Unusual Upper Extremity Nerve Compression Disorders Affecting Athletes

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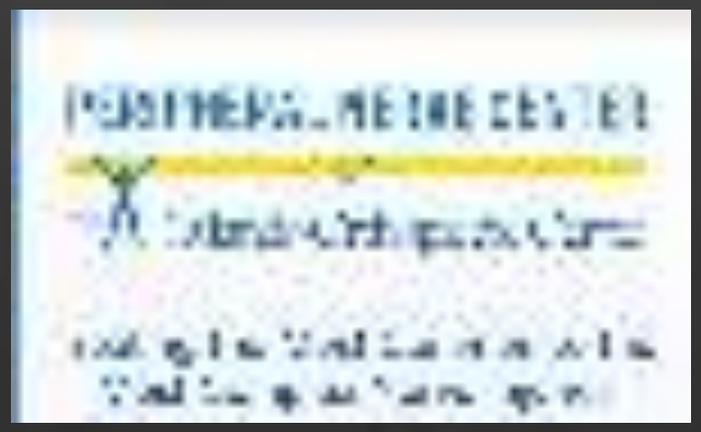
2.3.18



I have no disclosures

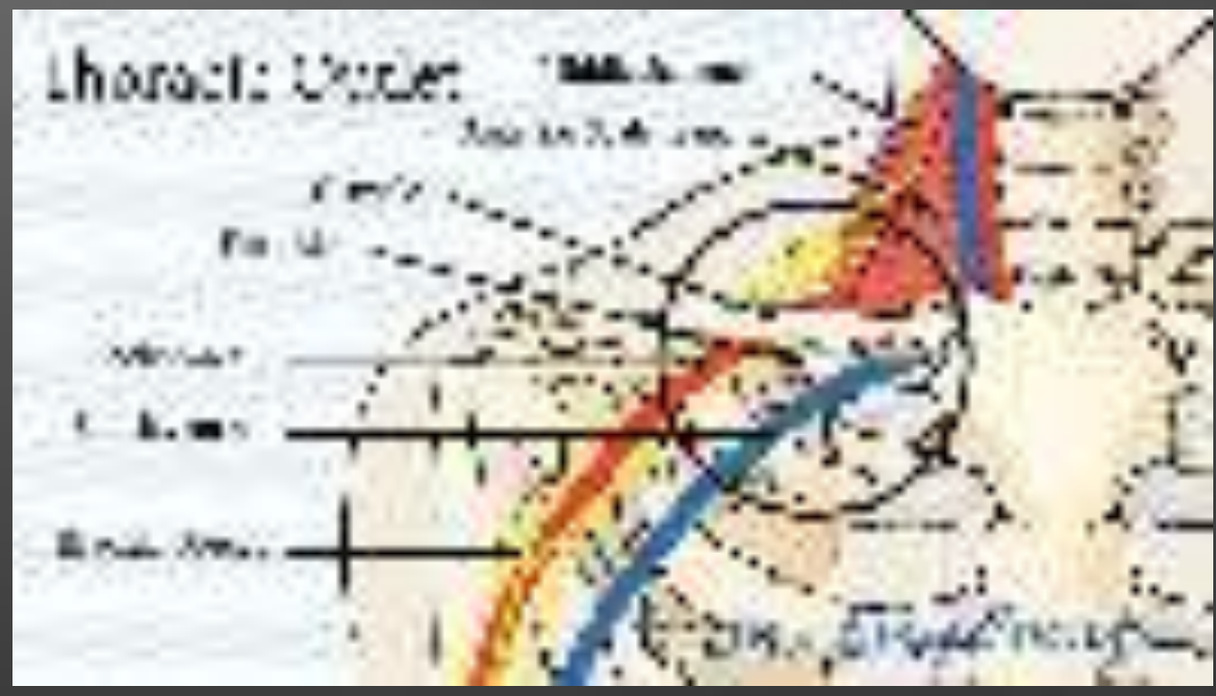
Thanks to Chris Warrell, MD

Topics to Cover

- Thoracic Outlet Syndrome (TOS)
- Suprascapular Nerve Palsy
- Quadrilateral Space Syndrome

Thoracic Outlet Syndrome

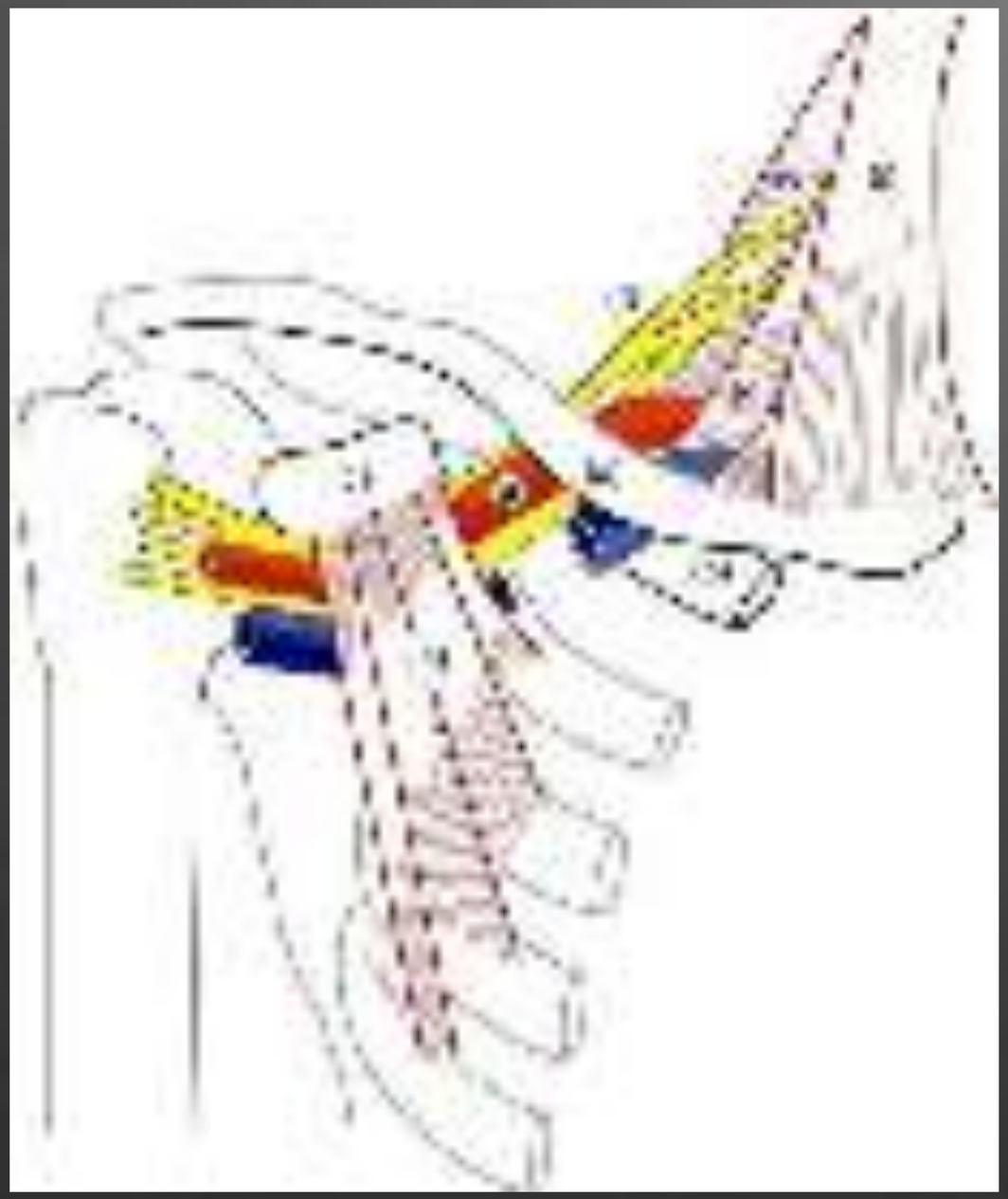
- Neurovascular compression of portions of brachial plexus
- First described in France in 1740
- Cervical rib removed 1861

