Traumatic Finger Injuries: What the Orthopedic Surgeon Wants to Know

Ged G. Wieschhoff, MD
Scott E. Sheehan, MD, MS
Jeremy R. Wortman, MD
George S. M. Dyer, MD
Aaron D. Sedickson, MD, PhD
Ketan I. Patel, MBBS
Bharti Khurana, MD

Abstract

Traumatic finger injuries account for a substantial number of emergency visits every year. Imaging plays an important role in diagnosis and in directing management of these injuries. Although many injuries can be managed conservatively, some require more invasive interventions to prevent complications and loss of function. Accurate diagnosis of finger injuries can often be difficult, given the complicated soft-tissue anatomy of the hand and the diverse spectrum of injuries that can occur. To best serve the patient and the treating physician, radiologists must have a working knowledge of finger anatomy, the wide array of injury patterns that can occur, the characteristic imaging findings of different finger injuries, and the most appropriate treatment options for each type of injury. This article details the intricate anatomy of the hand as it relates to common finger injuries, illustrates the imaging findings of a range of injuries, presents optimal imaging modalities and imaging parameters for the diagnosis of different injury types, and addresses which findings have important management implications for the patient and the orthopedic surgeon. With this fund of knowledge, radiologists will be able to recommend the most appropriate imaging studies, make accurate diagnoses, convey clinically relevant imaging findings to the referring physician, and suggest appropriate follow-up examinations. In this way, the radiologist will help improve patient care and outcomes.

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Introduction

Traumatic finger injuries are extremely common, accounting for approximately 20% of all emergency department visits (1). These include both sports- and work-related injuries that result from a variety of mechanisms. The severity of injuries varies, often requiring only reassurance or simple dressings; however, as many as 5% of hand injuries will require surgical intervention (1). Timely diagnosis of traumatic finger injuries is crucial in guiding management and preventing injury-related complications and loss of function. However, given the complicated soft-tissue anatomy of the hand and the diverse spectrum of injuries that can occur, accurate diagnosis is often challenging.

The role of imaging with traumatic finger injuries is to aid the accurate diagnosis of the type of injury sustained so that emergency physicians and orthopedic surgeons can initiate proper treatment. This requires that the radiologist be able to recognize a wide variety of injury patterns on radiographs, ultrasonographic (US) images, and magnetic resonance (MR) images and that the radiologist knows when to recommend further imaging studies or alternate imaging modalities.
In this article, we review the most common traumatic finger injuries encountered in the emergency department setting, describe the mechanisms of injury, and outline clinically important imaging findings across multiple modalities, as well as the prognostic implications of those findings. The common finger injury classification systems used by orthopedic surgeons are presented. This provides a framework for radiologists to accurately evaluate finger injuries and convey clinically relevant imaging findings.

Anatomy

Bones and Biomechanics

The osseous anatomy of the hand comprises eight carpal bones and five rays, which are composed of metacarpal bones and phalanges (Fig 1). The carpal bones are arranged into two congruent rows. The proximal row of three bones (scaphoid, lunate, and triquetrum) articulates with the distal radius and ulna at the wrist joint. The distal row (trapezium, trapezoid, capitate, and hamate) articulates with the proximal row and with the metacarpal bones of each ray. The eighth carpal bone, the pisiform, is a sesamoid bone within the flexor carpi ulnaris tendon, which articulates with the palmar facet of the triquetrum. The five rays of each hand can be named the thumb and index, long, ring, and small fingers, progressing from radial to ulnar locations, or the first to fifth digits.

Because approximately 74% of health care workers identify the “first finger” as the index finger, radiology reporting that refers to fingers by name, rather than number, may reduce ambiguity (2). Each finger is composed of a metacarpal bone and three phalanges, except for the thumb, which has two phalanges. The proximal interphalangeal (PIP) and distal interphalangeal (DIP) joints are bicondylar hinge joints. The metacarpophalangeal (MCP) joints are unicondylar, allowing radial and ulnar deviation (only in the extended position) and mild rotation.

Figure 1. Computer-generated three-dimensional (3D) model depicting the osseous anatomy of the hand. Each ray is composed of a metacarpal bone and three phalanges, except for the thumb, which has two phalanges. The proximal interphalangeal (PIP) and distal interphalangeal (DIP) joints are bicondylar hinge joints. The metacarpophalangeal (MCP) joints are unicondylar, allowing radial and ulnar deviation (only in the extended position) and mild rotation.

Figure 2. Computer-generated 3D model depicting the distal phalanx, which can be divided into three components: the tuft, shaft, and base. Management of distal phalanx fractures is often determined by the component that is fractured.
throughout their range of motion by the bone and ligamentous anatomic structures.

The thumb metacarpal articulates with the trapezium carpal bone and is oriented in a pronated and flexed position in relation to the other metacarpals. Its orientation and saddle-shaped articulation allow for both flexion and extension, as well as adduction and abduction (3–5). This anatomic structure and the biomechanics allow for unique motion of the thumb, including circumduction and opposition (4). The thumb has only one interphalangeal joint, which, similar to the other interphalangeal joints, allows only flexion and extension.

**Muscles and Tendons**

The musculature of the hand is divided into extrinsic and intrinsic hand muscles. The extrinsic muscles are primarily responsible for flexion and extension of the joints. The intrinsic muscles of the hand are responsible for abduction and adduction and also play a critical role in coordinating MCP joint flexion with interphalangeal joint extension, allowing complex hand motion (6). The thumb musculature is slightly more complex and will be discussed in further detail as it pertains to particular injuries.

The extrinsic extensor muscles include the extensor digitorum communis, extensor indicis proprius, and extensor digiti minimi (Fig 3). The extensor digitorum communis tendon travels under the extensor retinaculum and fans out into four tendons, with one tendon extending over the dorsal aspect of each of the index, long, ring, and small fingers. After passing through the sagittal band and crossing the MCP joint of each finger, the tendon splits into two lateral slips and a central slip (Fig 4). The central slip extends over the dorsal aspect of the proximal phalanx to insert at the dorsal base of the middle phalanx. The lateral slips extend along the radial and ulnar margins of the dorsal aspect of the PIP joint and are joined by fibers of the intrinsic hand muscles to form the conjoint tendons. The two conjoint tendons of each digit then converge along the dorsal aspect of the DIP joint to form the terminal tendon that inserts at the dorsal base of the distal phalanx. The extensor indicis proprius joins the extensor digitorum communis tendon at the level of the index finger MCP joint. The extensor digiti minimi tendon joins the digitorum communis tendon at the level of the small finger proximal phalanx.

