Forearm, Wrist and Hand Injuries in Football

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Football is the most popular spectator sport in the United States and is the top participatory sport for high school boys by a large margin. Given the contact nature of the sport, injury during participation is a risk. Epidemiological studies have demonstrated that 10–30% of football-related injuries involve the upper extremity. Upper extremity injuries range from simple contusions and sprains to complex fractures with potential lifelong sequela. This chapter reviews football injuries of the forearm, wrist, and hand.

Forearm

Forearm injuries are infrequently seen in football with one study demonstrating an occurrence rate of 0.05/1000 athletic exposures, less common than wrist and hand injuries [26]. Minor injuries such as contusions of the forearm are likely common and unreported. The most likely significant forearm injury is a fracture of either the radius, the ulna, or both forearm bones combined.

Radial Shaft

Isolated radial shaft fractures are most commonly displaced and require reduction and surgical fixation to allow for maintenance of reduction and early range of motion. A small percentage of fractures are minimally or non-displaced and may be amenable to treatment with immobilization. These fractures must be closely

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followed as the risk of late displacement is high. Prolonged immobilization can result in diminished range of motion, particularly forearm rotation.

Attention must be paid to the wrist joint and distal radioulnar joint (DRUJ) in the setting of a radial shaft fracture as injury to the DRUJ ligaments with resultant instability is possible. A radial shaft fracture with associated DRUJ instability is known as a “Galeazzi fracture” and requires surgical fixation of the fracture with possible ligament repair or reconstruction. DRUJ instability in the setting of a radial shaft fracture has been shown to be more likely if the radial shaft fracture is located within 7.5 cm of the distal radius articular surface [4].

Ulnar Shaft

Isolated ulnar shaft fractures are frequently the result of a direct blow and are commonly referred to as “nightstick” fractures. Unstable ulnar shaft fractures are displaced >50%, have >10-degree angulation, and are located in the proximal third of the ulna. Unstable fractures require surgery while most stable fractures can be treated with immobilization [8].

Careful evaluation of the elbow joint both clinically and radiographically is important in the setting of an isolated ulnar fracture. Dislocation of the radial head is possible and when combined with an ulnar shaft fracture is known as a “Monteggia” fracture. Anatomic reduction of the ulna reduces the radial head dislocation and should be confirmed postreduction with dedicated elbow radiographs [6, 7].

Radius and Ulnar Shaft (Both-Bone Forearm Fracture)

Both-bone forearm fractures can occur from high energy injuries or ground level falls (Fig. 2.1). The most common mechanism is an axial load through the hand. The injury is usually easily identified through exam and standard x-rays. The vast majority of both-bone forearm fractures are displaced and require surgical intervention. No study has evaluated the nonoperative treatment of non-displaced both-bone forearm fractures [5].

Acute Treatment

Suspected forearm fractures should be acutely immobilized and referred for specialized medical care on an urgent basis. A careful neurologic exam should be performed and carefully documented as soon as possible. Serial exams are extremely helpful in diagnosing compartment syndrome. When possible, an objective sensory measurement (i.e., two-point discrimination) should be utilized.

Fig. 2.1 Both-bone forearm fracture

Complications

Both isolated radius and ulna fractures can present as open fractures, but both-bone forearm fractures have a higher incidence of open injuries. Careful examination of the skin overlying these fractures is imperative to identify the injury as open. An open injury requires more urgent treatment, requires irrigation and debridement in addition to fixation of the fracture, and requires additional or alternative perioperative antibiotics when compared to closed injuries. In the field, nearly any open wound near the fracture site should be considered an open injury until it can be more carefully evaluated in a medical facility.

A known and feared complication associated with forearm fractures, particularly both-bone forearm fractures, is compartment syndrome. Acute compartment syndrome occurs when the "interstitial pressure increases with a closed fascial envelope, preventing adequate tissue oxygenation" [9]. Historically the classic signs and symptoms of compartment syndrome include the 5 Ps: pain, paresthesia, pallor, paralysis, and pulselessness. Compartment pressures can be measured in several different ways and different thresholds have been utilized to define compartment syndrome.

In practice, the diagnosis of compartment syndrome is often complex and far from straightforward. The hallmark is pain out of proportion to the exam and severe pain is noted in every patient with compartment syndrome. This pain is often significantly worsened by passive stretch of tendons that pass through the area of increased pressure. In the forearm, passive extension of the fingers stretches the finger flexors within the volar compartment of the forearm eliciting a significant increase in pain. Most who treat compartment syndrome would agree that once pallor, paralysis, and especially pulselessness are present, the diagnosis has been made too late.

