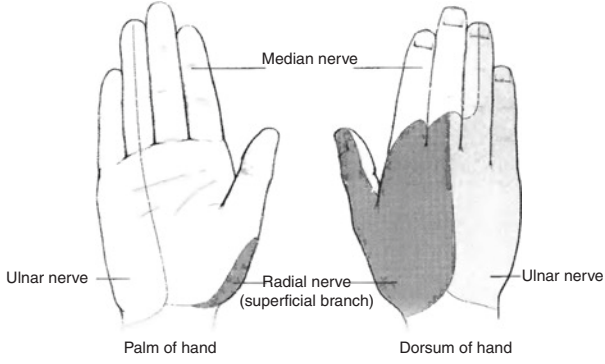


FIGURE 1.4 Cutaneous Innervation of Hand. (Reprinted with permission from White J. USMLE road map: gross anatomy. McGraw-Hill: Appleton & Lange; 2003. ©McGraw-Hill Education)

Figure 1.5

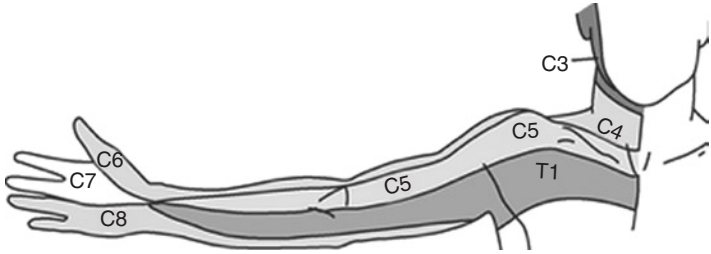


FIGURE 1.5 Dermatomes of upper extremity – anterior. (Reprinted from Keegan JJ, Garrett FD. The segmental distribution of the cutaneous nerves in the limbs of man. Anat Rec. 1948;102:409–37. With permission from John Wiley and Sons)

Figure 1.6

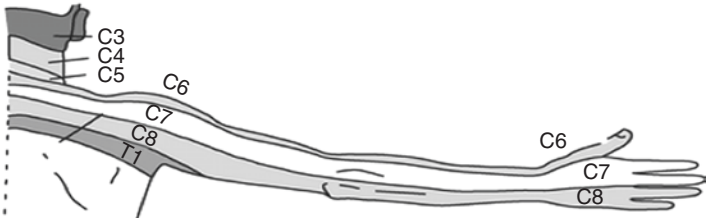


FIGURE 1.6 Dermatomes of upper extremity – posterior. (Reprinted from Keegan JJ, Garrett FD. The segmental distribution of the cutaneous nerves in the limbs of man. Anat Rec. 1948;102:409–37. With permission from John Wiley and Sons)

Table 1.2 Specialized testing: shoulder

| Test | What it's testing | How to do it | Positive test |
|---|---|---|---|
| Hyper-adduction (crossed-arm adduction) | AC joint pathology | Hand on affected side contacts contralateral shoulder. | Pain at AC joint as acromion contacts lateral end of clavicle. |
| Neer's sign | Subacromial impingement | Forward flexion and internal rotation (thumb points down); stabilize scapula throughout ROM. (See Figs. 1.7 and 1.8) | Pain at subacromial space at >90° flexion as posterior rotator cuff tendons pinched against coracoacromial arch. ***Positive Neer's test: inject 10 ml 1% lidocaine and repeat testing-pain relieved following injection*** |
| "Scaption"/"empty beer can" sign | Supraspinatus pathology | Humerus flexed 90 degrees, 30 degrees adduction, forearm extended/pronated (scapular plane)-patient points thumb down-apply downward pressure (See Fig. 1.9). | Pain/inability to resist downward pressure |

| Test | What it's testing | How to do it | Positive test |
|---|---|---|---|
| Apprehension/ relocation | Glenohumeral anterior instability | Apprehension: patient supine/upright with shoulder abducted 90°/maximal external rotation. Support patient elbow while applying anterior-directed pressure to proximal humerus.<br>Relocation: apply a posterior force | Pain, apprehension.<br>Relief of above |
| O'Brien's | Labral pathology (SLAP lesion) | Humerus: 90° forward flexion, 10° adduction, forearm pronation; apply inferior directed force | Positive test: pain that is relieved with the same movement repeated with forearm supination |
| Drop arm | Rotator cuff tear (supraspinatus dysfunction) | Passively abduct humerus and instruct patient to lower arm in controlled fashion. | Patient may be able to resist gravity initially due to intact deltoid, but eventually fails to control descent. |
| Spurling's sign | Cervical disc disease/root disorder | Head rotated to affected side-radicular symptoms reproduced with axial loading (See Fig. 1.10). | Radiation below elbow cervical spine pathology versus above elbow commonly rotator cuff pathology |

