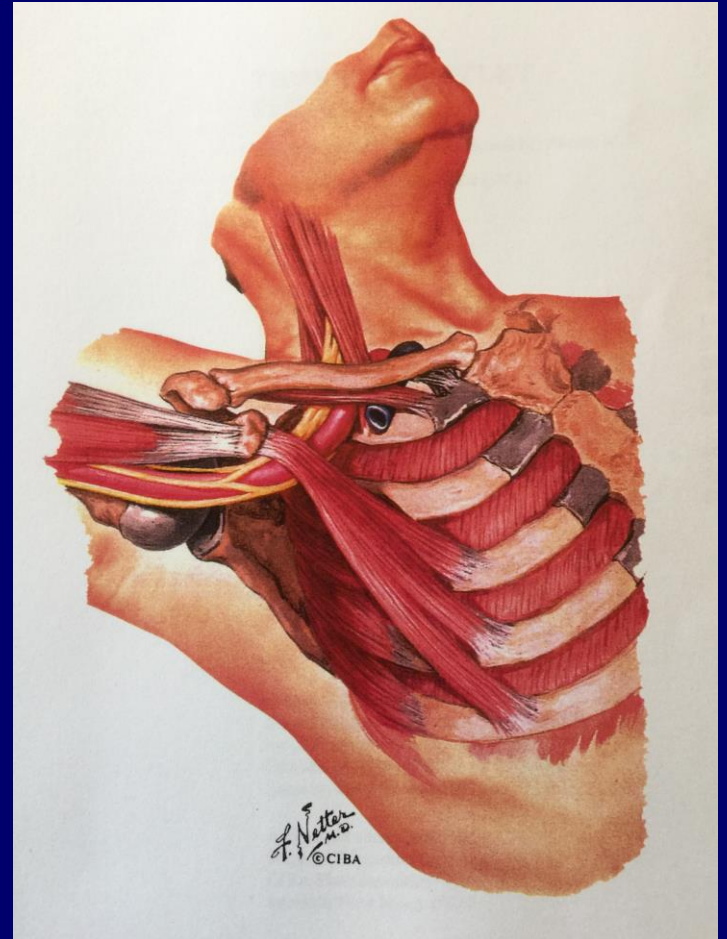
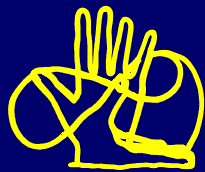


# UNDERSTANDING THORACIC OUTLET SYNDROME

California Orthopedic Association  
Annual Meeting 2018

RICHARD M. BRAUN, M.D.



# THORACIC OUTLET SYNDROME DEFINITION

A COMPLEX, CONFOUNDING, AND  
OFTEN DISABLING GROUP OF  
SUBJECTIVE COMPLAINTS AND  
OBJECTIVE FINDINGS ASSOCIATED  
WITH **NEUROVASCULAR**  
COMPROMISE IN THE AREA OF THE  
**BRACHIAL PLEXUS** AND THE  
**SUBCLAVIAN VESSELS**



# Understanding TOS...the literature:

- Sanders, RJ - Thoracic Outlet Syndrome – a common sequelae of neck injuries JB Lippencott, Philadelphia (1991)
- Atasoy, E-Thoracic Outlet Compression S. Ortho Clinics of NA 27:2 265-303 (1996)
- Fugate, MW (Freishlag) - Current Mgmt of TOS,:Current Treatment Options in Cardiovascuoar Medicine, V.11,i2 4/2009

# Understanding TOS...the conversation:

- TOS is real ...no it's not, those people are crazy.
- TOS can be diagnosed ... can't ever be certain, those people are crazy!
- TOS can be treated successfully ...no it can't, those people are crazy!!
- TOS patients can return to work ... of course!  
I agree. All my patients go back to work...

# THORACIC OUTLET SYNDROME CONFOUNDERS

## NEUROPATHIC PAIN

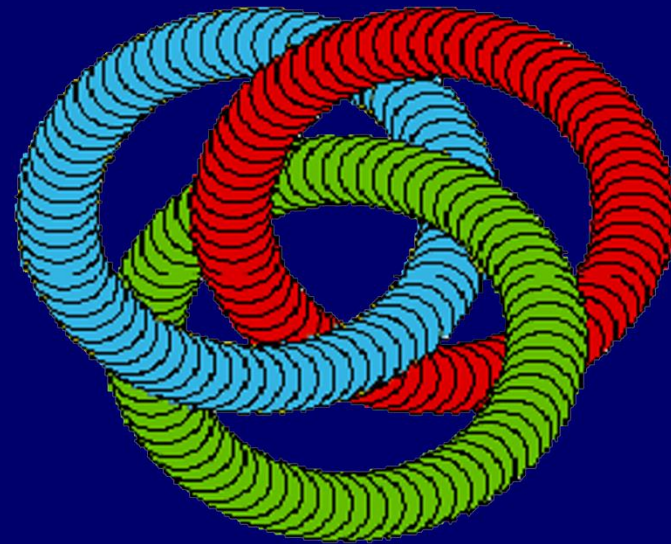
DIRECT NERVE INJURY

**NOCICENTRIC PAIN** PAIN  
MEDIATED THROUGH NORMAL  
NOCICEPTORS

- Possibilities...  
with multiple variables
- $2^n - 1$

VEIN

ARTERY



NERVE

# Understanding TOS...for the Doctor:

- Be ready to listen...look...examine ...and wonder...there may no *Eureka!* moment ...
- Accept the fact that the absence of proof is not the proof of absence !
- Understand that incremental evidence may accumulate slowly. Be patient.
- Complex problems have multiple parts and many possibilities (  $2^n-1$  ).

