SPECIAL THANKS

• We move our profession forward by sharing and building on the work of others. Thanks to these colleagues who allowed me to stand on their shoulders today:

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Learning Objectives

• Upon completion of this course, participants will be able to:
  • 1. Discuss the common mechanisms of nerve injuries.
  • 2. Delineate the pathways of the median, ulnar, and radial nerves through the arm.
  • 3. List the major entrapment sites for the median, ulnar and radial nerves of the upper extremity.
  • 4. Demonstrate typical nerve assessment tests.
  • 5. Discuss practical treatment interventions for massage therapists.

Nerve Injury Mechanisms

• Stretch
• Tear
• Entrapment/Compression
• Cumulative Injury (repetitive stress)
• Crush (Double-Crush phenomena)
Nerve Entrapment/Compression

• AKA: Nerve compression syndrome, compression neuropathy, or entrapment neuropathy.
• Usually defined as direct pressure on a single nerve.
• Symptoms vary widely and may include pain, tingling, numbness, and muscle weakness.

Double Crush Syndrome

• A peripheral nerve compression syndrome in which there is a 'central' compression on a nerve bundle (e.g. at the nerve root or the thoracic outlet) and a 2nd more peripheral compression (e.g. at the carpal tunnel).

Compression Injury Schematic

UE Nerve Entrapment Sites

• 1. spine
• 2. scalenes
• 3. 1st rib/clavicle
• 4. pec minor
• 5. coracobrachialis
Nerve Distribution Regions

Thoracic Outlet Syndrome

- Thoracic outlet syndrome (TOS) describes a group of disorders that result from compression, injury, or irritation of neurovascular structures at the root of the neck, the upper thoracic region, or beneath the pectoralis minor muscle.

TOS Locations

- Anterior Scalene Syndrome: entrapment between anterior and middle scalene muscles.
- Costoclavicular Syndrome: impingement between clavicle and first rib.
- Pectoralis Minor Syndrome: entrapment between pectoralis minor and underlying ribs.

Brachial plexus (C5–T1)

- The last four cervical spinal nerves, C5 through C8, and the first thoracic spinal nerve, T1, combine to form the brachial plexus.
- A tangled array of nerves, splitting, combining and recombing, to form the nerves that serve the upper extremity and upper back.
Neural TOS

- Neurogenic TOS = 95% of cases, more common in women
- Bony and/or soft tissues in the lower neck/upper chest compress and irritate the nerves of the brachial plexus.

- Symptoms:
  - Weakness or numbness of the hand (esp. 4th-5th fingers).
  - Atrophy of hand muscles on the affected side.
  - Pain, tingling, prickling, numbness and weakness in the neck, chest, and arms.

Arterial TOS

- Impingement of the subclavian artery by bony or soft tissues.

- Symptoms:
  - Cold sensitivity in the hands and fingers
  - Numbness, pain or sores of the fingers
  - Poor blood circulation to the arms, hands and fingers.
  - Skin may be pale.

Venous TOS

- Venous: caused by impingement to the subclavian vein. This vein does not pass through the scalenes, so is not affected by anterior scalene syndrome.

- The condition develops suddenly, often after unusual and tiring exercise of the arms.

- Symptoms:
  - Swelling of the hands, fingers and arms.
  - Heaviness and weakness of the neck and arms.
  - The veins in the anterior chest wall may appear swollen. Skin may be bluish/purple.

Assessment

- Accurate assessment of TOS symptoms in our clients is important because TOS responds well to massage and bodywork treatments.

- Due to the overlapping of nature of symptoms, it’s often difficult to make a definitive assessment. It’s common to have neural and vascular entrapment simultaneously.
Tests

- These three procedures start with locating the radial pulse. A diminished pulse during the test indicates arterial impingement at the structure being assessed. Neural symptoms may also increase during testing.

