THORACIC OUTLET SYNDROME

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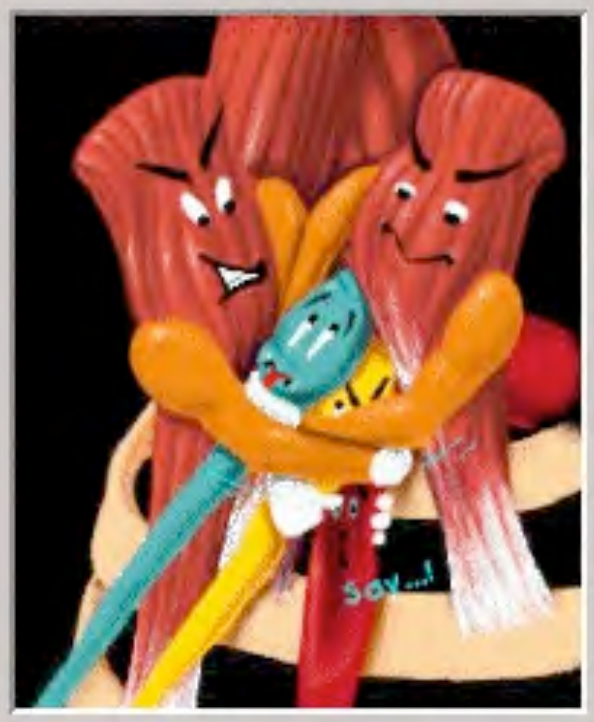
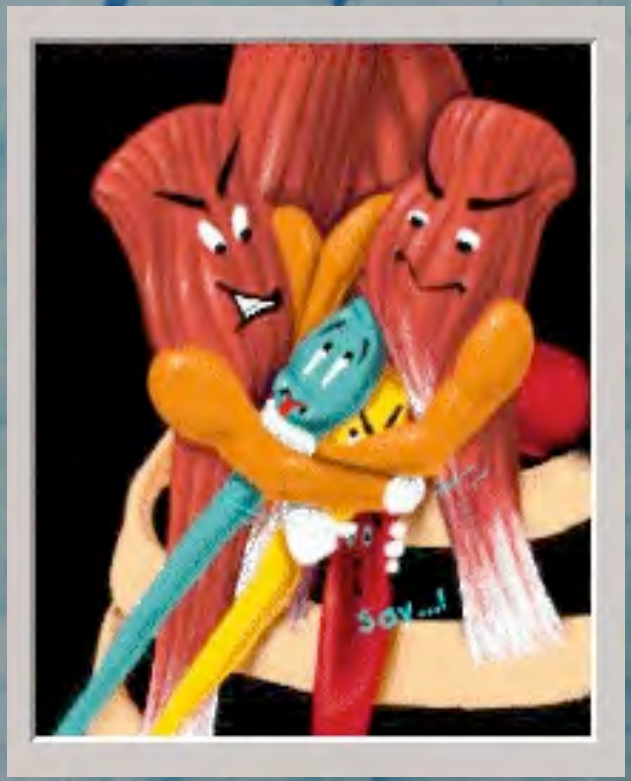
GEM 2005



THORACIC OUTLET SYNDROME

- INTRODUCTION
- ANATOMY
- DIAGNOSIS
- OERATIVE TECHNIQUE
- RESULTS
- MEDICO LEGAL ASPECTS
- CONCLUSIONS



INTRODUCTION

- TOS is a dynamic entity
- Symptoms can include :
  - Pain
  - Numbness
  - Paresthesias
  - Headaches
  - Weakness
  - Arm swelling
- The variability in presentation cause debate and misunderstanding

Time must be taken to fully comprehend the complex anatomy of the thoracic outlet region

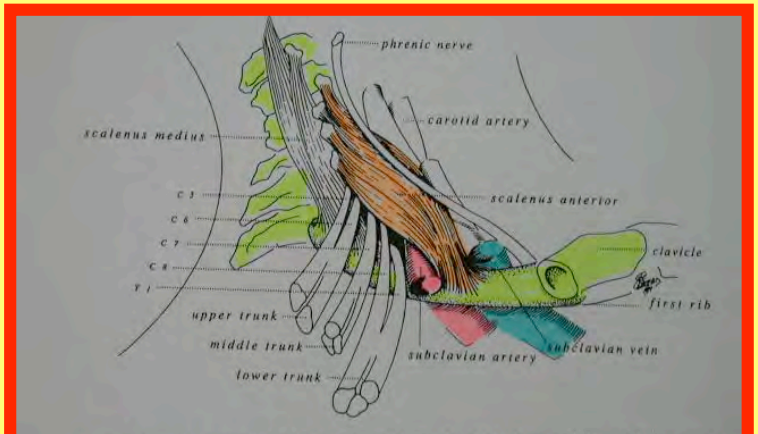


Fig. 49-4. Normal anatomy of the thoracic outlet. The brachial plexus and the subclavian artery exit between the anterior and middle scalene. The phrenic nerve arises from C4 and lies anteromedial to the anterior scalene.

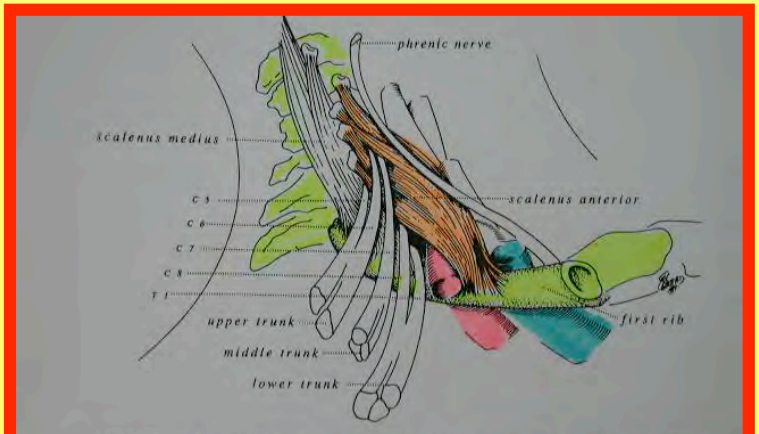


Fig. 49-5. Roots of the brachial plexus passing through the anterior scalene muscle. Here C5 and C6 lie between slips of muscle that are originating from the transverse processes rather than the anterior tubercles. In the most common variation, a portion of the anterior scalene passes between C5 and C6.

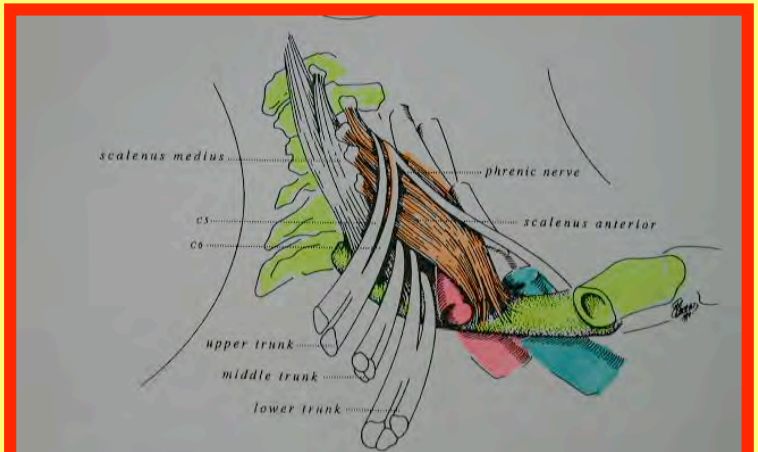


Fig. 49-6. Anterior displacement of the C5 and C6 nerve roots and low origin of the phrenic nerve. The phrenic nerve may arise anywhere along the upper trunk and thus may be more susceptible to injury during supraclavicular scalenectomy.

