1. What percentage of all athletic injuries are of the hand and wrist?

A. Less than 1%
B. 3% to 25%
C. 40% to 70%
D. More than 80%

The incidence of hand and wrist injuries in all athletic injuries is 3% to 25%. Hand and wrist injuries in athletic participation are common and usually involve athletes younger than 16 years. The more severe injuries such as fractures can be seen with greater contact sports such as football.

Answer: B

DeHaven, Linter, pp. 218-224
Rettig, Ryan, Stone, pp. 37-48

2. Cindy, a 23-year-old soccer player, fell and sustained a displaced, noncomminuted olecranon fracture (Type IIA). The patient underwent surgery with placement of a compression AO screw. When would you begin active range of motion (ROM)?

A. Same day of surgery
B. 3 to 7 days postoperatively
C. 4 weeks postoperatively
D. 6 to 8 weeks postoperatively

When a postoperative compression AO screw is used to stabilize an olecranon fracture, gentle active ROM should begin when postoperative pain has subsided, which is usually between 3 to 7 days after surgery. You should avoid extremes of motion, primarily flexion, for 4 weeks postoperatively. Begin strengthening around 8 weeks postoperatively.

Answer: B
Morrey, pp. 374-375
Refer to Fig. 12-1

Fig. 12-1 Mayo classification for olecranon fractures. Types IIB, IIA, and IIB are at risk for developing nonunions. (From Morrey BF: The elbow and its disorders, ed 3, Philadelphia, 2000, WB Saunders. By permission of the Mayo Foundation for Medical Education and Research. All rights reserved.)
3. What is the most difficult functional activity to recover after a successful hemiarthroplasty reconstruction of a four-part fracture of the proximal humerus?

A. Positioning the arm at the side comfortably
B. Strength to carry a gallon of milk at the side
C. Strength to hold the arm rotated against the body
D. Reaching overhead and behind the back to the shoulder blade
E. Ability to reach the hand to the face

Because fixation of the tuberosities is not rigid, ROM must be partially restricted until a provisional union with evidence of callus occurs. Recovery of motion, including reaching overhead and behind one's back, is the greatest difficulty after surgery. As long as the bone unites and the humeral head is located in the glenoid fossa, the strength and stability of the arm should be sufficient. Positioning the arm at the side and reaching the hand to the face is easily performed after hemiarthroplasty for four-part fractures.

Answer: D
Zyto, Kronberg, Brostrom, pp. 331-336

4. A 24-year-old man dislocates his elbow as a result of a fall but sustains no other injuries. The elbow is reduced and is stable. How long should the elbow be immobilized in a splint before motion can begin?

A. 3 to 10 days
B. 2 to 3 weeks
C. 4 weeks
D. 6 weeks
E. 8 weeks

Flexion contractures are the most common complication of dislocations of the elbow, and approximately 15% of patients lose more than 30 degrees of flexion. The risk of contracture is proportional to the duration of immobilization. The elbow is immobilized for protection and comfort and should be moved within the first few days after reduction.

Answer: A
Mehlhoff, Noble, Bennett, pp. 244-249

5. Mr. B, a 49-year-old retired football coach, underwent two previous shoulder stabilization procedures for recurrent dislocations. He now has advanced arthritis with continuous pain and severe restrictions of motion. Although shoulder replacement relieved his pain, he now has increased passive external rotation, weakness when using his arm in front of his body, and instability to lift the back of his hand away from his back. Which of the following muscles is related to the weakness in his arm?

A. Deltoid
B. Infraspinatus
C. Supraspinatus
D. Subscapularis
E. Pectoralis major

Patients with subscapularis tears have an increase in passive external rotation and weakness of internal rotation. The patient's inability to move the dorsum of the hand from the lumbar spine (the lift-off test, Fig. 12-2) indicates that the subscapularis muscle is incompetent.

Answer: D
Gerber, Hersche, Farron, pp. 1015-1023
Rockwood, Matsen, pp. 191-192
6. A 15-year-old girl who participates in high school gymnastics reports pain in the right shoulder with frequent numbness and paresthesias that began 1 week ago in the arm and hand. The left shoulder is normal. Examination reveals marked hyperlaxity of the elbows and metacarpophalangeal (MCP) joints, and her patellae are hypermobile. Stress X-rays in the clinic reveal inferior subluxation of the gleno-humeral joint. Initial treatment should consist of which of the following?

