Hand & Upper Extremity Rehabilitation

A Quick Reference Guide & Review
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1. While treating a patient after flexor digitorum profundus repair to the ring finger it is noted that he has a significant reduction of finger flexion force in the digits adjacent to the ring finger as well as a flexion contracture of the ring finger. What is described in this scenario?

A. Lumbrical-plus phenomenon  
B. Egawa’s sign  
C. Linburg’s sign  
D. Quadrigia phenomenon

When a quadrigia phenomenon occurs, the patient exhibits a flexion contracture of the involved digit and a decreased amount of flexion force in the digits next to the injured finger. The quadrigia effect can occur if the flexor digitorum profundus is advanced more than 1cm during repair, thus resulting in limited proximal excursion of the remaining flexor digitorum profundus tendons. To prevent a quadrigia effect, the physician should use advancement only for the flexor pollicis longus. The lumbral plus phenomenon results when the patient attempts to contract the profundus but instead the lumbral is pulled proximally resulting in PIPJ and DIPJ extension rather than flexion. Egawa’s sign is an indicator of ulnar nerve and interosseus muscle paralysis which means the patient is able to flex the middle finger but not able to deviate it radially and ulnarly. Linburg’s sign is an anatomic interconnection of the FPL and the FDP of the index finger.

Answer: D

Ejeskar, A., Pp. 63; Failla, J.M. Pp. 417-418  

2. Which of the following statements about Guyon’s canal is incorrect?

A. Contains the median nerve  
B. Contains the ulnar nerve  
C. Contains the ulnar artery  
D. Borders the hook of the hamate and the pisiform

The median nerve is in the carpal tunnel, not Guyon’s canal. The ulnar nerve and artery are contained in Guyon’s triangular canal. Guyon’s canal is immediately ulnar to the carpal tunnel and may be a site of ulnar nerve entrapment. The borders of this canal are the hook of the hamate and the pisiform.

Answer: A

Leclercq, C., Pp. 506-507; Matloub, H., Yusef, N., Pp. 201-214  

3. What structures form the anatomical snuffbox?

A. The lunate, ECRL and the radial artery  
B. The scaphoid, EPL, APL and EPB  
C. The trapezium. EPL, APL and the EPB  
D. The trapezoid, ECRL, EPB and the radial artery

The anatomical snuffbox is formed by the scaphoid at the base; the abductor pollicis longus and extensor pollicis brevis define the radial border; and the extensor pollicis longus lines the ulnar border.

Answer: B


Figure 1-1. Anatomic snuff box. EPL forms the ulnar border and the EPB and APL create the radial border.
4. Scapula position and motion is the result of the balanced interplay of numerous periscapular muscles. Which of these muscles contribute to the functional motion of reaching overhead?

A. The rhomboid major and the lower trapezius  
B. The serratus anterior and the lower trapezius  
C. The upper trapezius and the latissimus dorsi  
D. The serratus anterior and the upper trapezius

The serratus anterior, inserting into the lateral inferior angle of the scapula upwardly rotates the scapula during elevation of the humerus. This action is assisted and balanced by the action of the upper trapezius through its insertion into the acromion process. These muscles working in conjunction to upwardly rotate the scapula constitute a major force couple critical for smooth overhead elevation of the humerus. Little upward rotation of the scapula is noted during the first 30 degrees of humeral elevation and continues in a 1:1 ratio with humeral elevation over the terminal 60 degrees of overhead motion. An accepted ratio of humeral to scapula motion is 1.7:1.