The flexor muscles include the flexor digitorum profundus (FDP) and flexor digitorum superficialis (FDS) muscles (Fig 5). The FDP and FDS tendons pass through the carpal tunnel before traveling along the volar aspect of the index, long, ring, and small fingers. The FDS tendon inserts on the volar proximal portion of the middle phalanx; the FDP tendon travels deep to the FDS tendon and inserts on the volar aspect of the base of the distal phalanx. The FDS tendon splits at the level of the distal metacarpal to wrap around the FDP tendon on either side, forming an aperture through which the FDP tendon travels. The flexor tendons run along osteofibrous canals that provide nutritional support to the tendons and tether the tendons to the corresponding digit to prevent bowstringing during flexion. There are five annular pulleys (A1–A5), which are thickened fibrous portions of these canals. In addition, crossing fibers from the annular pulleys form three cruciform pulleys (C1–C3) (5).

The intrinsic muscles of the hand are named as such because they both originate and insert within the hand (Fig 6). There are four major groups of intrinsic muscles: thenar, hypothenar, interosseous, and lumbral. There are four
dorsal and three palmar interosseous muscles. The dorsal interosseous muscles are responsible for abduction of the index and ring fingers away from the long finger, as well as radial and ulnar movement of the long finger. They originate from the two metacarpals between which they insert (thumb and index finger metacarpals for the first interosseous muscle, index and long finger metacarpals for the second interosseous muscle, long and ring finger metacarpals for the third interosseous muscle, and ring and small finger metacarpals for the fourth interosseous muscle), attaching distally at the base of the proximal phalanx and the lateral slip. The abductor digiti minimi is responsible for abduction of the small finger. The palmar interosseous muscles are responsible for abduction of the index, ring, and small fingers toward the long finger. These muscles originate from the side of the metacarpal of the digit on which they act that is closest to the long finger (ulnar side for the index finger and radial side for the ring and small fingers), and they insert on the lateral slip. The lumbrical muscles are unique because they have no osseous attachments. These muscles originate from the FDP tendons as they travel over the metacarpal bones and insert on the radial lateral slip. The lumbrical muscles contribute to flexion at the MCP joints and extension at the interphalangeal joints (3,5,6).

**Ligaments**

The ligaments that surround each MCP, PIP, and DIP joint are all similar in configuration. For
each joint, there is both a radial collateral ligament (RCL) and an ulnar collateral ligament (UCL), each of which is further subdivided into a proper collateral ligament and an accessory collateral ligament (Fig 7) (5). The proper collateral ligament spans from the dorsolateral head of the more proximal bone to the volar and lateral base of the distal bone and is taut when the joint is flexed. The accessory collateral ligament spans from the dorsolateral head of the more proximal bone to the distal aspect of the volar plate and is taut when the joint is extended. These components of the collateral ligaments are difficult to distinguish on conventional images.

The volar plate is a fibrocartilaginous structure along the volar aspect of the joint capsule. The volar plate reinforces and stabilizes the joint capsule and limits joint hyperextension (Fig 7).

**Standard Imaging Workup**

The initial imaging modality of choice for finger injuries is radiography (7). At our institution, it is standard to acquire three views for finger injuries. These include posteroanterior, oblique, and lateral views. The posteroanterior view normally includes the entire hand, whereas the oblique and lateral views may be collimated to include only the finger or metacarpal involved in the injury. Oblique views have been proven to increase the confidence of the final radiographic diagnosis (8). On the oblique views, the proximal phalanx of the thumb can project anterior to the metacarpals, which should not be mistaken for MCP joint subluxation. In some instances, a supinated oblique view can be considered for better evaluation of fractures at the base of the small finger. Conversely, fully pronated views may be useful for evaluation of the index and long finger metacarpals.

Computed tomography (CT) plays a limited role in finger injury evaluation. Although particular wrist injuries may be occult on radiographs, most osseous injuries of the finger are depicted on radiographs (7). Soft-tissue injuries of the finger may be radiographically occult; however, the modalities of choice for evaluation of finger soft tissues include MR imaging and US, not CT. CT may play a role in surgical planning but plays only a limited role in the diagnosis of finger injuries.

MR imaging and US are useful adjunct imaging modalities for further evaluating the soft tissues of the hand or for evaluating common complications of particular finger injuries. MR imaging is an excellent modality for depiction of the flexor and extensor tendons and ligaments, as well as the pulley system (9–11). Although imaging protocols vary by institution, typical MR imaging evaluation of the hand includes at least a T1-weighted sequence in the sagittal plane, fat-saturated T2-weighted sequences in the axial and coronal planes, and a gradient-echo sequence in the coronal plane (12). In standard protocols at various institutions, additional T1-weighted or fat-saturated T2-weighted sequences will be used in additional planes; and often, proton density (PD)–weighted, fat-saturated PD-weighted, and short tau inversion-recovery (STIR) sequences will be substituted for T1-weighted and fat-saturated T2-weighted sequences. T1-weighted sequences allow evaluation of alignment, bone marrow signal intensity, occult fractures, hemorrhage, and fat-containing lesions. T2-weighted sequences allow evaluation of fluid signal inten-
sity within tendons and ligaments, tendon and ligament disruption, muscle edema, and bone marrow edema. Gradient-echo sequences allow evaluation of ligament integrity. The smallest possible field of view should be used to maximize resolution of small structures such as the collateral ligaments and volar plates, although the protocol should be optimized to maintain an adequate signal-to-noise ratio, most often by using contiguous sections 2–3-mm thick. Use of a 3-T magnet with a dedicated coil is preferred to a 1.5-T magnet for an improved signal-to-noise ratio and improved depiction of small structures. Tendons and ligaments appear as continuous, homogeneous bands of low signal intensity on most image series. Complete tears appear as areas of discontinuity in these bands, often with intervening fluid signal intensity. Strains or partial tears demonstrate increased signal intensity, often within thickened but otherwise intact continuous ligamentous bands on T2-weighted or STIR MR images. MR imaging and US are particularly useful imaging modalities whenever a Stener lesion is suspected (13,14).

**Injuries according to Location**

**Distal Phalanx Injuries**

**Fractures.**—The distal phalanges are the most commonly fractured bones of the hand, accounting for 50% of all hand fractures (15–17). The most common mechanisms of injury for distal phalanx fractures are crush injuries or axial loading (Table 1). Fractures can occur within the tuft, shaft, or base. The fractures can be longitudinal or transverse in orientation, or they may be comminuted (Fig 8). Numerous fibrous septa extend from the periosteum of the distal phalanx to the skin, which, in combination with the overlying nail bed, make dislocation of distal phalanx fractures unlikely and allows these injuries to usually be managed with immobilization (16). However, distal phalanx base fractures are considered unstable because of the insertion sites of the flexor and extensor tendons, and these fractures require surgery (16).

