

Thoracic Outlet Syndrome Rare Compression Neuropathies

Moritz Scholtes

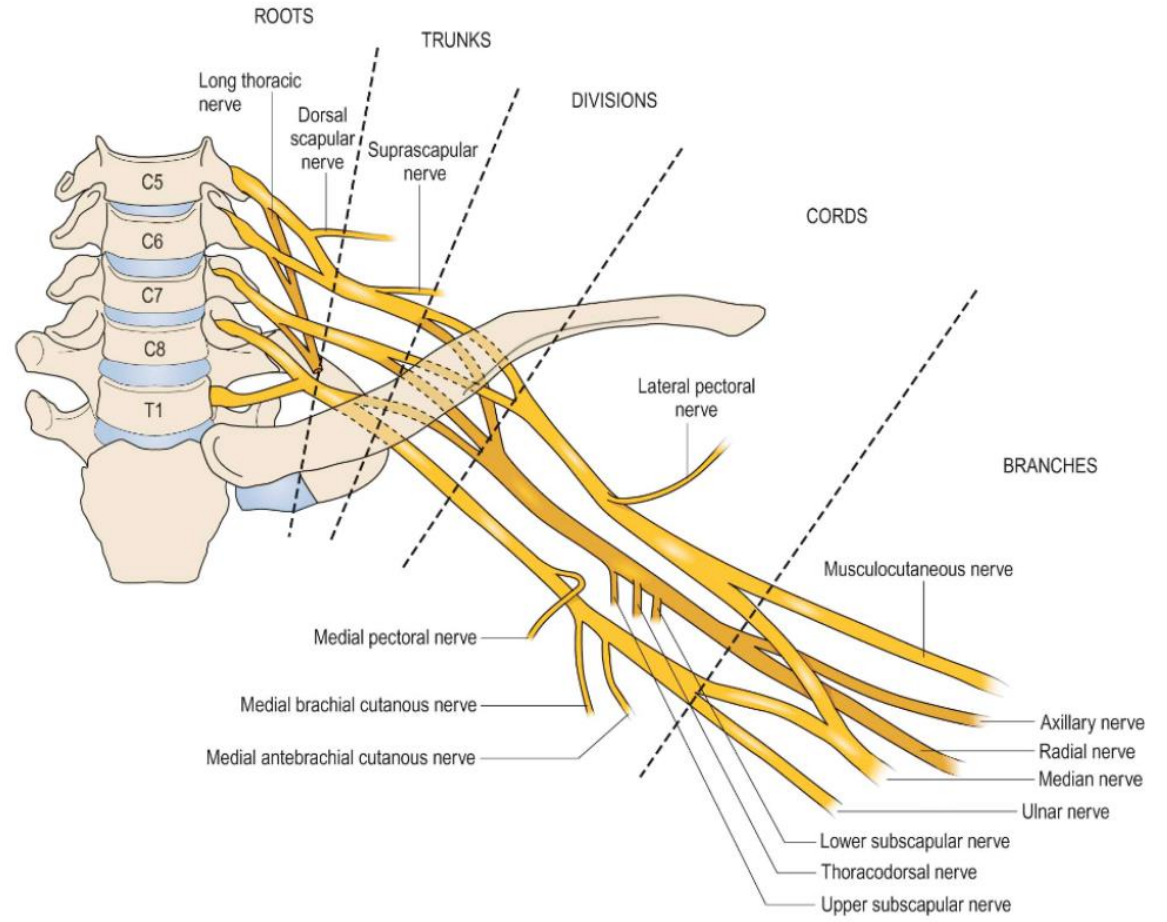
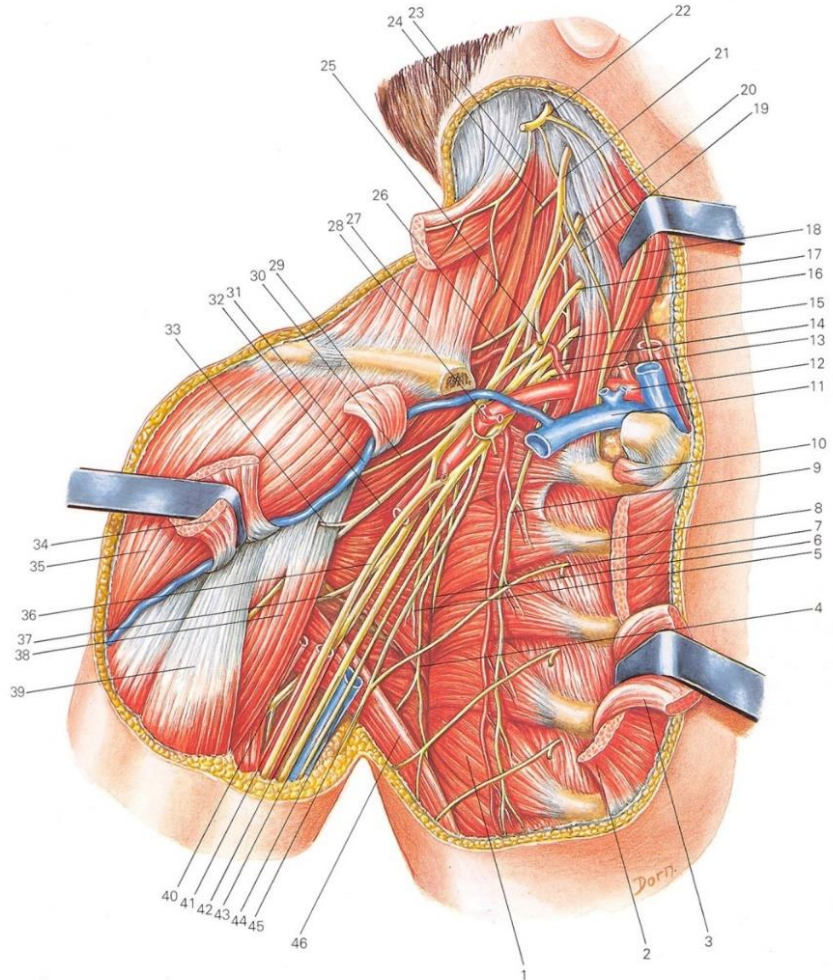
THORACIC OUTLET SYNDROME

TOS – definition

- Compression of the brachial plexus and subclavian artery between osseous and muscular or fibrous tissues
 - Most commonly affected: inferior trunk

TOS – anatomy

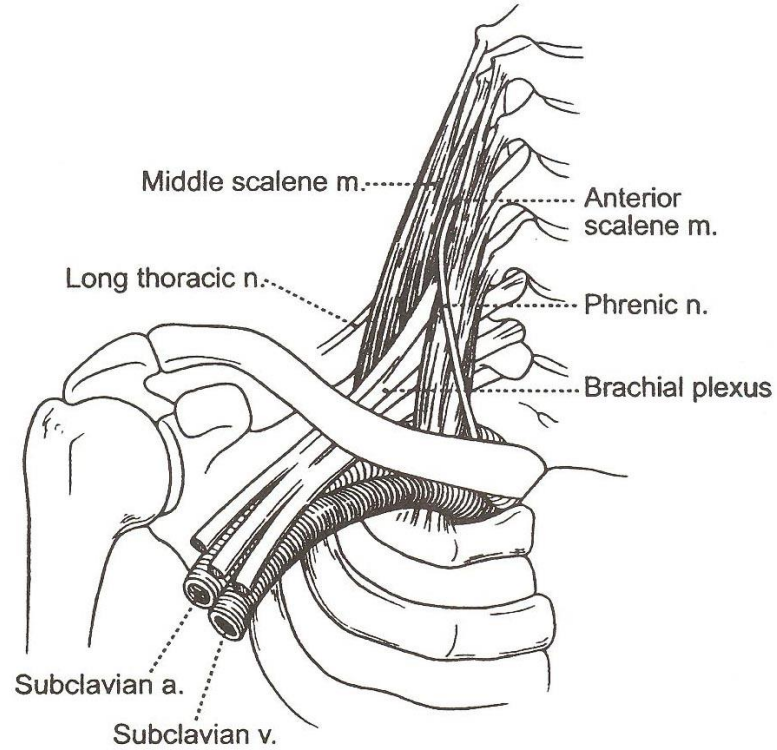
Remember to drink cold beer



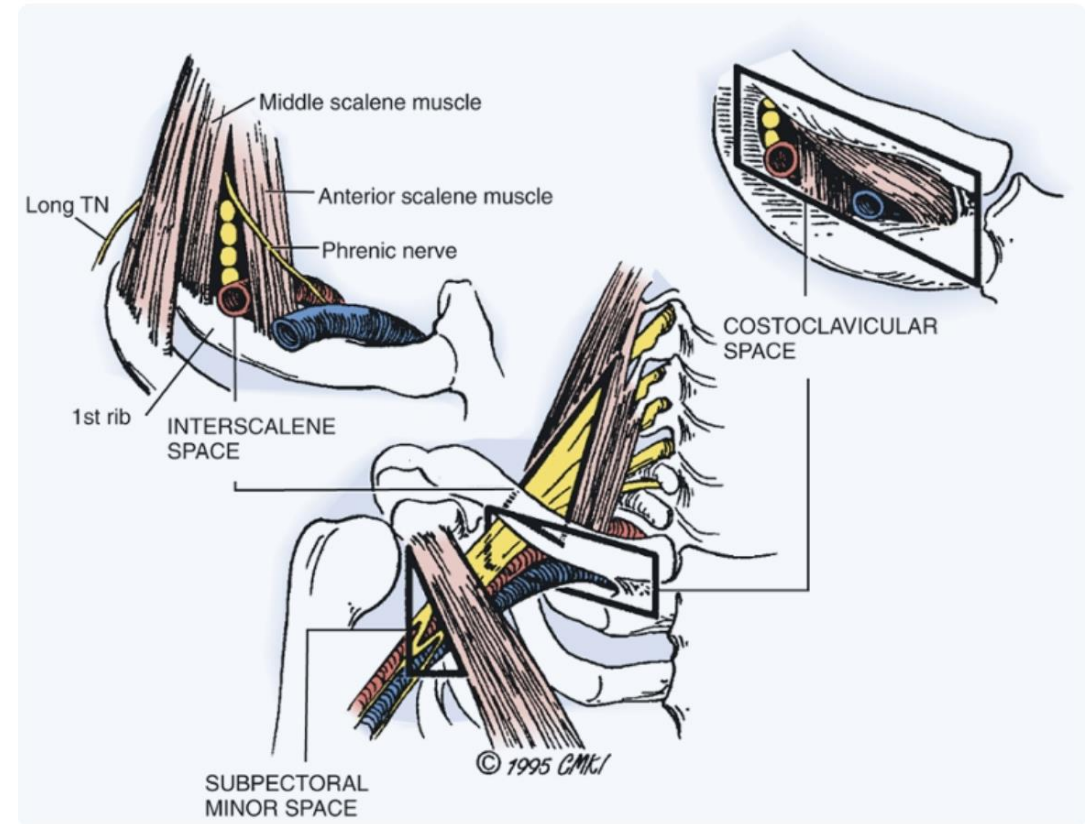
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A
R
M
U