A. Physical/occupational therapy  
B. Laser capsulorraphy  
C. Inferior capsular shift  
D. Bankart repair  
E. Arthroscopic capsular repair

Shoulder pain and paresthesias in a young female gymnast suggest the diagnosis of instability. Because of the recent onset, a nonsurgical approach of physical therapy for muscle strengthening should be undertaken. Surgery of any type should be performed only on those patients who have participated in a therapy program for at least 6 months without success.

Answer: A  
Burkhead, Rockwood, pp. 890-896

7. A 44-year-old woman reports persistent aching pain, a recurrent pop in the right shoulder when raising her arm in front of her, and weakness with pushing. She was injured in an automobile accident in which she braced herself before impact with her elbows locked and her arms holding the steering wheel. Examination reveals pain on internal rotation and forward elevation of the arm when a posterior directed force is applied along the humeral shaft. A sudden pop is noted on horizontal abduction to the coronal plane with the arm internally rotated. What is the most likely diagnosis?

A. Biceps tendon tear  
B. Subscapularis tear  
C. Posterior labral tear  
D. Supraspinatus tendon tear  
E. Internal impingement syndrome

The patient has a traumatic posterior labral tear and posterior instability. The jerk test (Fig. 12-3) is described here, and symptomatic pathologic posterior translation is produced when the humeral head is translated posteriorly in forward elevation and relocated as the arm is forced into coronal plane abduction.

Answer: C  
Matsen, Lippitt, Sidles, pp. 19-109  
Rockwood, Matsen, pp. 680-681
8. A 35-year-old woman sustains an isolated, minimally displaced fracture of the radial head as a result of a fall on the ice. Initial treatment includes immobilization in a posterior splint with a sling. The next step of treatment should consist of which of the following?

A. Application of a cast in 7 to 10 days
B. Application of a hinged elbow brace in 3 weeks
C. Beginning an active ROM program within 1 week
D. Continued use of the splint and sling at all times for the next 6 weeks
E. Continued use of the splint and sling for 4 weeks, followed by use of the sling only until radiographic union occurs

A minimally displaced radial head fracture should be immobilized for only 1 week to minimize long-term stiffness; then an active ROM program should begin. Begin to wean the patient from the sling when you begin active ROM.

Answer: C
Morrey, pp. 355-381

9. A 20-year-old woman who exercises her arms regularly has multidirectional instability (MDI) and ligamentous laxity. She wishes to have shoulders that “stay in place.” Results from Cybex testing reveal that her external rotators are only 40% as strong as her internal rotators. Why would specific exercises for MDI be effective?

A. External rotation strength should be at least 60% of internal rotation, and increasing muscular strength should help stabilize up to 80% of shoulders with MDI.
B. External rotation strength should be at least 80% of internal rotation, and increasing muscular tone improves glenohumeral stability in up to 80% of patients with MDI.
C. An external rotation strength of 30% of internal rotation is normal, but the scapular forces need to be trained to position the scapula and align the joint reaction forces in patients with MDI.
D. The ratio of external to internal rotation strength does not matter because the essential lesion is excessive capsuloligamentous laxity in patients with MDI.
E. The ratio of external to internal rotation strength is unimportant because the scapular stabilizers must be the primary focus of rehabilitation.

The essential lesion of MDI appears to multifactorial, and patients with MDI often exhibit rotator cuff weakness, diminished proprioception, lack of coordinated scapular motion, ligamentous laxity, and excessive capsular redundancy. External rotation strength is typically 60% of internal rotation strength in women. Burkhead and Rockwood report that MDI will improve with exercises in up to 80% of patients with MDI. Strengthening exercises should include rotator cuff, deltoid, and scapular stabilizers to align the glenohumeral joint reaction force. Scapular exercises alone would be insufficient for adequate stabilization of the glenohumeral joint.

Answer: A
Burkhead, Rockwood, pp. 890-896

10. A 30-year-old man participating in recreational hockey dislocates his right shoulder and stiffness develops in the elbow after he is immobilized in a sling for 4 weeks. Nine months after the arm was immobilized, the shoulder has healed, but the patient lacks 30 degrees of elbow extension, which equates to a residual flexion contracture. Management should now include which of the following?
1. When selecting a donor tendon for transfer, the hand surgeon is concerned with which of the following?