Distal phalanx fractures are commonly complicated by nail bed injuries. Fifty percent of the nail bed extends distal to the tuft of the distal phalanx and is therefore unsupported by underlying bone. Substantially displaced fractures imply nail bed injury and often require nail plate removal, K-wire fixation, and nail bed repair (15). It is critical for the radiologist to assess any widening of the fracture line on the lateral image, because this may indicate nail bed entrapment, which can prevent successful reduction (19).

**Mallet Finger.**—Mallet finger results from disruption of the extensor tendon at its insertion site at the dorsal aspect of the distal phalanx base, and mallet finger is the most common finger tendon injury in sports (20). This injury occurs because of forced flexion of the DIP joint during extensor contraction (Movie 1). Ultimately, this causes a flexion deformity at the DIP joint that is due to unopposed flexor tendon forces.

At presentation, most mallet fingers manifest as tendon injuries without radiographically depicted fractures (21). In some cases, an avulsion fracture fragment (“mallet fracture”) is seen at the dorsal base of the distal phalanx (Fig 9). Isolated tendon injuries are best depicted on sagittal MR images. In a partial tendon tear, increased intrasubstance signal intensity is seen within a portion of the tendon on T2-weighted MR images. With a full-thickness tear or complete laceration, there is complete discontinuity of the tendon fibers, often with retraction and intervening fluid signal intensity.

These injuries are generally treated conservatively, with splinting of the DIP joint in hyperextension (21–24). There is no indication for surgical treatment of a simple mallet finger. For mallet fractures, it has been demonstrated that fractures involving at least 50% of the articular surface, as well as those with volar subluxation of the distal phalanx, may be complicated by DIP joint instability. Persistent DIP flexion deformity can lead to swan-neck deformity (pathologic flexion of the DIP joint and hyperextension of the PIP joint),
### Table 1: Finger Injuries, Imaging Findings, and Treatment

<table>
<thead>
<tr>
<th>Finger Segment and Injury</th>
<th>Mechanism</th>
<th>Imaging Study</th>
<th>Findings</th>
<th>Management Considerations</th>
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<td><strong>Distal phalanx</strong></td>
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<tr>
<td>Fracture</td>
<td>Crush injury, axial loading</td>
<td>Radiography</td>
<td>Linear lucencies of various orientations and locations</td>
<td>Base fractures are unstable and require surgery; markedly displaced fractures imply nail bed injury, which often requires nail bed repair and fixation.</td>
</tr>
<tr>
<td>Mallet finger</td>
<td>Forced flexion of the DIP joint during extensor contraction</td>
<td>Radiography, MR imaging</td>
<td>DIP joint flexion on radiographs, disruption of the extensor tendon at its insertion site at the dorsal aspect of the distal phalanx base</td>
<td>Fractures involving at least 50% of the articular surface or those with volar subluxation of the distal phalanx may be unstable and require surgery to prevent deformity and loss of function.</td>
</tr>
<tr>
<td>Jersey finger</td>
<td>Forceful extension of the finger during active flexion</td>
<td>Radiography, US, MR imaging</td>
<td>Avulsion of FDP tendon at its insertion on the volar base of the distal phalanx</td>
<td>All require surgery, but the location, degree of tendon retraction, and presence of osseous fragment determine timing of surgery (Leddy and Packer classification [18]).</td>
</tr>
<tr>
<td>Seymour fracture</td>
<td>Forced flexion at the DIP joint in pediatric patients</td>
<td>Radiography</td>
<td>Separation of the physis and apex dorsal angulation of the distal phalanx</td>
<td>Seymour fracture requires surgical irrigation and release of the nail plate; radiologists need to have a high level of suspicion for this injury.</td>
</tr>
<tr>
<td><strong>Middle phalanx</strong></td>
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<tr>
<td>Fracture</td>
<td>Direct blow</td>
<td>Radiography</td>
<td>Linear lucencies of various orientations and locations</td>
<td>Fixation is required for oblique, spiral, comminuted, displaced, and malrotated fractures; displaced or comminuted intra-articular fractures require surgery.</td>
</tr>
<tr>
<td>Coach finger</td>
<td>Forced hyperextension with axial loading</td>
<td>Radiography</td>
<td>Dorsal dislocation of the PIP joint</td>
<td>V sign indicates instability after relocation; surgery is required for fracture dislocations involving at least 40% of the articular surface.</td>
</tr>
<tr>
<td><strong>Proximal phalanx</strong></td>
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<tr>
<td>Fracture</td>
<td>Direct blow, hyperextension, or rotation</td>
<td>Radiography</td>
<td>Linear lucencies of various orientations and locations</td>
<td>Base fractures often require surgery; displaced, oblique, and spiral shaft fractures often need surgery.</td>
</tr>
<tr>
<td><strong>Metacarpals</strong></td>
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<tr>
<td>Fracture</td>
<td>Direct blow, axial loading, crush injury, rotation</td>
<td>Radiography</td>
<td>Linear lucencies of various orientations and locations</td>
<td>Surgery of shaft and neck fractures is dictated by the degree of apex dorsal angulation and by which finger is involved; intra-articular base fractures require surgery if malaligned.</td>
</tr>
<tr>
<td><strong>Tendons and ligaments</strong></td>
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<tr>
<td>Extensor tendon laceration</td>
<td>Direct blow</td>
<td>MR imaging</td>
<td>Disruption of hypointense tendon with intervening fluid signal intensity</td>
<td>Partial or complete laceration must be determined; the location, degree of retraction, and quality of underlying tendon are helpful to the surgeon.</td>
</tr>
<tr>
<td>Injury</td>
<td>Mechanism/Loading</td>
<td>Imaging</td>
<td>Findings</td>
<td>Treatment</td>
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<td>--------------------------------------</td>
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<td>---------------------------------------------------------------------------</td>
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<tr>
<td>Boutonnière deformity</td>
<td>Forced flexion or direct blow</td>
<td>MR imaging</td>
<td>Avulsion of central slip from the middle phalanx</td>
<td>Surgery is required for osseous avulsions and chronic malalignment.</td>
</tr>
<tr>
<td>Sagittal band injury</td>
<td>Forced flexion or direct blow</td>
<td>MR imaging</td>
<td>Absence of a discrete band or edema or fluid, subluxation of extensor digitorum communis</td>
<td>Surgery is required for chronic injuries that are symptomatic.</td>
</tr>
<tr>
<td>Flexor tendon laceration</td>
<td>Direct blow</td>
<td>MR imaging</td>
<td>Disruption of hypointense tendon with intervening fluid signal intensity</td>
<td>Complete lacerations require surgery; the location, degree of retraction, and quality of the underlying tendon are helpful to the surgeon.</td>
</tr>
<tr>
<td>Collateral ligament injury</td>
<td>Varus or valgus stress</td>
<td>MR imaging</td>
<td>Disruption of hypointense ligament with intervening fluid signal intensity</td>
<td>Surgery is required for those who fail to recover with conservative treatment and for index finger RCL injuries.</td>
</tr>
<tr>
<td>Volar plate avulsion</td>
<td>Hyperextension or dorsal dislocation</td>
<td>MR imaging</td>
<td>Disruption of hypointense ligament with intervening fluid signal intensity</td>
<td>Surgery is required for avulsion fractures involving at least 40% of the articular surface, marked joint subluxation, and volar plate interposition in the joint space.</td>
</tr>
<tr>
<td>Pulley injury</td>
<td>Powerful flexion</td>
<td>MR imaging</td>
<td>Bowstringing, edema</td>
<td>Surgery is required for A2 annular pulley tears; otherwise, conservative management is appropriate.</td>
</tr>
</tbody>
</table>

