THORACIC OUTLET COMPRESSION SYNDROME

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4th grade medical student

Time 50-60 minutes

Objectives

HISTORY

Anatomic Features

Clinical Manifestations

Diagnosis and Treatment

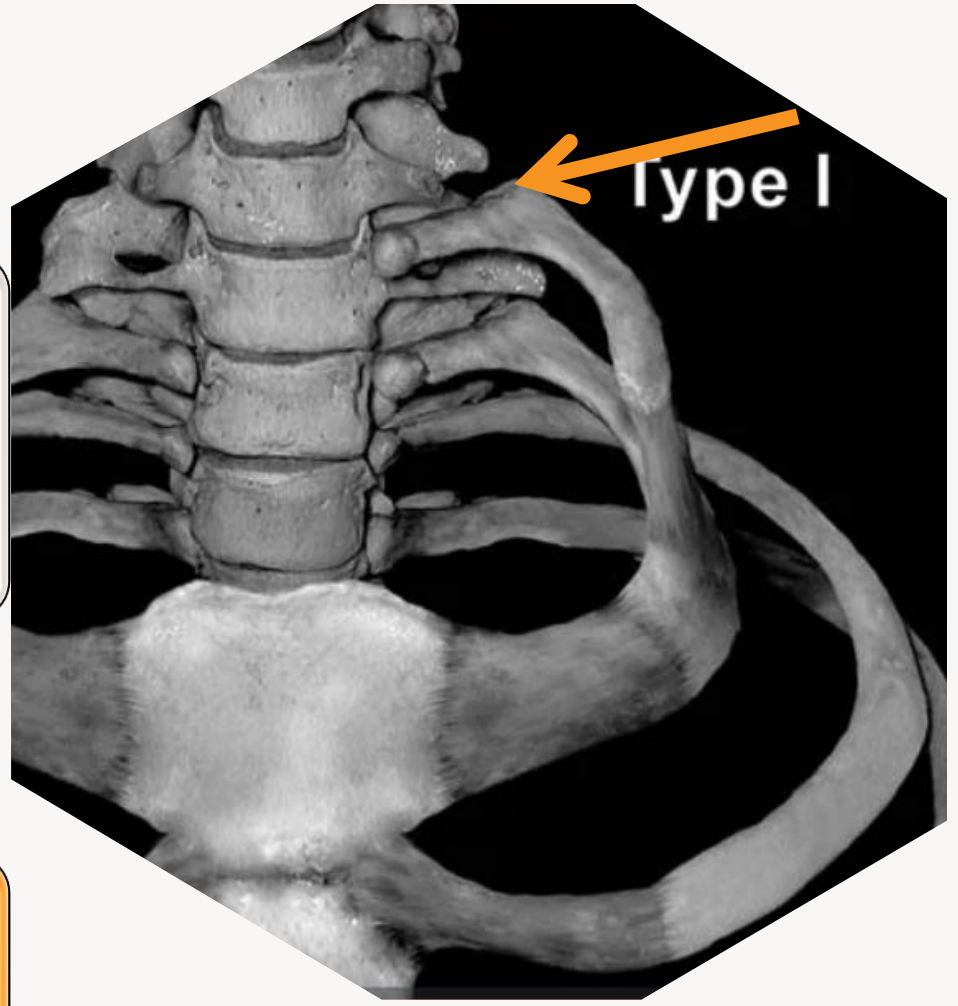
Introduction and History

1821 – Sir Astley Cooper first described compression of the subclavian artery

1861 – Aran described neurogenic symptoms

1939 – Peet et al. at the Mayo Clinic coined the term "Thoracic Outlet Syndrome" (TOS)

1970s–1990s: TOS was subdivided into: Neurogenic TOS (nTOS) 95% of cases.

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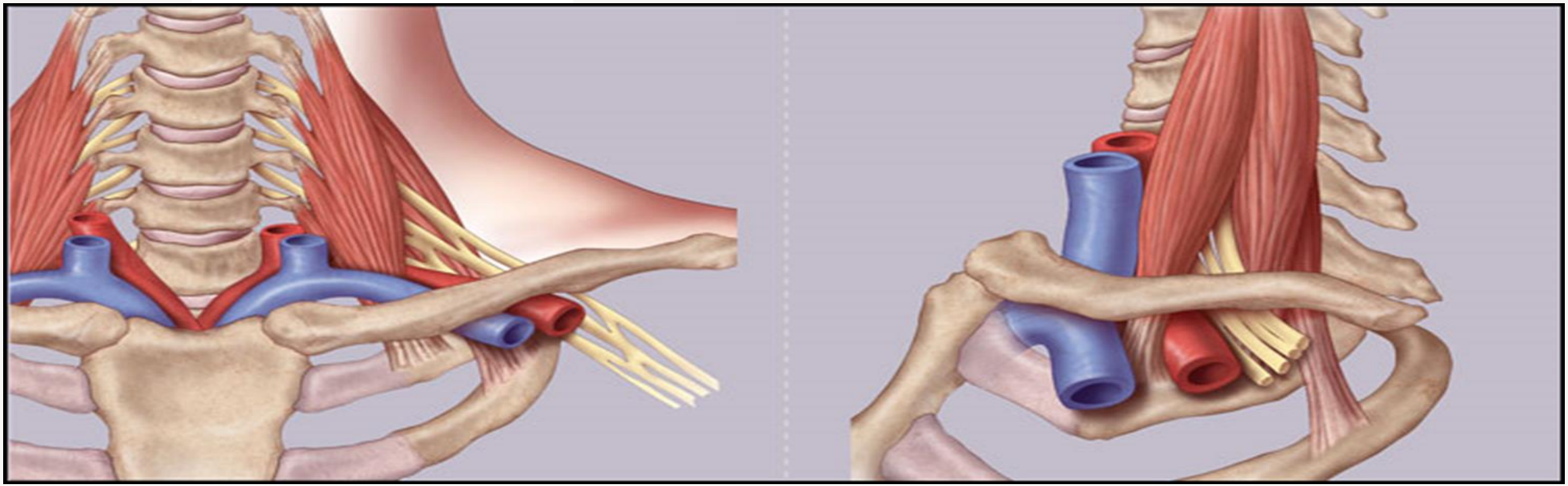
Cardinals