  - Adson’s Test: Anterior Scalene Syndrome
  
  - Eden’s Test: Costoclavicular Syndrome
  
  - Wright’s Test: Pec. Minor Syndrome

Palpate Radial Pulse

- Assessment of the strength of the client’s radial pulse when the client is relaxed and in a neutral position.

  - This is done at the beginning of the assessment for each of the three TOS locations.

Adson’s Test for Anterior Scalene Syndrome

- The client rotates the head toward (or away) from the affected side, then laterally flexes away from the affected side, then extends the neck, while the practitioner palpates the radial pulse.

  - Accentuate the test by having the client take and hold a deep breath (scalenes are respiratory muscles).

  - Decrease in strength of the radial pulse is positive for anterior scalene syndrome.

Edens Test for Costoclavicular Syndrome

- Client pulls the shoulder girdle back and down and pushes the chest forward (military posture), while the radial pulse is palpated.

  - Accentuate the test by having the client take and hold a deep breath (lifts ribs tighter against clavicle).

  - Decrease in strength of the radial pulse is positive for costoclavicular syndrome.
Wrights Test for Pec. Minor Syndrome

• Passively move the client’s arm up and back, while the radial pulse is palpated.

• Accentuate the test by having the client take and hold a deep breath (lifts ribs tighter against taut pec. minor).

• Decrease in strength of the radial pulse is positive for pectoralis minor syndrome.

Treatment Goals

• Short-term: relieve the impingements on the affected structures to allow them to heal.

• Long-term: correct upper quadrant postural asymmetries (slumped shoulders, forward heads, hyperkyphosis, etc.) to keep the thoracic outlet open.

Addressing Scalenes

• Reducing hypertonicity in the scalenes, especially the anterior and middle bellies will help relieve pressure on the brachial plexus as it exits the cervical spine.

• Caution: deep massage to the scalenes when they’re already too tight is counterproductive and may cause more irritation to the nervous system.

• Consider using light pressure as this can be more effective in helping restore proper tone.

Scalenes and Elevated Shoulders

• Reducing scalene hypertonicity allows the whole ribcage to drop, releasing the chronically elevated shoulder girdle and creating space between the clavicles and the first ribs.
Scalene Hypertrophy

- From Mike Reinold.com:
  - One of the major reasons that thoracic outlet syndrome occurs in baseball pitchers is from hypertrophy of the scalene muscles (and SCM). Throwing a baseball causes many adaptations to the body, including this increase in scalene size.
  - Here are photos of the athlete inhaling with his head turned to each side. Notice the significantly larger scalene and SCM on his right side.

Scalene Sweep

- The most comfortable way to work scalenes, which also helps pull the forward head back and up on top of the shoulders, is to sweep across them from the anterior neck all the way around to the spinous processes, thus assisting the other neck muscles to migrate back.
- In all cases, err on the side of conservativeness with your pressure. The point is to draw the muscles back, not to press into the neck - especially not pressing hard into the anterior and lateral aspect.

Treatment Interventions: Scalenes

- Scalenes Sweep
- Scalenes Facilitated Stretch

Scalenes Stretch on the Table

1. Active lateral flexion of the neck to stretch the scalenes.
2. Easy isometric contraction of the stretched scalenes.
3. Active stretch to new range motion

Ask me to demonstrate the shrug stretch option.
Addressing Pectoralis Minor

Since the Pectoralis Minor is a common entrapment area in Thoracic Outlet Syndrome, reducing the hypertonicity in this area is critical.

Palpating Pectoralis Minor

• With the client supine, lay your thumb along the clavicle, then slide inferiorly into the soft tissue.
• Slide laterally until you come to the first bony prominence (the coracoid), which is usually quite tender.
• Pec minor attachment is at 7 o’clock (left side).
• Coracobrachialis at 6 o’clock,
• Biceps brachii at 5 o’clock.

