بسم اللّٰه الرحمن الرحيم

Thoracic Outlet Syndrome

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Learning Objectives

Understand the pathophysiology of TOS

Learn the provocative maneuvers to diagnose TOS

Understand treatment options for TOS

Outlines

- Definition
- Anatomy
- Epidemiology
- Symptoms
- Physical Exam
- Diagnostic Testing
- Differential Diagnosis
- Treatment

Definition

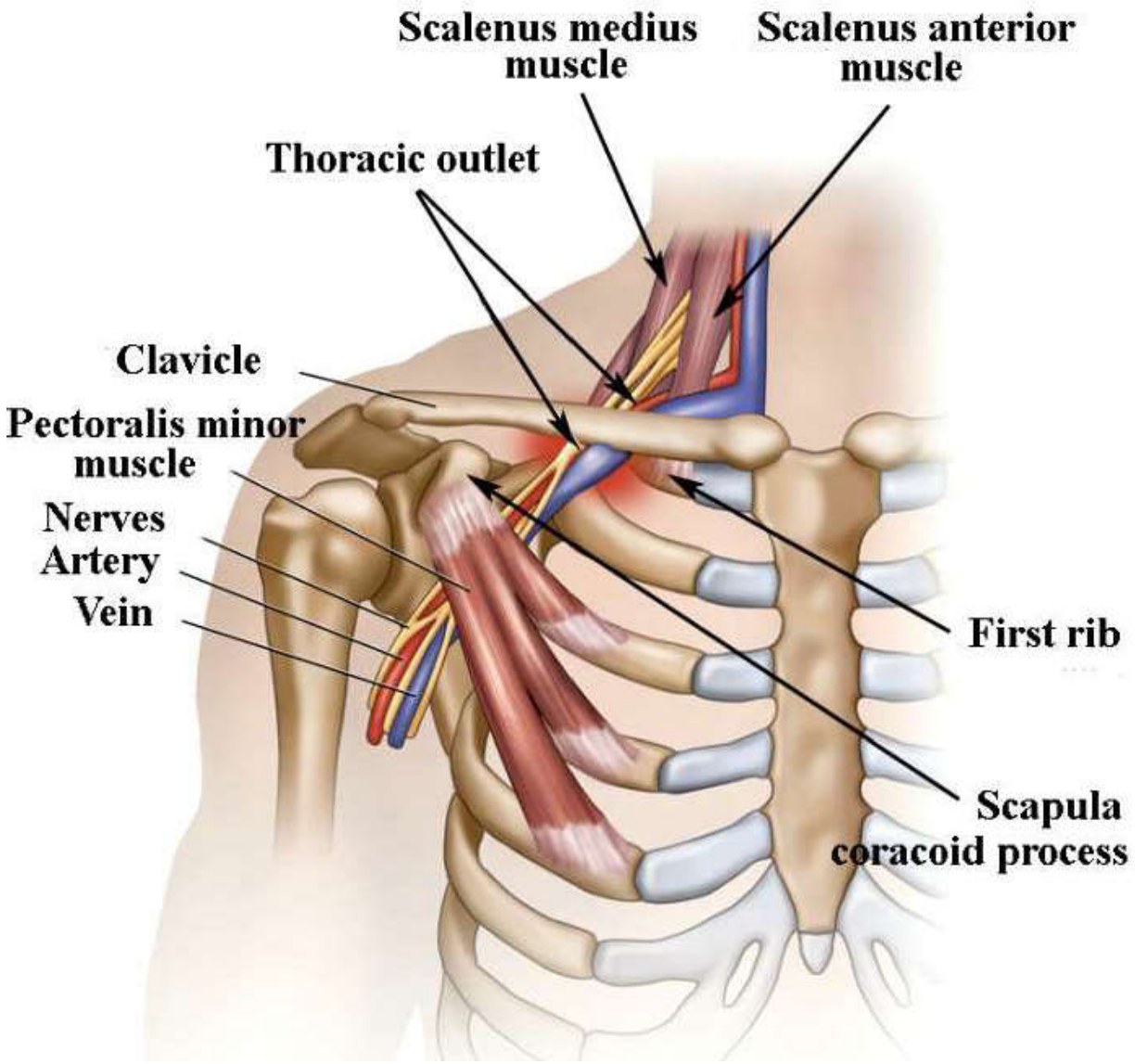
- Upper extremity symptoms due to compression of the neurovascular bundle in the thoracic outlet area (area of the neck just above the first rib).
- The specific structures compressed are usually :

➢ The nerves of the brachial plexus

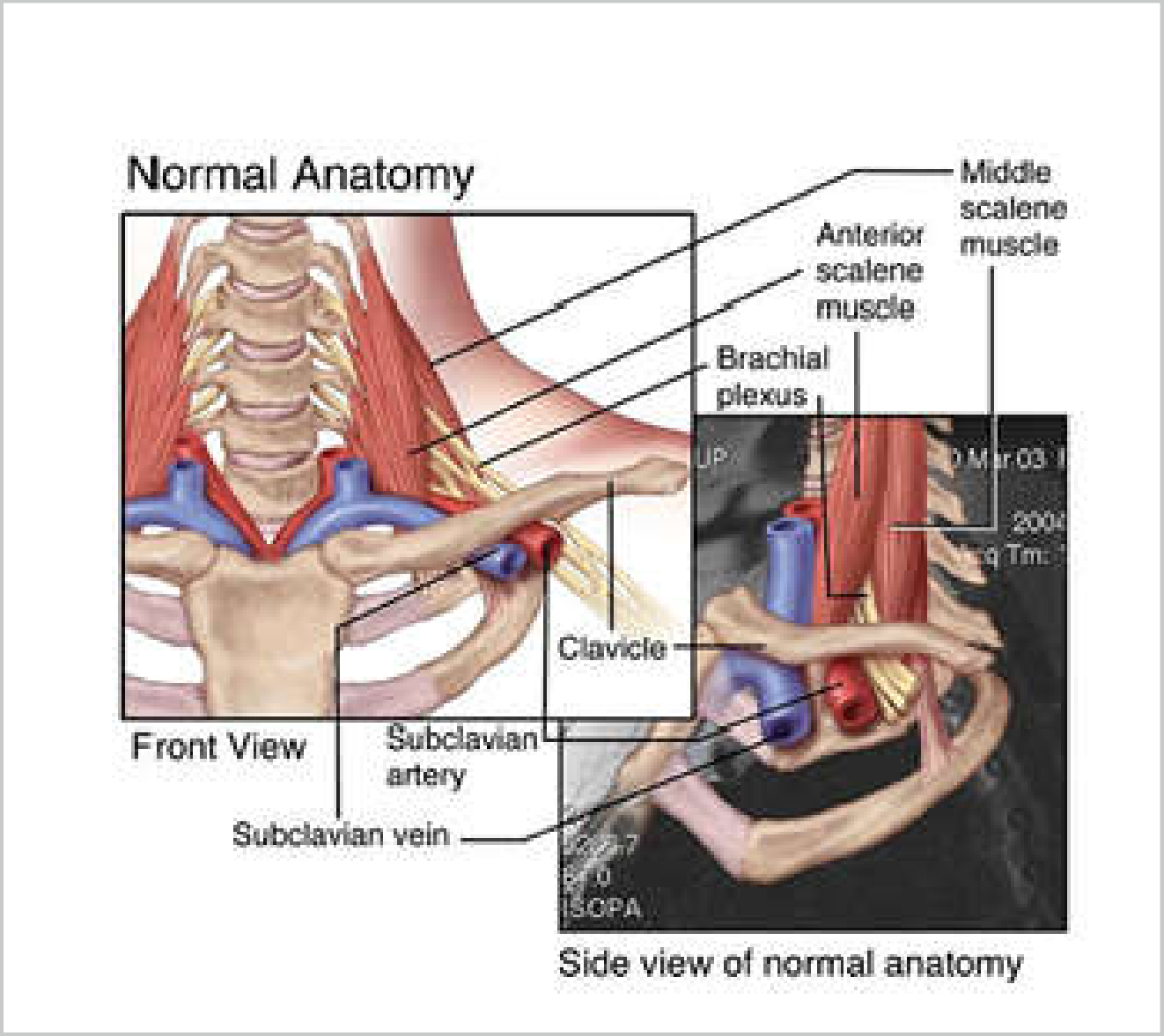
➢ The subclavian artery

➢ Subclavian vein

- And occasionally Sympathetic nerves.

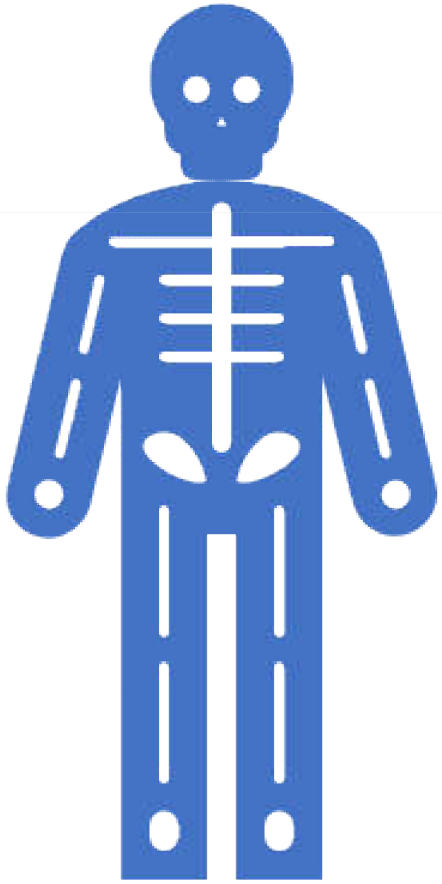

Scalenus medius muscle
Scalenus anterior muscle
Thoracic outlet
Clavicle
Pectoralis minor muscle
Nerves
Artery
Vein
First rib
Scapula coracoid process

TOS - Anatomy


Normal Anatomy
Middle scalene muscle
Anterior scalene muscle
Brachial plexus
Clavicle
Front View
Subclavian artery
Subclavian vein
Side view of normal anatomy