A. Strength
B. Amplitude of excursion
C. Direction of pull
D. Expendability
E. All of the above

The selection of donor tendons is based on several principles of tendon transfer. First, the tendon chosen for transfer must be strong enough to perform its new function in an altered position. The work capacity of different forearm muscles has been defined in the literature, and "classic" tendon transfers are based on these data. For a tendon transfer to provide full range of motion (ROM), the amplitude of tendon excursion must be adequate. Roughly, wrist extensors and flexors move about 33 mm; finger extensors and the extensor pollicis longus (EPL) move about 50 mm; and finger flexors move about 70 mm. Ideally, the most efficient tendon transfer is one that passes from a direct line from its own origin to the insertion of the tendon being substituted. Finally, sacrifice of the donor tendon should not result in functional deficit. Other muscles should exist that perform the same basic function as the donated muscle.

Answer: E

2. Match each of Newton’s laws with the appropriate description.

<table>
<thead>
<tr>
<th>Law</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. First law</td>
<td>A body at rest tends to remain at rest; a body in motion will remain in such motion at a constant velocity unless acted on by an external force.</td>
</tr>
<tr>
<td>2. Second law</td>
<td>To every action there is always an equal reaction, and the forces of action and reaction between interacting bodies are of equal magnitude, opposite in direction, and have the same line of action.</td>
</tr>
<tr>
<td>3. Third law</td>
<td>A body with a force acting on it will accelerate in the direction of that force, and the magnitude of the acceleration will be proportional to the magnitude of the net force.</td>
</tr>
</tbody>
</table>

Answers: 1, A; 2, C; 3, B

3. Match each of the following terms with the appropriate description.

<table>
<thead>
<tr>
<th>Terms</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Force</td>
<td></td>
</tr>
<tr>
<td>2. Moment</td>
<td></td>
</tr>
<tr>
<td>3. Velocity</td>
<td></td>
</tr>
<tr>
<td>4. Acceleration</td>
<td></td>
</tr>
</tbody>
</table>
Description

A. Action of one body against another
B. Time rate of increase of velocity
C. Time rate of change in position
D. Rotational, bending, or twisting action of one body on another

Answers: 1, A; 2, D; 3, C; 4, B
Ozkaya, Nordin, p. 6

4. In a patient with an irreparable radial nerve palsy, which of the following functions has been lost and needs to be restored by tendon transfer?

A. Wrist extension
B. Finger (metacarpophalangeal [MCP] joint) extension
C. Thumb extension
D. All of the above

The primary extensors of the wrist are the extensor carpi radialis longus (ECRL), the extensor carpi radialis brevis (ECRB), and the extensor carpi ulnaris (ECU) muscles. The primary extender of the finger MCP joints is the extensor digitorum communis (EDC) muscle. The extensor indicis proprius (EIP) provides independent MCP extension to the index finger, and the extensor digiti minimi (EDM) provides MCP extension to the little finger. The EPL is the sole extensor of the thumb interphalangeal (IP) joint. Both the extensor pollicis brevis (EPB) and the EPL help to extend the MCP joint of the thumb. The ECRL and the ECRB are innervated by the radial nerve, whereas the remaining wrist and digital extensors are innervated by the posterior interosseous nerve (PIN), a branch of the radial nerve. Because all the muscles mentioned above are innervated by the radial nerve or a branch of the radial nerve, an irreparable injury to the radial nerve results in loss of all the muscles mentioned.

Answer: D
Green in Green, Hotchkiss, Pederson, p. 1481
Skirven, Callahan in Mackin, Callahan, Skirven, et al, pp. 601-603
Refer to Fig. 16-1

5. The “standard” or most commonly used set of tendon transfers for radial nerve palsy includes which of the following?

A. Pronator teres (PT) to ECRB, flexor carpi ulnaris (FCU) to EDC, palmaris longus (PL) to EPL
B. PT to ECRL, flexor carpi radialis (FCR) to EDC, FCU to EPL
C. PT to EPL, PL to EDC, FCU to ECRB
D. PT to ECRL, FCR to EDC, PL to EPL

Multiple authors have described various methods for tendon transfer for radial nerve palsy, but it is important to understand what is most commonly seen in practice. Choice A is the correct answer. Some authors would suggest using the FCR instead of the FCU to the EDC. In choice B, both the FCU and FCR are used. This set of transfers is not a good choice because the PL is not strong enough to function effectively as the sole wrist flexor. C is not a good choice because the PL has a much lower work capacity than the EDC and is not strong enough to perform the duties of the EDC. Finally, in choice D, because the ECRB (which inserts at the base of the third metacarpal) is a more central tendon than the ECRL (which inserts at the base of the second metacarpal), transfer to the ECRB would provide better wrist extension, whereas transfer to the ECRL would result in radial deviation as well as wrist extension.