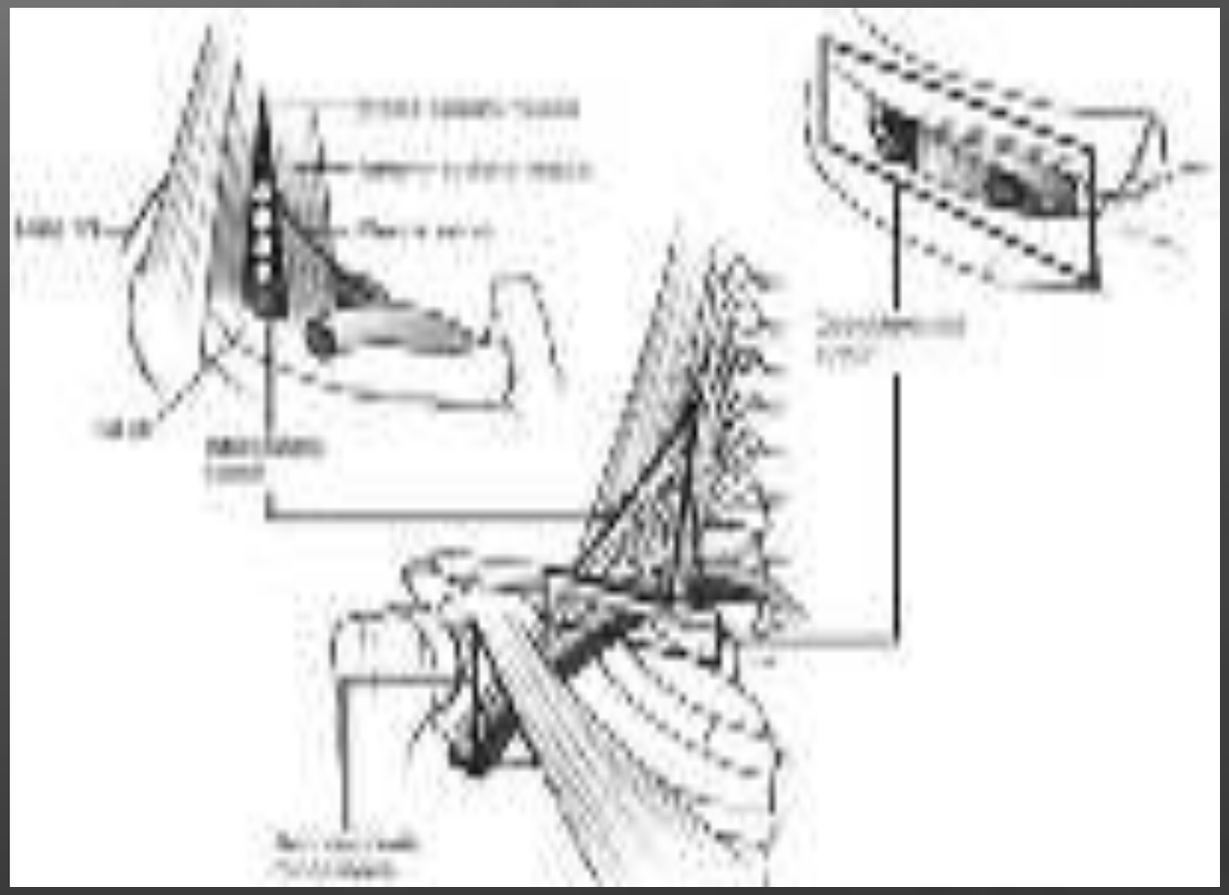


TOS Pathophysiology

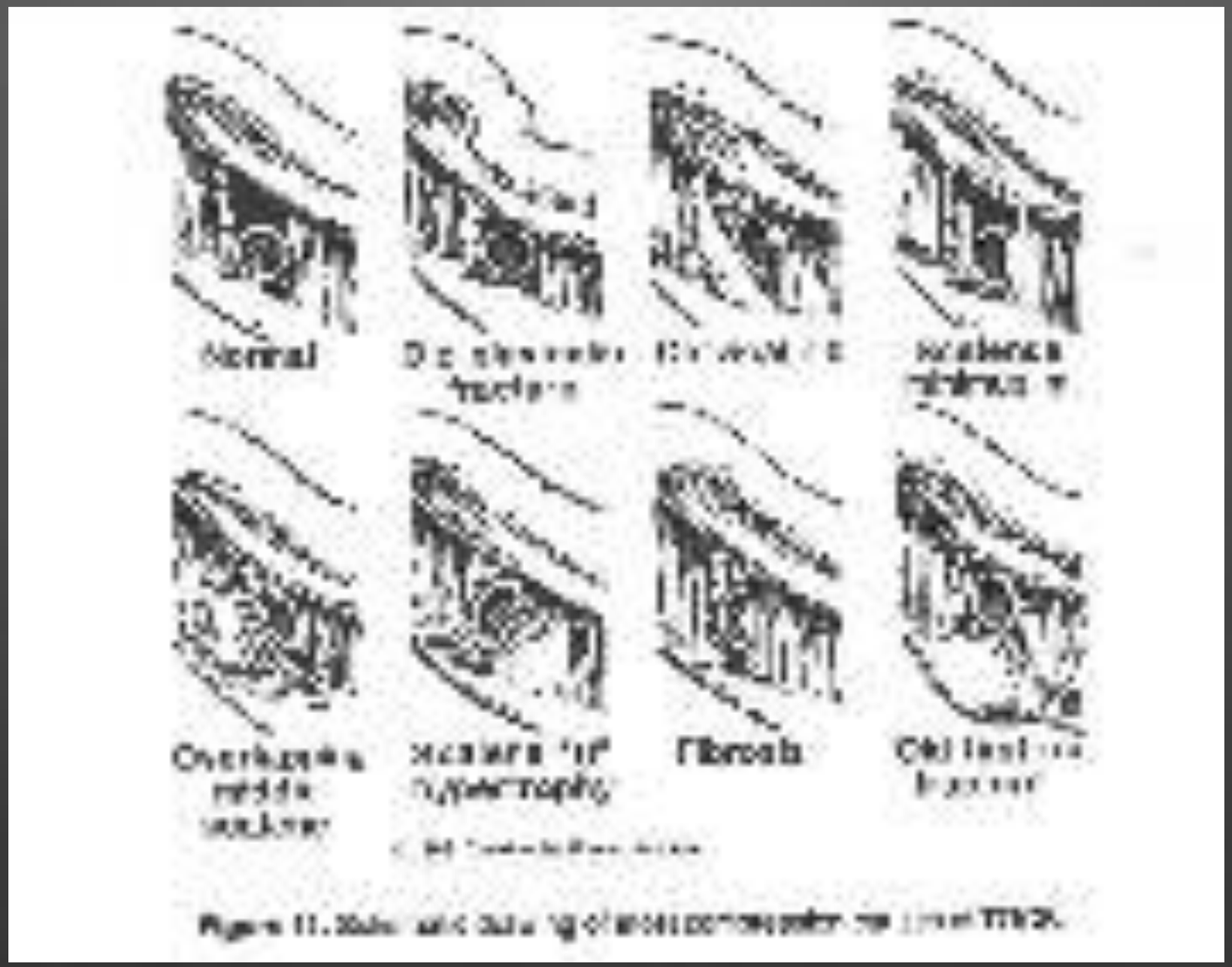
- Cervical rib
- Prominent C7 TP
- Anomalous first rib
- Ligamentous bands
- Hypertrophied pectoralis minor
- Scar formation after trauma

TOS Anatomy





Examples of Compression



Atasoy: Thoracic Outlet Compression Syndrome. Hand Clinics: 1996 265-301.

TOS History

- Young patients
- Multiple doctor visits
- Often had CTR, ulnar n. surgery
- Pain/numbness/heaviness with ADL's, or overhead
- Athletes/Throwers
    - Results in fatigue/loss control

TOS Presentation

- Symptoms
  - Paresthesias (98%)
    - All digits (58%)
    - 4th/5th (26%)
    - 1st-3rd (14%)
- Trapezius pain (92%)
- Neck pain (88%)
- Headache (76%)
- Chest pain (72%)

Sanders RJ, Hammond SL, Rao NM. Diagnosis of thoracic outlet syndrome. J Vasc Surg 2007;46(3):601-4

TOS Physical Exam

- Observe head/limb posture
  - Skin color/temperature/edema
  - Kyphosis, rounded shoulders,
  - Downward scapular tilt
- Cervical spine/extremity exam
  - Evaluate nerves at cervical/peripheral levels
  - Careful of concomitant peripheral nerve compression->”double crush”

TOS Physical Exam

- Wright's Test
- Adson's Test-
- Roos' Test-

TOS Physical Exam

- Roos' Test- 90 degrees Abd/ER
  - Open/Close hands x 3 min
  - (+): paresthesias, neck/shoulder pain; pallor w/ hyperemia; swelling and cyanotic discoloration
  - Most sensitive/specific provocative test for TOS (Hooper et al. 2010, Watson et al. 2009)

TOS Physical Exam

- Adson's Test
  - Palpate radial pulse w/ elbow extended
  - Extend neck, rotate to same/contralateral side
  - Inhale, hold
  - (+): pain paresthesias, decreased pulse
  - Often false positive (~50%)

Kuhn et al. JAAOS 2015

Imaging/Diagnostic Testing

- Radiographs
  - Cervical spine/Chest
    - Cervical rib
    - Large T7 Transverse Process
    - Clavicle abnormalities

Imaging/Diagnostic Testing

- NCS/EMG
  - Median nerve (APB)
  - **Medial antebrachial cutaneous nerve (T1 dermatome)****
  - Often normal
  - Exclude cervical/peripheral conditions
  - Diff Dx: ulnar n., cervical radiculopathy

Seror P. Medial antebrachial cutaneous nerve conduction study, a new tool to demonstrate mild lower brachial plexus lesions. A report of 16 cases. Clin Neurophysiol. 2004;115(10):2316-22

Imaging Diagnostic Testing

- Ultrasound
  - Seeking anatomic variants
    - Vascular (also seek compression of vessels w/ abduction)
    - Neurologic
- Piercing Variant
  - 50% incidence in symptomatic patients vs. 14% in asymptomatic patients

Leonhard et al. Ultrasonic Diagnosis of Thoracic Outlet Secondary to Brachial Plexus Piercing Variant. Diagnostics 2017.

Treatment

- Nonoperative
  - Physical Therapy
    - Postural correction/ Back, neck, periscapular strengthening
    - Ergonomic changes
    - Activity Avoidance
    - Weight loss

Treatment Nonoperative

- Outcomes
  - High performance athletes (27)
  - 67% failed PT->surgery
  - 82% RTP avg. 4.6 months
  - QuickDASH 40.9->11.7
- Systematic Review
  - 13 studies (9183-01)
  - 76-100% good/ST (1 mo)
  - 59-88% good/very good > 1 yr.