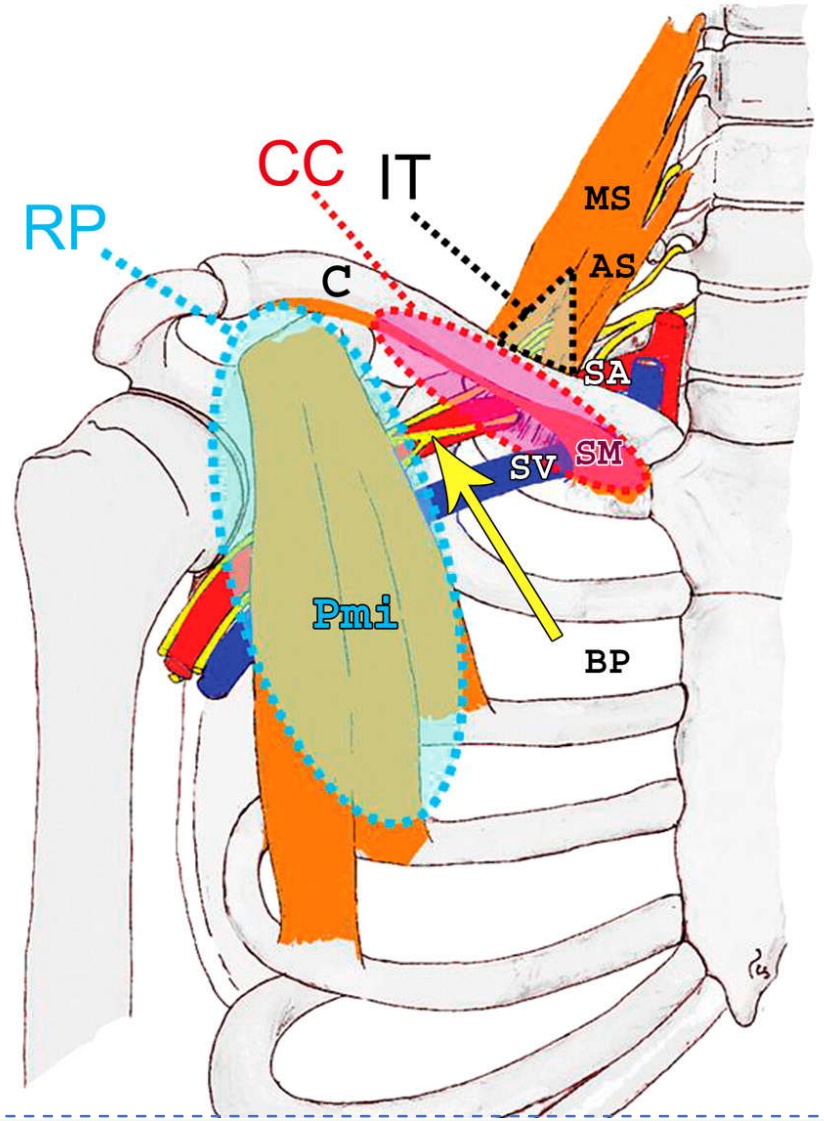
ANATOMIC CONSIDERATIONS

- The subclavian vessels and brachial plexus transverse the cervicoaxillary canal into the arm.



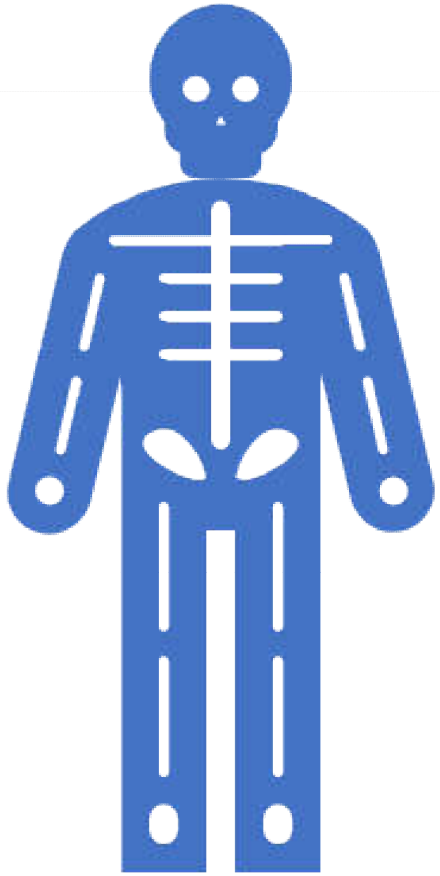
ANATOMIC CONSIDERATIONS

- The outer border of the first rib divides the canal into a proximal and a distal division.



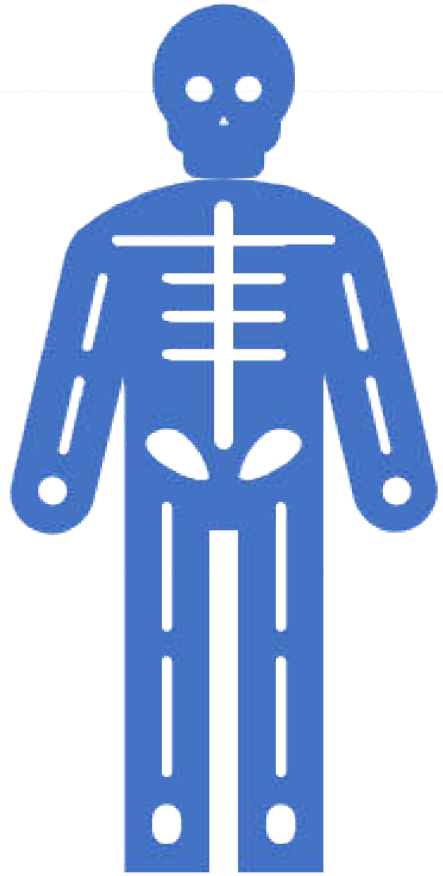
ANATOMIC CONSIDERATIONS

- The proximal division is composed of the scalene triangle and the space bounded by the clavicle and the first rib (costoclavicular space).



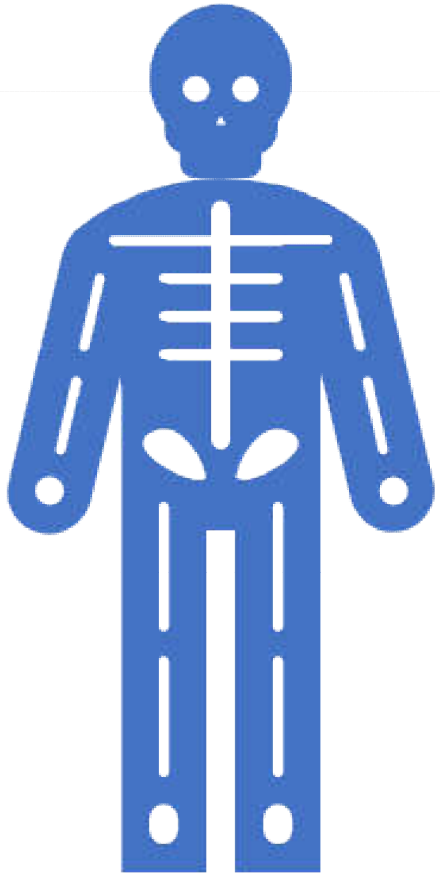
ANATOMIC CONSIDERATIONS

The proximal division is the most critical for neurovascular compression. It is bounded superiorly by the clavicle and the subclavius muscle; inferiorly by the first rib; anteromedially by the sternum, clavipectal fascia and the costocoracoid ligament; and posterolaterally the scalenus medius muscle and the long thoracic nerve.



ANATOMIC CONSIDERATIONS

The axilla, which is the outer division of the cervicoaxillary canal is bounded with pectoralis minor muscle, the coracoid process, and the head of humerus.

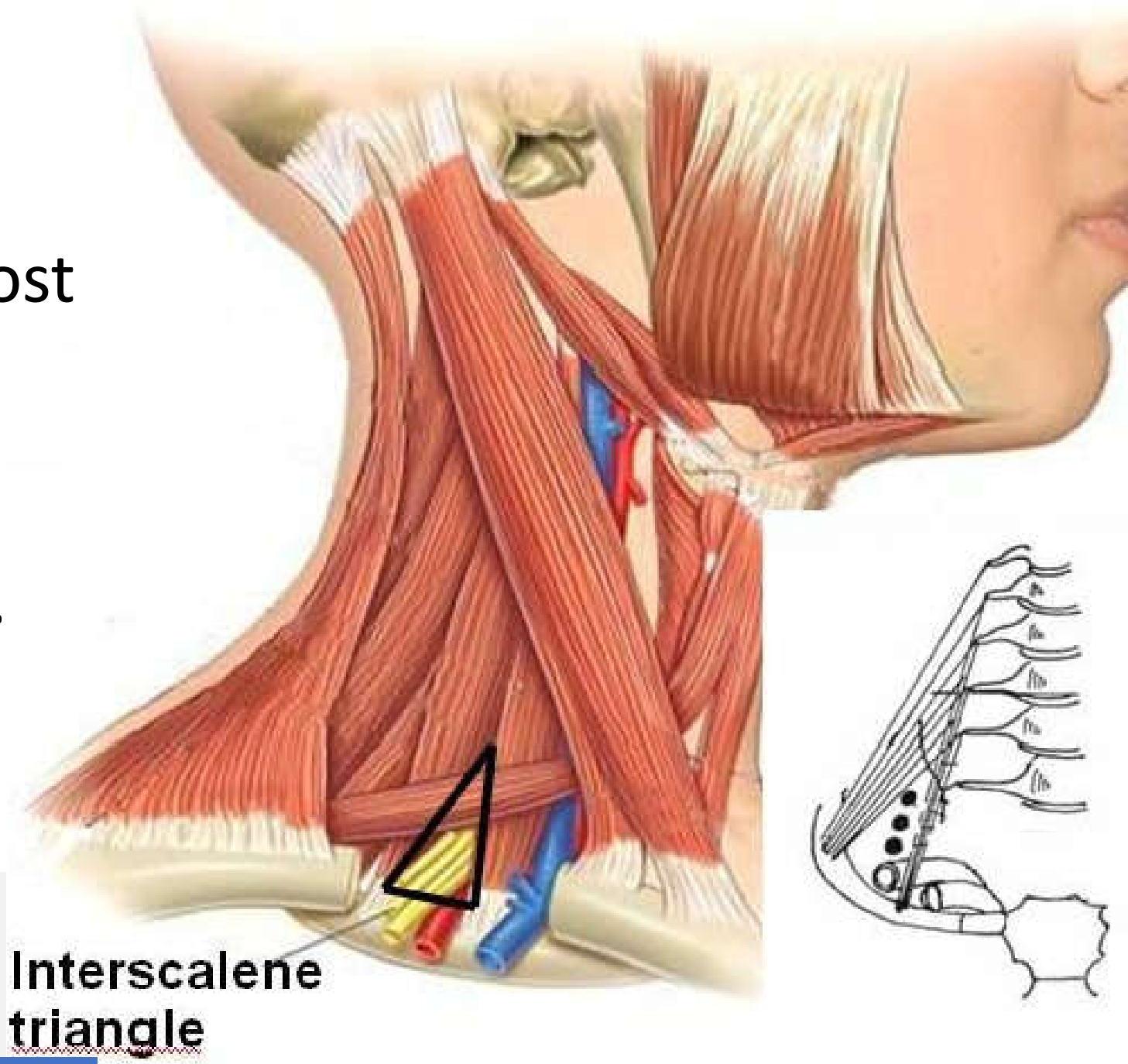


ANATOMY

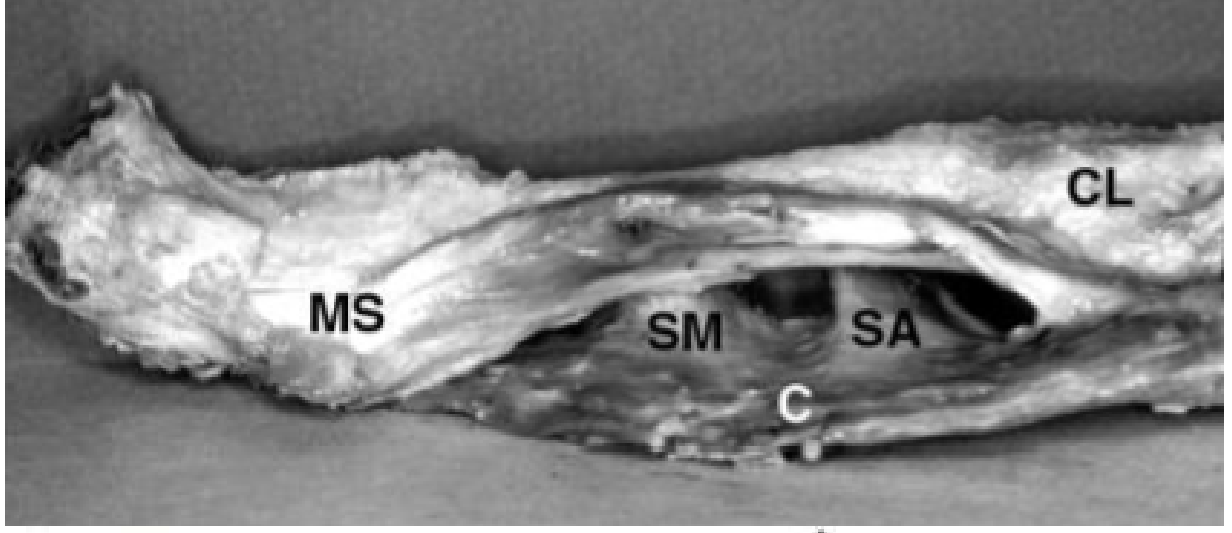
The thoracic outlet is composed of five successive spaces the vascular and nervous elements go through :