TOS – anatomy

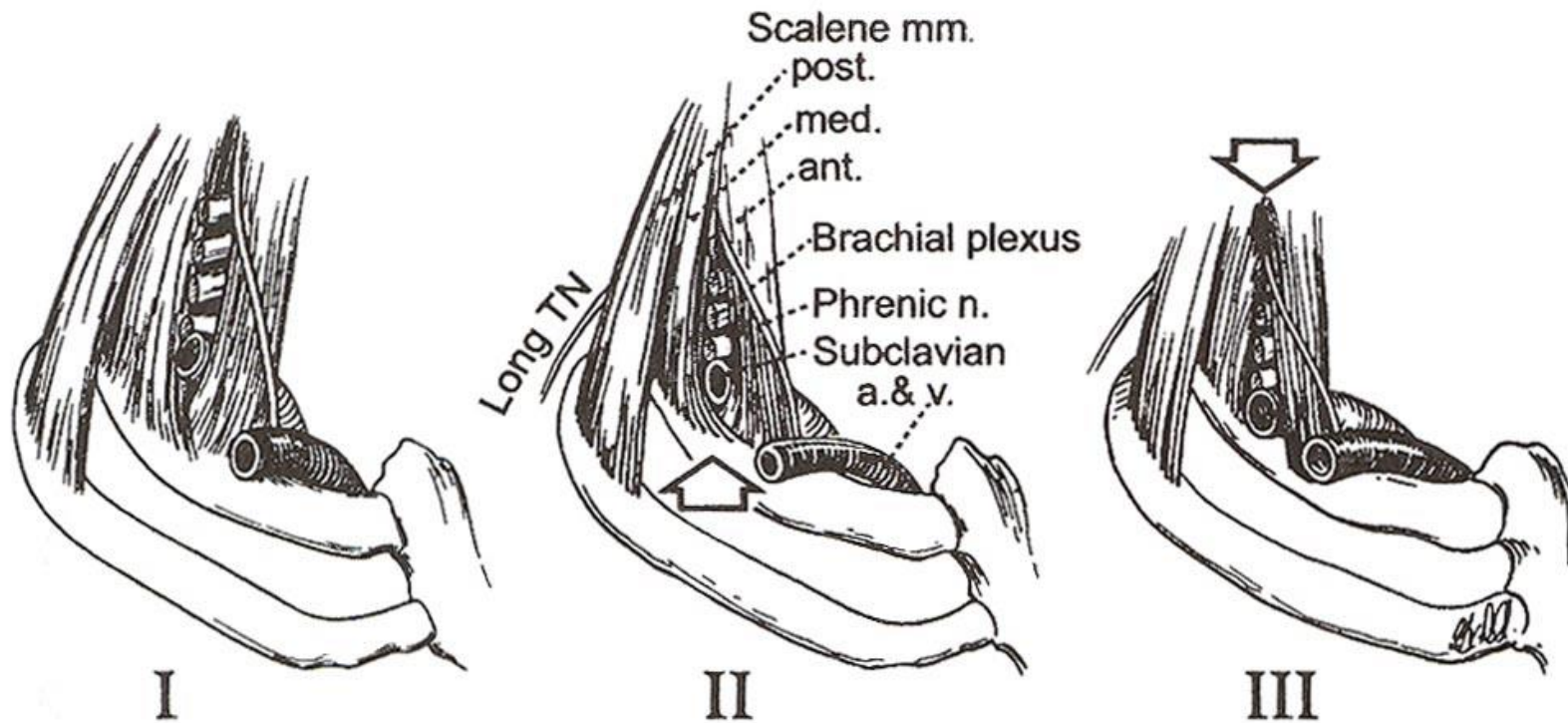
Normal anatomy



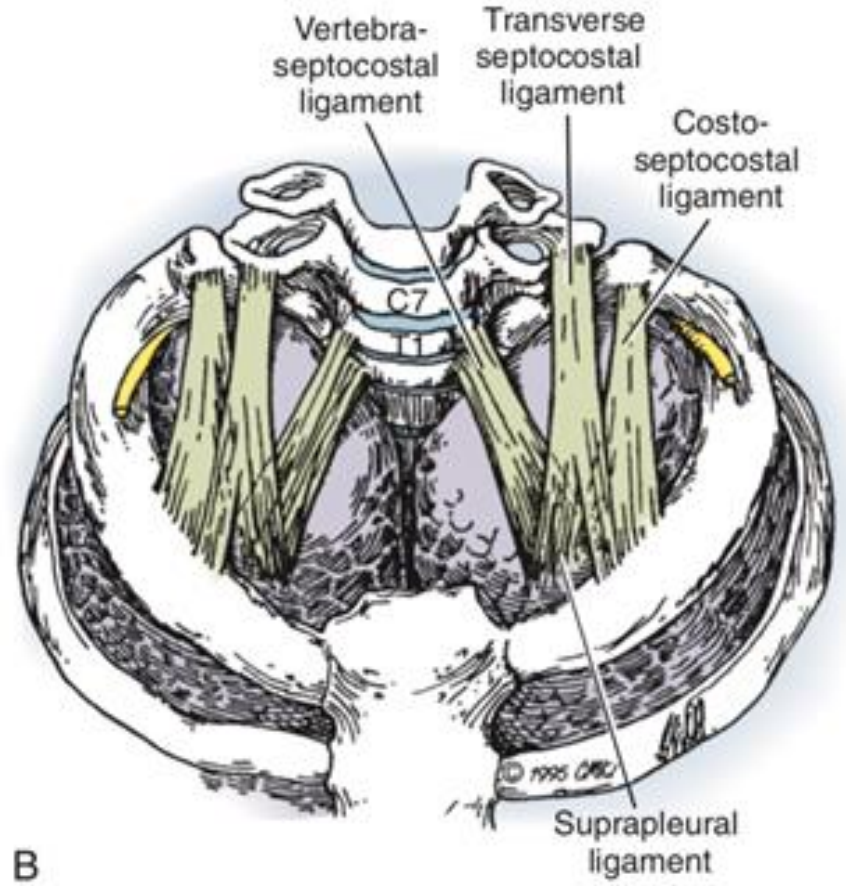
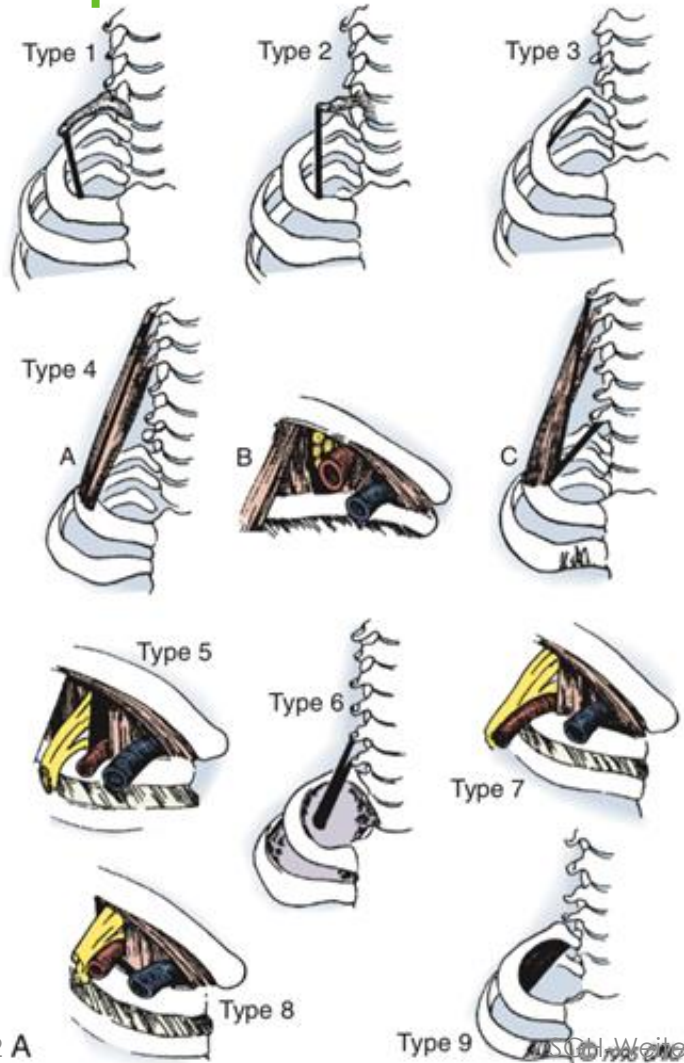
Regions of compression



Supraclavicular – muscular variants

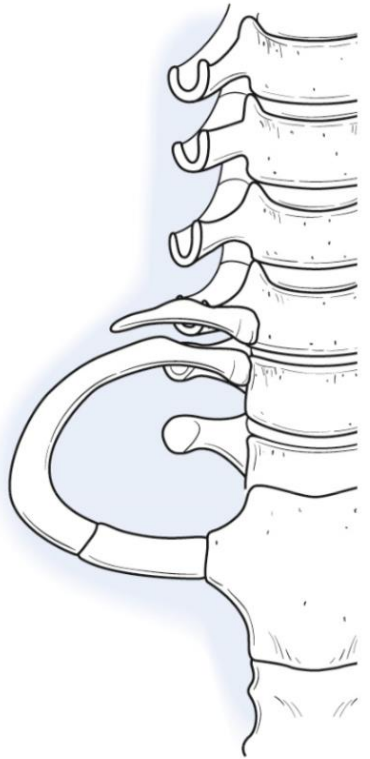


Supraclavicular – compressive bands

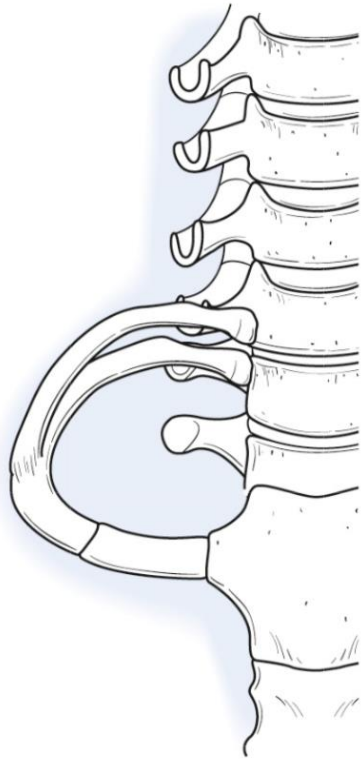


B

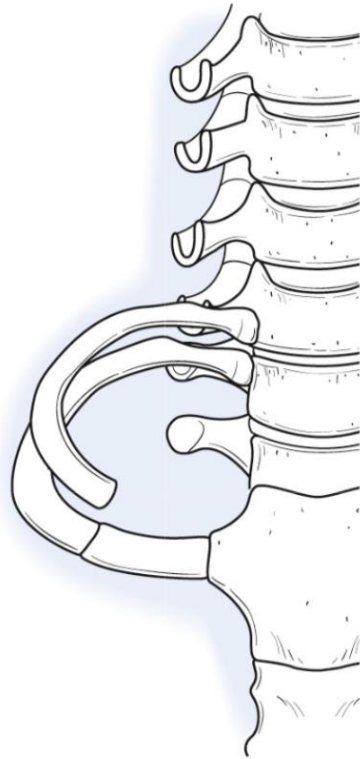
Supraclavicular – cervical rib



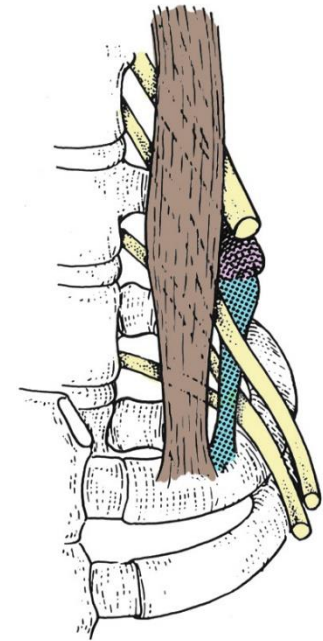
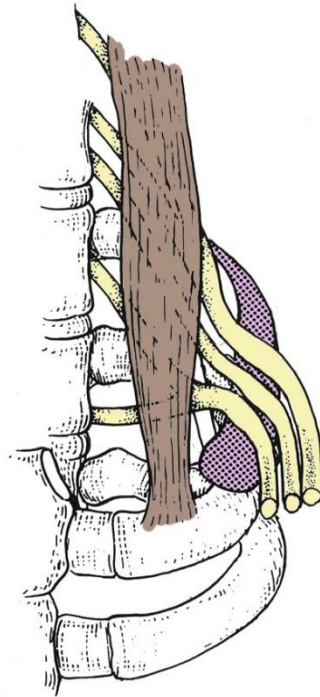
A
Rudimentary