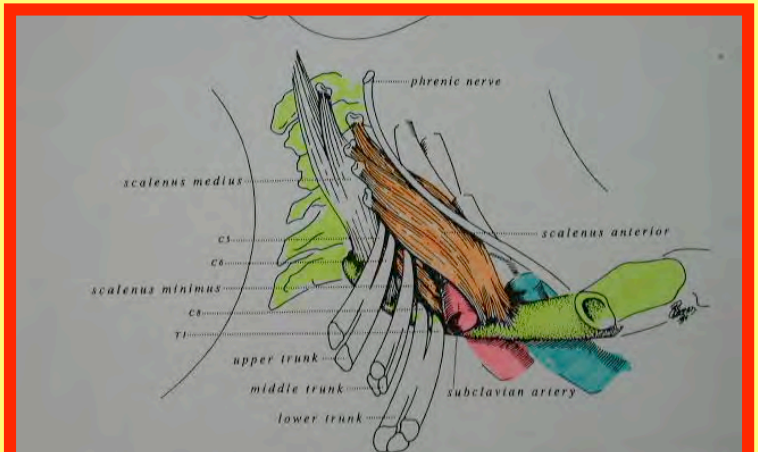
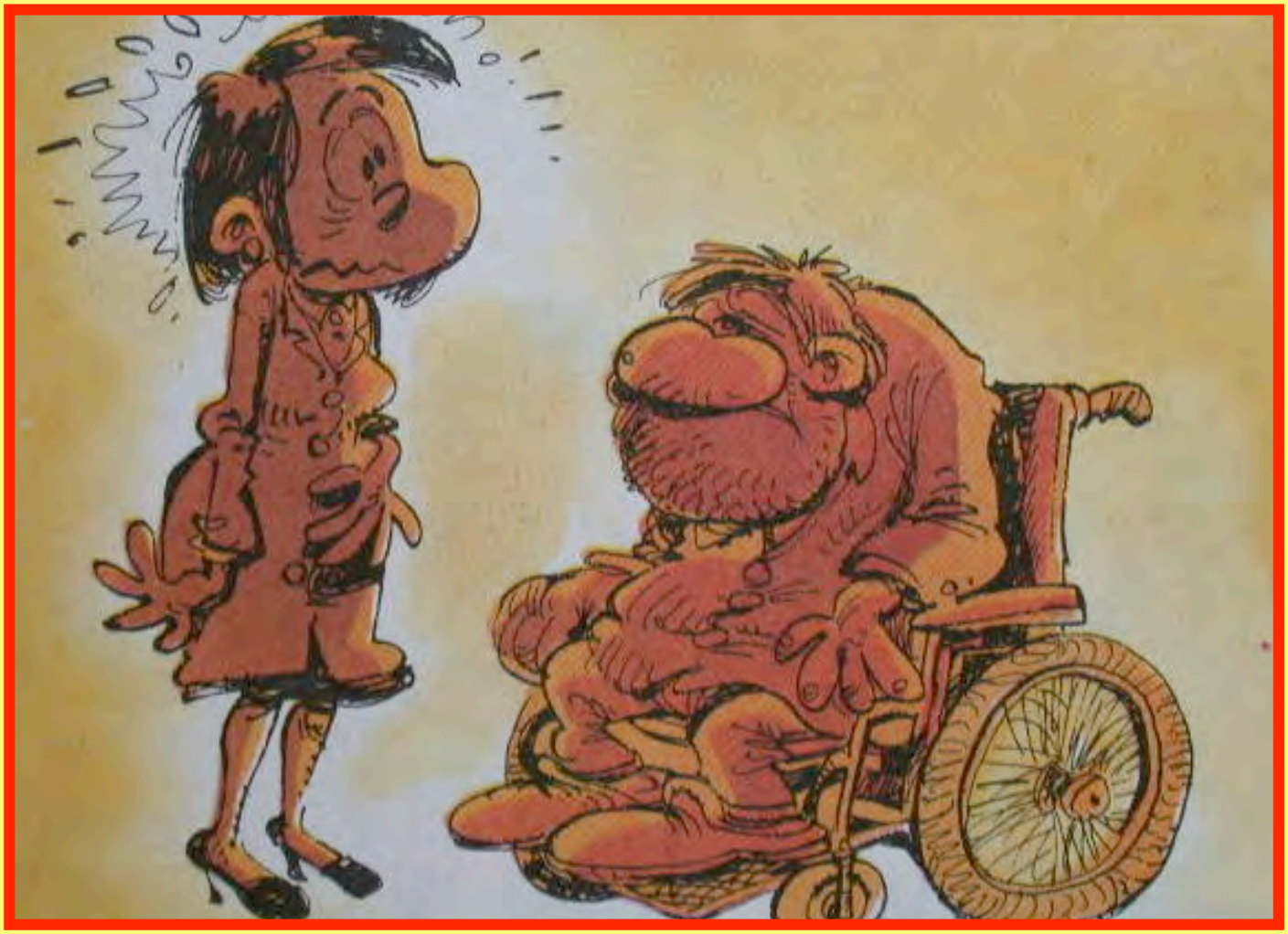


Fig. 49-7. Scalene minimus muscle causing lower-trunk compression. This muscle also may pass between the C8 and T1 nerve roots, causing only T1 compression.

HISTORICAL BACKGROUND



- **1627 W. HARVEY** ***Subclavian artery aneurysma***
- **1821 A. COOPER** ***1st clinical description***
- **1835 H. MAYO** ***Exatosis of the 1st rib with strong pulsations of the subclavian artery***
- **1860 W.H. WILLSHIRE** ***Cervical rib and paresthesias***
- **1861 H. COOTE** ***1st resection of cervical rib***
- **1915 J. PAGET** ***Subclavian vein thrombosis***
  L. S HRÖTTER
- ***1903*** **E. BRAMWELL** ***Lesion of the first dorsal root by 1st rib***
- ***1906*** **J.B. MURPHY** ***The role of the scalenus anticus muscle and significance of cervical rib***

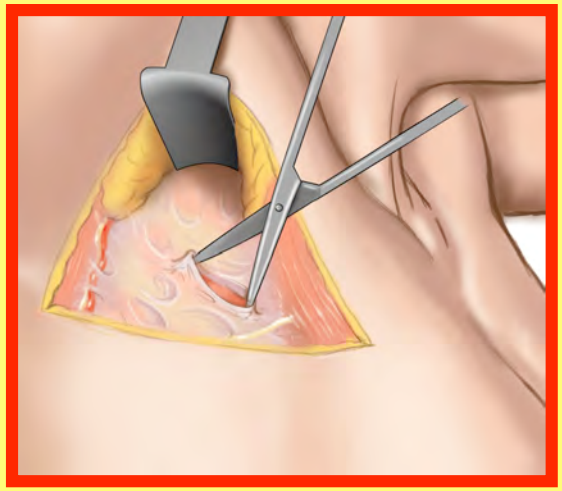
- **1910 T. MURPHY** *1st rib resection with relief of symptoms*
- ***1913*** **J. MORLEY** *Brachial pressure neuritis due to normal 1st rib*
- ***1915*** **E. GAUPP** ***) The role of the scalenus***
- ***1917*** **A. CLERCK** ***) medius on the inferior plexus***
- ***1927*** **W.M. BRIKNER** *Brachial plexus pressure by the normal 1st rib*
- ***1927*** **A.W. ADSON** *Relief of symptoms by division* **J.R. COFFEY** *of the scalenus anticus*
- **1931 L. PUUSEP** *« interscalenic-trigone » description*
- **1938 HL. NAFFZIGER** *« the scalenus syndrome » and the post operative « Naffziger's syndrome »*

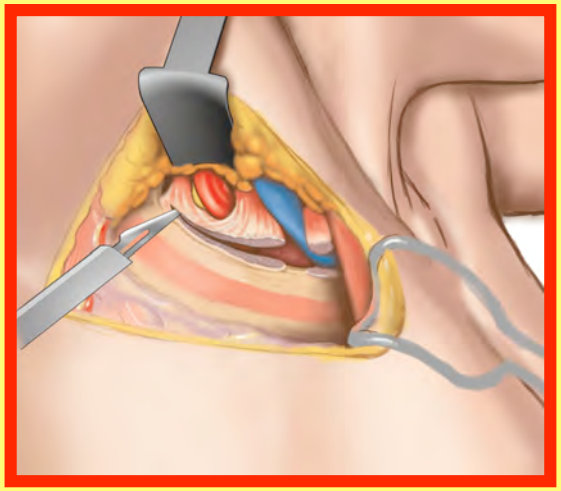
- **1943 RE.SEMMES** ***Cervical radiculopathy***
  F. MURPHY
- **1945 I.S. WRIGHT** ***The neurovascular syndrome produced by hyperabduction of the arm***
- **1950 GS. PHALEN** ***Neuropathy of the median nerve due to compression beneath transverse carpal ligament***
- **1952 M. KREMER** ***Nerve conduction abnomalities in carpal tunnel***
- **1953 J.W. LORD** ***Resection of the clavicle for relief of the costoclavicular compression syndrome***
- **1955 J. RAAF** ***Disenchantment with results of scalenotomy***