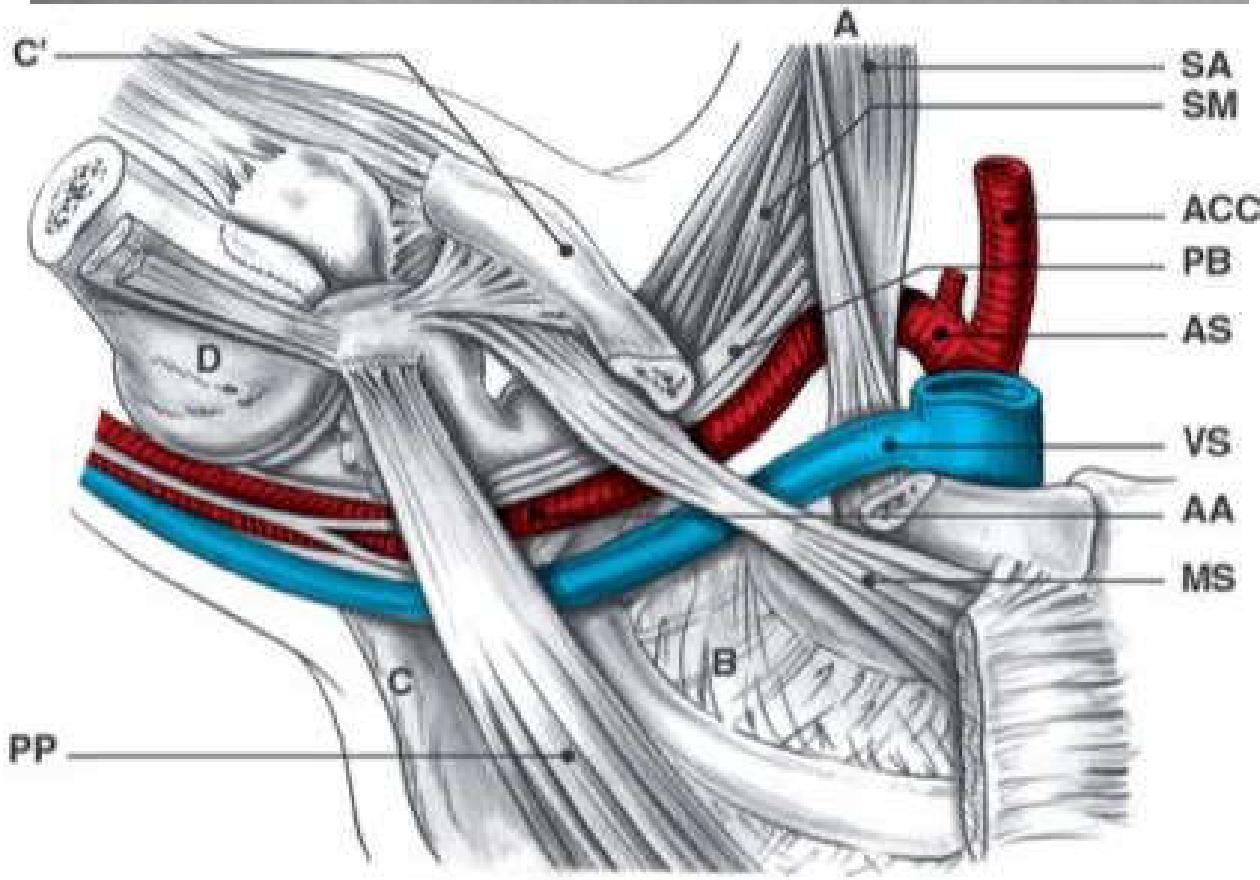
1. The inter costo scalenic space
2. The prescalenic defile(scalene)
3. The costoclavicular space
4. The sub-pectoral tunnel(subcoracoid)
5. The humeral space

Interscalene triangle (most commonly involved)
-Inferiorly : 1st rib
-Ant : scaleneus anterior
-Post : scaleneus medius.

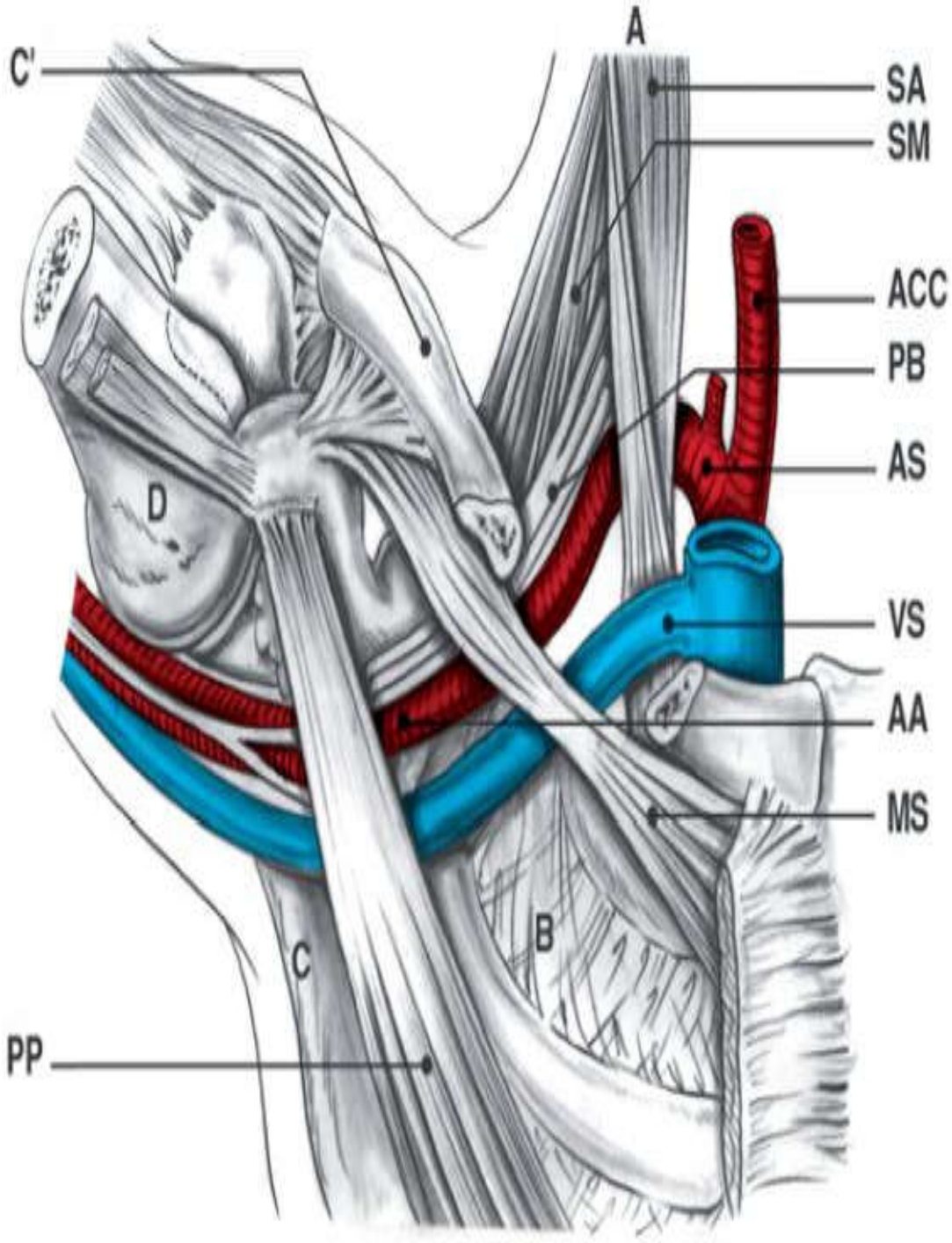


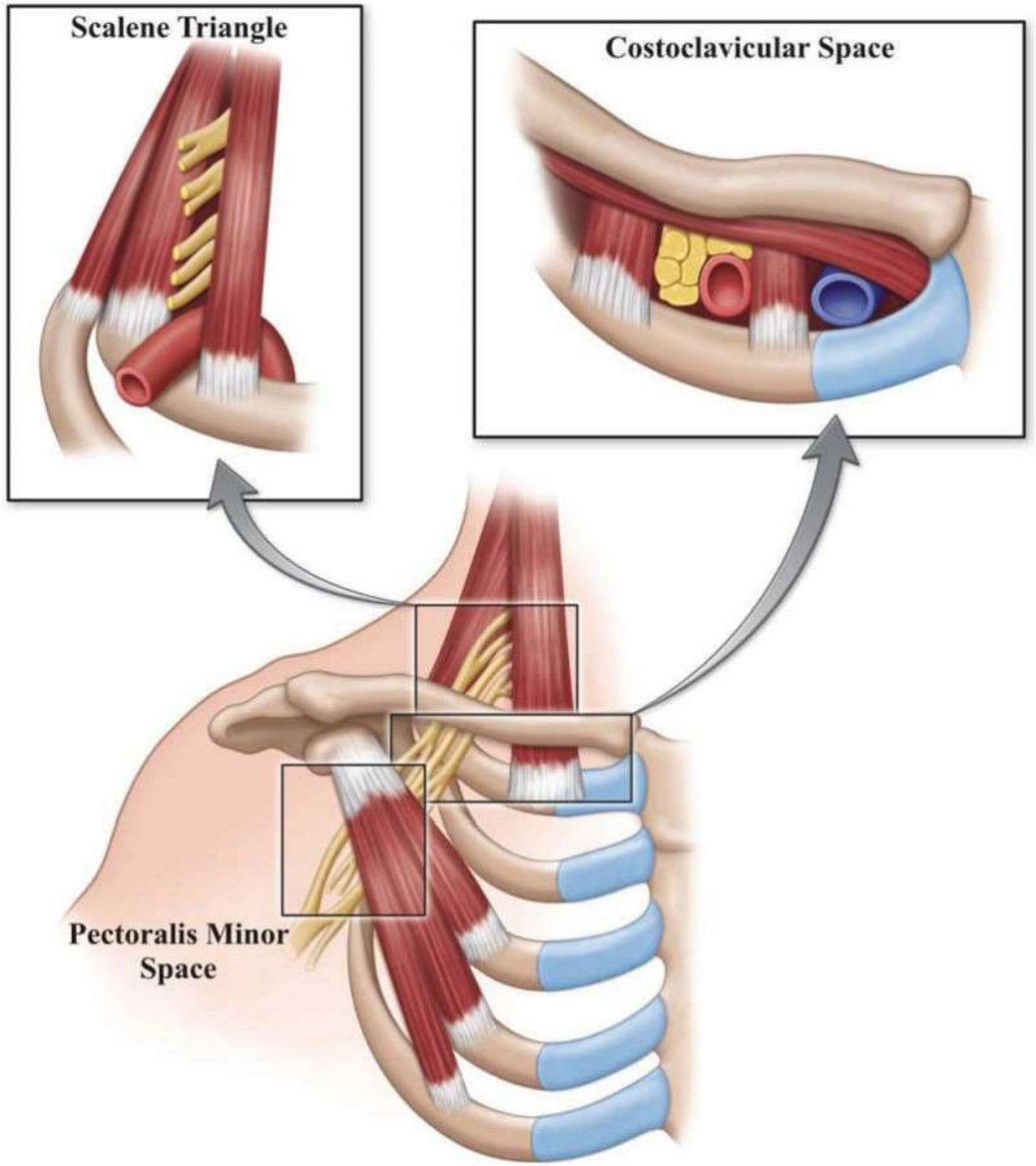
Costoclavicular space
-Ant : clavicle, subclavius muscle
-Post medial: 1st rib
-Post lateral: superior border of scapula