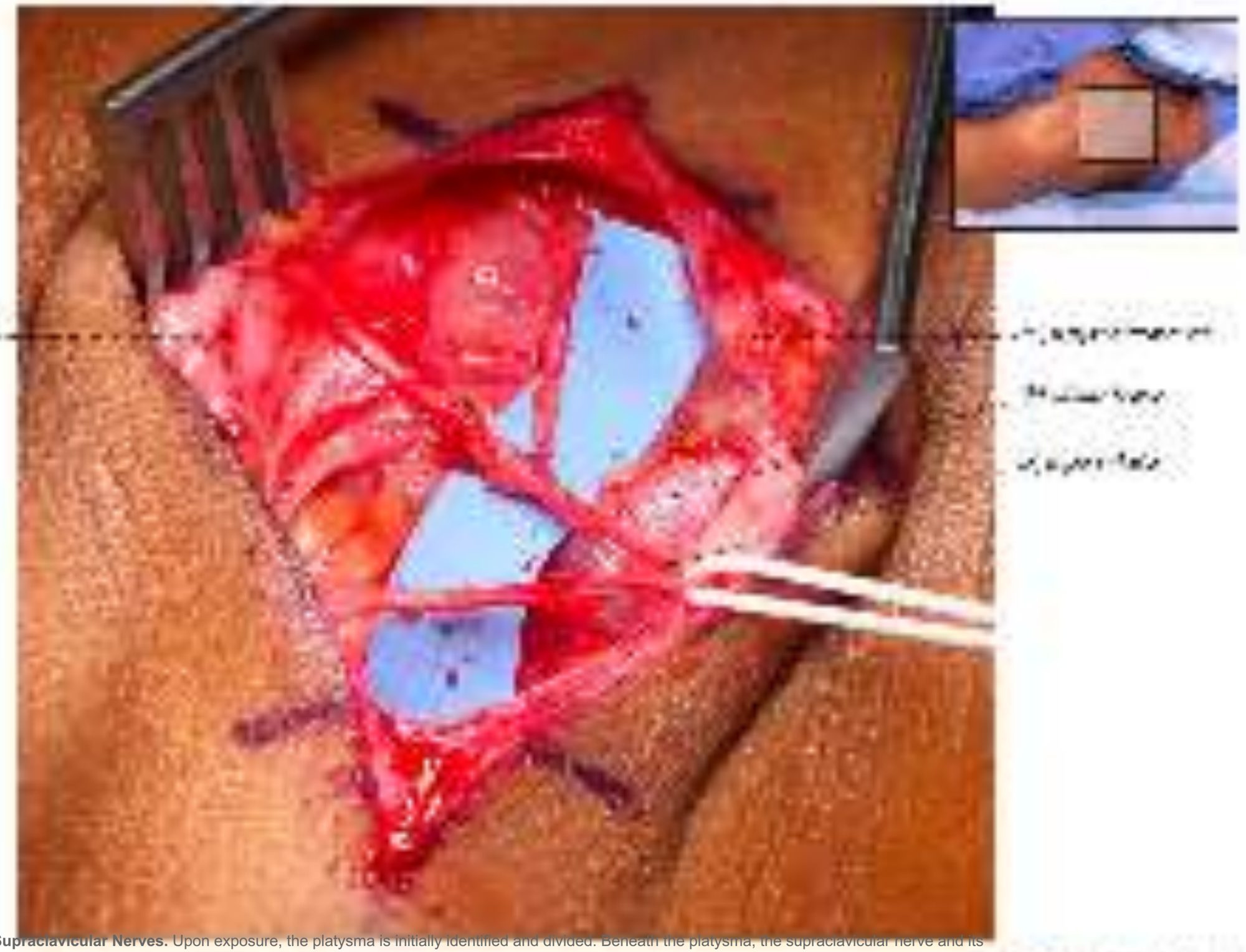
Vanti et al 2006

Operative Indications

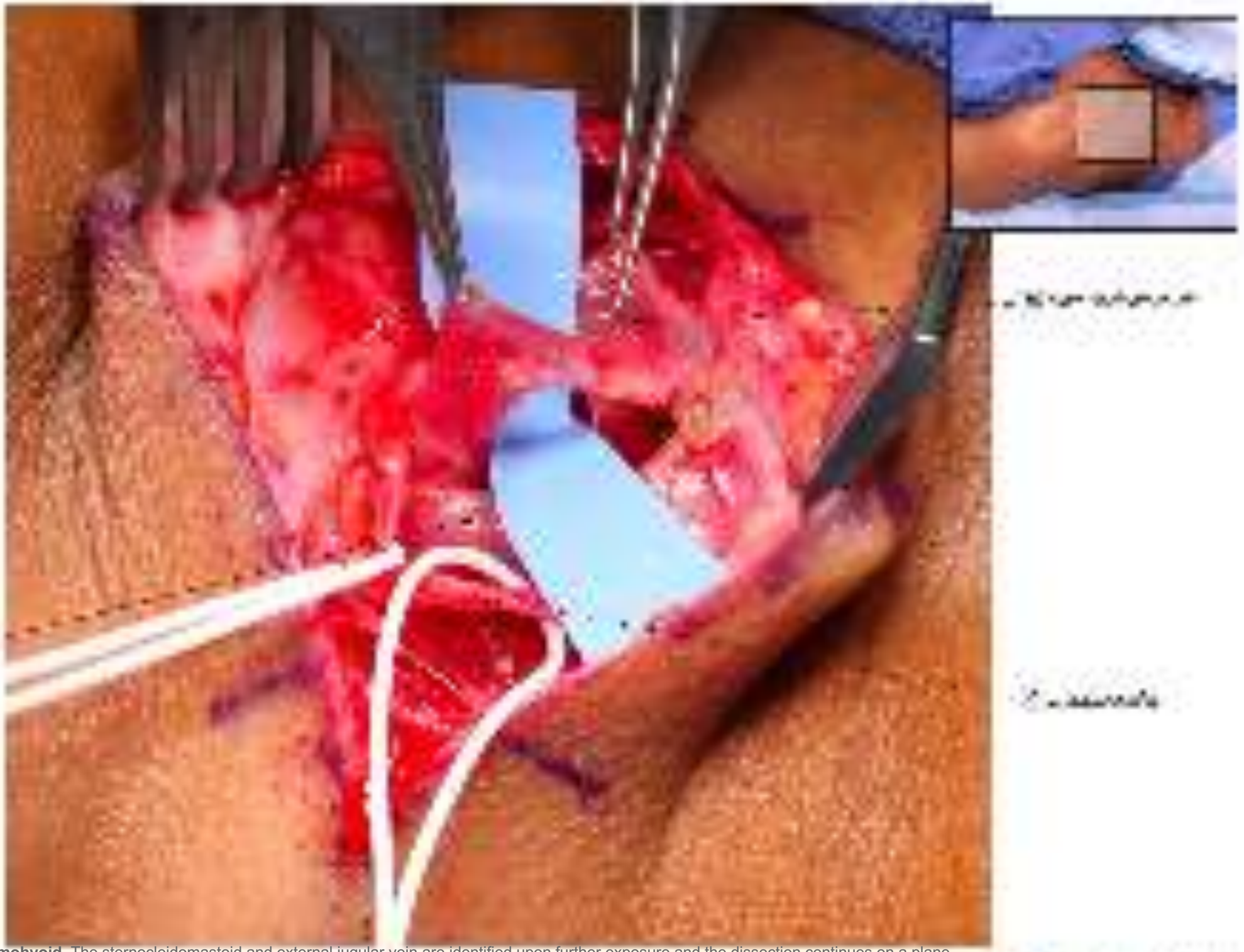
- Weakness/atrophy
- Persistent pain, sensory deficits, NCV<60 m/s (NL 85 m/s)
- Procedure
  - Resection of compressive structures (fascial bands, scalene muscles, ribs, TP)
  - Brachial plexus neurolysis
  - Transaxillary /supraclavicular

Urschel HC JR, Kourlis H Jr. Thoracic outlet syndrome: a 50-year experience at Baylor University Medical Center. Proc (Bayl Univ Med Cent) 2007;20:125-135

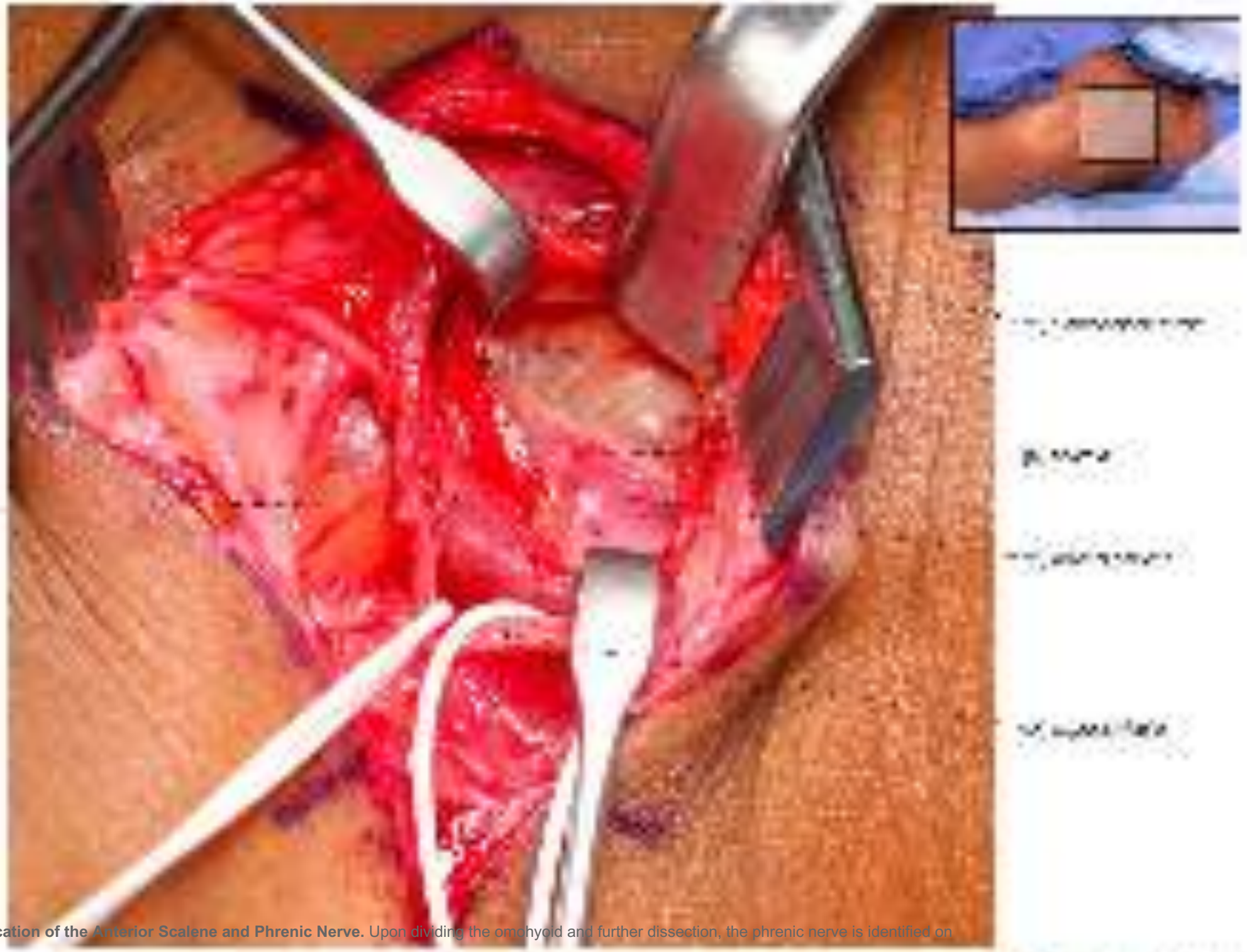
Supraclavicular Incision for a Thoracic Outlet Decompression. An incision is made a finger breath supraclavicular and approximately 8cm in length.



