1- Figures 1 through 3 are the radiographs of a 40-year-old woman who sustained a minor injury to her left ring finger. Prior to this injury she was asymptomatic, but she now notes pain and swelling. What is the best course of treatment?

A. Observation only

B. Fluoroscopic-guided intralesional steroid injection followed by serial radiographs

C. Immediate curettage without bone grafting

D. Splint immobilization with curettage and possible grafting after the fracture has healed

This patient has a fracture of the middle phalanx attributable to the presence of an enchondroma. Enchondromas are the most common benign bone tumor affecting the hand. This particular enchondroma has thinned the cortices extensively so that even minor trauma can cause a pathologic fracture. Observation is not the best treatment because a fracture is present, and, at a minimum, the digit should be immobilized.

Intralesional steroid injections have a role in the treatment of simple bone cysts; however, this treatment is not recommended for enchondromas. Immediate curettage alone is not the best treatment because it does not include bone graft (either autograft or allograft) or bone graft substitute. Also, it would be best to allow the fracture to heal prior to curettage to prevent fracture displacement. An enchondroma this size necessitates a graft because of high risk for refracture if curettage alone is performed. Many surgeons believe it is best if a fracture heals prior to curettage and grafting because this allows better graft containment and eliminates concern about fracture displacement. Recent data suggest early surgery using injectable calcium sulfate cement in the fracture setting can achieve satisfactory results. Splint immobilization would allow fracture healing, and then curettage with bone graft can be performed after healing occurs.

Correct answer : D

2- Figures 1 and 2 are the radiographs of an injury for which a closed reduction procedure was unsuccessful. A dorsal approach to the metacarpophalangeal (MCP) joint is chosen for open reduction. What is the most likely structure to impede the reduction?

A. Flexor tendon
B. Palmar plate
C. Dorsal capsule
D. Adductor aponeurosis

The radiograph shows the proximal phalanx nearly parallel with the metacarpal, where the simple dorsal dislocation of the phalanx is nearly perpendicular to the joint. A simple dislocation can be converted into a complex dislocation with attempts at closed reduction. The palmar plate, which is entrapped within the MP joint, should be incised longitudinally through its midline, allowing the metacarpal head to be reduced. For reduction of a simple dislocation, the wrist should be flexed to allow relaxation of the flexor tendons, and distal traction as well as volar-directed pressure to the base of the proximal phalanx can be successful in reducing a simple dislocation. Surgical reduction can be approached either dorsally or volarly. The volar approach jeopardizes the digital nerve. With a dorsal approach, the extensor hood and dorsal capsule should be incised longitudinally.

Correct answer : B

3- Which ligament is most important in maintaining stability of the scapholunate joint?

A. Dorsal scapholunate interosseous

B. Dorsal radiocarpal

C. Proximal (membranous) scapholunate interosseous

D. Volar scapholunate interosseous

Scapholunate instability frequently develops as a consequence of blunt trauma to the wrist and is associated with significant clinical morbidity. The ligamentous anatomy and kinematics of the carpus are complex and have been the focus of much clinical and biomechanical research. Multiple ligamentous structures contribute to the structure and function of the scapholunate articulation .

The wrist can be viewed as a 3-tiered structure with the forearm bones and carpometacarpal segments separated by the intercalated proximal row. The link between the distal and proximal carpal rows depends in large part on the scapholunate articulation. Instability of this articulation leads to altered kinematics and clinical symptomatology .

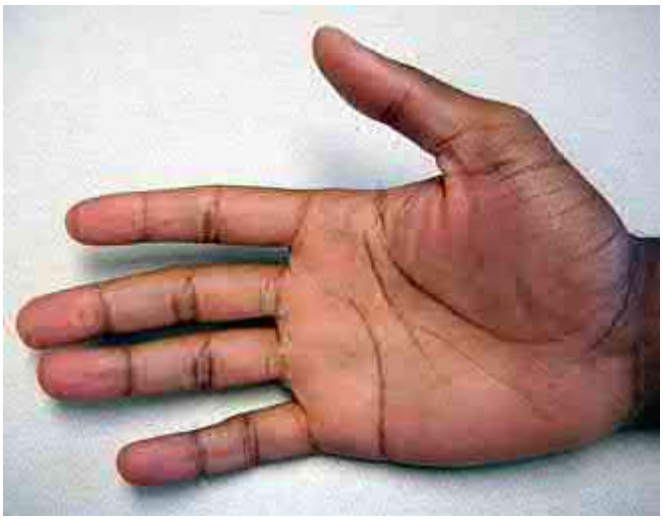
Multiple ligaments contribute to scapholunate joint integrity. They can be divided into intrinsic and extrinsic groups. The scapholunate interosseous ligament (SLIL) is described as intrinsic and is a C-shaped ligamentous structure that can be divided into 3 parts for descriptive purposes. The dorsal component is the thickest, with an average thickness of 3 mm and is approximately 5 mm in proximal-distal dimension. It attaches the proximal pole of the scaphoid to the dorsal aspect of the lunate. The proximal component has variable thickness and is composed largely of fibrocartilage. The volar component averages only 1 mm in thickness and 5 mm in proximal-distal dimension. It merges with the radioscapholunate ligament proximally and with the radioscaphocapitate (RSC) ligament distally. The other stabilizers are referred to as extrinsic because they connect the scaphoid and lunate to the radius and other carpal bones. Several ligaments at the palmar aspect of the carpus contribute to scapholunate stability. The RSC ligament runs from the radial styloid to the scaphoid fossa. The long radiolunate ligament (LRL) extends from the volar radius to the volar lunate. The radioscapholunate ligament (RSL) attaches the volar distal radius to the volar aspect of the SLIL. The scaphotrapezial ligament (ST) attaches the distal pole of the scaphoid to the trapezium .

Other extrinsic ligaments contributing to scapholunate stability are found at the dorsal aspect of the carpus. The dorsal radiocarpal ligament (DRC) originates from the dorsal distal radius and inserts onto the dorsum of the lunate, triquetrum, and lunotriquetral interosseous ligament. The dorsal intercarpal ligament (DIC) attaches to the dorsum of the triquetrum and extends radially, past the lunate, to insert on the dorsal distal pole of the scaphoid .

Although the exact contribution of each ligament to scapholunate stability is not fully understood, some interesting observations have been made. The SLIL appears to be the primary stabilizing structure. Sectioning the SLIL alone, without disturbing the extrinsic stabilizers, leads to substantial widening of the scapholunate interval and altered motion patterns of both the scaphoid and

lunate. Sectioning the RSC and ST ligaments with an intact SLIL does not significantly alter scaphoid or lunate kinematics with respect to motion in the flexion-extension and radial-ulnar planes. Similarly, sectioning of the ST and DIC ligaments by another study group demonstrated no alterations in scapholunate motion, whereas DRC sectioning led to only modest ulnar deviation of the lunate. Although many ligaments contribute to the stability of the scapholunate joint, the SLIL appears to be the primary stabilizer. The most robust and functionally important part of the SLIL appears to be the dorsal component. The role of the secondary stabilizers is significant, and more work is necessary to fully understand their contributions.
Correct answer : A

4- Figures 1 and 2 are the clinical photographs of a 22-year-old man who was injured 1 year ago when he grasped an opponent during a football game. He experienced immediate pain and has been unable to close his ring finger into a fist since then. He also has noticed swelling and a painful lump in his palm with attempted forceful gripping. What is the most likely diagnosis?



A. Lumbrical plus finger

B. Distal rupture of the profundus tendon with entrapment at the superficialis chiasm

C. Distal rupture of the profundus tendon with the proximal tendon stump in the palm

D. Quadrigia

The most common location (ring) and mechanism at which the flexor digitorum profundus (FDP) tendon ruptures resulting in a jersey finger (rupture of the FDP with attempted active flexion while the finger is being forcibly extended) is at its distal insertion at the base of the distal phalanx (as in the description of a player attempting to escape another player's grasp). The proximal tendon stump often retracts into the palm where it forms a tender lump. This patient can passively flex but has no ability to actively flex the distal interphalangeal joint. Although this is a classic description, this injury also can occur during an altercation or when attempting to separate fighting dogs by the collar, for example.

A lumbrical plus deformity may result from this injury, but that is not demonstrated in these clinical photographs. Lumbrical plus would demonstrate paradoxical extension of the proximal interphalangeal (PIP) joint with attempted active flexion, secondary to a proximally retracted FDP that is applying progressive tension to its lumbrical. This PIP extension worsens with attempted active flexion because there is increasingly more tension applied to the lumbrical.

Quadrigia is iatrogenic secondary to a distal advancement of the FDP or a repair in the setting of tendon substance loss. Either of these pulls the FDP too far distally. Because the long ring and small finger FDP tendons are interconnected through a common muscle belly, pulling 1 tendon distally effectively pulls the others distally. Then, with attempted active flexion, there is not enough excursion of the profundi to fully flex the fingers, and a flexor lag is seen in the ulnar 3 digits. The index can be spared because its FDP is often functionally separate from the others. An entrapment of the FDP at the superficialis chiasm may produce a triggering or a mass overlying Camper chiasm at the level of the proximal phalanx and not the palm. With the exception of the small finger, rupture of the FDP in the palm is rare.
Correct answer : C

5- After biopsy confirmation, the most appropriate treatment for the squamous cell carcinoma of the thumb involving the distal phalanx shown in Figures 1 and 2 is

A. ray amputation.

B. curettage and bone grafting.

C. radiation therapy.

D. amputation at the interphalangeal joint level.

Squamous cell carcinoma of the fingertip/nail region is uncommon. A high degree of suspicion is needed to diagnose this condition. Radiographs and biopsy are necessary to make the diagnosis. The treatment choice is dependent upon the extent of the lesion at the time of presentation. It can vary from Mohs microsurgery to digital amputation. Amputation is recommended when there is bone involvement. Because the distal phalanx tip is involved and no further bone is involved proximally, an amputation at the interphalangeal joint level is recommended. More proximal involvement would require a more proximal amputation level. Only the distal phalanx is involved. Curettage and bone graft is not appropriate for this malignant lesion. Radiation alone is not an appropriate treatment option for this condition. Metastatic spread is uncommon.

Correct answer : D

6- Distal pole scaphoid excision is contraindicated for patients with

A. carpal instability.

B. scaphotrapezotrapezoidal (STT) arthritis.

C. failed STT arthrodesis.

D. distal scaphoid nonunion.

Distal pole scaphoid excision is a surgical option for STT arthritis, a failed STT arthrodesis, and distal pole scaphoid nonunion involving the distal 25% of the scaphoid. Distal pole scaphoid excision may lead to a nondissociative intercalated segment instability pattern, so carpal instability is a contraindication. Presurgical assessment for a dorsally unstable midcarpal joint should be performed. This procedure involves excision of the distal quarter of the scaphoid with postsurgical immobilization for 4 to 6 weeks. STT arthrodesis is a technically demanding procedure with reported complication rates as high as 78%. Postsurgical immobilization is continued for 6 to 8 weeks until evidence of STT fusion healing is seen.

Correct answer : A

7- What is the most common site of nerve compression in radial tunnel syndrome?

A. Fibrous bands anterior to the radiocapitellar joint

B. Recurrent radial vessels

C. Medial edge of the extensor carpi radialis brevis (ECRB)

D. Proximal aponeurotic edge of the supinator (arcade of Frohse)

Radial tunnel syndrome occurs as the result of radial nerve compression at 5 potential sites. These are the fibrous bands anterior to the radiocapitellar joint, the radial recurrent vessels (known as the leash of Henry), the medial edge of the ECRB, the proximal aponeurotic edge of the supinator (arcade of Frohse), and the distal edge of the supinator. The arcade of Frohse is the most common site of compression. The chief discomfort is deep, aching pain in the dorsoradial proximal forearm. Motor and sensory symptoms usually are absent. This condition often is seen when pain persists after surgery for lateral epicondylitis. Lateral epicondylitis and radial tunnel syndrome coexist 5% of the time.

Examination findings are tenderness 4 cm distal to the lateral epicondyle, pain with resisted supination, and pain with resisted long finger extension. Electromyogram/nerve conduction study and MRI results usually are normal. A steroid injection can be diagnostic and also may provide temporary relief of symptoms. Surgery involves decompression of all potential areas of compression and allows good to excellent results in only 50% to 90% of cases. Symptoms may take 9 to 18 months to resolve after surgery.
Correct answer : D

8- A 25-year-old man has an isolated flexor digitorum profundus laceration just proximal to the distal interphalangeal (DIP) flexion crease of his ring finger. The tendon ends are trimmed, removing 10 mm from each end (secondary to fraying) and the tendon repaired. Four months later, he reports limited finger motion of the long, ring, and small fingers. He cannot fully extend his wrist and all joints of the 3 fingers simultaneously. He has full passive flexion but cannot actively completely close his fingers into a fist. What is the most likely cause?

A. Quadrigia

B. Intrinsic tightness

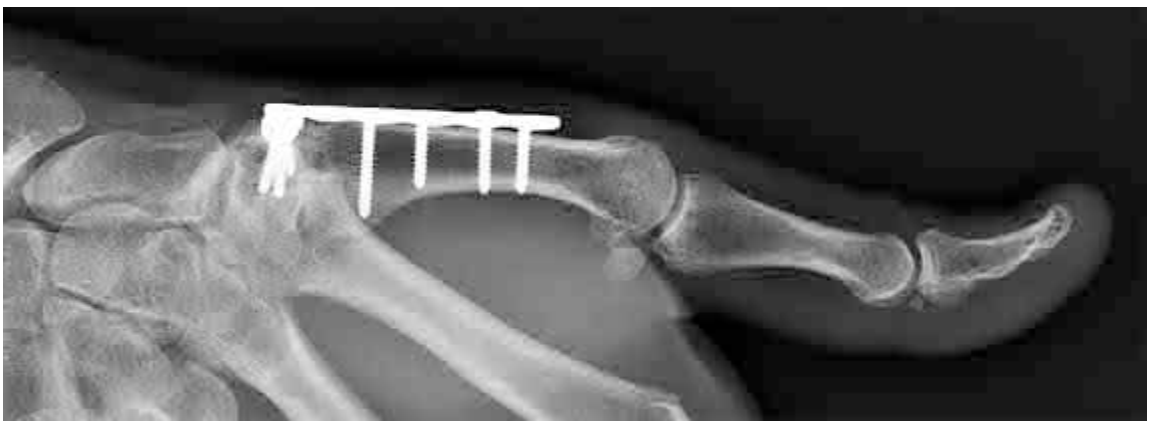
C. Lumbrical plus deformity

D. Disruption of the tendon repai

If a single flexor digitorum profundus (FDP) tendon is debrided more than 1 cm prior to repair, the tendon is advanced too far distally, essentially shortening the musculotendon unit. The finger will likely develop a flexion posture. Because of the common muscle belly and interconnections of the profundi, the long and small fingers adjacent to the injured finger will be affected because of loss of some of their normal proximal excursion. The result is an inability of the adjacent fingers to completely flex. This condition, known as quadrigia, is named after the Roman chariot driver who held control of the reins of 4 horses, forcing them to move as one. Quadrigia occurs when the FDP tendon is advanced too far distally, when a tendon graft is too short, or when the profundus is sutured over the end of an amputated digit.

Intrinsic muscles of the hand flex the metacarpophalangeal (MP) joints and extend the PIP joint. Intrinsic tightness causes decreased PIP flexion when the MP joint is in extension. The lumbrical muscle modulates tension on the flexor profundus tendon. When a tendon graft to repair the profundus tendon is too long, a lumbrical plus deformity occurs. This is a paradoxical PIP extension as the finger is flexed. Disruption of the tendon repair causes limited flexion of the injured finger.
Corrent answer : A

9- A 35-year-old man has substantial pain at the base of his dominant right thumb. Orthosis use, anti-inflammatory medication, and corticosteroid injections have failed to improve his symptoms. Which condition is a contraindication to the surgery shown in the radiograph (Figure 1)?



A. Lack of hyperextension of the thumb metacarpophalangeal (MCP) joint

B. Scapholunate advance collapse

C. Arthritis of the scaphotrapezial-trapezoid (STT) joint

D. Bilateral disease

There are multiple surgical options for treatment of symptomatic thumb carpometacarpal (CMC) joint arthritis, including trapeziectomy with or without suspensionplasty and with or without tendon interposition, prosthetic replacement, or arthrodesis. However, for a young manual laborer, a more robust solution is required so he can withstand the rigors of occupational activities. Arthrodesis of the CMC joint provides good pain relief but a relatively high nonunion rate (8%-21%). Presence of STT arthritis is a contraindication to CMC fusion because the STT joint will undergo increased stresses following CMC fusion, which will cause early failure of the surgical intervention. Bilateral thumb CMC fusions can be performed, and bilateral disease is not a contraindication to this procedure. Concomitant wrist arthritis does not preclude CMC fusion because this can be addressed with scaphoid excision and partial wrist fusion, which is not compromised by CMC fusion. Lack of MCP joint hyperextension does not preclude CMC fusion; substantial MCP hyperextension should be addressed at the time of arthroplasty for CMC arthritis with MCP fusion or volar capsulodesis.

Correnct answer :C

10- Figures 1 through 3 are the radiographs of a 45-year-old construction worker who has severe wrist pain. He has failed nonsurgical measures and requests surgery. The most appropriate surgical option is

A. bone graft with fixation of the scaphoid.

B. proximal row carpectomy.

C. scaphoid excision with 4-corner fusion.

D. total wrist joint replacement.

The radiographs show a long-standing scaphoid nonunion with avascular necrosis and collapse of the proximal pole. This is referred to as a scaphoid nonunion advanced collapse wrist. He also has advanced arthritis of the capitolunate joint. This patient has a physically demanding occupation, so the best option for him is scaphoid excision with 4-corner fusion. Proximal row carpectomy would be inappropriate because of the advanced arthritis of the capitolunate joint.

This procedure's success is reliant upon normal cartilage/joint articulation of the capitate and lunate fossa of the distal radius. A total wrist replacement is not appropriate for a man with a physically demanding job. Finally, the patient has a long-standing scaphoid nonunion with advanced proximal pole collapse. Therefore, bone grafting with fixation is not an option at this point.

Correct answer :C

11- In addition to the anterior oblique ligament, which other structure is an important stabilizer of the thumb carpometacarpal (CMC) joint when the thumb is in a position of opposition?

A. Osseous architecture

B. Abductor pollicis brevis

C. Radiovolar joint capsule

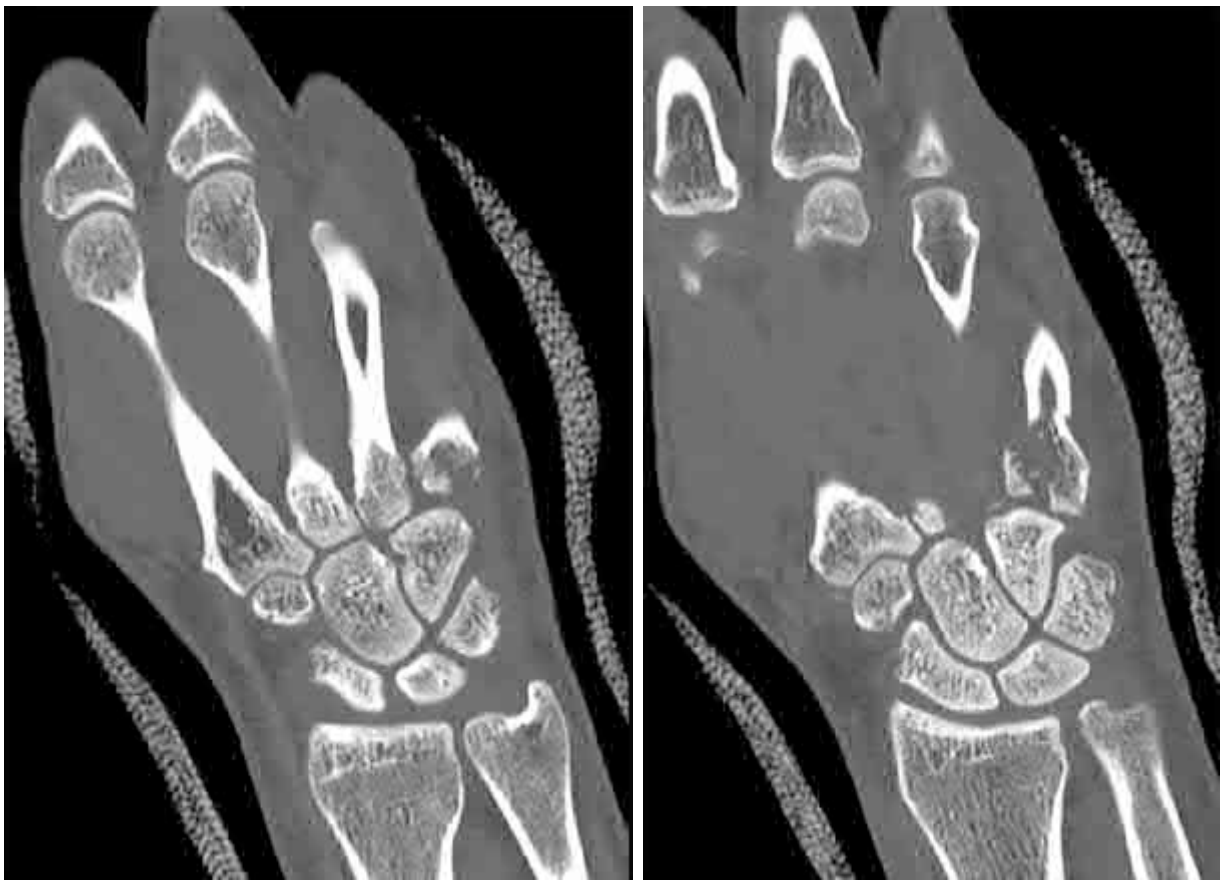
D. Dorsoradial ligament

The anterior oblique (volar) ligament was considered the primary stabilizing structure of the thumb CMC joint until alternative theories were offered in the mid 1970s. Multiple clinical and anatomic studies since that time have supported the theory that the primary stabilizing structure is the dorsoradial ligament.