**Thumb metacarpal**

<table>
<thead>
<tr>
<th>Injury</th>
<th>Mechanism</th>
<th>Imaging</th>
<th>Findings</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fracture</td>
<td>Axial loading on partially flexed thumb</td>
<td>Radiography</td>
<td>Linear lucencies of various orientations and locations; for intra-articular extension, Bennett fracture has a single fracture line, and Rolando fracture is comminuted.</td>
<td>Percutaneous pinning is necessary for Bennett fractures with anatomic reduction; ORIF is necessary for displaced Bennett and Rolando fractures.</td>
</tr>
<tr>
<td>UCL injury</td>
<td>Forced hyperabduction</td>
<td>MR imaging, US</td>
<td>Gamekeeper thumb: nondisplaced injury of the UCL; Stener lesion: interposition of adductor aponeurosis with UCL retraction (yo-yo on a string sign)</td>
<td>Complete tears of the UCL require surgery.</td>
</tr>
</tbody>
</table>

**Special diagnostic considerations**

<table>
<thead>
<tr>
<th>Injury</th>
<th>Mechanism</th>
<th>Imaging</th>
<th>Findings</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pathologic fractures</td>
<td>Normal use</td>
<td>Radiography, MR imaging</td>
<td>Enchondroma most common</td>
<td>Treatment is dictated by the aggressiveness of the lesion, with more aggressive treatment for malignancies.</td>
</tr>
<tr>
<td>Foreign bodies</td>
<td>Puncture injuries</td>
<td>Radiography, US, MR imaging</td>
<td>Metal and glass are usually radiopaque; all foreign bodies are usually hyperechoic at US and have low signal intensity on MR images.</td>
<td>Foreign bodies often require extraction, especially if infected; US can provide real-time imaging during extraction.</td>
</tr>
</tbody>
</table>

Note.—ORIF = open reduction internal fixation.
terminal joint extensor lag, and degenerative joint disease (24–26). Surgical intervention should therefore be considered for these patients.

**Jersey Finger.**—Jersey finger results from the avulsion of the FDP tendon at its insertion on the volar aspect of the distal phalanx base (Fig 10). This occurs by means of forceful extension of the finger during active flexion (Movie 2). Seventy-five percent of cases involve the ring finger (20). Osseous avulsion fragments may be depicted radiographically; however, soft-tissue injury is the most common finding, and these injuries are often invisible on radiographs, requiring US or MR imaging for definitive diagnosis. The Leddy and Packer classification system is used to categorize these injuries and is based on the location of the injury, the degree of tendon retraction, and the presence or absence of an osseous fragment (Table 2) (18). These injuries are treated surgically: Type I injuries require surgery within 1 week, given their tenuous...
Figure 10. Jersey finger in three patients. (a) Lateral radiograph of a 25-year-old man with the thumb equivalent of jersey finger shows an osseous avulsion fragment (arrow), a finding that is not seen in all cases but is helpful for confirming the diagnosis when present. (b) Axial PD-weighted MR image of a 40-year-old man shows the absence of the FDP tendon (straight arrow) along the volar aspect of the long finger, compared with the normal appearance of the FDP tendon (curved arrow) along the volar aspect of the adjacent ring finger. (c) Sagittal fat-saturated PD-weighted MR image of a 31-year-old woman shows retraction of the tendon (arrowhead) proximal to the PIP joint, making this a Leddy and Packer type II injury (18).

Table 2: Leddy and Packer System for Classification of Distal Phalanx FDP Avulsion Jersey Finger Injuries

<table>
<thead>
<tr>
<th>Injury Type</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Tendon retraction to palm</td>
</tr>
<tr>
<td>Type II</td>
<td>Tendon retraction to PIP joint</td>
</tr>
<tr>
<td>Type III</td>
<td>Large fracture fragment with little tendon retraction</td>
</tr>
</tbody>
</table>

Source.—Reference 18.

Seymour Fracture.—A Seymour fracture is a displaced open physeal fracture of the distal phalanx in children, with laceration through the nail bed that causes (a) the nail plate to lie superficial to the proximal nail fold and (b) the germinal matrix of the nail to become interposed between the fracture fragments (28,29) (Fig 11). This is caused by forced flexion at the DIP joint in a pediatric patient. The deformity is seen most easily on lateral radiographs, showing separation of the physis and apex dorsal angulation of the distal phalanx. Seymour fractures require surgical irrigation and release of the nail plate to allow fracture reduction. If surgery is not performed, growth arrest, infection, and deformity are highly likely (30). Radiologists must have a high level of suspicion when this injury pattern is seen and should closely scrutinize lateral images of the finger to address the possibility of this injury.

Middle Phalanx Injuries

Fractures.—The middle phalanges are the least commonly fractured bones of the fingers (31). The middle phalanges are typically fractured by a direct blow and are commonly angulated (Fig 12). The angulation depends on the relationship of the fracture line to the insertion of the FDS tendon: Fracturing distal to the insertion of the FDS tendon produces apex volar angulation, and fracturing proximal to the FDS insertion produces apex dorsal angulation. Internal fixation is generally required for fractures that are oblique, spiral, comminuted, displaced, or malrotated. Various treatment options exist for intra-articular fractures of the middle phalanx head, depending on their classification (32,33).
Nondisplaced fractures are considered stable, and the digit can be splinted and the patient followed up with serial radiographs. Displaced intra-articular fractures that involve one of the condyles are considered unstable, and closed reduction with a K-wire is typical. The radiologist must scrutinize the postreduction lateral radiograph to ensure superimposition of the condyles with this injury. Displaced bicondylar or comminuted fractures are also considered unstable but require open reduction and internal fixation (34).