**Answer:** D


5. Name the structures that are contained in the carpal tunnel.

A. Median nerve, flexor digitorum profundus, flexor digitorum superficialis, flexor carpi radialis  
B. Median nerve, flexor pollicis longus, flexor digitorum profundus, flexor digitorum superficialis  
C. Median nerve, palmaris longus, flexor digitorum profundus, flexor digitorum superficialis, flexor carpi ulnaris  
D. Median nerve, flexor pollicis longus, palmaris longus, flexor digitorum profundus, flexor digitorum superficialis

The carpal tunnel contains ten structures: the median nerve, four flexor digitorum profundus tendons, four flexor digitorum superficialis tendons, and the flexor pollicis longus tendon. The carpal tunnel lies deep to the palmaris longus and the wrist flexor tendons. The hook of hamate, triquetrum and pisiform form the ulnar border of the tunnel and the trapezium, scaphoid and the fascia over the flexor carpi radialis form the radial border. The floor of the tunnel is created by the concave carpal arch and the roof of the tunnel is comprised of the flexor retinaculum, the deep forearm fascia and the distal aponeurosis of the thenar and hypothenar eminences.

**Answer:** B


6. What is the anatomic interconnection between the flexor pollicis longus and the index finger flexor digitorum profundus called?

A. Linburg’s sign  
B. Reiter’s syndrome  
C. Egawa’s sign  
D. None of the above

An anatomic interconnection between the flexor pollicis longus and the index finger flexor digitorum profundus is present in a large percentage of the population (varies in different studies and recent studies indicate that is is more common than once thought). The connection may be through an anomalous tendon, musculotendinous slip, or an adherence to the tenosynovium. This anatomic variation is called Linburg’s sign. Linburg’s syndrome can occur when this interconnection leads to pain and aggravation with activity. The discomfort is located over the radiopalmar aspect of the distal forearm and thumb.

**Answer:** A

Conway, W., Linscheid, R., Dobyns, J., Pp. 1194  
Prause, D., Power, M., Khalid, T., S., Pp. 909 vol. 91

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**Clinical Gem:**

Scapula position is an important consideration in the development and management of impingement syndromes. Decreased upward rotation and increased anterior tipping and scapula medial rotation have all been associated with individuals with impingement syndrome. It is postulated that altered scapulothoracic kinematics develop as compensatory patterns for rotator cuff/deltoid force couple weakness. The clinician must consider addressing the altered scapulothoracic kinematics as part of a comprehensive rehabilitation program.
7. An interosseous ligament complex links the scaphoid and lunate. This complex is composed of:

A. A dorsal and volar ligamentous portion  
B. A contiguous band linking both bones  
C. A dorsal and volar ligamentous portion and a central membranous portion  
D. A contiguous band reinforced by the dorsal radiocarpal ligament

The scapholunate ligament complex consists of dorsal and volar ligamentous portions and a central membranous portion. The dorsal portion is considered the strongest and is vital for normal scapholunate kinematics during wrist motion. When this ligament is disrupted, the carpus may assume a dorsal intercalated segment instability pattern (DISI) particularly if the dorsal radio carpal ligament is also disrupted. Characteristic x-ray features include a widening of the scapholunate interval of greater than 4 mm, a scaphoid “ring” sign and a dorsally facing lunate seen in a true lateral view.

Answer: C  

Figure 1-3. Check reit ligaments and volar plate contribute to finger contractures.

8. Which of the following structures are implicated in the development of PIPJ flexion contractures?

A. Check-rein ligaments  
B. Collateral ligaments of the PIP joint  
C. The volar plate  
D. All of the above

Contractures of the proximal interphalangeal joint can develop from seemingly insignificant injuries particularly if the digit is positioned in a flexion posture at the PIP joint following injury. While the check reit ligaments are most often implicated in contracture development; contractures are frequently multifactorial with involvement of the collateral ligaments and the volar plate.

Answer: D  

9. Match the extensor tendons to their corresponding dorsal compartments

Compartments
1. First dorsal wrist compartment  
2. Second dorsal wrist compartment  
3. Third dorsal wrist compartment  
4. Fourth dorsal wrist compartment

Figure 1-3. Check reit ligaments and volar plate contribute to finger contractures.