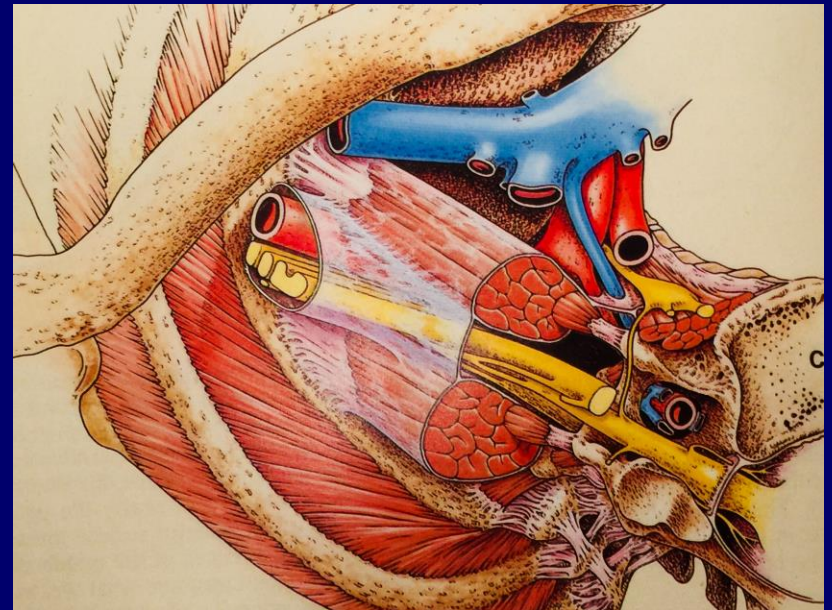
# Understanding TOS...for the Doctor:

- What do you **hear**? ...Pain and fatigue in the arm, neck, chest and face-headaches...
- Trauma Hx? Possible suspicious CT Hx?
- Sx increase with overhead activities ...I can't do my hair (the flip), I can't do my job or sport, dead arm, cold arm, pale hand
- Depression, Anxiety, Anger, Rejection ...

# Understanding TOS...for the Doctor:

Listen...look...examine ...and wonder.

- What were you doing when the symptoms first appeared?
- How do you reduce the symptoms?
- What makes the symptoms worse?



# Understanding TOS...for the Doctor:

- What do you **see**? Sloping shoulder?...Arm support, handbag, belt, pocket, furniture etc.
- Hair (women) short, if not, why (the flip)?
- Hand color? Pale (white hand with elevation?) Increased venous markings ?
- Arm position to initiate Sx – r/o BP stretch
- Imaging: Collins JD, Radiology, UCLA

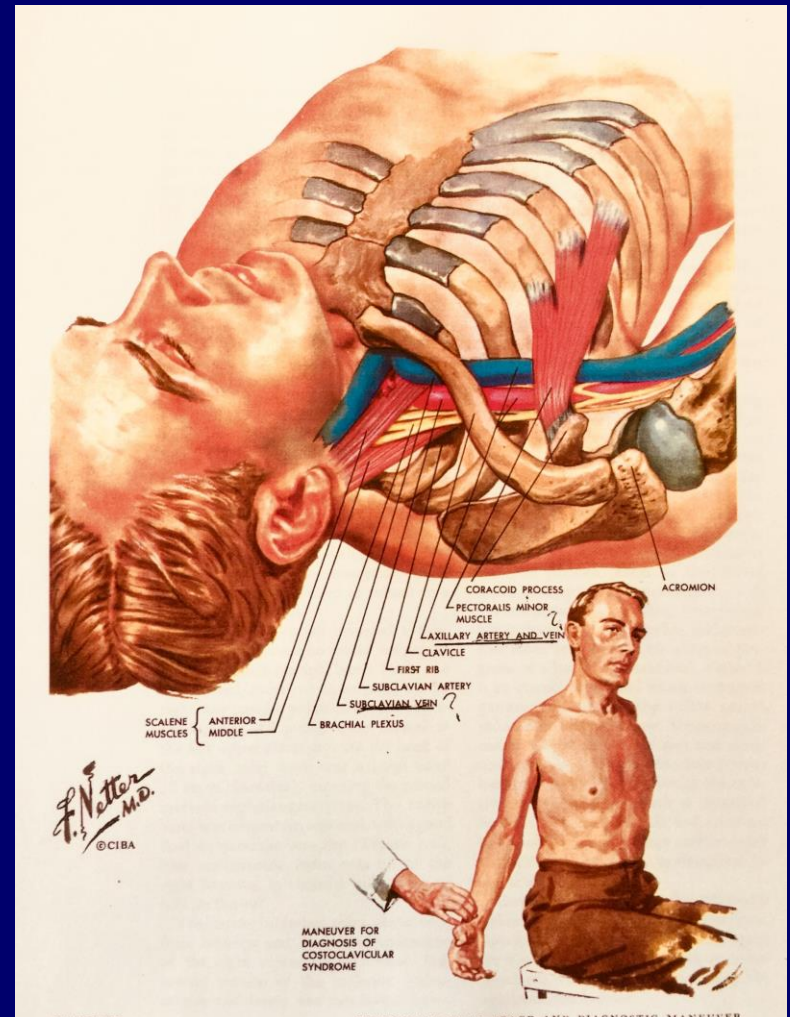
# Understanding TOS...for the Doctor:

- What's in the **Medical Record?** ... the Hx!
- Trauma-MVAs, Falls, Fx(ORIF-Iatrogenic)  
Clavicle or chest wall, Cervical rib, etc.
- Stretch injury to arm (Brachial Plexus) e.g.  
conveyor belt, bed collapse ICU, Delivery  
Room accident, fall out of Humvee,  
Wheelchair on stairs.
- Work CT – Rep. Reaching on assembly  
line, Rep Lifting (Sh-Neck), overhead pass.

# Understanding the Examination for TOS

Why does it happen?

- Supraclavicular tenderness. (3 zone.)
- Arm abduction cumulative stretch.
- Anatomy of injury.  
Acute or Chronic
- Vascular dynamics.  
Artery • Vein • Nerve



# The physical Examination for TOS... why does it happen ?

- Supra-clavicular tenderness (3 zone bilateral)
- Arm Abduction-cumulative stretch (3 zone nerve gliding-neck/sh, elbow, wrist/hand)
- Spurling's Test ( RO Cervical DJD )
- Vascular- ART (static pulse loss vs posture, dynamic Arm Abd Stress Test-Roos Test)
- Vascular- Vein (venous prominence)