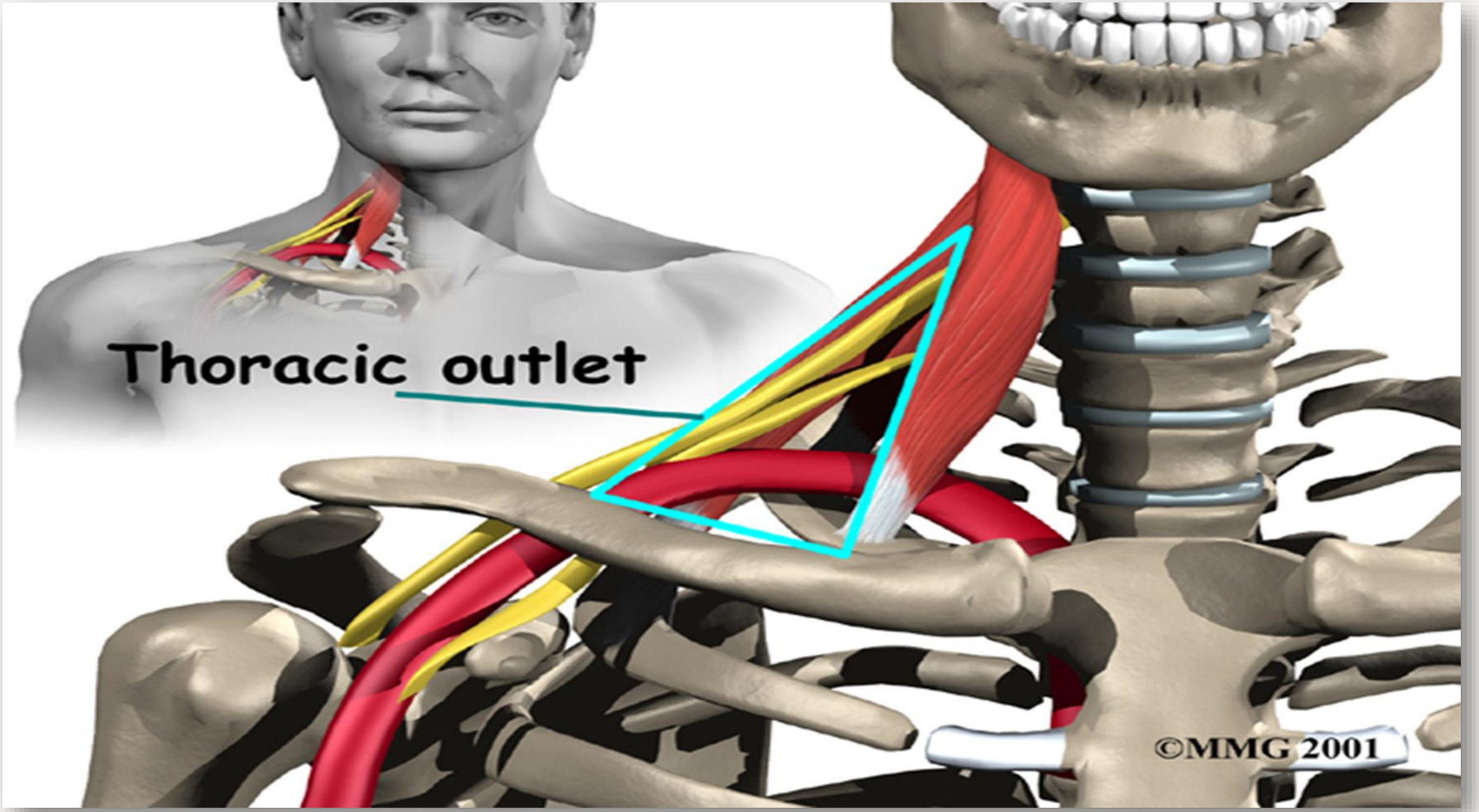
Definition AND ANATOMY

It is the compression of the subclavian vessels and brachial plexus at the superior aperture of the chest.

Scalenus muscle ,which inserts on the scalene tubercle of the first rib , divides the costa-clavicular space into two compartment The anteromedial one containing subclavian vein and the poster lateral one contain the subclavian artery and the brachial plexus

(Scalene triangle) , which is bounded by the scalenus anticus anteriorly , the scalenus mediums posteriorly , and the first rib inferiorly .




Thoracic outlet
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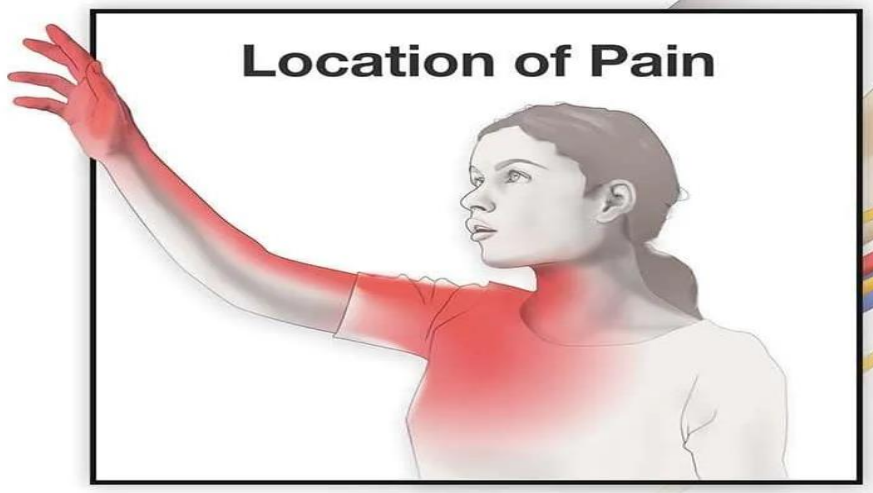
Common points of compression include:

- scalene triangle
- costoclavicular junction
- interpectoral space



Scalene muscles

Collarbone (clavicle)