Pilon fractures are comminuted fractures of the middle phalanx base, with central depression and splaying of fracture fragments in the coronal and sagittal planes. These fractures occur as a result of high-energy axial loading of an extended finger. Immobilization, traction, external fixation, and ORIF are all treatment options for this type of fracture (35,36).

**Dislocation.**—Coach finger is a dorsal dislocation of the PIP joint (Fig 13). This dislocation occurs as a result of forced hyperextension with axial loading (Movie 3). Imaging is usually not necessary for diagnosing this type of dislocation, but imaging may be performed for an irreducible joint or to look for complications after reduction. After reduction, a “V sign” may be seen on a lateral radiograph because of separation of the dorsal aspects of the middle phalanx base from the head of the proximal phalanx, which indicates instability (37) (Fig 14). By definition, collateral ligaments and the volar plate will be injured with dorsal dislocation, so postreduction MR images may demonstrate collateral ligament tears at the midsubstance or avulsion from the attachments on either side of the joint, as well as volar plate avulsions at the proximal attachment or transverse volar plate tears through the proximal portion (the consequence and treatment of which are discussed later in the “Tendon and Ligament Injuries” section). On T2-weighted MR images, bone contusions may also be depicted as high bone marrow signal intensity along the volar base of the middle phalanx and dorsal head of the proximal phalanx in the setting of a dorsal dislocation or within one of the condyles of the head of the proximal phalanx in the setting of a rotatory dislocation.

Surgical consultation should be considered when the dislocation is irreducible, which can occur when the volar plate is trapped within the joint. Surgical consultation should also be considered for all fracture dislocations. Surgical fixation is usually indicated for fracture dislocation that involves at least 40% of the articular surface (38). In comparison with dorsal dislocation, volar dislocation of the PIP joint is rare.
and may cause tearing of the central slip (39). This often occurs as a result of axial loading and rotation of a flexed joint.

**Proximal Phalanx Fractures**

Proximal phalangeal fractures occur most commonly from a direct blow, hyperextension, or rotation. Angulation (generally apex volar) is common and is best depicted on the lateral image. Management is dictated according to the fracture location (Fig 15) (16). Intra-articular fractures of the proximal phalanx head are treated similarly to intra-articular fractures of the middle phalanx head (discussed previously).

Subcondylar neck fractures of the proximal phalanx are more common in children than in adults. Although nondisplaced subcondylar neck fractures can be treated with splinting, displaced fractures that maintain bone-to-bone contact likely need percutaneous fixation, and completely displaced fractures most often require ORIF (16). Shaft fractures of the proximal phalanx can be oblique, spiral, or transverse in orientation. Transverse shaft fractures without displacement are usually stable and require only splinting (40); instability and the need for surgical repair increase with the degree of displacement (41). Oblique or spiral fractures are often unstable and require surgery (16). Intra-articular fractures of the proximal phalanx base require surgical correction if there is joint instability or if a fracture fragment limits the range of motion (42). Extra-articular fractures of the proximal phalanx base are often transverse in orientation but frequently require surgical correction, because reduction often cannot be maintained (16).

**Metacarpal Fractures**

Metacarpal fractures account for approximately 30% of hand fractures (43,44). Several types of metacarpal fractures exist, each with different mechanisms of injury. Metacarpal shaft fractures result from direct blows and axial loading of a flexed MCP joint, with the fifth metacarpal being the most commonly injured and termed a boxer fracture (Fig 16) (45). Transverse shaft fractures are caused by a direct blow or crush injuries, and spiral shaft fractures occur during forceful deflection of the finger as torque is carried to the distal metacarpal bone through the taut collateral ligaments of the flexed MCP joint (Fig 17). These fractures are generally well depicted on radiographs.

Surgical consideration for metacarpal shaft and neck fractures with apex dorsal angulation is often based on the degree of angulation (45). As a general rule, the more ulnar-sided fingers are able to tolerate a greater degree of angulation deformity. The greatest metacarpal neck fracture angulation tolerated by the index, long, ring, and small fingers is 10°, 15°, 30°, and 40°, respectively. The greatest metacarpal shaft fracture angulation tolerated by the index, long, ring, and small fingers is 0°, 0°, 20°, and 30°, respectively (45).

Additional indications for surgery of metacarpal shaft fractures include irreducibility, open or multiple fractures, and rotational deformity, with rotational malalignment being the most common indication for surgery. Rotational malalignment can be difficult to demonstrate on radiographs and in some cases is only evident at physical examination. Patients typically demonstrate finger scissoring (overlapping) while closing the fist (45). The condyles of each phalangeal head are shaped in such a way that when each finger is flexed at the MCP and interphalangeal joints, the fingertips point toward a common point near the base of the thumb. They are deliberately engineered to crowd each other when flexed simultaneously, and friction between the sides of fingers is essential to having a powerful grip. Rotational malunion disturbs this delicately coordinated movement and makes the grip weak, awkward, or impossible. Although
they are rare, intra-articular fractures of the metacarpal head that involve more than 20% of the articular surface should also be treated surgically (46).

Metacarpal base fractures often occur with forced flexion at the wrist while the arm is extended. These fractures are commonly associated with dislocations caused by the high-energy mechanism (Fig 18). Although the fractures are well depicted on posteroanterior radiographs, associated dislocations are best evaluated with true lateral or oblique radiographs and with CT, if needed (47). Extra-articular metacarpal base fractures are managed similarly to shaft fractures. Intra-articular fractures are treated primarily on the basis of alignment, because malalignment leads to premature osteoarthritis, poor range of motion, and a weakened grip (45). The more ulnar-located metacarpals allow a greater range of motion at the carpometacarpal joint and are thus more likely to exhibit malalignment (48). Minimally displaced intra-articular metacarpal base fractures can most often be managed with closed reduction and casting, but displaced fractures require percutaneous pinning or ORIF (48). Kjaer-Petersen and colleagues (49) developed a classification system for metacarpal base intra-articular fractures, although the system does not directly relate to prognosis or management (Fig 19).