Answer: A
Green in Green, Hotchkiss, Pederson, pp. 1481-1496
Skirven, Callahan in Mackin, Callahan, Skirven, et al, p. 619
6. Which of the following transfers is part of the superficialis transfer (“Boyes transfer”) for radial nerve palsy?

A. PT to ECRB  
B. Flexor digitorum superficialis (FDS) III to EDC  
C. FDS IV to EPL  
D. FCR to abductor pollicis longus (APL)/EPB  
E. All of the above

All of the above are part of the superficialis transfer for radial nerve palsy. With the standard transfers, the FCR or FCU is transferred to the EDC. However, because the wrist flexors have less amplitude of excursion (33 mm) in comparison with the finger extensors (50 mm), active extension of the fingers can only be achieved when the wrist is in volar flexion, relying on the tenodesis effect of the wrist. Thus wrist and finger extension cannot be achieved simultaneously. The FDS tendon has greater excursion (70 mm), which overcomes this limitation. In addition, use of the FDS allows the FCR to be used for thumb abduction. The FDS can be used because finger flexion is still provided by the flexor digitorum profundus (FDP).

Answer: E

Boyes, pp. 958-969  
Green in Green, H ochkiss, Pederson, p. 1491  
Refer to Fig. 16-2

7. In addition to thumb opposition, what other functions are lost (and must be replaced) in a high median nerve palsy?

A. Thumb IP flexion  
B. Thumb IP extension  
C. Index and long distal interphalangeal (DIP) flexion  
D. Index and long proximal interphalangeal (PIP) flexion  
E. A, C, and D

The median nerve innervates the following musculature in the upper extremity: pronator teres, FCR, flexor pollicis longus (FPL), FDP (index and long fingers), FDS, pronator quadratus, abductor pollicis brevis (APB), flexor pollicis brevis (FPB), index and long finger lumbricals, and opponens pollicis (OP). In a high median nerve palsy, thumb opposition, thumb flexion, and flexion of the index and long fingers are all lost (flexion of the ring and little fingers is preserved because the FDP to these fingers are innervated by the ulnar nerve).
8. All but which of the following can be used in the treatment of high median nerve palsy?

A. FDS ring to APB for thumb opposition
B. Extensor digiti minimi (EDM) to APB for thumb opposition
C. Brachioradialis (BR) to FPL for thumb IP flexion
D. FDP index and long to FDP of ring and little (side to side)

Although choice A is excellent for low median nerve palsy, this choice is poor in high median nerve palsy because the FDS is innervated by the median nerve and thus would not function in a high median nerve palsy. Therefore thumb opposition would have to be recreated with another tendon transfer such as choices B, C, and D. All of these transfers are used commonly for high median nerve palsy. The EDQ is innervated by the ulnar nerve; the BR by the radial nerve; and the FDP ring and little fingers by the ulnar nerve.

9. A patient sustains a closed humeral shaft fracture with minimal displacement, angulation, and shortening. On initial physical examination, the patient is noted to have a complete radial nerve palsy. He is referred to occupational therapy. Initial management should be which of the following?

A. Splinting to immobilize the humerus fracture and elbow until open reduction and internal fixation (ORIF) of the fracture with exploration of the radial nerve can be performed
B. Splinting of the humerus fracture, including prolonged immobilization of the elbow, wrist, and MCP joints
C. Surgery for ORIF of the fracture and tendon transfers
D. Splinting to immobilize the humerus fracture with therapy to maintain ROM of the wrist, thumb, and fingers

A minimally displaced or angulated fracture of the humerus can be treated with a fracture brace (Sarmiento) (see Fig. 5, p. 349). Some physicians may include the elbow in the immobilization splint. The most important aspect of nonoperative management in a patient with radial nerve palsy is maintenance of full ROM in all joints of the wrist and hand, including the thumb-index web space. Splints are often provided that help maintain the wrist, thumb, and fingers in extension through the day. These splints are then removed to allow daily therapy to maintain ROM. 92% of radial nerve palsies resulting from closed humerus fractures will resolve. If no nerve function returns, nerve repair, nerve graft, or tendon transfers are considered. However, for these procedures to be effective, the joints in the hand and wrist must be kept supple.