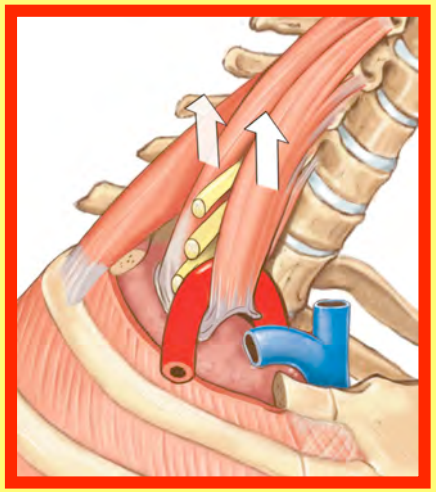
- **1956 R.M. PEET** ***Evaluation of a therapeutic exercice – program in TOS***
- ***1958*** **E.G. ROB** ***« The thoracic outlet compression syndrome » with arterial occlusion***
- ***1961*** **O. CLAGETT** ***1st rib is the common denominator in the physiopathology of TOS. (Posterio approach for rib resection)***
- **1962 MA FALCONER** ***1st rib resection as direct*** **FWP LI** ***attack by supraclavicular approach***

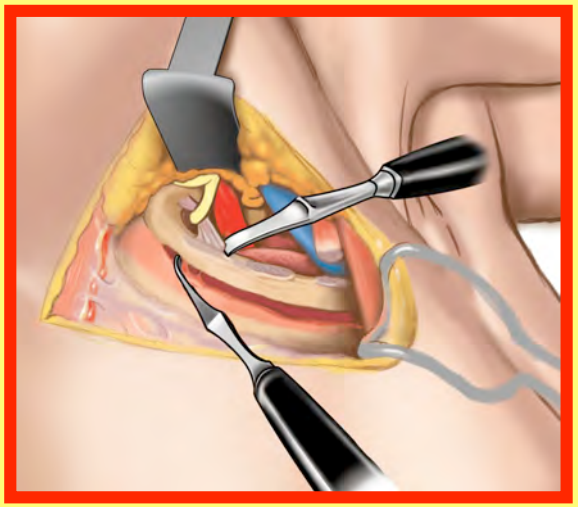
- **1966 DB. ROOS** ***The axillary approach for 1st rib resection - improvement rate : 93 % in vascular syndrome 88 % in neurologic syndrome***
- ***1972*** **H.C. URSCHEL** ***) Scalenotomy versus 1st rib***
- **1973 R.J. SANDERS** ***) resection***
- **1980 L.A. POITEVIN** ***Anatomical numerous variations explain the failures***
- **1982 W.A. DALE** ***Complications of the transaxillary 1st rib resection. Réhabilitation of the supraclavicular approach***
- **1990 A.O. NARAKAS** ***« double crush syndrome » in 30 % of TOS***

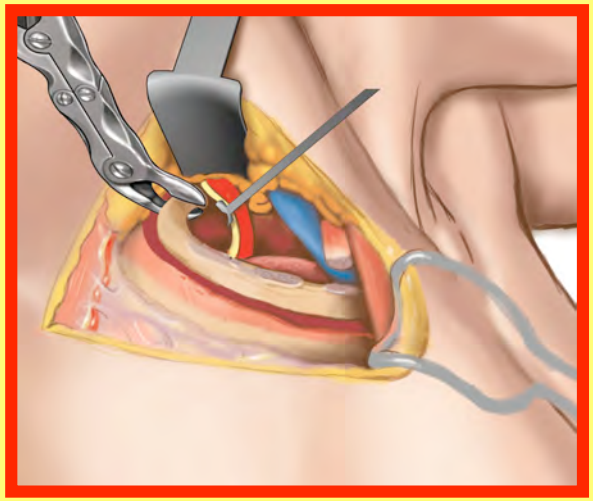
TECHNIQUE DE ROOS

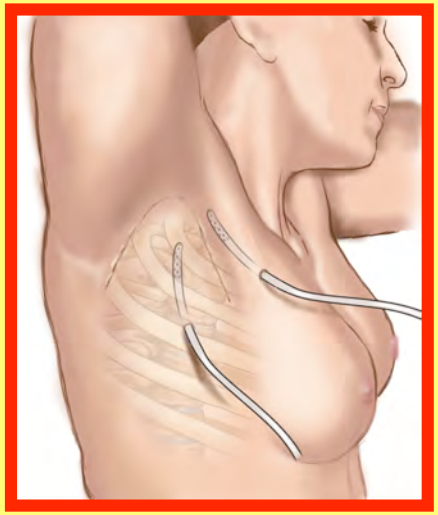






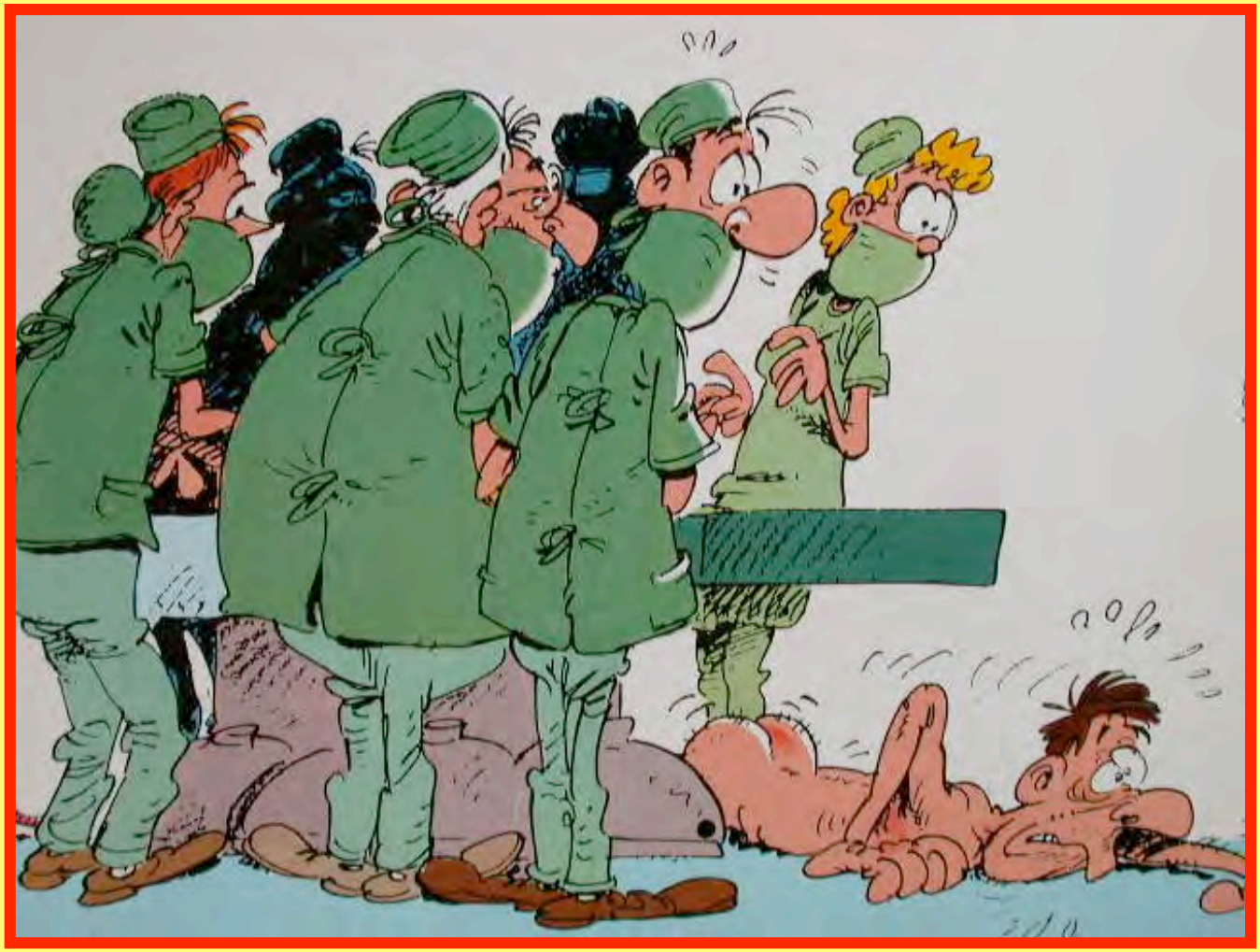






- **1991 Y. ALLIEU** ***Scalenus medius in neurologic TOS***
- **1994 F. CORNIER** ***Sus and Subclavian approach in neurologic disorders and intricated syndromes is suitable***
- **2004 M. MERLE** ***Experience with sus and sub clavian approach, 1st rib resection and scalenectomy***

VASCULAR DISORDERS : 15 %



Vascular disorders…

- **Arterial :**

  Dead arm, fatigue with use

  Aneurysm of the subclavicular artery

  Embolization of radial and/or ulnar artery

Vascular disorders…

- Venous : arm swelling, cyanosis
  thrombosis of the subclavian vein
  (Paget – Shrötter's syndrome)