# THORACIC OUTLET SYNDROME

## DIAGNOSIS / TESTING

### STATIC

#### HISTORY

#### CLINICAL EXAM

- PULSE LOSS
- ADSON / WRIGHT

#### IMAGING

- X-RAY
- MRI
- A / MRA - V

### DYNAMIC

#### HISTORY

#### FUNCTIONAL CAPACITY

- ROOS TEST
- O<sub>2</sub> SATURATION



# THORACIC OUTLET SYNDROME

## DIAGNOSIS

### DYNAMIC

### PHYSIOLOGICAL METHODS

### OBJECTIVE MEASUREMENT

- SYMPTOM PROVOCATION

EXERCISE TOLERANCE

- SYMPTOM SURPRESSION

SCALENE MUSCLE BLOCK

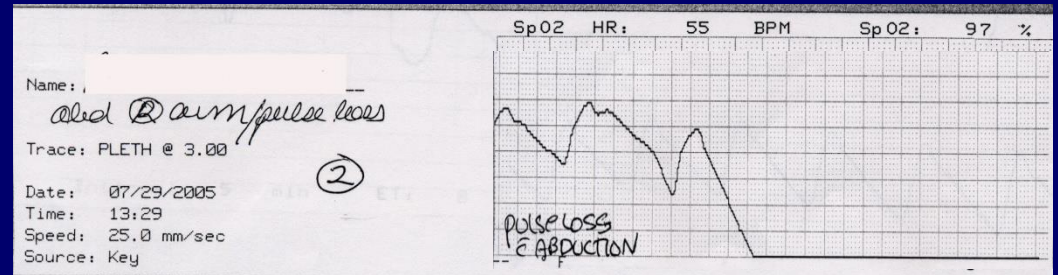


# THORACIC OUTLET SYNDROME

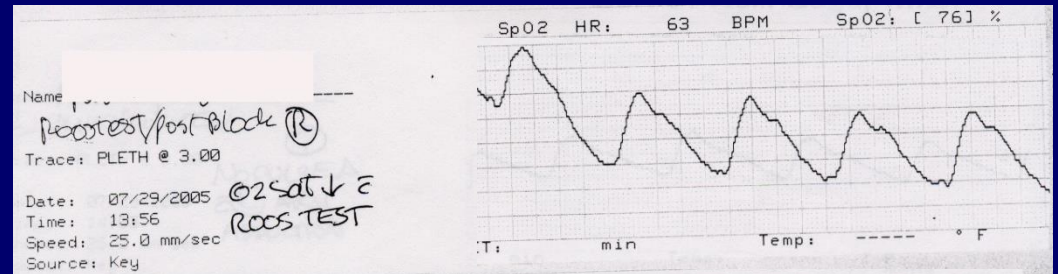
## DIAGNOSIS / PROGNOSIS

### NON-INVASIVE VASCULAR FLOW STUDIES

**ARM ABDUCTION**  
**O<sub>2</sub> SATURATION**  
**97%**



**ROOS TEST**  
**90 SECONDS**  
**O<sub>2</sub> SATURATION ↓**  
**98% - 76%**



# THORACIC OUTLET SYNDROME

## FUNCTIONAL DIAGNOSTIC TESTING

### RESTING

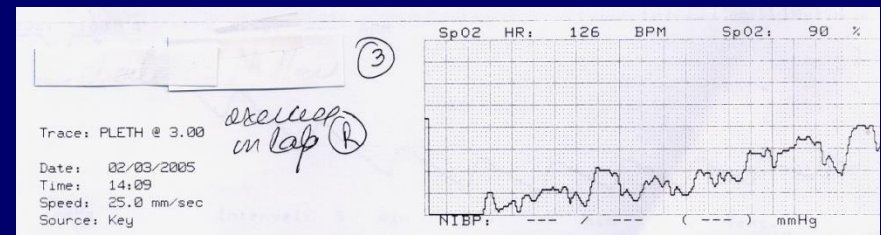
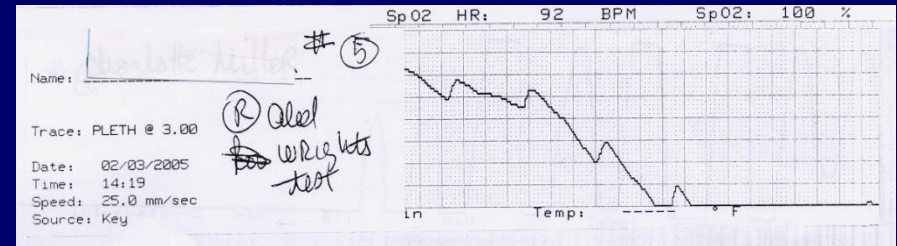
O<sub>2</sub> SATURATION 100%  
PULSE LOSS IN ARM  
ABDUCTION ( &  
WRIGHT'S TEST)