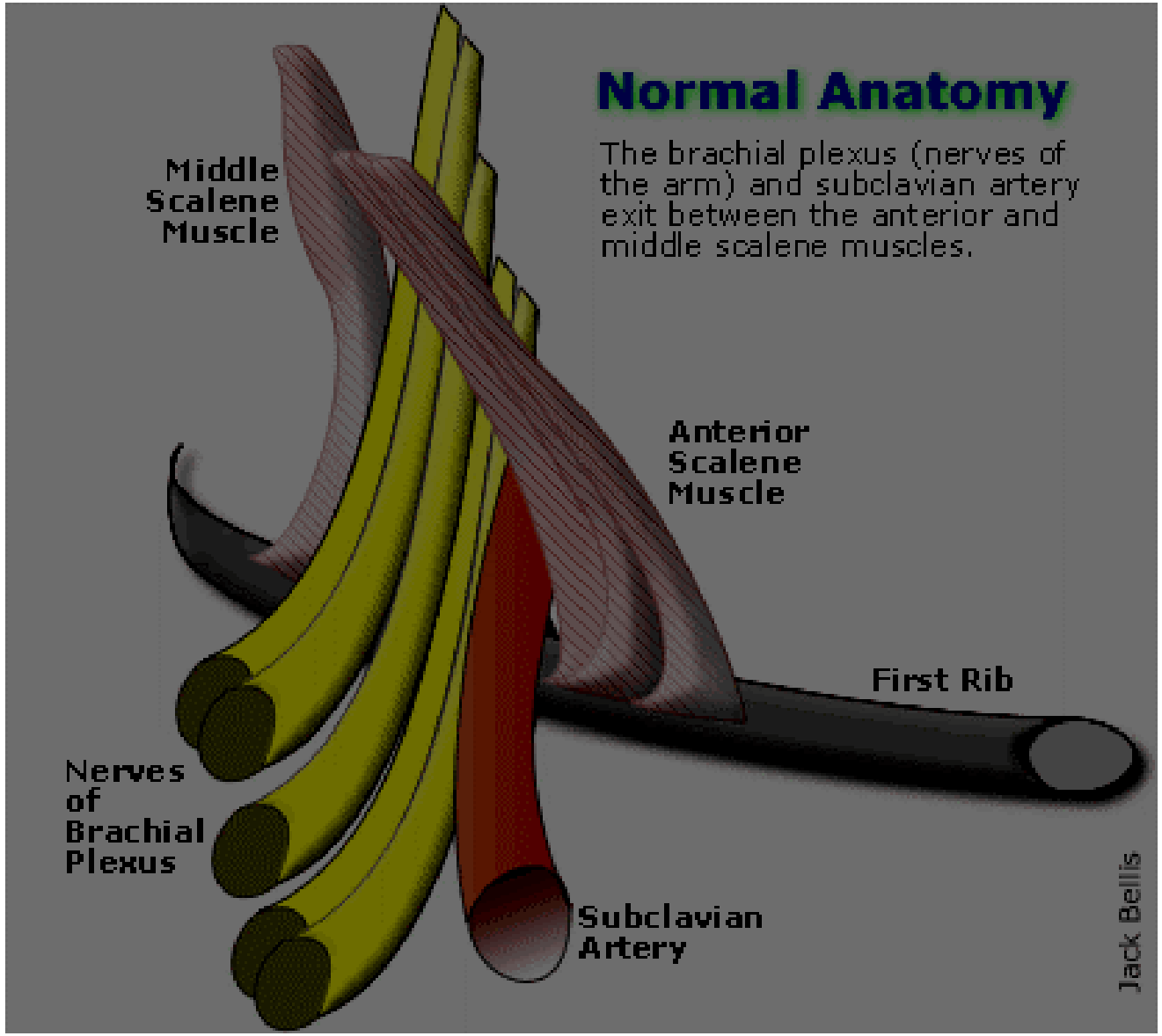


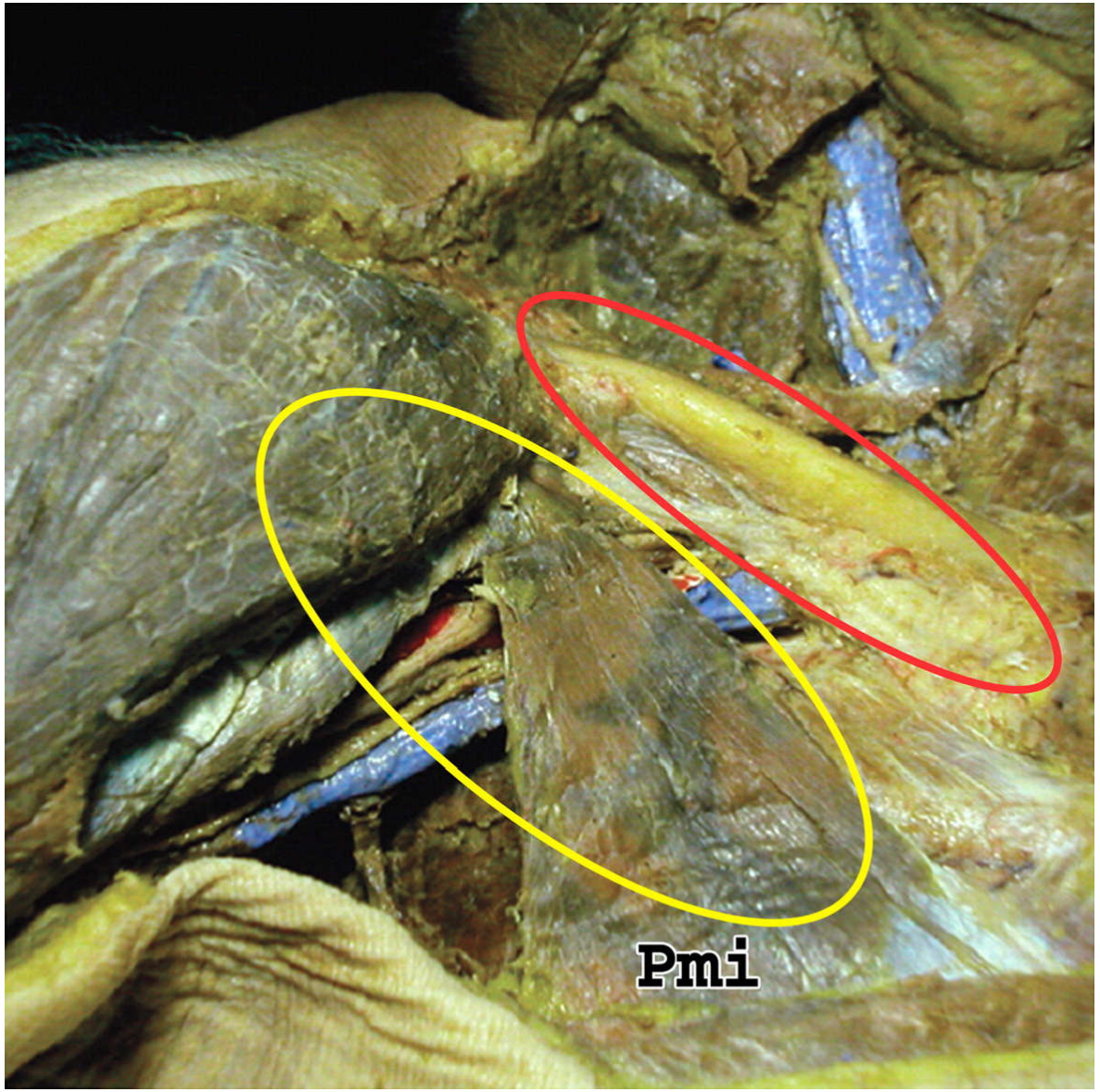


Pectoralis minor space
-Anteriorly by Pectoralis minor and posteriorly by Chest wall