Shah and Patel reported on 4 cases of thumb CMC dislocation in 1983 and demonstrated that in each case, the dorsal ligaments were ruptured while the anterior oblique ligament remained intact. Strauch and associates sectioned the supporting structures of 38 cadaveric specimens. Isolated sectioning of the dorsoradial ligament complex led to the maximum degree of subluxation. Preserving the dorsoradial complex alone maintained the highest degree of stability.

The radiovolar and dorsal capsular ligaments are thin and insert farther from the articular surface, allowing for increased mobility. The ulnovolar capsule and anterior oblique (volar) ligament attach close to the articular surface and are short and robust. Further stability comes from the infratendinous layer of the abductor pollicis longus tendon. The abductor pollicis brevis does not substantially contribute to stability of the CMC joint.
Correct answer :D

12- Figures 1 through 5 are the radiographs and CT scans of a 21-year-old right-hand-dominant man who injured his right hand in a martial arts competition 3 weeks before seeking treatment. An examination reveals substantial ulnar-sided hand swelling and tenderness at the base of the fifth metacarpal. Digital flexion is nearly full with no malrotation. The most appropriate treatment is



A. cast immobilization.

B. closed reduction percutaneous pin fixation.

C. open reduction and internal fixation.

D. fifth carpometacarpal (CMC) arthrodesis.

This fifth metacarpal base fracture is displaced, comminuted, and impacted. It is also associated with dorsal subluxation of the metacarpal on the hamate. The CT scan confirms the impaction of a sizable portion of the articular surface of the metacarpal base. In addition, the injury is 3 weeks old and is not likely to reduce by closed means. Open reduction, which would enable more accurate restoration of the articular surface, is necessary. If the patient had arrived for treatment earlier, a closed reduction percutaneous pinning may have been successful but may not have reduced the impacted articular segment. This injury usually results from a longitudinally directed force along the axis of the fifth metacarpal. Although a fifth CMC arthrodesis is an option, it likely is not appropriate as an initial treatment option and should be reserved for patients with painful posttraumatic arthritis.

Correct answer : C

13- Video 1 shows a 20-year-old right-hand dominant man with a 6-month history of left wrist pain and popping that has failed nonsurgical measures. No other positive findings upon examination are noted. What is the most appropriate course of treatment?

A. Lunotriquetral fusion
B. Distal radioulnar joint (DRUJ) tenodesis
C. Triangular fibrocartilage complex (TFCC) repair
D. Extensor carpi ulnaris (ECU) tendon sheath reconstruction

Upon examination, this patient is exhibiting dislocation of the ECU tendon because of a disrupted sheath. He has failed nonsurgical measures, so surgery that would involve either direct repair or reconstruction of the tendon sheath is indicated. An option for reconstruction is to use a portion of the extensor retinaculum as a sheath substitute. Deepening of the ECU tendon groove at the distal ulna with direct repair of the sheath is another option, although a 2016 paper by Ghatan and associates did not find depth of the groove as a risk factor for subluxation. TFCC repair, lunotriquetral fusion, and DRUJ tenodesis are not appropriate because the examination clearly shows ECU tendon dislocation. TFCC and lunotriquetral ligament tears can occur along with ECU tendon dislocation, but no other examination findings suggest these conditions for this patient.
Correct answer : D

14- A 53-year-old woman is experiencing thumb weakness. She has a remote history of a wrist fracture treated with a cast. She cannot lift her thumb off of a table when her hand is lying flat, palm-down. What is the most appropriate course of treatment?

A. Abductor pollicis longus reconstruction with palmaris autograft
B. Extensor pollicis brevis repair
C. Extensor pollicis longus (EPL) repair
D. Extensor indicis proprius (EIP) to extensor pollicis longus tendon transfer

The EPL is the only tendon that will lift a thumb off of a table as described. It is the most frequently ruptured tendon associated with distal radius fractures. Rupture is more common with nondisplaced fractures. Rupture after a nondisplaced or minimally displaced fracture suggests an ischemic etiology. The patient will not be able to lift her thumb off of a table with her hand lying flat, palm-down. Direct repair is often difficult because of retraction of tendon ends, atrophy, and fraying. The EIP has a similar amplitude and direction of pull. Prerequisites for the use of the EIP to EPL tendon transfer include independent extension of the index finger.
Correct answer : D

15- Figure 1 is the clinical photograph of a very functional 17-year-old boy with cerebral palsy and quadriplegia. He has no active supination but has full passive supination. His ability to determine position and sensibility without visual input are good. Radiographs show no osseous malalignment. Which treatment can best improve this patient's function?

A. Physical therapy for supination strengthening
B. Pronator teres muscle transfer
C. Humeral derotation osteotomy
D. Pronator quadratus muscle release

The inability to actively supinate affects many functions; this patient has a pronation deformity of the forearm that affects function. Transfer of the pronator teres by rerouting the insertion point allows this muscle to act primarily as a supinator of the forearm rather than as a pronator. This can markedly improve his ability to accomplish activities of daily living. Release of the pronator quadratus is not necessary because there is full passive supination and no presurgical contracture. A physical therapy program would not be helpful in this situation because of the total absence, rather than weakness, of active supination. A humeral derotational osteotomy is not necessary because this patient has normal radiograph findings and bony alignment.

Correct answer : B

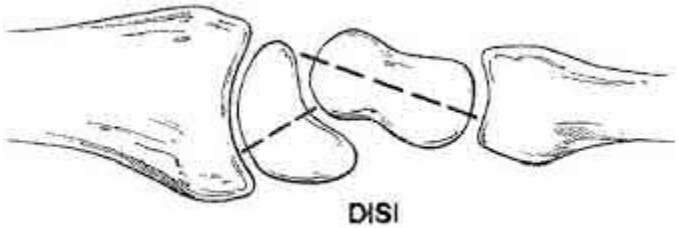
16- Dorsal intercalated segment instability (DISI) describes which carpal deformity?

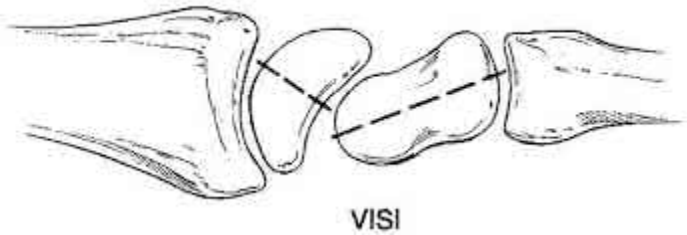
A. Scaphoid extension
B. Lunate extension
C. Lunate flexion
D. Triquetral flexion

The DISI deformity (Figure 1) simply describes dorsal lunate tilt or lunate extension on a lateral radiograph. DISI deformity usually occurs after dissociation between the lunate and the scaphoid (as in a scapholunate ligament tear). The scaphoid has a tendency to flex, and, when the scapholunate ligament is torn, the lunate loses its attachment to the scaphoid and shifts into an extended position.

The scaphoid does not extend when the scapholunate ligament is torn. The triquetral bone extends with the lunate, assuming there is an intact lunotriquetral ligament. The midcarpal joint and capitate extend when the lunate flexes. Conversely, when the lunate extends into a DISI deformity, the midcarpal joint tends to compensate with flexion at the capitolunate joint.

Correct answer : B





17- Figures 1 and 2 are the radiographs of a healthy 54-year-old right-hand dominant man 3 months after he fell onto his outstretched left hand. He was initially treated with 8 weeks of closed reduction and casting. He reports ongoing ulnar-sided wrist pain, stiffness, and diminished function. An examination reveals a clinical sag deformity with a loss of radial length but no substantial swelling. The distal radius is nontender, and rotation is nearly full. Wrist motion is limited, with 55° of flexion, 25° of extension, and full digital motion. The most appropriate treatment is

A. distal ulna excision (Darrach procedure).
B. wrist arthrodesis and distal ulna excision.
C. immediate distal radius corrective osteotomy.
D. delayed distal radius corrective osteotomy.

This patient has a substantial nascent malunion of his distal radius. Although a distal ulna excision would likely improve his ulnar-sided wrist pain, the Darrach procedure is more appropriate for older, somewhat less active individuals. In addition, the distal radius malunion is substantial, and it would be preferable to address the malunion given the major loss of radial length, inclination, and increased palmar tilt. The joint surface of the distal radius is uninvolved, and there is no evidence of arthrosis. It is preferable to osteotomize the distal radius sooner rather than later. Delayed osteotomy is often more difficult with more severe soft-tissue contractures, and improved results have been demonstrated following surgical treatment of nascent rather than mature distal radius malunions. Advantages include easier correction, no need for structural bone grafts, less overall total disability, and earlier return to work.
Corrent answer : C

18- By which mechanism can a true aneurysm of the ulnar artery result?

A. Blunt trauma
B. Stab wound
C. Gunshot wound
D. Arterial catheterization

True aneurysms contain all arterial layers. As such, they occur following an arterial injury that allows the vessel to gradually dilate. A true aneurysm is more uniform in shape and is characterized by having an endothelial lining. True aneurysms result from repeated blunt trauma or vessel diseases that weaken the wall. A pseudoaneurysm, or false aneurysm, results from an arterial wall penetration. The extravasated hematoma subsequently organizes and then recanalizes. The lumen of this false aneurysm has no endothelial lining. Pseudoaneurysms result from penetrating injuries from external sources or from fractures.
Correct answer : A

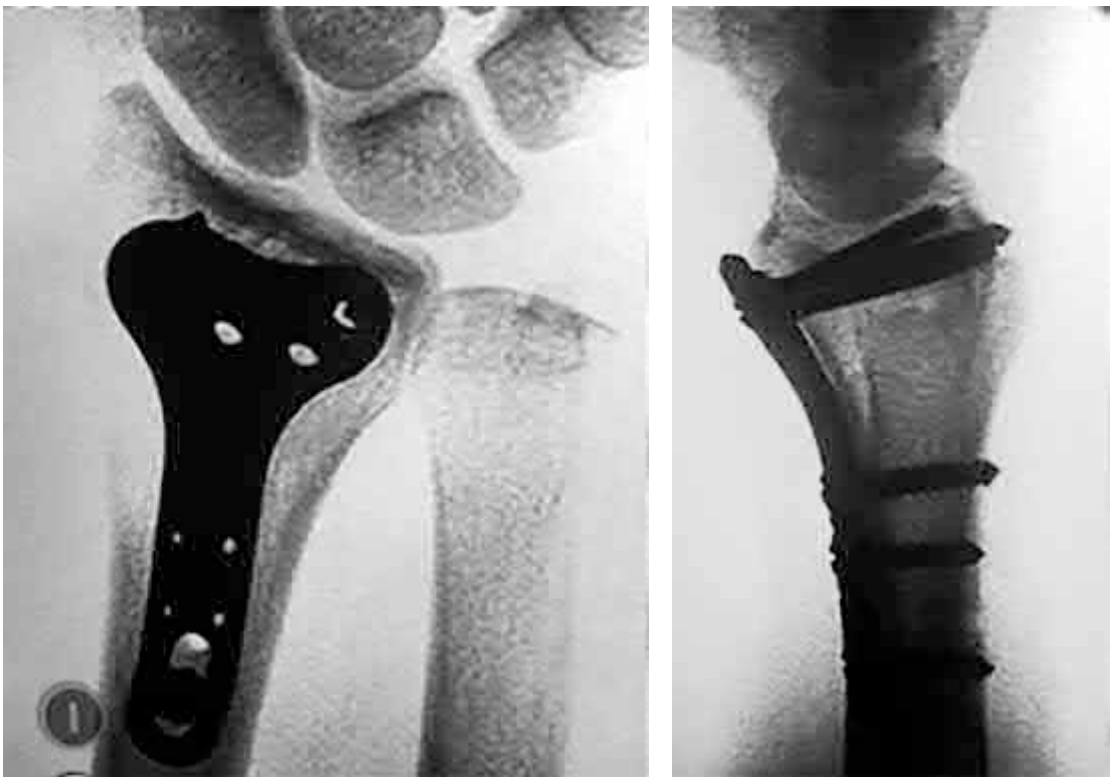
19- Figures 1 and 2 are the radiographs of a 17-year-old boy who injured his wrist 6 months ago. He is experiencing pain and limited motion. What is the most effective treatment option?

A. Long-arm thumb spica casting
B. Bracing and bone stimulation
C. Scaphoid excision with intercarpal fusion
D. Bone grafting with screw placement

Figures 1 and 2 show a scaphoid nonunion with substantial bone resorption at the nonunion site. Cast immobilization and bracing with bone stimulator use would not be successful treatments at this point because the fracture is 6 months old and there is considerable bone resorption at the fracture site. Scaphoid excision with intercarpal fusion is an option to use only after bone-grafting procedures have failed or arthritis is present.

Bone-grafting procedures using both vascularized and nonvascularized graft sources are associated with a high success rate that decreases with avascular necrosis of the proximal pole. If left untreated, scaphoid nonunions can progress to carpal collapse and degenerative arthritis.
Correct answer : D

20- Figures 1 and 2 are the initial radiographs from a volar plating of the distal radius performed 8 months previously. This patient has not been able to actively extend her thumb for 2 days. What is the most appropriate course of treatment?



A. Cast placement, keeping the thumb in a fully extended position for 4 weeks
B. Repair of the extensor pollicis longus (EPL) tendon and hardware removal
C. Removal of hardware with tendon transfer of the extensor indicis proprius
D. (EIP) to the EPL Tendon transfer of the EIP to the EPL

Although the fracture is aligned in an anatomic position, there is prominence of at least 1 of the distal screws noted on the lateral radiograph view. Most likely, the prominent screw(s) is the cause of EPL tendon rupture. The best solution is removal of offending hardware combined with EIP to EPL tendon transfer. If the tendon transfer is performed without hardware removal, the prominent screw(s) may rupture the adjacent extensor tendons. Also, it is rarely possible to repair the EPL tendon primarily because of damage to the tendon over a long segment. Casting would not provide any benefit in this situation. This problem can be avoided by using screws that do not violate the dorsal cortex.
Correct answer : C

21- Assuming that the fracture shown in this radiograph (Figure 1) is aligned on the anteroposterior radiograph and heals in this position, secondary to fracture malalignment, the most likely loss of active motion will be

A. metacarpophalangeal (MP) joint extension.
B. proximal interphalangeal (PIP) joint extension.
C. metacarpophalangeal (MP) joint flexion.
D. proximal interphalangeal (PIP) joint flexion.

This is a transverse proximal phalanx fracture with apex volar angulation. The deforming force of the central slip inserting onto the middle phalanx pulls the distal segment into extension. The proximal deforming force is the insertion of the medial slip of the interossei at the proximal phalanx, leading to flexion of the proximal segment. If allowed to heal in apex volar malunion, the predicted corresponding extensor lags are for a 10° lag at 16° of angular deformity, a 24° lag at 27° of deformity, and a 66° lag at 46° of deformity. These fractures can be treated either with closed reduction or with surgical stabilization.
Correct answer : B

22- A close-range gunshot injury necessitates partial amputation of a patient's right index finger at the metacarpophalangeal (MCP) joint. Intraoperative exploration reveals an intact ulnar digital artery and ulnar skin bridge. What is the most appropriate treatment?

A. Replantation of the index finger
B. Ray resection
C. MCP joint fusion
D. Middle finger transposition to the index metacarpal

Replantation following a blast injury is problematic. Stiffness after replantation is common and impedes hand function. Ray resection leads to the loss of the index finger but will allow the earliest unrestricted use of the hand. MCP joint fusion would necessitate either shortening or bone grafting, internal fixation, and soft-tissue reconstruction, resulting in a stiff insensate index finger. Although middle finger transposition to the index metacarpal is possible, the gap left behind between the new index and the ring finger is unsightly and functionally problematic because patients can drop or lose small objects through the gap. Typically, the index ray is transferred to the middle finger position for reconstruction of the middle finger.
Correct answer : B

23- A 75-year-old woman has persistent pain at the metacarpophalangeal (MCP) joint of her right thumb attributable to degenerative arthritis. Bracing and corticosteroid injections have provided only temporary relief. What is the best surgical option?

A. Silicone arthroplasty
B. Surface replacement arthroplasty
C. Arthrodesis in 15 to 20 degrees of flexion and slight pronation
D. Arthrodesis in 45 to 50 degrees of flexion and slight supination

Symptomatic thumb MCP arthritis is best managed with arthrodesis. The majority of thumb motion occurs at the carpometacarpal and interphalangeal joints, and, as such, arthrodesis of the thumb MCP is well tolerated. The ideal position for arthrodesis of the MCP joint is in slight flexion and pronation, which optimizes key pinch. A study by Saldana and associates recommended 20 degrees of flexion for women and 25 degrees for men. Arthroplasty for thumb MCP problems does not offer enough stability against pinch forces and is not performed.
Correct answer : C

24- A patient with a displaced and comminuted fracture of the radial head and neck also has pain and swelling about the ipsilateral distal radioulnar joint. Which treatment option may exacerbate the wrist disorder?

A. Cross-pinning of the radius and ulna
B. Open reduction and internal fixation (ORIF) of the radial head and neck fracture
C. Metallic radial head implant arthroplasty
D. Radial head excision

his scenario describes a forearm-axial instability pattern, which must be recognized before pursuing treatment. Fracture or dislocation of the lateral elbow compartment (radial head/capitellum) associated with ipsilateral distal radioulnar joint derangement is a form of radioulnar dissociation commonly known as Essex-Lopresti fracture dislocation. Radial head excision sets off a chain of events, and delayed diagnosis can result in considerable morbidity following these injuries. Excision of the radial head allows proximal migration of the radius, causing potential problems at both the elbow and wrist. After such proximal migration has occurred, there is no reliable method of forearm reconstruction.

There are a number of treatments for this condition. Salvage of the radial head by open reduction and internal fixation is preferable if possible. However, in cases of marked comminution, radial metallic head implant arthroplasty is an acceptable substitute. The need for soft-tissue repair or pin stabilization of the distal radioulnar joint has not been defined, although some form of forearm immobilization is necessary to allow healing of the injured interosseous membrane.
Correct answer : D

25- A 50-year-old woman has had acute weakness in her dominant hand for 6 weeks. Before noticing the onset of weakness, she experienced several weeks of vague discomfort in her shoulder and forearm, generalized fatigue, and a low-grade fever. There is no history of trauma. An examination reveals weakness of thumb and index finger distal interphalangeal (DIP) joint flexion. Electrodiagnostic testing shows fibrillations and positive sharp waves in the flexor pollicis longus and index flexor digitorum profundus muscles. The next appropriate step is

A. observation.
B. corticosteroid injection.
C. immediate surgical decompression.
D. tendon transfers.

This clinical scenario describes anterior interosseous nerve (AIN) syndrome. Identifying factors include weakness of the muscles innervated by the AIN, which include the flexor pollicis longus, index flexor digitorum profundus, and pronator quadratus. The same findings are present when fascicles contributing to the AIN are affected more proximally in the median nerve or brachial plexus, at which the findings are referred to as pseudo-anterior interosseous syndrome.