Treatment Interventions: Pectoralis Minor

• Pin and Stretch
• Facilitated Stretch

Pin and Stretch Technique

Pectoralis Minor:

• With client supine, use the pads of your fingers to palpate the pectoralis minor at the coracoid attachment.
• Gently stretch the muscle inferiorly, away from the coracoid process, while the client pulls the shoulders toward the table and brings the shoulder blades together and down, as if putting them in the back pockets.
• Then ask the client to externally rotate the arms and slide them up the table toward their head to increase the stretch on the pec minor (and the pec major).
Pec Minor Stretch

- This stretch reduces hypertonicity in the pec minor and may reduce compression on the neurovascular structures.
- Hold the client’s hand to keep the arm from bouncing around.
- Client first stretches by pulling the shoulder toward the table and sliding the scapula down the back.
- During the isometric phase, the client attempts to push the shoulder toward the ceiling.

Common Median Nerve Compression Syndromes

- Pronator Teres Syndrome
- Carpal Tunnel Syndrome

Median Nerve Pathway

Median Nerve Entrapment Sites

- 1. spine
- 2. scalenes
- 3. 1st rib/clavicle
- 4. pec minor
- 5. coracobrachialis
- 6. ligament of struthers
- 7. pronator teres
- 8. flexor digitorum arch
- 9. carpal tunnel
Illustrations of Entrapment

1. Entrapment at the pronator teres
2. Fibrous arch of the flexor digitorum superficialis.
3. Lacertus fibrosus (bicipital aponeurosis)
4. Supracondylar process and ligament of Struthers

Assessing Nerve Mobility

- Gliders and Sliders
- Using assessments to help pinpoint possible entrapments

Pronator Teres Syndrome

- A compression neuropathy of the median nerve at the pronator teres.
- Often accompanied by medial epicondylitis

Pronator Teres Syndrome

- Symptoms:
  - Paresthesia in thumb, index, middle finger and radial half of ring finger (similar to carpal tunnel syndrome).
  - Paresthesia often made worse with repetitive pronation-supination.
- Differentiate from carpal tunnel syndrome (CTS):
  - Exacerbated by repetitive elbow flexion
  - Aching pain over proximal forearm
  - Lack of night symptoms
Pronator Teres Syndrome Assessment

- The client stands with the elbow in 90 degrees of flexion.
- Place one hand on the client's elbow for stabilization and hold the client's hand in a handshake position.
- The client holds this position as you attempt to supinate the client's forearm (forcing the client to contract the pronator muscles).
- While holding this isometric effort, straighten the client's elbow (stresses flexor digitorum superficialis).

Carpal Tunnel Syndrome (CTS)

- Compression neuropathy of the median nerve as it passes under transverse carpal ligament.
- Often results from tenosynovitis of the flexor tendons in the carpal tunnel.
- Considered a repetitive stress condition.
- Double crush condition makes the nerve more susceptible to CTS.

Carpal Tunnel Anatomy

- The carpal tunnel, formed by the carpal bones and the flexor retinaculum, contains 9 sheathed tendons:
  - 1 flexor pollicis longus
  - 4 flexor digitorum superficialis
  - 4 flexor digitorum profundus
  - And the median nerve.

Carpal Tunnel Syndrome (CTS)

- Symptoms:
  - Paresthesia, numbness, pain in the median nerve distribution of the hand and fingers. At the wrist, the nerve is composed of over 90% sensory fibers.
  - “Night symptoms” caused by sleeping with the wrists flexed.
- Primary Assessment:
  - Phalen’s Test
Note About Carpal Tunnel

- True carpal tunnel syndrome does not have sensory loss over the thenar eminence.

- This is because the palmar cutaneous branch of the nerve(sensory), which innervates that area, branches off the median nerve and passes over the carpal tunnel.

- This feature of the median nerve can help separate carpal tunnel syndrome from thoracic outlet syndrome, or pronator teres syndrome.