Scalene Triangle
Costoclavicular Space
Pectoralis Minor
Space


Normal Anatomy
The brachial plexus (nerves of the arm) and subclavian artery exit between the anterior and middle scalene muscles.
Middle Scalene Muscle
Anterior Scalene Muscle
First Rib
Nerves of Brachial Plexus
Subclavian Artery
Jack Bellis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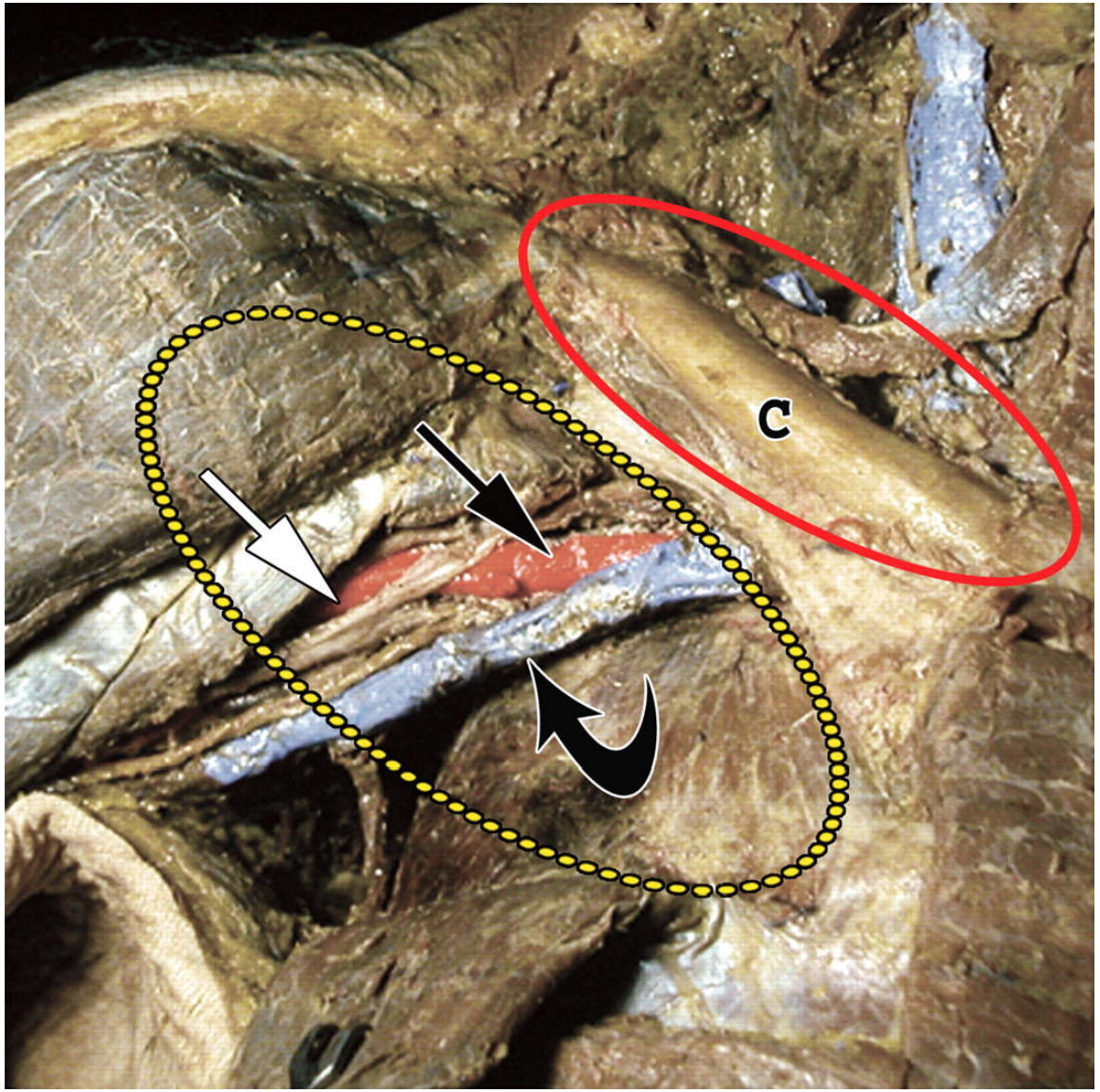
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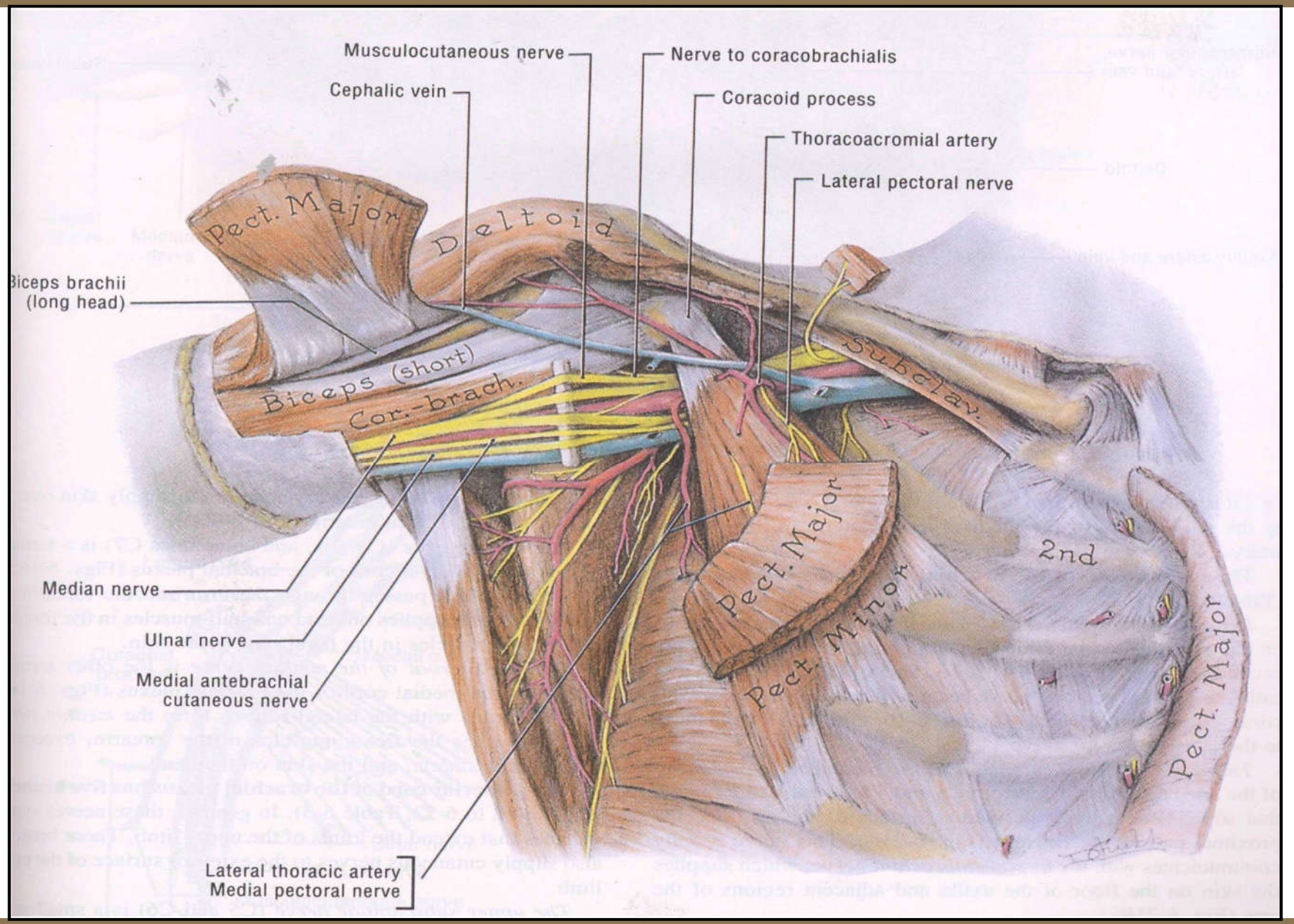
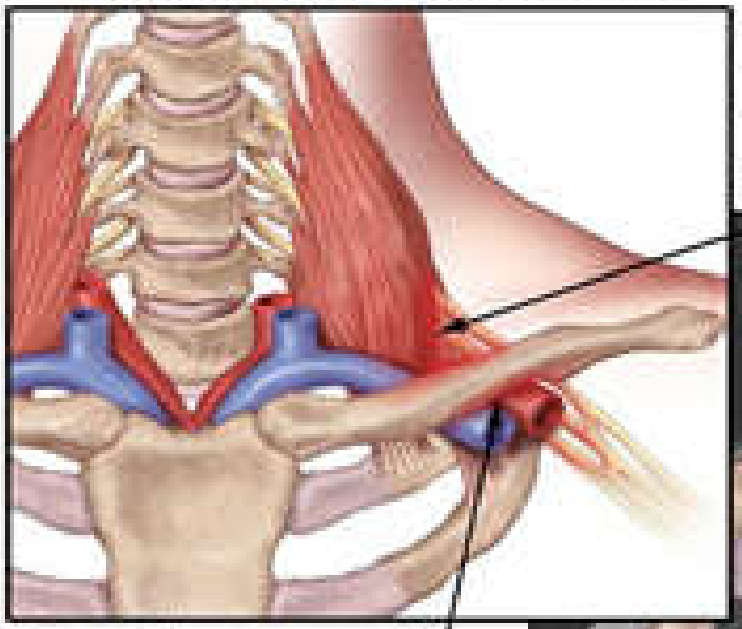

Musculocutaneous nerve
Nerve to coracobrachialis
Cephalic vein
Coracoid process
Thoracoacromial artery
Lateral pectoral nerve
Pect. Major
Deltoid
Biceps brachii (long head)
Biceps (short)
Cor.-brach.
Subclav.
Median nerve
Ulnar nerve
Medial antebrachial cutaneous nerve
Pect. Major
Pect. Minor
2nd
Pect. Major
Lateral thoracic artery
Medial pectoral nerve

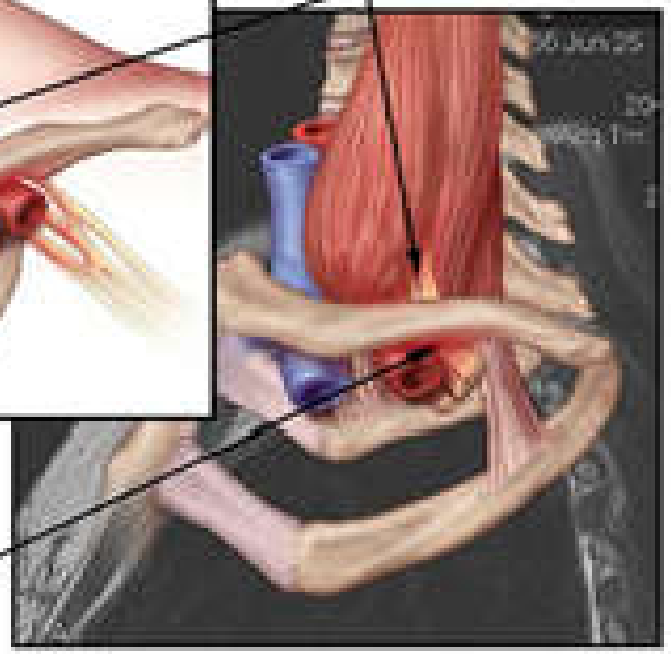
Thoracic Outlet Syndrome



Front View

Hypertrophied scalene muscles compresses the vessels and nerves against the clavicle

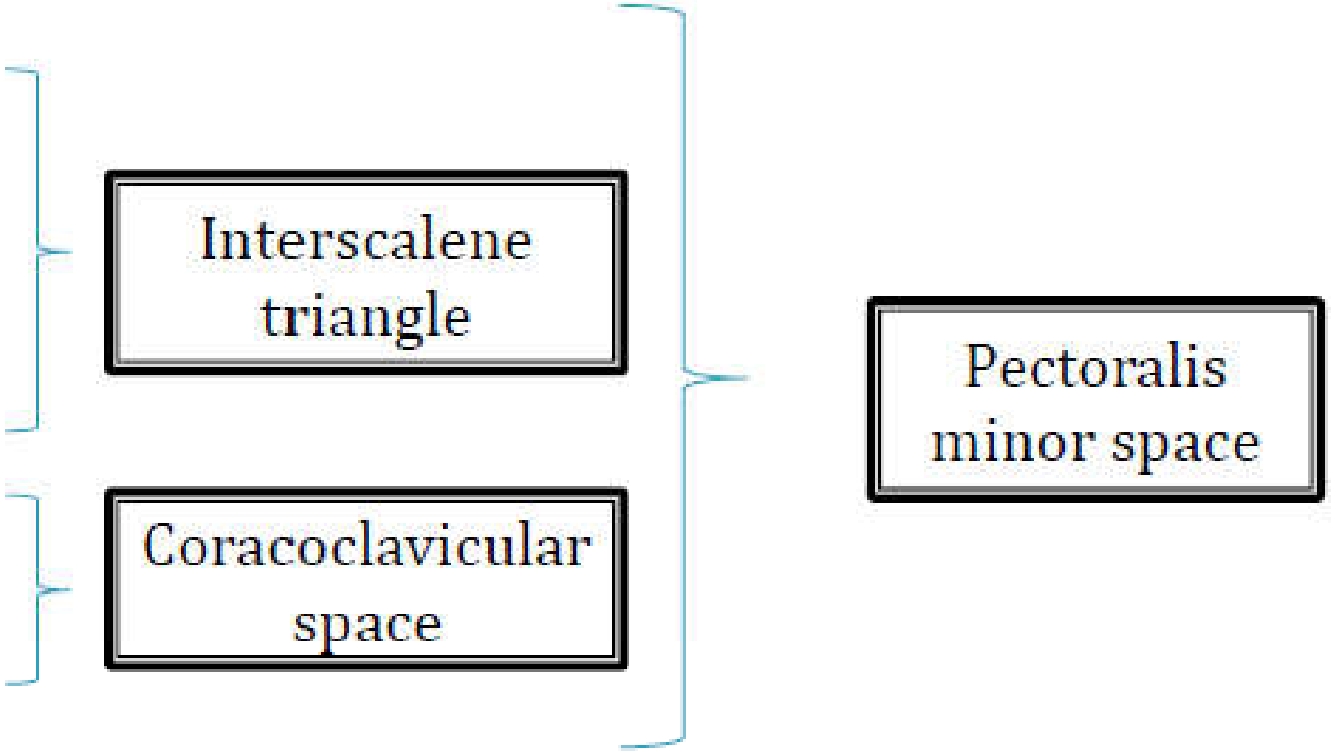
Nerves and vessels compressed between the clavicle and first rib



Side view of post-accident condition

Contents

- Brachial plexus
- Subclavian artery
- Subclavian vein



Wilbourn's Classification of TOS

Two basic types of TOCS and four subtypes.