AIN syndrome can be present following blunt or penetrating trauma. It can also be seen in the absence of trauma, in which case there may be a prodrome of upper extremity discomfort, generalized fatigue, and/or fever. Clinical findings include weakness of the thumb interphalangeal (IP) joint and index DIP joint flexion, sometimes referred to as the “Playboy bunny sign.” Pronator quadratus weakness is also present; however, there is uncertainty as to the validity of manual muscle testing in determining pronator quadratus weakness. Electrodiagnostic studies demonstrate evidence of denervation of the muscles supplied by the AIN.

In the setting of acute trauma exploration, decompression and repair of the AIN is indicated early. In the case of a spontaneous and sudden onset of symptoms, especially when associated with other indications of an inflammatory process, a viral or inflammatory neuritis is much more likely. In these cases, multiple studies demonstrate a high incidence of spontaneous resolution over 6 to 12 months. Although systemic corticosteroids may be of benefit in the case of inflammatory neuritis, there are no data to support their use and no data to support the use of AIN corticosteroid injection. Although surgical exploration is supported in the literature for patients who do not show improvement within 3 months of onset, immediate surgical exploration at 6 weeks is not indicated. Tendon transfers are indicated only if recovery fails to occur spontaneously or after surgical exploration of the AIN.
Correct answer : A

26- Following an open reduction and internal fixation of an acute Monteggia fracture, radiographs shown in Figures 1 and 2 reveal a persistently dislocated radial head. An attempted closed reduction of the radial head is unsuccessful. What is the best next step?

A. Radial head excision
B. Removal of the plate from the ulna and revision osteosynthesis
C. Closed reduction and pin fixation of the radial head to the capitellum
D. Pin fixation of the radial head and reconstruction of the annular ligament

A comminuted proximal ulnar fracture is often plated in a shortened position, forcing the radial head into a nonanatomical position. Attempted reduction and pin fixation without addressing the length of the ulna often results in failure, even with a ligament reconstruct. Radial head excision is a salvage procedure. A helpful technique for comminuted proximal ulna fractures is to first pin the radial head in a reduced position and then plate the ulnar out to length.
Correct answer : B

27- Figures 1 through 3 are the clinical photograph and radiographs of a 25-year-old, left-hand dominant man who injured his left index finger. Which treatment option will most effectively allow satisfactory fracture alignment and maximize motion?

A. Buddy-taping to the long finger with an early range of motion (ROM) program
B. Closed reduction and static external fixation in extension
C. Open reduction and internal fixation (ORIF) with an early ROM program
D. Digital splinting for 4 weeks followed by a ROM program

This patient has an oblique index proximal phalanx fracture with malrotation. Buddy-taping and digital splinting would not predictably maintain fracture reduction and would result in a malunion with rotational deformity and possible shortening. Closed reduction and spanning external fixation in extension would result in significant digital stiffness. ORIF (Figures 4 and 5) followed by an early ROM program would allow anatomic fracture alignment and give this patient the best chance to regain the majority of motion in the shortest amount of time.

Correct answer : C

28- Figures 1 and 2 show the postreduction radiographs of a 32-year-old man who fell from a ladder onto his outstretched right arm. He reports right wrist pain and dense numbness in his radial digits. What is the most appropriate treatment option?

A. Emergent surgery, including open carpal tunnel release, open reduction of the perilunate dislocation, repair of the scapholunate ligament, and intercarpal pinning
B. Emergent surgery, including open carpal tunnel release, closed reduction of the perilunate dislocation, and casting
C. Elective outpatient surgery, including open carpal tunnel release, open reduction of the perilunate dislocation, repair of the scapholunate ligament, and intercarpal pinning
D. Emergent surgery, including open reduction of the perilunate dislocation, repair of the scapholunate ligament, and intercarpal pinning

This patient sustained a lesser-arc perilunate dislocation. As a result of the injury, he also developed acute carpal tunnel syndrome. The closed reduction attempt was unsuccessful; therefore, this injury is best managed with emergent surgery, an open carpal tunnel release, an open reduction of the perilunate dislocation, scapholunate ligament repair, and intercarpal pinning. Outpatient surgery in a delayed fashion is not advised because of the acuity and severity of the carpal tunnel syndrome. Closed reduction and casting is not advised, because it commonly leads to continued carpal instability with subsequent dorsal intercalated segment instability deformity and scaphoid lunate advanced collapse wrist arthritis.
Correct answer : A

29- What is the most common complication after distal biceps tendon repair at the elbow?

A. Lateral antebrachial cutaneous neuritis
B. Radial sensory neuritis
C. Symptomatic heterotopic ossification
D. Rupture of the repair

Cain and associates retrospectively reviewed 198 consecutive surgical repairs of the biceps and noted a 36% overall complication rate, including 26% paresthesia of the lateral antebrachial cutaneous nerve, 6% paresthesia of the sensory branch of the radial nerve, 2% superficial infection, 4% injury to the posterior interosseous nerve, 3% symptomatic heterotopic ossification, and 2% rerupture.

Grewal and associates randomized 47 patients to have single-incision repair with two suture anchors and 44 patients to have two-incision transosseous suture repair. They reported that the single-incision technique had a higher rate of transient neurapraxia to the lateral antebrachial cutaneous nerve, affecting 19 of 47 in the suture anchor group and three of 43 in the transosseous group. Also, four reruptures occurred, which appeared to be independent of the repair technique.

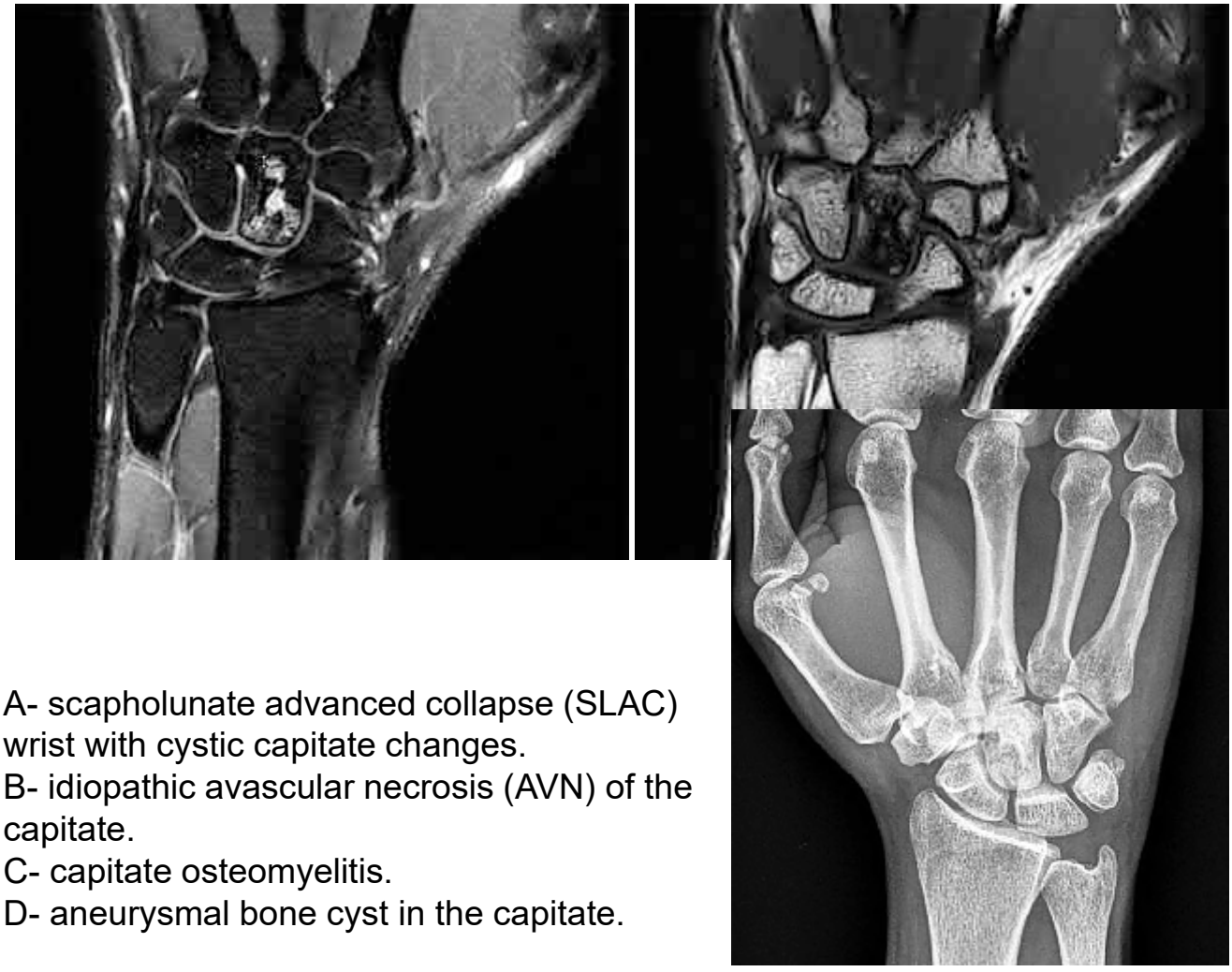
Recordon and associates found only three complications in their series of 46 patients, 19 having endobutton repair and 27 with transosseous suture repair. They reported two injuries to the lateral antebrachial cutaneous nerve and one case of heterotopic ossification.

The review by Banerjee and associates showed one rupture of repair (disengagement of the cortical button), two persistent lesions of the superficial branch of the radial nerve, and one symptomatic heterotopic ossification.

Cohen remarked that rerupture of the tendon after repair is uncommon in both one-incision and two-incision techniques.

Van den Bogaerde and Shin presented a case of posterior interosseous nerve incarceration with endobutton repair.
Correct answer : A

30- Figures 1 through 3 show the MRI scans and a radiograph of a 31-year-old woman who has a 1-year history of diffuse right wrist pain that is gradually worsening. She denies fever or chills and also denies a history of injury. Her examination reveals no swelling, no erythema, an 80° arc of active wrist flexion and extension, and dorsal wrist tenderness. The most likely diagnosis is



A- scapholunate advanced collapse (SLAC) wrist with cystic capitate changes.
B- idiopathic avascular necrosis (AVN) of the capitate.
C- capitate osteomyelitis.
D- aneurysmal bone cyst in the capitate.

This patient's history, examination, and imaging suggest a rare condition known as capitate AVN. SLAC arthritis would show osteoarthritic changes in the radioscaphoid joint. Capitate osteomyelitis would likely have more diffuse edematous changes on MRI and less range of motion secondary to associated septic arthritis. An aneurysmal bone cyst in the capitate would likely show fluid-fluid levels on the MRI.

The treatment of capitate AVN is usually surgical and varies on the extent of the area of necrosis, the degree of fragmentation, the degree of collapse, and the absence or presence of arthritic changes. Common treatment options include vascularized bone grafts, resection of the affected area with interposition tendon graft, intercarpal fusion, and complete wrist fusion or replacement.

Correct answer : B

31- Figures 1 and 2 show the postoperative radiographs of a 22-year-old man who was involved in a motor vehicle accident. The most likely limitation in motion arising from this treatment is loss of

A- wrist flexion.
B- wrist extension.
C- elbow extension.
D- pronation.

This patient sustained fractures of his radius and ulna; both were treated with plate and screw fixation. The plate used on the radius was straight, resulting in loss of the radial bow, which is critical for enabling the radius to curve around the ulna during pronation. This patient is unable to pronate beyond 20°.

Schemitsch and Richards correlated a good functional outcome, defined as more than 80% of normal rotation of the forearm, with restoration of the normal amount and location of the radial bow. Additionally, they related the restoration of grip strength with appropriate restoration of the radial bow. Matthews and associates reported little significant loss of rotation with 10° of angulation; however, 20° of angulation resulted in a statistically and clinically significant loss of forearm rotation.

Correct answer : D

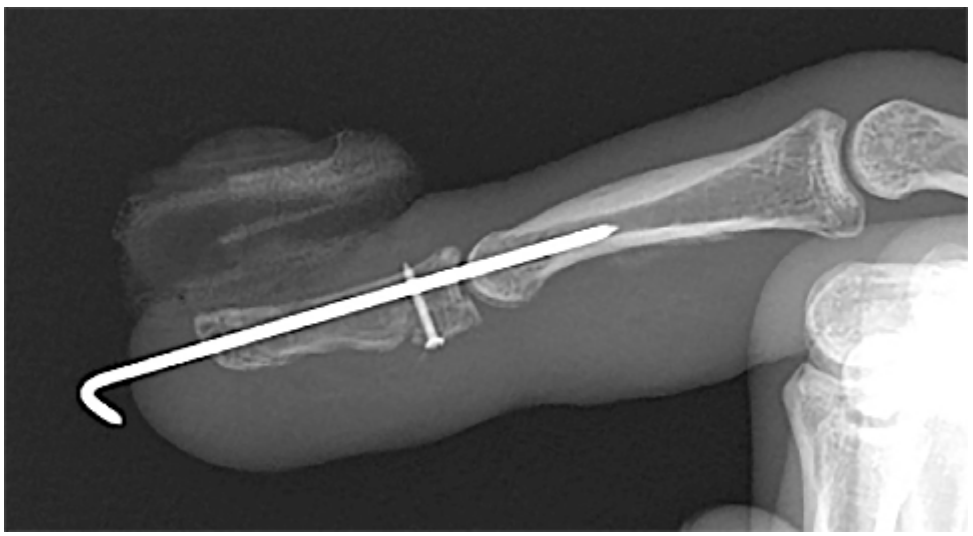
32- Figure 1 shows a radiograph of an active 30-year-old man who sustained an injury to his ring finger 1 week earlier. The most appropriate treatment is

A. open reduction and internal fixation (ORIF).
B. a mallet splint.
C. repair of the terminal tendon.
D. arthrodesis.

Figure 1 reveals evidence of an intra-articular distal phalanx fracture with a distal interphalangeal (DIP) joint dorsal subluxation. This injury is unstable and requires surgical management for an active individual. Volar distal phalanx fractures are often associated with flexor digitorum profundus avulsion injuries, which are addressed concomitantly. This injury was treated with ORIF of the intra-articular fracture, pinning of the DIP joint, and repair of an avulsed flexor digitorum profundus tendon with a button on the dorsal nail plate, as shown in Figure 2.

Splint immobilization would not maintain a reduction of this unstable injury. The terminal tendon is not injured in this patient but is often injured in a dorsal distal phalanx fracture with a volar dislocation. Arthrodesis of the DIP is a salvage procedure and would not be considered acutely.

Correct answer : A



33- Figures 1 through 3 are the radiographs of a 25-year-old man who injured his right hand, by punching a wall 3 weeks earlier. He notes pain and deformity about the ulnar aspect of his hand. The best treatment option is

A. closed reduction and cast immobilization.
B. open reduction and internal fixation (ORIF).
C. arthrodesis.
D. resection arthroplasty.

The initial radiographs reveal a fourth and fifth carpometacarpal (CMC) joint fracture dislocation. The injury is associated with a shear fracture of the dorsal rim of the hamate. Further assessment with CT might be helpful in fully evaluating the extent of injury. Extensor carpi ulnaris is a deforming force at the base of the fifth metacarpal. This unstable fracture dislocation could be treated with closed reduction and pinning if the patient presented within a few days of injury. However, because he presented in a delayed fashion (3 weeks after injury), open reduction with internal fixation was required (Figures 4 and 5). In the series by Zhang and associates, patients with fourth and fifth CMC fracture dislocations presenting in a delayed fashion and treated nonsurgically had suboptimal results. Therefore, closed reduction and casting are not appropriate. An arthrodesis and resection arthroplasty are salvage procedures considered for a painful arthritic joint and would less likely should not be considered for this acute injury.

Correct answer : B

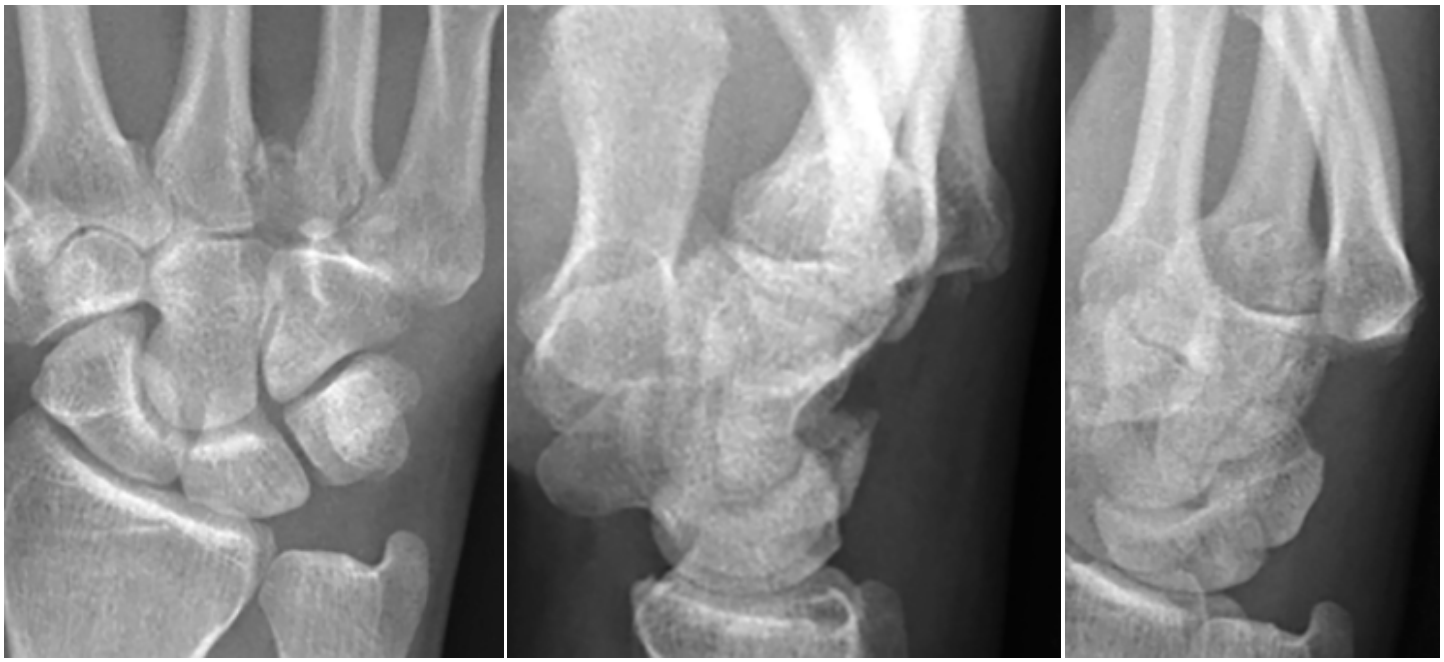
34- What sign or symptom may occur with cubital tunnel syndrome that does not occur with Guyon neuropathy?

A. Abnormal sensation of the dorsal ulnar hand
B. A positive Froment sign
C. Abnormal sensation in the volar ring and small fingers
D. Weakness of the interosseous muscles

Ulnar neuropathy at the elbow is termed cubital tunnel syndrome, whereas ulnar nerve compression at the wrist is considered Guyon neuropathy. Patients with cubital tunnel syndrome have numbness on the dorsal ulnar aspect of the hand due to involvement of the dorsal ulnar sensory nerve branch (DUSN). Ulnar neuropathy at both the elbow and the wrist may manifest with abnormal sensation about the volar ring and small fingers and with weakness of the interosseous muscles, which can lead to a positive Froment sign. The Froment sign is considered positive when flexion of the thumb interphalangeal joint occurs to compensate for a lack of adductor function. Patients with a Guyon neuropathy do not have symptoms of numbness in the dorsal ulnar distribution, because the DUSN branch arises more proximally in the forearm and is not compressed in the ulnar tunnel at the wrist.

Correct answer : A

35- A 44-year-old man sustains the injury shown in Figures 1 through 3. What is the most appropriate treatment?