- Lymphatic : role in reflex sympathetic distrophy

- Deep fascial bands running forward from a cervical rib or prolonged transverse process of C7, are the usual structural anomalies which predispose to vascular syndrome

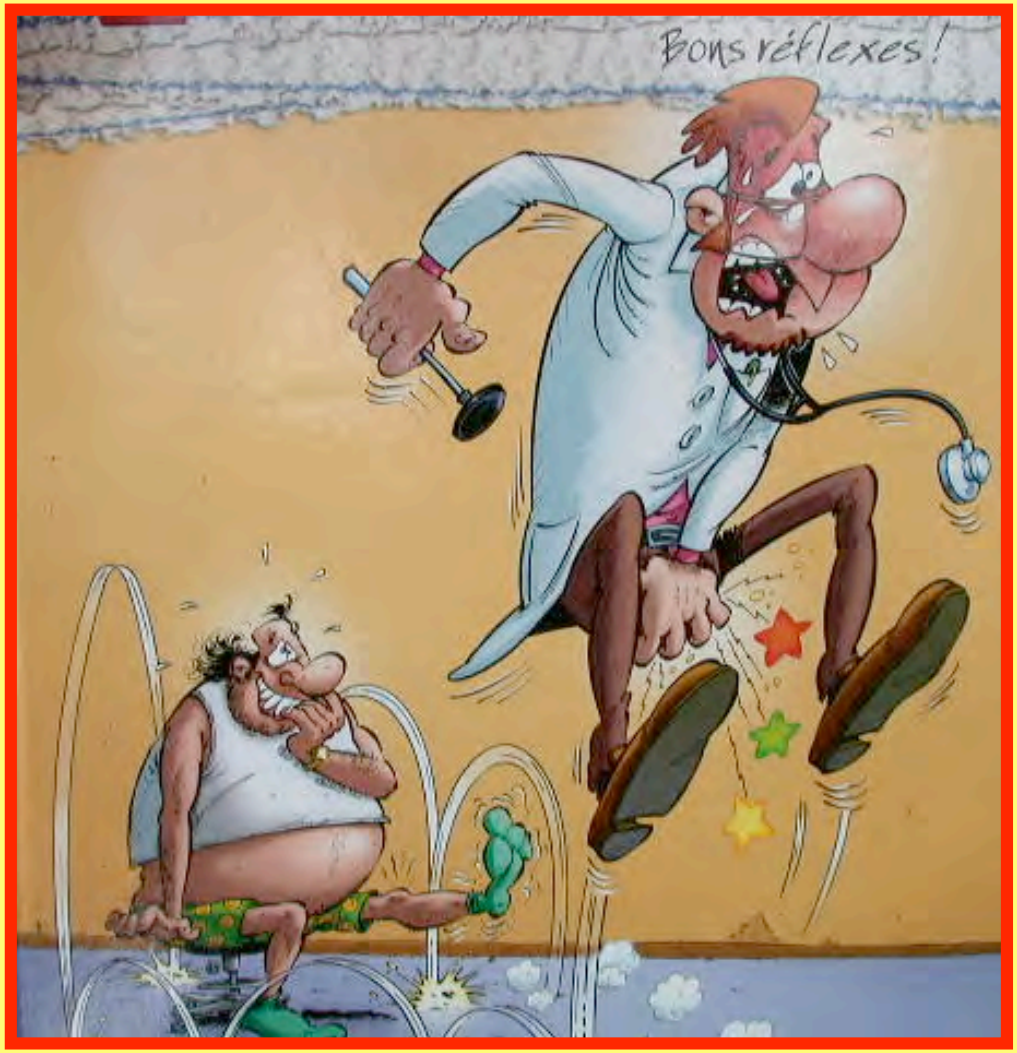
Vascular disorders…

Vascular disorders…

Other etiologies must be considered :

- **Factor VIII abnormalities**
- **Antithrombin III**
- **Dissiminated intravascular coagulapathy**
- **Occult malignancy**
- **Subclavian veinous catheter for intraveinous access (dialysis)**

NEUROLOGIC SYNDROME



NEUROLOGIC SYNDROMES…

- **TRUE NEUROGENIC**

  TOS : 10 % (isolated neurologic syndrome)

  Paresthesias

  Ulnar complaints in arm and hand

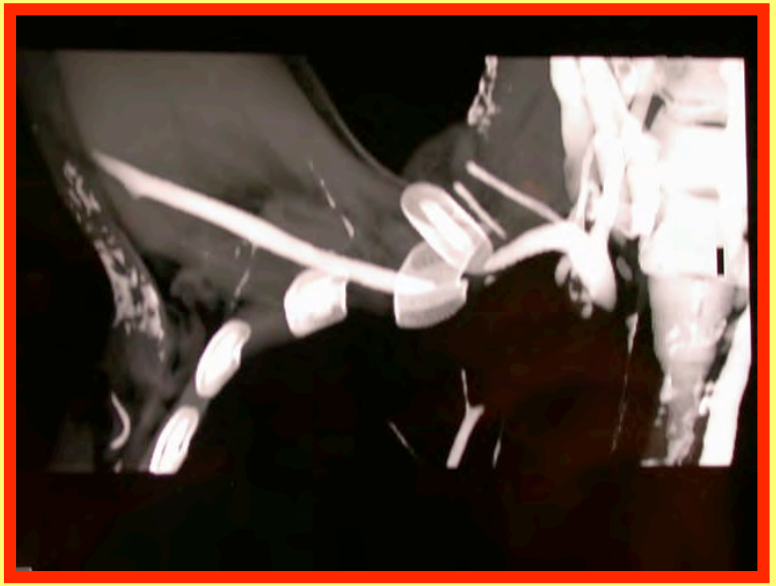
  Intrinsic atrophy

The majority have been involved in some type of significant trauma, particulary with a flexion – extension component.

Clear EMG peripheral evidences of neuron loss with or without cervical rib. (GILLIAT's desease, 1970)

NEUROLOGIC SYNDROMES…

- **<u>DISPUTED OR CLASSIC TOS</u> (combined vascular and neurologic syndrome) : 75 %**



NEUROLOGIC SYNDROMES…

- **LOWER TOS C8 T1**

  The pain is beginning at the base of the neck and supraclavicular fossa heading the deltopectoral groove.

  Parethesias into the fourth and fifth fingers

- **UPPER TOS C5 C6 C7**

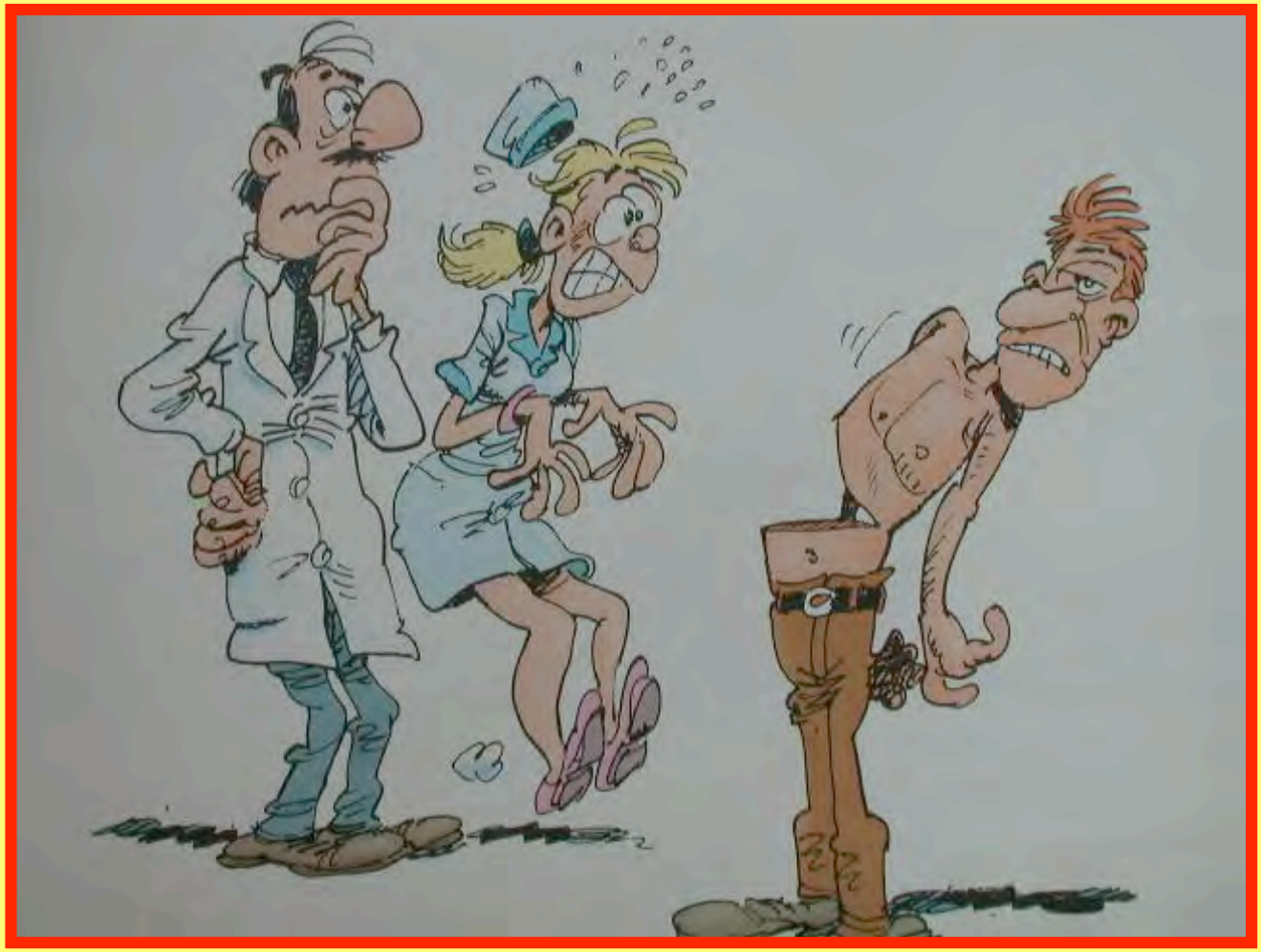
  Pain along the trapezius bridge, into the suprascapular notch and along medial scapular border.