When identified in a timely manner, emergent forearm fasciotomies are performed and sequela of compartment syndrome are avoided. When treated too late, compartment syndrome results in dysfunction of some or all contents of the forearm compartments. Muscle death and later necrosis occur relatively early in the process and are irreversible. In its most severe form, forearm compartment syndrome can be devastating with few reasonable salvage options.

Author's Preferred Approach

Acute forearm fractures usually pose little diagnostic dilemma. The forearm should be immobilized in a splint that extends above the elbow. Any laceration of the forearm should be carefully evaluated due to concern for an open fracture. The patient should be monitored for signs and symptoms of compartment syndrome. The patient should be transported to a medical facility for radiographic evaluation.

Isolated radius (Fig. 2.2) and isolated ulna fractures are treated surgically (Fig. 2.3) if displaced and with immobilization only following the criteria outlined above. Monteggia and Galeazzi fractures are treated surgically.

Nearly all both-bone forearm fractures, except in children, are treated with open reduction and internal fixation (Fig. 2.4). Very rarely can a non-displaced both-bone forearm fracture be treated with nonoperatively and then only with close radiographic follow-up.

Return to sport following open reduction and internal fixation is highly variable and based on a number of factors. Surgical wounds should be well healed prior to returning to sport, to avoid an increased risk of wound infection. Cases of high-level athletes returning around 6 weeks after surgical repair have been described. In those cases, custom-fabricated splints, bone stimulators, and medication (parathyroid hormone [*Forteo*], vitamin D, and calcium) were utilized, which would not be a common approach outside of the highest level of football. In most cases, evidence of complete healing is ideal, which often takes anywhere from three to six months.

Fig. 2.2 Radial shaft fracture

Wrist

Wrist injuries are more frequently seen in football with approximately 0.11/1000 athletic exposures according to one study [26]. Wrist injuries can involve fractures or soft tissue injuries. Some injuries are mild, treated nonoperatively, and self-limited. Other injuries are higher energy, require surgical intervention, and can lead to lifetime functional deficits.

Distal Radius

Distal radius fractures usually occur from a fall on an outstretched hand (Fig. 2.5). The fracture mechanism varies depending on hand, wrist, and forearm positioning

Fig. 2.3 Open reduction, internal fixation of radial shaft fracture

at the time of injury and the amount of force. A multitude of classification systems have been designed to describe distal radius fractures, but these are primarily useful for research purposes. In practice, distal radius fractures are more simply divided by three characteristics: displacement (displaced vs. non-displaced), the number of bony fragments (comminuted vs. non-comminuted), and the location of the fracture in relationship to the joint articular surface (intra- or extra-articular).

Simple fractures are non-displaced or minimally displaced, non-comminuted, and extra-articular. The majority of these fractures are treated nonoperatively with immobilization for 4–6 weeks. Displaced, simple fractures can be reduced (the fracture manipulated and aligned). These fractures must be followed radiographically for signs of delayed displacement. More complex fractures are displaced, comminuted, and intra-articular. These fractures require surgery for reduction and fixation (Fig. 2.6).

Fig. 2.4 Both-bone forearm fracture following open reduction, internal fixation

Author's Preferred Treatment

Distal radius fractures should be immobilized on the field and patients transferred to a medical facility for radiographic evaluation. Complex, intra-articular fractures may require evaluation with a CT scan. A closed reduction in a medical facility should be attempted on simple, extra-articular fractures as an acceptable reduction can often be accomplished potentially eliminating the need for surgical intervention. Fractures that cannot be acceptably reduced and displaced intra-articular fractures require surgical treatment.

Fig. 2.5 Distal radius fracture

Return to sport is dictated by the degree of articular involvement and stability of fixation. In most cases, complete healing is necessary prior to return. For non-displaced and stable fractures, return to play in a cast a few weeks after the injury is an option, but would also depend on the position and skill level of the athlete.

Scaphoid

Scaphoid fractures are common fractures of the wrist (Figs. 2.7 and 2.8). The scaphoid is the most proximal, radial carpal bone. The fracture is typically caused by a fall on the outstretched hand. The fracture is thought to occur when extension of the carpus allows the scaphoid to impact the distal radius resulting in fracture. Importantly, scaphoid fractures heal less readily and reliably than other bones around the wrist due to their relatively poor blood supply.