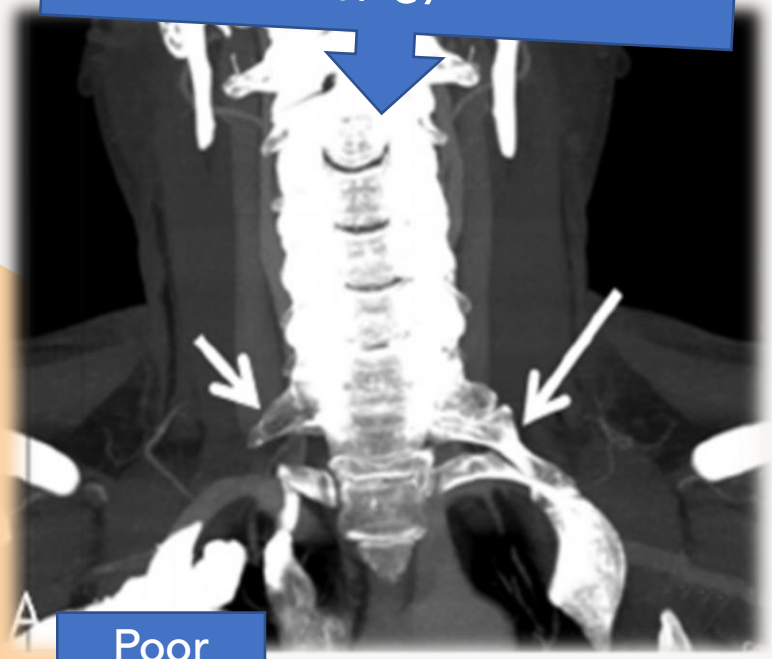
Pectoralis minor muscle

Causes (Etiology)

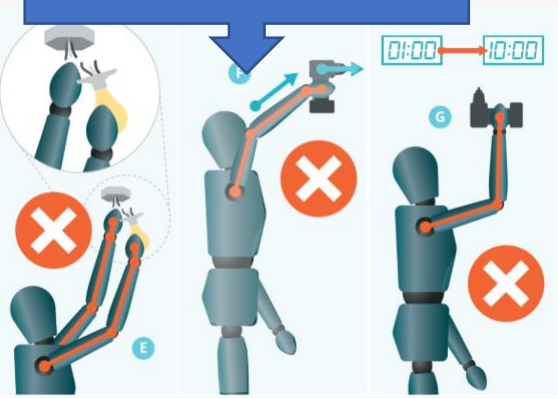
Congenital / Anatomical	Acquired Causes	Postural / Mechanical Factors
• Cervical rib (C7 rib) – found in ~0.5–1% of the population, symptomatic in some • Fibrous bands from C7 and below • first rib Anomalous first rib • elongated transverse process of C7 • Abnormal scalene muscle insertion or hypertrophy	• **Repetitive arm movements** (e.g. athletes, overhead workers) • **Post-traumatic fibrosis or callus** (clavicle or first rib fracture) • **Whiplash injury** → scalene muscle spasm and fibrosis • **Poor posture** (drooping shoulders, forward head posture)	• **Heavy backpacks or shoulder loads** • **Weightlifting / bodybuilding (scalene hypertrophy)** • **Pregnancy** (due to postural changes)

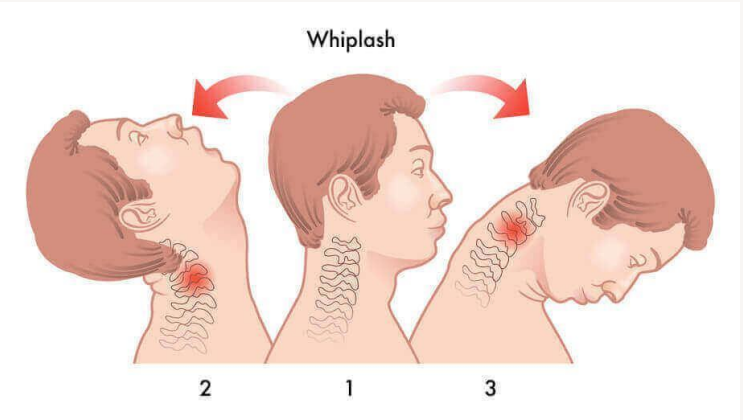
Cervical rib

elongated transverse process of C7



overhead workers





shoulder loads

Poor posture

Weightlifting

Box 26.1 Causes of Neurovascular Compression Syndromes

Anatomic

- Potential sites of neurovascular compression
  - Interscalene triangle
  - Costoclavicular space
  - Subcoracoid area

Congenital

- Cervical rib and its fascial remnants
- Rudimentary first thoracic rib
- Scalene muscles
  - Anterior
  - Middle
  - Minimus
- Adventitious fibrous bands
- Bifid clavicle or first rib
- Exostosis of first thoracic rib
- Enlarged transverse process of C7
- Omohyoid muscle
- Anomalous course of transverse cervical artery
- Abnormal lateral insertion of costoclavicular ligament
- Flat clavicle

Traumatic

- Fracture of clavicle
- Dislocation of head of humerus
- Crushing injury to upper thorax
- Sudden, unaccustomed muscular efforts involving shoulder girdle muscles
- Cervical spondylosis and injuries to cervical spine