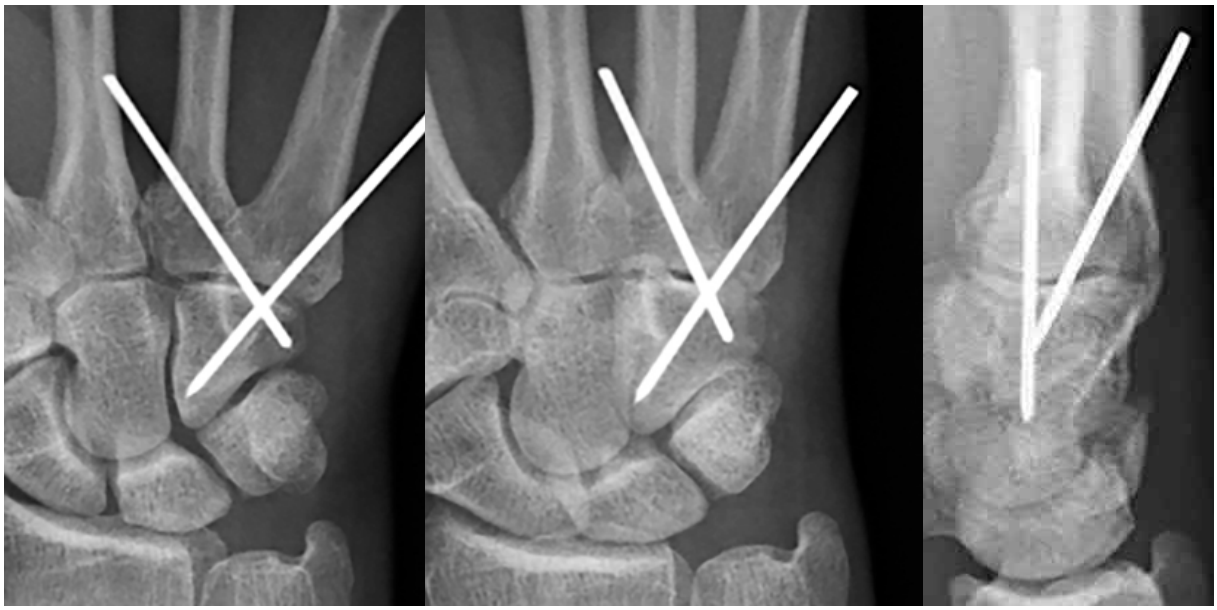


A. Reduction and internal fixation
B. Closed reduction and splinting alone
C. Carpometacarpal (CMC) arthrodesis
D. Carpometacarpal joint suspension arthroplasty

Reduction, either open or closed, with internal fixation (pinning) is the recommended treatment for the majority of these injuries. Closed reduction with pinning is most often performed for acute injuries. Open reduction with pinning is performed for those injuries that cannot be reduced by closed means or those with a delayed presentation.

Four cases of successful closed reduction and splinting, all performed upon presentation in the emergency department, have been described by Storken and associates, but the authors note that their review of three prior reports uncovered cases of secondary dislocation, which required surgical stabilization. One of the dislocations occurred 4 months after the reduction. They assert that an indication for primary ORIF is a CMC dislocation associated with major fractures.

Primary arthrodesis can be considered in cases with severe intra-articular comminution, but this procedure substantially limits the ability of the hand to increase and decrease the transverse metacarpal arch, which is an important functional movement. It can also lead to osteoarthritis of the triquetrohamate joint.
Suspension arthroplasty has been described for old fracture-dislocations of the fifth CMC joint, using a partial slip of the extensor carpi ulnaris.**correct answer: A**



36- A 45-year-old man underwent a fingertip amputation through the distal phalanx after his ring finger was caught in a garage door. He was treated in the emergency department with a revision amputation by advancement of the flexor digitorum profundus (FDP) tendon to the extensor mechanism. Three months following the injury, he is able to fully flex his injured ring finger to touch his palm, but he reports that it is difficult for him to make a tight fist due to decreased flexion of his other fingers. What is this complication called?

A. Lumbrical plus deformity
B. Intrinsic tightness
C. Quadrigia effect
D. Proximal interphalangeal joint contracture

The quadrigia effect can occur due to over-advancement of the FDP tendon during repair (usually greater than 1 cm), development of FDP tendon adhesions, and (as in this case) "over the top" repair of the FDP tendon to the extensor tendon after amputation at the distal phalanx level. All of these conditions result in a functionally shortened FDP tendon of the injured digit. Because the FDP tendons of the long, ring, and small digits share a common muscle belly, excursion of the combined tendons is equal to the shortest tendon. Therefore, the uninjured digits will not have full excursion of their respective FDP tendons and will not be able to close into a full fisting position. Treatment of this condition is most commonly release of the injured FDP tendon.

A lumbrical plus deformity can occur in amputations distal to the flexor digitorum superficialis insertion through the middle phalanx. The FDP tendon retracts and increases tension on the lumbrical muscle, which leads to paradoxical interphalangeal (IP) joint extension with attempted flexion. Intrinsic tightness and interphalangeal joint contractures can be caused by hand trauma but would not lead to the clinical condition this patient has.**correct answer: C**

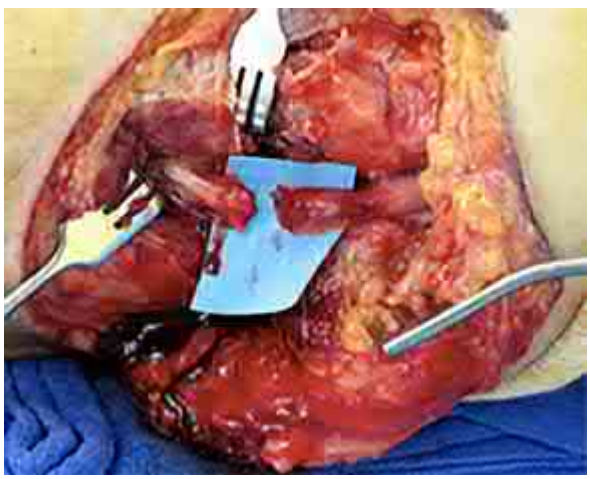
37- When performing a Green transfer for cerebral palsy—flexor carpi ulnaris (FCU) to extensor carpi radialis brevis (ECRB)—in addition to improving wrist extension, what other motion may be improved if the FCU is routed around the ulna instead of through the interosseous membrane?

A. Thumb extension
B. Forearm supination
C. Finger extension
D. Forearm pronation

The typical upper extremity deformity in spastic hemiplegic cerebral palsy consists of shoulder internal rotation, elbow flexion, forearm pronation and wrist flexion, and ulnar deviation. The pronation position of the forearm can make bimanual activities more challenging for the child. The wrist flexion and ulnar deviation deformity interferes with finger function and therefore with grasp and release patterns. By transferring the FCU tendon to the ECRB, the deforming force is released, and central wrist extension is augmented. This transfer can lead to a supination moment when it is routed around the ulna to the ECRB insertion on the dorsum of the wrist.

Thumb and finger extension are not affected by an FCU-to-ECRB tendon transfer. Forearm supination, not pronation, is potentially improved with this tendon transfer.
Correct answer : B

38- A 55-year-old man was injured when a large piece of sheet metal lacerated his medial elbow while working at a factory. He underwent primary repair of the lacerated structures shown in Figures 1 and 2 on the day of injury. In addition to this surgical treatment, what nerve transfer procedure should be considered during this primary operative intervention to improve his functional recovery?



A. Flexor digitorum superficialis (FDS) branch transfer to the extensor carpi radialis brevis (ECRB) branch
B. Third web space median fascicle transfer to the ulnar sensory fascicle
C. Flexor carpi ulnaris fascicle (FCU) transfer to the biceps branch
D. Terminal anterior interosseous nerve (AIN) transfer to the deep ulnar motor fascicle

In adults, the repair of high ulnar nerve injuries typically yields incomplete motor recovery and disappointing functional results despite early surgical intervention and careful surgical technique.

Early transfer of the terminal branch of the AIN to the deep ulnar motor fascicle can rapidly reinnervate distal targets and potentially preserve motor end plate function in the intrinsic musculature of the hand because of the proximity of the nerve transfer to the target muscle.

Sensory deficits due to an ulnar nerve injury can be restored through a transfer of median sensory fascicles to the distal ulna sensory fascicles. This procedure typically would not be considered at the time of the original surgery, because sensory recovery is more likely than motor recovery in the setting of a high ulnar nerve injury.

For radial nerve injuries, wrist extension can be restored through an FDS branch of the median nerve transfer to the ECRB branch of the radial nerve. The FCU fascicle of the ulnar nerve can be transferred to the biceps branch of the musculocutaneous nerve to restore elbow flexion and supination.
Correct answer : B

39- A 35-year-old man sustained a traumatic low ulnar nerve palsy 18 months ago. The extent of the clawing and intrinsic atrophy as well as the active radial deviation are seen in Figures 1 through 3. No hyperextensibility of any of the proximal interphalangeal (PIP) joints is observed. Preoperatively, the patient is not able to fully extend the PIP joints with the wrist in neutral position and the examiner holding the metacarpophalangeal (MCP) joints flexed. Figure 4 shows the intraoperative photograph obtained during the intrinsic reconstruction procedure that is performed. The tendon grafts were inserted distally into the

A. proximal phalanx.
B. radial lateral bands.
C. first annular pulley.
D. second annular pulley.

Originally, Burkhalter and Strait recommended bony insertion into the proximal phalanx through a drill hole. This procedure does require more surgical dissection and flexes only the MCP joints; thus it cannot extend the PIP joints directly. It does improve clawing in the fingers if the PIPs can extend with preoperative MCP flexion. The ability to extend the PIP joints is evaluated preoperatively using the Bouvier test. With the wrist in neutral position, the examiner holds the MCPs flexed and looks for the ability in that position to actively extend the PIPs. If the patient is able to do so, then the test is considered positive, and this describes "simple" clawing. In such cases, procedures that flex only the MCPs are appropriate. The insertion sites for these procedures include the proximal phalanx, the first annular pulley, and the second annular pulley .

If the Bouvier test is negative, then it is best to insert the tendon grafts distally into the lateral bands. This technique has a low chance of leading to hyperextension of the PIP joints, particularly when performed with a wrist extensor motor (which leaves the flexor digitorum superficialis undisturbed) and with no preoperative hyperextensibility of the PIPs.
Correct answer : B

40- Figures 1 and 2 are the radiographs of a 55-year-old woman homemaker with a 1-year history of insidious onset left wrist pain. She has failed conservative treatment and desires surgery. Her medical history is complicated by a smoking history of 1.5 packs of cigarettes per day. At the time of surgery her capitate articular surface is normal in appearance. The best procedure for her would be

A. radial shortening osteotomy.
B. capitate shortening osteotomy.
C. scaphoid excision and four-corner fusion.
D. proximal row carpectomy.

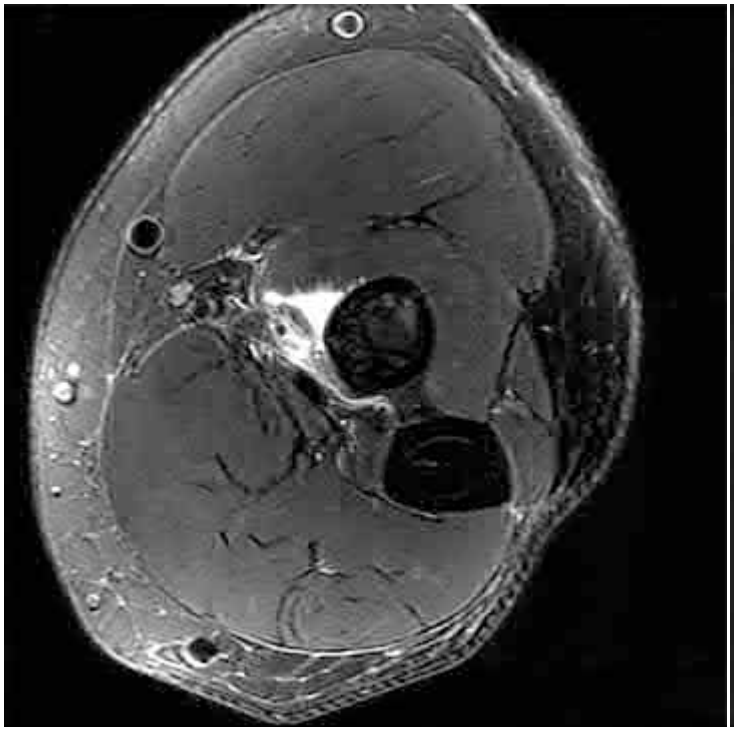
This patient has Lichtman stage 3B Kienbock disease. She is 55 years old and is a "low-demand" patient; however, she is a heavy smoker. Based on her condition and her current smoking status, salvage treatment that does not require bone healing such as a proximal row carpectomy is likely the best treatment option. A radial shortening osteotomy and a capitate shortening osteotomy may be helpful in offloading the lunate, but both procedures require bone healing and are better options in earlier stages of Kienbock disease. A scaphoid excision and four-corner fusion is typically performed for scapholunate advanced collapse or scaphoid nonunion advanced collapse wrist arthritis and would not be recommended in this scenario, as the lunate is avascular.
Correct answer : D

41- Figures 1 and 2 show the clinical photograph and ultrasonography image of an 8-month-old boy who has a 2-month history of a well-circumscribed mass in the palm, just proximal to the palmar digital crease of the index finger. The mass has not changed in size and does not seem to cause pain. What is the best next step in treatment?

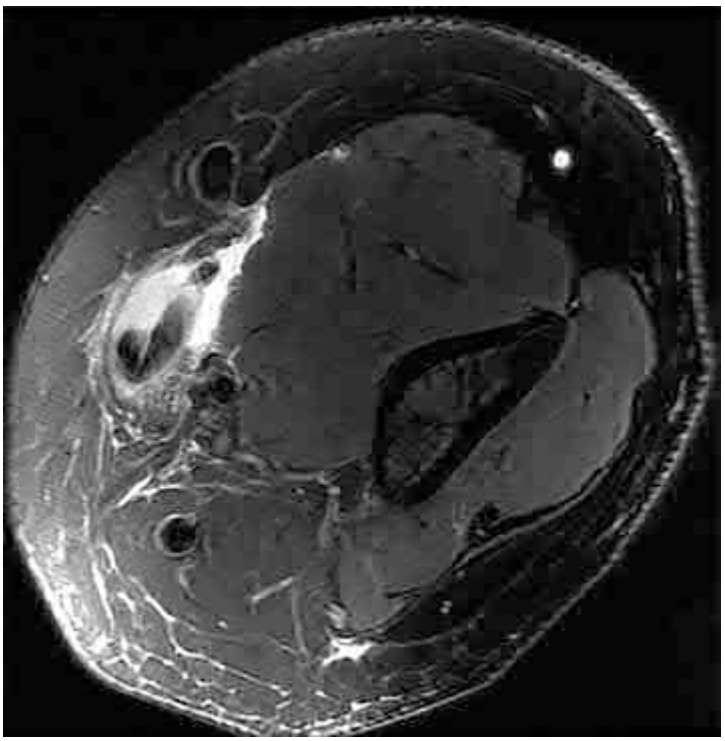
A. Ultrasonography-guided aspiration
B. Excisional biopsy
C. Observation
D. MRI of the hand for further characterization of the mass

The history, clinical photograph, and ultrasonography evaluation point to a diagnosis of ganglion cyst. The likelihood of resolution of ganglion cysts without intervention in pediatric patients ranges from 66-79%. Therefore the most appropriate treatment at this time is observation. Because the diagnosis is confirmed with the information provided, excisional biopsy and further imaging are not necessary.
Correct answer : C

42- Figures 1 through 3 show the MRI scans of a 36-year-old man with an injury to the elbow. The expected result of nonsurgical treatment would be weakness of



A. finger flexion.
B. elbow extension.
C. finger extension.
D. forearm supination.



The axial T2-weighted MRIs demonstrate a distal biceps rupture. The increased signal is noted superficial to the brachialis muscle and adjacent to the biceps tuberosity. The distal biceps tendon is not seen in the distal cuts and has retracted proximally. The physical examination of patients with these injuries show abnormal contour of the arm and tenderness in the antecubital fossa.

The hook test is a provocative maneuver that documents biceps integrity. When performing the maneuver, the examiner attempts to hook a finger around the distal biceps tendon while the patient actively supinates with the elbow held in flexion. Nonsurgical treatment has been documented to result in an average loss of 40% of supination strength and 30% of elbow flexion strength. Repair is optimal within several weeks of injury. The alternative options would not occur with a distal biceps rupture.

Correct answer : D

43- A 50-year-old patient underwent multiple debridements for an open radial shaft fracture with bone loss. The bed currently shows no evidence of infection but has a 14-cm diaphyseal bone defect. The most appropriate treatment includes open reduction and internal fixation along with

A. free vascularized fibula.
B. calcium sulfate pellets.
C. corticocancellous autograft.
D. demineralized bone matrix.

The patient developed a large bone defect after undergoing multiple débridements for an open fracture. The most appropriate graft in this setting is a vascularized bone graft. Considering the length of the defect, a free vascularized fibular graft would be a suitable graft. The indications for a vascularized bone graft include infection, inadequate vascularity of the surrounding tissues, bone defects larger than 6 centimeters, and previous failed bone grafts. The osteocytes survive in the vascularized graft, allowing primary bone healing and thereby limiting a loss of graft strength. In contrast, nonvascularized bone graft heals by creeping substitution with a loss of its initial strength. Calcium sulfate pellets and calcium phosphate cement are synthetic bone substitutes with osteoconductive properties. Their role in fracture healing is limited. Demineralized bone matrix is the matrix remaining after allograft undergoes decalcification processing. These products alone would not be optimal in the treatment of such a large bone defect.
Correct answer : A

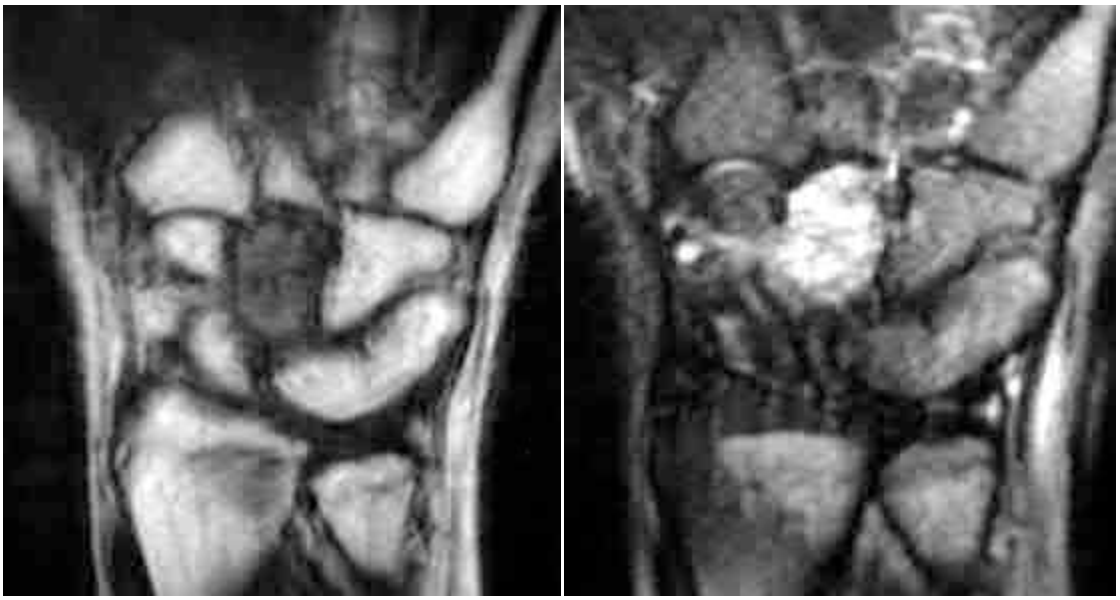
44- The decision to perform fasciotomy of the fingers for a hand compartment syndrome is most appropriately made using

A. clinical examination.
B. invasive pressure measurement.
C. arterial Doppler study.
D. MRI.

Compartment syndrome of the hand can result from a variety of factors, including a traumatic event such as crush injury, fracture, vascular insult, a high-pressure injection injury, or an insect or spider bite. The treatment involves decompressive fasciotomy of the involved compartments. The diagnosis of hand compartment syndrome is determined by history, examination, and objective testing. Patients experience pain out of proportion to the injury, along with swelling and tense skin. Pain may occur with passive motion of the metacarpophalangeal joints as the intrinsic muscles are stretched. Invasive intracompartmental pressures can be measured in the compartments of the hand but not in the fingers. Arterial Doppler studies assess arterial blood flow, and an abnormality would be a late finding.

MRI would show edema of the hand and fingers, but the decision to perform surgical release is less likely made from the findings. The most appropriate method of determining the need for finger fasciotomy is the history and physical examination.
Correct answer : A

45- Figures 1 and 2 show the MRI studies of a 35-year-old manual laborer with persistent wrist pain despite immobilization. At the time of surgery, collapse of the capitate and arthritic changes of the midcarpal joint are noted. What is the most appropriate procedure for this condition?