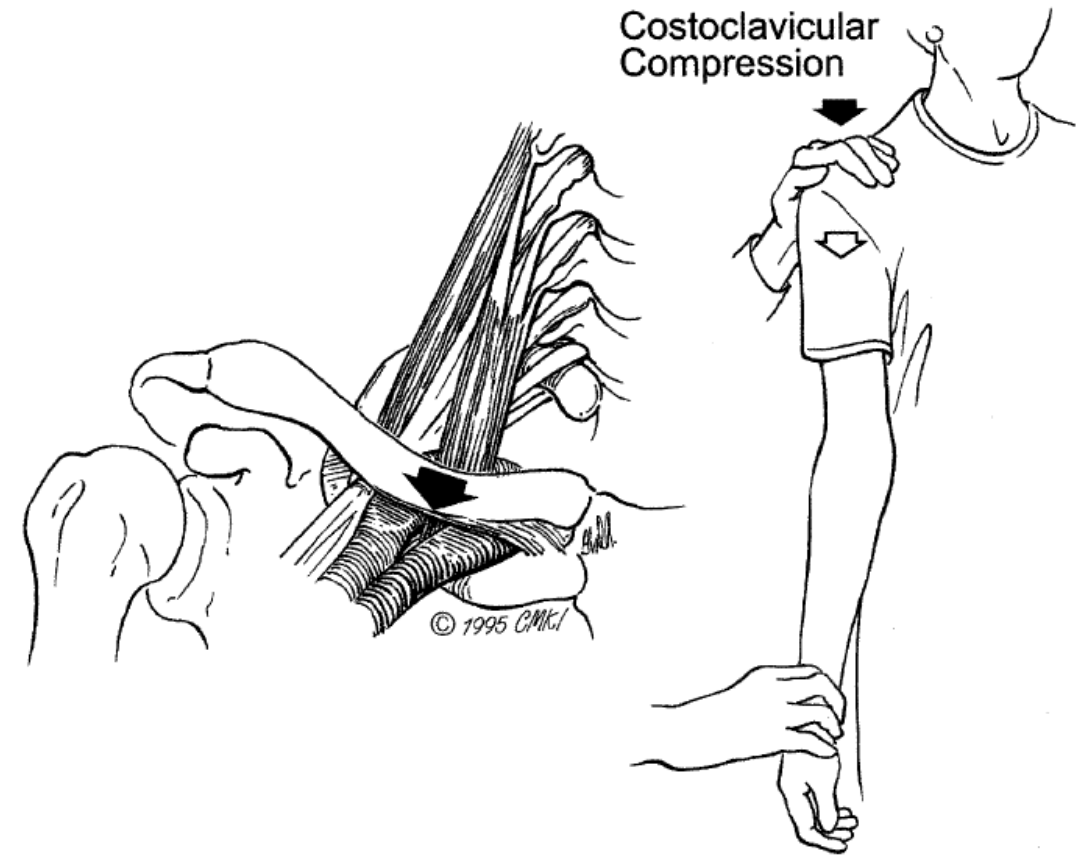
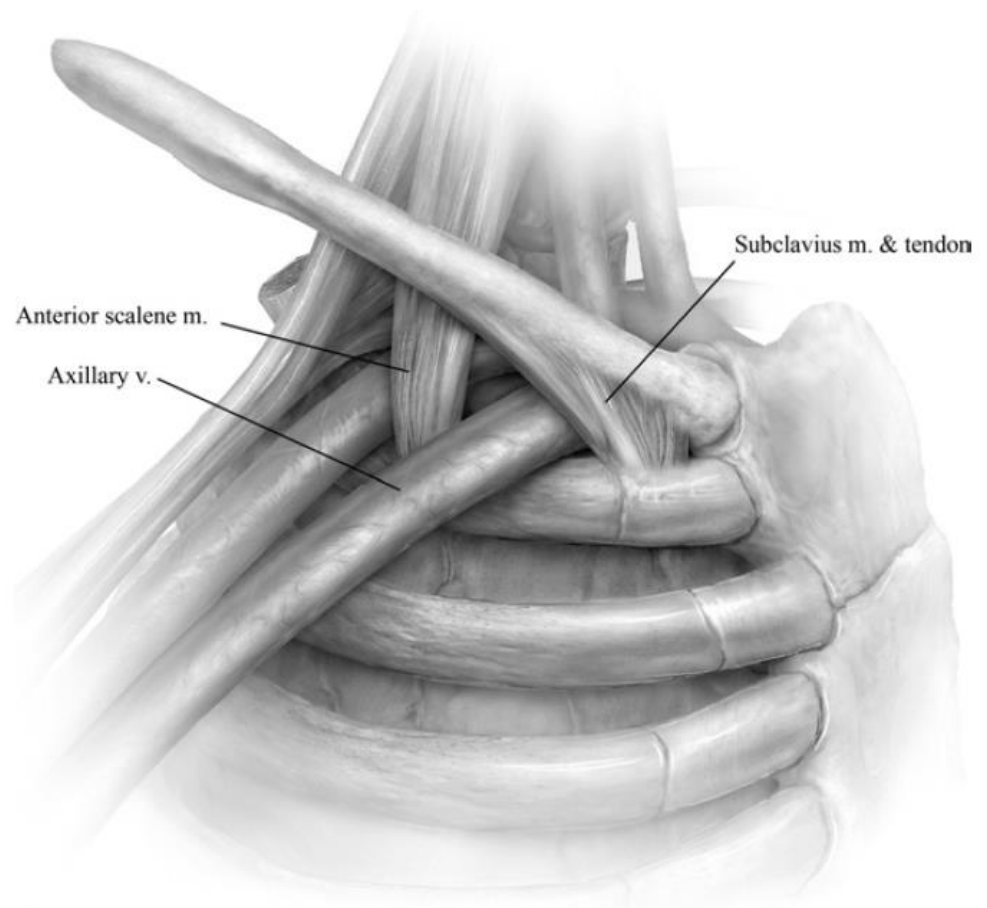
B
Fused with first thoracic rib



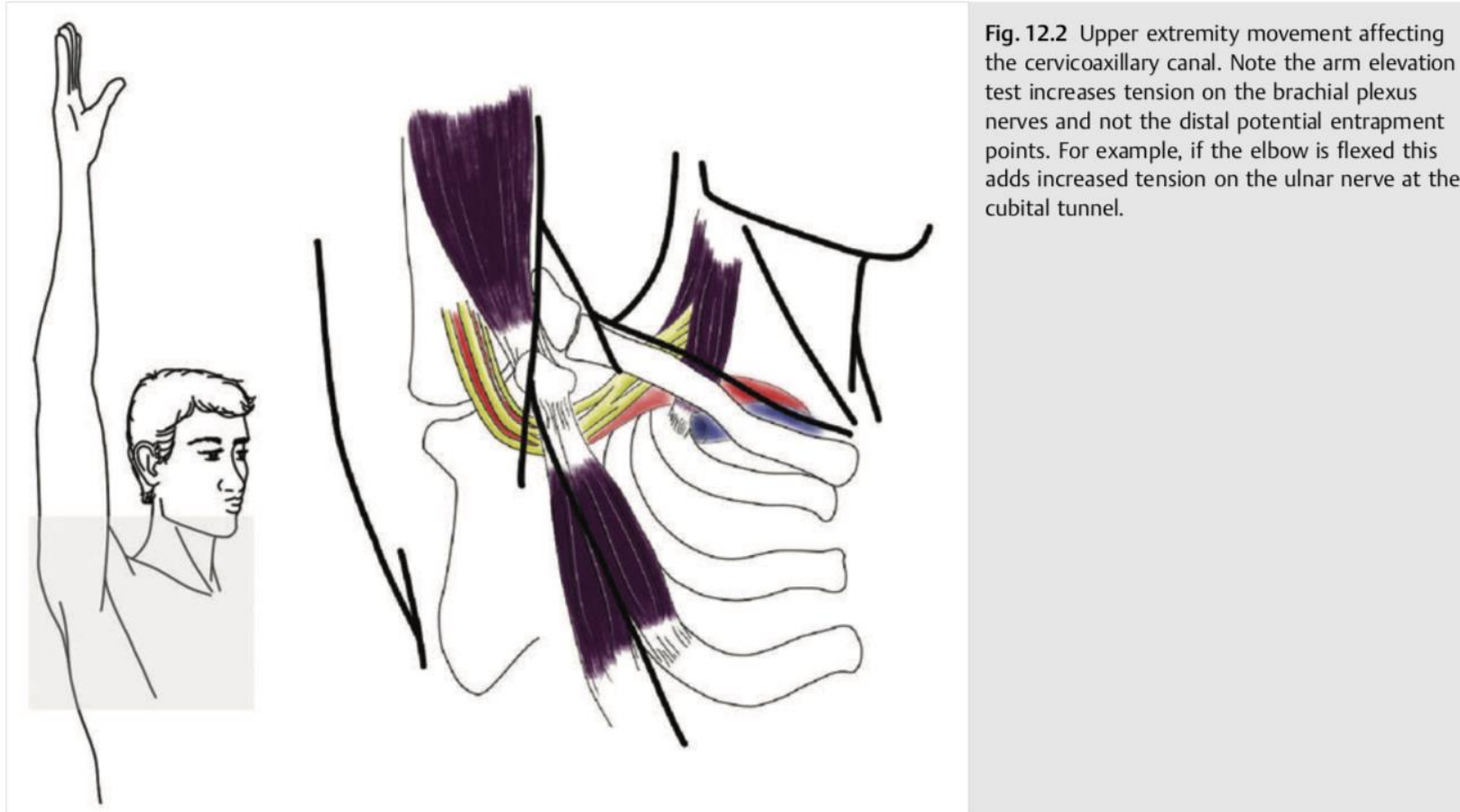
C
Fully developed



Costoclavicular compression



Subpectoral compression



TOS – classification (Wilbourn)

Table 12.1

| Neurogenic TOS | Arterial TOS | Venous TOS |
|----------------------------------|------------------------|----------------------------|
| Insidious or posttraumatic onset | Cold extremity | Edema |
| Pain (proximally) | Easy fatigue | Distended veins |
| Paresthesias (distally) | Raynaud syndrome | Achy pain |
| Symptoms follow activity | Symptoms with activity | Positional/intermittent |
| | | Persistent with thrombosis |

Abbreviation: TOS, thoracic outlet syndrome.

True neurogenic TOS

- 1:1.000.000 of TOS patients
- Objective findings
- C8/T1 affected
- Cervical rib often present



Arterial TOS

- 1-2% of TOS patients
- Frequent osseous anomaly
 - Cervical rib, 1st rib, fracture
- \pm stenosis or aneurysm



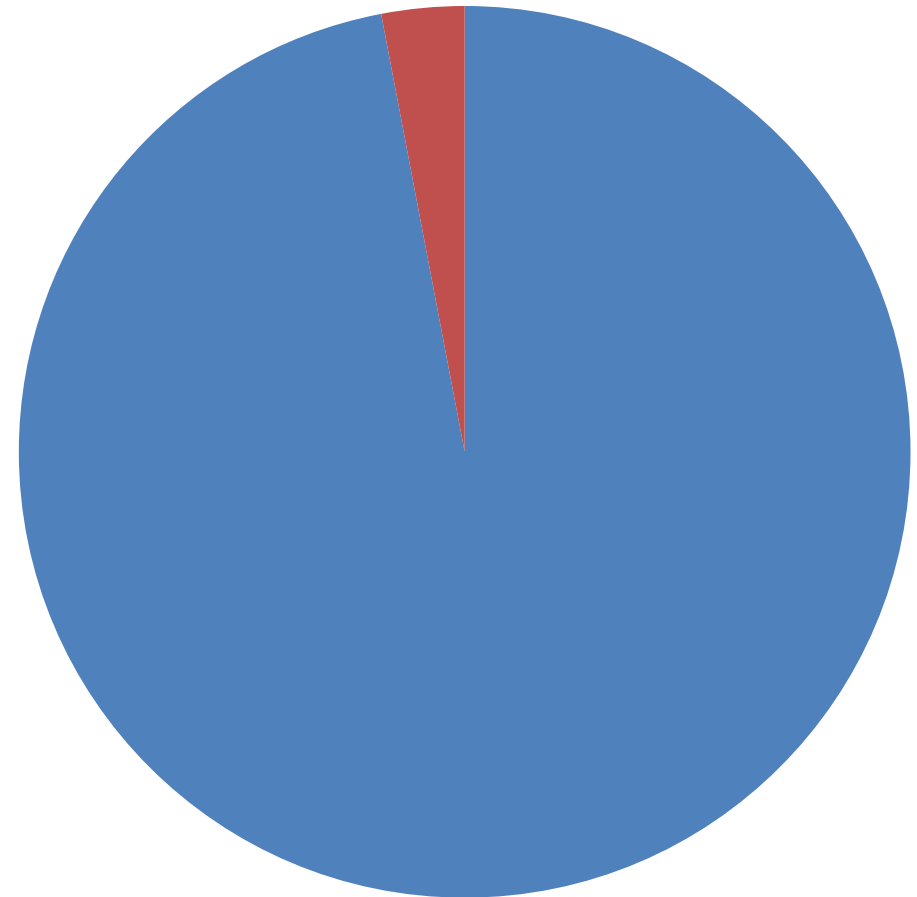
Venous TOS

- 2-3% of TOS patients
- Intermittent compressions
± sudden events
- Collaterals in chronic
compression
- Complete thrombosis
 - Paget-Schroetter-Syndrome
 - Sudden activity-related
thrombosis



Disputed neurogenic TOS

- 95-97% of TOS patients
- Wide variety of upper extremity symptoms
- No objective findings on ENMG, Doppler, Rx etc.