Tendon and Ligament Injuries

**Extensor Tendon Laceration.**—The extensor tendons are particularly prone to laceration, given their superficial location. Although advanced imaging is rarely used in diagnosing these injuries, a full-thickness tear is seen as discontinuity of the tendon with intervening fluid on MR images (Fig 20). Lacerations may be identified first with sagittal sequences; however, axial sequences must be used to confirm tendon disruption, because the entire extensor tendon may not be in plane on a single sagittal image, creating the appearance of tendon discontinuity. Typically, the location of the laceration is reported as the location of the proximal margin of the distal tendon remnant in relation to the underlying bone of the digit involved. Because multiple fibers attach to the extensor mechanism to keep it located centrally along the digits, lacerations of the extensor mechanism do not often result in proximal tendon retraction, unlike flexor tendon injuries (50). If tendon retraction does occur, the degree of tendon retraction is important to report for surgical repair and is most easily measured in the sagittal plane. Perhaps most useful to the surgeon is describing (a) the quality of the tendon margins at the laceration (sharp vs frayed margins, and whether there is attrition of the tendon bulk) and (b) bone prominences that may interfere with apposition of the lacerated tendon margins (eg, osteophytes or fracture fragments). Close scrutiny of adjacent digits is essential when a laceration is identified, because lacerations can often involve more than one digit.

**Boutonnière Deformity.**—Similar to the mallet finger deformity, the boutonnière deformity oc-
curs as a result of avulsion of the central slip from its insertion at the base of the middle phalanx (Fig 21). This injury frequently occurs because of forced flexion at the PIP joint or a direct blow, resulting in flexion at the PIP joint and extension at the DIP joint that is due to volar displacement of the lateral slips of the extensor mechanism on either side of the PIP joint (51). Central slip avulsion injuries are often diagnosed clinically. Radiographs may show an associated fracture at the attachment site of the central slip. MR imaging may be useful in suspected sagittal band injury. The volar plate and other ligaments of the PIP joint should also be scrutinized carefully for injury. For acute injuries, immobilization is the treatment of choice, unless there is an osseous avulsion or laceration, in which case surgery is indicated (52). For chronic injuries that cause deformity, surgery is usually indicated (52).

**Sagittal Band Injury.**—Sagittal band injuries occur because of a direct blow or forced flexion of the finger, often with ulnar deviation (53). At physical examination, the patient will often have swelling at the dorsal aspect of the MCP joint and an inability to fully extend the finger. Radiographs may demonstrate soft-tissue swelling over the affected MCP joint. On MR images, there will be deformity of the sagittal band with increased T2 signal intensity of the soft tissues at the site of injury and disruption of the thin low-signal-intensity sagittal band with intervening fluid signal intensity in complete tears (Fig 22) (54). The extensor digitorum communis tendon may demonstrate subluxation to the side of the MCP joint in complete tears. MR imaging has been shown to be of variable sensitivity (29%–86%) for the detection of sagittal band injuries, but evaluation of the band and the location of the extensor digitorum communis tendon on axial images is essential for making the diagnosis (54,55). Imaging with the fingers flexed at the MCP joints can improve the identification of extensor tendon subluxation (54). Acute injuries are often treated with splinting of the MCP joint in extension. Surgical intervention may be required in chronic injuries that are symptomatic (5).

**Flexor Tendon Laceration.**—The flexor tendons are less commonly injured than the extensor tendons, because they are more protected by their deeper location within the hand. Laceration of the tendons within their midsubstance is more common than avulsion at osseous insertions (Fig 23) (5). The course of the flexor tendon can be divided into five anatomic zones: zone I, insertion of the FDP to insertion of the FDS; zone II, insertion of the FDS to the distal palmar fold; zone III, A1 annular pulley to the flexor retinaculum; zone IV, carpal tunnel; and
Figure 19. Computer-generated 3D models depicting the different types of metacarpal base fractures in the Kjaer-Petersen classification system (49). Type I involves less than 50% of the articular surface, type II involves approximately 50% of the articular surface, and type III involves more than 50% of the articular surface, either without (IIa) or with (IIb) articular surface comminution.

Figure 20. Extensor tendon laceration. Sagittal STIR MR image of a 24-year-old man shows complete extensor tendon laceration. Substantial soft-tissue edema surrounds the laceration, and the lacerated tendon is retracted (arrow).

Figure 21. Boutonnière deformity. Lateral radiograph of a 63-year-old woman shows disruption of the central slip and an associated avulsion fracture (arrow), which resulted in a boutonnière deformity (flexion at the PIP joint and extension at the DIP joint).

Flexor tendon laceration that occurs in zone I results in loss of DIP joint flexion from injury of the FDP, and lacerations that occur in zones II–V result in loss of both DIP and PIP joint flexion from injury to both the FDP and FDS tendons. US or MR imaging can help to differentiate between complete and partial lacerations, with an appearance similar to that of extensor tendon injuries (57,58).

Unlike the extensor tendons, the flexor mechanism does not have a robust connection of fibers to keep the tendon from retracting proximally; thus, proximal retraction often occurs to a greater degree than with extensor tendon laceration. As with extensor tendon lacerations, flexor tendon laceration may be identified best in the sagittal plane but may require confirmation on axial images. Axial images also help determine if the FDS or FDP tendons are affected alone or together. The location of the tear and degree of retraction are important to communicate to the surgeon. Although there are anatomic zones of the flexor tendon apparatus (as delineated earlier), often the surgeon will use the landmarks set forth in the Leddy and Packer classification for FDP avulsions to characterize the degree of tendon retraction (type I, retracted to the palm; type II, retracted to the PIP joint; type III, retracted distal to A4 annular pulley) (18). Complete lacerations
require surgical correction; partial lacerations can often be managed conservatively (59).

**Collateral Ligament Injuries.**—Radial or ulnar deviation of the extended finger can cause collateral ligament injury, which includes ligament sprain, partial tear, and complete ligamentous rupture (Fig 24). Ulnar deviation causes RCL injury, and radial deviation causes UCL injury. Radiographic findings that are suggestive of collateral ligament tear or rupture include ulnar or radial deviation of the affected finger or soft-tissue abnormality (60). Although these injuries are usually of little clinical importance (except for UCL injuries of the thumb MCP joint, discussed subsequently), they are best depicted in the coronal plane with fluid-sensitive MR imaging sequences if imaging is performed. Partial tears are generally treated with immobilization, with surgery reserved for those patients who fail to recover with conservative treatment. The exception is the index finger, in which RCL injuries are treated surgically (61).