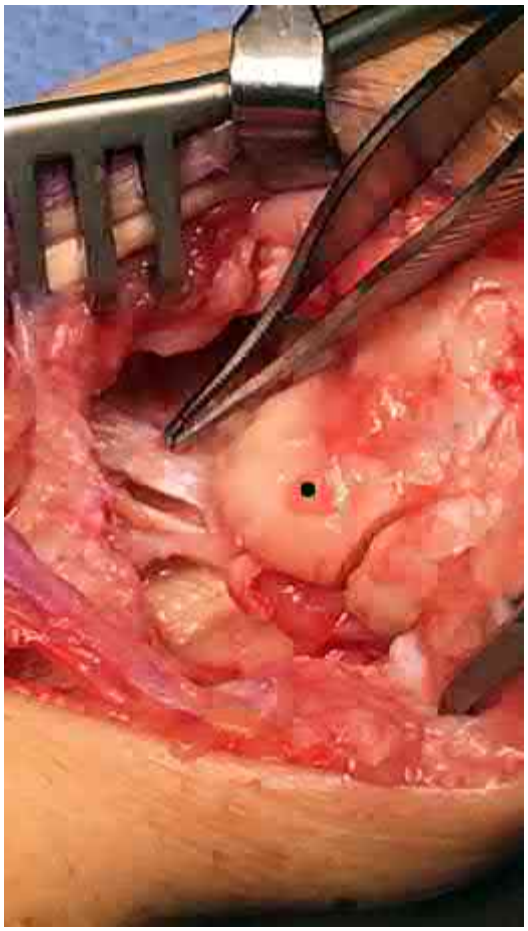


A. Local vascularized bone graft
B. Proximal row carpectomy
C. Midcarpal fusion
D. Total wrist arthroplasty

The T1-weighted MRI reveals decreased signal that is consistent with avascular necrosis (AVN) of the capitate. Figure 2 demonstrates increased signal of the capitate consistent with edema. The etiology of AVN of the capitate may be related to trauma, abnormal interosseous vascular supply, and hypermobility. Surgical treatment is considered for patients who have had persistent symptoms despite immobilization. At the time of surgery, collapse of the capitate and arthritic changes would be treated most appropriately with a salvage procedure. A midcarpal fusion is a motion-preserving salvage procedure and is the most appropriate option given to address the pain associated with the midcarpal arthritic changes. The alternative options are not appropriate for this patient. Local vascularized bone grafts are considered for situations in which no evidence of capitate collapse or arthritis is observed.

A proximal row carpectomy would lead to suboptimal results, because the collapsed proximal pole of the capitate would articulate with the lunate facet of the radius. In addition, a high rate of failure has been seen in young patients requiring full wrist fusion following proximal row carpectomy. A total wrist arthroplasty is a salvage procedure but is not indicated in this young manual laborer. This patient population experiences a high rate of failure due to mechanical prosthetic complications.
Correct answer : C

46- Figure 1 shows an intraoperative photograph taken following proximal row carpectomy. The black dot denotes the capitate. The top of the figure is radial and the bottom of the figure is ulnar. Surgical disruption of the structure identified by the forceps would result in



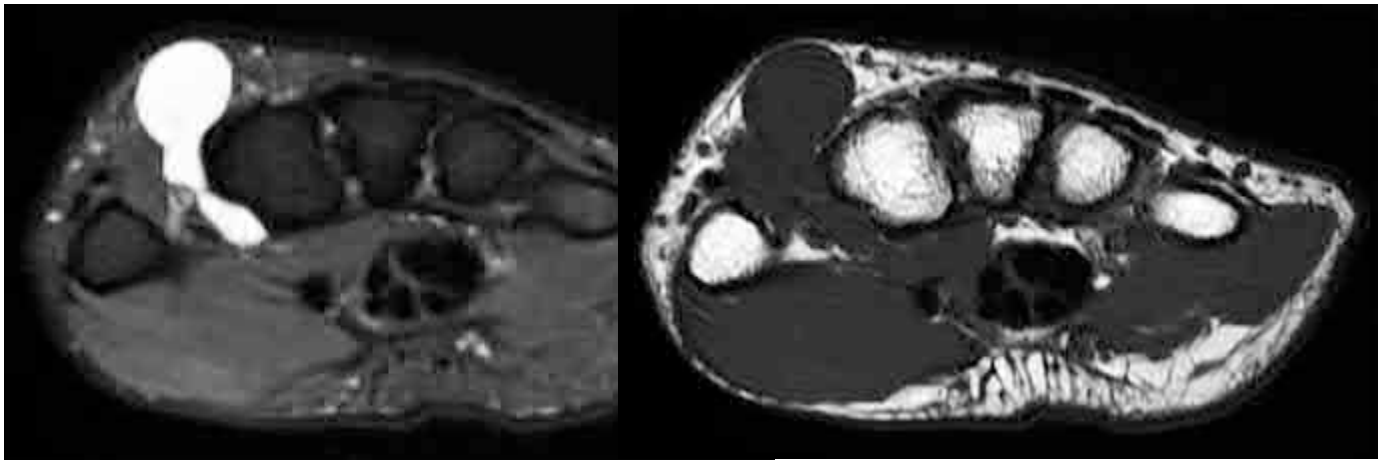
A. distal radioulnar joint instability.
B. ulnar carpal translocation.
C. avascular necrosis of the capitate.
D. loss of active thumb interphalangeal (IP) flexion.

The structure identified by the forceps is the radioscaphocapitate ligament. During a proximal row carpectomy, it is very important to identify and protect this ligament. Compromise of the ligament would result in ulnar translocation of the carpus and early failure of the proximal row carpectomy procedure. If the ligament is injured during surgery, immediate repair should be performed. Green and associates discuss the importance of the radioscaphocapitate ligament in stabilizing the carpus after this procedure is performed.

Nakamura and associates compared 3-mm, 6-mm and 10-mm radial styloidectomies, and only the 3-mm styloidectomy subsequently preserved carpal stability. Compromise of the radioscaphocapitate ligament occurred when larger portions of the radial styloid were excised.

Distal radioulnar joint instability would result only from the disruption of the distal radioulnar joint stabilizers. Avascular necrosis would not occur, because the capitate receives its blood supply mainly from the palmar vessels. Finally, loss of active thumb IP flexion would not occur, because the flexor pollicis longus tendon would remain intact even if ligament compromise were to occur.
Correct answer : B

47- The pathology of the lesion shown in Figures 1 and 2 reveal what cellular pattern?



A. Uniform distribution of stromal cells and giant cells
B. Mixture of mature fat cells and spindle cells
C. Mucin-filled space with occasional spindled fibroblasts
D. Lobular pattern of vascular proliferation with inflammation

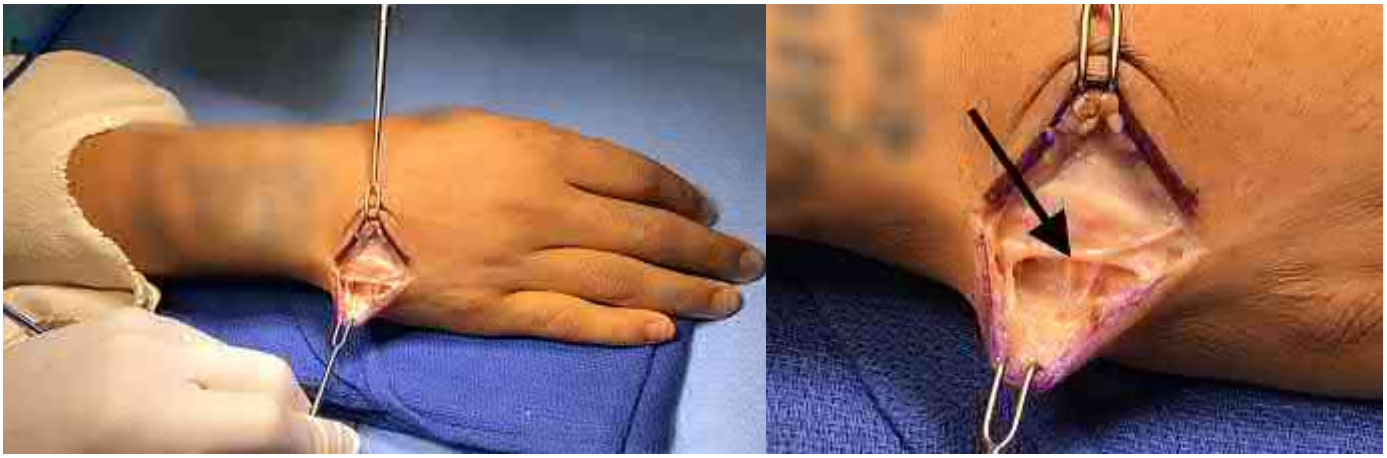
The MRIs display the classic appearance of a ganglion cyst, which is a benign fluid-filled sac most commonly presenting at the wrist level. The signal characteristics of a ganglion on MRI are low signal on the T1-weighted image and high signal on the T2-weighted image, as revealed in Figures 1 and 2. The pathology of a ganglion cyst is characterized by a mucin-filled synovial lined sac with spindled fibroblasts.

A uniform distribution of stromal cells and giant cells would fit the pathologic description of a giant cell tumor of the tendon sheath, and numerous giant cells are the hallmark of this lesion. This type of tumor is benign, usually presenting in the region of the digital flexor sheath. Recurrence after excision is common. MRI of giant cell tumors shows an extra-articular soft-tissue mass, and on both T1-weighted and T2-weighted images, some portions of the tumor show decreased signal intensity.

A mixture of mature fat cells and spindle cells would fit the pathologic description of a spindle cell lipoma. This benign tumor of mature fat usually is found in a superficial/subcutaneous location. The pathology is characterized by a mixture of mature fat cells and spindle cells. MRI would show high signal intensity on both T1-weighted and T2-weighted images.

A lobular pattern of vascular proliferation with inflammation would fit the pathologic description of a pyogenic granuloma. These skin growths are small, round, and usually blood red in color. They frequently bleed, because they contain a large number of blood vessels. The pathology is characterized by a lobular pattern of vascular proliferation with inflammation. MRI findings show isointensity on the T2-weighted image. These MRI findings are consistent with hypervascularity.
Correct answer : C

48- Figures 1 and 2 show the intraoperative photographs of a man who is undergoing open reduction and internal fixation of a fifth carpometacarpal joint fracture dislocation. If the structure marked with an arrow in Figure 2 is cut, the patient can expect to experience

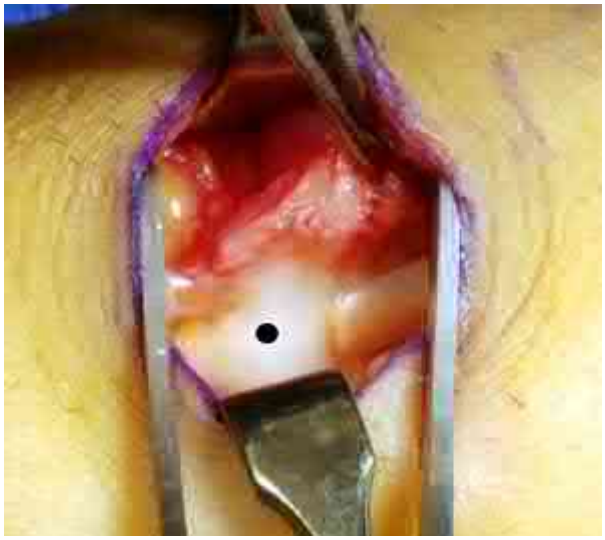


A. the inability to extend the small finger.
B. weakness of small finger abduction.
C. sensory loss of the dorsal ulnar hand.
D. clawing of the small and ring fingers.

The arrow in Figure 2 marks the dorsal sensory branch of the ulnar nerve. Injury to this nerve results in sensory loss of the dorsal ulnar palm and the dorsal small and ring finger digits. The dorsal sensory branch of the ulnar nerve exits the main ulnar nerve at an average distance of 8.3 cm from the proximal border of the pisiform. It becomes subcutaneous on the ulnar aspect of the forearm at an average distance of 5 cm from the proximal edge of the pisiform. It then travels dorsal to the extensor carpi ulnaris tendon to innervate the dorsal ulnar hand and the dorsal ring and small digits. Injuries to this nerve can occur from open and arthroscopic procedures (such as triangular fibrocartilage complex repair) as well as from procedures requiring percutaneous pinning. Care must be taken to identify and protect this nerve to avoid the complications of numbness and possible neuroma formation.

The inability to extend the small finger would be caused by an injury to the extensor tendon(s) in this area, and the inability to abduct the small finger would require an injury to the abductor digiti minimi muscle/tendon unit or the ulnar nerve motor branch, which is located on the volar aspect of the proximal palm. Clawing of the small and ring fingers would be caused by absent intrinsic function due to an injury to the ulnar motor nerve branch located on the volar proximal palm.
Correct answer : C

49- Figures 1 and 2 show the intraoperative photographs taken during surgical treatment for de Quervain tendonitis. For orientation purposes, dorsal is at the top. Figure 1 is obtained just after the initial first extensor compartment release, and Figure 2 shows the floor of the first extensor compartment. If the structure marked by the black dot is not addressed, the most common postoperative problem would be



A. persistent pain.
B. tendon subluxation.
C. altered sensation.
D. tendon rupture.

The black dot identifies an accessory compartment of the extensor pollicis brevis (EPB) tendon. The incidence of accessory EPB compartment in patients undergoing surgical treatment for de Quervain syndrome ranges from 46% to 60%. Failure to release this compartment at the time of initial surgery can cause persistent postoperative pain.

The patient would not experience altered sensation if this compartment were not released. Altered sensation would most commonly occur following injury to the dorsal radial sensory nerve branch during surgery. EPB tendon subluxation also would not occur should the accessory compartment not be released. For EPB tendon subluxation to occur, its own compartment would need to be released first. Finally, EPB tendon rupture would be an extremely uncommon complication of failure to release the accessory compartment.
Correct answer : A

50- The radiographs shown in Figures 1 and 2 reveal squamous cell carcinoma of the thumb involving the distal phalanx. Following biopsy confirmation, what would be the most appropriate course of management?

A. Curettage and bone grafting
B. External beam radiation
C. Ray amputation of the thumb
D. Interphalangeal (IP) joint disarticulation

Squamous cell carcinoma of the fingertip/nail region is uncommon but remains the most common malignancy in the hand. A high degree of suspicion is needed to diagnose this condition. Biopsy and radiographs are necessary initially. The subsequent treatment depends on the extent of the lesion at the time of presentation. Treatment can vary from Mohs micrographic surgery (MMS) to digital amputation.

Amputation is recommended when bone involvement is present. In this patient, because the distal phalanx tip is involved and no further bone involvement proximally was observed, an amputation at the IP joint level is recommended. More proximal involvement would require a more proximal amputation level.

Curettage and bone graft is not appropriate for this malignant lesion. External beam radiation therapy is not a first-line treatment option for this condition. Metastatic spread is uncommon. MMS is inappropriate when bone invasion has occurred.
Correct answer : D

51- Figures 1 and 2 show a clinical photograph and radiograph that reveal a Wassel-Flatt type IV polydactylous thumb, with a divergent-convergent pattern. To avoid persistent or recurrent coronal plane deformity, what procedure(s) should be included in the ablation and reconstruction?

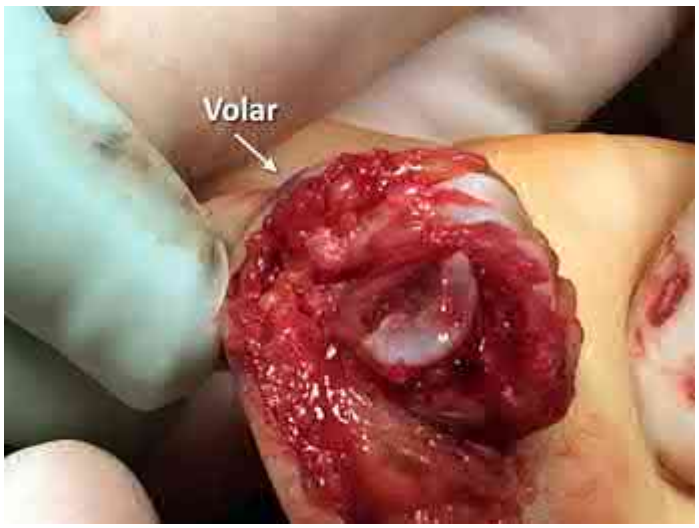
A. Arthrodesis of the remaining interphalangeal (IP) and metacarpophalangeal (MP) joints of the thumb
B. Excision of the ulnar thumb with reconstruction of the radial thumb
C. Centralization of the flexor and extensor tendons on the remaining thumb
D. Reconstruction of the ulnar collateral ligament of the MP joint

So-called zig-zag deformity of the thumb can be seen in several congenital hand differences (pollux abductus, thumb hypoplasia, delta phalanx), but most commonly in the Wassel-Flatt type IV thumb polydactyly, in which the duplication occurs at the level of the MP joint, and divergence of the proximal phalanges and convergence of the distal phalanges are observed. This pattern is characterized by insertion of the flexor and/or extensor tendons eccentrically on the distal phalanx. Sometimes, the flexor and extensor tendons are conjoined in their insertion on the side of the distal phalanx.

This manifestation creates a flexion moment in the coronal plane. Unless corrected by release and centralization of the tendon(s), the deforming force remains. The deformity tends to worsen with growth. Often, proximal phalanx osteotomy is also necessary to correct the coronal plane deformity at the time of reconstruction of the polydactylous digit. Simply pinning the thumb straight at the time of digit reconstruction does not correct the underlying problem, and the deformity tends to recur as soon as the pin is removed. Although it is possible to fuse the epiphysis of a phalanx to the bone below, arthrodesis of both the MP and IP joints would sacrifice too much movement, unless the digit proved globally unstable.

Correct answer : C

52- Figures 1 and 2 show the radiograph and clinical photograph of the left ring finger of a 23-year-old woman 10 weeks after injury. The proximal interphalangeal joint is hyperextended, with distal to the left, and ulnar to the top. This volar view shows the flexor tendons dislocated ulnarly, revealing the articular surface of the middle phalanx. When treating this injury, the most appropriate bone graft is

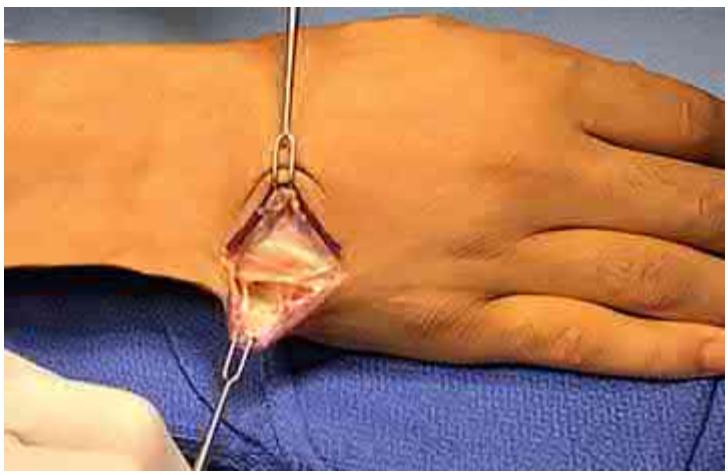


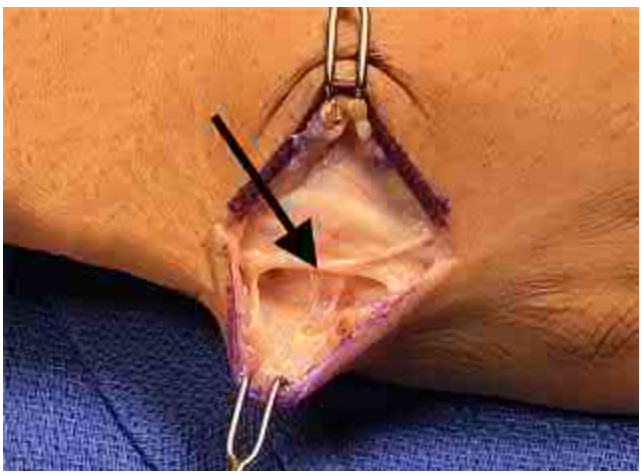
A. autograft dorsal-distal homolateral hamate.
B. autologous vascularized medial femoral condyle.
C. autologous distal radius.
D. allograft middle phalangeal condyle.