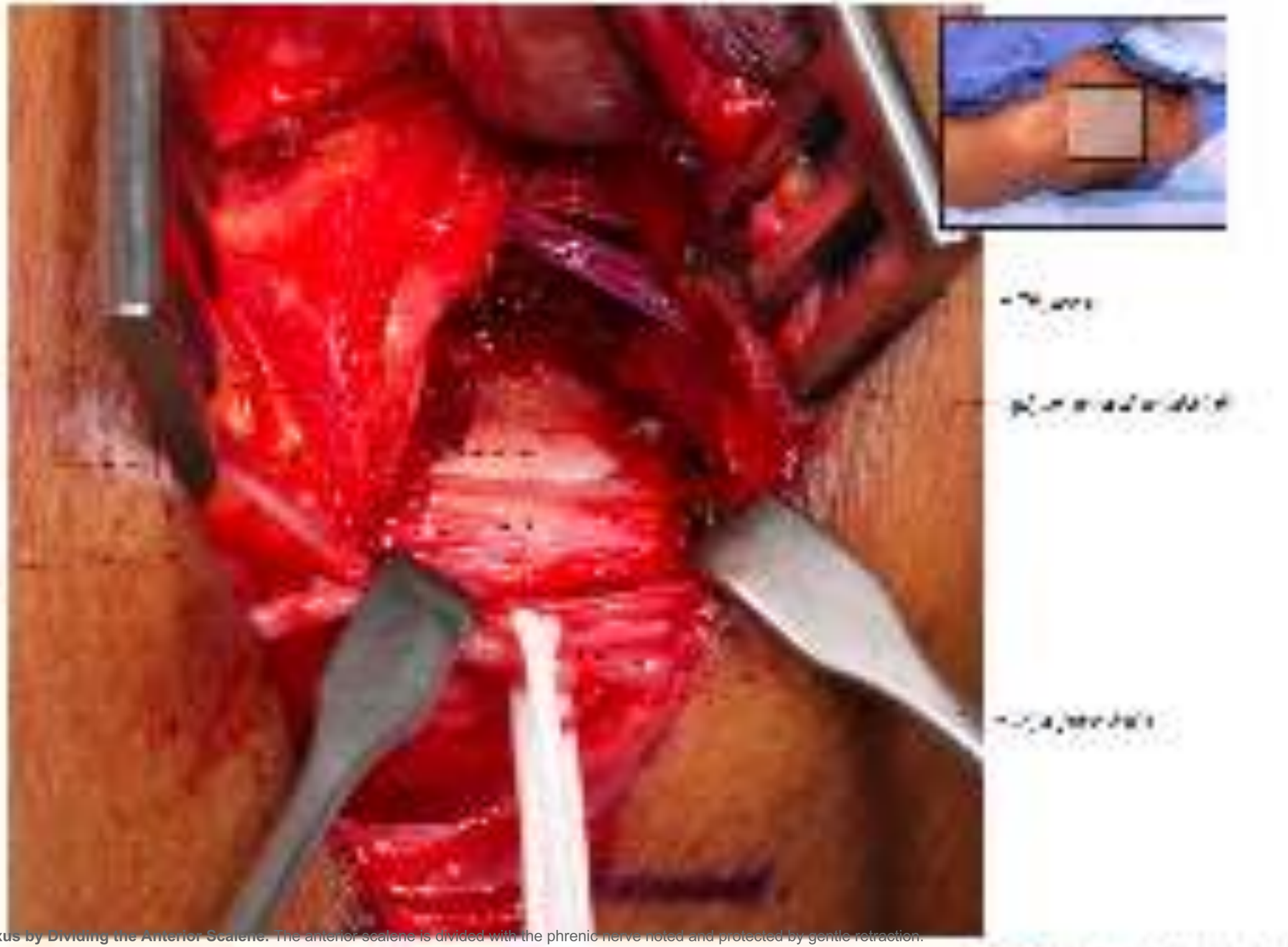
Exposure and Identification of the Supraclavicular Nerves. Upon exposure, the platysma is initially identified and divided. Beneath the platysma, the supraclavicular nerve and its branches are identified, carefully dissected both proximally and distally, and protected. The supraclavicular nerve branches originate from a proximal trunk noted with a vessel loop. Two vessel loops are used to protect and retract the supraclavicular nerves.



Exposure and Identification of the Omohyoid. The sternocleidomastoid and external jugular vein are identified upon further exposure and the dissection continues on a plane beneath the sternocleidomastoid. The omohyoid is identified through this plane and divided to expose the anterior scalene and brachial plexus. The supraclavicular nerve is protected and mobilized by two vessel loops

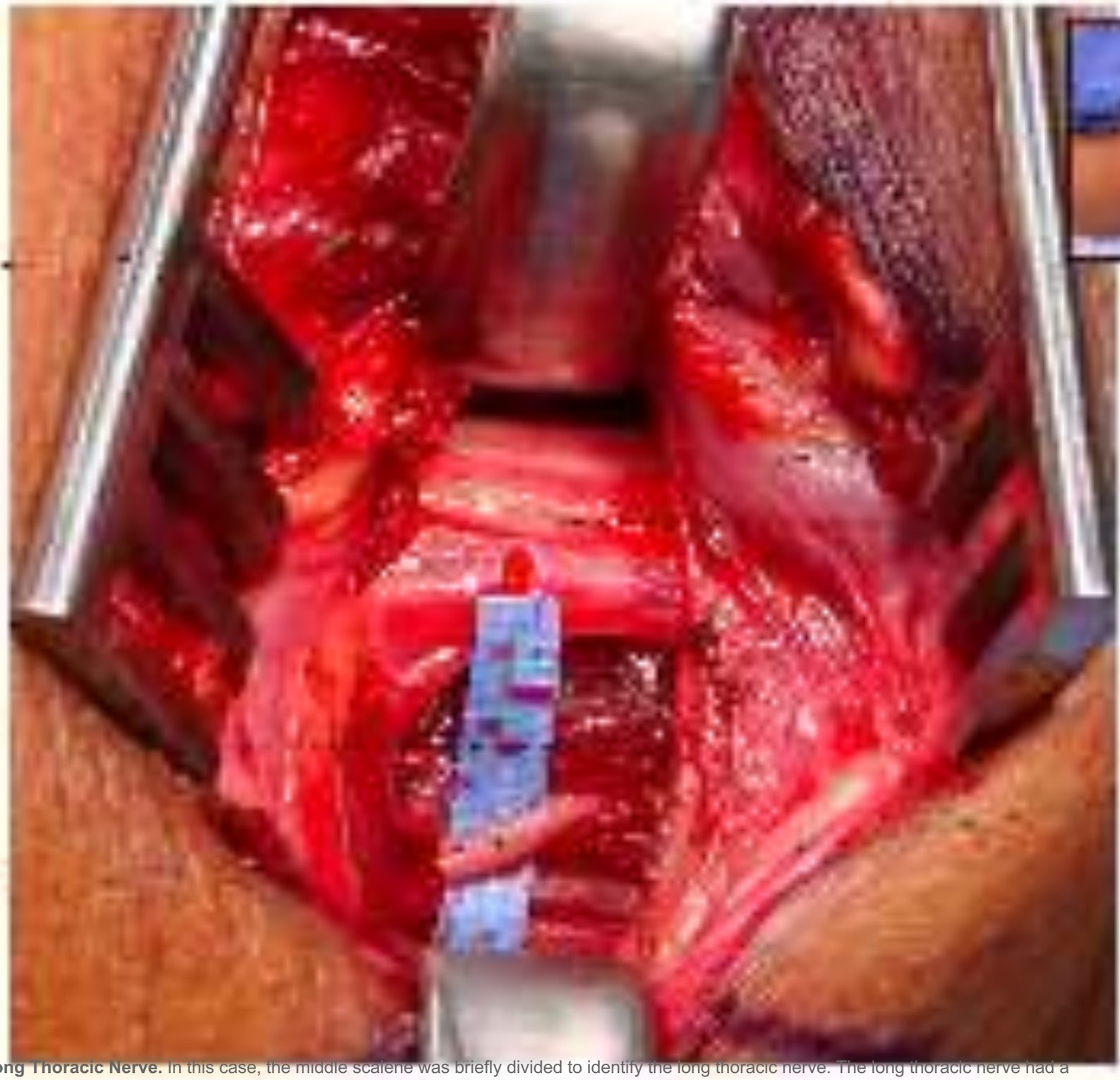


Exposure and Identification of the Anterior Scalene and Phrenic Nerve. Upon dividing the omohyoid and further dissection, the phrenic nerve is identified on the anterior surface of the anterior scalene. The nerve has a lateral to medial course to innervate the diaphragm. The phrenic nerve is isolated and protected by gentle retraction. Due to the sensitivity and critical function of this nerve, a vessel loop is not used to protect the nerve. The anterior scalene is identified deep to this nerve and occasionally an accessory phrenic nerve is present and has a course through this muscle.

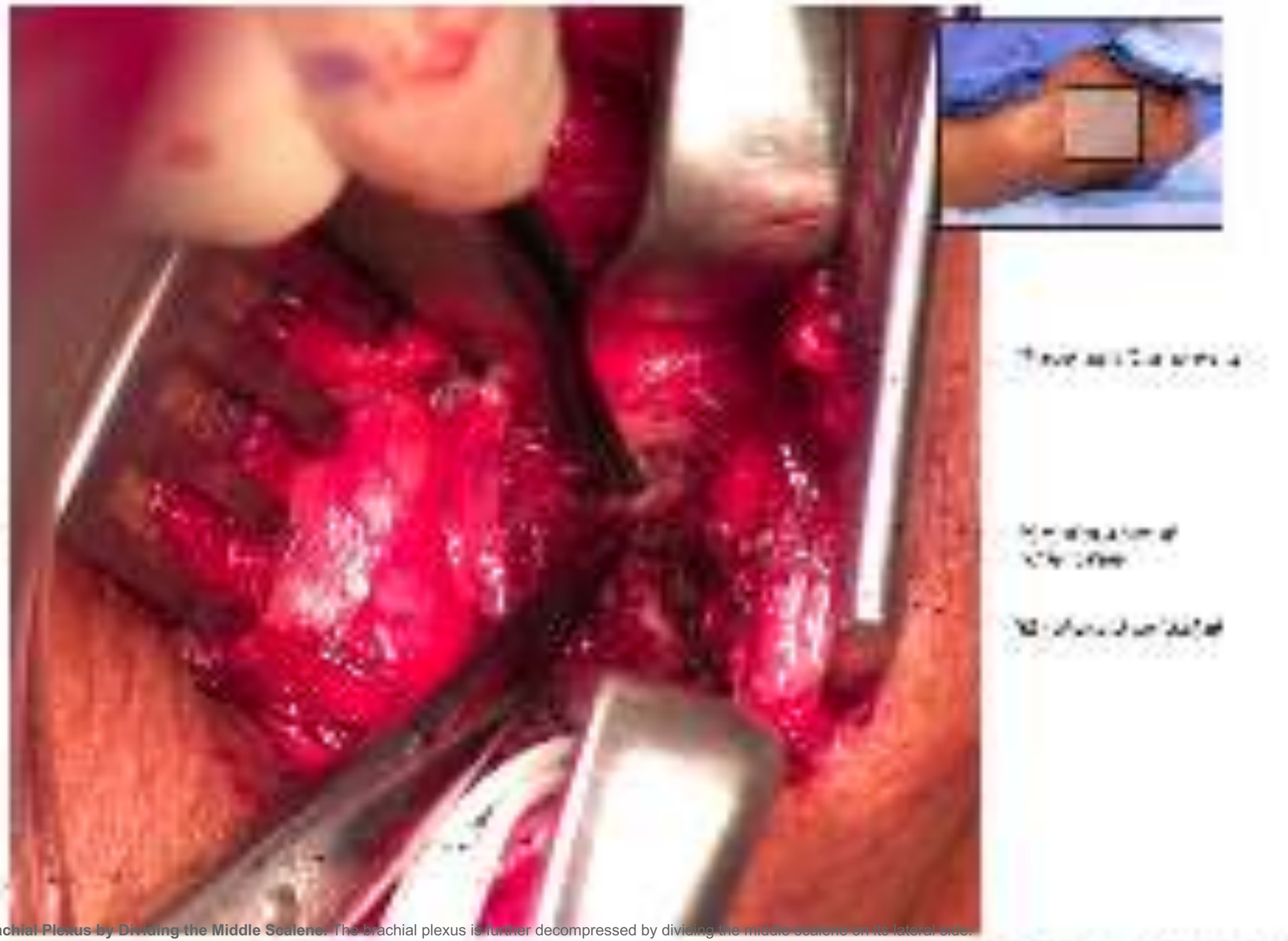


Decompressing the Brachial Plexus by Dividing the Anterior Scalene. The anterior scalene is divided with the phrenic nerve noted and protected by gentle retraction. Occasionally, an accessory phrenic nerve is present and has a course through the anterior scalene. If encountered during the division of the anterior scalene, it is protected. The phrenic nerve has been marked in purple for visualization. The upper and middle trunks are visualized following the division of the anterior scalen