TOS – Epidemiology

- Incidence 1-2%
 - Underdiagnosed or undertreated?
 - 25% had previous upper extremity surgery and numbness/tingling at time of initial presentation
- Working age population
 - Repetitive lifting
 - Repetitive uninterrupted arm movements with the hand at or above shoulder level
 - Worker's compensation
- w:m = 4:1

TOS – patient history

Common symptoms

- Chronic pain of shoulder, neck and back
- 95% paresthesias
 - Ulnar and median nerve distribution

Other symptoms

- Neurological symptoms ± double crush (carpal/cubital tunnel)
- Rapid fatigue of arm in provocational positions
- Nocturnal complaints
- Vascular complaints
 - swelling, coolness of hand, discoloration
- Psychological issues

TOS – physical examination

Inspection and palpation

- Posture
 - Neck, back
- Asymmetry
 - Head to one side
 - Scapular asymmetry
- External compression signs
- Always start distally
 - Carpal / cubital tunnel
 - Infraclavicular, interscalene triangle

Provocative tests

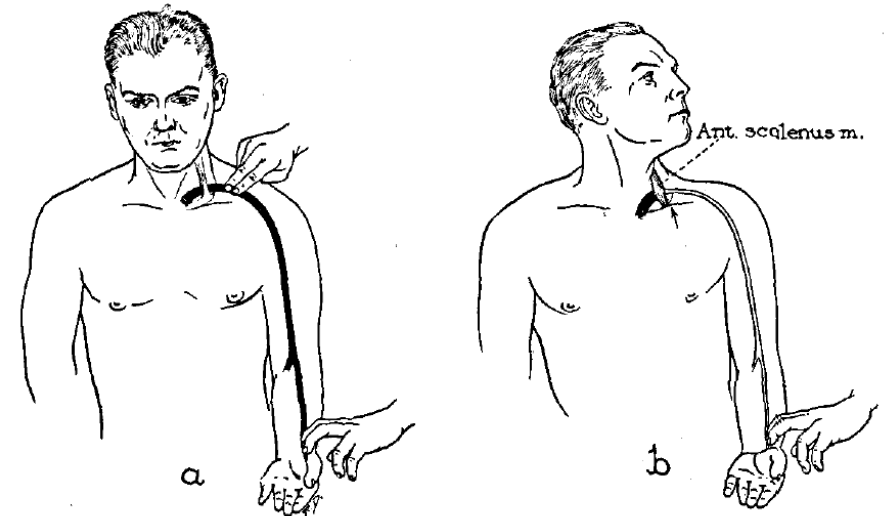
- Vascular tests
 - Adson test
 - Halstead test
 - Wrights hyperabduction test
- Plexus tests
 - Roos test (EAST elevated arm stress test)
 - Novak test
 - Upper limb tension test ULTT
 - Scratch collapse test

Adson Test

- Rotation towards affected side
- Elevation of chin
- Breathe in and hold breath
- \pm tilt away from affected side
- Positive test:
 - reduction in pulse volume

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SURGERY, GYNECOLOGY AND OBSTETRICS



Adson 1947

Fig. 1. The vascular test; a, the subclavian and radial arteries identified; b, pulsations of arteries obliterated by inspiration, elevation of patient's chest and rotation of his head to the affected side; in this case, the left.

Halstead test

- Chest out
 - Shoulders down
 - «military position»
-
- Positive test:
 - reduction in pulse volume



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Wright's hyperabduction test

- Hyperextension of arm
- Positive test:
 - reduction in pulse volume or
 - reproduction of symptoms

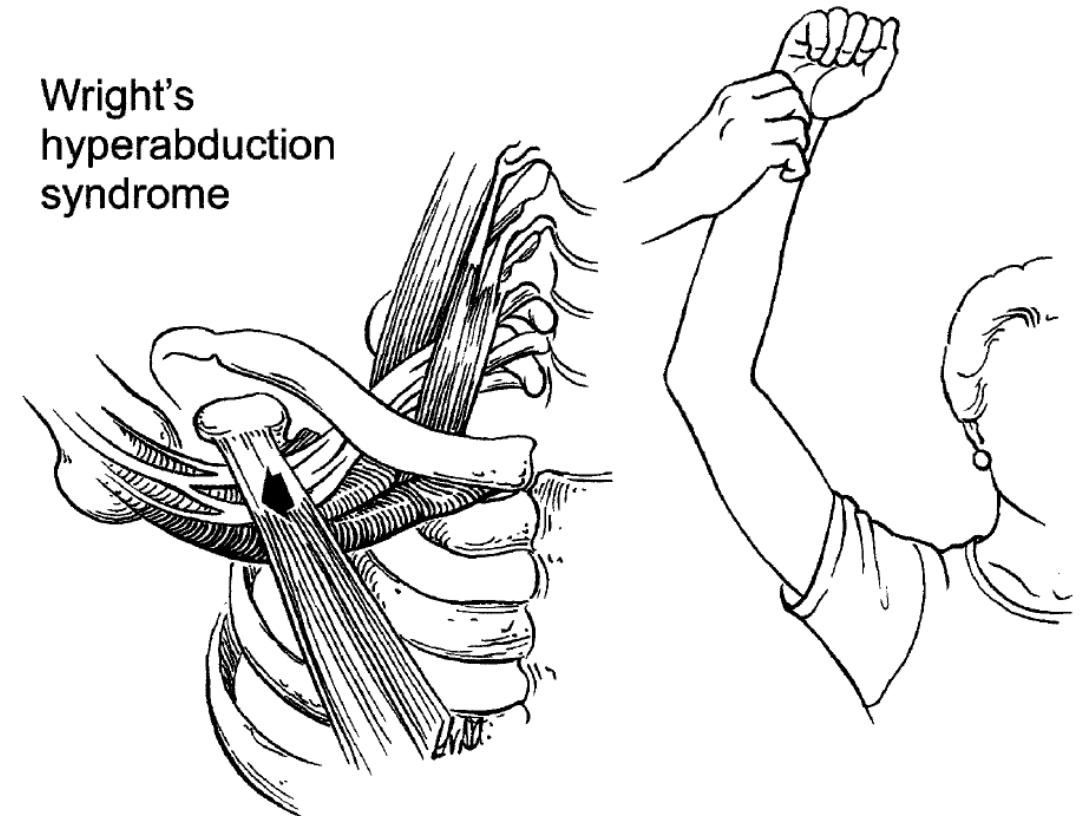


Fig. 11. Subscapularis minor space in hyperabduction syndrome.

Roos test - EAST

- Elevation of arms 90/90°
- Open/close fist for 3 min

- Positive test:
 - Side different fatigue
 - reproduction of symptoms



Novak/Mackinnon/Patterson test

- Elevation of arms 180°
- Elbow and wrist straight
- Hold for 1 min
- \pm digital compression of plexus

- Positive test:
 - reproduction of symptoms



Fig. 12.6 Specific provocative test for thoracic outlet syndrome. This test was developed due to the lack of specificity and potential confounding presence of distal nerve compression with many other tests. The arms are hyperabducted to 180 degrees and held in position for 1 minute, taking care to keep the wrists and elbows straight to avoid eliciting symptoms of carpal tunnel or cubital tunnel syndrome.

Upper limb tension test ULTT (Elvey's test)

- Shoulder abduction
 - Wrist extension
 - tilt away from affected side
 - tilt towards affected side
-
- Positive test:
 - reproduction of symptoms and stepwise increase
 - Decrease with tilt towards affected side



TOS – imaging / testing

- Radiographs

- Cervical rib

- Sonography

- Duplex

- CT scan

- Bony status
- angiography



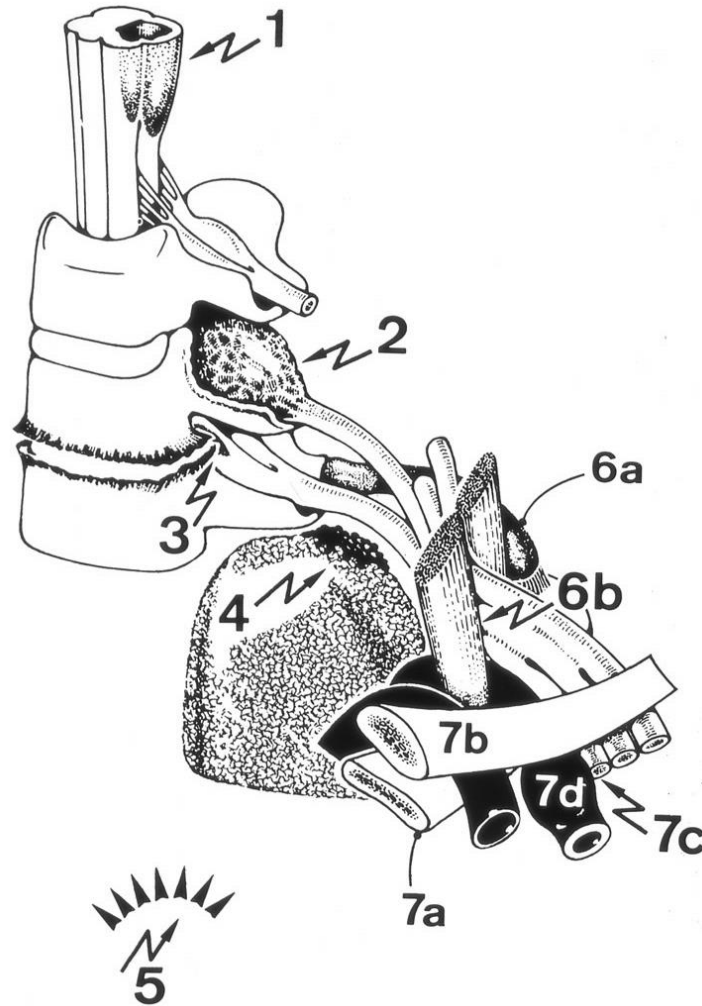
- MRI

- Rule out other causes (tumours)
- Anatomical variations
- Low sensitivity (30-100% depending on structure)

- Nerve studies

- Rule out peripheral compression
- F-waves
- EMG intrinsic

TOS – differential diagnoses



TOS – treatment

Conservative

- Disputed neurogenic TOS ($\geq 95\%$)
- Risk factors for failure
 - Obesity
 - Poor cardiovascular condition
 - Poor compliance / therapy adherence
- Staged physical therapy program

Operative

- principle
 - release or excise anomalous anatomy
 - 1st rib resection
 - release or excise ant./med. scalene
 - neurolyse brachial plexus
 - Release minor pectoral as needed

TOS – conservative treatment

Stage 1

- Physical therapy: identify and treat
 - Trigger points
 - Local areas of spasm
 - Tendinitis, bursitis
- Medical therapy:
 - Muscle relaxants
 - Antidepressants
 - Antiinflammatory
 - Gabapentin or pregabalin
 - Trigger point injections

Stage 2

- Stretching, relaxation, myofascial manipulation
- Posture correction
- Muscle imbalance correction
- Nerve gliding
- Cardiovascular, weight loss

- No strengthening of scalenes

TOS – conservative treatment

Stage 3

- Parascapular and core muscle training
 - Not scalenes
- Endurance
- Restoration of presymptomatic level of function

Stage 4

- Home program
- Return to work
 - Ergonomic changes
- **Success rate 50-100%**
 - Avoidance of surgery
 - Satisfactory pain relief
 - Return to work

TOS – operative treatment

Indications

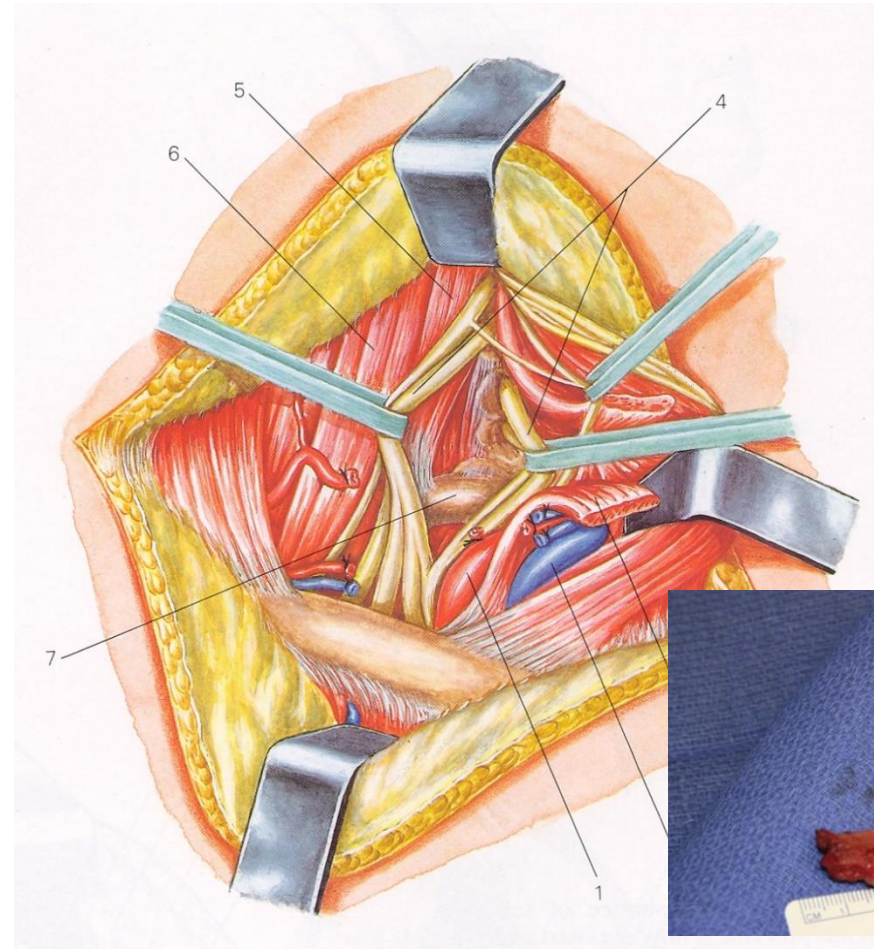
- Vascular complications
 - Ischemia
 - Paget-Schroetter Syndrome
- True neurogenic TOS
- Disputed neurogenic TOS
 - Failed conservative treatment