Atherosclerosis

Pathophysiology

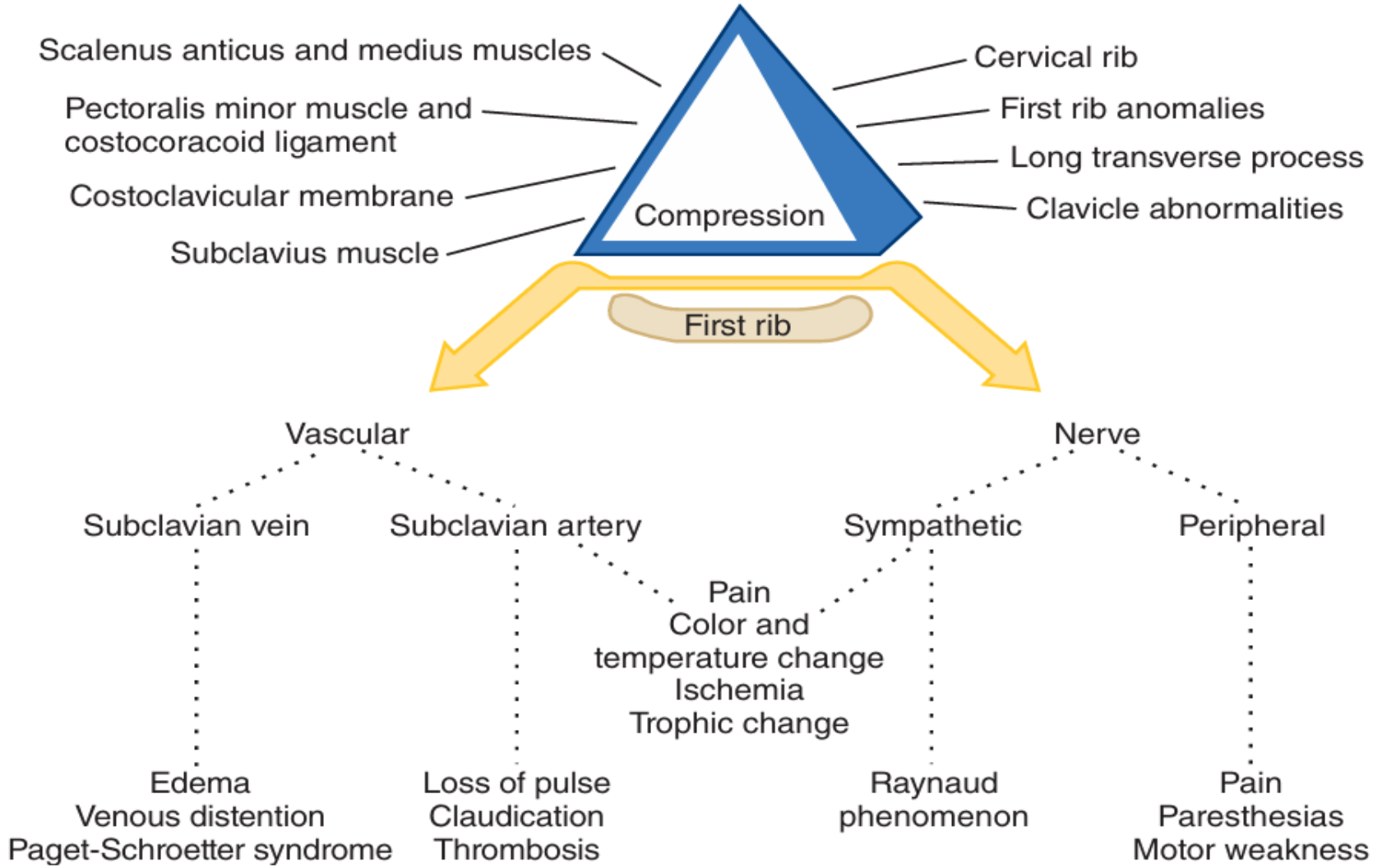


Fig. 26.1 Diagram of the relationships of muscle, ligament, and bone abnormalities in the thoracic outlet that can compress neurovascular structures against the first rib.

Paget-Schroetter syndrome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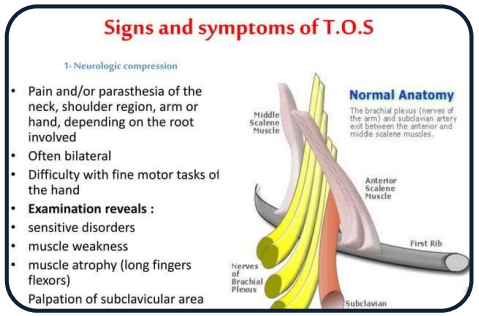
Clinical Manifestations

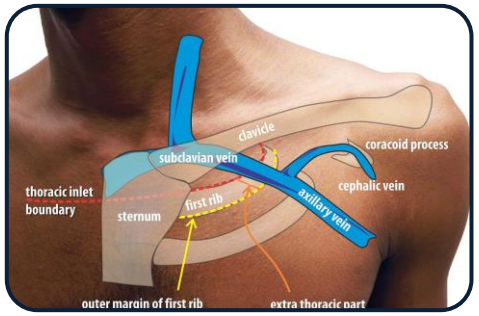
The symptoms of TOS depend on whether the nerves or blood vessels, or both, are compressed in the cervico-axillary canal

Neurogenic manifestations are observed more frequently than vascular ones. Pain and paresthesia's are present in approximately 95% of cases;

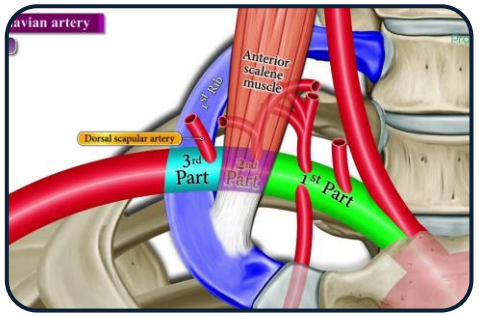
Symptoms may be initiated by sleeping with the arms abducted and the hands clasped behind the neck.



Neurogenic TOS (nTOS) Brachial plexus (C8–T1) Pain, paresthesia, weakness in upper limb • Pain and tingling radiating from neck/shoulder to ulnar side (4th–5th fingers)•Numbness, especially when arm is elevated• Weak hand grip• Thenar/hypothenar muscle wasting in advanced cases• Neck/shoulder pain (often dull, aching)



Venous TOS (vTOS) Subclavian vein Venous congestion symptoms • Swelling of arm and hand• Heaviness and cyanosis (bluish discoloration)• Prominent superficial veins (collaterals)• May develop effort thrombosis (Paget-Schroetter syndrome) after exercise