10. Match the biomechanical term to its correct description.

<table>
<thead>
<tr>
<th>Biomechanical Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Stress</td>
<td>Occurs when one force acting on a lever has doubled the moment arm of the opposing force</td>
</tr>
<tr>
<td>2. Shear stress</td>
<td>Force per unit area</td>
</tr>
<tr>
<td>3. Mechanical advantage</td>
<td>Occurs in tissue that is subjected to two opposing forces that are not exactly in line</td>
</tr>
<tr>
<td>4. Axis</td>
<td>Two bones moving around each other at a joint and one line that does not move in relation to either bone</td>
</tr>
</tbody>
</table>

Answers: 1, B; 2, C; 3, A; 4, D

11. In relation to a muscle contraction, the resting length is which of the following?
A. Distance between the maximal stretch and the maximal contracture of a fiber
B. Maximal stretch of a muscle fiber
C. Optimal position for a muscle to generate a strong contraction
D. A and B
E. A and C

The resting length is the length that a sarcomere, or a muscle fiber, assumes when a limb is in its resting and balanced condition. Resting length is approximately equal to the distance between the maximal stretch and the maximal contracture of a fiber. The optimal strength of active contraction is obtained when the muscle is in the middle of its normal excursion (neutral). At the two extremes of maximal stretch and maximal contraction, the ability of a muscle to form an active contraction is close to 0. In contrast, when a muscle is at resting length, it has the maximal power to perform a strong contraction of a fiber.

Answer: E
Brand, Hollister, p. 14
Tubiana, Thomine, Mackin, pp. 44-46

12. Match each term to the correct description.

Term
1. Force
2. Friction
3. Static friction
4. Coulomb friction
5. Radian

Description
A. Frictional force resulting between two surfaces that move relative to one another
B. Defined as that which will cause acceleration
C. A unit of angular measurement
D. A friction force produced when two surfaces do not move relative to one another
E. Resisting force parallel to and resulting from direct contact between two surfaces

Answers: 1, B; 2, E; 3, D; 4, A; 5, C
Brand, Hollister, pp. 5-6
Giurintano, p. 84

13. Which of the following signs will not be present on low ulnar nerve palsy?

A. Pollock's sign (loss of extrinsic power of the ulnar innervated portion of the FDP, with an inability to flex the DIP joints of the ring and little fingers)
B. Claw hand (hyperextension of proximal phalanges, and flexion of the IP joints of the ring and little fingers)
C. Jeanne's sign (hyperextension of the thumb MCP joint with key pinch or gross grip)
D. Froment's sign (obligate flexion of the thumb IP joint to 80 to 90 degrees to pinch object between thumb and index finger)

Choice A is the correct answer. The only tendons that flex the DIP joints of the ring and little fingers are the ulnar portion of the FDP, which is innervated by the ulnar nerve. However, the innervation is in the proximal forearm and is not compromised in low ulnar nerve palsy. In claw hand, the intrinsic function of the ring and little fingers (dorsal and volar interossei, and third and fourth lumbricals) is lost. In a normal hand, these muscles allow MCP flexion and IP joint extension. Conversely, when compromised, the MCP joints will extend, and the IP joints will flex, thus causing a claw-like position of the hand if extrinsic function is normal (Fig. 16-4). With normal lateral pinch, the adductor pollicis helps the thumb adduct, flex at the MCP joint, and extend at the IP joint. In low ulnar nerve palsy, the adductor pollicis is compromised. Instead, the person will adjust and generate pinch strength by hyperextending the MCP joint 10 to 15 degrees. In low ulnar nerve palsy, the first dorsal interosseous muscle, which abducts the index finger, and the adductor pollicis do not function. Thus, when attempting to grasp an object between the thumb and index finger, the person will flex