  Headaches passing from the back of the skull foward toward the eye.

  Pain into the pectoral region.

  Pain along the long thoracic nerve with winging of the scapula.

PHYSICAL EXAMINATION



PHYSICAL EXAMINATION…

- **HANDS LOOKING**

  Prior surgery or trauma

  Color, warmth, moisture

  Excessive nail or hair growth

  Muscle atrophy

  Pulses at the wrist

  Capillary refill of the fingers

  Embolic disease or gangrene

PHYSICAL EXAMINATION…

- **UPPER EXTREMITY :**

  Sensory testing

  Tendon reflexes

  Motor fonction

  Inspection of the shoulder (Droopy's shoulder syndrome)

  Cervical spine

  Palpation of supraclavicular fossa

  Muscles about the shoulder girdle

PHYSICAL EXAMINATION…

- **<u>PROVOCATIVE MANEUVERS :</u> it is only a piece of the puzzle !**
  - **Pressure provocative test (spurling maneuver)**

    Direct pressure applied to a nerve at the point of irritation reveals tenderness

PHYSICAL EXAMINATION – PROVOCATIVE MANEUVERS

- **TINNEL'S SIGN**

  The « electric shocks » with percussion of a nerve is used to show the upper or lower plexus involvement.

PHYSICAL EXAMINATION – PROVOCATIVE MANEUVERS

- **ADSON'S TEST (1927)**
  - Paresthesias in ulnar fingers and loss of radial pulse by placing the arm at the side with head turned toward the affected side and with a deep inspiration
  - Loss of radial pulse with the head turned slighty hyperextend to either side with the arm at the side
- **FALCONER-WEDDEL'S TEST (1943) : costo clavicular compression test**
  - The patient is placed in exagerated military posture with shoulder braced firmly backward.

ADSON

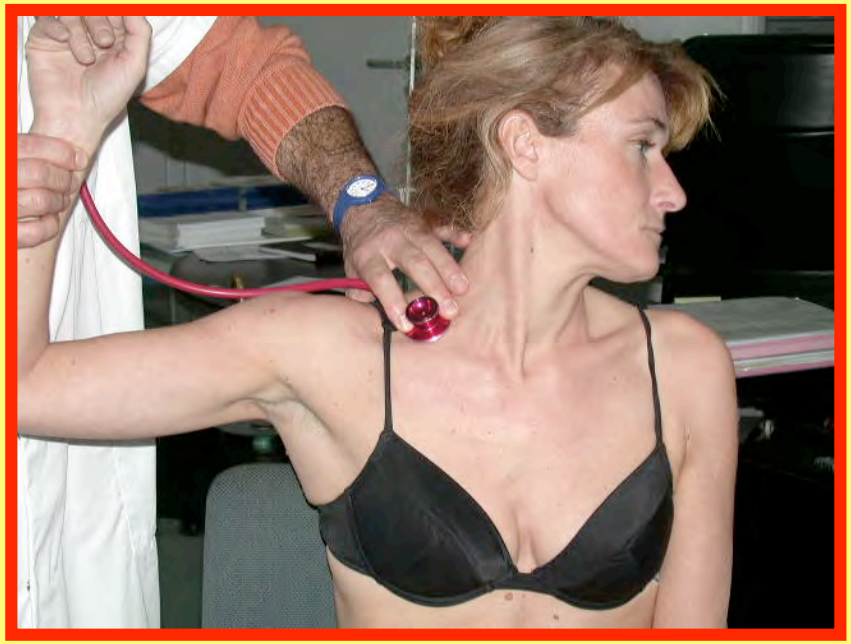
FALCONER

PHYSICAL EXAMINATION – PROVOCATIVE MANEUVERS

- **WRIGHT'S TEST (1945) :**
  - **Progressive hyperabducion of the arm with palpatin the radial pulse, the head away from the affected side**

    (Auscultation of the supraclavicular fossa and the subpectoral tunnel)

WRIGHT



PHYSICAL EXAMINATION – PROVOCATIVE MANEUVERS

- **ROOS TEST (1976) « Elevated arm stress »**

  The patient opens and closes the hands slowly during 3 minutes, the arms in abduction and retropulsion with the elbow at 90 °

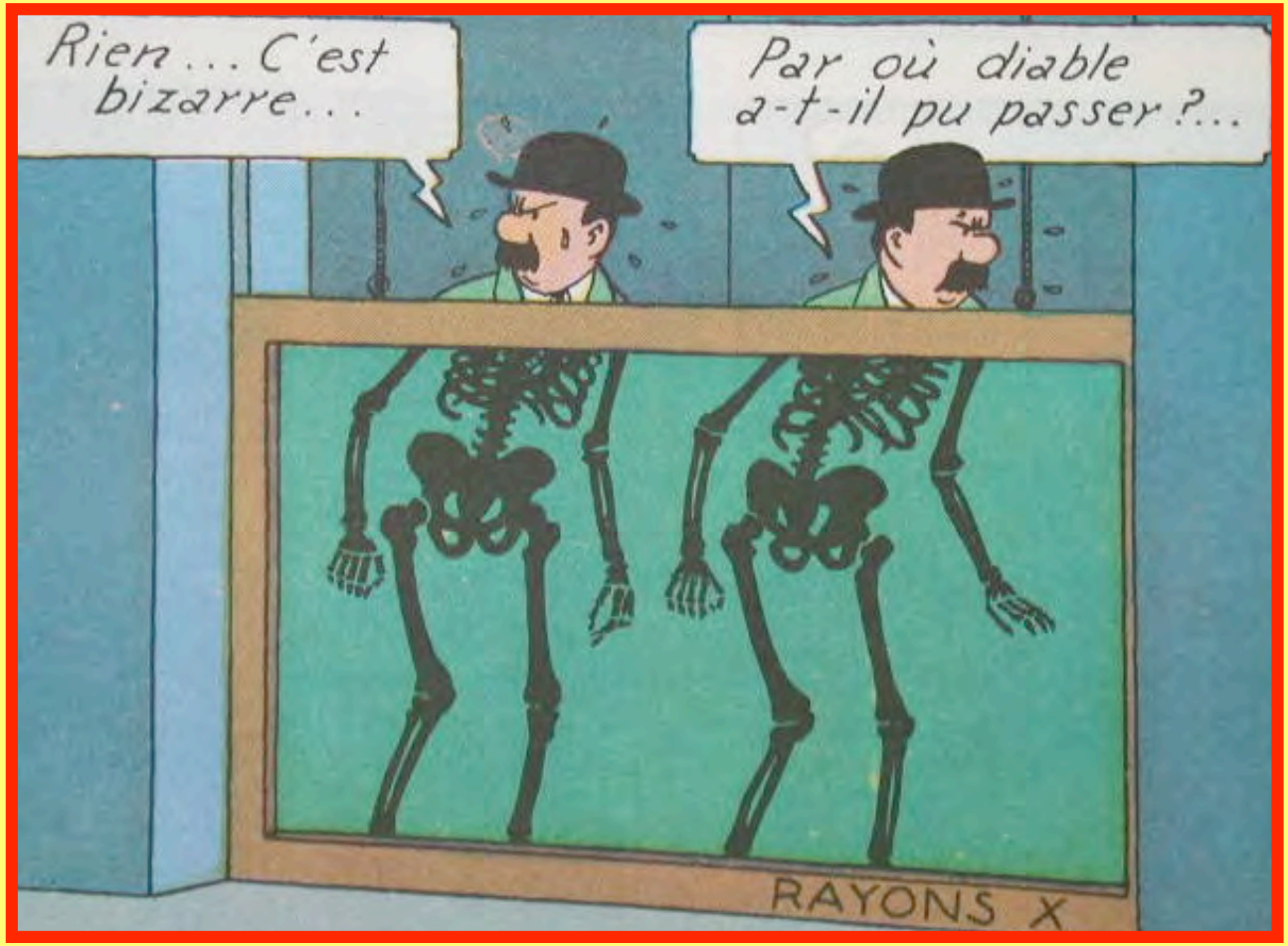
- **ELVEY – HUNTER'S TEST (1986) : Brachail plexus tension test**