### ROOS TEST – 30SEC

O<sub>2</sub> SATURATION 100% → 84%  
ARM DROPS TO SIDE  
CLAUDICATION PAIN

### LAP EXERCISE 1MIN

TO PAIN ONSET /  
O<sub>2</sub> SATURATION  
DROPS TO 90% WITH  
ARM IN REST POSITION

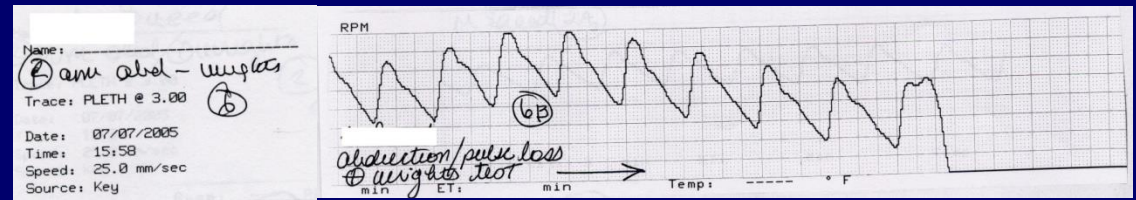


# THORACIC OUTLET SYNDROME

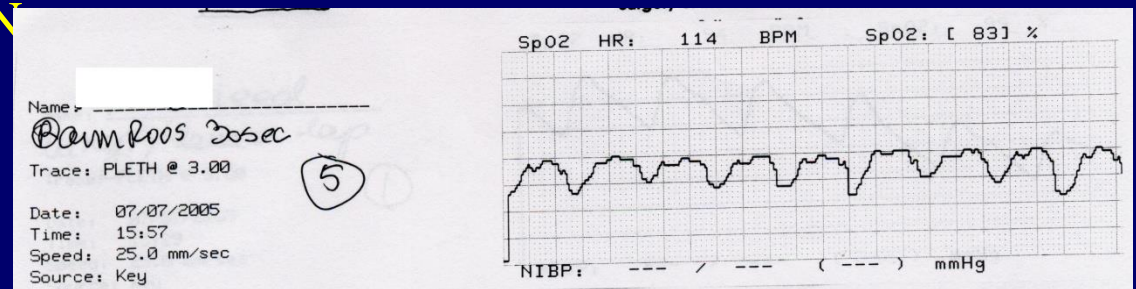
## DOPPLER FLOW STUDIES

IMPAIRED FLOW  
ARM ABDUCTION  
SATURATION  
ACCEPTABLE AT REST

O<sub>2</sub>



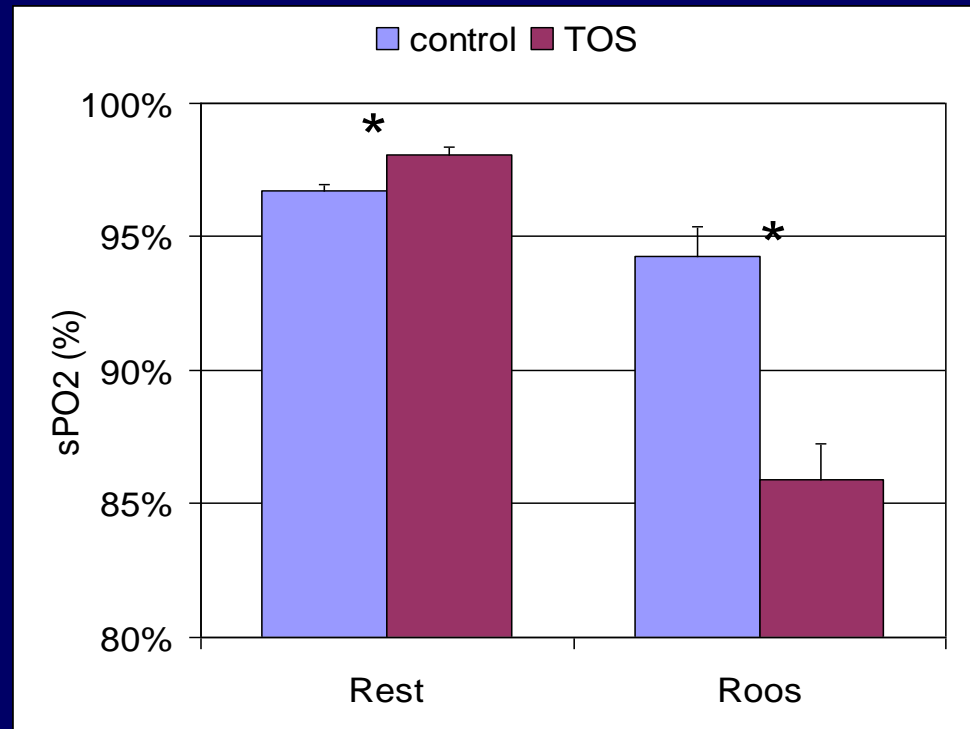
EXERCISE PROVOCATION  
ARM ABDUCTED  
O<sub>2</sub> SATURATION ↓ 83%  
(+) ROOS TEST



# THORACIC OUTLET SYNDROME

## PULSE OXIMETRY TESTING

- NORMAL O<sub>2</sub> SATURATION ABOVE 95% AT REST -- BOTH GROUPS
- ROOS PROVOCATION
  - CONTROLS 94%
  - TOS PATIENTS 86%