The use of autograft dorsal-distal hamate for the reconstruction of the volar base of middle phalanx fracture-dislocations was first described in 2002 by Williams and associates and subsequently by multiple other authors. In a systematic review of 177 articles that included 71 cases, the technique was shown to be reliable for the treatment of this injury, although having an overall complication rate of 35%. DeNoble and Record offered a modification of the technique that simplified graft harvest by removing a portion of the fourth and fifth metacarpal bases. Tyser and associates conducted a cadaver study, in which this injury was re-created and then repaired with hemi-hamate arthroplasty followed by a volar plate arthroplasty (VPA). Both methods restored stability, although VPA created a flexion contracture proportionate to the size of the defect, whereas no flexion contractures were produced with the hemi-hamate reconstructions.

Distal radius and iliac crest autografts can be used to provide subchondral support for the treatment of acute injuries in which the articular cartilage can be reduced, but they are not useful in the treatment of delayed volar impaction injuries. The use of autologous vascularized medial femoral condyle bone graft has been reported for scaphoid and humerus nonunions as well as for recurrent failed arthrodesis of the distal interphalangeal joint but not for volar base impacted fracture dislocations of the middle phalanx. No peer reviewed reports of condylar allograft exist for this injury.
Correct answer : A

53- Figure 1 shows the clinical photograph obtained from a man who is undergoing open reduction and internal fixation of a fifth carpometacarpal joint fracture dislocation using a dorsal approach. If the structure indicated by an arrow in the magnified view of the incision (Figure 2) is cut, the patient would experience





A. the inability to extend the small finger.
B. weakness of small finger abduction.
C. sensory loss of the dorsal ulnar hand.
D. loss of palmar sensation of the small finger.

The arrow marks the dorsal sensory branch of the ulnar nerve. Injury to this nerve results in sensory loss of the dorsal ulnar palm and dorsal small and ring fingers. The dorsal sensory branch of the ulnar nerve exits the main ulnar nerve at an average distance of 8.3 cm from the proximal border of the pisiform. It becomes subcutaneous on the ulnar aspect of the forearm at an average distance of 5 cm from the proximal edge of the pisiform. Then, it most commonly divides into two branches, and at least one branch crosses dorsal to the extensor carpi ulnaris tendon prior to its insertion at the base of the fifth metacarpal. Injuries to this nerve can occur from open and arthroscopic procedures such as triangular fibrocartilage complex repair as well as from procedures requiring percutaneous pinning. Care must be taken to identify and protect this nerve to avoid the complications of numbness and possible neuroma formation.

An inability to extend the small finger would be caused by an injury to the extensor tendon(s) in this area. In this situation, the inability to abduct the small finger would require an injury to the abductor digiti minimi muscle/tendon unit or the ulnar motor nerve branch, which is located on the volar aspect of the proximal palm. Sensation to the palmar aspect of the small finger is provided by the digital nerves, which would not be injured using the dorsal approach.
Correct answer : C

54- A 66-year-old man presents with bilateral hand pain. The clinical examination and the radiograph shown in Figure 1 reveal diffuse osteoarthritis throughout the proximal interphalangeal (PIP) and distal interphalangeal (DIP) joints. His dominant index finger is the most symptomatic, and nonsurgical treatment, including bracing and cortisone injections, has failed. The patient elects PIP arthroplasty of the index finger. Compared with index arthrodesis, the expected outcome of index arthroplasty would be

A. a lower complication rate.
B. stronger pinch strength.
C. a higher reoperation rate.
D. less pain.

Hand arthritis can be debilitating for patients, resulting in pain and reduced range of motion, strength, and functionality. Nonsurgical treatment should be maximized before surgical intervention. The treatment for the DIP joints is arthrodesis, whereas the treatment for the PIP joints varies from arthrodesis to arthroplasty. Classically, the ulnar PIP digits are treated with arthroplasty, and the radial digits, especially the index finger, are treated with arthrodesis. The rationale for this tactic is that the index finger sustains greater lateral force during pinch and requires the stability built into an arthrodesis. Studies have shown that index finger arthroplasty leads to increased complication rates (including for hardware loosening/dislodgement, fracture, and instability), weaker pinch strength, and increased operation rates. Motion is preserved with arthroplasty; the average amount preserved is 40° to 60° of motion. No literature exists to support the assertion of less pain after an arthroplasty than after an arthrodesis. Some patients' professional and personal goals require motion at the PIP joint; therefore, arthroplasty should be an option, but patients need to understand the increased risks and expectations.

Correct answer : C

55- Figure 1 displays the radiograph of a 54-year-old woman with rheumatoid arthritis who presents with thumb pain and dysfunction. Nonsurgical treatment has failed. The most appropriate surgical intervention is thumb carpometacarpal (CMC)

A. arthroplasty with ligament suspensionplasty.
B. fusion and metacarpophalangeal (MCP) fusion.
C. arthroplasty with MCP fusion.
D. distraction arthroplasty.

Various options exist to treat thumb CMC arthritis, including trapezial resection alone or with ligament suspensionplasty or tendon interposition, trapezial resection with both ligament suspensionplasty and tendon interposition, CMC fusion, and CMC replacement. MCP hyperextension can develop in long-standing CMC arthritis, contributing to CMC instability as well as thumb pain and weakness. In patients with concomitant MCP hyperextension that exceeds 30°, correction of the deformity of the MCP joint must also be performed.

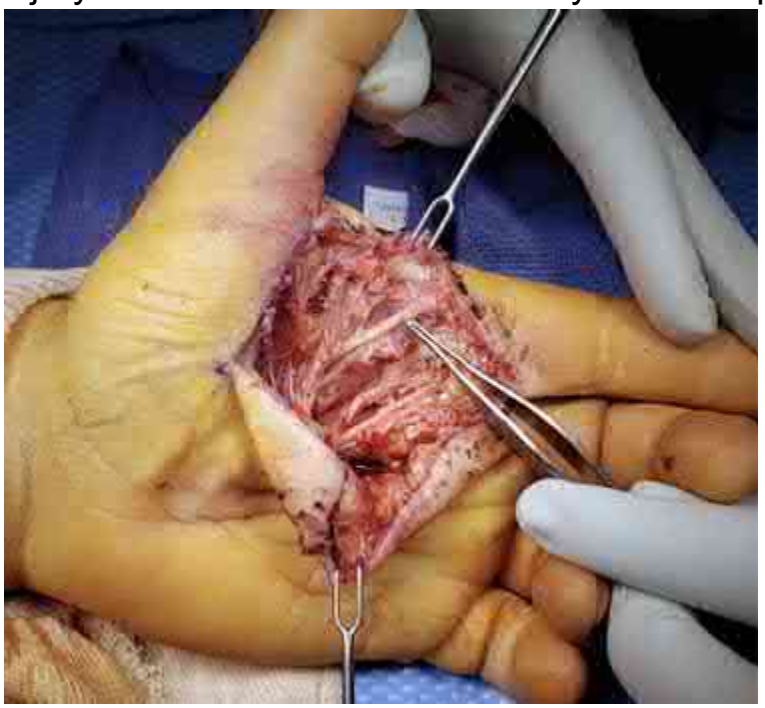
This correction can be done with MCP capsulodesis, extensor pollicis brevis transfer, or MCP fusion. In this patient with rheumatoid arthritis, MCP fusion may be the most reliable option, because soft-tissue procedures can be less reliable in this population. Fusion of the CMC joint is not indicated, given the amount of trapezial erosion and given that fusion of both the CMC and MCP joints would limit functionality.
Correct answer : C

56- The closed reduction technique used for the treatment of the fracture shown in the radiographs in Figures 1 and 2 requires pressure on the metacarpal base and

A. adduction and pronation.
B. palmar abduction and pronation.
C. palmar abduction and supination.
D. radial abduction and pronation.

The primary deforming forces in a Bennett fracture are caused by the abductor pollicis longus and the adductor pollicis muscles. These muscles cause the distal metacarpal fragment to displace proximally, flex, adduct, and supinate. Palmar abduction, pronation, and pressure on the metacarpal base allows reduction. Radial abduction and extension (the hitchhiker position) causes the fracture to gap. This particular fracture usually is treated by closed reduction and percutaneous pinning or open reduction and internal fixation.
Correct answer : B

A 25-year-old man undergoes surgical exploration for a laceration to his left palm, as shown in Figure 1. Injury to the structure indicated by the forceps leads to numbness of the



A. second webspace.
B. dorsal first webspace.
C. radial index finger.
D. ulnar index finger.

The structure at the tip of the forceps is the radial digital nerve to the index finger. If this nerve is accidentally cut, the patient will experience numbness to the radial aspect of the index finger. Laceration of the common digital nerve to the index-long interspace or laceration to the proper ulnar digital nerve to the index finger and the proper radial digital nerve to the long digit results in numbness at the second webspace. Numbness to the ulnar aspect of the index finger occurs after an injury to the ulnar digital nerve to the index finger. Numbness in the dorsal first webspace results from an injury to the dorsal radial sensory nerve, which is not located in the palm.

Lourie and associates showed that the location of the radial digital nerve to the index finger could be located topographically by the intersection of a line drawn down the central aspect of the index finger with the proximal palmar crease. They showed that this is a reliable method to locate the nerve. They also demonstrated that this method would help the surgeon determine the likelihood of injury after penetrating trauma and also prevent injury during elective surgical procedures.

Jolley and associates further analyzed nerve anatomy in this particular area and found three patterns or types of innervation to the thumb and index finger. Type 1 (69% of cases) consists of a radial digital nerve to the thumb and a common digital nerve to the thumb-index interspace, which subsequently divides into a radial digital nerve to the index finger and an ulnar digital nerve to the thumb. Type 2 (6%) consists of a common digital nerve to the thumb, which divides into a proper radial and ulnar digital nerve and a proper digital nerve on the radial side of the index finger. Type 3 (25%) consists of a trifurcation pattern of three proper digital nerves, specifically the radial and ulnar digital nerves to the thumb and the radial digital nerve to the index finger.

Correct answer : C

58- Figures 1 and 2 show the AP and lateral radiographs of a 25-year-old office manager who sustained an injury to the left small finger 1 day earlier and notes an extension lag of the distal interphalangeal joint (DIP). The most appropriate initial treatment for this patient is

A. arthrodesis of the DIP.
B. dorsal block pin fixation.
C. open reduction with screw fixation.
D. extension splint immobilization.

The patient sustained a mallet fracture with no evidence of joint subluxation. The risk of subluxation is increased if the size of the fragment is greater than one-third of the articular surface. Nonsurgical treatment is recommended in mallet fractures without subluxation and includes a mallet splint or cast immobilization holding the DIP joint in full extension for 6 weeks, followed by night splinting. A fusion is a salvage procedure and is not indicated for this injury.

Correct answer : D

59- What is the approximate ratio of the scaphoid distal (volar) blood supply to the proximal (dorsal) blood supply?

A. 20:80
B. 40:60
C. 60:40
D. 70:30

Gelberman and associates injected the radial and ulnar arteries of 15 cadavers with Ward's blue latex solution and cleared the specimens with full-strength bleach (sodium hypochlorite) and the Spalteholz technique, using formalin, formic acid, hydrogen peroxide, 95% ethanol, chloroform, and oil of wintergreen, in a process requiring about 3 weeks. This process produced a transparent bone, through which the stained vessels could be seen and photographed. The authors discovered that the radial and the anterior interosseous arteries supply the scaphoid. The volar supply enters through the volar tubercle and accounts for 20% to 30% of the internal vascularity of the bone.

The authors found that the dorsal vessels entered through the dorsal ridge and, depending upon the vascular pattern encountered, they supplied between 70% and 85% of the scaphoid.

Morsy and associates recently used contrast micro-CT scanning and found that the average volume of the scaphoid supplied by the distal network was 16.9%, and that supplied by the proximal network was 83.1%. The authors determined that inserting the screw in the central axis had the lowest vascular impact, followed by dorsal insertion. The highest vascular impact was produced by the volar insertion axis.
Correct answer : A

60- Figures 1 and 2 display the AP and lateral radiographs of a 55-year-old laborer who has thumb metacarpophalangeal (MP) joint pain despite splint immobilization and medications. The most appropriate surgical treatment option for this patient is MP joint

A. arthroscopic debridement.
B. resection arthroplasty.
C. arthrodesis.
D. silicone replacement.

The patient has thumb MP osteoarthritis. The preferred surgical treatment option for thumb MP osteoarthritis is arthrodesis. The recommended position for thumb MP joint fusion is 5° to 15° of flexion and 15° of pronation. More recent studies have shown that fusion of the MP joint in a position of greater flexion may offload the trapeziometacarpal (TMC) joint and shift the contact stress more dorsally on the TMC. Limited data exists regarding arthroscopic débridement, which has been reported for mild arthritis and synovitis. Resection arthroplasty is performed for TMC arthritis. Thumb MP arthroplasty is considered for extensive involvement of the TMC, MP, and IP joints to preserve MP joint motion; it would not be optimal for this laborer for whom stability is important.
Correct answer : C

61- What type of median-ulnar nerve interconnection carries only sensory fibers?

A. Martin-Gruber
B. Berrettini
C. Riche-Cannieu
D. Marinacci

Four interconnections of the median and ulnar nerves in the forearm, wrist, and hand have been described, and each has been further classified. The most common interconnection is the Berrettini. It is so common that it may be considered an anatomic normal rather than a variant. It contains sensory fibers and courses between the third common digital nerve of the median nerve to the fourth common digital nerve of the ulnar nerve. Because it is sensory only and involves a limited territory, no nerve conduction study evidence of this interconnection can be elicited.

The Martin-Gruber and Marinacci interconnections are found in the forearm and carry motor fibers. The Martin-Gruber interconnection travels from the median nerve or the anterior interosseous nerve proximally to the ulnar nerve distally. The Marinacci is the least common interconnection and runs from the proximal ulnar nerve to the distal median nerve. The Riche-Cannieu interconnection is a motor connection between the deep motor branch of the ulnar nerve and the recurrent motor branch of the median nerve in the hand.
Correct answer : B

62- Several pedicled dorsal distal radius bone grafts are available for the treatment of the prefragmentation stages of Kienböck disease. The arterial pedicle with the greatest arc of rotation is the

A. 1 + 2 intercompartmental supraretinacular.
B. 2 + 3 intercompartmental supraretinacular.
C. fourth extensor compartment.
D. 4 + 5 extensor compartment.

The 4 + 5 extensor compartment artery (ECA) pedicle has the greatest range of the listed pedicles. It is based on the posterior division of the anterior interosseous artery and can reach the proximal and distal carpal rows and the bases of the metacarpals in some instances. If the fourth ECA is not present, the 2 + 3 intercompartmental supraretinacular artery (ICSRA) graft can be used, because it also has a proximal connection to the fifth ECA. The 1 + 2 and the 2 + 3 ICSRA pedicles are available and useful in many situations, including scaphoid nonunion and the treatment of Kienböck disease, however their pedicles are much shorter than that of the 4 + 5 ECA.

The fourth ECA alone can be used as a retrograde vascularized bone pedicle, but it also has a shorter arc of rotation than the 4 + 5 ECA pedicle.
Correct answer : D

63- The intrinsic property of calcium phosphate bone cement can be described best as being

A. osteoinductive.
B. osteogenic.
C. osteoconductive.
D. immunogenic.

To obviate the need for the procurement of autologous bone, biological materials including allograft and demineralized bone matrix may be employed. Allograft bone or calcium phosphate bone cement provides a scaffolding along which osteogenic cells can traverse (osteoconduction). Osteogenesis is the creation of bone tissue and is achieved by osteoblasts and mesenchymal stem cells. Osteoinduction involves the recruitment of immature cells to the site of healing and then stimulating these cells to form osteogenic cells. Demineralized bone matrix and bone morphogenetic protein 2 are osteoinductive bone graft substitutes. Although allograft may be immunogenic, synthetic materials typically do not elicit an immune response.
Correct answer : C

64- Figures 1 and 2 show the radiographs of a 32-year-old woman who presents with pain in her ring finger following an altercation. Swelling and ecchymosis are present, but no lacerations are seen in the skin. Attempted closed reduction of her fracture results in persistent rotational deformity. What method of stabilization would provide the best stability and enable the early initiation of a range of motion program?

A. Kirschner wire (K-wire) fixation
B. Cast immobilization
C. Plate and screw fixation
D. External fixation

The fracture seen in Figures 1 and 2 is a short oblique fracture pattern with comminution of the cortex. El-Saeed and associates demonstrated improved postoperative motion in patients with proximal and middle phalanx fractures treated with titanium plates compared with those treated with K-wires. Plate fixation of phalanx fractures is primarily performed through a dorsal or lateral application of the plate. Despite the development of lower-profile plates, a reduction in plate-associated complications following fixation dorsally or laterally has not been observed. External fixation would not be as stable as internal fixation and would not allow an early range of motion program. Cast immobilization would not provide sufficient stability to initiate early motion and is unlikely to maintain reduction of the proximal phalanx fracture. K-wire fixation would be challenging, based on the mid-diaphyseal location of the fracture.

Correct answer : C

65- What upper extremity abnormality is most commonly associated with Holt-Oram syndrome?

A. Syndactyly
B. Radial longitudinal deficiency (RLD)
C. Cleft hand
D. Ulnar longitudinal deficiency (ULD)

Holt-Oram syndrome, or hand-heart syndrome, is an autosomal dominant condition linked to a mutation in the TBX5 gene. This condition involves RLD and has an association with an atrial septal defect or ventricular septal defect in the heart. In Holt-Oram syndrome, the thumb is almost always hypoplastic or absent. The forearm is generally involved, and the radius can be absent or shortened. Wall and Piper describe the common manifestation of the upper extremity in patients with Holt-Oram syndrome.

Syndactyly is a commonly inherited and clinically heterogenous malformation. Ahmed and associates attempted to summarize all current knowledge, noting that more than 300 distinct syndromic syndactylies and 9 nonsyndromic syndactylies have been described. ULD is a rare condition resulting from sporadic gene mutation and is described as being 4 to 10 time less common than RLD. ULD is not associated with other systemic conditions but is associated with other musculoskeletal conditions such as proximal femoral focal deficiency, fibular deficiency, phocomelia, and scoliosis. Cleft hand, or central deficiency, is not seen in Holt-Oram syndrome but is often associated with split-hand/split-foot malformation, ectrodactyly, ectodermal dysplasia, and cleft lip/palate syndrome.

Correct answer : B

66- Figures 1 and 2 exhibit the radiographs of a 70-year-old, right–hand dominant woman who has pain in the right index finger distal interphalangeal (DIP) joint that limits daily activity. She has a 15° extensor lag at the DIP joint and can flex to 25°. If nonsurgical management fails, what is the most appropriate surgical treatment?

A. Implant arthroplasty
B. Extensor tendon reconstruction
C. Resection arthroplasty
D. Arthrodesis

The radiographs reveal osteoarthritis of the DIP joint. The patient history notes limited motion, along with pain that interferes with daily activities. Nonsurgical treatment provides symptomatic relief, but after it has been exhausted, surgical management is indicated. In the index finger, stability is more important than motion. Resection and implant arthroplasty may relieve pain, but the instability that often results can limit usefulness. Extensor mechanism reconstruction may be indicated for a recalcitrant mallet finger; however, this patient's deformity is related to arthritis and not tendon insufficiency. Joint arthrodesis will eliminate pain and provide a stable joint for lateral pinch in the index finger.

Correct answer : D

67- During the surgical reconstruction of a Wassel type IV preaxial polydactyly with thumbs of equal size, as shown in Figures 1 and 2, it is preferable to excise the radial thumb in order to preserve the

A. metacarpophalangeal (MCP) joint ulnar collateral ligament (UCL).
B. abductor pollicis longus.
C. extensor pollicis longus.
D. MCP joint radial collateral ligament (RCL).

In Wassel type IV polydactyly, a complete duplication of the distal and proximal phalanges is present. The duplicated thumbs can be of equal or variable size and function. When the thumbs are equally sized, it is preferable to excise the radial thumb to maintain the UCL of the more ulnar thumb because of its importance during pinch activities. The abductor pollicis longus inserts on the first metacarpal and would not be affected by resection of the more distally located phalanges. Typically, both the extensor pollicis longus and the flexor pollicis longus are duplicated and have a clear bifurcation point. In resecting the more radial thumb, the abductor pollicis brevis and the RCL are carefully dissected for transfer to the more ulnar thumb after excision of the radial thumb but are not maintained in their native position.
Correct answer : A

68- The comparative outcomes of needle aponeurotomy (NA) and collagenase Clostridium histolyticum (CCH) use in the treatment of Dupuytren contracture indicate that patients treated with CCH have

A. greater direct costs.
B. better range of motion at 2 years.
C. a higher reintervention rate at 5 years.
D. better metacarpophalangeal (MCP) contracture correction at 12 months.