  Interesting in patients who are considered they have a « double crush » neuropathy

ROOS

ELVEY

RADIOLOGIC STUDIES



RADIOLOGIC STUDIES…

CERVICAL RX

- Cervical ribs
- Malunited fractures of the clavicule
- Evidence of masses
- The lenght of the C7 transverse process
- Arthrosis

RADIOLOGIC STUDIES…

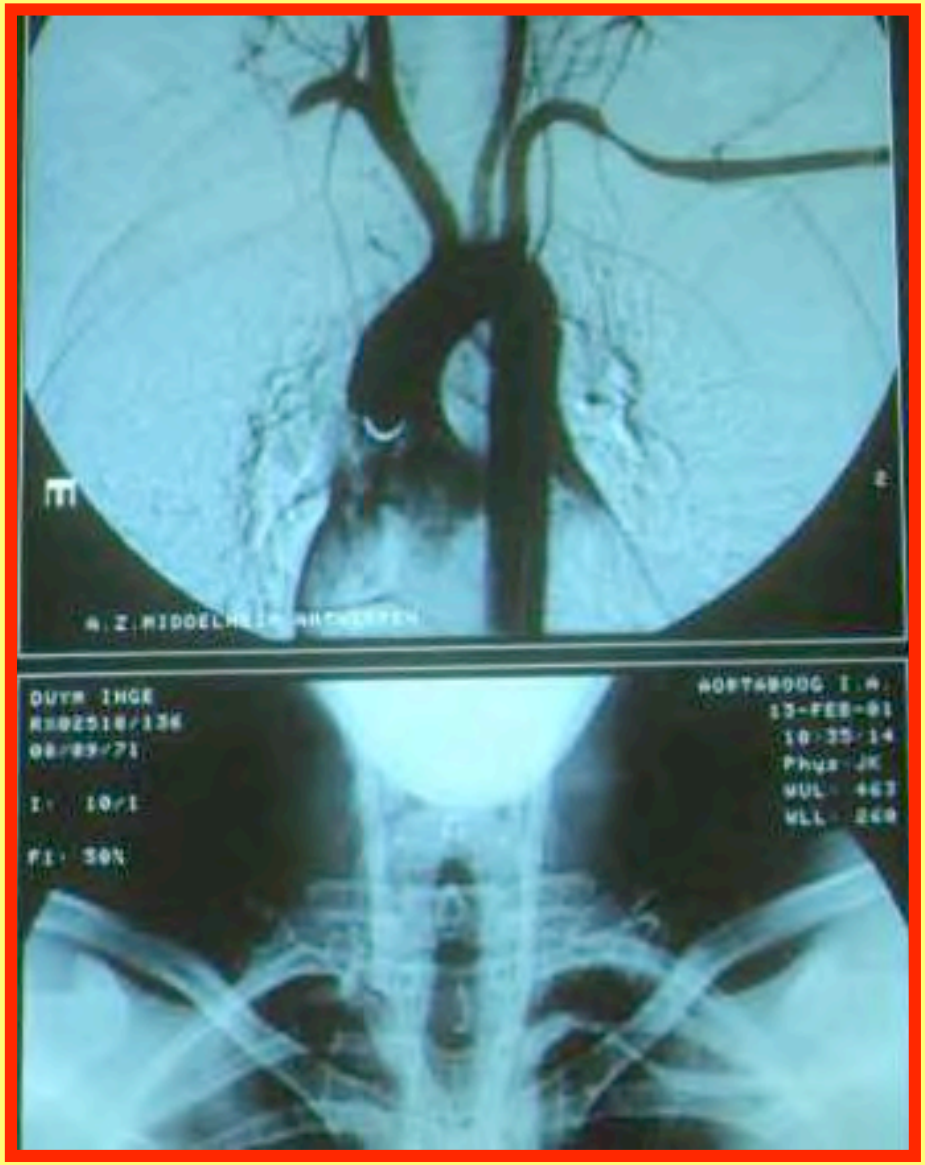
CHEST RX

- Cervical ribs
- First rib anomalies
- Myeloma of ribs
- Lung's carcinoma (PANCOAST)
- Intercostal artery aneurysms

RADIOLOGIC STUDIES…

- **ANGIOGRAPHY**

  Therapeutic clot lysis



RADIOLOGIC STUDIES…

- **M R I (MAGNETIC RESONANCE IMAGING)**
  - Evaluate discogenic desease of the cervical spine
  - The additional cost of M R I cannot be justified in clear cut cases or TOS
  - Should be performed to eliminate entities such
    - Syringomyelia
    - Gliomas of the spinal cord
    - Intradural metastases

    When there are other long-tract signs such as Horner's syndrome or loss of bladder control
  - Evaluate muscle's denervation