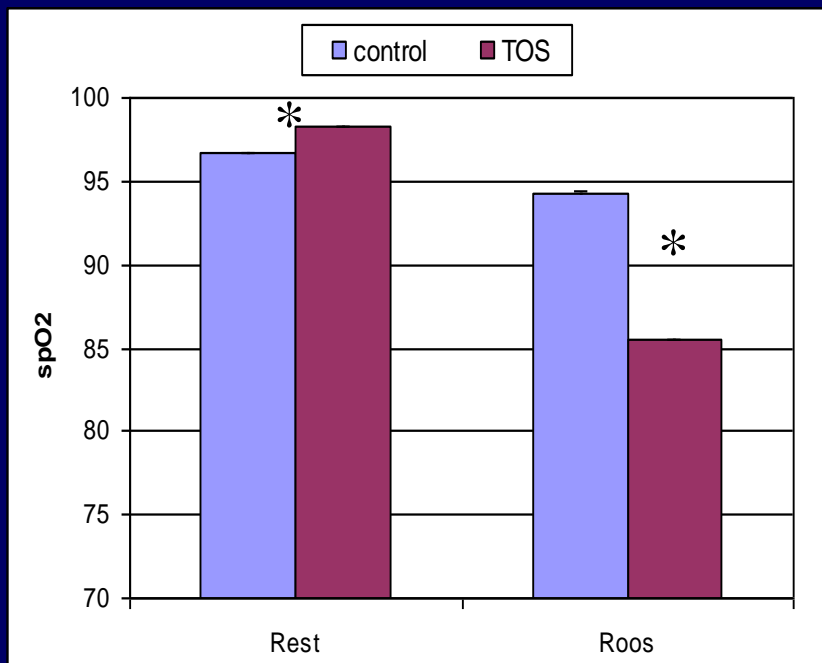


\* INDICATES P<0.001

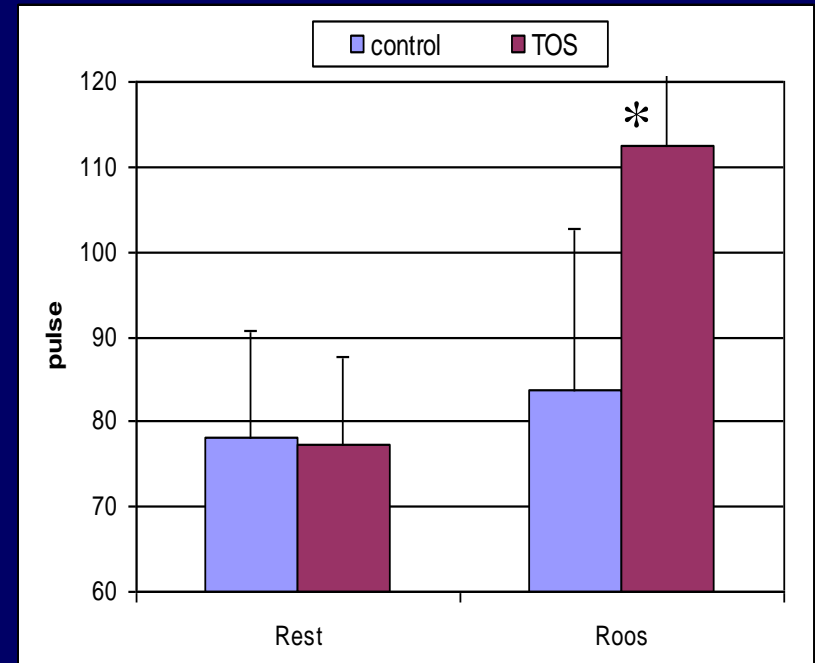
# THORACIC OUTLET SYNDROME

## PULSE OXIMETRY TESTING

### O<sub>2</sub> SATURATION



### PULSE RATE

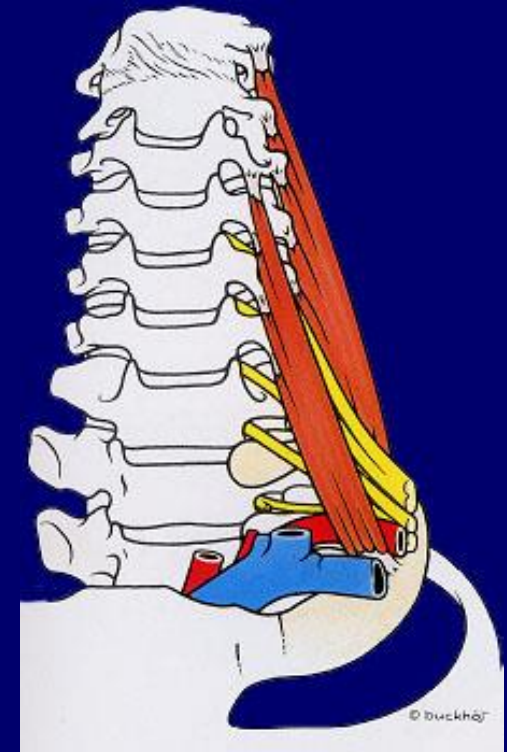


**ISCHEMIA / CLAUDICATION PAIN**

# THORACIC OUTLET SYNDROME

## DEFINITION

**SCALENUS ANTICUS SYNDROME** is a definite clinical entity, characterized by the clinical manifestations of **neurocirculatory disturbances**, resulting from compression of both the **brachial plexus** and the **subclavian artery** by the scalenus anticus muscle.



**GAGE, M. SURGERY 1939; 5:599-601**

# THORACIC OUTLET SYNDROME DIAGNOSIS / PROGNOSIS

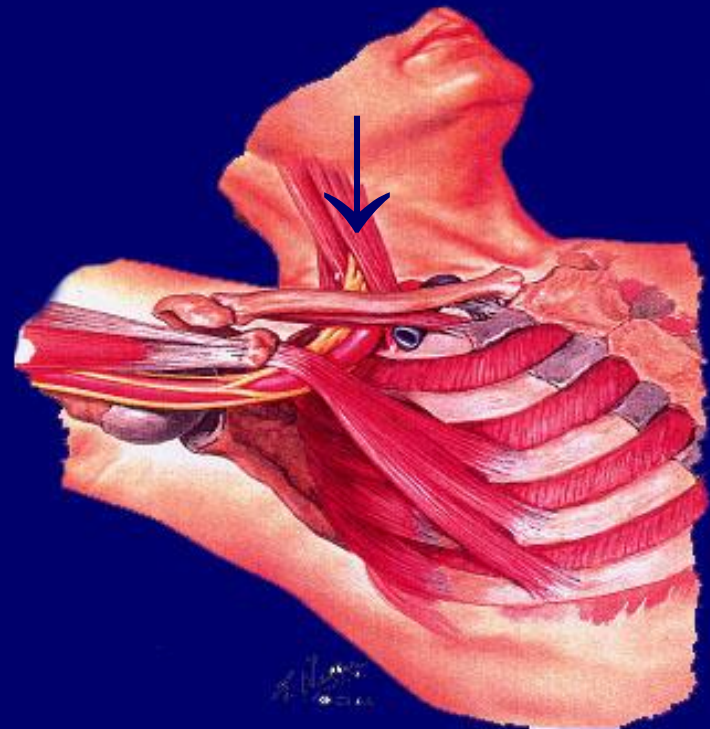
## SCALENE MUSCLE BLOCK

### THEORY

1% INTRAMUSCULAR  
LIDOCAINE

WEAKENS SCALENE  
MUSCLES

**GAGE, M. SURGERY 1939;  
5:599-601**



# THORACIC OUTLET SYNDROME

## DIAGNOSIS

### SCALENE MUSCLE BLOCK

GAGE, M. *Scalenus anticus syndrome: a diagnostic and confirmatory test.*  
Surgery 5:599-601 (1939).

SANDERS, R. *Thoracic outlet syndrome: a common sequela of neck injuries.*  
JB Lippincott Co., Philadelphia (1991).

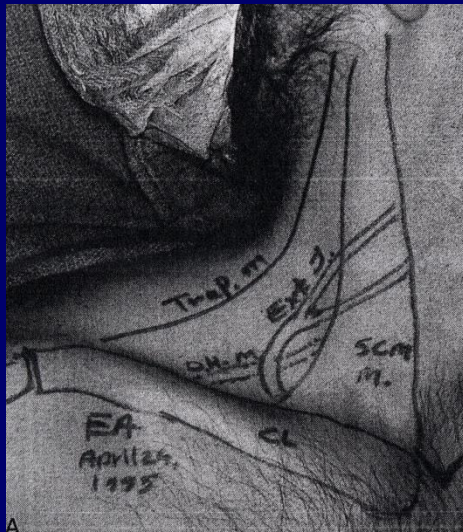
ATASOY, E. *Thoracic Outlet Compression Syndrome.* Orthopaedic Clinics of North America 27(2):265-303 (1996).

JORDAN et al. *Diagnosis of thoracic outlet syndrome using electrophysiologically guided anterior scalene blocks.*  
Annals of Vascular Surgery 12(3):260-4 (1998).