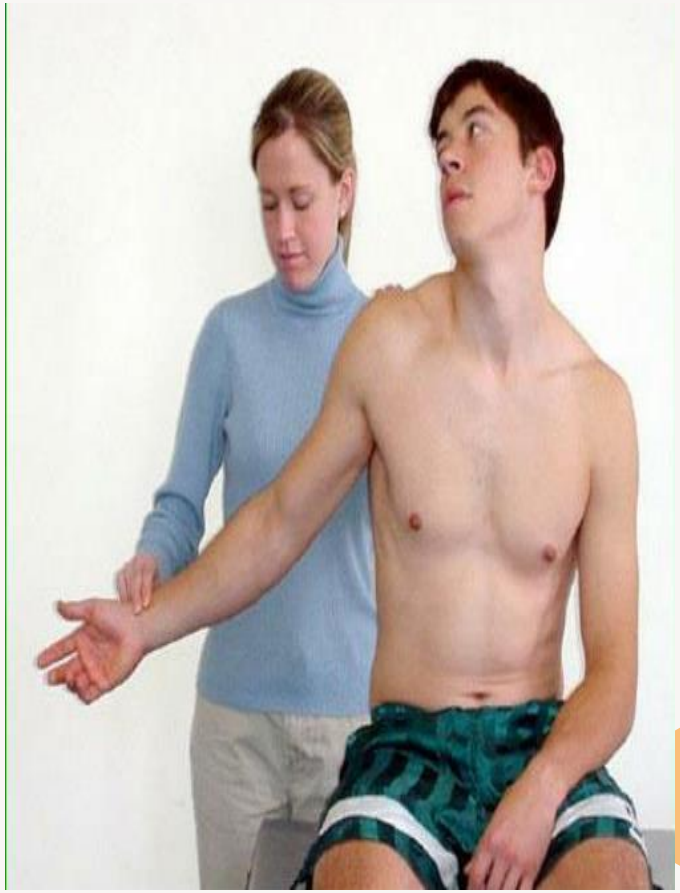


Arterial TOS (aTOS) Subclavian artery Ischemic symptoms • Coldness, pallor, or color change of hand• Diminished or absent distal pulse (especially with arm elevation)• Pain on exertion (claudication)• Possible digital ischemia or gangrene in severe cases• Bruit over supraclavicular fossa

Diagnostic Tests for TOS

Adson's Test (Scalene Test)

- Patient turns head toward affected side,
- inhales deeply,
- and extends neck while examiner palpates radial pulse.
- ↓ or loss of radial pulse,
- Compression between anterior and middle scalene muscles



Diagnostic Tests for TOS

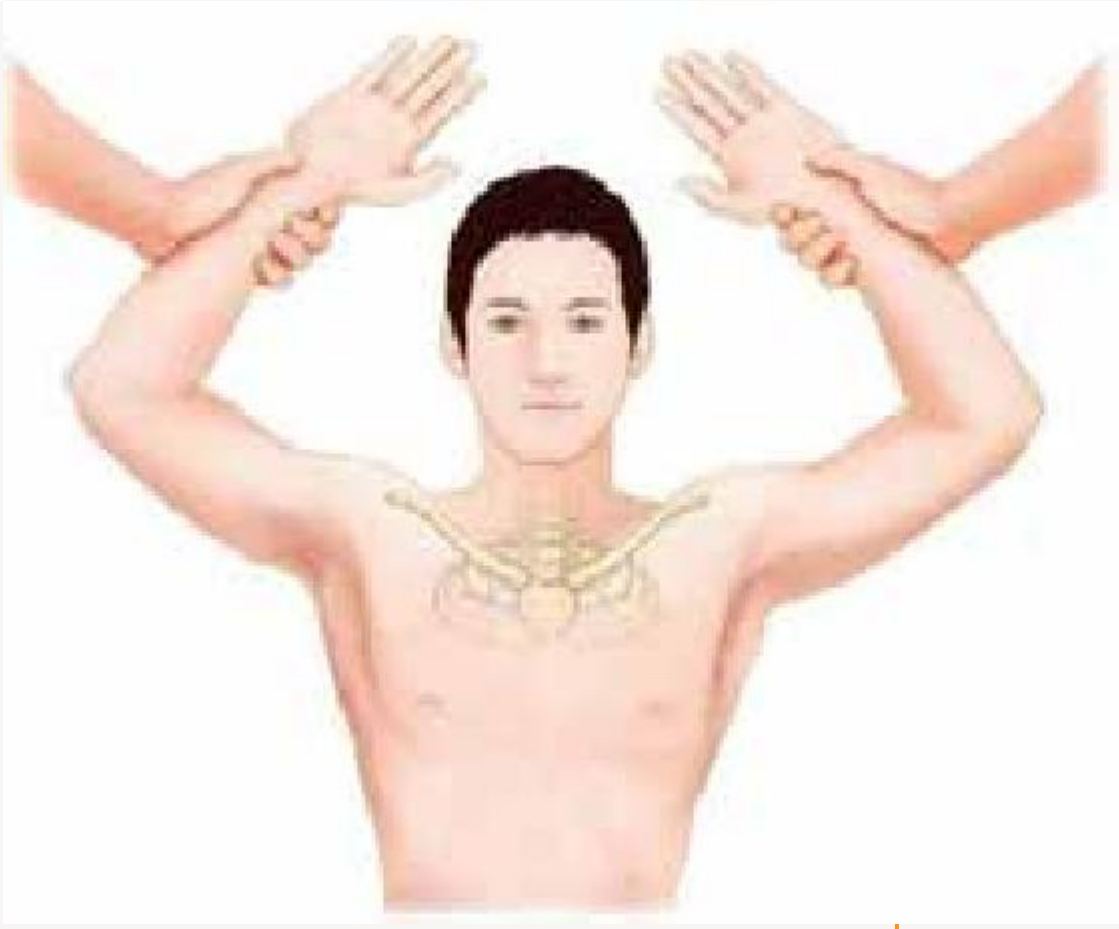
Halstead (Costoclavicular) Maneuver

- Patient draws shoulders down and back (military posture).
- Loss of pulse or symptoms
- Compression between clavicle and first rib

Diagnostic Tests for TOS

Hyperabduction) Test

- Arm is abducted and externally rotated above head
- while monitoring radial pulse.
- Loss of pulse or symptoms
- Compression under pectoralis minor / coracoid process



Diagnostic Tests for TOS

Roos (Elevated Arm Stress Test)

- Patient holds arms in 90° abduction/external rotation,
- opens and closes fists for 3 min.
- Pain, numbness, heaviness, or fatigue
- Sensitive test for neurogenic TOS

Diagnostic Tests for TOS

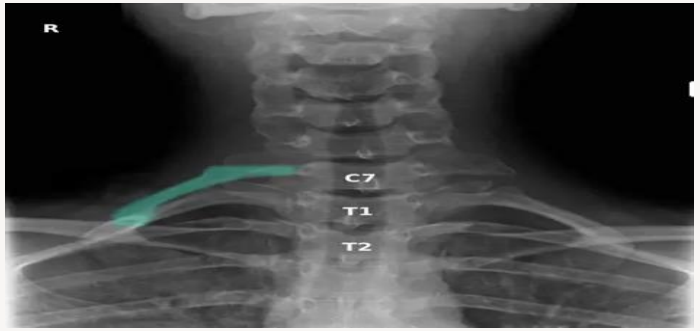
Allen's Test (Modified)