Carpal Tunnel Syndrome

Phalen’s Test

- The client presses the back of the hands together to flex the wrists to approx. 90°.
- If pain, paresthesia or numbness in the median nerve distribution are reproduced within about 60 seconds, the test is considered positive.

Carpal Tunnel

Tethered Median Nerve Test

- Useful in detecting chronic, low-grade median nerve compression.
- Produces the greatest amount of distal nerve excursion in the carpal tunnel.

- Perform by hyperextending the supinated wrist and the index finger for one minute.

Carpal Tunnel

Tinel’s Test

- Light percussion over the median nerve as it passes under the transverse carpal ligament.
- The least sensitive of the median nerve tests but is the most specific test for median neuropathy at the carpal tunnel.
Median Nerve Treatment Goals

• Short-term: relieve the impingements on the affected structures to allow them to heal. Accomplish this through soft-tissue work and stretching.

• Long-term: identify and correct perpetuating factors.

Effective Treatment Interventions

• Pin and Stretch Techniques

• Transverse Friction

• Facilitated Stretching

Pin and Stretch: Forearm Flexors

• Client supine.

• Supinated forearm fully supported on the treatment table, with the wrist free to flex and extend.

• Beginning at the fully-flexed wrist, use your loose fist to apply a firm gliding stroke toward the elbow, along the length of the forearm while the client slowly extends the wrist & fingers.

• For more specific work, use a smaller contact, such as a flat thumb pointing along the length of the forearm.

Pin and Stretch: Pronator Teres

• Client supine. Upper arm fully supported on the treatment table, with the elbow bent.

• With the forearm in neutral or somewhat pronated, use a broad thumb or loose fist to apply a firm gliding stroke diagonally from the radial attachment to the medial epicondyle while slowly supinating the forearm.

• OK to keep the forearm on the table and use a loose fist for the stroke.
Transverse Friction: Forearm

- Use transverse friction work to address adhesions in muscles, tendons and ligaments and to release the median nerve entrapped in these tissues.

- Start with general friction to an entire structure and then get more specific as necessary.

- To perform transverse friction well, palpate the desired structure and then work across the grain of the tissue. Apply the stroke using a thumb or finger, as if glued to the skin.

Transverse Friction: Wrist

- Use fingers or thumb to apply transverse friction to the tendons and the retinaculum at the wrist.

- Start with general friction and then get more specific as necessary.

- To perform transverse friction well, palpate the desired structure and then work across the grain of the tissue. Apply the stroke using a thumb or finger, as if glued to the skin.

Facilitated Stretching: Wrist Flexors

- Client supine, forearm fully supported on the table, wrist & fingers fully extended.

- Match your fingers and thumb to client, use your other hand to stabilize the forearm.

- Direct the client to slowly try to flex the wrist and fingers, while you prevent the movement. Hold this isometric contraction for 6 seconds.

- After the isometric, the client actively stretches by extending the wrist and fingers to a new ROM.

Facilitated Stretching: Pronators

- Client supine, elbow bent, forearm supinated.

- Support the forearm with one hand and place the other across the wrist and hand.

- Direct the client to slowly try to pronate, while you prevent the movement. Hold this isometric contraction for 6 seconds.

- After the isometric, the client actively stretches by supinating to a new ROM.
Common Ulnar Nerve Compression Syndromes

- Cubital Tunnel Syndrome
- Guyon’s Canal Syndrome (cyclists palsy)

Ulnar Nerve Pathway

Ulnar Nerve Entrapment Sites

- The 6 sites of potential ulnar nerve entrapment around the elbow: arcade of Struthers, medial intermuscular septum, medial epicondyle, cubital tunnel, deep flexor pronator aponeurosis (between the heads of the flexor carpi ulnaris) and Guyon’s canal.