Scaphoid blood supply has been studied extensively. In the most common arterial pattern, the blood supply enters through a single dorsal artery which then divides into proximal and distal branches that travel within the scaphoid [33]. A fracture disrupts this blood supply preferentially affecting blood flow to the proximal portion of the scaphoid. Diminished blood flow due to fracture leads to a relatively high nonunion rate. Avascular necrosis of the proximal pole of the scaphoid can also result [29].

Fig. 2.6 Distal radius following open reduction, internal fixation

Fig. 2.7 Scaphoid waist fracture

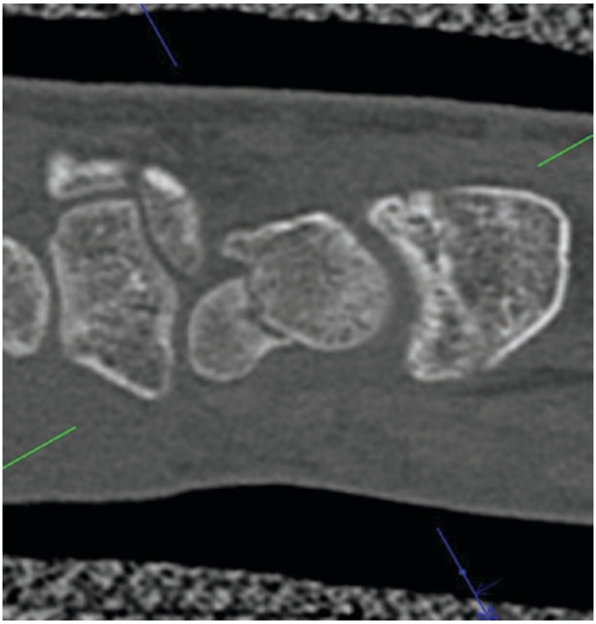


Fig. 2.8 Sagittal CT image of displaced scaphoid fracture

Author's Preferred Treatment

The treatment algorithm for scaphoid fractures is dictated in part by the vascular anatomy. Fractures of the proximal pole have the highest rate of nonunion. Surgical reduction and fixation are recommended for even non-displaced fractures [29]. Scaphoid waist fractures that are non-displaced are treated either with immobilization or open reduction and fixation based on patient preference. Most high-level athletes undergo surgery (Figs. 2.9 and 2.10). Fractures of the distal pole or scaphoid tubercle have the least likelihood of symptomatic nonunion and are treated non-operatively [32, 35].

The evaluation for a patient with a suspected scaphoid fracture includes careful physical exam and radiographic evaluation. Tenderness in the "anatomic snuffbox" is the classic finding, but tenderness over the scapholunate (SL) interval and tenderness over the scaphoid tubercle are also seen. Scaphoid fractures are frequently not visible on initial radiographs. A negative radiograph taken acutely does not rule out the presence of a scaphoid fracture. Any patient with a clinical exam concerning for a scaphoid fracture should be immobilized and subsequently reevaluated clinically and radiographically. Repeat x-rays taken before visible changes of fracture healing could be evident are useless. A delay of at least 3 weeks from injury to repeat imaging is recommended. Alternatively, advanced imaging can be utilized to assess for scaphoid fracture. Both CT and MRI have demonstrated high sensitivity and specificity in identifying acute, occult scaphoid fractures. MRI remains the gold standard [30].

Fig. 2.9 Open reduction, internal fixation scaphoid fracture

Fig. 2.10 CT following ORIF scaphoid fracture

The importance of an adequate evaluation for scaphoid fracture cannot be overemphasized. When identified and managed appropriately, the union rate for scaphoid fractures is over 90%, and once the fracture is healed patients typically return to preinjury activity levels (Goffin). Missed scaphoid fractures can progress to fracture nonunions. The natural history of scaphoid nonunions has been well described [36] and includes the development of a predictable, progressive, and irreversible pattern of wrist arthritis and commonly lifelong wrist functional limitations.

Following fixation, return to play is allowed once healing of the fracture is noted. In lower-risk cases (non-displaced, stable, etc.), return to play following internal fixation in a thumb-spica cast may be possible a few weeks after surgery [31]. The athlete should be aware that returning to sport prior to complete healing could increase the risk of nonunion and need for further surgery. A thumb-spica cast should be utilized for play for the first 6–12 weeks to minimize stress on the healing fracture.