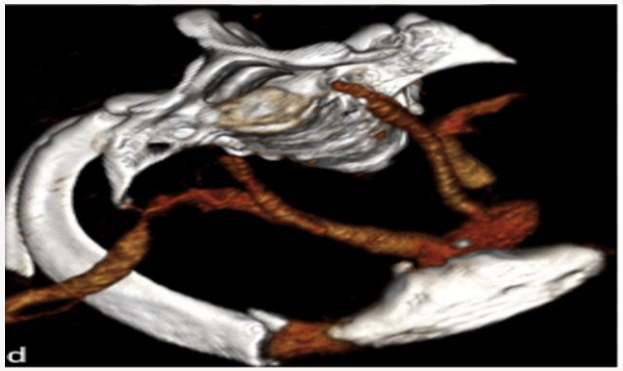
- Arm abducted and externally rotated
- patient looks away while examiner palpates pulse
- ↓ Pulse, paresthesia
- Arterial compression

Investigations for TOS

Chest & neck radiograph:

- Bony deformity
- Vertebral abnormality





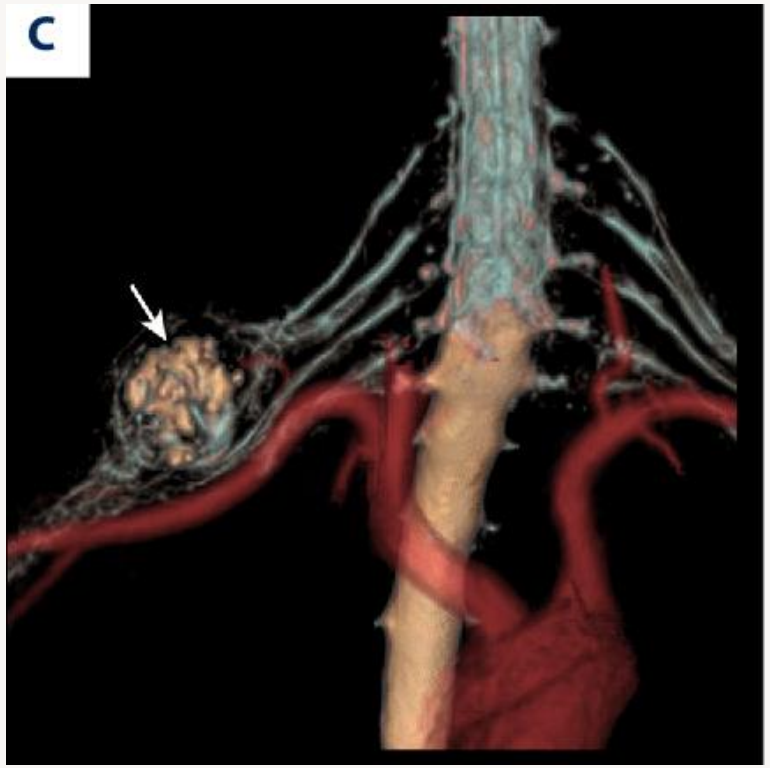
CT / CT Angiography (CTA)

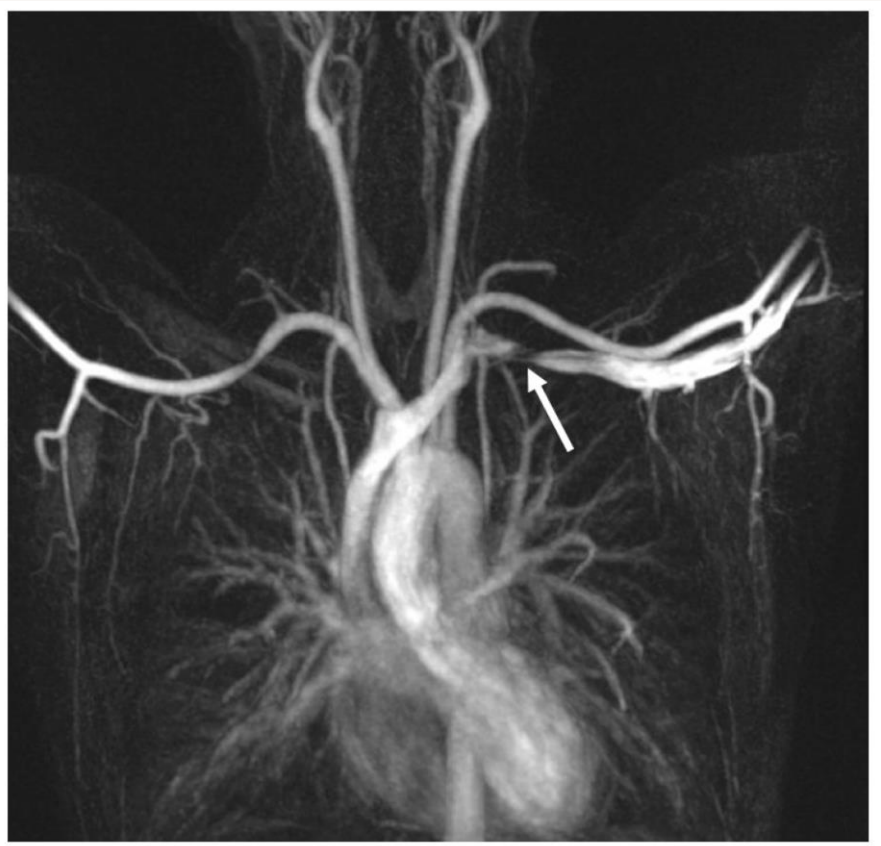
- Defines bony anatomy,
- vascular compression, aneurysm, or thrombosis

Diagnostic Tests for TOS

MRI / MR Angiography (MRA)

- Shows soft-tissue structures
- (scalene muscles, fibrous bands)
- vessel narrowing dynamically