NA and CCH are the treatment options for Dupuytren contracture. The treatments of MCP contractures with NA and CCH were compared in two randomized trials that showed equivalent outcomes at 12 months, based on correction and Unité Rhumatologique des Affections de Main (URAM) scores. A recent retrospective study showed reintervention rates at 2 years of 24% for NA and 41% for CCH. At 5 years, the rates were 61% for NA and 55% for CCH. Standardized direct costs for NA and CCH were $624 and $4,189, respectively. Including all reinterventions, the cumulative costs per digit at 5 years after NA and CCH were $1,540 and $5,952, respectively. A 2-year follow-up by Strömberg showed no difference in range of motion or patient-reported outcomes.
Correct answer : A

69- A 48-year-old woman presents with an insidious onset of dorsal wrist pain and decreased motion. Her radiographs are unremarkable, showing no carpal collapse or malalignment. MRI reveals avascular necrosis of the capitate. Her condition does not improve with immobilization. What would be the most appropriate surgical intervention?

A. Proximal row carpectomy
B. Vascularized bone graft
C. Radial shortening osteotomy
D. Capitate shortening osteotomy

Osteonecrosis of the capitate is a rare condition that presents with an insidious onset of dorsal wrist pain. When nonsurgical treatment fails to alleviate symptoms, surgical intervention is appropriate. When collapse of the capitate is present, partial excision of the capitate with interposition, partial wrist arthrodesis, or wrist denervation can be considered. In the absence of collapse, capitate-preserving options are available. Vascularized grafting is a mainstay of treatment. Grafting with distal radius vascularized grafts based on the 1,2 intercompartmental supraretinacular artery or the 4 + 5 extensor compartment artery and second metacarpal graft based on the first dorsal metacarpal artery have been described.

Radius shortening and capitate shortening osteotomy are described for the treatment of osteonecrosis of the lunate.
Correct answer : B

70- What radiographic parameter has been shown to increase the risk of progressive lunate collapse in Kienböck disease?

A. Type II lunate
B. Ulnar negative variance
C. Increased radial inclination
D. Increased radial height

No one can predict who will have progressive collapse in Kienböck disease. The factors theorized to be associated with collapse are ulnar negative variance and type I lunate (articulating only with the capitate). A recent review by van Leeuwen and associates showed that patients with more negative ulnar variance had a higher risk of having more advanced Kienböck disease. Additionally, more negative ulnar variance was seen in patients with stage IIIA and IIIB disease, compared with stage II. Increased age was independently associated with a higher Lichtman stage. Neither radial height nor radial inclination was associated with lunate collapse. Rhee and associates showed significantly more advanced disease (stage IIIA or greater) and more coronal fractures of the lunate in patients with type I lunate morphology.
Correct answer : B

71- When treating metacarpal neck fractures with a retrograde cannulated compression screw, poor outcomes can be expected with what fracture characteristic?

A. Axial instability
B. Angulation greater than 30°
C. Rotational deformity
D. Displacement greater than 50%

Axial instability is one of the few contraindications for using retrograde cannulated screws for the treatment of metacarpal neck fractures. Compression screws in axially unstable fracture patterns can lead to excessive shortening of the fracture. Rotational, angular, and translational deformities can be corrected prior to guidewire placement, and the fracture can then be stabilized with a headless screw.
Correct answer : A

72- A 16-year-old girl sustains the closed injury shown in Figure 1. On physical examination, she is found to have a complete radial nerve palsy. Her fracture is treated nonsurgically, and her nerve palsy is followed clinically for improvement. What muscle is most likely to improve last as her nerve recovers?

A. Brachioradialis (BR)
B. Extensor carpi radialis brevis (ECRB)
C. Extensor carpi ulnaris (ECU)
D. Extensor indicis proprius (EIP)

The incidence of radial nerve palsy after a humeral shaft fracture has been estimated as being between 7% and 22%. Controversy remains regarding the need for early exploration in a patient presenting with a closed humerus fracture and concurrent radial nerve palsy, because approximately 77% of patients treated without exploration have spontaneous recovery of radial nerve function. Within 3 to 4 months of the injury, the BR and extensor carpi radialis longus (ECRL) should begin to show signs of reinnervation. Anatomic studies have demonstrated a relatively consistent order of the radial nerve motor branches in the forearm (proximal to distal): BR, ECRL, supinator, ECRB, extensor digitorum communis, ECU, extensor digit quinti, abductor pollicis longus, extensor pollicis longus, extensor pollicis brevis, and EIP. Because the EIP is the last motor branch from the radial nerve, it is likely to be the last to recover following a high radial nerve palsy.

Correct answer : D

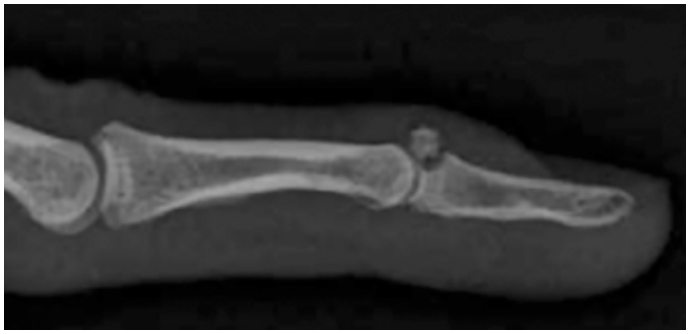
73- A 35-year-old man reports ulnar sided wrist pain. Radiographs show ulnar positive variance with cystic changes in the ulnar head and lunate. His body mass index (BMI) is 22, and he has had a 1.5–pack-per-day smoking history for the past 10 years. He undergoes an oblique ulnar shortening osteotomy with volar placement of the plate. Nine months after surgery, he reports continued pain, and radiographs reveal a nonunion. Of the factors cited for this patient, which has been shown to most likely increase the risk of nonunion?

A. Volar placement of the plate
B. Oblique osteotomy pattern
C. His smoking history
D. BMI of 22

Ulnar impaction syndrome occurs with abutment of the ulnar head, triangular fibrocartilage complex, and carpus, typically in the setting of ulnar positive variance. Patients present with ulnar sided wrist pain, can have cystic changes and edema on radiographs, and have MRI indicating ongoing compression across the ulnar head and carpus. Ulnar shortening osteotomy is a well-accepted treatment to decompress the ulnar side of the wrist for this clinical problem. Nonunion following ulnar shortening osteotomy has been estimated to occur in 4% to 8% of cases. Multiple studies have demonstrated that smoking is associated with a higher rate of nonunion in patients undergoing ulnar shortening osteotomy. The placement of the plate (volar versus ulnar) and osteotomy trajectory (oblique versus transverse) have not been found to affect the rate of union. Low bone mineral density, not BMI, has been associated with higher rates of nonunion following ulnar shortening osteotomy
Correct answer : C.

74- Figure 1 shows the radiograph of a 33-year-old woman with a 1-week history of pain and swelling after injuring her long finger while attempting to catch a football. When the ball hit the tip of her finger, she noted an immediate onset of pain and swelling along with a flexion posture of 20° at her distal interphalangeal (DIP) joint. What is the most appropriate treatment for this injury?

A. Continuous splinting for 6 to 8 weeks
B. Buddy tape and early active motion
C. Open reduction and screw fixation of the fracture fragment
D. Arthrodesis of the DIP joint



This injury is known as a mallet finger or disruption of the terminal extensor tendon distal to the DIP joint. The injury can be purely tendinous or can include a bony fragment from the distal phalanx. Patients present with pain, swelling, and a flexed posture at the DIP joint due to disruption of the extensor mechanism. As little as 1 mm of tendon lengthening results in 25° of extension lag. Depending on the size of the bony fragment, joint subluxation can develop at the DIP joint. The treatment for acute mallet finger injuries with minimal displacement of the fracture fragment and no evidence of joint subluxation is continuous splinting for 6 to 8 weeks. Delayed initiation of treatment has also been described as successful.

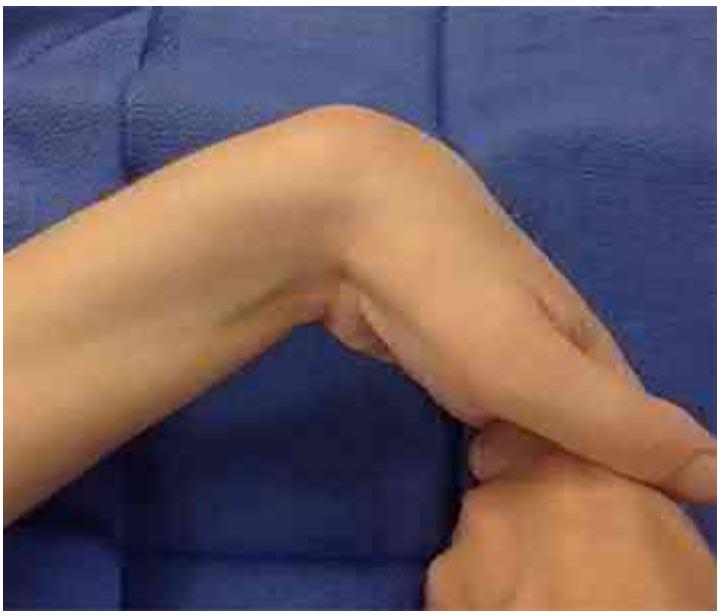
Open reduction and pinning are indicated in patients with a displaced mallet finger injury and joint subluxation. Closed reduction and percutaneous pinning are indicated for irreducible mallet finger injuries with a large bony fragment. Arthrodesis is indicated for a painful, stiff arthritic DIP joint.
Correct answer : A

75- When evaluating carpal tunnel syndrome with the Carpal Tunnel Syndrome 6 (CTS 6) questionnaire, what is the minimum score considered diagnostic of carpal tunnel syndrome?

A. 4
B. 8
C. 12
D. 16

When evaluating carpal tunnel syndrome with the CTS 6 questionnaire, a score of 12 or higher is considered diagnostic of carpal tunnel syndrome. The questionnaire consists of both history and physical examination findings, including median nerve distribution numbness, nocturnal symptoms, thenar atrophy or weakness, a positive Phalen test, a loss of two-point discrimination (more than 5 mm), and a positive Tinel sign.
Correct answer : C

76- A 19-year-old woman with spastic quadriplegia is evaluated for a longstanding wrist contracture. She is nonverbal and uses her hands intermittently for the gross manipulation of objects. She has minimal volitional control of her finger flexors and has no active wrist extension. Her parents report that the wrist contracture is interfering with her ability to use her hands, and it is becoming challenging for them to clean her palmar wrist crease. Figures 1 and 2 show the clinical photographs of her wrist in the resting position and in maximal passive extension, respectively. What is the most appropriate treatment?



A. Nocturnal wrist and finger extension splinting
B. Botox injections to the finger and wrist flexors
C. Flexor carpi ulnaris transfer to the extensor carpi radialis brevis
D. Wrist arthrodesis with a proximal row carpectomy

The typical resting position of the upper extremity in spastic cerebral palsy is shoulder internal rotation, elbow flexion, and forearm pronation with wrist and finger flexion. Each patient should be examined to specifically note the passive motion of the joints as well as the active motion and volitional control of the shoulder, elbow, wrist, and fingers to better guide individual treatment. In younger patients with supple joints, therapy, splinting, injections of Botulinum toxin A, and soft-tissue procedures such as tendon transfers or tendon lengthenings may improve the resting position and the function of the upper limb. In longstanding contractures in older children with poor motor control, a wrist arthrodesis is the most reliable option to improve wrist positioning for hygiene and potentially improve function. Performing a proximal row carpectomy concurrently with the wrist arthrodesis can provide a source of bone graft and decreases the tension on the remaining soft-tissue structures, allowing better deformity correction. In this patient, who has passive wrist extension only to 90° of flexion, nocturnal splinting, Botox injections, and/or tendon transfers would not be sufficient to address the longstanding wrist flexion contracture.
Correct answer : D

77- A 24-year-old man is involved in a motorcycle collision and sustains a right closed femur fracture, an open right distal radius fracture, and a right traumatic brachial plexus injury. On physical examination, drooping of his ipsilateral eyelid and constriction of his pupil are present. He does not have any active motion of the right upper extremity other than shoulder shrug, which remains full strength. MRI of the brachial plexus reveals pseudomeningoceles from C5 to T1. What is the best nerve transfer to restore elbow flexion?

A. Medial pectoral to medial cord
B. Intercostal to musculocutaneous
C. Spinal accessory to suprascapular
D. Double fascicular to musculocutaneous

Traumatic brachial plexus injuries are most commonly seen in male patients aged 15 to 25 years. The mechanism of injury often includes a high-velocity injury with a torque of the head away from the shoulder, often the consequence of a high-speed motorcycle crash.

The patient displays signs of Horner syndrome (ptosis and miosis), which is suggestive of lower root avulsions. The MRI reveals pseudomeningoceles at all roots levels, suggestive of avulsions with a resultant global plexus palsy. In this clinical scenario, it will not be possible to restore elbow flexion with an intraplexal nerve donor, eliminating double fascicular nerve transfer as an option. Intercostal nerve transfer to the musculocutaneous nerve utilizes an extraplexal nerve to restore elbow flexion, with successful restoration of useful elbow flexion reported in 50% to 87% of cases. Medial pectoral nerve transfer to the medial cord and spinal accessory to the suprascapular would not restore elbow flexion.

Correct answer : B

78- A 9-year-old boy with spastic hemiplegia is evaluated for left upper extremity dysfunction. Evaluation of the left upper extremity reveals active elbow range of motion of 20° to 140°, active forearm rotation from 80° pronation to neutral supination, and active wrist motion 70° of flexion to 30° of extension. Passive motion in the forearm and wrist is full. What is the most appropriate surgical treatment to improve forearm rotation function?

A. Pronator teres release
B. Pronator teres rerouting
C. Biceps tendon lengthening
D. Flexor carpi ulnaris to wrist extensor transfer

The patient demonstrates a lack of active forearm supination, although passive supination is full. A pronator teres rerouting will improve forearm rotation by converting the pronator teres muscle into a supination force. Čobeljić and associates compared three surgical techniques, pronator teres transfer to the extensor carpi radialis brevis (ECRB) and rerouting of the pronator teres with and without pronator quadratus muscle myotomy. Only the pronator teres rerouting improved the functional classification score and the Disabilities of the Arm, Shoulder, and Hand score. Pronator quadratus myotomy was not found to be helpful.

Pronator teres release will weaken the pronation deformity but fail to provide improvement in active supination. This technique would be indicated in patients in whom passive rotation is limited because of contracture of the joint or tendon. Biceps tendon lengthening would improve elbow extension if limited, but this patient's elbow motion is excellent. Flexor carpi ulnaris to ECRB tendon transfer is indicated for improving wrist extension and can secondarily provide some supination based on the vector of the transfer; however, this patient has acceptable active wrist motion.

Correct answer : B

79- Figure 1 shows the radiograph of an otherwise healthy 30-year-old laborer. What is the most appropriate treatment for this injury?

A. Closed reduction and cast immobilization
B. Open reduction and internal fixation
C. Closed reduction with percutaneous pinning
D. Ligament reconstruction

The radiograph in Figure 1 reveals a Bennett fracture dislocation. This injury is unstable due to the displacing forces of the abductor pollicis longus, extensor pollicis longus, extensor pollicis brevis, and adductor pollicis. The reduction maneuver involves axial traction, palmar abduction, and pronation with pressure over the dorsal metacarpal base in a palmar ulnar direction. The injury will not maintain reduction with cast immobilization. Surgical stabilization is recommended, using either closed reduction with percutaneous pinning (the most common method used) or open reduction and internal fixation.

A ligament reconstruction is not required, because the joint is typically stable after fixation of the fracture dislocation. A resection arthroplasty is a salvage procedure often performed for arthritis and is not indicated in this case.

Correct answer : B

80- Figure 1 is the 3-month, post surgery radiograph of a 58-year-old right–hand dominant man who sustained an intra-articular distal radius fracture following a fall from a ladder. He underwent open reduction and internal fixation of his fracture with a volar locking plate. What tendon is most likely to rupture if the plate is not removed?

A. Extensor pollicis longus (EPL)
B. Flexor pollicis longus (FPL)
C. Flexor digitorum superficialis (FDS) to index finger
D. Abductor pollicis brevis (APB)

Soong and associates established a grading system to evaluate volar plate placement for distal radius fractures. A critical line (red) is drawn from the volar extent of the volar rim parallel to a line (green) drawn on the volar cortex of the radial shaft, as shown in Figure 2. According to the Soong grading system, plates that do not extend volar to the critical line are grade 0, plates placed volar to the critical line but proximal to the rim are grade 1, and plates positioned directly on the rim or beyond the volar rim are grade 2. In further analysis, Kitay and associates established that higher Soong grades are associated with a higher rate of flexor tendon rupture. The radiograph in Figure 1 demonstrates a volar plate that extends volar to the critical line and a malreduction of the articular portion of the distal radius. The FPL is the deepest flexor tendon to pass over the volar rim and therefore is most vulnerable to plate prominence. The EPL could potentially be injured with drilling and/or volar to dorsal screws that are too long. The FDS to the index finger is volar to the FPL and therefore less likely to be ruptured than the FPL with volar plate prominence. The APB should not be affected by distal radius plate fixation.

Correct answer : B

81- Figures 1 and 2 depict the radiographs of a 64-year-old woman who sustained a thumb metacarpal fracture that was treated with open reduction and internal fixation 10 years earlier. She now has pain that has persisted despite nonsurgical treatment. The best surgical option to provide long-term pain relief is a thumb carpometacarpal (CMC)

A. resection arthroplasty.
B. ligament reconstruction.
C. corrective osteotomy.
D. arthroscopic debridement.

This patient has developed symptomatic, posttraumatic thumb CMC arthritis following open reduction and internal fixation of an intra-articular thumb metacarpal fracture. Eaton and Glickel have classified CMC arthritis into four stages. Stage I includes mild narrowing or subchondral sclerosis. Stage II involves narrowing of the joint with osteophyte formation of less than 2 mm. Stage III consists of further joint narrowing with osteophytes of more than 2 mm. Stage IV includes changes similar to those seen in stage III along with arthritis changes of the scaphotrapeziotrapezoid joint. This patient would be classified as having stage III thumb CMC arthritis. The best surgical option includes a salvage procedure such as a resection arthroplasty. Ligament reconstruction and corrective osteotomy would be considered for a painful thumb CMC joint without significant arthritic changes. Arthroscopic débridement alone would be an inappropriate treatment for this degree of arthritis.

Correct answer : A

82- Following a brachial plexus injury, weakness in what muscle suggests a poor prognosis for spontaneous recovery?

A. Rhomboid
B. Biceps
C. Deltoid
D. Teres minor

A detailed history and physical examination are important in the assessment of a brachial plexus injury. A preganglionic injury occurs proximal to the dorsal root ganglion and has a poor prognosis for spontaneous recovery. A Horner sign and weakness of the proximal muscles such as the rhomboids suggest a preganglionic injury. The distal musculature can be affected by both preganglionic and postganglionic injuries. However, in postganglionic injuries, the musculature innervated by the cervical nerve roots (levator scapulae, rhomboids, and serratus anterior) would be preserved.
Correct answer : A

83- When evaluating the motor function affected in a patient with carpal tunnel syndrome, it is best to assess the strength of active thumb

A. palmar abduction.
B. interphalangeal flexion.
C. palmar adduction.
D. radial abduction.

Carpal tunnel syndrome is a compression neuropathy of the median nerve at the wrist beneath the transverse carpal ligament. The abductor pollicis brevis muscle (APB) is the best muscle to assess when evaluating the motor function of the median nerve in a patient with carpal tunnel syndrome, because it is innervated solely by the median nerve distal to the transverse carpal ligament. APB strength is evaluated by testing the palmar abduction strength of the thumb. The alternative options are incorrect, because thumb palmar adduction tests the adductor pollicis muscle innervated by the ulnar nerve, interphalangeal joint flexion tests the flexor pollicis muscle innervated by the median nerve proximal to the carpal tunnel, and radial abduction tests the abductor pollicis longus muscle innervated by the radial nerve.
Correct answer : A

84- A 35-year-old laborer sustains a crush injury to the hand from a metal plate. On physical examination, the hand is well perfused but shows diffuse, marked swelling and elicits exquisite pain on passive flexion and extension of the fingers. Radiographs show no evidence of fracture or dislocation. What is the best next step in the treatment of this patient?