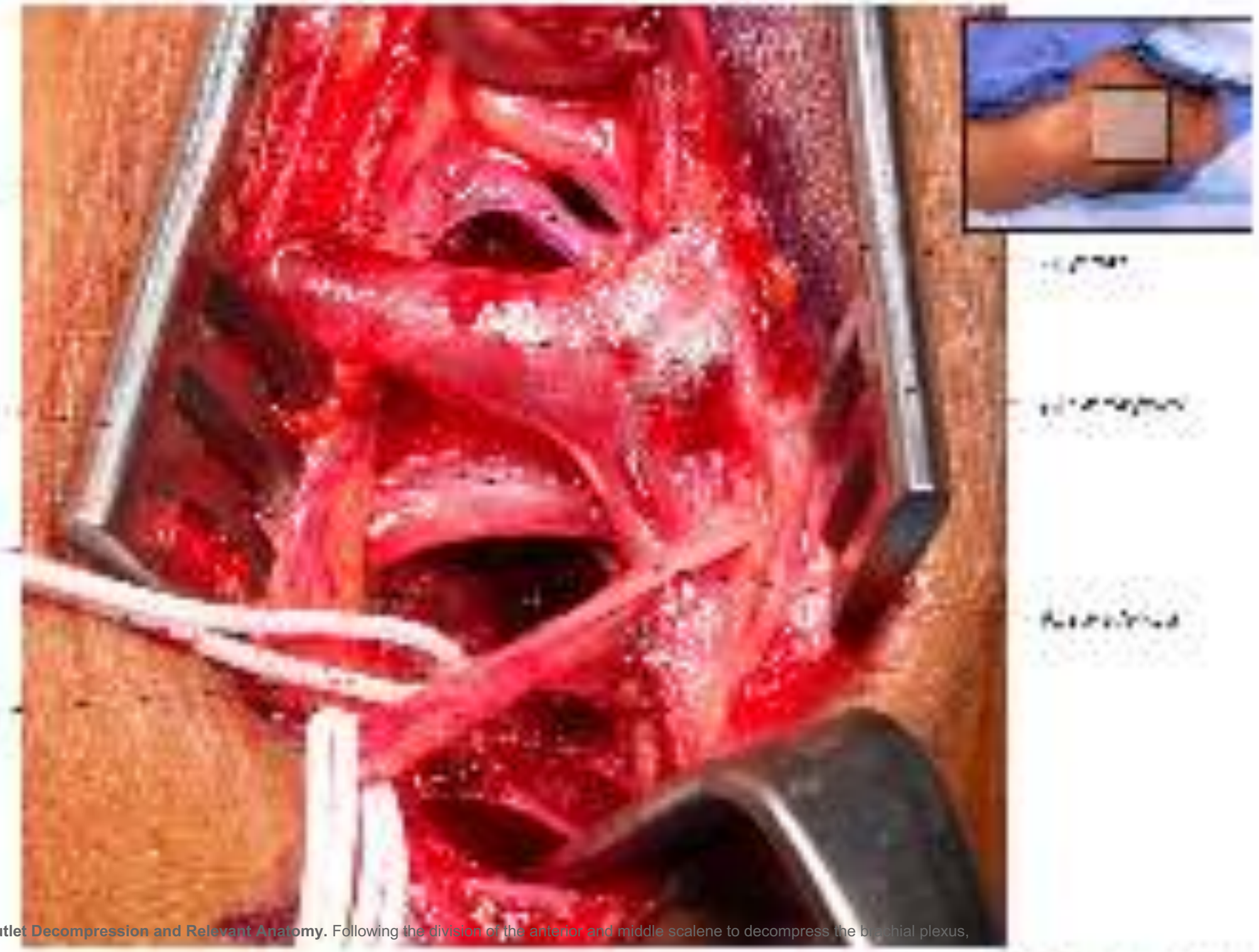
Exposure and Identification of the Middle Scalene. To identify and divide the middle scalene, the surgical approach continues lateral to the brachial plexus. The middle scalene is identified lateral to the brachialis plexus. Typically, the long thoracic nerve has a course through this muscle or posterior to it. In this case, the long thoracic nerve was identified deep and lateral to the middle scalene.



Identification of the Long Thoracic Nerve. In this case, the middle scalene was briefly divided to identify the long thoracic nerve. The long thoracic nerve had a course through the middle scalene and deep and lateral to the middle scalene. This nerve is isolated and protected. A vessel loop can be used, unlike the phrenic nerve.



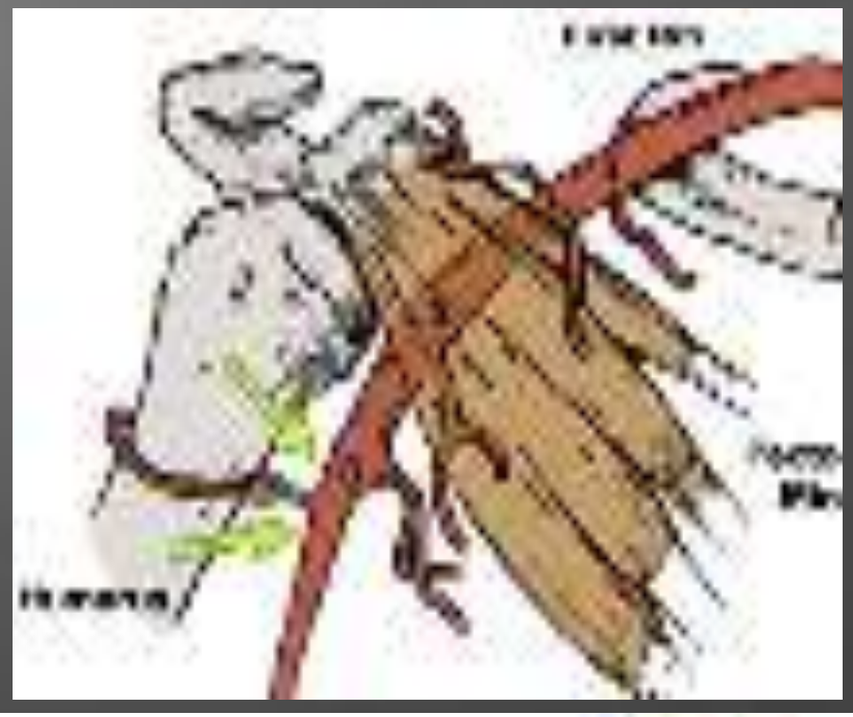
Decompressing the Brachial Plexus by Dividing the Middle Scalene. The brachial plexus is further decompressed by dividing the middle scalene on its lateral side. A tendinous band of the middle scalene was identified deep in this case and was released in this case. The lower trunk is identified following the division of the middle scalene. The long thoracic nerve is protected by retraction.



Thoracic Outlet Decompression and Relevant Anatomy. Following the division of the anterior and middle scalene to decompress the brachial plexus, the anatomical structures are reviewed for their integrity. The phrenic nerve is identified having a lateral to medial course to innervate the diaphragm. The long thoracic nerve is identified to innervate the serratus anterior. The supraclavicular nerves are protected by vessel loops. The upper, middle, lower trunks are reviewed to be intact and decompressed. Electrical stimulation is used to test motor nerve response.

Arterial TOS

- Most rare and severe of subtypes
- Subclavian artery occlusion
- Acute presentation
  - Dead arm
  - Claudication pain in hand
  - Paresthesias
  - Raynaud's phenomenon



Duwayri YM, Emery VB, Driskill MR, et al. Positional compression of the axillary artery causing upper extremity thrombosis and embolism in the elite overhead throwing athlete. J Vasc Surg 2011;53:1329-40

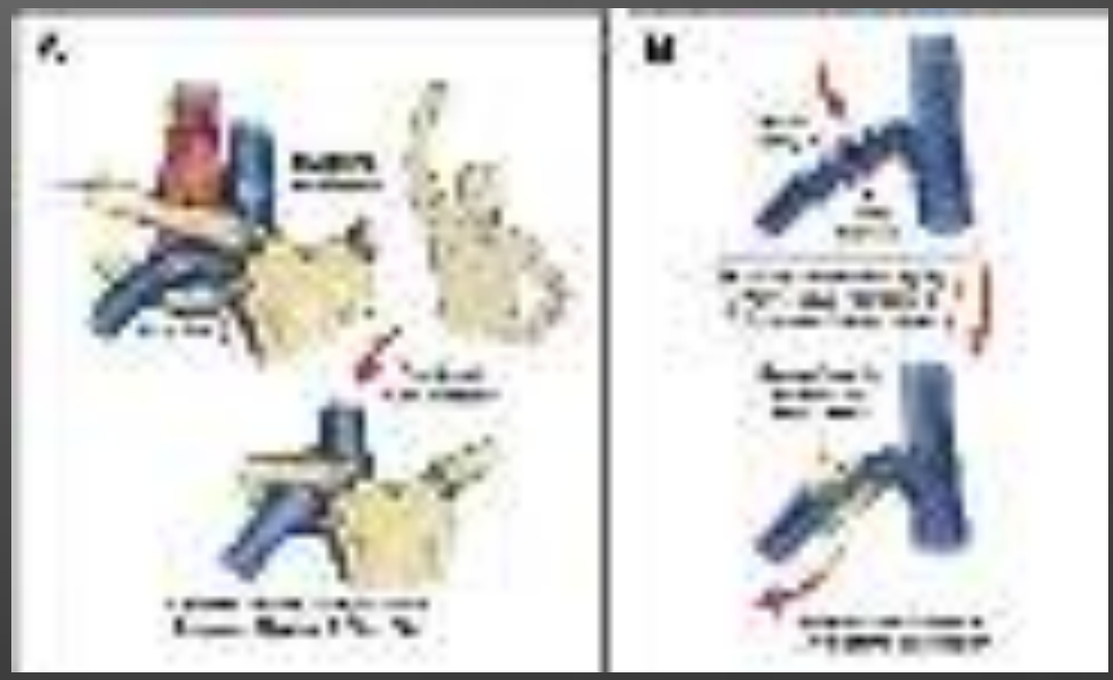
Arterial TOS

- Physical Exam
  - Pale/cyanotic hand
  - Diminished pulse
  - Significant fatigue
- Treatment
  - Thrombolysis, anticoagulation
  - Remove thrombus/patch
  - Vascular excision/bypass