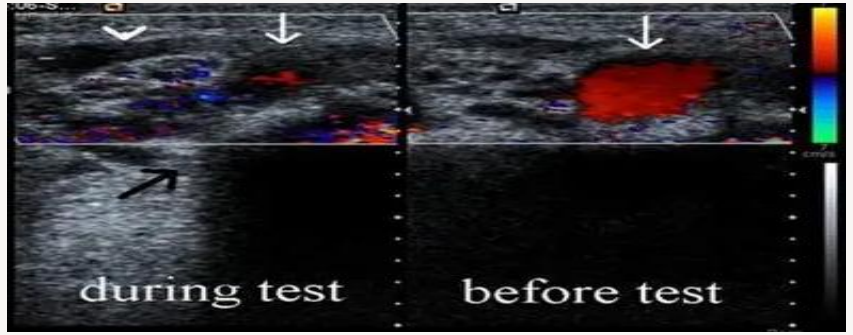




Diagnostic Tests for TOS

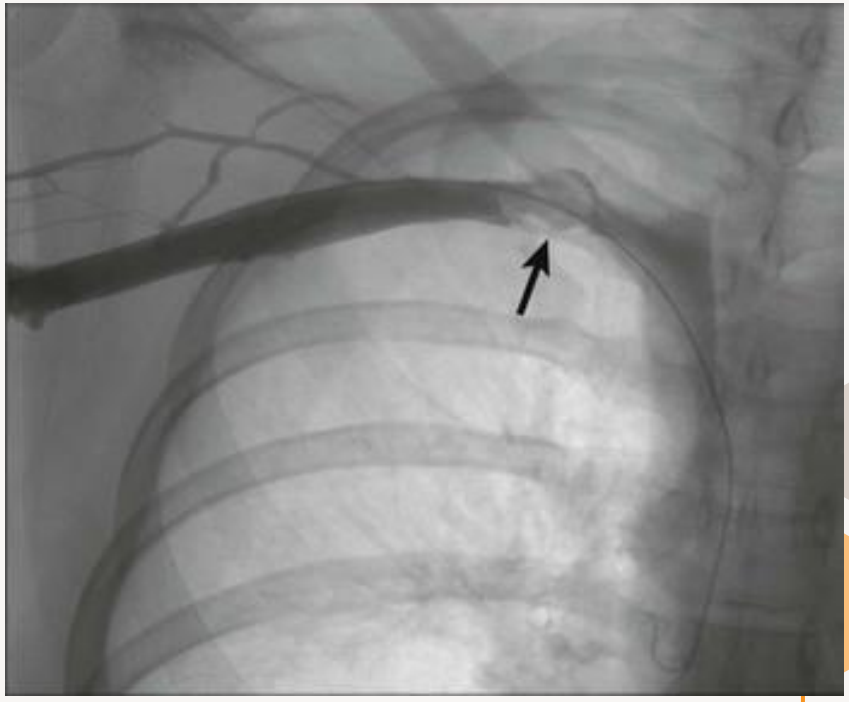
Ultrasound / Duplex Scan

- Evaluates arterial or venous flow during arm movement; non-invasive



Venography / Arteriography

- Confirms dynamic vascular compression or thrombosis
- (gold standard for vascular TOS)



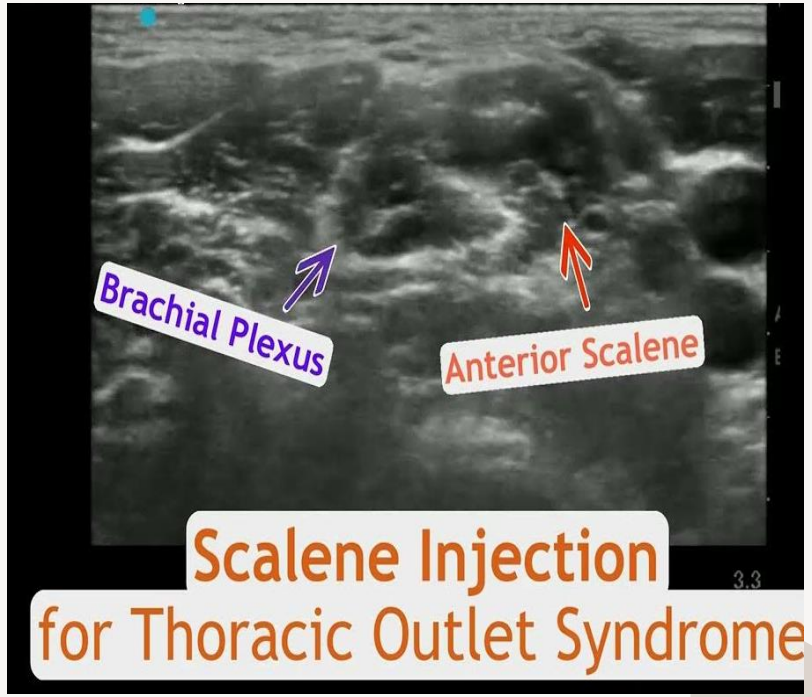
Diagnostic Tests for TOS

Electrodiagnostic Tools Test

- Role Nerve Conduction Study (NCS)
- ↓ conduction in lower brachial plexus (C8–T1) → neurogenic TOS
- Electromyography (EMG) Denervation in small hand muscles
- Somatosensory Evoked Potentials (SSEPs) Confirms neural transmission delay

Scalene muscle block (local anesthetic):

- Temporary symptom relief supports neurogenic TOS diagnosis.



Treatment of TOS

Conservative (Non-Surgical) Management

- First-line therapy for most patients (especially neurogenic TOS).
  - Lifestyle & Postural Modification
  - Avoid repetitive overhead activities
  - Correct poor posture (shoulder droop, forward head)
  - Avoid carrying heavy loads on the shoulder

B. Physical Therapy (Mainstay)

- Postural training: Strengthen trapezius, levator scapulae, rhomboids Stretching exercises: Scalene, pectoralis minor Range of motion and nerve gliding exercises
- Breathing exercises to relax scalene muscles Improvement seen in 60–70% of neurogenic cases within months

C. Pharmacologic Therapy

- NSAIDs → reduce pain and inflammation Muscle relaxants (e.g., tizanidine)
- relieve scalene spasm Neuropathic pain agents (gabapentin, pregabalin)
- Short course of corticosteroids (in resistant inflammatory cases)

D. Local Injections Scalene muscle block (lidocaine + steroid)

- diagnostic & therapeutic Botulinum toxin injection into scalene or pectoralis minor → temporary relief

Treatment of TOS

Surgical Management Indicated

- Vascular compression (arterial or venous TOS)
- Failed conservative therapy (≥6 months)
- Progressive neurologic deficit or muscle wasting
- Thrombosis / embolization due to compression

Surgical Procedures Procedure

- First rib resection Relieves compression from rib–clavicle space
- Scalenectomy (anterior ± middle) Removes hypertrophied scalene muscles
- Cervical rib excision Removes congenital cause of compression
- Pectoralis minor tenotomy For subcoracoid compression
- Thrombectomy / bypass graft
- vascular TOS with thrombosis or aneurysm
- Surgical approach Transaxillary, supraclavicular, or infraclavicular depending on the structure compressed.