Wrist Ligament Injuries

The radiocarpal and intercarpal joints are stabilized by robust ligaments that provide stability but allow a wide range of movement. Injuries to these ligaments that are untreated often result in the progressive development of wrist arthritis. The most common pattern of wrist ligament injury was described by Mayfield and progresses from isolated injury to the SL ligament to disruption of multiple intrinsic and extrinsic ligaments resulting in a perilunate dislocation of the carpus.

Isolated SL injuries result from the fall on an outstretched hand. X-rays are usually normal as the development of carpal malalignment can occur late or could show acute SL interval widening (Fig. 2.11). The diagnosis is made by clinical exam often combined with MRI for high-level athletes (Fig. 2.12).

With disruption of the SL ligament, the lunate rotates into hyperextension and the scaphoid rotates into volar flexion (Fig. 2.11). This carpal malalignment is known as dorsal intercalated segment instability (DISI). Identified and treated acutely, the ligament can be repaired or reconstructed returning the wrist to its normal alignment and biomechanics. Untreated, the wrist develops a progressive pattern of arthritis and collapse known as scapholunate advanced collapse (SLAC) [37].

Fig. 2.11 Scapholunate ligament injury with avulsion fracture from the scaphoid

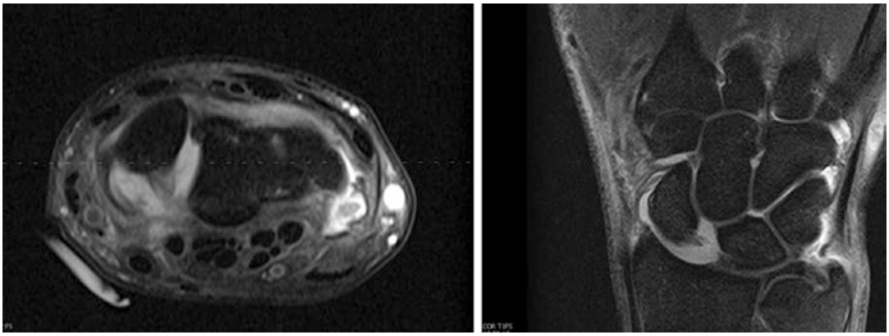


Fig. 2.12 Axial and Coronal images demonstrating scapholunate ligament injury

An injury with greater force can result in disruption of multiple wrist ligaments leading to perilunate dislocation. The lunate remains in position while the carpus dislocates dorsally. In some cases the carpus relocates forcing the lunate to dislocate volarly. Perilunate dislocations are frequently missed on initial radiographs not reviewed by specialists in wrist injuries [38]. Treatment techniques are varied and new surgical procedures are perpetually being developed. In one study of ten NFL players suffering perilunate dislocations, five players were treated with open reduction and pinning while five were treated with closed reduction and pinning. All players experienced diminished wrist ROM and five of ten had either intercarpal widening or degenerative changes on follow-up x-rays. Nine of ten players, however, returned to play within a year and the tenth retired, though his training staff felt his wrist did not limit him from continuing to play [27].

Author's Preferred Treatment

Given the natural history of untreated SL ligament injuries, for acute SL ligament injuries, the author recommends surgical repair and/or reconstruction of the ligament (Fig. 2.13). The timing of surgery is somewhat controversial. In many cases treatment can be delayed until the off-season seemingly without a negative impact on surgical complexity or ultimate outcome. In other cases, however, delayed treatment may result in a fixed deformity of the carpus that is less amenable to surgical reconstruction. An appropriate discussion with the patient regarding the unpredictability of delayed surgery is warranted.

Perilunate dislocations require urgent transport to a capable medical facility where a closed reduction under sedation should be performed. In some cases, closed reduction in the athletic training room has been performed, but can be very difficult in that setting. If a closed reduction is not possible, open reduction and treatment of the injury should be performed within a few days. If the patient is having symptoms of acute carpal tunnel syndrome, a more urgent surgical intervention should be performed.

Return to sport is dependent on the degree of involvement and surgical treatment. In a study of NFL players, return to sport varied from 1.5 weeks to 3 months or the

Fig. 2.13 Wrist PA view following scapholunate ligament reconstruction and scaphocapitate pinning

next season. In all cases, immobilization in a cast was utilized for a minimum of 4 weeks. One athlete returned prior to pin removal and sustained a deep wound infection requiring surgical debridement. In all other cases, return to play was delayed until pin removal, and that is the author's recommendation for approaching this injury [27].