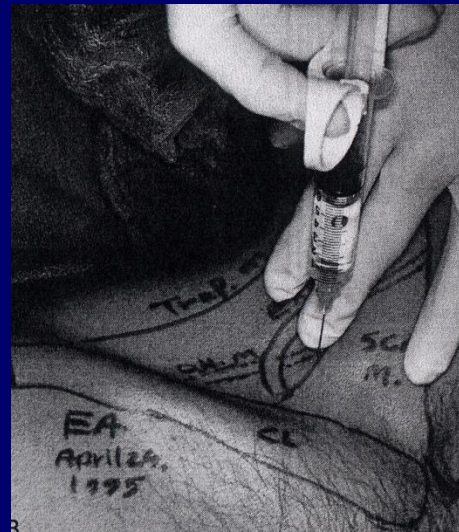
BRAUN, R. *Confirmatory Needle Placement Technique for Scalene Muscle Block in the Diagnosis of Thoracic Outlet Syndrome.*  
Techniques in Hand & Upper Extremity Surgery 10(3):173-6 (2006).

# THORACIC OUTLET SYNDROME EXAMINATION

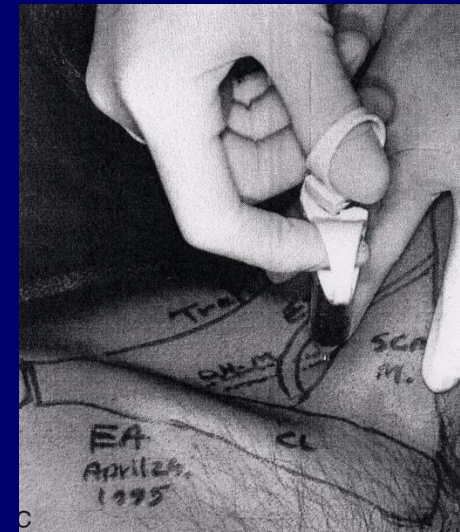
## SCALENE MUSCLE BLOCK



**LANDMARK FOR  
RIGHT ANTERIOR  
SCALENE MUSCLE  
INJECTION**



**LEFT LONG FINGER PALPATES THE ANTERIOR  
SCALENE MUSCLE ABOUT 1.5 IN ABOVE THE  
CLAVICLE AT THE LATERAL BORDER OF  
STERNOCLEIDOMASTOID MUSCLE**



**ATASOY, E. *Thoracic Outlet Compression Syndrome*. Orthopaedic Clinics of North America 27(2):265-303 (1996).**

# THORACIC OUTLET SYNDROME DIAGNOSIS / PROGNOSIS

## SCALENE MUSCLE BLOCK TECHNIQUE



**EXHALE**



**INHALE**

# THORACIC OUTLET SYNDROME DIAGNOSIS / PROGNOSIS

## SCALENE MUSCLE BLOCK

### RESULTS OF RESPONSE TO BLOCK AND SURGERY R.J. SANDERS

RESPONSE TO BLOCK	NO. OF CASES	GOOD RESPONSE TO SURGERY	POOR RESPONSE TO SURGERY
POSITIVE (IMPROVED)	442	415 (94%)	27 (6%)
NEGATIVE (NO IMPROVEMENT)	21	18 (86%)	3 (14%)