THORACIC OUTLET SYNDROME REHABILITATION EXERCISES

1. SCALENE STRETCH: This stretches the neck muscles that attach to your ribs. Sitting in an upright position, clasp both hands behind your back, lower your left shoulder, and tilt your head toward the right. Hold this position for 15 to 30 seconds and then come back to the starting position. Lower your right shoulder and tilt your head toward the left until you feel a stretch. Hold for 15 to 30 seconds. Repeat 3 times on each side.

SCALENE STRETCH

2. PECTORALIS STRETCH: Stand in a doorway or corner with both arms on the wall slightly above your head. Slowly lean forward until you feel a stretch in the front of your shoulders. Hold 15 to 30 seconds. Repeat 3 times.

PECTORALIS STRETCH

3. SCAPULAR SQUEEZE: While sitting or standing with your arms by your sides, squeeze your shoulder blades together and hold for 5 seconds. Do 3 sets of 10.

SCAPULAR SQUEEZE

4. ARM SLIDE ON WALL: Sit or stand with your back against a wall and your elbows and wrists against the wall. Slowly slide your arms upward as high as you can while keeping your elbows and wrists against the wall. Do 3 sets of 10.

ARM SLIDE ON WALL

THORACIC OUTLET SYNDROME REHABILITATION EXERCISES

5. THORACIC EXTENSION: While sitting in a chair, clasp both arms behind your head. Gently arch backward and look up toward the ceiling. Repeat 10 times. Do this several times per day.

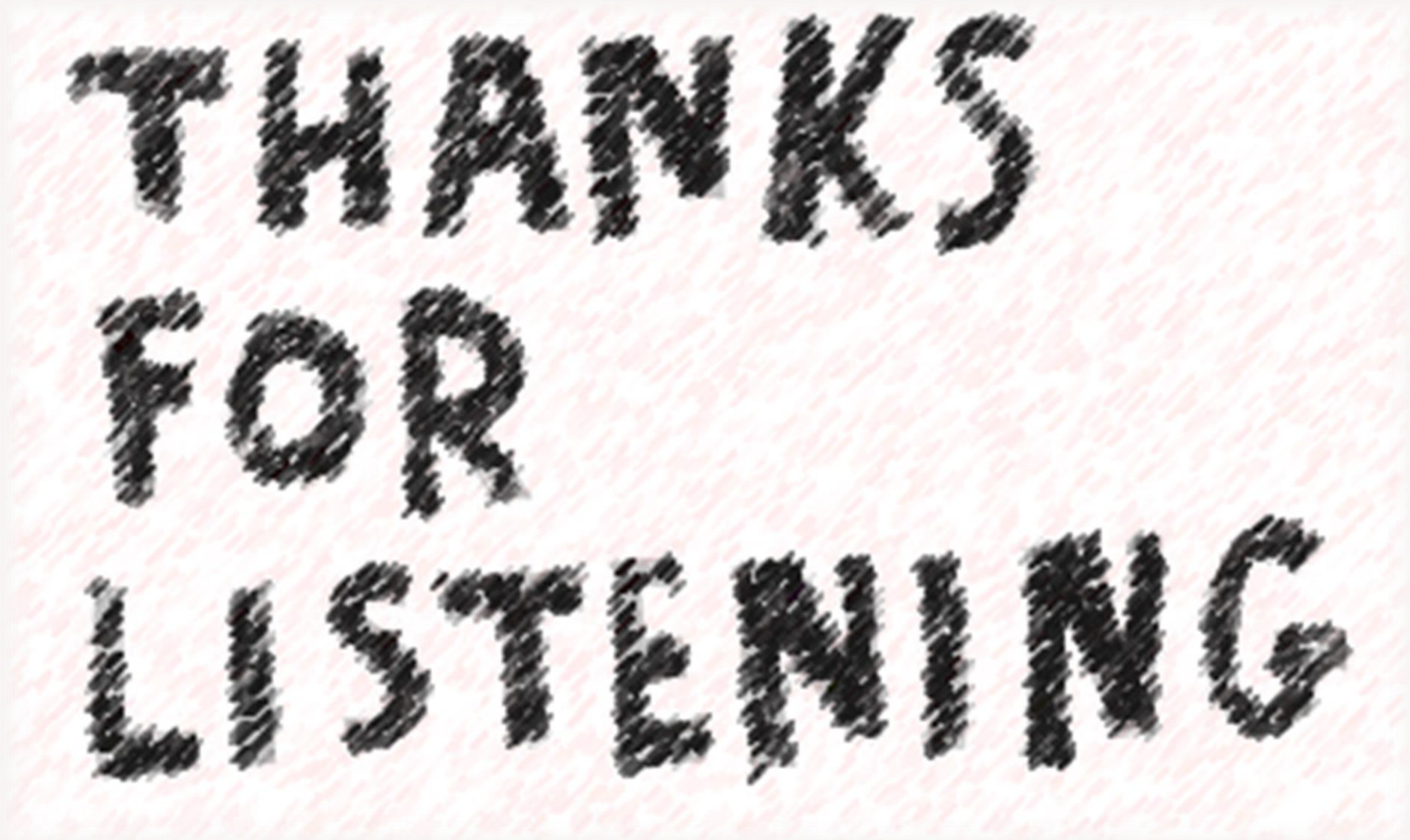
THORACIC EXTENSION

6. ROWING EXERCISE: Tie a piece of elastic tubing around an immovable object and grasp the ends in each hand. Keep your forearms vertical and your elbows at shoulder level and bent to 90 degrees. Pull backward on the band and squeeze your shoulder blades together. Repeat 10 times. Do 3 sets.

ROWING EXERCISE

7. MID-TRAP EXERCISE: Lie on your stomach on a firm surface and place a folded pillow underneath your chest. Place your arms out straight to your sides with your elbows straight and thumbs toward the ceiling. Slowly raise your arms toward the ceiling as you squeeze your shoulder blades together. Lower slowly. Do 3 sets of 15. Progress to holding soup cans or small weights in your hands.

MID-TRAP EXERCISE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