THORACIC OUTLET SYNDROME

and

The Pectoral Bowing Ratio

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ETIOLOGY OF TOS

Myofascial v. Ribs/Bands

Between Anterior and Middle Scalenes
Under Pectoralis Minor (against Rib 1,2)
Costoclavicular (between Clavicle and 1st Rib)
Fibrous Bands-off rudimentary Rib/Transverse Process- Roots/Plexus “tethered”

Trauma- Episodic

Insidious- CTD, Postural
 PAT H O LO GY / T YP ES O F T O S  

NEUROGENIC  
- True  
- Disputed  
- Nonspecific  

VASCULAR  
- Venous  
- Arterial  
- Mixed  

COMBINED
TOS Case #1

48 y/o female with right UE pain, numbness, tingling, and weakness, for the past 2 months. Most paresthesias involve the entire hand, especially medial, and medial forearm, worse at night and with driving or keyboard activity, especially with arms overhead. Treatment with wrist and elbow braces did not provide much relief. Carpal tunnel surgery 3 years ago provided relief at that time.

PE: normal, except for Phalen test and Tinel over the carpal and cubital tunnels. Posture revealed anterior head/shoulder position, and thoracic outlet stress was positive with abduction and focal pectoral stress.

EDX:
Median DML         3.4ms / 13mV     [ Ulnar 2.6 / 17mV; no slowing across elbow ]
Median DSL D-1  2.8ms / 32mcv   [ Radial 2.5 / 15mcv ]
Median DSL D-2  3.4ms / 38mcv  [Ulnar 3.1ms / 39mcv]
Median F-wave 26.0ms
Ulnar F-wave 26.2ms
TOS

Medial cord plexus irritation
During arm abduction

- Pectoralis minor
- Axillary artery
- Axillary vein
- Pec major
TOS

Medial cord plexus irritation
During arm abduction

Axillary vein
Abduction Stress Test

Neutral:
- Arm adducted at side
- No symptoms
- Linear orientation of pec minor

Abduction stress:
- Progressive, up to 125 degrees
- Symptoms exacerbated
- Note indentation of pec minor by Neurovasc bundle from below (dorsal)
**DIAGNOSTIC ULTRASOUND OF TOS – Abduction Stress Test**

Neutral – arm adducted at side
No symptoms
Note linear orientation of pec minor

Abduction stress – 140 degrees
Symptoms exacerbated
Note indentation of pec minor by neurovasc bundle from below (dorsal)
Description of motion study

The thinner hypoechoic (dark) wedge shaped structure in the middle of Image that is horizontally directed is the pectoralis minor (the larger muscle above it is the pec major). At the start of the motion sequence, when the arm is adducted, it is relaxed and straight, but as the arm abducts (slowly moving to 140 degrees), notice the pect develop an angulation (‘bows’ upward, ventrally), as the structures below (deep, dorsally) along the posterior edge of the muscle ‘push’ up ventrally against and into the muscle.

The posterior structures are the neurovascular bundle. There are 2 round hypoechoic (dark) vessels, the smaller one on the left is the axillary artery and the larger to the right is the axillary vein. 3 smaller hypoechoic structures (outlined with hyperechoic rims) surround the artery: the one on the left (superior) is the lateral cord of the plexus; the one below (posterior) is the posterior cord and the one to the right (inferior) is the medial cord. Notice how the artery and medial cord push up against and into the posterior edge of the pectoralis minor during abduction, as symptoms develop and increase.
Neutral:
Arm adducted at side
No symptoms
Linear orientation of pec minor

Abduction stress:
Progressive, up to 135 degrees
Symptoms exacerbated
Note indentation of pec minor by Neurovasc bundle from below (dorsal)
[lateral cord + medial cord]
DIAGNOSTIC ULTRASOUND OF TOS – Abduction Stress Test - Pectoral Bowing Ratio

Neutral:
Arm adducted at side
No symptoms
Linear orientation of pec minor

Abduction stress:
Progressive, 135-150 degrees
Symptoms exacerbated
Note indentation of pec minor by Neurovasc bundle from below (dorsal)
[lateral cord + medial cord]

PBR = .08 L; .11 R

.22/2.74 = .08
.33/2.95 = .11
**Pectoral Bowing Ratio - Normal**

Normal Subject

**Anterior**

- \( A - B = 28\text{mm} \)
- \( C - D = 1\text{mm} \)
- \( C - D / A - B = 0.036 = 3.6\% \text{ Pectoral Bowing Ratio} \)

**Posterior**

- \( A - B = 28\text{mm} \)
- \( C - D = 1\text{mm} \)
- \( C - D / A - B = 0.036 = 3.6\% \text{ Pectoral Bowing Ratio} \)
Pectoral Bowing Ratio - TOS

A-B = 21mm
C-D = 5.5mm
C-D/A-B = .262 = 26.2% Pectoral Bowing Ratio
**Abduction Stress Test**

**Neutral:**
- Arm adducted at side
- No symptoms
- Linear orientation of pec minor

**Abduction stress:**
- Progressive, up to 125 degrees
- Symptoms exacerbated
- Note indentation of pec minor by Neurovasc bundle from below (dorsal) [lateral cord]

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**Images:**
- Series of ultrasound images showing the progression of stress test, with arrows pointing to specific areas.

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**Notes:**
- Linear alignment before abduction.
- Indentation noted during abduction.
- Neurovascular bundle position change.

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**Diagnosis:**
- TOS (Thoracic Outlet Syndrome) evaluation using ultrasound imaging.

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**Technical Details:**
- Ultrasound settings: frequency, depth, gain.
- Imaging protocols: transverse, longitudinal views.

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**Conclusion:**
- Abnormal findings indicating potential TOS.
**Neutral:**
Arm adducted at side
No symptoms
Linear orientation of pec minor

**Abduction stress:**
Progressive, up to 150 degrees
Symptoms exacerbated
Note indentation of pec minor by Neurovasc bundle from below (dorsal) [lateral cord + medial cord]
Neutral – arm adducted at side
No symptoms
Note linear orientation of pec minor

Abduction stress – 140 degrees
No symptoms
Note persistent linear orientation of pec (no indentation)
REFERENCES

References (cont)