**RJ SANDERS / TOS / LIPPINCOTT / 1991**

# THORACIC OUTLET SYNDROME FUNCTIONAL CAPACITY TESTING

## SCALENE MUSCLE BLOCK BTE EVALUATION

**TOOL 802**



**TOOL 901**



**TOOL 162**



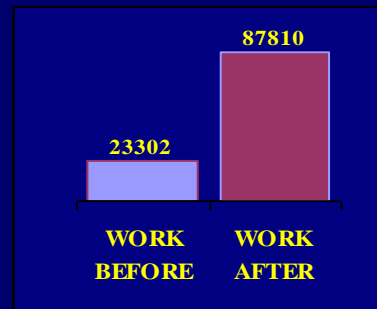
# THORACIC OUTLET SYNDROME FUNCTIONAL CAPACITY TESTING

## SCALENE MUSCLE BLOCK BTE EVALUATION

### TOS STRESS TEST



**TOOL 802**



**TOOL 901**

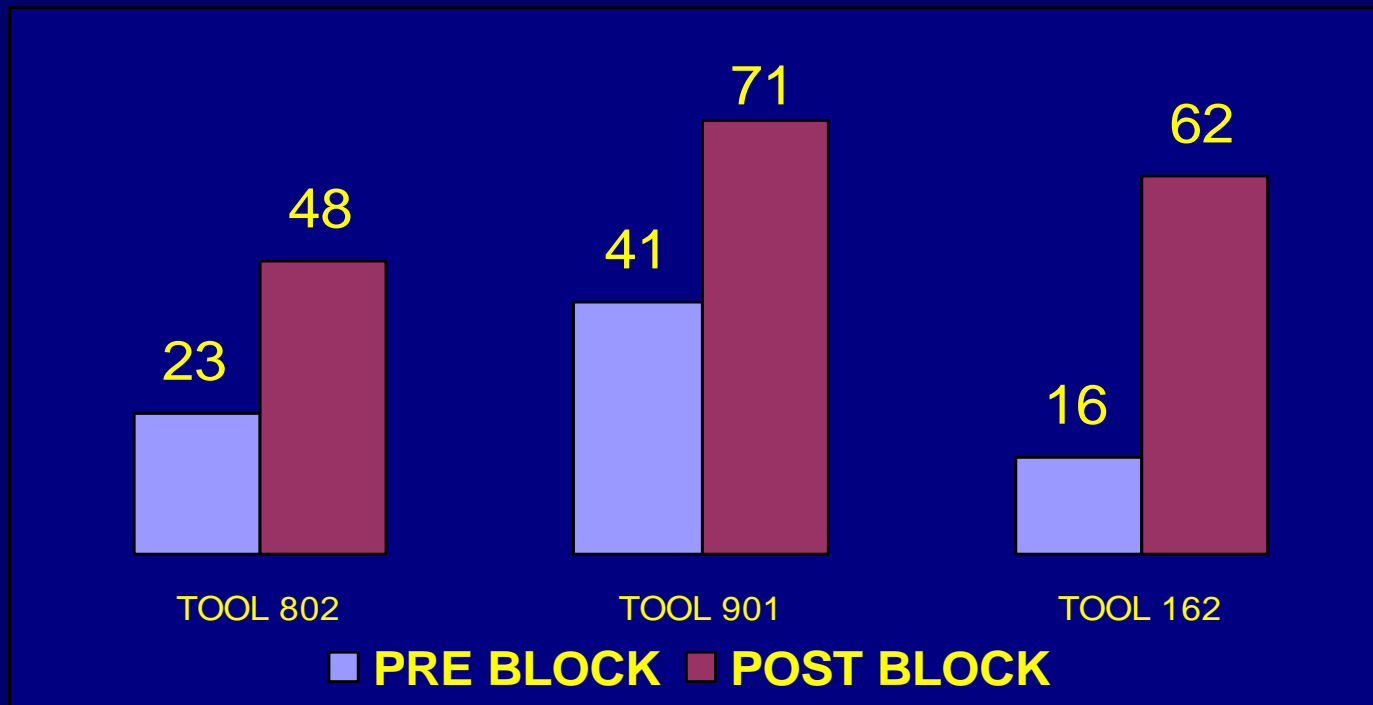


**TOOL 162**

# THORACIC OUTLET SYNDROME

## SCALENE MUSCLE BLOCK

### BTE FUNCTIONAL CAPACITY TESTING

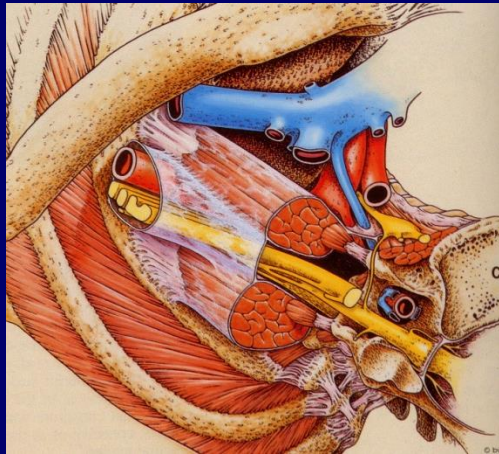


**Pre & Post Scalene Muscle Block**

# THORACIC OUTLET SYNDROME

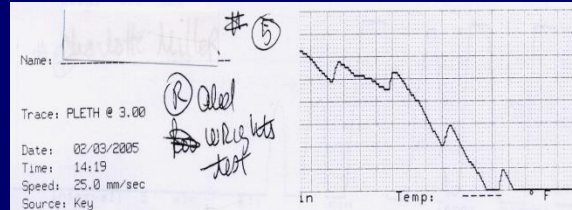
## EVALUATION / TREATMENT

### SURGICAL RESULTS



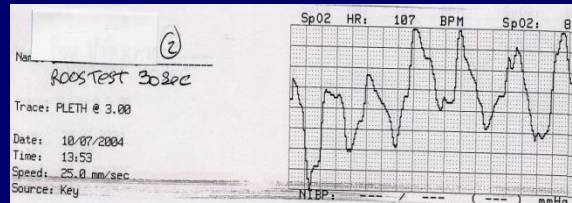
ANATOMY

ANATOMY



PREOP

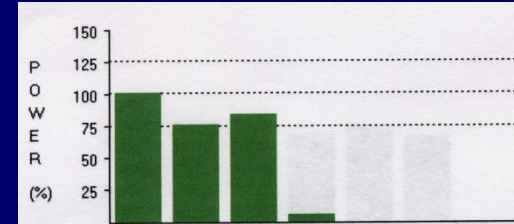
CM



POST OP

KH

PHYSIOLOGY



BTE

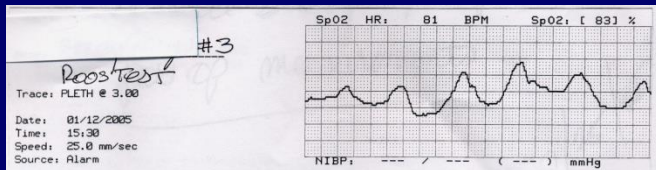
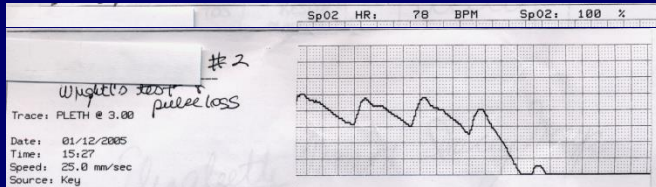
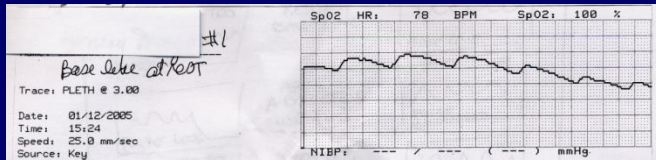
SC

FUNCTION

# THORACIC OUTLET SYNDROME

## OBJECTIVE VASCULAR TESTING

### PRE-OP

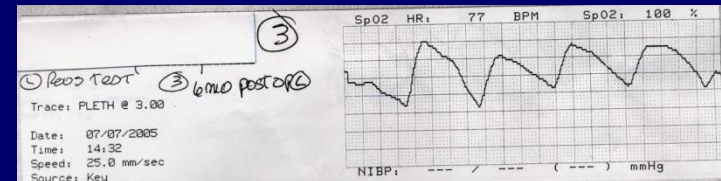
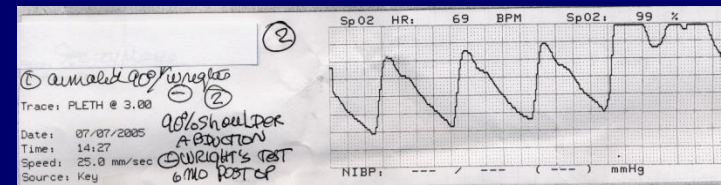
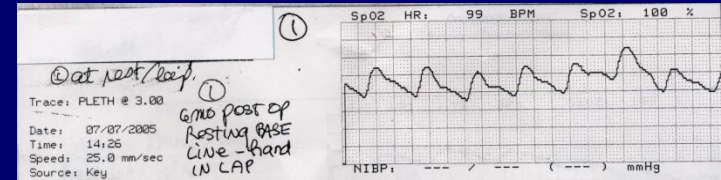