Approaches

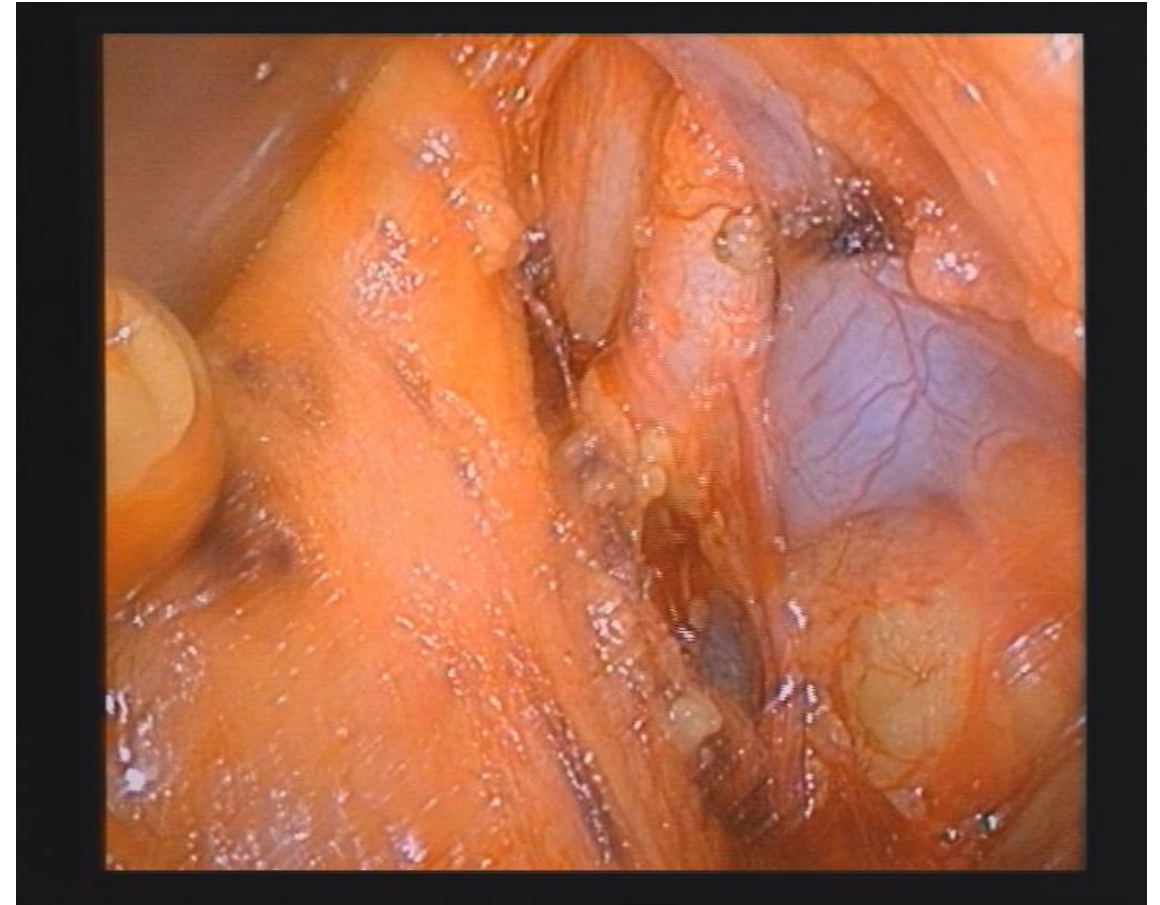
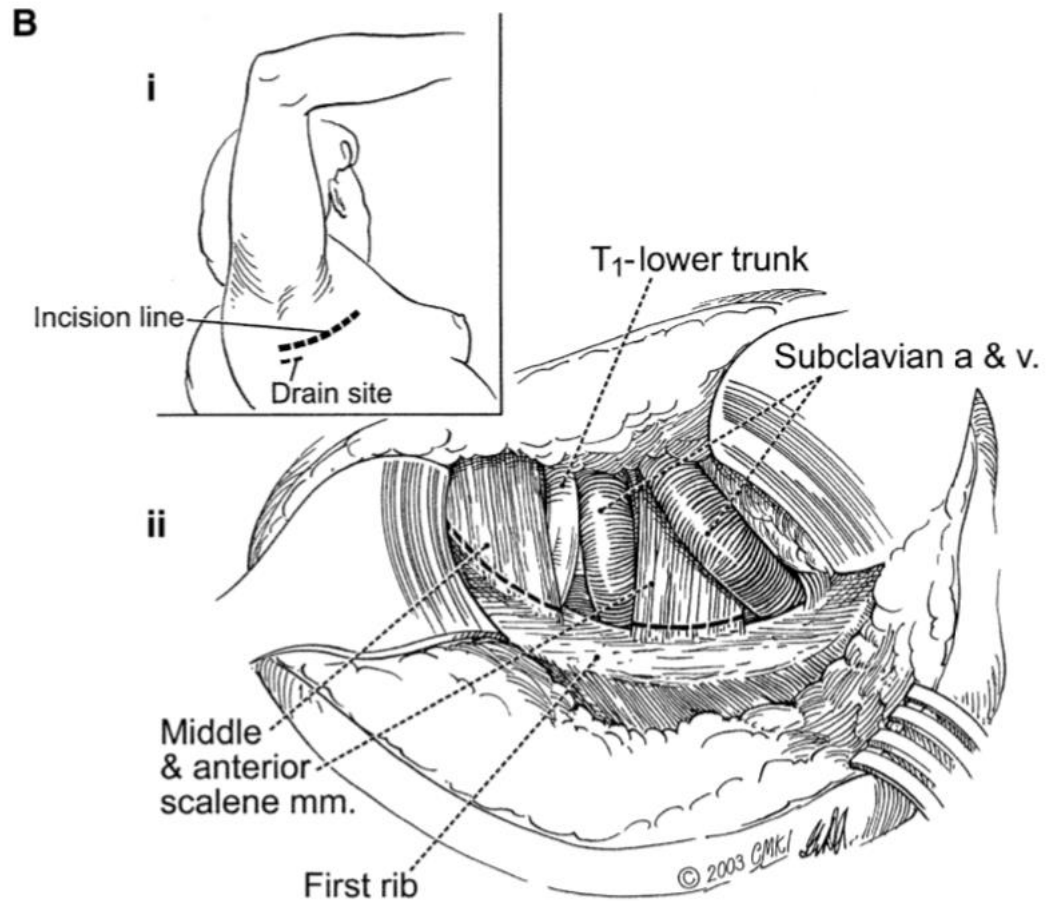
- Supraclavicular
- Transaxillary
- Combined
- Thoracoscopic ± daVinci robot

Supraclavicular approach

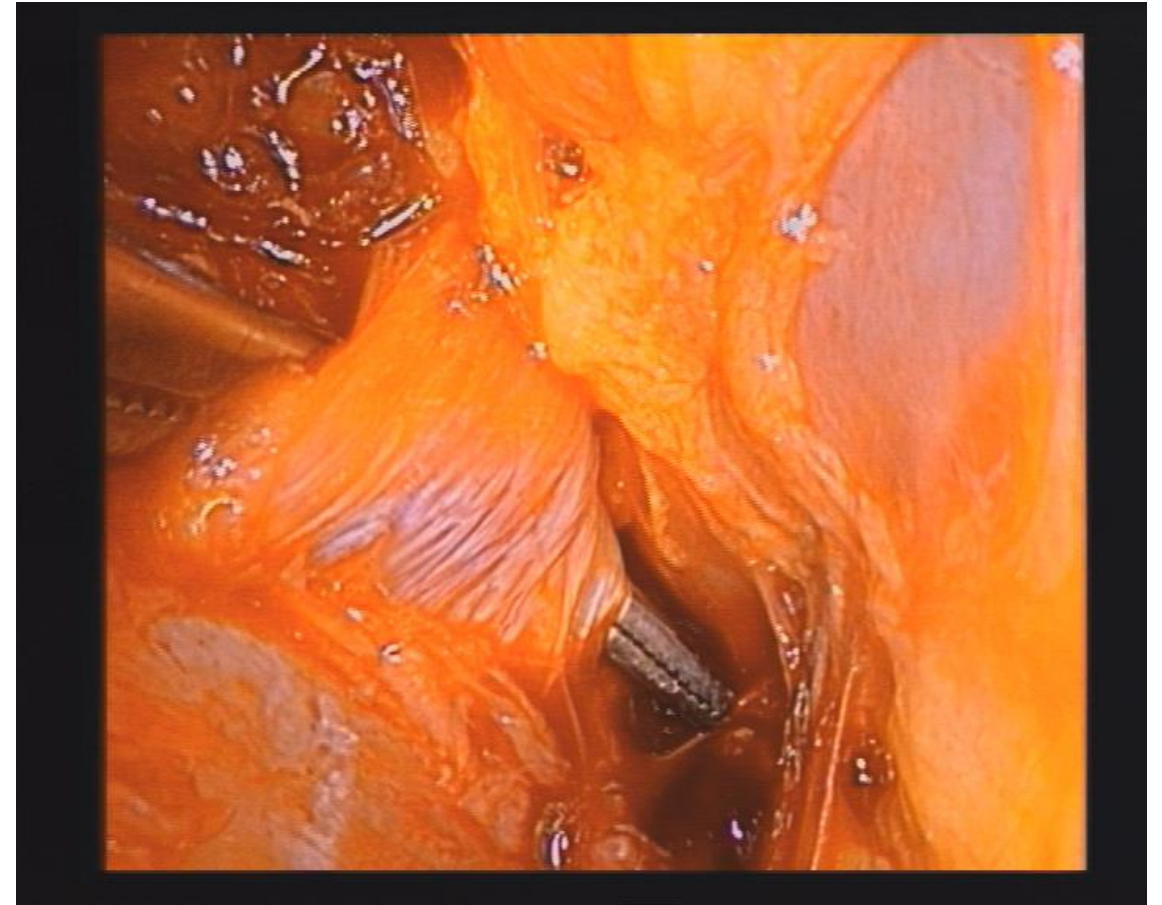
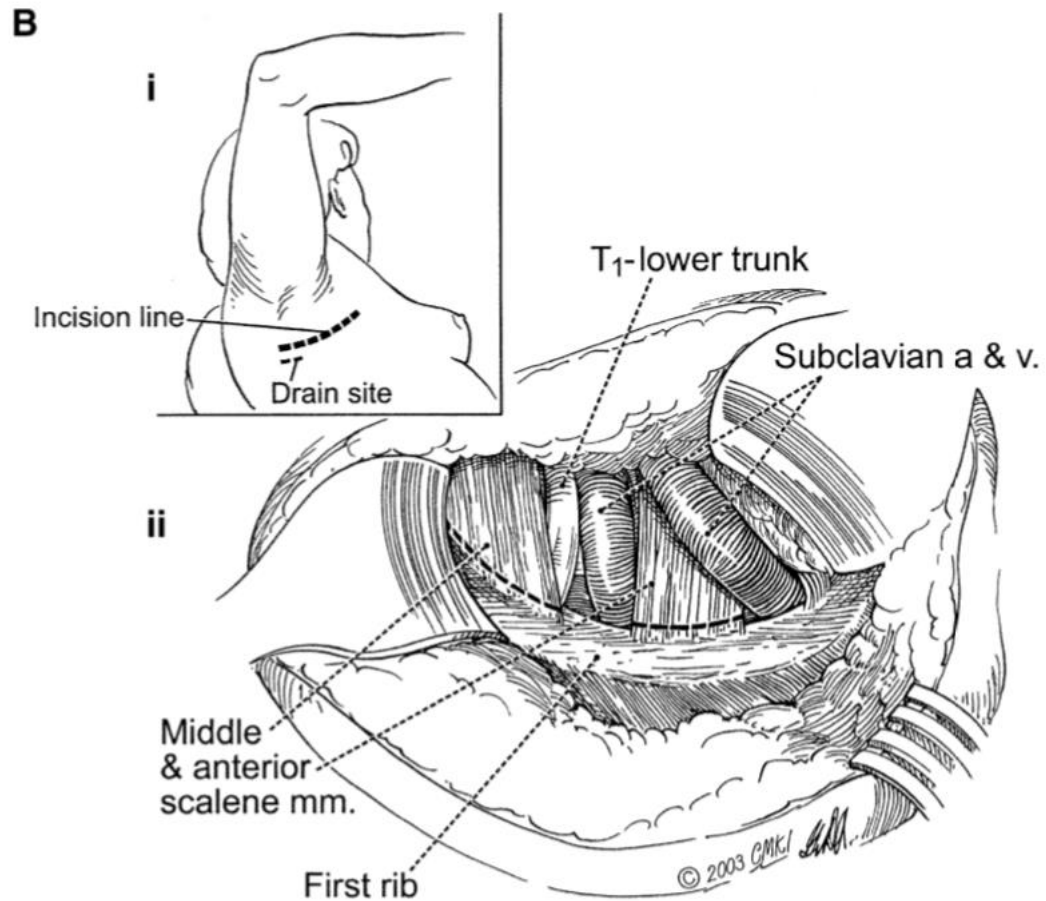
- lateral approach
- Transverse cervical and supraclavicular vessels
- Cut anterior scalene from 1st rib
- Excise middle scalene (cave LTN)
- Excise Scalenus minimus and ligaments
- Excise cervical rib and 1st rib