A. Compartment release
B. Splint immobilization and elevation
C. Admission for observation
D. Increase in pain medication

The patient exhibits the signs and symptoms of compartment syndrome. The hand has ten compartments, including the thenar, hypothenar, and adductor pollicis, four dorsal interosseous, and three volar interosseous. A compartment syndrome occurs when increased pressure within the restrictive fibro-osseous spaces limits tissue perfusion. The diagnosis is made clinically and is suspected in a hand with swollen, tense compartments. Pain out of proportion to the injury with passive flexion and extension of the digits is one of the earliest indicators of a compartment syndrome. Management involves the early release of the fascial compartments. The alternative responses are incorrect, because elevation, observation, and pain medication would delay the surgical decompression and increase the likelihood of tissue necrosis.
Correct answer : A

85- A 25-year-old baseball player notes wrist pain and paresthesia of the ring and small fingers after batting practice. Examination the following day shows tenderness in the hypothenar eminence with grip weakness. An Allen test is negative. AP, lateral, and carpal tunnel radiographs are negative. What is the best next step?

A. CT
B. Clenched-fist radiograph
C. Electromyography (EMG)/nerve conduction velocity testing
D. Wrist arthrogram

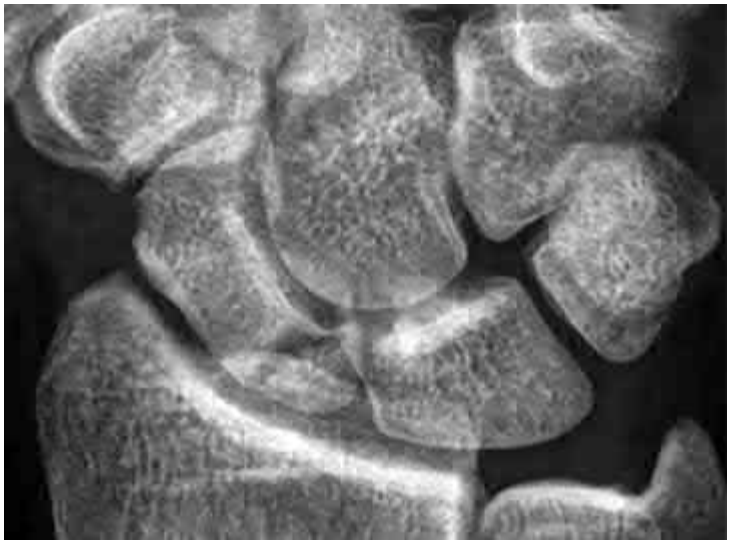
The patient exhibits the signs and symptoms of a hook of the hamate fracture. This injury often occurs from direct trauma while using a racket, bat, or golf club. Patients note pain in the hypothenar eminence, grip weakness, and occasionally paresthesias in the ulnar nerve distribution. Examination reveals tenderness over the hook of the hamate.

Specific radiographic views that may be helpful in the diagnosis include a carpal tunnel view and a semisupinated oblique view. Having a high index of suspicion, as in this case, the clinician would consider CT or MRI for further evaluation. A clenched-fist view would be considered for the suspicion of a scapholunate ligament tear, which would manifest as pain distal to the Lister tubercle. An EMG would not be considered one day following injury, because the extent of nerve injury is best evaluated electrodiagnostically several weeks following the injury. An arthrogram would be considered for the evaluation of an intercarpal ligament or triangular fibrocartilage complex injury.

Correct answer : A

86- Figure 1 shows the radiograph of a 32-year-old accountant who sustained a wrist injury. Examination shows snuffbox tenderness. What is the best treatment option for this patient?

A. Long arm cast immobilization
B. Short arm cast immobilization
C. Open reduction and internal fixation
D. Bone stimulation



Following the traumatic event, this patient, who has snuffbox tenderness, sustained a displaced proximal pole scaphoid fracture. Open reduction and internal fixation is the recommended treatment, because the fracture is displaced more than 1 mm. Displaced scaphoid fractures have an increased incidence of nonunion with nonsurgical treatment. Surgical management also is recommended for proximal pole fractures because such fractures require prolonged immobilization when treated nonsurgically. Nonsurgical management is considered for nondisplaced scaphoid waist fractures with equal outcomes using short arm or long arm immobilization. The nonunion rates of nonsurgically treated proximal pole fractures range between 5% and 50%. The time to union of proximal pole fractures treated with casting averages 3 to 6 months.

Correct answer : C

87- Figures 1 through 3 show the emergency department radiographs of a 25-year-old man who fell off of his bike, landing onto an outstretched hand. No evidence is seen of ecchymosis or edema; however, the patient has substantial pain in the anatomic snuffbox. What radiographic view is indicated to fully assess the suspected injury?

A. AP with clenched-fist view
B. Carpal tunnel view
C. 30° supinated lateral view
D. AP ulnar deviation view

Standard initial wrist radiographs include an AP, lateral, and oblique view. In this series, no fracture or bony pathology is identified. Figure 4 is an AP view in ulnar deviation, often referred to as a scaphoid view, which brings the scaphoid in line with the angle of the beam. This view demonstrates a fracture line through the waist of the scaphoid. The site of the patient's tenderness in the anatomic snuffbox and the mechanism of injury—a fall onto an outstretched hand—are suspicious for a scaphoid fracture. Compson and associates discuss the anatomy of the scaphoid and how it relates to imaging, along with many variations of imaging protocols for visualizing the scaphoid. One of the most common techniques is an AP view in ulnar deviation of the wrist, which brings the scaphoid out of flexion, allowing a perpendicular view of the fracture. Hyperextension with axial imaging is a carpal tunnel view used for the evaluation of a hook of the hamate injury. A 30° supinated lateral view is used to evaluate the pisiform and pisotriquetral joint. This view can also help visualize metacarpal neck fractures of the small finger metacarpal.

An AP with clenched fist view is recommended for the evaluation of scapholunate ligament disruption.

Correct answer : D

88- Figure 1 shows the radiograph of an 18-year-old woman with a 6-week history of pain in the left index finger. She was playing softball when a ball hit the end of her finger. She did not initially seek treatment but is now being evaluated because of continued pain, swelling, and difficulty with motion. What is the most appropriate surgical option for this patient?

A. Volar plate arthroplasty
B. Hemi-hamate arthroplasty
C. Proximal interphalangeal (PIP) joint arthrodesis
D. Open reduction and internal fixation (ORIF) of the middle phalanx

Fracture dislocations of the PIP joint are challenging to manage, and poor results, including pain and limited range of motion, are common. Hemi-hamate arthroplasty is an alternative for the treatment of severe acute and chronic dorsal PIP fracture dislocations. As described by Hill Hastings, the dorsal distal osteoarticular segment of the hamate is used to recreate the volar fractured segment of the middle phalanx at the PIP joint.

A systematic review by Frueh and associates demonstrated good range of motion and minimal pain reports. Calfee and associates and Afendras and associates reported on hemi-hamate arthroplasty for PIP fracture dislocations at a mean follow-up of 4.5 years and a minimum follow-up of 4 years, respectively. Both studies found that hemi-hamate arthroplasty is an attractive alternative treatment for these difficult injuries. Both studies showed reasonable Disabilities of the Arm, Shoulder, and Hand scores and range of motion, along with good grip strength (91% to 95% that of the contralateral hand). In a young patient with a comminuted fracture and delayed presentation, hemi-hamate arthroplasty is the optimal treatment to provide pain control and preserve motion. ORIF is unlikely to be successful due to comminution. Volar plate arthroplasty (resection of the bone and advancement of the volar plate) would fail because of the large segment of bone involved. PIP joint arthrodesis provides good pain control; however, it does not preserve motion.
Correct answer : B

89- What would be the expected outcome after treating a small finger metacarpal neck fracture of up to 40° of apex dorsal angulation nonsurgically without fracture reduction?

A. Normal metacarpophalangeal joint appearance
B. Decreased grip strength compared to surgically treated patients
C. Worse Visual Analog Scale (VAS) score for pain
D. Normal Disabilities of the Arm, Shoulder, and Hand (DASH) score

Small finger metacarpal neck fractures without rotational deformity are generally stable, usually do not require manipulation, and heal reliably after nonsurgical treatment, with good outcomes. Westbrook and associates showed that the angulation did not affect the outcome of 105 metacarpal neck fractures or 113 metacarpal shaft fractures treated nonsurgically without manipulation. The outcomes were equivalent to those seen in patients treated with surgery. The DASH scores and the aesthetic outcomes were better for the fractures treated nonsurgically than for the fractures treated surgically. Strub and associates studied 40 patients with 30° to 70° of apex dorsal angulation who were treated with either closed reduction and intramedullary pinning, or nonsurgical treatment without fracture reduction.

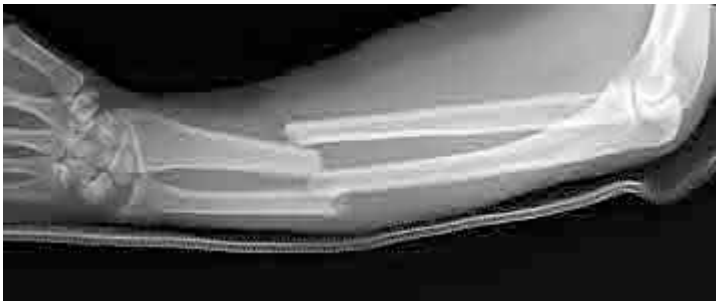
They concluded that the appearance improved after reduction, but no functional advantage was observed, noting no differences in range of motion or grip strength between the two groups.
Correct answer : D

90- A collegiate baseball player sustains a hook of the hamate fracture. He has persistent pain 3 months later. If this fracture is treated with excision of the hook of the hamate, the most likely outcome is

A. continued pain.
B. grip weakness.
C. a high Disabilities of the Arm, Hand, and Shoulder (DASH) score.
D. a return to play in 6 weeks.

Hook of the hamate fractures are reliably and safely treated with excision. Devers and associates evaluated 12 hook of the hamate fractures in 11 patients, all of whom were high-level athletes. All patients returned to full participation in sports at 3 to 8 weeks after surgery. All patients had a score of 0 (normal) on the DASH Sports form. Scheufler and associates treated six patients with casting for 6 weeks and eight patients with primary surgery. Five of the six treated nonsurgically continued to have symptoms, but those subsequently treated surgically achieved elimination of all symptoms. Of the eight patients treated with primary surgery, five underwent fragment excision and three underwent open reduction and internal fixation. All eight had complete elimination of their symptoms 3 months after surgery. Aldridge and associates excised the fractured hook of the hamate in seven golfers. All patients achieved complete resolution of pain and return to the previous level of play.
Correct answer : D

91- Figures 1 and 2 show the radiographs of a 46-year-old man who was injured in a car accident. How should open reduction and internal fixation of the radius and ulna be performed for this injury?



A. Each with a 3.5-mm plate through a single incision
B. Each with a 3.5-mm plate through two incisions
C. Each with a one-third tubular plate through a single incision
D. Each with a one-third tubular plate through two incisions

The standard of care in the management of diaphyseal radius and ulna fractures in adults is open reduction and internal fixation through two incisions (one incision per bone) using a 3.5-mm dynamic compression plate with three bicortical screws on either side of the fracture. One-third tubular plates do not provide sufficient bending rigidity for these fractures. Using a single incision to fix both fractures is not recommended, because it leads to a much higher risk of synostosis between the radius and ulna.
Correct answer : B

92- A patient sustains a comminuted mid shaft proximal phalanx fracture and elects to undergo nonsurgical management. No rotational malalignment is present. However, the fracture has shortened by 3 mm and is expected to heal in this position. As a consequence, the patient may develop a 30°

A. proximal interphalangeal (PIP) flexion contracture.
B. metacarpophalangeal (MCP) flexion contracture.
C. MCP extensor lag.
D. PIP extensor lag.

Vahey and associates showed that an approximate 12° PIP extensor lag is seen for each millimeter of phalangeal shortening. A mid shaft proximal phalanx fracture would not be expected to cause a flexion contracture of the PIP or MCP joints or an extensor lag of the MCP joint. Correction of this extensor lag in a malunited (shortened or dorsally angulated proximal phalanx) fracture can be achieved by performing either a phalangeal corrective osteotomy or an extensor mechanism slide, as described by Beekman and associates.
Correct answer : D

93- A 50-year-old man is evaluated 2 weeks after jamming his middle finger while playing volleyball. He has mild pain over the middle finger distal interphalangeal (DIP) joint and a 50° extensor lag. Plain radiographs are normal. The patient is treated in a DIP extension splint for 8 weeks. On average, how much of a DIP extensor lag can this patient expect in the future?

A. 0°
B. 10°
C. 25°
D. 45°

After closed treatment in a splint for 8 weeks, the average residual DIP extensor lag is approximately 10°.
Correct answer : B

94- Figures 1 through 3 are the radiographs and CT scan of a 19-year-old woman who is evaluated for right wrist pain after a fall onto an outstretched hand 3 months ago. She is not a nicotine or tobacco user. What is the most appropriate treatment option?

A. Excision of the distal pole of the scaphoid and radial styloidectomy
B. Scaphoidectomy and partial wrist fusion
C. In situ fixation of the scaphoid
D. Open reduction, bone grafting, and fixation of the scaphoid

The radiographs and CT demonstrate a scaphoid waist nonunion with humpback deformity. No obvious arthritic changes are present; therefore, excision of the distal pole of the scaphoid and radial styloidectomy are not appropriate. A dorsal intercalated segmental instability (DISI) pattern is evident on the lateral radiograph. Proper surgical management includes open reduction of the humpback deformity (typically from a volar approach to the scaphoid), bone autografting, and internal fixation. Percutaneous fixation without bone grafting of a displaced scaphoid nonunion is inappropriate. Open reduction, bone grafting, and fixation of the scaphoid nonunion without restoring normal scaphoid alignment do not improve the humpback deformity and resultant DISI deformity. Scaphoidectomy and partial fusion are not appropriate in a young patient without evidence of degenerative changes and a viable scaphoid on imaging.

correct answer : D

95- A patient is found to have a severely swollen hand with firm compartments. He has an otherwise soft forearm and upper arm. A decision is made to perform a carpal tunnel release and a compartment release of the hand. In addition to the palmar and dorsal interossei, thenar, and hypothenar compartments, what needs to be released?

A. Flexor pollicis longus
B. Adductor pollicis
C. Midpalmar space
D. Parona space

Ten muscle compartments exist in the hand that need to be released surgically in the setting of acute hand compartment syndrome. They include the thenar compartment, the hypothenar compartment, three palmar interosseous compartments, four dorsal interosseous compartments, and the adductor pollicis compartment. The ten compartments can be released effectively through four skin incisions: one over the thenar compartment; one over the hypothenar compartment; one dorsally over the index finger metacarpal to release the first dorsal interosseous, second dorsal interosseous, second palmar interosseous, and adductor pollicis compartments; and one over the ring finger metacarpal to release the third and fourth dorsal interossei compartments and the third and fourth palmar interossei compartments. The flexor pollicis longus muscle belly is not contained within the compartments of the hand. The midpalmar space is a space in which deep infections potentially can spread but is not a compartment of the hand. The Parona space is a space in the distal forearm between the digit flexors and the pronator quadratus where infection also can spread.

Correct answer : B

96- Figure 1 shows the radiograph of a 63-year-old woman who has pain in her middle finger metacarpophalangeal (MCP) joint. She is dissatisfied with nonsurgical measures and is now interested in surgical management. What anatomic structures must be intact when electing pyrocarbon rather than silicone arthroplasty?

A. Collateral ligaments
B. Sagittal bands
C. Intermetacarpal ligaments
D. Lateral bands

The patient has osteoarthritis of the middle finger MCP joint. The surgical treatment options include joint denervation, arthrodesis, and joint arthroplasty. Under the joint arthroplasty options, two of the more common implants used are pyrocarbon and silicone. Pyrocarbon implants are unlinked surface replacement arthroplasties and therefore rely on the soft tissues—namely the collateral ligaments and the volar plate—for joint stability.

However, a silicone implant is a one-piece linked implant that provides joint stability inherent in its design. Deficiencies in the radial sagittal band, the radial lateral band, and the subchondral bone of the metacarpal head are not contraindications to the use of pyrocarbon or silicone arthroplasties in the MCP joint.

Correct answer : A

97- Figures 1 and 2 show the radiographs of a 42-year-old carpenter who is evaluated for pain in his right index finger proximal interphalangeal (PIP) joint. He has tried anti-inflammatories as well as a steroid injection without satisfaction. He requests surgery to alleviate the pain. What surgical option has been shown to provide the most reliable and durable outcomes?


A. Pyrocarbon replacement
B. Silicone replacement
C. Resection arthroplasty
D. PIP arthrodesis

For arthritis in the PIP joint, several surgical options exist, including denervation, implant arthroplasty (silicone or pyrocarbon), and arthrodesis. The index finger PIP joint differs from the other PIP joints, because it experiences more lateral or ulnar deviation forces during key pinch. Therefore, in a young laborer, arthrodesis of the index finger PIP joint is preferred for its durability over implant arthroplasty. Resection arthroplasty is not a reasonable treatment option for this patient.

Correct answer : D

98- A 55-year-old woman is evaluated following 1 year of numbness and tingling in the radial digits of her right hand. The symptoms initially bothered her only during sleep but now also disturb her during the day. She is interested in having surgery. What examination finding suggests a diagnosis other than carpal tunnel syndrome?

A. Weakness of the abductor pollicis brevis
B. Numbness of the long finger with wrist flexion
C. Numbness at the radial base of the palm
D. Index finger 8-mm static two-point discrimination

Carpal tunnel syndrome is a compression neuropathy of the median nerve by the transverse carpal ligament at the level of the wrist. At this level, the median nerve typically includes sensory branches to the radial 3 1/2 digits and the recurrent motor branch, which innervates the thenar musculature and radial 2 lumbricals. The palmar cutaneous branch provides sensibility at the radial base of the palm. It arises from the median nerve as well but several centimeters proximal to the level of the wrist crease, and it travels superficial to the level of the transverse carpal ligament. Therefore, if a patient has numbness at the radial base of the palm, consideration should be given for more proximal median nerve entrapment (such as at the lacertus fibrosis or the ligament of Struthers). All of the other answer options are positive examination findings in a patient with carpal tunnel syndrome.
Correct answer : C

99- An angulated, short oblique index metacarpal shaft fracture is treated with closed reduction and casting. No evidence is present of a rotational deformity after reduction, but a persistent 40° apex dorsal angulation of the metacarpal is seen despite three reduction attempts. If the metacarpal heals in this position, the patient will most likely develop

A. first web space contracture.
B. pseudoclawing of the fingers with metacarpophalangeal (MCP) hyperextension.
C. overlap of the fingers with active finger flexion.
D. nonunion of the metacarpal fracture.

Angulation is less well-tolerated in metacarpal shaft fractures than in metacarpal neck fractures. Additionally, because of the decreased mobility of the second and third carpometacarpal (CMC) joints compared with the fourth and fifth CMC joints, less angulation can be tolerated in the index and middle finger metacarpals than in the ring and small fingers. Typically, reduction is attempted with 10° of angulation or more in the second and third metacarpals. If the radial metacarpals heal in an apex dorsal position, the MCP joints will hyperextend to overcome the flexion posture of the metacarpal, which can lead to a pseudoclawing. Although apex dorsal angulation can lead to a weakness of grip, it is unlikely to cause first web space contracture. This particular fracture does not have a rotational deformity and therefore is unlikely to result in overlap or underlap of the digits with flexion. Nonunion is uncommon in metacarpal shaft fractures, although it is reported more frequently with transverse fracture patterns.
Correct answer : B

100- In a patient with a distal radius fracture, calcium phosphate bone cement is used to augment a metaphyseal void following volar plate fixation of the fracture. Studies have shown that, at 1 year after surgery, the expected radiographic findings would include

A. bone-cement interface lucency.
B. a loss of radial height and inclination.
C. greater ulnar positive variance.
D. incorporation of the cement into host bone.

Randomized controlled trials evaluating the use of allograft in the treatment of distal radius fractures are sparse. However, calcium phosphate cement has been studied as a possible substance to augment the fixation of distal radius fractures. Calcium phosphate is a percutaneous injectable and moldable substance that has physical and chemical characteristics similar to those in the mineral phase of bone. Some studies have shown improvement in grip strength and range of motion in the first 6 to 8 weeks after calcium phosphate cement is used to augment distal radius fracture fixation. Other authors have demonstrated no significant differences between patients with and without calcium phosphate cement augmentation in Disabilities in Hand, Arm, and Shoulder scores, grip strength, or healing 3 to 12 months following surgery. Some studies have shown no change in radiographic parameters. Others have shown that the use of bone cement improved volar tilt and ulnar variance but produced no change in radial height or inclination, when compared with fractures treated without calcium phosphate augmentation. Postoperative radiographs obtained 12 months after calcium phosphate cement use did show incorporation of the cement into the host distal radius.
Correct answer : D