Distal Radioulnar Joint (DRUJ)/Triangular Fibrocartilage Complex (TFCC) Injuries

The DRUJ is stabilized by the bony relationship of the sigmoid notch of the radius and the ulnar head and by soft tissue restraints of the volar and dorsal radioulnar ligaments and TFCC. Disruption of the soft tissue stabilizers results in acute dislocation of the DRUJ. Dislocations can be volar or dorsal (most common). Obvious deformity of the ulnar head and diminished pronosupination are seen on exam.

Once reduced, the wrist including the DRUJ is immobilized. An above-elbow splint is used initially to immobilize the DRUJ. By definition the stabilizers of the DRUJ are disrupted during dislocation, but stability can be restored with concentric reduction and immobilization. Chronic instability can be identified with thorough examination, and surgical intervention is warranted.

Author's Preferred Treatment

Closed DRUJ dislocations should be assessed radiographically and then reduced acutely, though the direction of the dislocation of the ulnar head (dorsal or volar) should be noted. If reduction cannot be achieved, open reduction should be performed on an urgent, not emergent, basis. If a successful reduction is achieved, the patient is immobilized in a long arm splint/cast for 6 weeks. If the dislocation was dorsal as is most common, the forearm should be immobilized in supination. If the dislocation was volar, the forearm should be immobilized in pronation. I obtain a CT scan once the patient is immobilized to confirm concentric reduction.

After 6 weeks the cast is removed and the patient is placed in a removable splint which is removed multiple times daily for the patient to work on pronosupination. Usually the patient's forearm rotation is very limited immediately following the casting phase of treatment, but most patients regain motion easily post-casting. I follow the patient clinically until acceptable motion is achieved and an adequate clinical assessment of DRUJ stability can be performed. If the DRUJ is stable, the patient can gradually return to activities as tolerated. If the DRUJ is unstable, an additional MRI is obtained and a plan made for surgical intervention. Due to the length of time of treatment, return to play is often the following season with this injury.

Hand

Fractures

Metacarpal

Metacarpal fractures are the most common hand injury sustained by NFL players (Part 1) and are the most likely hand injury to require surgery with 25% of injuries requiring surgery in one study [2]. Diaphyseal fractures are most common in football players while metacarpal neck, head, and base fractures are seen less commonly [21]. The majority of fractures are treated nonoperatively with immobilization. Open fractures, fractures resulting in unacceptable malalignment or malrotation, and displaced, intra-articular fractures require surgery [16]. Treated with or without surgery, metacarpal fractures can be easily immobilized allowing early return to play. Average return to play for all in-season athletes was 6.3 days with a recommended period of immobilization of 21 days and no reported re-fractures in one study [21]. Geissler et al. reported on ten athletes who underwent ORIF. All returned to play in 1–2 weeks. One patient sustained a refracture 1 year from injury [34].

Bennett's fracture is a fracture of the thumb metacarpal base in which the smaller, ulnar fracture fragment remains in its normal anatomic location due to its attachment to the volar beak ligament of the thumb CMC joint. The remainder of the thumb metacarpal displaces radially due to the pull of the abductor pollicis longus (APL). This fracture frequently displaces requiring reduction and casting or fixation. A similar fracture, a "reverse Bennett's fracture," occurs at the base of the small finger metacarpal. In this case the smaller radial fragment remains reduced while the metacarpal displaces.

Phalanx

Phalangeal fractures are also common injuries among football players and their prevalence is likely underreported as many of these injuries are not severe enough to warrant an x-ray. Unfortunately, phalanx fractures vary widely in severity and sequelae though the clinical presentation may be similar. The pain and clinical findings after a simple, non-displaced fracture that requires no treatment may not be significantly different from an intra-articular fracture of the PIP joint that requires surgery and results in lifelong impairment. Additionally, all the soft tissues critical for finger motion traverse in close proximity to the phalanges, especially the proximal phalanx. Post-injury adhesions and scarring are universal and result in difficulty regaining finger motion. For that reason establishing fracture stability to allow early range of motion is important.

Minimally displaced fractures of the phalangeal shaft are treated nonoperatively with immobilization followed by early motion usually at 2–3 weeks depending on the characteristics of the fracture. Displaced shaft fractures (Fig. 2.14) require either closed or open reduction and fixation (Fig. 2.15). Minimally displaced intra-articular fractures can be treated in the same manner. Some more displaced intra-articular fractures can also be treated nonoperatively. Avulsion fractures of the collateral ligaments and of the tendinous insertions of the central slip and terminal tendon can be treated with immobilization.