Figure 1.7 Neer's maneuver setup

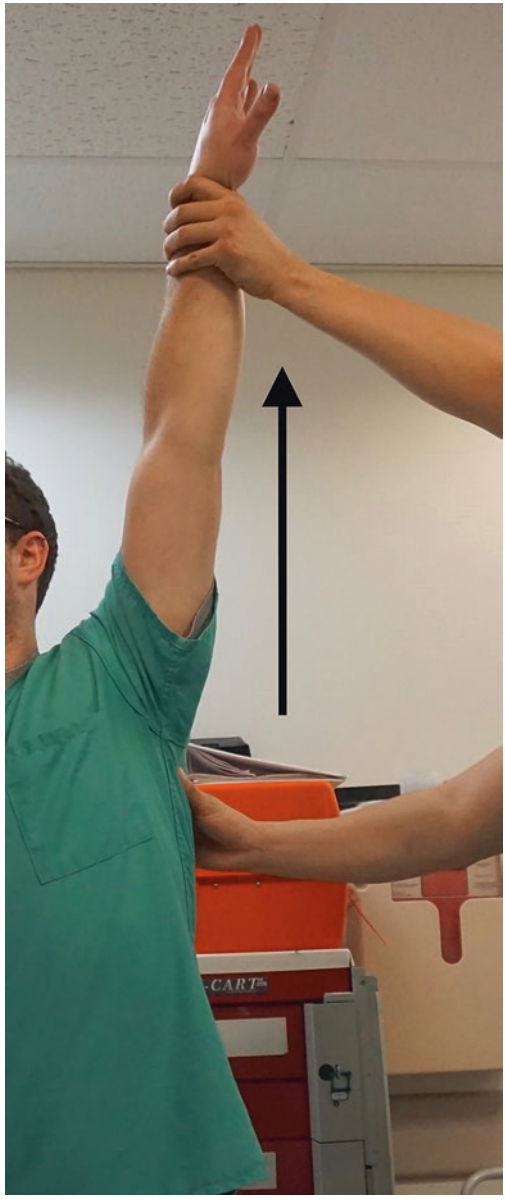

FIGURE 1.8 Neer's maneuver


Figure 1.9 "Empty beer can" test/"Scaption"


Figure 1.10 Spurling's maneuver performed on the patient's right side. Reproduction of symptoms is a positive sign

## Pearls (Upper Extremity)

- Assessment of vascular status: palpate distal pulses, measure capillary refill, and qualify temperature and color (compare versus unaffected extremity).
- ***Indications for emergent reduction: neurovascular deficit*** (e.g., radial nerve neuropraxia with mid-shaft humeral fracture) and/or ***tenting of skin from bony deformity*** (e.g., superiorly displaced clavicle fracture can lead to skin/tissue necrosis).
- Must have multi-planar imaging of shoulder (axillary lateral, velpeau axillary view, or CT) if concern exists for shoulder dislocation.

## Shoulder X-Ray (See Figs. 1.11, 1.12, 1.13, and 1.14)


Figure 1.11 Axillary view radiograph setup

FIGURE 1.12 Velpeau view setup

## Pearls (Upper Extremity) Continued

- Decreased ER (external rotation) shoulder: osteoarthritis, adhesive capsulitis, and/or posterior dislocation (electrocution, seizures).
- Adhesive capsulitis ("frozen shoulder"): **decreased *active* ROM versus *passive* ROM** (decreased ER most common).
- Diabetic patient with an infected shoulder-suspect syrinx (Charcot shoulder).

FIGURE 1.13 Modified Velpeau view setup

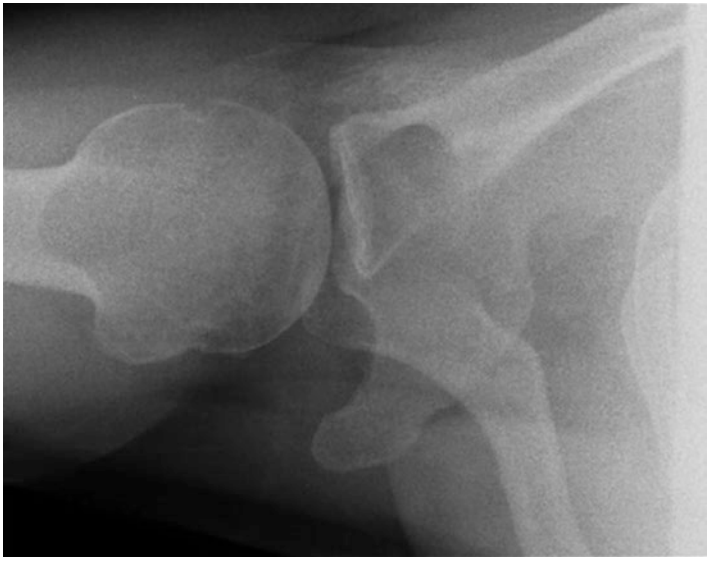

FIGURE 1.14 Axillary view radiograph. (Reprinted from http://eorif.com/shoulder-dislocation-images. With permission from eORIF, LLC)