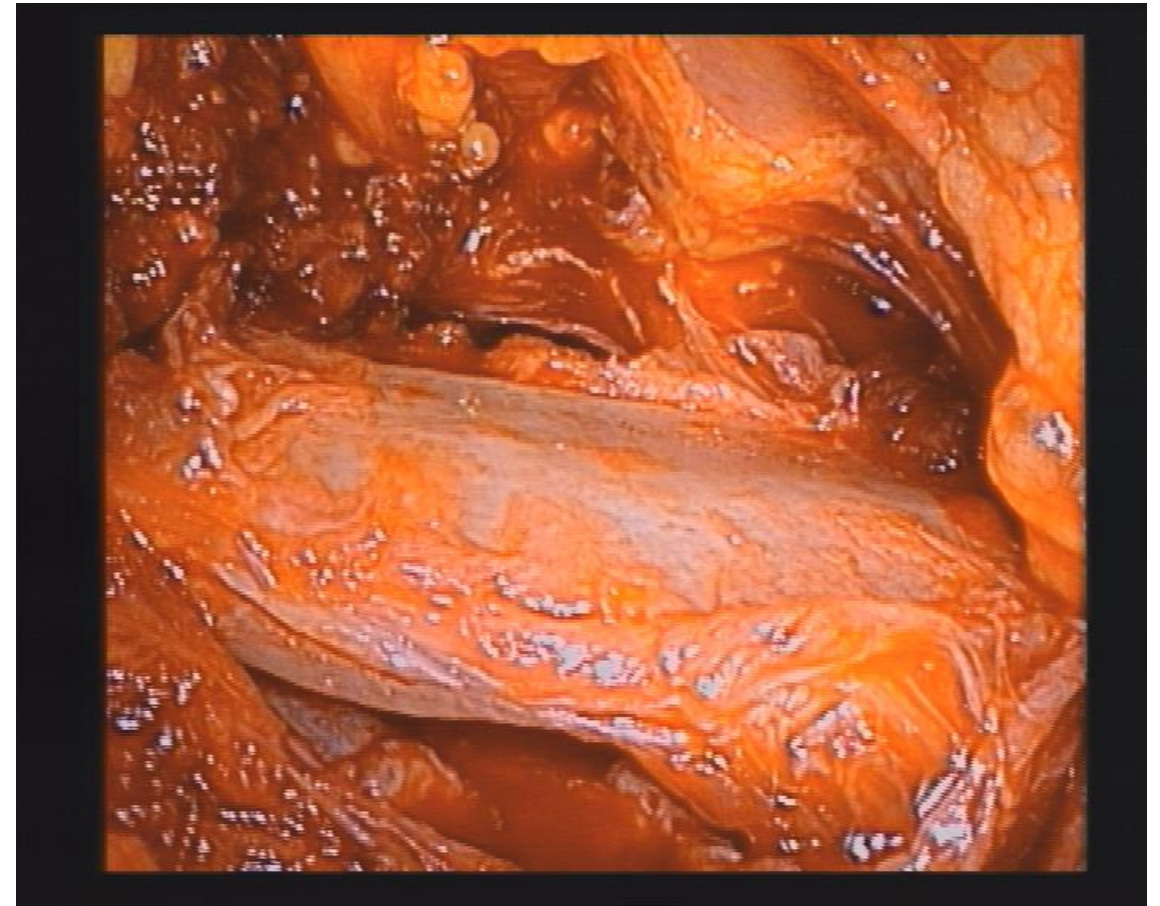
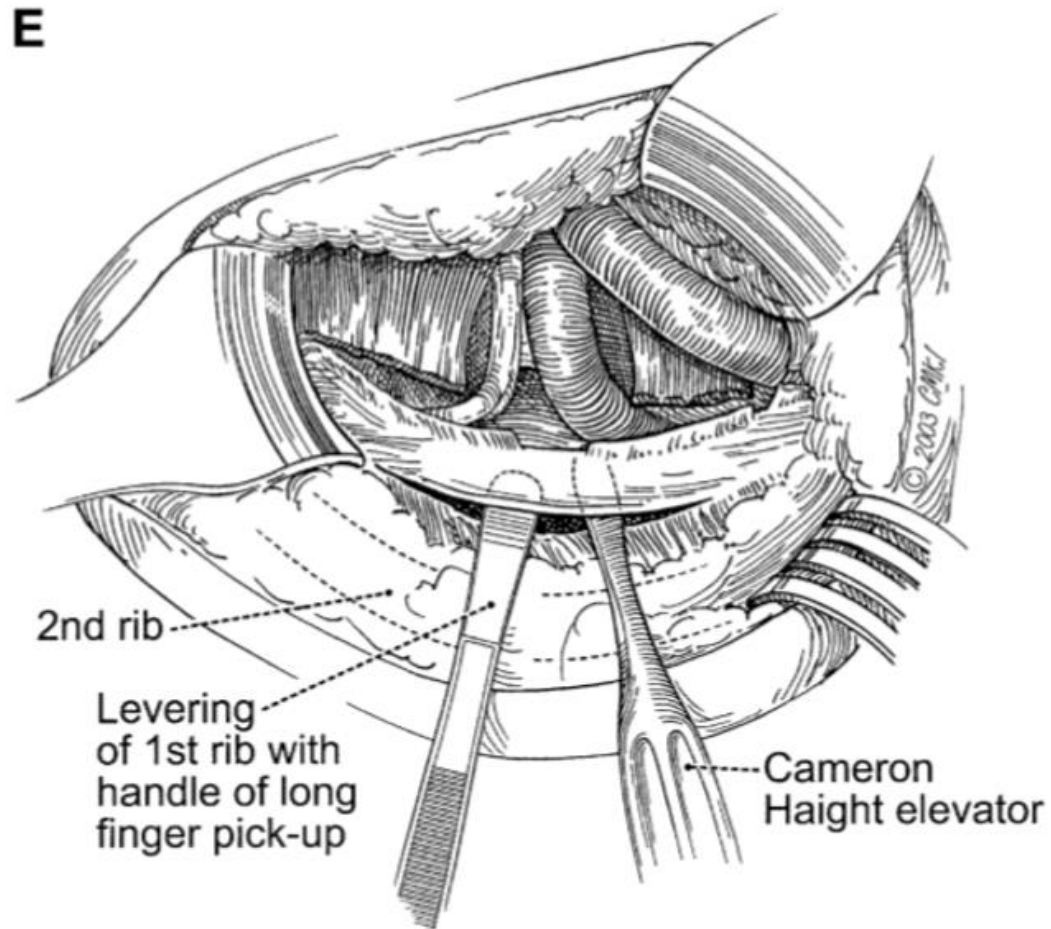
Transaxillary approach