**Volar Plate Avulsion.**—Volar plate avulsion injuries are caused by joint hyperextension or dislocation, most commonly at the PIP joint. Avulsion injuries are most common at the distal attachment of the volar plate (Fig 25). They are categorized into three types: type I, avulsion of the distal aspect of the plate; type II, greater involvement of the surrounding soft tissues, which can cause subluxation of the joint; and type III, injury with associated fracture and dislocation (62). On radiographs, soft-tissue injury may be the only finding if there is no large avulsion fragment. If a fracture is present, it is best depicted on the lateral image. Sagittal MR images are optimal for evaluating these injuries. These injuries are often treated with splinting, but surgery should be considered if a fracture fragment is large and involves at least 40% of the articular surface, because in these cases, the collateral ligaments are often attached to the fracture fragment rather than the donor bone (62). Appreciable joint subluxation may also necessitate surgical repair, because this finding implies collateral ligament injury. Surgery is also necessary if the volar plate becomes interposed in the joint space. Volar plate entrapment should be suspected if the joint is irreducible or if there is persistent joint space widening on radiographs. MR imaging or US can be performed to evaluate for the presence of this complication.
Figure 24. Collateral ligament tear. Coronal STIR MR image of a 62-year-old woman shows a full-thickness tear (arrow) of the RCL of the MCP joint of the index finger.

Figure 25. Volar plate injuries in three patients. (a) Sagittal PD-weighted MR image of a 54-year-old woman with a type I injury (arrow) of the MCP joint shows an avulsion of the distal aspect of the volar plate. (b) Sagittal fat-saturated PD-weighted MR image of a 59-year-old woman with a type II injury (arrow) of the MCP joint shows greater involvement of the surrounding soft tissues with soft-tissue edema. (c) Lateral radiograph of a 77-year-old woman with a type III injury of the PIP joint shows a fracture (arrowhead), with resulting dorsal displacement of the proximal phalanx.

Figure 26. A2 annular pulley injury in two patients. (a) Axial fat-saturated PD-weighted MR image of a 40-year-old man shows soft-tissue edema (arrowhead), absence of normal A2 pulley fibers along the radial aspect of the proximal long finger (white arrow), and volar displacement of the flexor tendons, findings which are consistent with an A2 pulley tear. This is in comparison to the normal A2 pulley (black arrow) of the adjacent index finger. (b) Sagittal STIR MR image of a 33-year-old woman with an injury to the A2 pulley shows clinically important bowstringing, as evidenced by the increased distance (double-headed arrow) between the flexor tendon and the proximal phalanx.

Pulley Injuries.---The A2 annular pulley is the most commonly injured pulley (“climber’s finger”), followed by A3, A4, and A1 (63). These injuries occur during powerful flexion. MR images obtained in the sagittal plane are useful for making the diagnosis and may also demonstrate secondary signs of injury. Axial images are useful to confirm abnormal morphologic appearance and signal intensity of a suspected injured pulley. Pulley injury can be directly demonstrated by increased intrasubstance signal intensity and edema within the pulley itself or disruption of its fibers (Fig 26). An important secondary sign of pulley injury is bowstringing, which is increased distance between the flexor tendon and the underlying bones of the finger (64). This distance is greatest at the proximal phalanx for A2 injuries and at the middle phalanx for A4 injuries. Surgical correction is recommended for A2 pulley injuries when bowstringing extends proximal to the base of the proximal phalanx because this implies complete disruption of the A2 pulley; otherwise, nonsurgical management can be considered (65).

Thumb Metacarpal Injuries

Fracture.---Fractures of the thumb metacarpal are particularly important to recognize, because they can result in clinically important morbidity if not treated properly (31). A Bennett fracture is a two-part oblique intra-articular fracture of the base of the thumb metacarpal (Fig 27a). A Rolando fracture is similar to a Bennett fracture but is a comminuted intra-articular fracture of the thumb metacarpal base and is a less common injury (Fig 27b). Both Bennett and Rolando fractures are
caused by axial loading on partially flexed thumbs, and both are associated with disruption of the first carpometacarpal joint and injury to the stabilizing ligaments. Bennett and Rolando fractures are generally well characterized on radiographs. Bennett fractures are categorized by using the Gedda classification system (Table 3) (66). Percutaneous pinning can be considered for patients with Bennett fractures in whom anatomic reduction is achieved; otherwise, ORIF is required. ORIF is necessary for treatment of all Rolando fractures (47).

**Gamekeeper Thumb and Stener Lesions.**—The UCL of the thumb MCP joint is uniquely positioned just deep to the aponeurosis of the adductor pollicis muscle, which crosses over the UCL as a band of fibers on its way to inserting on the ulnar tubercle of the base of the proximal phalanx of the thumb and into the extensor hood of the extensor pollicis longus (Fig 28). This anatomic structure allows unique UCL ligament injury patterns at the thumb MCP joint. Gamekeeper thumb is an injury of the UCL (usually the distal portion) of the thumb MCP joint caused by forced radial deviation (Movie 4). This is the most common injury to the thumb MCP joint and frequently occurs while skiing, when an individual falls and the thumb gets stuck in the snow while the rest of the hand and body continue to move forward (67) (Fig 29). A Stener lesion develops in cases of complete UCL tear and retraction when there is interposition of the adductor aponeurosis between the retracted UCL and its insertion site, with fibers of the torn UCL lying superficial to the adductor aponeurosis (Fig 30, Movie 4). On radiographs, there may be subtle subluxation of the joint or even an avulsion fracture. MR imaging and US are the imaging modalities of choice to evaluate for the presence of a Stener lesion (14,68). A Stener lesion often demonstrates the classic “yo-yo on a string” appearance, where the proximally retracted and balled-up UCL ligament makes up the yo-yo and is in contact with the proximal aspect of the thin band of interposed adductor aponeurosis, which makes up the string of the yo-yo (Fig 31) (68). Although the classic appearance of a yo-yo on a string is

### Table 3: Gedda System for Classification of Bennett Fractures

<table>
<thead>
<tr>
<th>Injury Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Large fracture fragment and metacarpal subluxation</td>
</tr>
<tr>
<td>Type II</td>
<td>Impaction of fracture without subluxation</td>
</tr>
<tr>
<td>Type III</td>
<td>Small fracture fragment and metacarpal subluxation</td>
</tr>
</tbody>
</table>

Source.—Reference 66.
helpful in making the diagnosis of a Stener lesion, the absence of UCL fibers spanning the thumb MCP joint and the presence of a heterogeneous masslike abnormality proximal to the thumb MCP joint are diagnostic of a complete UCL tear with retraction, which also requires surgical repair (Fig 32) (14). It may be difficult to clearly discriminate the adductor aponeurosis from the subjacent torn UCL fibers with US, because both commonly are heterogeneously hypoechoic and are in approximation, but they can often be discriminated with a dynamic examination with US. Partial tears of the UCL can be treated nonsurgically, and complete tears of the UCL and Stener lesions need to be repaired surgically (13).