- The two basic types are vascular and neurogenic.
- The vascular type is further divided into arterial and venous subtypes.
- The neurogenic type has been subdivided into "true“ neurogenic and non specific.

New classification

Uncomplicated TOS(Disputed TOS, Nonspecific TOS, Common TOS)

The Uncomplicated Form should also be divided into

-Predominant Neurogenic,

-Predominant Arterial, and

-Predominant Venous types.

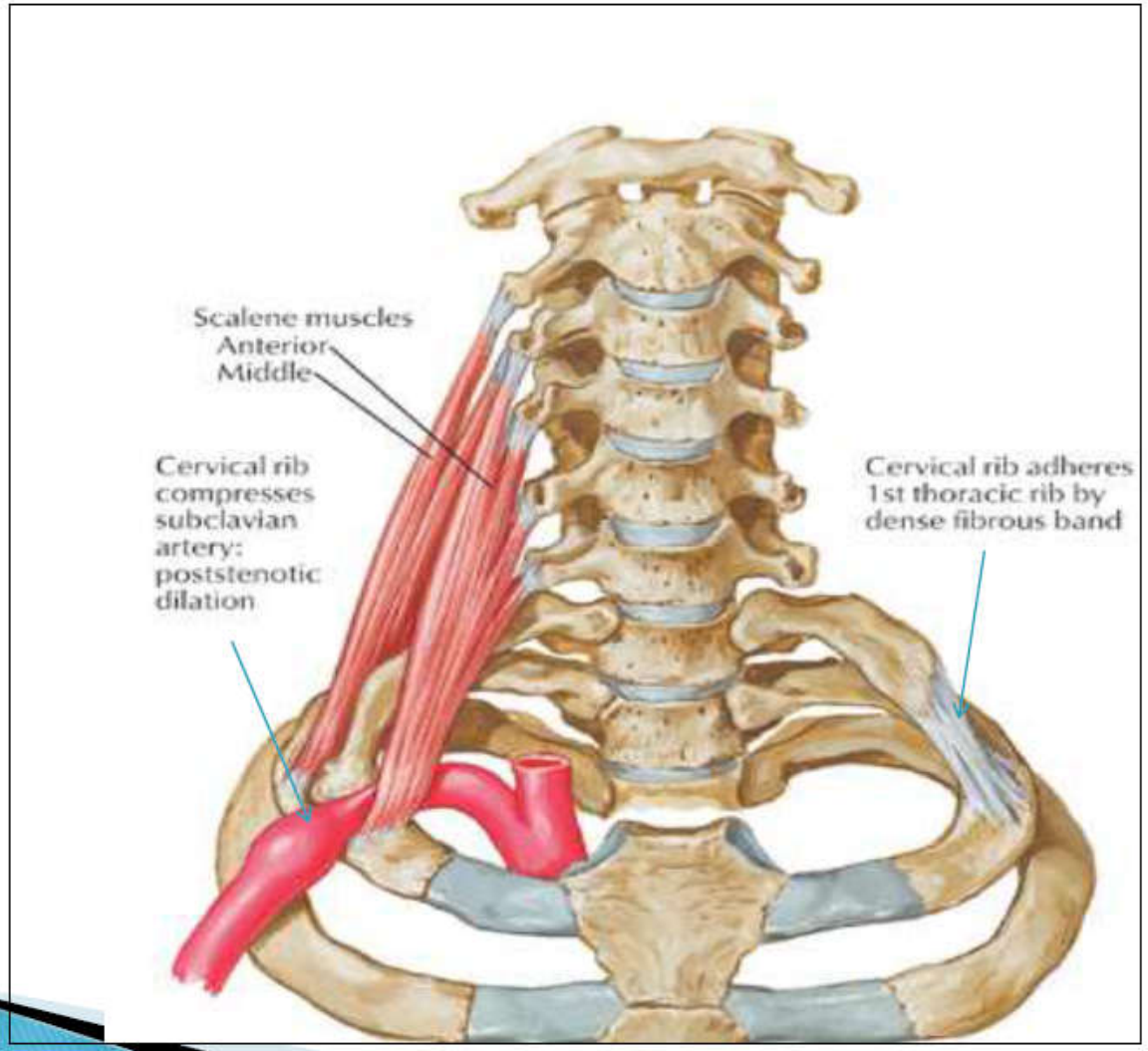
Complicated Form(true TOS)

TOS - Epidemiology

- 3 to 80 cases per 1000
- Ages 20-40
- Women > Men (3:1)
- Neurogenic TOS (95%) > Venous TOS > Arterial TOS (<1%)
- Cervical ribs occur in < 1% of population (70% women)

Principal Causes of TOS

- Skeletal and bone abnormalities
  - Cervical rib
  - Elongated C7 transverse process
  - Exostosis or tumor of the first rib or clavicle
  - Excess callus of the first rib or clavicle


Scalene muscles
Anterior
Middle
Cervical rib compresses subclavian artery: poststenotic dilation
Cervical rib adheres 1st thoracic rib by dense fibrous band

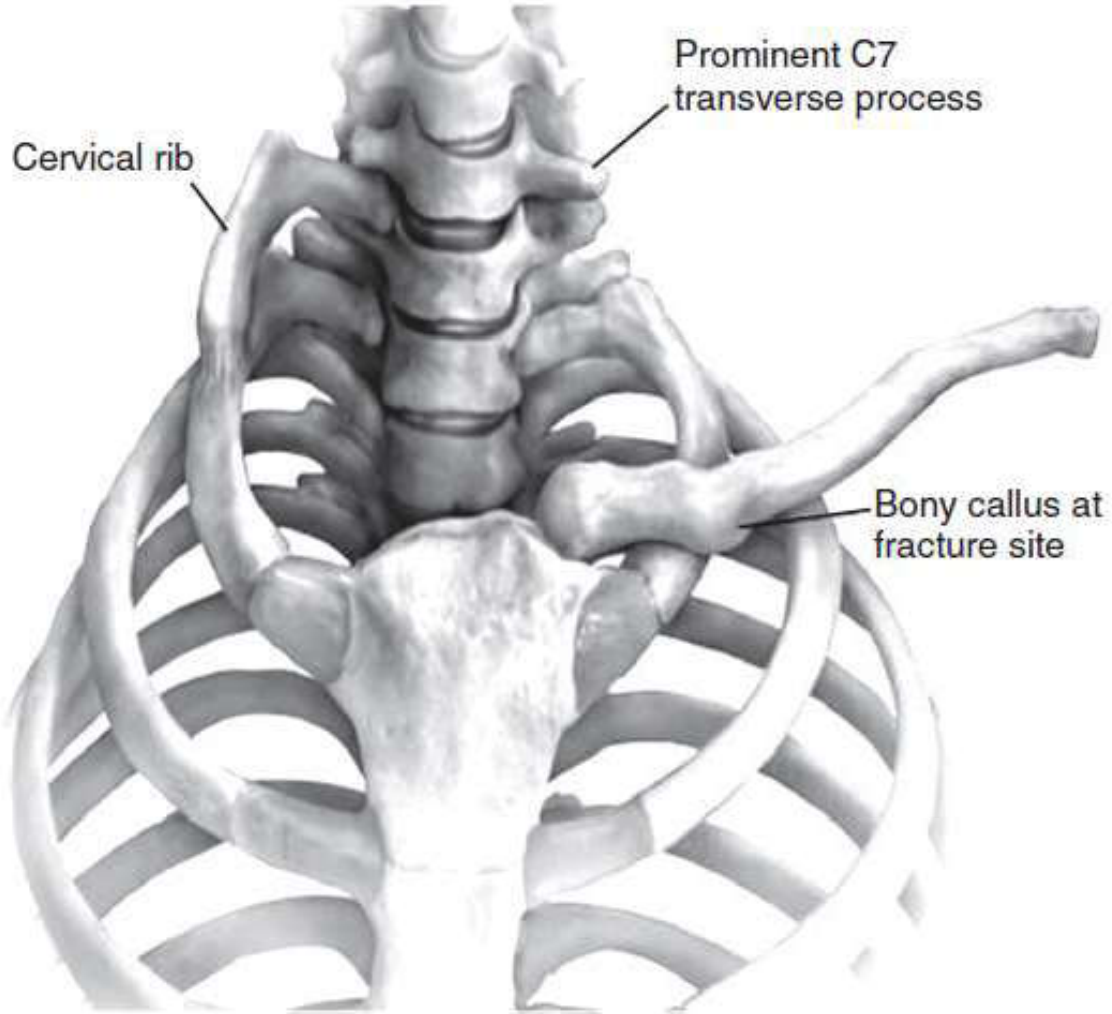


FIGURE 59-4 Common bony anomalies in persons with thoracic outlet syndrome.

Muscle anomalies

- Anomalous insertion of scalene muscles
- Scalene muscle hypertrophy
- Scaleneus minimus
- Passage of the brachial plexus through the substance of the anterior scalene muscle
- A broad, excessively anterior middle scalene muscle insertion on the first rib

Tumors

Trauma

Brachial plexus trauma/Whiplash injury.

Poor posture:
Drooping the shoulders or holding the head in a forward position.

Repetitive activity.

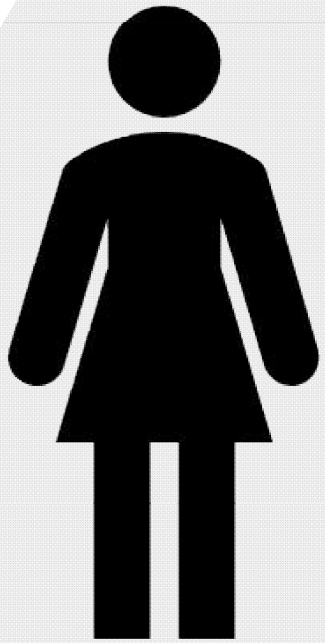
- Typing on a computer
- Athletes and swimmers
- Baseball pitcher

Obesity.