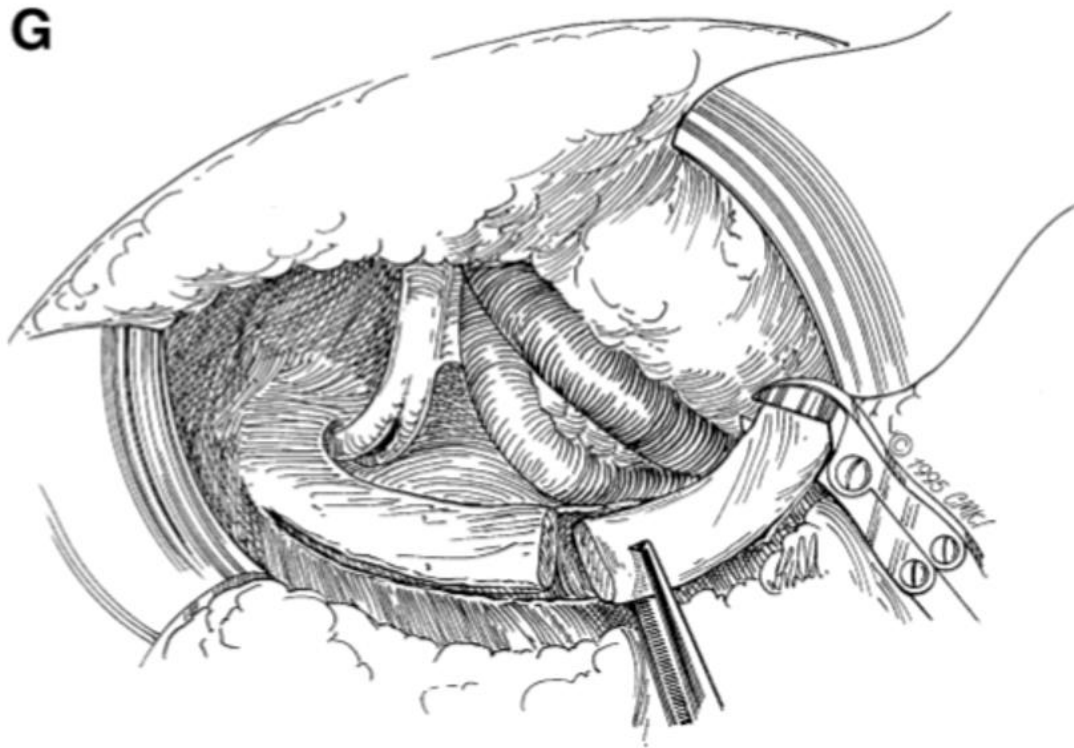
Transaxillary approach



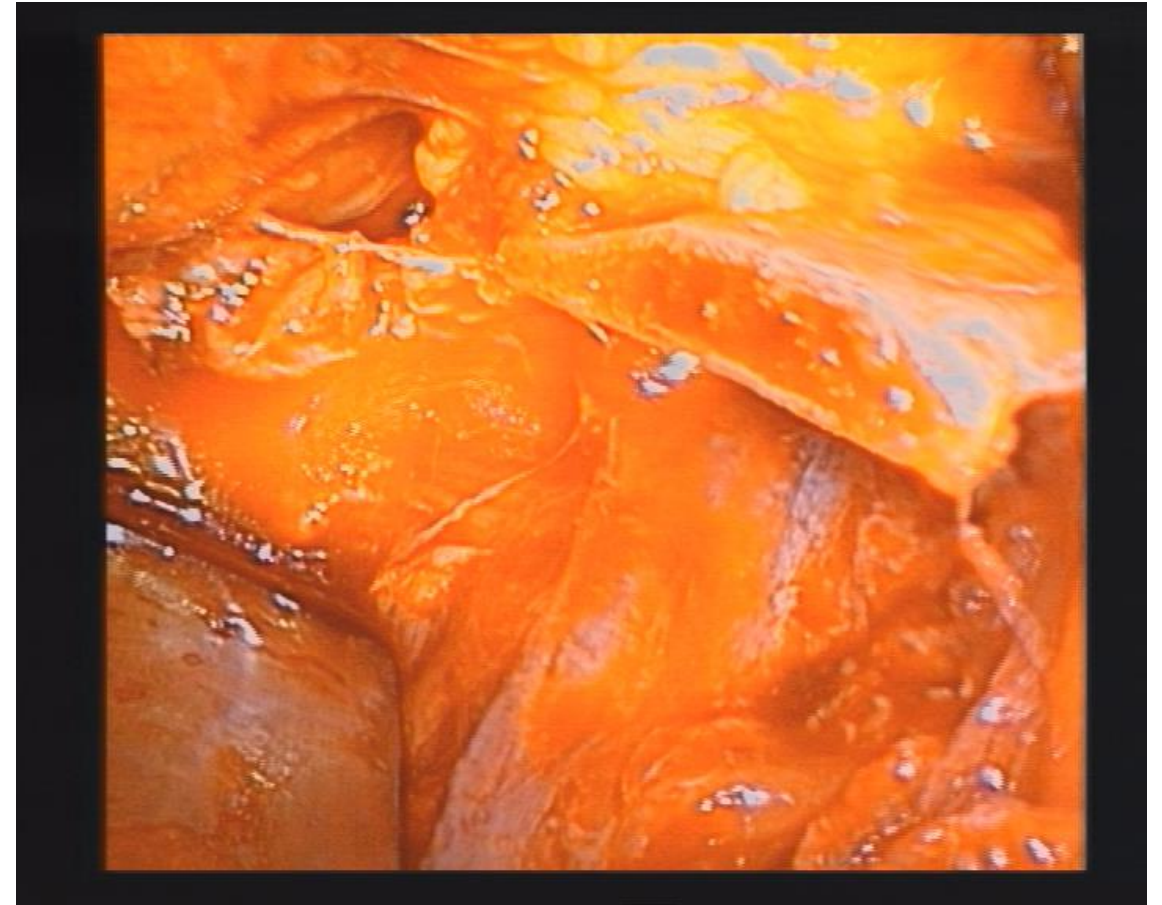
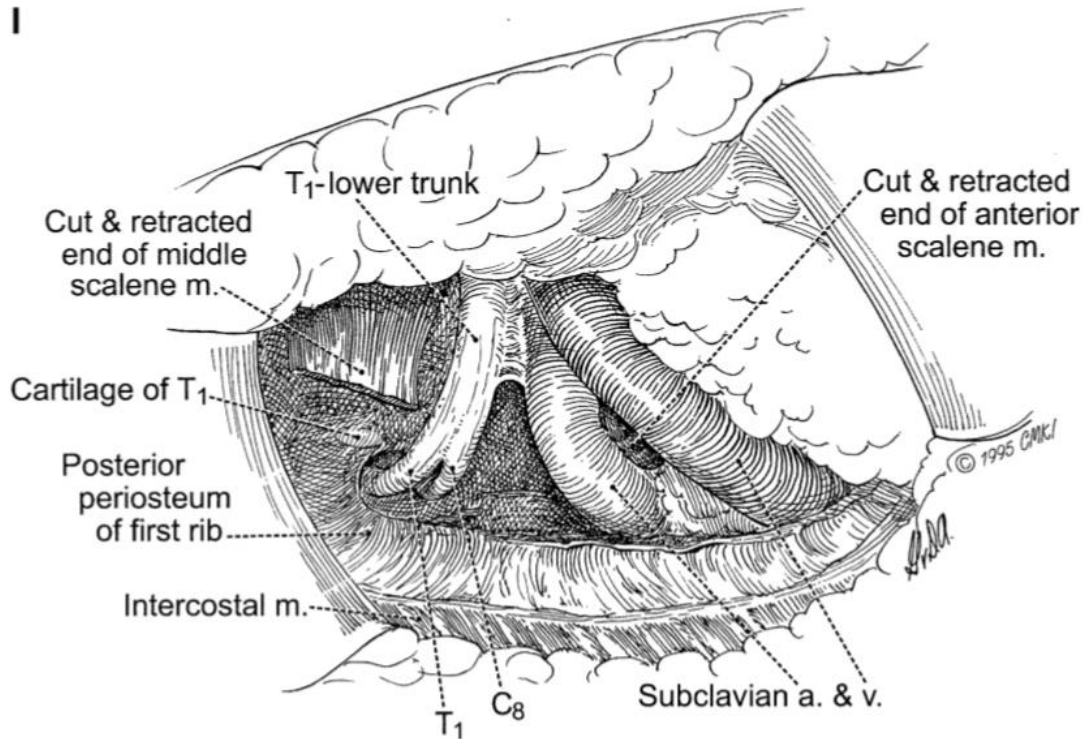
Transaxillary approach



Transaxillary approach



Transaxillary approach



Thoracoscopic approach

- Thoracoscopic 1st rib resection
- Robotic assisted

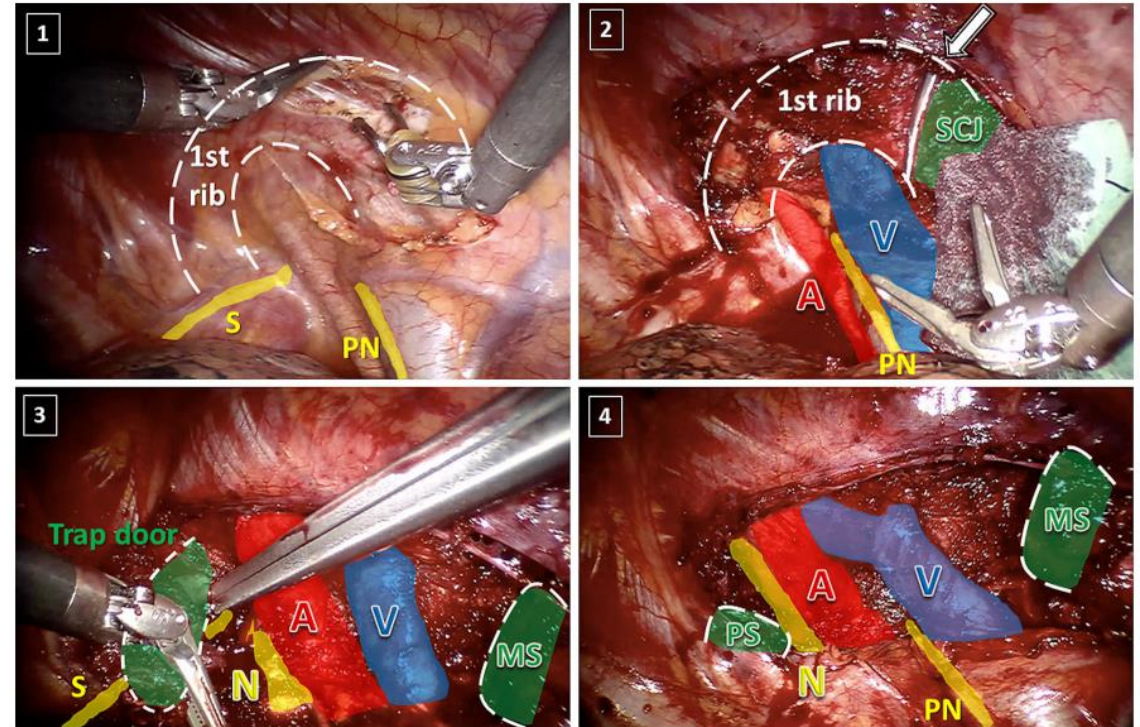
World J Surg (2018) 42:3250–3255
<https://doi.org/10.1007/s00268-018-4636-4>



ORIGINAL SCIENTIFIC REPORT WITH VIDEO

First Rib Resection for Thoracic Outlet Syndrome: The Robotic Approach

Gregor J. Kocher¹ · Adrian Zehnder¹ · Jon A. Lutz¹ · Juerg Schmidli² · Ralph A. Schmid¹



Which approach to use

Transaxillary approach

- Primary target (1st rib) is not obscured by plexus
- Less working space

Thoracoscopic approach

- Robotic surgery
- Minimally invasive
- Good outcomes reported

Supraclavicular approach

- More structures need to be mobilised
- Easier to handle intraoperative complications
- Better access to cervical rib

Take home – TOS

- Combination of
 - Neurological disturbances of the hand
 - shoulder girdle pain
- Therapy: CONSERVATIVE
- Operative therapy for vascular and true neurogenic TOS
- Surgeon should be experienced (>10/a)
- Success rate 80%
- Recurrence rate is low

Rare compression neuropathies

MERALGIA PARAESTHETICA

Definition

- Lateral femoral cutaneous nerve (LFCN) entrapment – Bernhardt-Roth-Syndrome
- Lumbar roots L2/3
- Crosses psoas and iliacus muscle

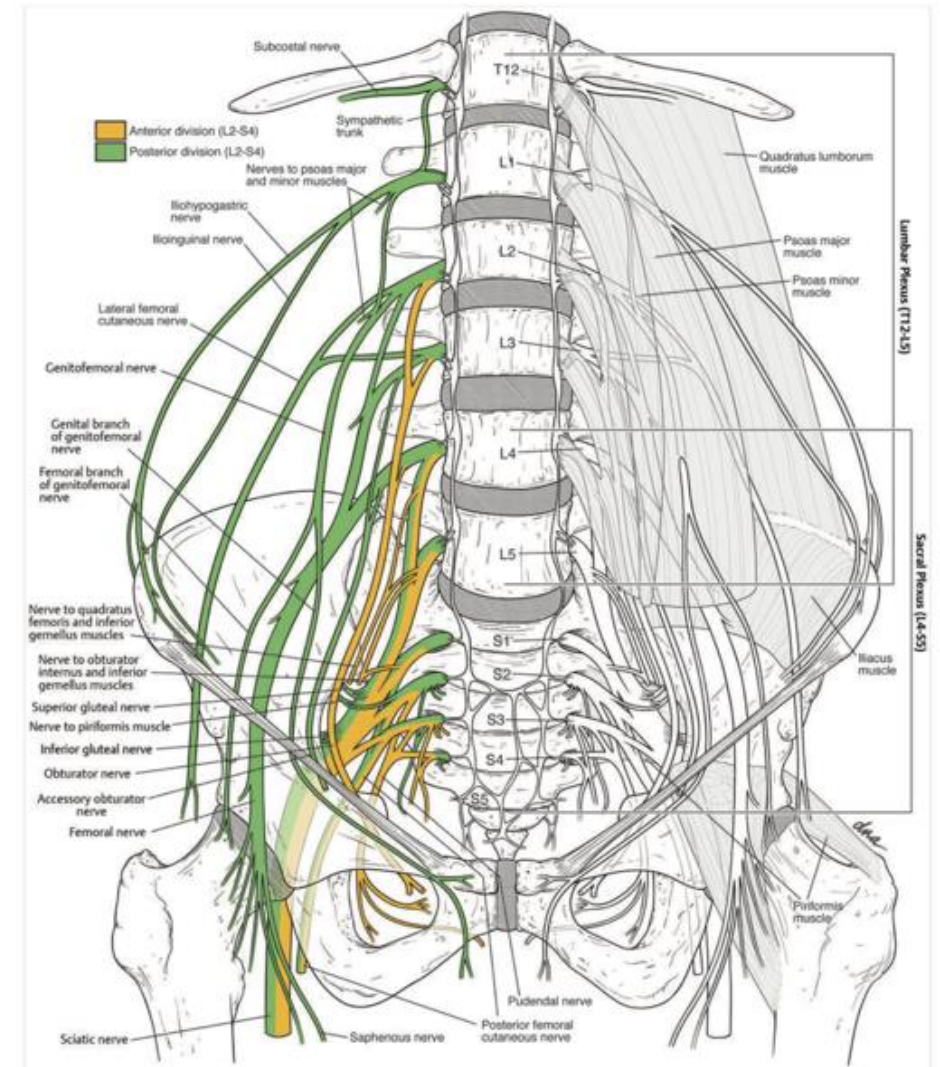
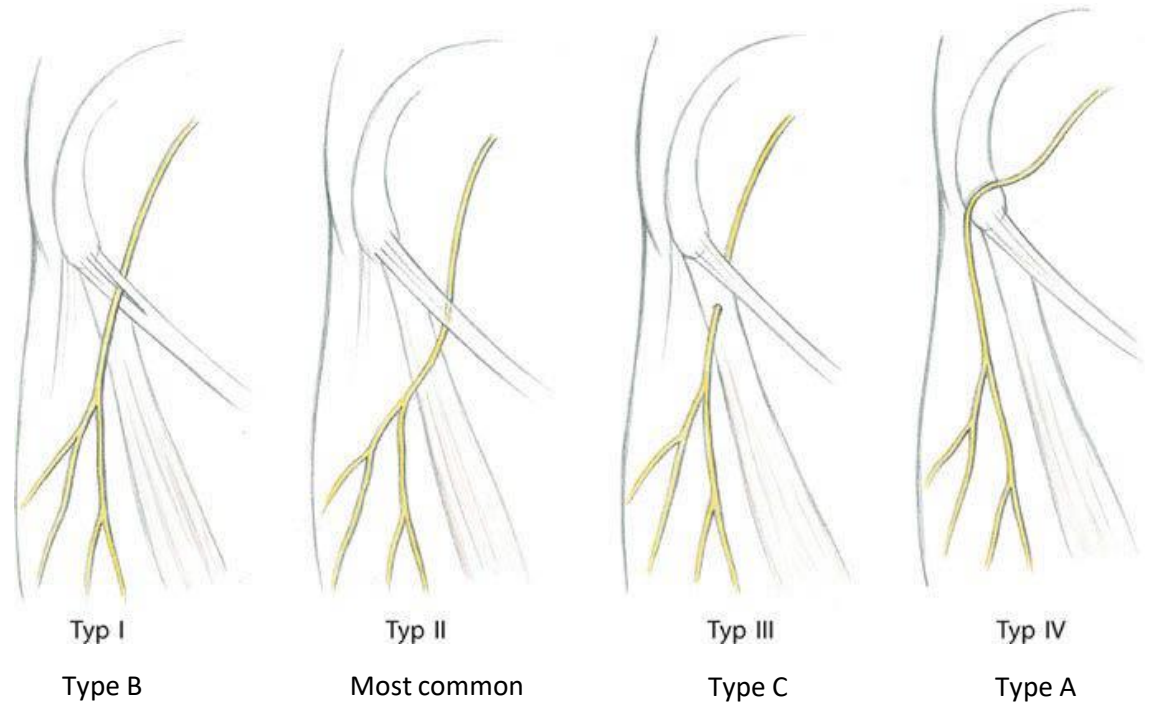


Fig. 13.1 Lumbosacral plexus anatomy. The lumbosacral plexus involves multiple components and further organized into the lumbar plexus (T12-L5) and the sacral plexus (L4-S5). Major components involve abdominal nerves (iliohypogastric, ilioinguinal, genitofemoral, and lateral femoral cutaneous), the femoral nerve, and the sciatic nerve.