Duwayri YM, Emery VB, Driskill MR, et al. Positional compression of the axillary artery causing upper extremity thrombosis and embolism in the elite overhead throwing athlete. J Vasc Surg 2011;53:1329-40

Venous TOS

- Venous compression-> Paget-Schroetter's syndrome
- History
- Diffuse arm swelling
- Shortly after aggravating activity
- Fatigue/weakness
- Paresthesias
- Arm discoloration, swelling
- Prominent veins



Mall MA, Van Thiel GS, Heard WM. Paget-Schroetter Syndrome: A review of effort thrombosis of the upper extremity from a sports medicine perspective. Sports Health 2013;5(4):353-6

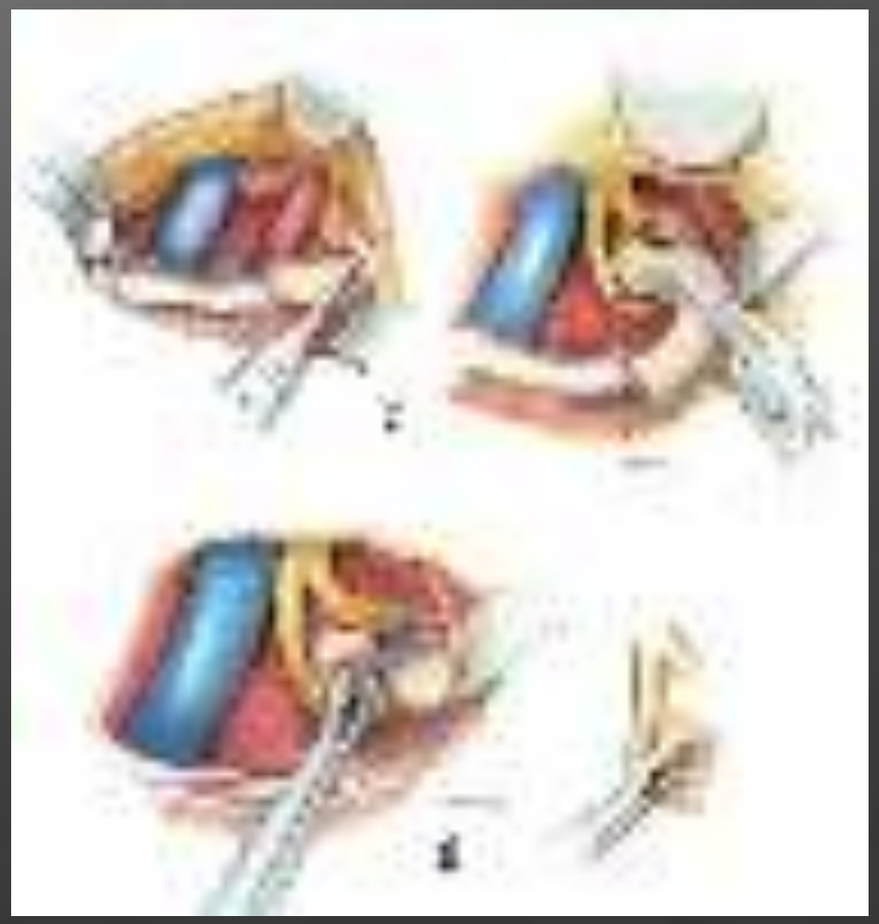
Venous TOS

- UE DVT from repetitive activity
- Subclavian vein compression
- Duplex U/S: 78-100% sens. 82-100% specific
- Test for hypercoagulability
- Rx: Anticoagulation vs. angioplasty, thrombectomy, rib resection

Mall MA, Van Thiel GS, Heard WM. Paget-Schroetter Syndrome: A review of effort thrombosis of the upper extremity from a sports medicine perspective. Sports Health 2013;5(4):353-6

Outcomes

- Chandra
- 27/41 athletes pts w/ NTOS
- 14 w/ PSS all had rib resection
- 18 Underwent scalenectomy, rib resection, neurolysis
- 85% returned to sport
- 83% of NTOS returned
- Quick DASH: 40.9->11.7
- Recurrent symptoms (2) NTOS, 2 PSS



Chandra V, Little, Lee JT. Thoracic outlet syndrome in high performance athletes. J Vasc Surg 2014;60(4):1012-7

Outcomes

- Thompson et al
  - 13 MLB pitchers
  - Retrospective
  - 10.8 months rehab(+/-1.5)
  - 10/13 RTP

Outcomes

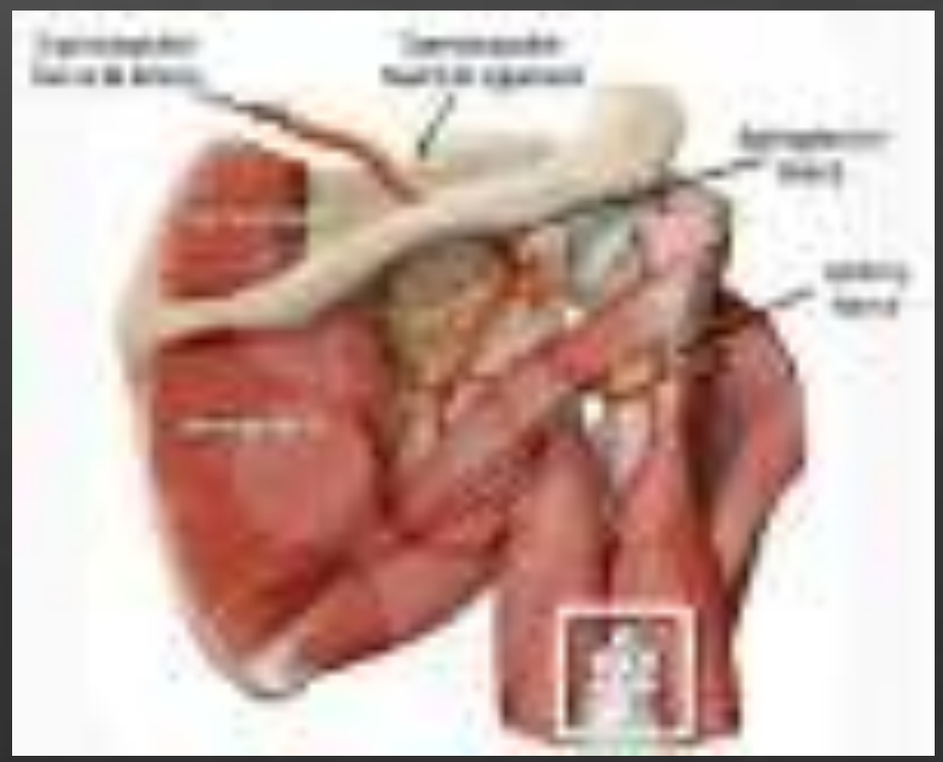
- Chang et al. 2009
  - Prospective observational
  - N=70 (44 NTOS, 26 venous)
  - 50% NTOS, 77% PSS returned FT work
  - 50% by 4 mo, 75% by 5 mo
  - Significant improvement in DASH score of .85 per month
  - SF-12, DASH scores significantly worse for NTOS pts

Suprascapular Nerve Entrapment

- Weakness of infraspinatus +/- supraspinatus
- ER weakness
- Seen in overhead athletes/throwers

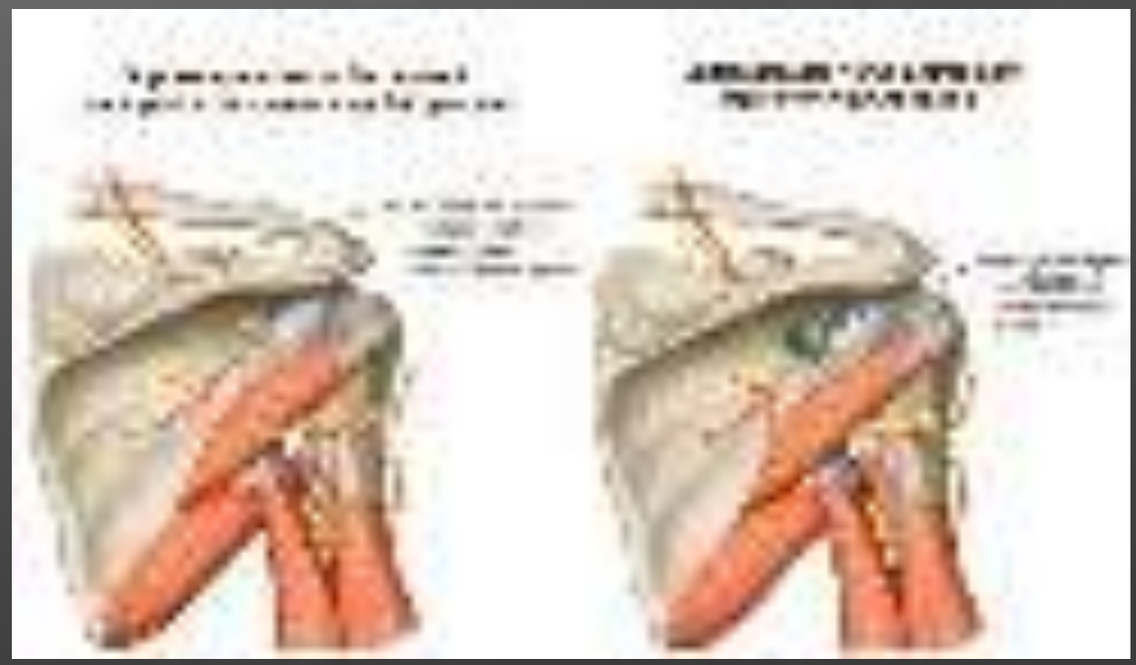
Suprascapular Nerve Anatomy

- Anatomy
- C5-6 contribution
- Arises from superior trunk
- Travels deep to transverse scapular ligament
- Mixed Nerve:
  - Innervates supra/infraspinatus
  - Sensory to glenohumeral, Acromioclavicular joints