Displaced intra-articular fractures involving more than a tendinous insertion require surgery to restore articular congruity. These injuries, particularly involving fracture/dislocations of the PIP joint, can be difficult problems requiring complex operative solutions. In some cases joint reconstruction is accomplished by replacing a portion of the PIP joint with articular autograft from the hamate. Prolonged rehab and recovery and multiple surgical procedures are common in the treatment of these fractures.

Fig. 2.14 5th metacarpal shaft fracture

Fig. 2.15 Open reduction, internal fixation of 5th metacarpal fracture

Author's Preferred Treatment

Most hand fractures are minimally or non-displaced and can be treated with a short period of immobilization. Long-term immobilization should be avoided as significant loss of finger range of motion can result. I strictly immobilize most hand fractures for 2–3 weeks from injury and then repeat x-rays. If the fracture has remained stable, I transition the patient to a removable splint to be worn like a cast initially, but for multiple times daily, the split is removed for range of motion exercises. The patient then gradually decreases the amount of time the splint is worn and increases the frequency and aggressiveness of home range of motion exercises over the next 3 weeks, at which time the split is discontinued except during contact drills or play. In non-skill position players, I recommend continued splint immobilization during contact for 3 months post-injury. For skill position players, the risks of earlier, unsplinted return to play are discussed. If the patient wishes to return to play, immobilization options such as buddy taping are used where possible.

For displaced fractures, intra-articular injuries including Bennett's fractures (Fig. 2.16), multiple metacarpal fractures, and open fractures, surgical treatment is necessary (Fig. 2.17). When possible, I preferentially utilize fixation techniques that can be buried under the skin as opposed to percutaneous K-wires, as infection risk and time to return to play are both lessened.

Fig. 2.16 Bennett's fracture

Ligament Injuries

Soft tissue injuries to the fingers occur frequently in football players and are certainly underreported. It is likely that anyone who plays a contact or ball sport will sustain a "jammed" finger at some point. Such injuries involve injury to the soft tissues such as the joint capsule, collateral ligaments, and volar plate that surround the affected joint. Occasionally these injuries result in small bony avulsion fractures either radially or ulnarly (collateral ligament injury) or volarly (volar plate injury) [1]. Swelling and pain with motion ranging from mild to severe are the hallmarks of these injuries. The treatment for these injuries is temporary immobilization for protection of the finger combined with immediate range of motion as pain and swelling allow. Even complete collateral ligament avulsions of the PIP and DIP joints generally are well treated nonoperatively.

Increased soft tissue disruption at a finger joint can result in dislocation. Dislocations of the CMC, MP, PIP, DIP, and IP joint can all occur, but dislocation of the PIP joint is most common [25]. Dorsal displacement of the part of the finger distal to the involved joint occurs most commonly. For most dislocations an acute reduction on the field of sideline is common. A single attempt at reduction is best as the need for multiple reductions likely signals a complex dislocation that requires sedation or surgical intervention to complete. A joint that can be reduced easily but redislocates easily often has additional injury such as a fracture.

Fig. 2.17 Bennett's fracture following open reduction, internal fixation

A finger joint that is easily reduced should be immobilized with a splint or buddy taping. Immediate return to play as able is not contraindicated but player activity may be reduced by pain [3]. Each dislocation should follow up within a week for x-rays to confirm concentric reduction and assess for additional injuries such as fracture. Finger stiffness can result from these injuries so immobilization with early protected ROM limiting finger terminal extension is warranted.