RADIOLOGIC STUDIES…

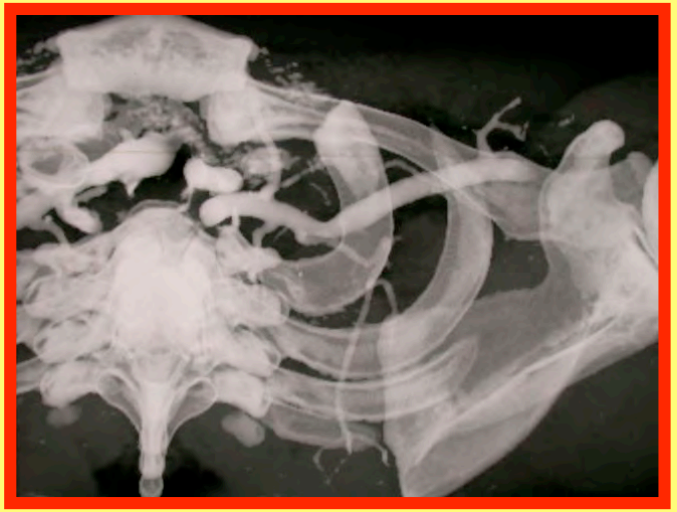
CT SCAN

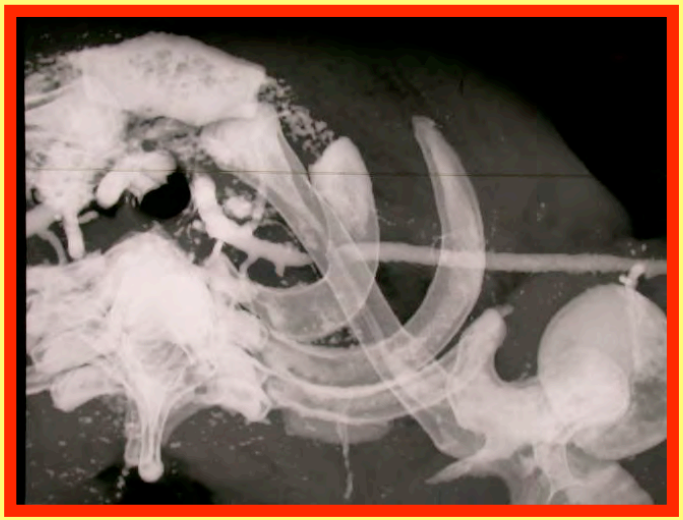
- Computerized tomography

  superior for bony abnormalities

- Angio CT SCAN

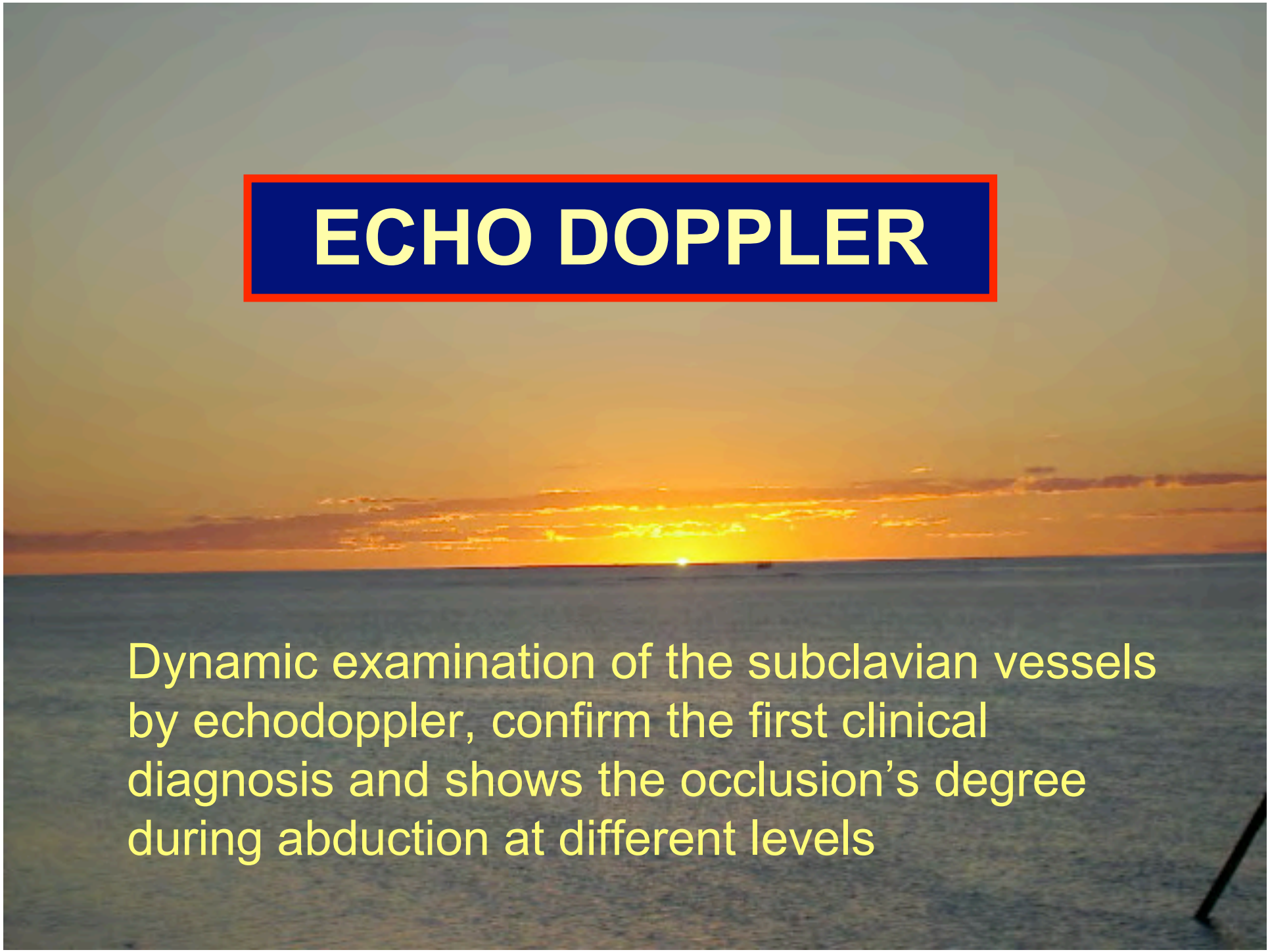
  vessels and bones seen but not yet in dynamic situation





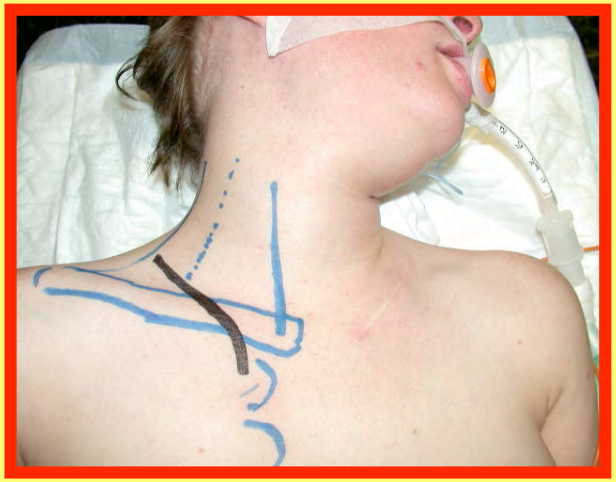
ELECTROMYOGRAPHY AND NERVE CONDUCTION VELOCITY STUDIES

- Depends on the ability and interest of the examiner to study the plexus
- Somato sensory evoked potential examination aids in mesurement of brachial plexus conduction deficits
- Interest in intraoperative ?


ECHO DOPPLER
Dynamic examination of the subclavian vessels by echodoppler, confirm the first clinical diagnosis and shows the occlusion’s degree during abduction at different levels

SURGERY

SURGERY…



- Failure of conservative therapy is an indication for surgery if the symphoms are severe enough to warrant intervention
- Surgery would be undertaken rapidly :
  - Muscle atrophy
  - Venous and/or arterial thrombosis
  - « whiplash » trauma

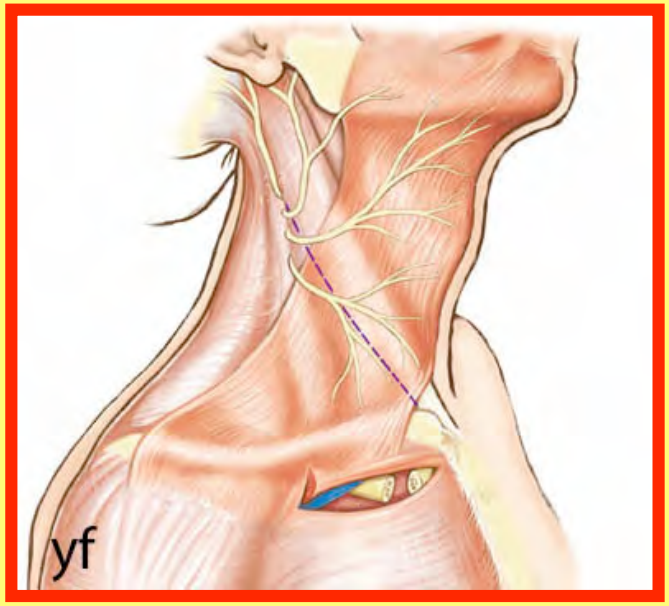
SURGERY…

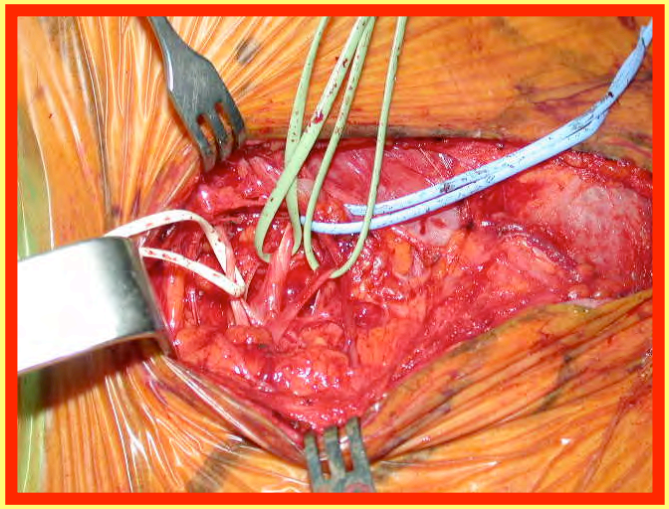
INCISIONS

- Posterior
- Subclavian
- Supraclavicular
- Axillary
- Sub and supraclavicular

SURGERY…

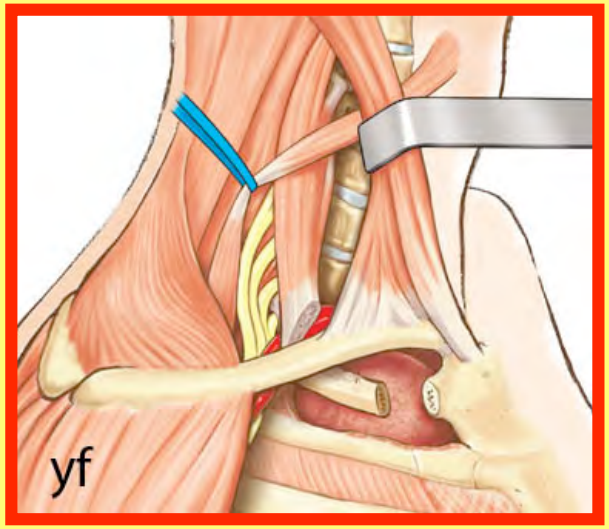
- Supra and subclavicular approach
- Skin and platysma incision
- Pectoralis major muscle
- Anterio first rib