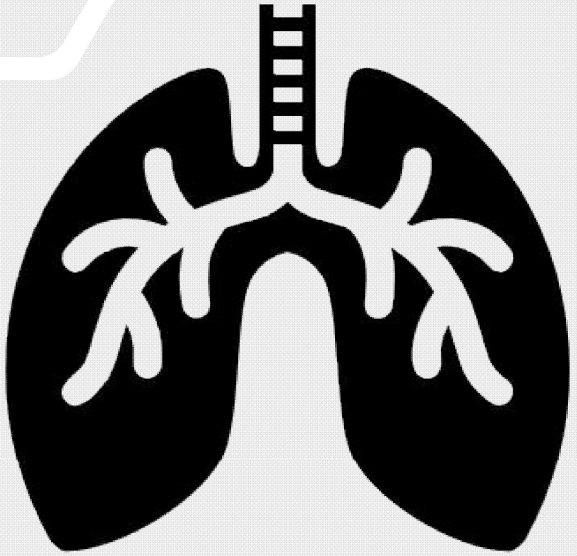
Pregnancy.

- Thin women with poor posture and weak muscular support of the shoulder girdle have been reported to be predisposed to developing TOS.

- Indeed, drooping and sagging of the shoulder increase acromioclavicular descent and compression of neurovascular structures in the costoclavicular space.



- A cervical rib is a supernumerary (or extra) rib which arises from the seventh cervical vertebra.
- Sometimes known as "neck ribs"
- A cervical rib is present in less than 1% of the normal population, have been reported in 5%–9% of patients with TOS
- Usually asymptomatic



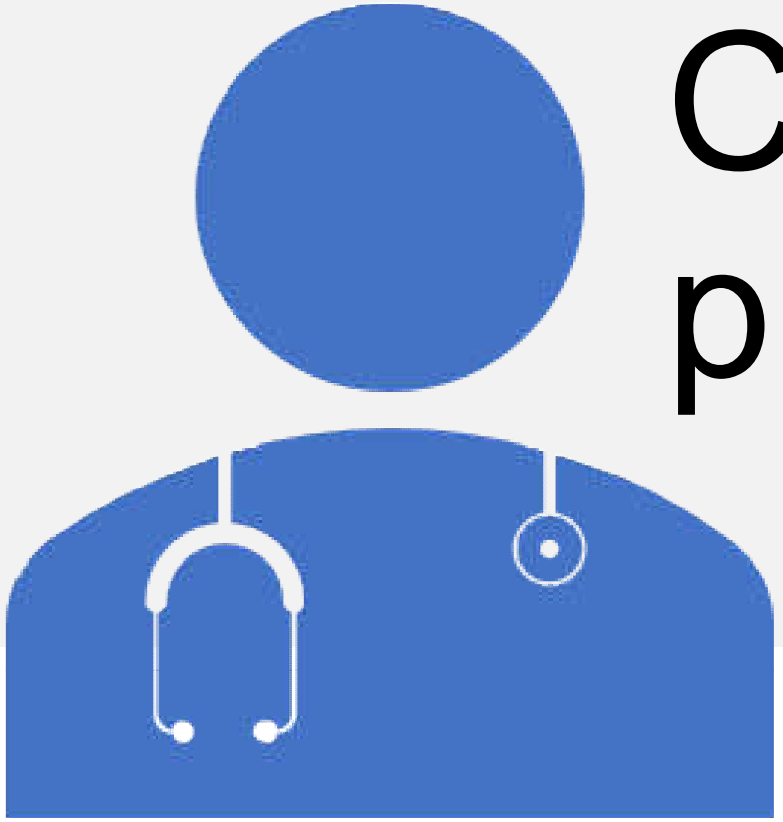
Pathogenesis

Depending on the exact site of injury and the injury component of the neurovascular bundle, three distinct syndromes or a combination of these may be encountered.

I. Neurological syndrome. NTOS(95%)

II. Venous syndrome. ATOS(4%)

III. Arterial syndrome. VTOS (1%)



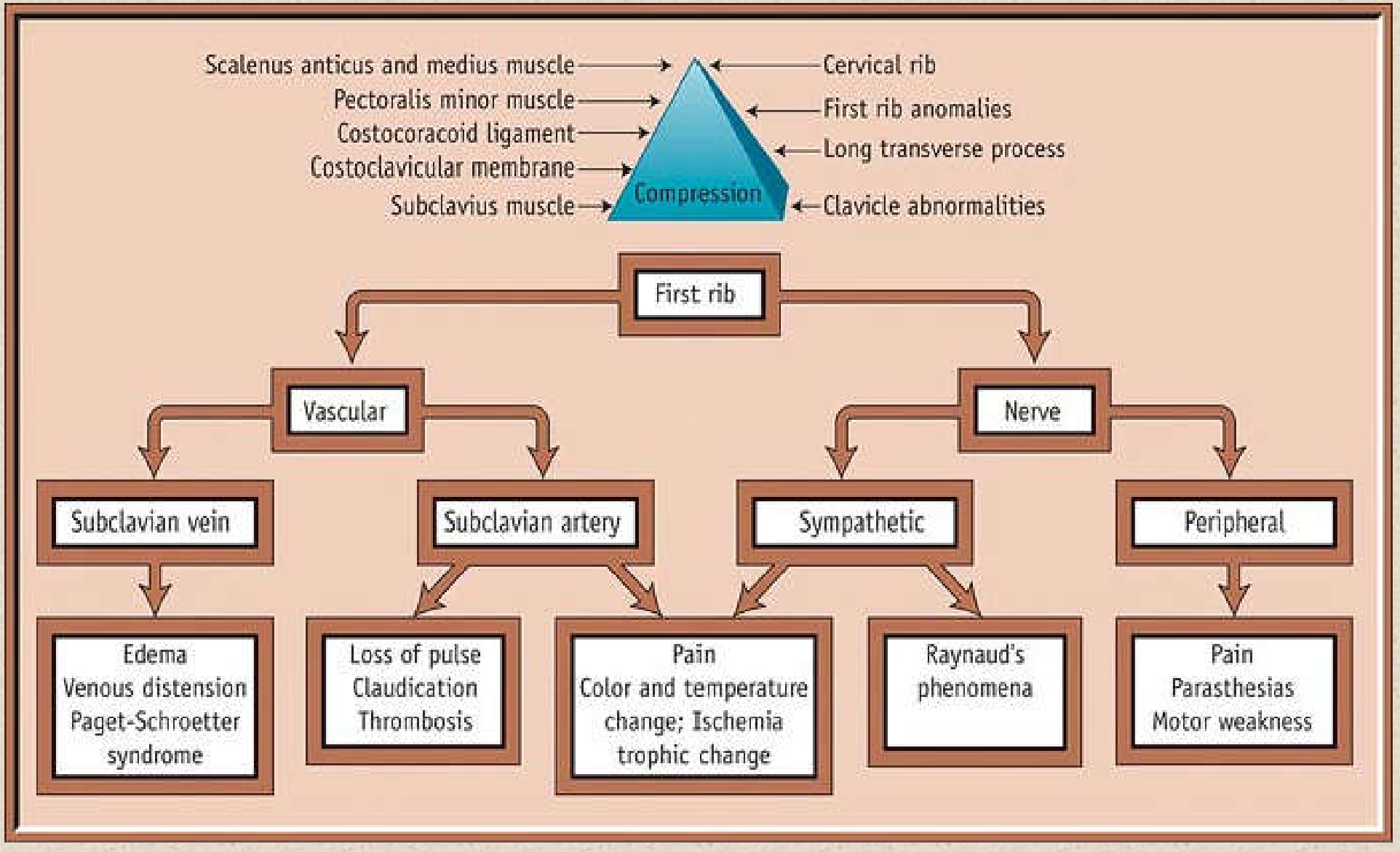
Clinical presentation

General Rules

Symptoms depends on:

- Frequency
- Duration
- Degree of Compression

Etiology


Scalenus anticus and medius muscle
Pectoralis minor muscle
Costocoracoid ligament
Costoclavicular membrane
Subclavius muscle
Compression
Cervical rib
First rib anomalies
Long transverse process
Clavicle abnormalities
First rib
Vascular
Nerve
Subclavian vein
Subclavian artery
Sympathetic
Peripheral
Edema
Venous distension
Paget-Schroetter syndrome
Loss of pulse
Claudication
Thrombosis
Pain
Color and temperature change; Ischemia
trophic change
Raynaud's phenomena
Pain
Parasthesias
Motor weakness

The Uncomplicated Form is the most common and the most undiagnosed, or misdiagnosed.

Presentation:

- Mild-to-severe pain,
- Positional paresthesias as the only symptom.
- No atrophy of the hand muscles

The symptoms are frequently intermittent and oscillating.

The Complicated Form is easy to diagnose, but too late,

Symptoms and signs:

- Slowly progressive unilateral atrophic weakness of the intrinsic hand muscles & Sensory abnormalities in the C8- T1 distribution in the Neurogenic type.

- Non-positional ischemia of the fingers and hands,

- Thrombosis and or embolism of the arteries of the upper extremities, subclavian aneurysm, and cerebral embolism ,are symptoms of Arterial TOS.

- Venous thrombosis of the subclavian and axillary veins,(Paget-von Schrötter syndrome)

- Pain and paresthesias of the upper extremities are common in all the three types.

- Shoulder, neck, and chest pains, facial pain, and occipital headaches are usually ignored symptoms in the Predominant Neurogenic type, both in the uncomplicated or Complicated Forms.

- The symptoms and signs are mixed among these three types.
- They should be called Predominant Neurogenic Arterial, or Venous.
- Before the complications of TOS occurs, there is a period where uncomplicated TOS is misdiagnosed.
- Delay from symptoms to diagnosis -3 months to 15 years.

TOS - Symptoms

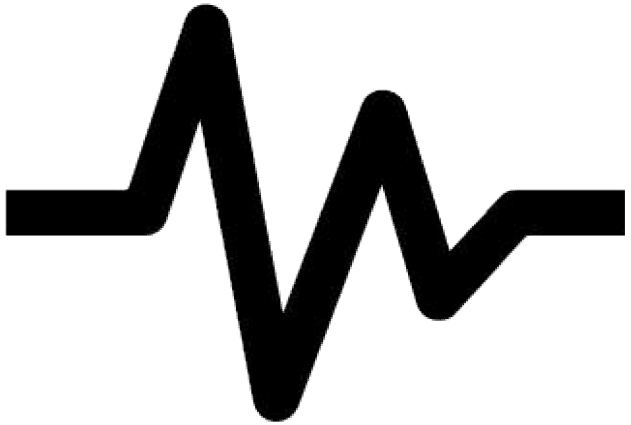
- Neurogenic TOS
  - Pain, paresthesia, and weakness in the hand, arm and shoulder, plus neck pain and occipital headaches
    - Raynaud's phenomenon, hand coldness and color changes are also seen frequently in NTOS

TOS - Symptoms

- Arterial TOS
  - Digital ischemia, claudication, pallor, coldness, paresthesia and pain in the hand (but rarely in the shoulder/neck)
  - Symptoms are a result of arterial emboli from a mural thrombus in a subclavian artery aneurysm or from thrombus forming distal to subclavian artery stenosis

TOS - Symptoms

- Venous TOS
  - Swelling of the arm, plus cyanosis is strong evidence of subclavian vein obstruction
  - Pain often present, but may be absent
  - Arm swelling distinguishes VTOS from ATOS and NTOS



DIAGNOSIS

PE, history, radiographs of chest and cervical spine, Pulmonary, esophageal and chest wall causes must be ruled out.