Special Diagnostic Considerations

Pathologic Fractures

Pathologic fractures result from minor trauma to abnormal bone. In the hand, the most common underlying pathologic condition is an enchondroma (69). Enchondromas will manifest as a predominantly lucent lesion of the tubular long bones of the hand with a lobular sclerotic margin, endosteal scalloping, and internal ring and arc or stippled mineralization on radiographs (Fig 33). A fracture will demonstrate a linear lucency that extends from the bone cortex through the sclerotic margin of the lesion. MR imaging is usually not necessary in making the diagnosis of an enchondroma, but an enchondroma will be depicted as a primarily T1 intermediate-signal-intensity to T1-hypointense, T2-hyperintense lobulated lesion with discrete borders within the medullary canal of the tubular long bones of the hand. The lesion will often demonstrate a hypointense internal matrix and peripheral and septal lobular enhancement. Fractures can be seen as T1 low signal intensity through the bone cortex and can cause surrounding bone marrow and soft-tissue edema. Chondrosarcomas are rare in the hand, but suspicion should be raised if there is extensive endosteal scalloping, cortical breakthrough, or a soft-tissue component of the tumor.

Less common causes of pathologic fractures of the hand include aneurysmal bone cysts, giant cell tumors, epidermal inclusion cysts, fibrous dysplasia, and Paget disease (70). Chondrosarcoma is the most common malignancy that results in pathologic fractures of the hand (69). Metastases to the hand are rare but include metastases from lung, breast, and kidney cancers (70). The abnormality underlying pathologic fractures must be determined before appropriate treatment can be initiated. For enchondromas, the fracture will often be al-
Followed to heal nonsurgically, if possible, and the enchondroma will be removed with curettage once the fracture is healed. However, if surgical intervention is required to fix the pathologic fracture, the enchondroma is often removed at that time (70). Treatment of other lesions ranges from treatment of the fracture without the need for treatment of the underlying lesion (eg, Paget disease) to amputation (eg, fracture through a chondrosarcoma) (70).

**Foreign Bodies**

A retained foreign body is a common concern after a multitude of finger injuries, particularly penetrating trauma. The most commonly retained foreign bodies of the hand are wood, glass, and metallic fragments (71). Identification and removal of foreign bodies are important for preventing infection and potentiation of soft-tissue injuries. Radiography is the preferred modality for the initial workup of potential retained foreign bodies of the hand (Fig 34a). Metal is identifiable with radiography 100% of the time, and glass is identifiable 96% of the time, whereas wood is identifiable with radiography 0%–15% of the time (71,72). US is a powerful tool for identifying nonradiopaque foreign bodies (Fig 34b). US has been shown to be more effective than CT in the identification of foreign bodies, and US is cheaper than MR imaging (73). Nearly all foreign bodies are hyperechoic (74,75). A large number of foreign bodies will demonstrate shadowing, the appearance of which varies according to the regularity or irregularity of the surface of the foreign body (75). After being present for more than 24 hours, foreign bodies commonly develop a hypoechoic rim that is due to edema and granulation tissue (75). The sensitivity of foreign body detection with US has been reported to be 90%–94%, with a specificity of 97%–99% (74,76). Surgical exploration is minimized when foreign bodies are localized with imaging, and US has the added advantage of easily providing real-time imaging during foreign body retrieval, if necessary (77). Foreign bodies will demonstrate low signal intensity on MR images and will most often have surrounding edema.
Figure 33. Pathologic fracture through an enchondroma in two patients. (a) Posteroanterior radiograph of the small finger metacarpal of a 32-year-old woman shows an enchondroma, characterized by its lucent appearance with a lobular sclerotic margin and faintly stippled internal matrix. Note the pathologic fracture (arrow) through the lesion. (b, c) Coronal T1-weighted (b) and fat-saturated T2-weighted (c) MR images of a 46-year-old man show a lobulated lesion that has predominantly intermediate to low T1 signal intensity and high T2 signal intensity, with small foci of low T2 signal intensity scattered internally, findings that are classic for an enchondroma. No fracture was depicted with this lesion.

Figure 34. Foreign body of the finger in a 38-year-old man. (a) Lateral radiograph of the long finger shows moderate soft-tissue swelling (arrow) of the volar aspect of the long finger, centered at the PIP joint and middle phalanx. No radiopaque foreign body is depicted. (b) Gray-scale transverse US image of the area of swelling shows a linear hyperechoic foreign body (arrowheads) with a surrounding hypoechoic area (arrow) that represents a small abscess. (c) Coronal STIR MR image shows a hypointense foreign body (arrowhead) with a small surrounding fluid collection (arrow). (d) Axial contrast material–enhanced fat-saturated T1-weighted MR image shows a hypointense foreign body (arrowhead) and the surrounding enhancement (arrow) that is consistent with a small abscess. At extraction, the foreign body turned out to be a thorn.

and enhancing granulation tissue, depending on their chronicity; however, the low signal intensity of the foreign body on MR images can be challenging to differentiate from scar tissue, tendons, or calcifications (Fig 34c, 34d) (75). MR imaging is useful when there is concern for osteomyelitis (Fig 35).

Conclusion

The array of finger injury patterns is vast, and each injury pattern has its own unique imaging, diagnostic, and treatment considerations (Table 1). Radiologists with a firm grasp of finger anatomy and common finger injuries are best equipped to guide referring clinicians to order appropriate imaging studies, make an accurate diagnosis, and initiate proper treatment. Although finger anatomy is intricate and there is a wide array of possible injury patterns, this article highlights the essential finger anatomy that radiologists should know and the management of the most common and the most important finger injuries that a radiologist will encounter. Understanding these basics will allow prompt diagnosis, proper treatment, and better patient outcomes.

Acknowledgment.—We thank Donald S. Bae, MD, Boston Children’s Hospital, and Children’s Orthopedic Surgery Foundation, Boston, Mass, for supplying the Seymour fracture radiograph.
Figure 35. Osteomyelitis caused by a foreign body in a 27-year-old man. (a) Axial fat-saturated PD-weighted MR image of the base of the proximal phalanx of the index finger shows a hypointense foreign body (arrow) embedded in the base of the index finger proximal phalanx, with a dorsal entry site. Note the surrounding bone marrow edema (arrowhead). (b, c) Axial T1-weighted (b) and contrast-enhanced fat-saturated T1-weighted (c) MR images of the base of the proximal phalanx of the index finger show hypointense bone marrow (arrowhead on b) adjacent to the foreign body and enhancement (arrow on c), findings which are consistent with osteomyelitis.

References