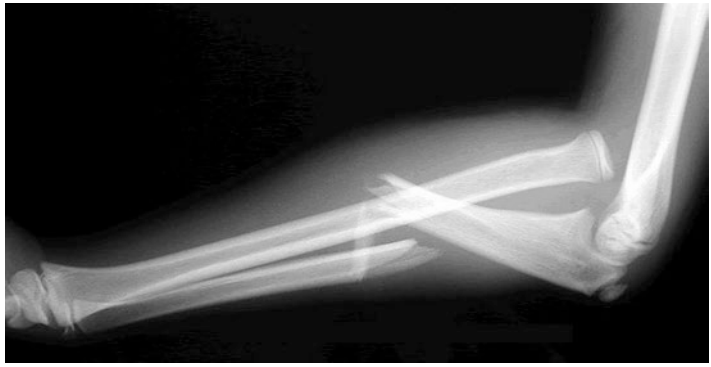

Figure 1.15 Monteggia fracture: proximal ulna fracture/radial head dislocation. (Image reprinted with permission from Medscape Drugs & Diseases (http://emedicine.medscape.com/), 2017, available at: http://emedicine.medscape.com/article/1231438-overview)

- **"Terrible triad" injury**: elbow dislocation, radial head fracture, and coronoid process fracture.
- Radial head/neck occult fracture: check for **"sail sign"** (posterior fat pad elevation), assess for block to elbow motion (+/− local anesthetic injection to decrease pain) (See Fig. 1.17).
- Educate patient regarding signs of acute carpal tunnel syndrome (ACTS) following radio-carpal dislocation/displaced distal radius fractures (median nerve can be stretched/tethered).
- Not all distal radius fractures are "Colles'" fractures (apex volar (palmar)/dorsal displacement of distal fracture fragment) versus opposite pattern (Smith fracture = reverse Colles' fracture).
- Flexor tenosynovitis: ***KANAVEL signs*** – flexed posture finger(s), fusiform swelling, pain with passive extension of the affected finger(s), and associated tenderness along the flexor tendon sheath.
- Snuff box tenderness and/or pain with axial loading of the thumb (FOOSH injury): treat for **presumed** scaphoid fracture (thumb spica immobilization even with initial negative imaging to decrease risk of nonunion/AVN *(distal → proximal blood supply)*

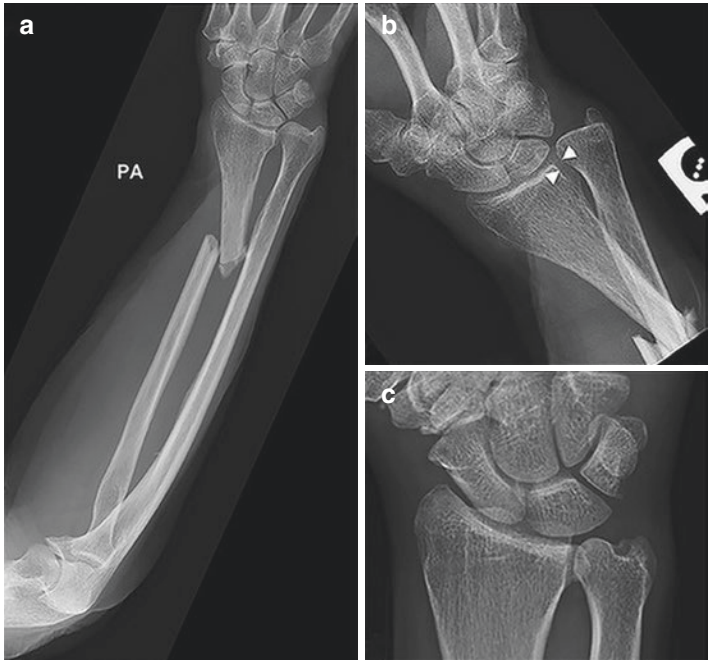


Figure 1.16 Galeazzi fracture. (**a**) PA forearm radiograph with displaced fracture of the distal one third of the radial shaft. (**b**) Wrist radiograph in the same patient demonstrates subluxation of the distal radioulnar joint (DRUJ), with mild DRUJ widening, measuring 5 mm (arrowheads), and mild radial foreshortening. (**c**) Comparison normal wrist radiograph. Notice the small caliber of a normal, tight DRUJ. (Reprinted from Wong PK-W, Hanna TN, Shuaib W, Sanders SM, Khosa F. What's in a name? Upper extremity fracture eponyms (Part 1). Int J Emerg Med. 2015;8(1):27. With permission from Creative Commons License 4.0: https://creativecommons.org/licenses/by/4.0/)