CLINICAL GEM:

Appropriate treatment of the stiff PIP joint can take many forms however; most established contractures will require orthotic management for functional resolution. Author’s preferred technique is to use a serial static orthotic or serial plaster casting. This is preferable to dynamic mobilization due to the concept of stress relaxation. When observed on a stress-strain curve, static force application will ultimately allow the tissue to relax in a lengthened position. Application of persistent dynamic force does not allow the tissue to relax at any point. This can cause microfibril injury within the collagen fibers with resultant inflammation and eventually increased stiffness.

CLINICAL GEM:

The clinical signs of scapholunate ligament injury include pain to palpation over the scapholunate interval (1 cm distal to Lister’s tubercle) and a characteristic “clunk” that is produced with movements from ulnar to radial deviation. The scaphoid shift test may reproduce this clunk.

CLINICAL GEM:
1. The scapula “wings” when which muscle is paralyzed or weakened?

A. Subscapularis  
B. Serratus anterior  
C. Rhomboid major  
D. Serratus posterior

During normal scapulohumeral rhythm, the serratus anterior holds the scapula in place as it slides over the rib cage. Winging of the scapula occurs when the serratus anterior muscle becomes weak from an injury to the long thoracic nerve. The muscle originates from ribs 1 through 9 and inserts along the medial border of the scapula.

Answer: B

Greenfield, B. & Sty, D. Pp. 201-207  

Figure 21-1AB: As a pushup is performed, “winging” of the scapula is evident (A). Scapula winging (B) Photo B used with permission from Eugenia Papadopoulos MA, OTR/L, CHT

2. Which of the following muscles comprise the rotator cuff?

A. Supraspinatus, teres minor, teres major, infraspinatus  
B. Teres minor, subscapularis, posterior deltoid, infraspinatus  
C. Supraspinatus, infraspinatus, teres minor, subscapularis  
D. Supraspinatus, teres major, infraspinatus, subscapularis

The four muscles in answer C originate on the scapula and become tendons that fuse with the capsule of the shoulder, thus forming a musculotendinous cuff, which is termed the rotator cuff. All four muscles stabilize the humeral head. The supraspinatus (Figure 21-2B) abducts the shoulder, the infraspinatus and teres minor (Figure 21-2B) externally rotate the shoulder and the subscapularis (Figure 21-2A) interally rotates the shoulder.

Answer: C


Figure 21-2AB: Muscles of the rotator cuff, acting together centralize the axis of humeral head rotation. Subscapularis & Teres Minor (A). Supraspinatus, Infraspinatus & Teres Minor (B). Photos are used with permission from Michelle Reiner OTR/L, CHT from Illustrated Shoulder 2nd ed. www.illustratedseries.com

3. Two prime retractors of the scapula are the rhomboid major and the rhomboid minor. Name the nerve that innervates these muscles.

A. Thoracodorsal nerve  
B. Long thoracic nerve  
C. Subscapular nerve  
D. Dorsal scapular nerve

The dorsal scapular nerve is derived from C4 and C5 nerve roots and innervates the rhomboid major, rhomboid minor, and levator scapulae.

Answer: D

Mager, D. Pp. 104
4. The nerve most commonly injured in fractures around the proximal humerus is which of the following?

A. Musculocutaneous nerve  
B. Radial nerve  
C. Axillary nerve  
D. Suprascapular nerve

The axillary nerve (Figure 21-3) exits the axilla from the brachial plexus and wraps around the posterior aspect of the surgical neck of the humerus, thus innervating the deltoid and teres minor muscles. This nerve is susceptible to trauma from fractures to the proximal humerus.

Answer: C

Donatelli, R. Pp. 202  
Greenfield, B. & Geist, K. Pp. 169  
Basti, J., Dionysia E., & Sherman, P. Pp. 111-112  

5. A primary extensor of the shoulder is which of the following?

A. Teres minor  
B. Long head of the triceps  
C. Latissimus dorsi  
D. Trapezius

Primary extensors of the shoulder include the posterior portion of the deltoid, the teres major, and the latissimus dorsi. The teres minor and the long head of the triceps are secondary extensors.