Anatomy

- Variable exit point:
 - Most common: triangle SAIS – inguinal ligament – sartorius muscle
- Runs deep to fascia lata
- Anterior and posterior branch

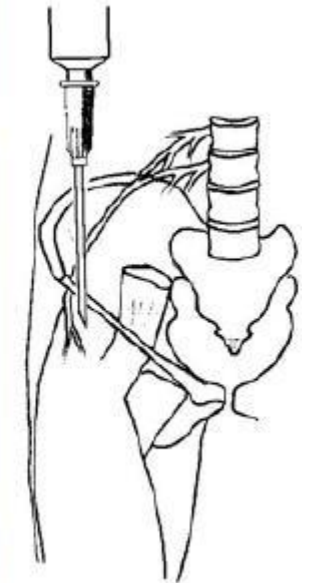


Clinical findings

- Pain, paresthesia
 - Standing and walking
 - Relief (or exacerbation) in sitting position
 - Day or night
- Numbness
- Compression pain and Tinel sign
- Diagnostic nerve block
- Nerve studies and imaging of little value

Treatment

- Most cases resolve with time
- Conservative treatment
 - Weight loss
 - Avoid compression (clothes etc.)
 - NSAID
 - Injection (LA/steroid)
 - Repeat as necessary



Treatment

- Skin incision parallel to inguinal ligament
- Longitudinal incision of fascia lata
- Partial incision of inguinal ligament
 - Decompression as necessary
- Neurectomy in case of refractory symptoms or recurrence

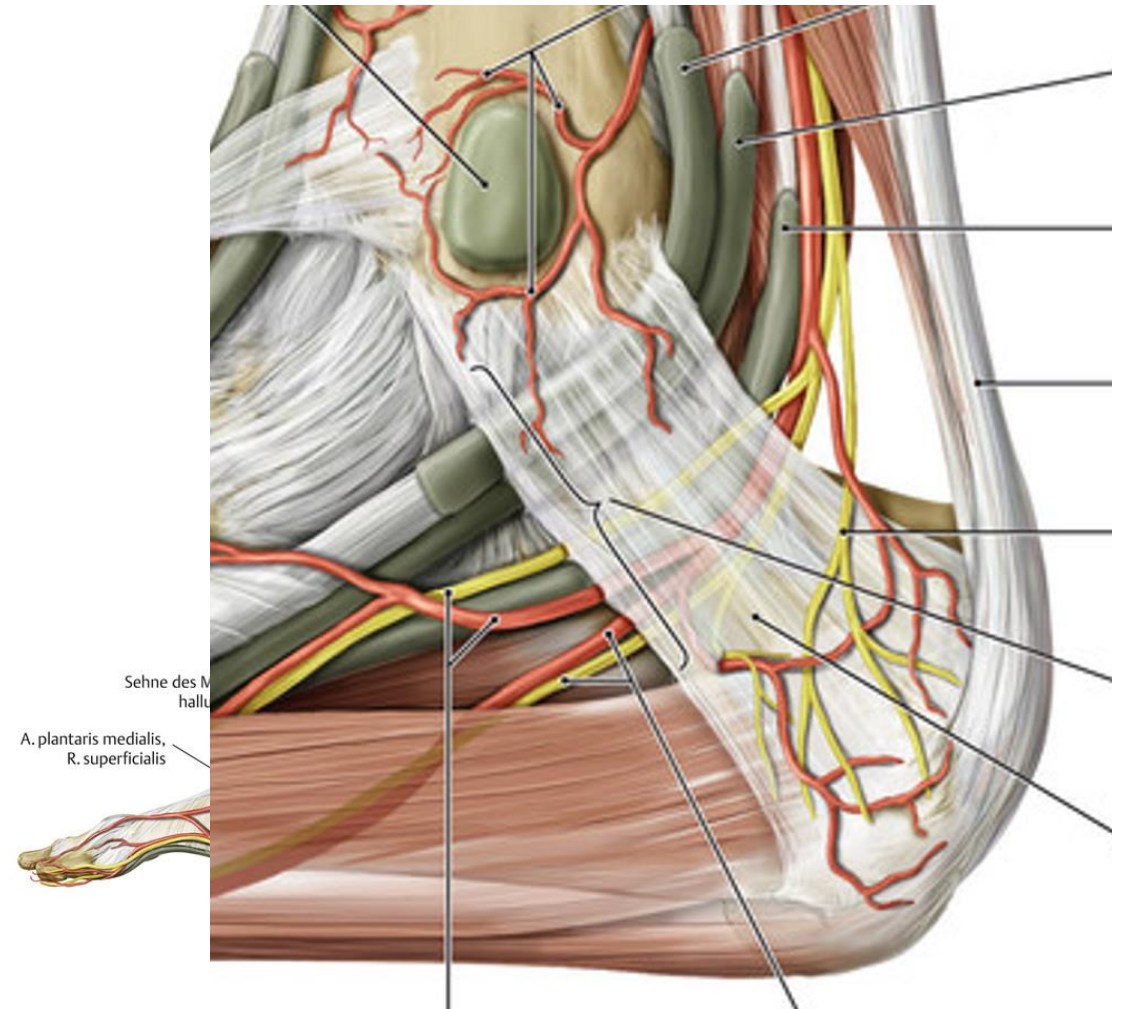


Rare compression neuropathies

TARSAL TUNNEL SYNDROME

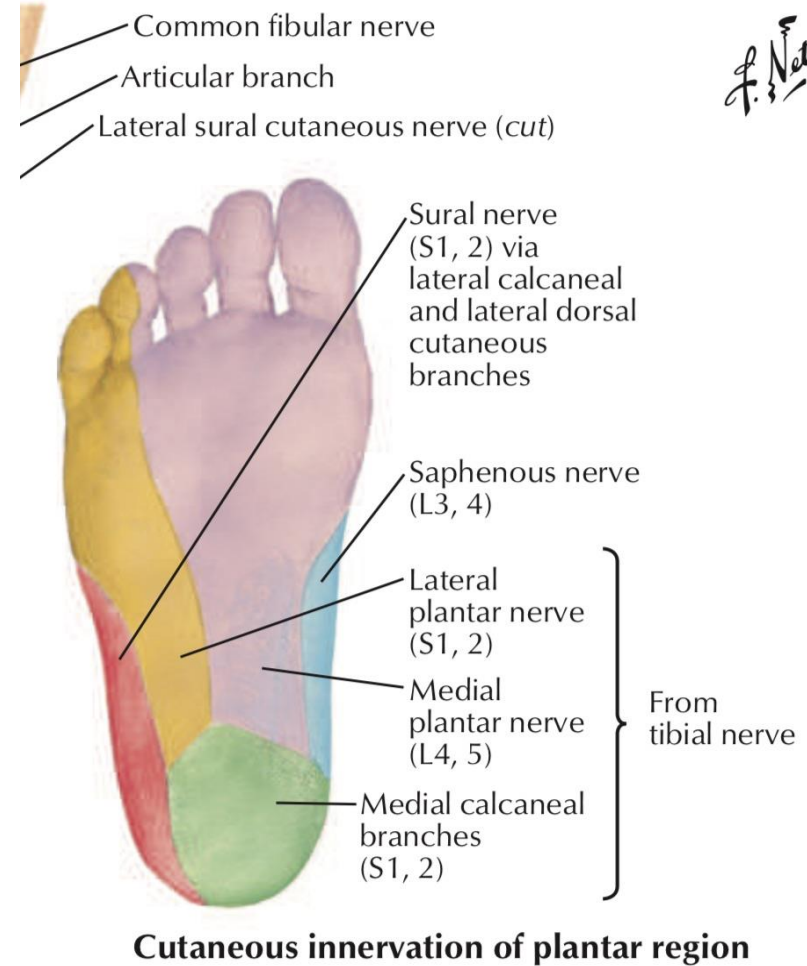
Definition

- Posterior tibial nerve entrapment
 - Keck 1962
 - Flexor retinaculum and distal tunnel
 - Branches
 - Medial calcaneal branch
 - Medial and lateral plantar nerve



Clinical findings

- Trauma and swelling, foot posture, arthritis
- Pain, paresthesia, numbness
- Compression pain and Tinel sign, SCT
- Nerve studies of little value
- Imaging may play a role



Treatment

- Physiotherapy
 - Foot posture
 - Avoid external compression
- Surgical decompression
 - Flexor retinaculum
 - Distal tarsal tunnel with septum

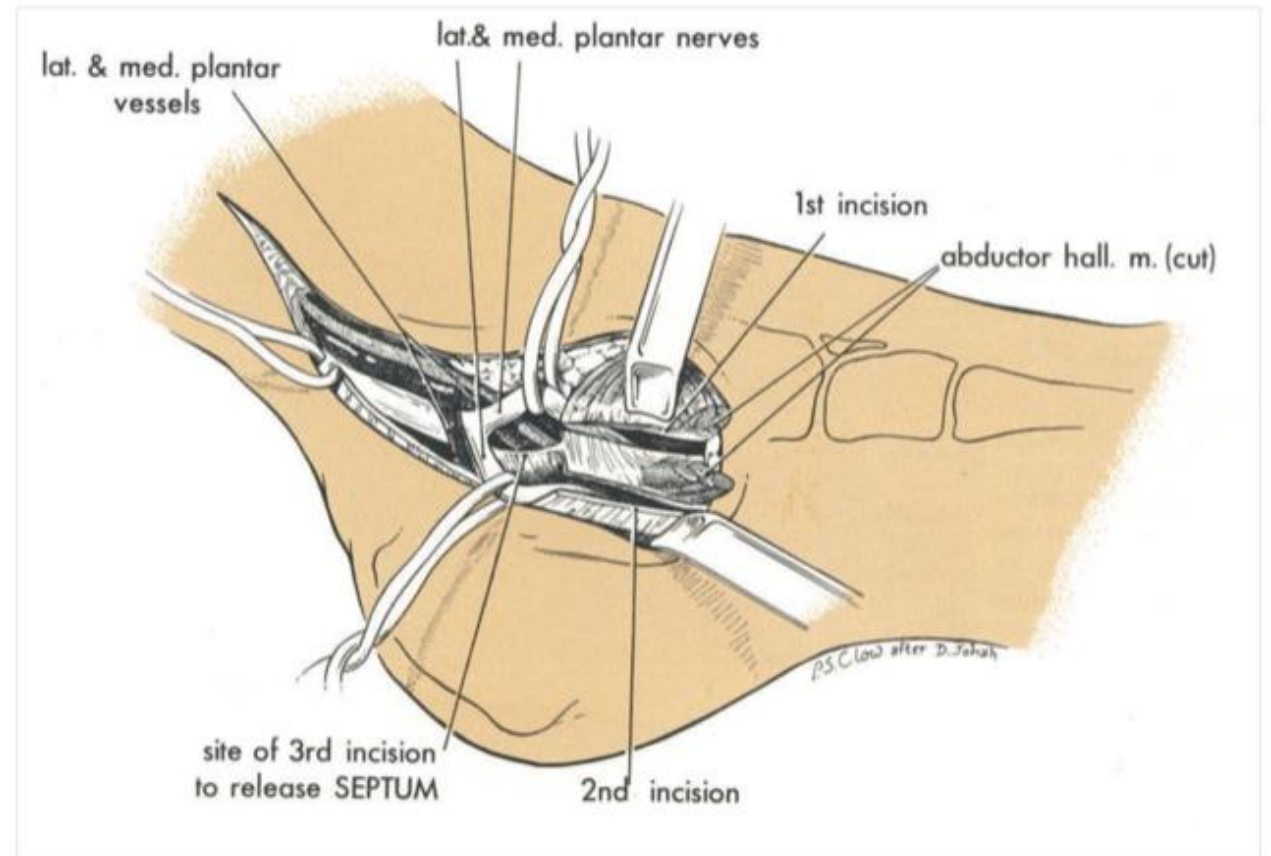


Fig. 13.47 Operative technique for release of the medial and lateral plantar tunnels. The release of the medial and lateral plantar tunnels involves dividing the tendinous fascia over the tunnels within the abductor hallucis muscle. A septum separates the two tunnels. (Used with permission from Mackinnon SE, Dellon AL, eds. Surgery of the Peripheral Nerve. New York, NY:Thieme 1988:312.)

Thank you for your attention

References TOS

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