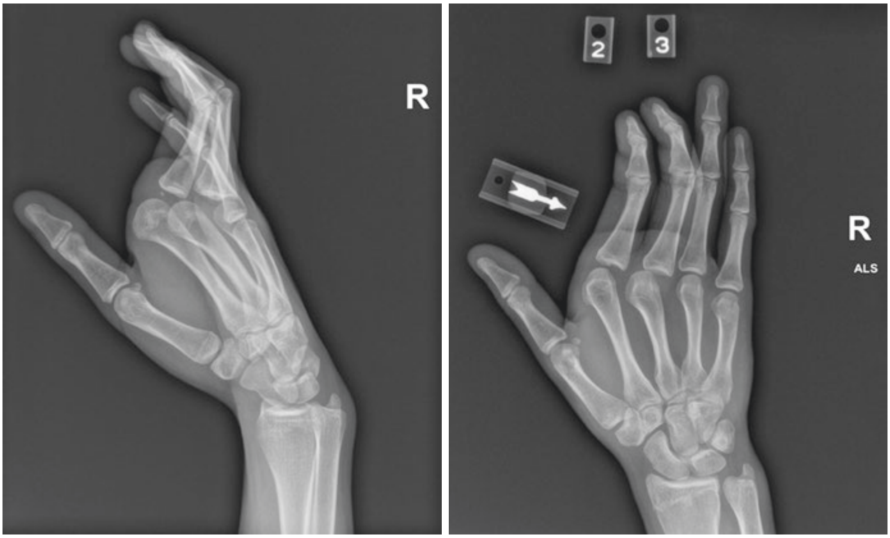
Ligament injuries of the thumb MP require more attention and intervention than most other soft tissue injures of the hand. The thumb MP joint ulnar collateral ligament (UCL) is injured with forced hyperabduction of the thumb. Resulting injuries can be strains or partial tears in which joint stability is maintained. These injuries are treated with immobilization, usually for approximately 6 weeks. More severe injuries can avulse the ligament from its bony attachment, usually from the proximal phalanx. If the displacement of the ligament is severe enough, the avulsed end is pulled from deep to superficial to the adductor aponeurosis. The interposed adductor aponeurosis prevents the ligament from healing; therefore surgical repair is necessary.

When acutely identified and treated surgically, complete avulsions of the UCL of the MP joint of the thumb can do well. In one study collegiate football players who required surgical repair of the thumb UCL were able to return quickly to play, returned to the same level of play, and had good long-term outcomes. Skill position players had surgery sooner and returned to play later than non-skill position players with no difference in final level of play or clinical outcomes [20]. One study of NFL players found that 25% of players with UCL injuries of the thumb had a combined injury to the radial collateral ligament (RCL) of the thumb as well. High clinical suspicion for this combined injury and the use of MRI when the possibility of a combined injury exists was recommended. All players with isolated UCL or combined UCL/RCL injuries returned to play in the NFL following surgery [15].

Author's Preferred Treatment

The vast majority of soft tissue finger injuries are treated symptomatically with buddy taping and early range of motion. Early motion is important in these injuries as loss of digital motion can be significant and occur rapidly following injury. Deciding which finger injury requires radiographic evaluation can be confusing. Certainly not all "jammed" fingers need an x-ray, but at the same time, missed PIP intra-articular fractures can result in important functional limitation. I recommend reassessment of finger injuries at 1 week. If pain, swelling, and ROM (of which ROM is most important) are all significantly improved from the time of injury, an x-ray is generally not needed. If sufficient improvement is not seen, x-rays are obtained.

Joint dislocations are acutely reduced – sideline reductions are acceptable. Postreduction x-rays must be obtained to rule out a fracture and confirm concentric reduction. Difficult reductions, such as a metacarpal-phalangeal dislocation, may require open reduction (Figs. 2.18, 2.19 and 2.20). Early immobilization is important



Figs. 2.18 and 2.19 Index and long finger MCP dorsal dislocations

Fig. 2.20 Radial digital nerve of the index finger is subcutaneous and at risk for injury during open reduction of a dorsal MP joint dislocation

and acutely I apply a dorsal block splint for the first 2 weeks followed by a transition to buddy taping only. For dislocations that are clinically stable immediately after reduction and are reduced on x-ray, immediate return to play with buddy taping is allowed with close clinical follow-up.

Stable, partial tears of the thumb collateral ligaments are treated with splint immobilization for 4–6 weeks. The patient is encouraged to remove the splint to work on straight-line thumb flexion and extension during this time as pain improves. At 6 weeks full-time splinting is discontinued, but a splint is worn for contact drills and play for non-skill position players. Skill position players can play unsplinted when pain-free. A soft splint or taping is utilized where possible to provide some level of protection.

Unstable tears of the thumb UCL are treated surgically. If treated acutely, a stable repair is often achieved and return to play with splint immobilization is common for non-skill players. With newer techniques return to play times unsplinted for skill position players is possible, often within a few weeks.

Tendon Injuries

Tendon injuries of the fingers in football players nearly always occur due to excessive force during a blunt traumatic injury. Lacerations to tendons occur but are far less common. An extensor tendon disruption at the DIP joint results in a "mallet finger." The terminal tendon is pulled off of its insertion in the distal phalanx with or without a small fragment of bone. Clinically this tendon results in the loss of active DIP joint extension to neutral. The fingertip will "droop" at the DIP joint at a variable amount but can be passively extended to neutral. Treatment consists of full extension splinting of the DIP joint 24 hours a day for 4–8 weeks. The patient is then weaned from the splint and gentle motion exercises are performed. Results from this treatment have been universally successful [10].