Pathophysiology

- Suprascapular notch
  - Cysts (Paralabral & Supraglenoid)
  - Fractures
  - Ossified TSL
  - Masses
  - Fascial bands from subscapularis
- Spinoglenoid notch
  - Spinoglenoid ligament
  - Paralabral cysts



Pathophysiology

- Traction on the nerve from throwing
- Repetitive traction/microtrauma
  - Infra/supra compresses nerve in Abd/ER
  - Ligamentous compression at spinoglenoid notch from overhead position
  - Arterial damage->ischemic injury
- Labrum tear->paralabral cyst

History

- Posterolateral/superior shoulder pain (Dull)
- +/- radiation to neck/arm
- Weakness/fatigue w/ overhead activity
- Complaints of atrophy

Physical exam

- Atrophy
  - Infraspinatus/Supraspinatus
- Tenderness over SG/SS notches
- Abd/ER weakness
- Cross body adduction- posterior shoulder pain (SGL tightens)
- Complete neuro/MSK exam

Imaging

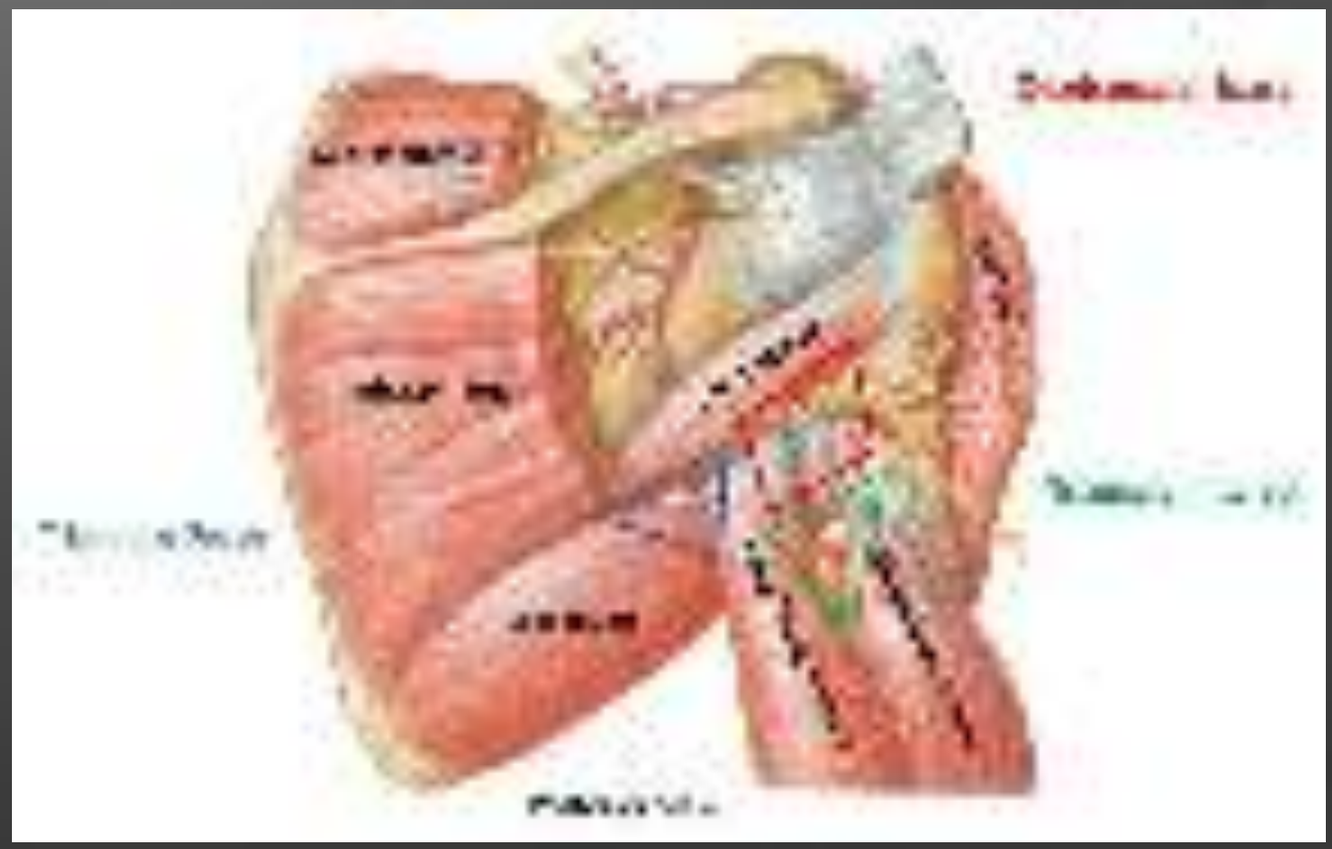
- Shoulder xrays
- Stryker Notch view
- CT scan

Imaging

- MRI
  - Follow nerve
  - RC atrophy/tear
  - Labral tears
  - Mass

Adjunctive Tests

- NCS/EMG
  - Isolate level pathology in SSN
  - Evaluate for global plexus
  - Localize level
  - High false negative rate
- Diagnostic injection



Treatment

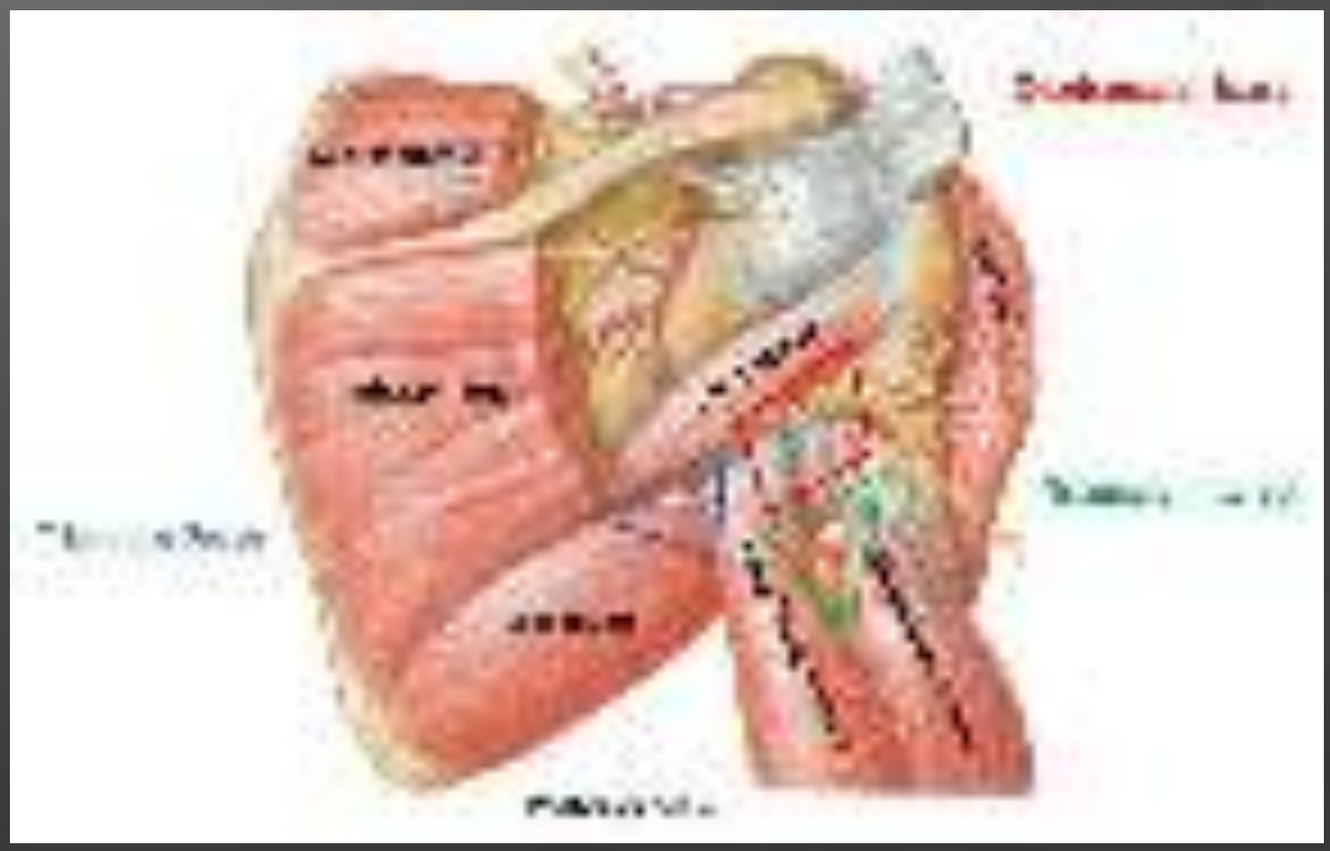
- Non-Operative
  - Overuse w/o masses
    - OTW Activity modification
    - NSAID's
    - Therapy->RTC/shoulder girdle/periscapular strength, posterior capsule stretch
- Operative
  - Reversible entrapment
  - Failed conservative treatment-> 6 months non-op w/ persistent pain, weakness, no NCS improvement

Non-operative Outcomes

- Martin et al
  - 15 pts, no masses
  - 6 mo. min. 80% good/exc.
  - Atrophy/weakness persisted
  - 4 year followup
- Feretti et al
  - 38 pts w/ therapy
  - 35/38 (92%) excellent results
  - 3 required surgery
- Piatt
  - 53% patients w/ spinoglenoid cyst satisfied after non-op
  - 96% satisfied after operative treatment

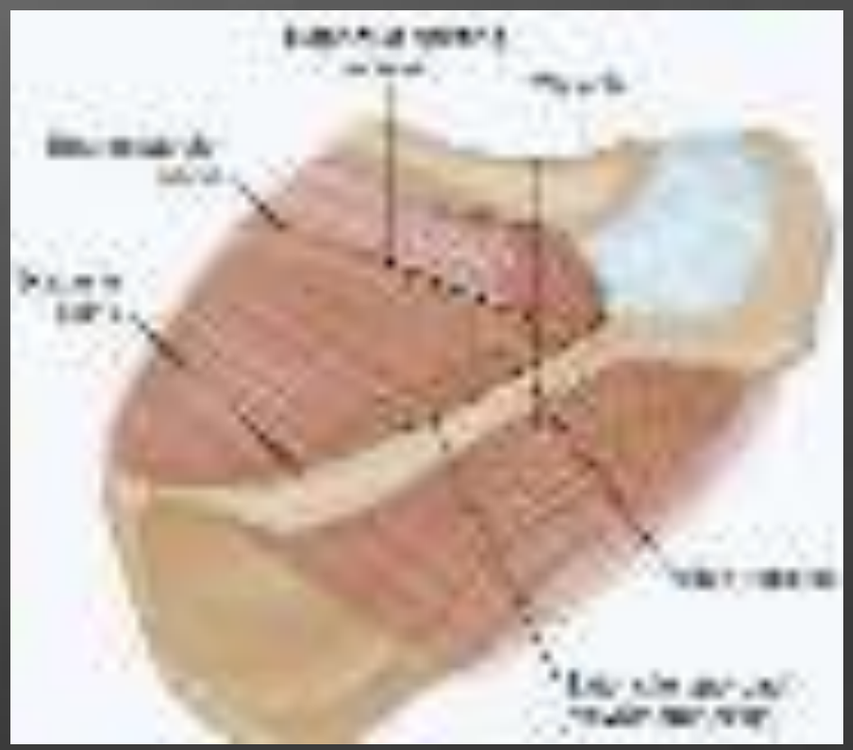
Operative Treatment

- Open vs. Arthroscopic
- Decompression of suprascapular nerve
  - Release transverse scapular ligament
  - Release spinoglenoid ligament
  - Decompress cyst
- Repair labrum