RESTING  
 BASE LINE  
 100 100

ARM  
 ABDUCTION  
 WRIGHT'S  
 TEST

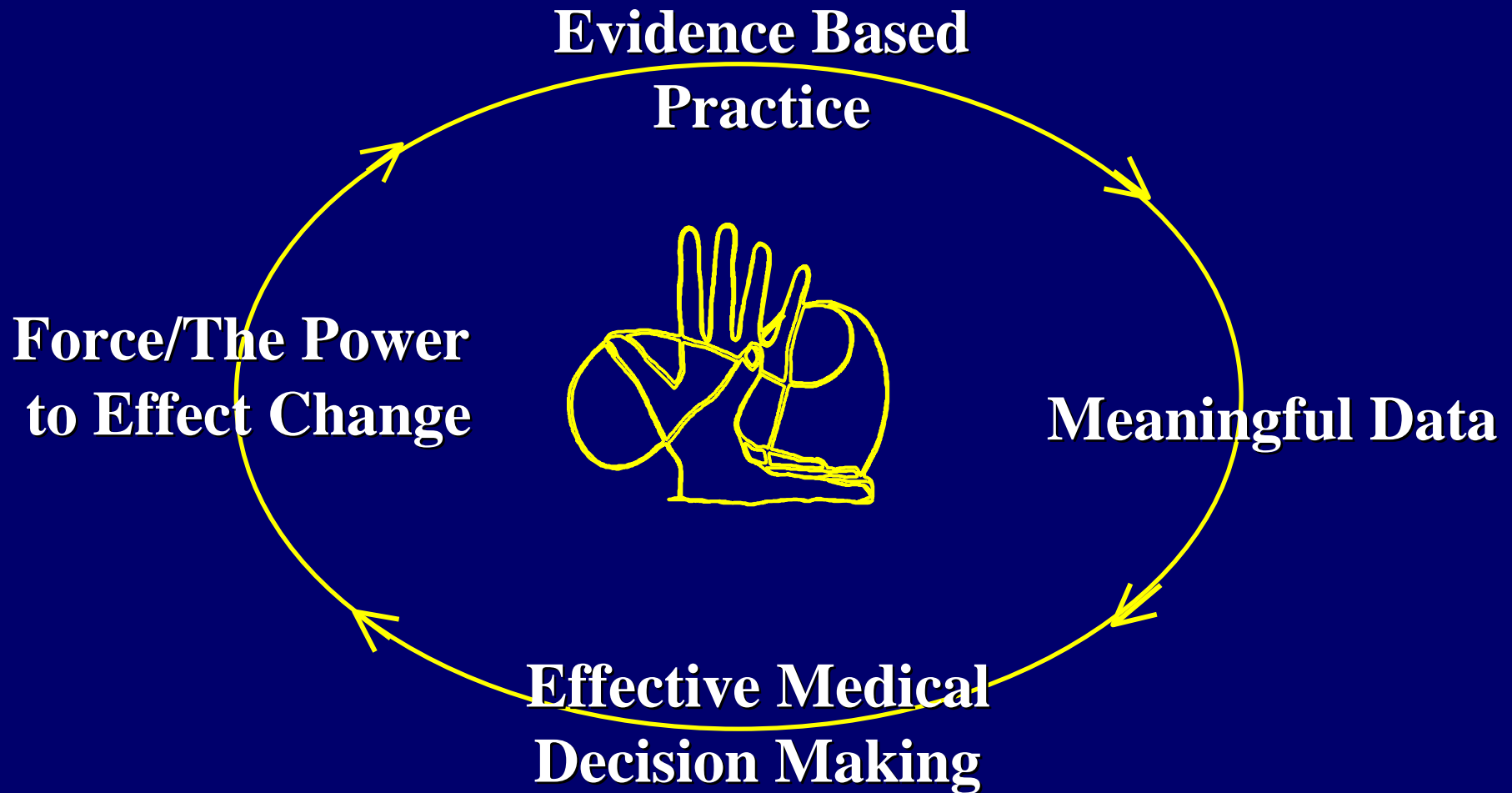
ROOS TEST  
 O<sub>2</sub> SAT  
 83 100

### POST-OP 6 MONTHS



# Work Place Injuries

## Cumulative Trauma Syndrome



# THORACIC OUTLET SYNDROME

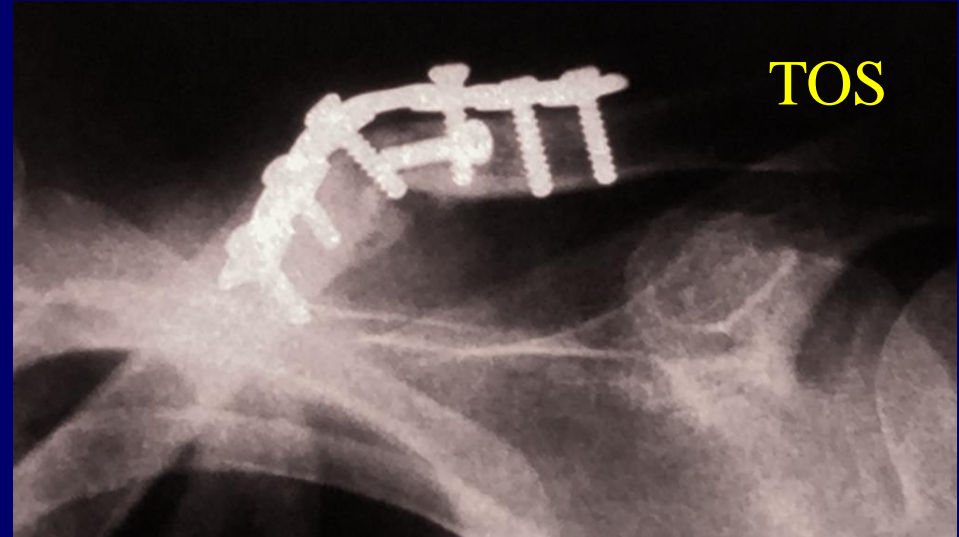
## UNDERSTANDING TOS

**WILL ROGERS ON  
LEARNING...**

**ROGERS #1** Some folks  
learn from reading a book.

**ROGERS #2** Some folks  
learn from watching others  
do it.

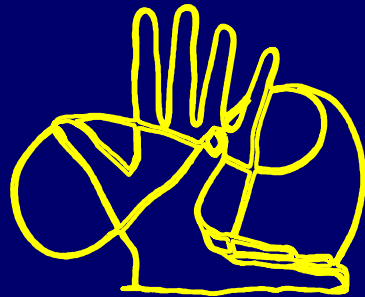
**ROGERS #3...**



Will Rogers:

“Never miss the  
opportunity to shut up!”

Thank you!



Dick Braun