Answer: C

Hoppenfeld, S., Pp. 26

6. Match each muscle with the nerve that supplies it.

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Nerve</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Serratus anterior</td>
<td>1. Dorsal scapular</td>
</tr>
<tr>
<td>2. Rhomboid major</td>
<td>2. Thoracodorsal</td>
</tr>
<tr>
<td>3. Latissimus dorsi</td>
<td>3. Accessory</td>
</tr>
<tr>
<td>4. Trapezius (upper fibers)</td>
<td>4. Long thoracic</td>
</tr>
</tbody>
</table>

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

Reid, D.C., Pp. 92  

7. True or False: The coracoclavicular ligament is the only noncontractile structure suspending the scapula from the clavicle.

The coracoclavicular ligament (Figure 21-4) is the only noncontractile structure that suspends the scapula from the clavicle. The major support of the acromioclavicular (AC) joint is the coracoclavicular ligament. It comprises two parts—the conoid and the trapezoid ligaments—and connects the clavicle and coronoid process. The two parts are oriented differently and resist different forces placed on the scapula and clavicle.

Answer: True

Pratt, N.E., Pp. 66-67  
Reid, D.C., Pp. 92  
www.illustratedseries.com
8. True or False: The three structures that make up the coracoacromial arch are the acromion, the coracoacromial ligament, and the coracoid process.

The coracoacromial arch comprises the acromion, the coracoacromial ligament, and the coracoid process. The arch is anatomically above the rotator cuff. Compression of the rotator cuff, especially the supraspinatus tendon, is believed to lead to rotator cuff degeneration and possibly even biceps tendon rupture. This is because of supraspinatus compression between the humeral head below and the coracoacromial arch above.

Answer: True

Flatow, E.L., Pp. 20-21

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9. True or False: In normal shoulder biomechanics, both the deltoid and the rotator cuff allow elevation of the humerus to occur.

Elevation of the shoulder occurs because of the combined actions of the rotator cuff muscles and the deltoid muscle acting as a “force-couple.” As abduction occurs, the action of the deltoid causes the humerus to move into the glenoid fossa. At the end range of motion, the deltoid causes the head of the humerus to translate downward, out of the glenoid cavity. This action is counteracted by the group of muscles known as the rotator cuff. The rotator cuff acts to stabilize the humerus in the glenoid fossa. The deltoid muscle is the primary workhorse of the shoulder joint.

Answer: True

Lofth, T., & Wadsworth, C., P. 395

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10. Match each muscle to the correct innervation.

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Innervation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Coracobrachialis</td>
<td>A. Subscapular nerve</td>
</tr>
<tr>
<td>2. Subscapularis</td>
<td>B. Thoracodorsal nerve</td>
</tr>
<tr>
<td>3. Levator scapulae</td>
<td>C. Musculocutaneous nerve</td>
</tr>
<tr>
<td>4. Subclavius</td>
<td>D. Fifth and sixth cervical nerves</td>
</tr>
<tr>
<td>5. Latissimus dorsi</td>
<td>E. Dorsal scapular nerve</td>
</tr>
</tbody>
</table>

Answer: 1, C; 2, A; 3, E; 4, D; 5, B

Sieg, K. & Adams, S., P. 27, 30, 34, 36

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11. Which muscle is not a horizontal abductor of the shoulder?

A. Infraspinatus
B. Posterior deltoid
C. Teres major
D. Teres minor

The teres major is an internal rotator of the shoulder at 90 degrees of shoulder abduction; it is not a horizontal abductor of the shoulder. It is innervated by the subscapular nerve derived from C6-C7.

Answer: C

Warner, & Dam, A.D. P. 261

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**CLINICAL GEM**

Infraspinatus attaches to the superior facet of the greater tubercle of the humerus, posterior deltoid inserts on a tuberosity on the lateral aspect of the humerus, and teres minor inserts on to lower facet of the greater tubercle of humerus. However, teres major attaches to the medial lip of the bicipital groove. Muscles contract towards the origin. Visualize these muscles contracting towards the origin and you will be able to see that teres major will NOT function as a horizontal abductor.