Injury at the insertion site of the central slip of the extensor tendon results in loss of active extension at the PIP joint. The injury occurs in a similar manner to a mallet finger with excessive force resulting in avulsion of the tendon from its insertion in the dorsal base of the middle phalanx. With an acute, complete disruption, the patient will be unable to actively extend at the PIP joint and he will have positive Elson's test. To perform Elson's test, the PIP joint is bent 90 degrees over the end of a table. The PIP joint is held flexed while the patient attempts to extend the finger. A positive test is characterized by a weak PIP extension and rigid DIP joint hyperextension. This injury results in a Boutonniere deformity characterized by PIP flexion and DIP joint hyperextension that can become fixed if the injury is not identified and treated appropriately. Treatment for an acute injury is 4–6 weeks of full-time PIP extension splinting while performing active DIP flexion and extension exercises. Treatment for chronic injuries requires restoration of full passive PIP motion followed by tendon repair or reconstruction. Return to play in splint is an option based on position.

Injuries to the flexor tendons occur less commonly than injuries at the insertions of the extensor tendons. In the general population, tendon injuries are almost always the result of a sharp laceration. In football players, however, a unique injury can occur. A "jersey finger" injury is an avulsion of the flexor digitorum profundus (FDP) tendon from its insertion in the distal phalanx. This was described originally as a football injury usually occurring when a player grabs another player's jersey with the tips of his fingers while that player is running away. The resulting force on the tendon can lead to avulsion of the flexor tendon from its insertion. The ring finger is the injured finger 75% of the time for reasons that are unknown. Several explanations for the propensity for injury to the ring finger have been suggested. One proposed explanation is that during full grip the ring fingertip is 5 mm more prominent than the other fingers in 90% of patients and so is subjected to greater force during pull-away [11]. Another explanation is that the ring finger is uniquely tethered by bipennate lumbrical muscles radially and ulnarly and is therefore more vulnerable to a hyperextension injury [22]. Another is that the ring has less independent motion that the other digits [12]. The FDP insertion of the ring finger is weaker than that of the long finger [13].

The history and clinical exam findings of tenderness over the flexor tendon and absent DIP flexion are usually diagnostic. X-rays should be obtained as in some cases the tendon avulsion is accompanied by fracture of the distal phalanx. The results of surgical treatment are successful but must be undertaken acutely as after approximately 3 weeks, the muscle may have contracted making repair impossible [24]. Multiple studies have demonstrated nearly full DIP flexion and grip strength but some losses of DIP extension after repair [12, 19, 23]. Tendon reconstruction is possible but surgical complexity is greater and the outcome worse than direct repair [18, 23]. Not all patients are functionally limited by absent DIP flexion and elect no intervention, though diminished grip strength will result [14, 17].

Author's Preferred Treatment

Early identification of mallet finger and central slip injuries is imperative and non-operative treatment for acute injuries is usually successful with many players regaining nearly normal function of the finger. Extension splinting of the DIP and PIP joints for 6–8 weeks is required, but many athletes including skill position players can continue to participate while splinted. When these injuries become chronic, the treatment becomes surgical and the outcomes are usually worse than acutely treated injuries.

Disruption of a flexor tendon such as "Jersey finger" requires surgical treatment to restore to preinjury function. Early classification systems for "Jersey finger" were used to determine surgical urgency with delayed treatment for some injury types deemed acceptable. Additional variants of "Jersey finger" have been more recently identified that make delayed treatment of these injuries unacceptable in my experience. I treat all acute "Jersey finger" injuries with urgent surgical repair and have found some tendons unrepairable at 3 weeks post-injury due to shortening and contracture of the flexor tendon muscle. Post-surgery therapy is critically important including splinting for 6 weeks postoperatively, immediate limited motion, and the avoidance of any gripping activities. Therapy is progressed through a standard protocol and return to full function restricted until 3 months postop at a minimum.

Chronic "Jersey finger" injuries should be approached with caution. Tendon reconstruction is possible, but postoperative adhesions and limited motion are common [39]. For a patient with a chronic "Jersey finger," no pain, and a full MP and PIP motion, the best outcome may result from no additional treatment.

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