TOS – Differential Diagnosis

- Cervical disc disease
- Cervical facet disease
- Malignancies (Pancoast/local tumors, spinal cord tumors)
- Peripheral nerve entrapments (ulnar or median nerve)
- Brachial plexitis
- Rotator cuff injuries
- Fibromyalgia, muscle spasm
- Neurologic disorders (MS)
- Chest pain, angina
- Vasculitis
- Vasospastic disorder (Raynaud's)
- Neuropathic syndromes of upper extremity

TOS – Physical Exam

- VTOS
  - arm swelling
  - cyanosis
  - distended superficial veins over the shoulder and chest wall
- NTOS
  - Tenderness over scalene muscles
  - Positive provocative tests

Elevated Arm Stress Test (EAST) / ROOS Test

Patient seated with arms above 90 degrees of abduction and full external rotation with head in neutral position.

Patient opens and closes hands into fists while holding the elevated position for 3 minutes.

- Positive test: pain and/or paresthesia and discontinuation with dropping of the arms for relief of pain.
- Sensitivity- 52 – 84%
- Specificity- 30 – 100

Adson or Scalene Test

1. The patient is asked to (1) take and hold a deep breath (2) extend the neck fully (3) turn the face into one side. Elbow is flexed.
2. It will tighten the anterior and middle scalene muscles.
3. Diminution or loss of the radial pulse suggests compression.
4. The patient rotates his head towards the tested arm while the examiner extends the arm

Costo clavicular maneuver

Patient sits straight with arms at the side. Radial pulse is assessed. Patient retracts and depresses shoulders while protruding the chest. Position is held for up to 1 minute.

Positive test: change in radial pulse and/or pain and paresthesia.

Sens.-NT

Spes.-53–100

Cervical rotation lateral flexion test

Patient seated, Examiner passively rotates the head away from the affected side and gently flexes the neck forward to end range moving the ear toward the ventral chest.

Positive test: forward flexion part of the movement is notably decreased with a hard end feel.

Sens.-100

Spec.-NT

Hyper abduction

1. The arm is hyper abducted to 180 degrees.
2. Diminution or loss of the radial pulse suggests compression.

Arm Claudication Test

The shoulder is drawn backward and upward. The arm is raised horizontally with the elbow flexed 90 degrees.

With exercise of hands, pain and numbness indicates compression.

Upper limb tension Test (Elvays)

Upper limb tension testing is sensitive for irritation of the neural tissue including cervical roots, brachial plexus and peripheral nerves .

It has been advocated for the diagnosis of neurogenic TOS with reported high sensitivity.

The test appears to be excellent for screening for sensitization of the neural tissue in the cervical spine, brachial plexus and upper limb but is not specific for one area.

Head is turned contra laterally, the arm is abducted with the elbow extended.

Sens-90%, Spec.-38%.

Fig. Upper Limb Tension Test (ULTT).

- Position 1: Arms abducted to 90° with elbows extended.
- Position 2: Dorsiflex wrists.
- Position 3: Tilt head to side, ear to shoulder. Each maneuver progressively increases stretch on the brachial plexus.

Lidocaine interscalene block

More objective

Under image guidance, either computed tomography,ultrasound, or fluoroscopy, the anterior scalene muscleis injected with lidocaine.

Patients with nTOS should have some decrease or complete relief of symptoms for four hours, if positive, predicts 90% success for subsequent treatments including physical therapy and surgical intervention

- Neck or chest x-ray
  - Detects cervical rib or elongated C7 transverse process
- EMG/NCS
  - Normal in large majority of clinically + NTOS
  - Most common finding in NTOS is ulnar neuropathy
  - Recent study suggests NCV abnormalities of the sensory medial antebrachial cutaneous nerve are seen in NTOS (MAC)
- MRI/CT
- Venography/venous duplex
  - VTOS
- Arteriography
  - Only indicated in ATOS

Treatment

✓ Non operative management

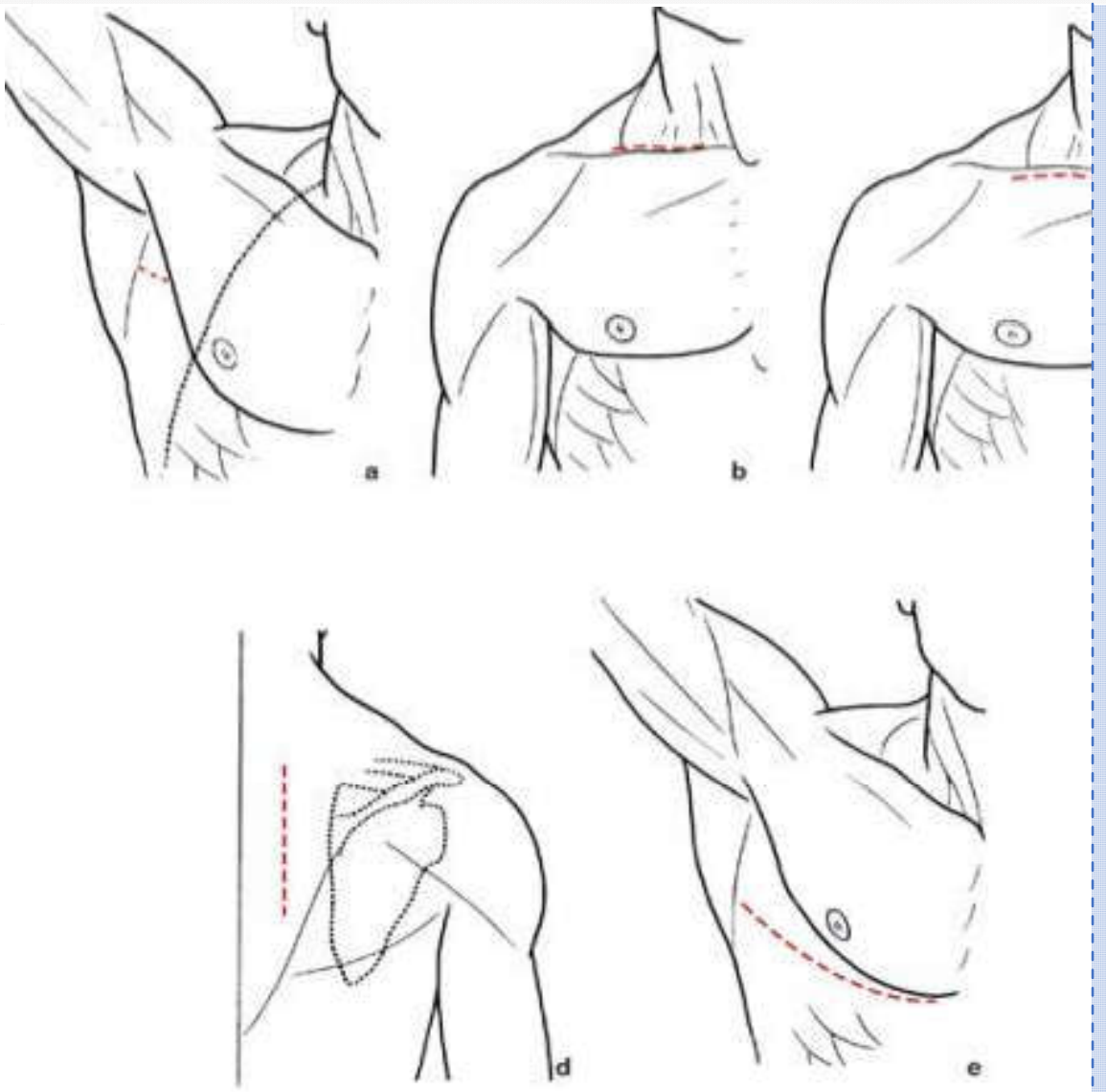
- Posture improving exercises.
- Breathing exercises.
- Avoid aggravating activities.
- Avoid repetitive upper extremity mechanical work and muscular trauma.
- Analgesics, muscle relaxants, antidepressants.
- Physiotherapy .

✓ Definitive management

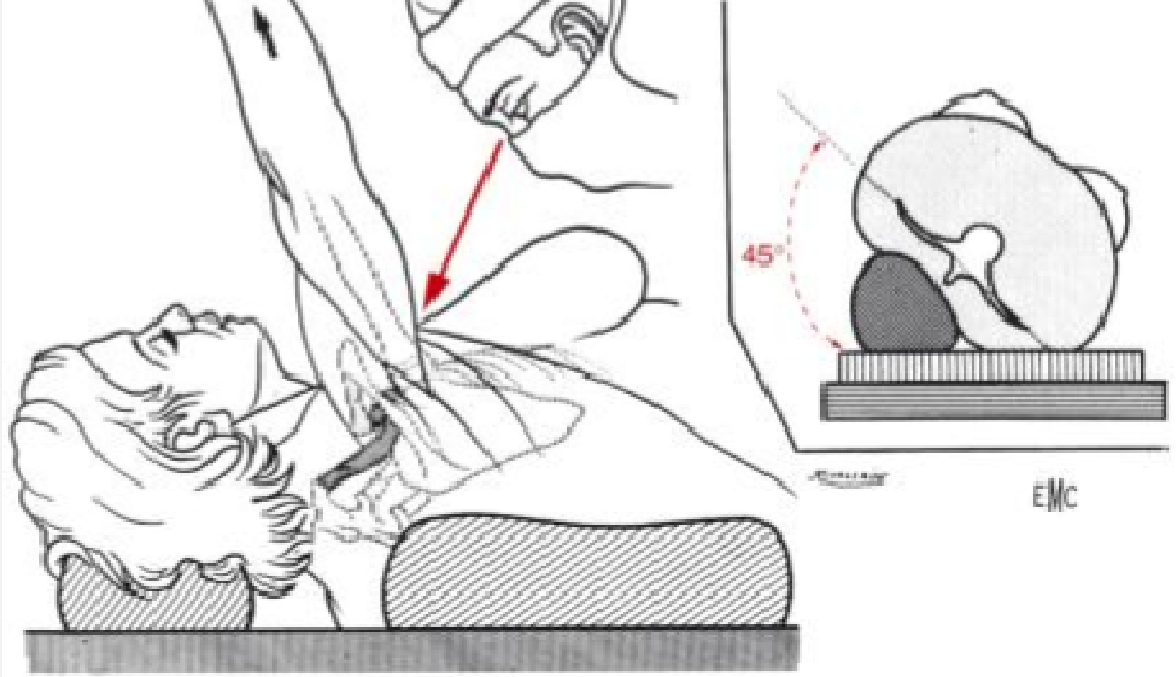
- Surgical decompression of the neurovascular bundle
  - First rib resection
  - Scalenectomy
  - Subclavian artery reconstruction
  - Cervical sympathectomy

SURGICAL TREATMENT OF T.O.S.

1. FRIST RIB RESECTION
    1. Possible approaches



SURGICAL TREATMENT OF T.O.S.



1. FRIST RIB RESECTION : Trans axillary approach (ROOS technique)

    1.Patient installation

SURGICAL TREATMENT OF T.O.S.

1. FRIST RIB RESECTION
    1. Arm Position

The secret of 1st rib resection in this technique is discontinued traction

5 minutes !

Recently

VATS

Thank You