Arcade of Struthers

- Thin aponeurosis extending from medial head of triceps to the medial intermuscular septum.
- Not to be confused with the Ligament of Struthers (which may compress the median nerve).
- Located 8-10 cm (3-4 in.) proximal to the medial epicondyle. Not always present.
Cubital Tunnel Syndrome

- Ulnar nerve compression at the elbow is the 2nd most common nerve entrapment of the upper extremity, after carpal tunnel syndrome.
- The cubital tunnel is formed by the two heads of flexor carpi ulnaris. One head blends with the flexor tendon attachments at medial epicondyle (humerus), the other attaches to the olecranon process (ulna). They’re connected by an aponeurosis.

Cubital Tunnel Syndrome

- Symptoms may include:
  - pain, paresthesia, burning, and weakness in the fifth finger and ulnar side of the fourth finger and numbness in the dorsal ulnar aspect of the hand and fingers.

Cubital Tunnel Syndrome Elbow Flexion Test

- Client stands with elbows flexed and wrists extended for 30-60 seconds.
- This position compresses the ulnar nerve at the cubital tunnel and adds some stretch at the level of the wrist.
- Symptoms may appear in less than 30 seconds.

Cubital Tunnel Syndrome

- Due to compression of the ulnar nerve at the wrist (Guyon’s canal).
- Symptoms include pins and needles in the little and ring finger.
- May also include impaired motor function.
- Often present along with cubital tunnel syndrome (double-crush).

Cycler’s palsy

- Due to compression of the ulnar nerve at the wrist (Guyon’s canal).
- Symptoms include pins and needles in the little and ring finger.
- May also include impaired motor function.
- Often present along with cubital tunnel syndrome (double-crush).
Ulnar Nerve Treatment Goals

• Short-term: relieve the impingements on the affected structures to allow them to heal. Accomplish this through soft-tissue work and stretching.

• Long-term: identify and correct perpetuating factors.

Effective Treatment Interventions

• Ulnar Nerve treatment focuses on the same muscle groups as for Median Nerve, with the addition of coracobrachialis.

• Pin and Stretch Techniques

• Transverse Friction

• Facilitated Stretching

Coracobrachialis

• Notice the compact relationship between biceps and coracobrachialis.

• Palpation and friction work on the inside of the arm will help identify nerve entrapment in either the median or the ulnar nerve (Arcade of Struthers).

Common Radial Nerve Compression Syndromes

• Radial Tunnel Syndrome

• Posterior Interosseous Nerve (PIN) Syndrome
Radial Nerve Pathway

- The radial nerve dives posterior and passes next to the long head of the triceps and through the space between the teres minor and the teres major.

Radial Nerve & Teres Group

- Radial nerve entrapment is the least common of the three main UE nerves.
- The most frequent site of compression is at the radial tunnel (Arcade of Frohse) at the proximal edge of the supinator muscle.

Radial Nerve Entrapment Sites

- The edge of the arcade is normally thin and membranous.
- A thickened, tendinous proximal edge is developmental, occurring in 30–100% of people, likely due to repetitive pronation–supination.
Radial Tunnel Syndrome

• Compression of the sensory fibers of the radial nerve.

• **Symptoms:** pain, paresthesia, or numbness near the lateral epicondyle. Aching or burning sensation along the lateral aspect of the forearm, mimicking lateral epicondylitis.

Radial Nerve (PIN): Posterior Interosseous Branch

• Posterior interosseous nerve syndrome (motor fibers): weakness of the extensor muscles of the forearm.
• Also called supinator syndrome.

Radial Tunnel Syndrome Assessment

**Isometric Muscle tests:**

1. **Client attempts supination,** with elbow extended (to minimize biceps brachii recruitment).
2. **Resisted Long Finger Extension.**

Positive Test = increased pain or weakness.

Radial Nerve Treatment Goals

• **Short-term:** relieve the impingements on the affected structures to allow them to heal. Accomplish this through soft-tissue work and stretching.

• **Long-term:** identify and correct perpetuating factors.
Effective Treatment Interventions

• Pin and Stretch Techniques

• Transverse Friction

• Facilitated Stretching

Pin and Stretch: Forearm Extensors

• Client supine.