Open suprascapular notch decompression

- Transverse incision centered between acromion, medial scapula
- Split trapezius in line with fibers
- Retract supraspinatus posteriorly
- Sweep finger along superior border scapula for upturn in scapula
- Cut ligament medial



Mackinnon, S: Spinal Accessory to Suprascapular Nerve Transfer. YouTube

Arthroscopic Suprascapular Notch Decompression

- Viewing portal lateral portal
- Follow CA lig to coracoid, just medial to CC ligament is transverse scap ligament
- Working portal 2cm medial to Neviasers portal
- Trocar can dissect, expose, manipulate nerve, vessel

Portals - Bursal

Open Spinoglenoid Notch Decompression

- Retract deltoid to expose superior edge of IS
- Retract IS to expose ligament
- Release ligament/excise mass

Approach to Spinoglenoid Notch

Beach chair position

3 portals:

- Posterior
- Anterior
- Midlateral
  - transcuff

Treatment of associated lesions
- labral tears

Outcomes

- Open Suprascapular notch decompression
  - 90% improved pain and strength at 8 months Kim et al. Knee Surg. Sports Traum. 2009
- Arthroscopic decompression
  - Improved pain 10/10 @ 15mo. Normalized NCS at 7/8 pts Lafosse et al.

Outcomes

- Open spinoglenoid notch decompression with arthroscopic labral repair. 6/6 pain free
- 14 pts w/ arthroscopic cyst decompression. @ 51 mo. no cyst recurrence, Westerheide et al
- Labral repair alone can fix problem: 88% of 42 its had complete resolution, 12% decrease in size
  Schroder et al:

Quadrilateral Space Syndrome

- Described by Cahill and Palmer 1983
  - Compression of the PHCA or axillary nerve within quadrilateral space
- Rare, seek other causes
- Vascular: repetitive tension w/ overhead motion
- Neurogenic: axillary nerve compression within the QS w/ overhead motion

Neurogenic QSS

- Abd/ER: quadrilateral space closes with Teres minor/major contraction

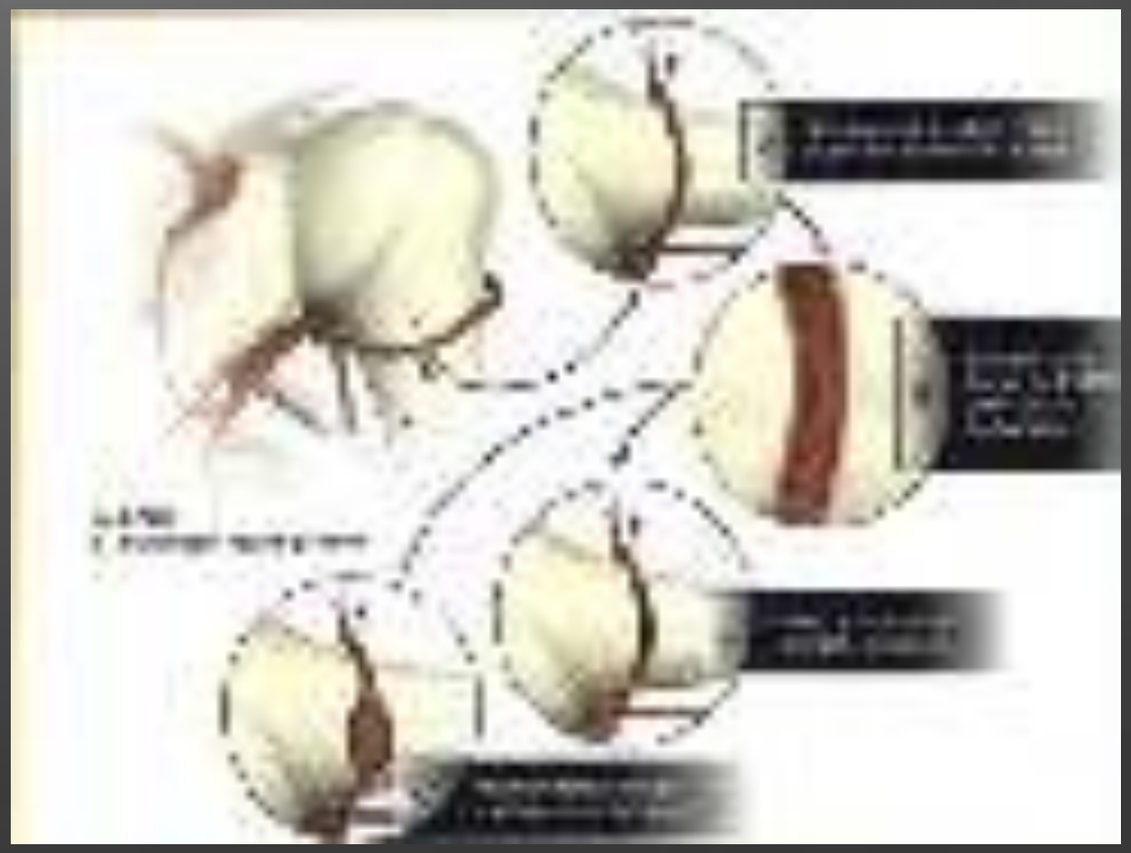
- Exacerbated by space occupying lesions, paralabral cysts dilated veins fibrous bands

Presentation

- Poorly localized dull posterior shoulder pain, paresthesias
- Weakness, pain w/ overhead activity
- Deltoid asymmetry
- Ischemic signs (?)
- Abd/ER weakness, deltoid/TM weakness, tenderness

Presentation

- Diagnostics
  - Xrays, Diagnostic nerve blocks
  - EMG/NCV
  - Arteriogram: 80% positive tests are asymptomatic
  - MRI
  - Course of axillary nerve, soft tissue masses, no specific.



Adjunctive Tests

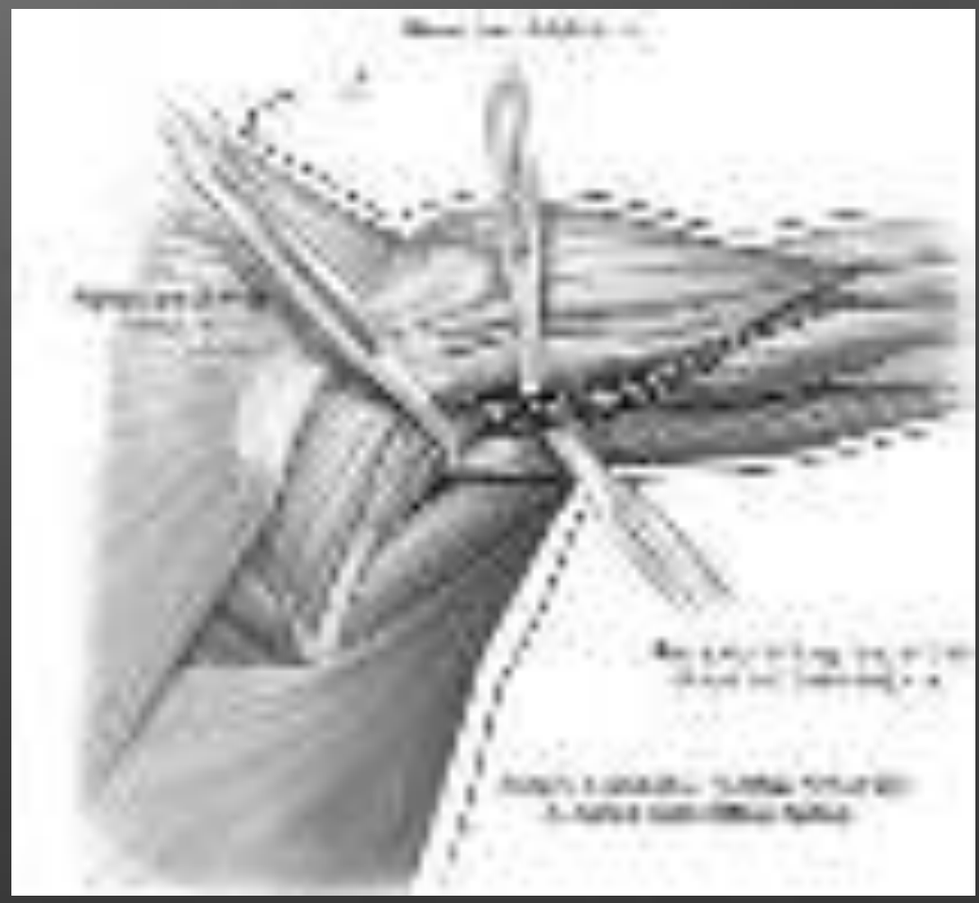
- X-rays
- Diagnostic nerve block
  - Be wary of false negative
- NCS
  - High false negative rate
- Angiogram: 80% false positive
  - Abd/ER causes occlusion in NL patients
- MRI
  - Soft tissue, teres minor atrophy

Treatment

- Non-op
  - Initial treatment
  - NSAID's
  - Relative Rest
- Operative
  - Persistent symptoms >6 mo
  - (+ arteriogram)
  - Neurogenic : decompress axillary nerve
  - Vascular: ligate PHCA

Surgical Treatment

- Posterior approach
- Retract posterior deltoid laterally,
- Find Lateral brachial cutaneous nerve
- Identify axillary nerve superior to T. Major



Patient Outcomes

- Quality literature lacking
- McAdams Am J. Sports Med
  - 4 pts treated surgically
  - 3 fibrous bands, 1 vein
  - All 4 RTP no pain @12wks

Summary

- Nerve compression disorders are not uncommon
- This group is particularly rare
- Thorough evaluation to localize source/etiology
- Extensive nonoperative trial period recommended
- Surgery can allow return to sport/previous activity level

Thank you