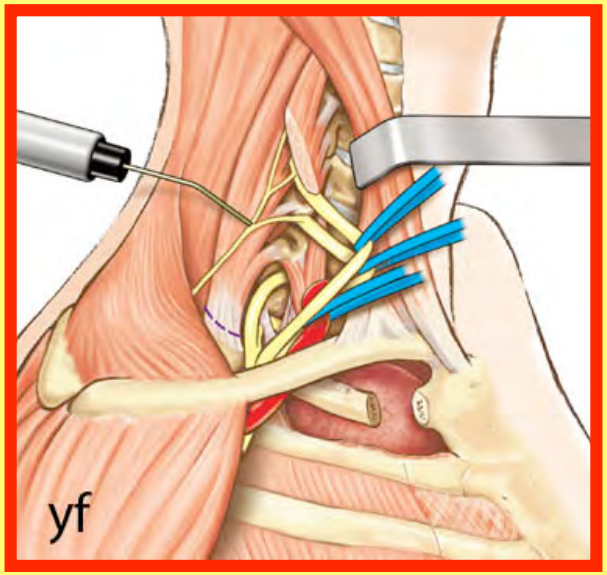




SURGERY…

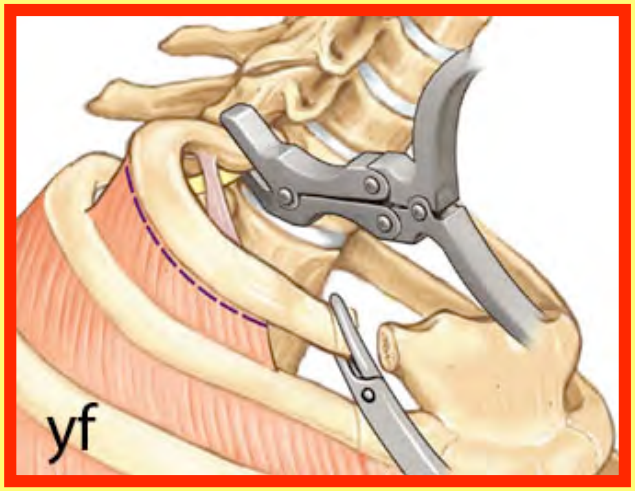
- Subclavian muscle
- Intercostal dissection
- Pleural detachement, release of costopleural ligaments
- Supraclavicular dissection
- Digastric muscle
- Scalinus medius reclination

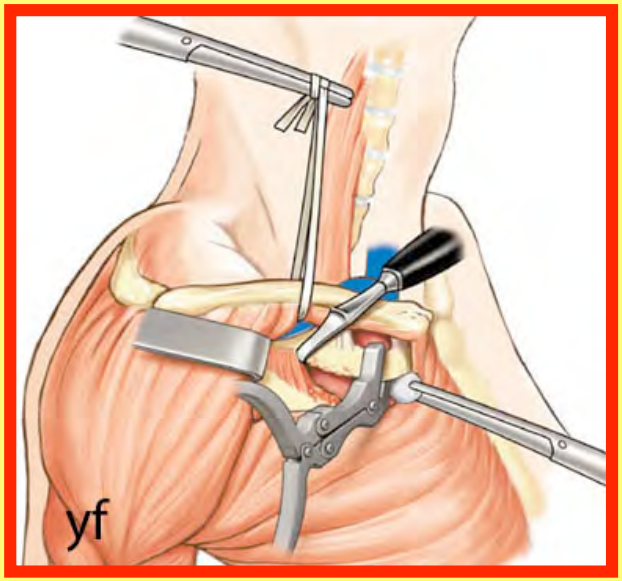


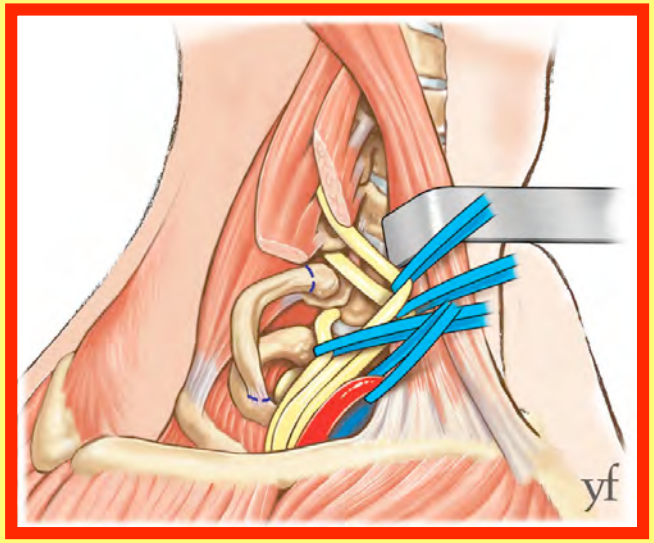


SURGERY…

- Scalinus anticus section or resection
- Costal osteotomy, posterior and anterior (+/- cervical rib)
- Aspirative drain
- Closure



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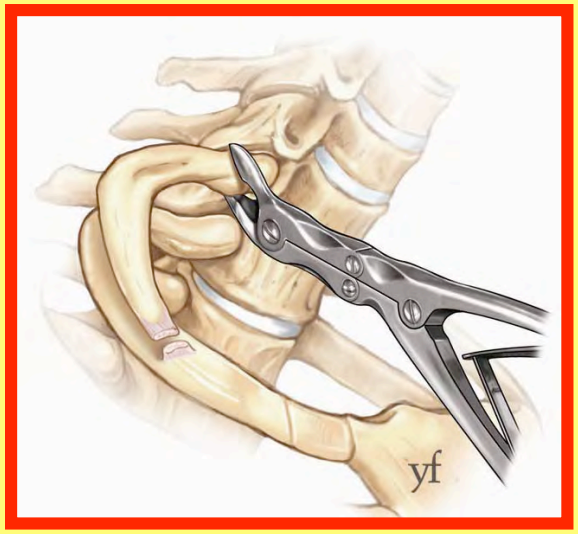
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POST OPERATIVE CARE

- Self mobilisation of shoulder and arm
- Respiratory exercices
- Physiotherapy

RESULTS

MATERIAL : (1990 TO 2005)

- 221 TOS on 178 patients
- 43 bilateral (25 %)
- Average age : 43 years (14-67)
- Sex ratio : 124 women (70 %), 54 men (30 %)
- Right side : 106 cases (60 %)
- Left side : 72 cases (40 %)
- Both sides : 43 cases (25 %)

RESULTS…

DOUBLE CRUSH : 53 cases (30 %)

- **Prior surgery : 32 cases (30 %)**
  (*lateral epicondylitis, DEQUERVAIN's desease, carpal tunnel syndrome, ulnar entrapment*)
- **Later surgery : 17 cases (10 %)**
- **Before and after TOS : 4 cases (2 %)**
- **Median nerve at the wrist : 17 cases (10 %)**
- **Median nerve at the elbow : 1 case (0,5 %)**
- **Ulnar nerve at the elbow : 7 cases (4 %)**
- **Median and ulnar nerve : 7 cases (4 %)**

RESULTS…

- **PECTORALIS MINOR TUNNEL (Bands on the coracoïd apophysis) :**
  - **In the time : 4 cases**
  - **2/3 months later : 7 cases**
- **SUPRA SCAPULAR NERVE ENTRAPMENT :**
  - **6 months later : 2 cases**

RESULTS…

- **Satisfaction (patient's self evaluation) : 83 % at 3 years**
- **Residual symptomatologia or recurrence :**
  - **Positional paresthesia**
  - **Residual weakness**
  - **Persistant intrinsic amyotrophy (2 cases)**
  - **Reinjury for repeat accidents**

COMPLICATIONS

- Iatrogenic lesion of the subclavian artery : 1
- Rupture of the costotome : 1
- Loss of the first rib (endoscopic removal) : 1
- Neuroma of sensitive nerve : 2
- Scars hypertrophy : 1
- ALDN with shoulder limitation : 1

CONCLUSIONS

Thoracic outlet compressive syndrome remains a complex problem that can be understood by study of the anatomy, embryology, pathomechanics, neurophysiology of the brachial plexus and evaluation of the patient.


OBRIGADO
THANK YOU
MUCHAS GRACIAS
MERCI