• The pronated forearm is resting on the treatment table, with the wrist free to flex and extend.

• Beginning at the fully-extended wrist, use your loose fist to apply a firm gliding stroke toward the elbow, along the length of the forearm while the client slowly flexes the wrist & fingers.

• For more specific work, use a smaller contact, such as a flat thumb pointing along the length of the forearm.

Pin and Stretch: Forearm Supinator

• Client supine. Hold the forearm in neutral, upper arm rests on the treatment table.

• Beginning at the distal end of the supinator, use your loose fist to apply a firm gliding stroke toward the lateral elbow, while passively pronating the clients forearm.

• For more specific work, use a smaller contact, such as a flat thumb.

Transverse Friction: Forearm

• Use transverse friction work to address adhesions in muscles, tendons and ligaments and to release the median entrapped in these tissues.

• Start with general friction to an entire structure and then get more specific as necessary.

• To perform transverse friction well, palpate the desired structure and then work across the grain of the tissue. Apply the stroke using a thumb or finger, as if glued to the skin.
Facilitated Stretching: Wrist Extensors

- Client supine, forearm supported on the table, loose fist with thumb inside.
- Wrap your hand over the fist, use your other hand to stabilize the forearm.
- Direct the client to slowly try to extend (open) the wrist and fingers, while you prevent the movement. Hold this isometric contraction for 6 seconds.
- After the isometric, the client actively stretches by flexing the wrist and fingers to a new ROM.

Facilitated Stretching: Supinator

- Client supine, elbow bent, forearm pronated.
- Support the forearm with one hand and place the other across the wrist and hand.
- Direct the client to slowly try to supinate, while you prevent the movement. Hold this isometric contraction for 6 seconds.
- After the isometric, the client actively stretches by pronating to a new ROM.

Palpation Practice

- Locate coracoid process (what muscles attach here?)
- Coracobrachialis in upper arm
- Arcade of struthers (ulnar nerve)
- Ligament of struthers (median nerve)
- Pronator teres (median nerve)

Assessment Workflow

- Client History and Symptom Pattern
- Working Hypothesis: TOS or Other
- Appropriate Neural Tests
  - TOS: Adson’s, Eden’s Wright’s
  - Assess for Pronator Teres Syndrome, Carpal Tunnel (Phalen’s), Cubital Tunnel (Elbow Flexion), Radial Tunnel Syndrome.
  - Nerve Glides
Treatment Strategies

- Protect (Don’t Over-Treat, Work in the Pain-Free Zone)
- Pin and Stretch
- Transverse Friction
- Facilitated Stretching
- Nerve glides

Brugger Relief Posture

- Sit with your “sit bones” at the edge of the bench/chair.
- Lengthen your back and neck and tuck your chin.
- Drop your shoulders.
-Externally rotate your arms so the palms face to the side. Keep your fingers as wide as possible.
- Hold this position for 10 seconds, relax, repeat 5-10 times.

Self-Care:
Resistance Band Pulldowns

- This exercise engages the scapular retractors and depressors as you pull the band slowly outward and downward to the base of the skull.
- Tuck your chin to your throat and keep your ears over your shoulders. Don’t bend the neck forward.
- You get the most benefit from the eccentric phase of the exercise.

Self-Care:
Resistance Band Pulldowns

- Exhale as you pull the band down and out.
- Complete 8-10 repetitions per set.
- Performing this exercise between client sessions will retrain your shoulder and upper back muscles.
Recommended Reading

- Orthopedic Assessment in Massage Therapy
  by Whitney Lowe

- Freedom from Thoracic Outlet Syndrome
  by Joe Muscolino, D.C.
  AMTA Journal, 2006
  http://www.amtamassage.org/articles/3/MTJ/detail/1666

References


  http://www.wsiat.on.ca/english/mlo/carpal.htm

Let’s Get Social

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