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Vascular Diseases in Young Adults and Athletes

Richard L. Hallett, MD

RC412D 29 Nov 2011 *1630 – 1800*

Vascular Diseases in Athletes

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RC412D *29 Nov 2011* *1630 – 1800*

Disclosures: None

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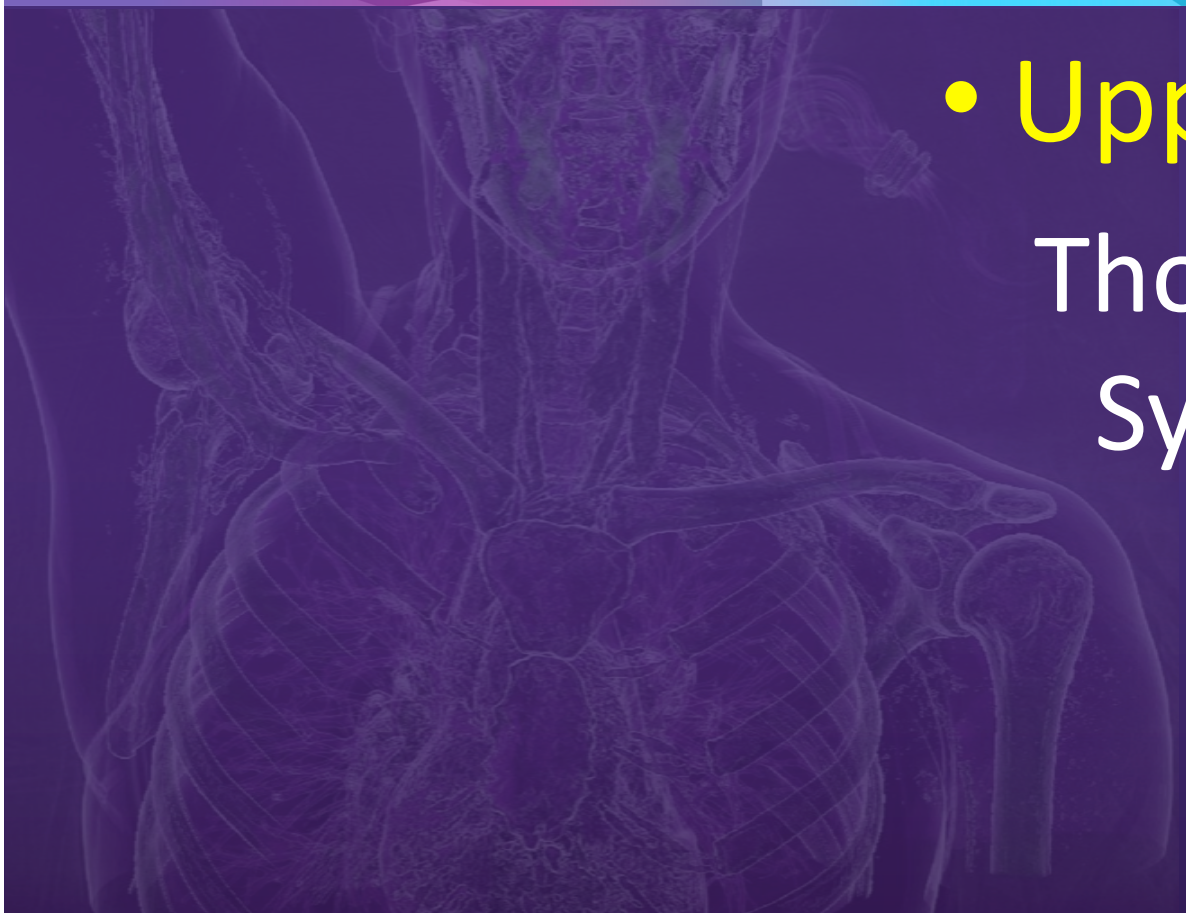
Background…….

- In athletes, MSK injuries are most common
- Uncommon vascular disorders may present with similar signs and symptoms
- Vascular Diagnoses are easily overlooked
  - Young, healthy pts
  - May have plausible MSK diagnosis
  - Vascular history & physical exam needed
- Especially consider if: parasthesias, limb swelling, early fatigue, skin changes, evidence of emboli

Vascular Diseases in Athletes

- Upper Extremity
  - Thoracic Outlet Syndrome (TOS)
- Pelvis
  - External Iliac Endofibrosis (EIE)
- Lower Extremity
  - Popliteal Entrapment Syndrome (PAES)

Vascular Diseases in Athletes



- Upper Extremity
  - Thoracic Outlet Syndrome (TOS)

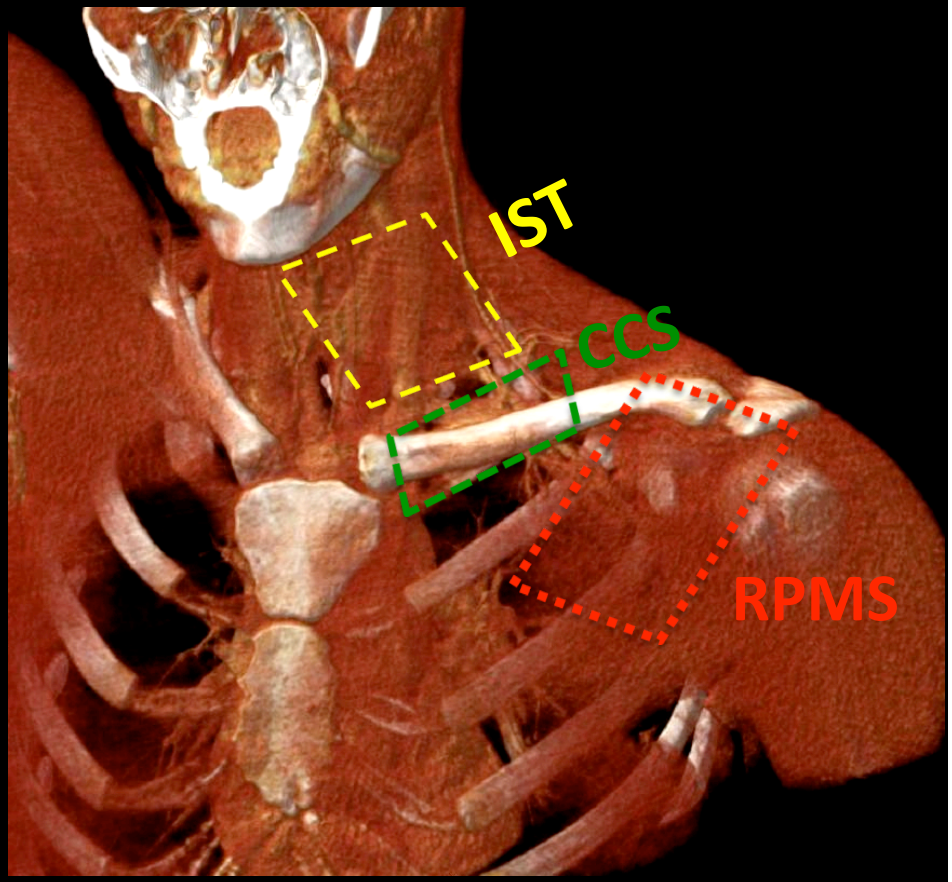
Thoracic Outlet Syndrome (TOS)

- Symptomatic extrinsic compression/ entrapment of the **neurovascular** structures of the upper extremity by bone and/or soft tissue as they pass through the cervicoaxillary canal

aka “Cervico-axillary Compression Syndrome”

Components of Cervico-Axillary Canal

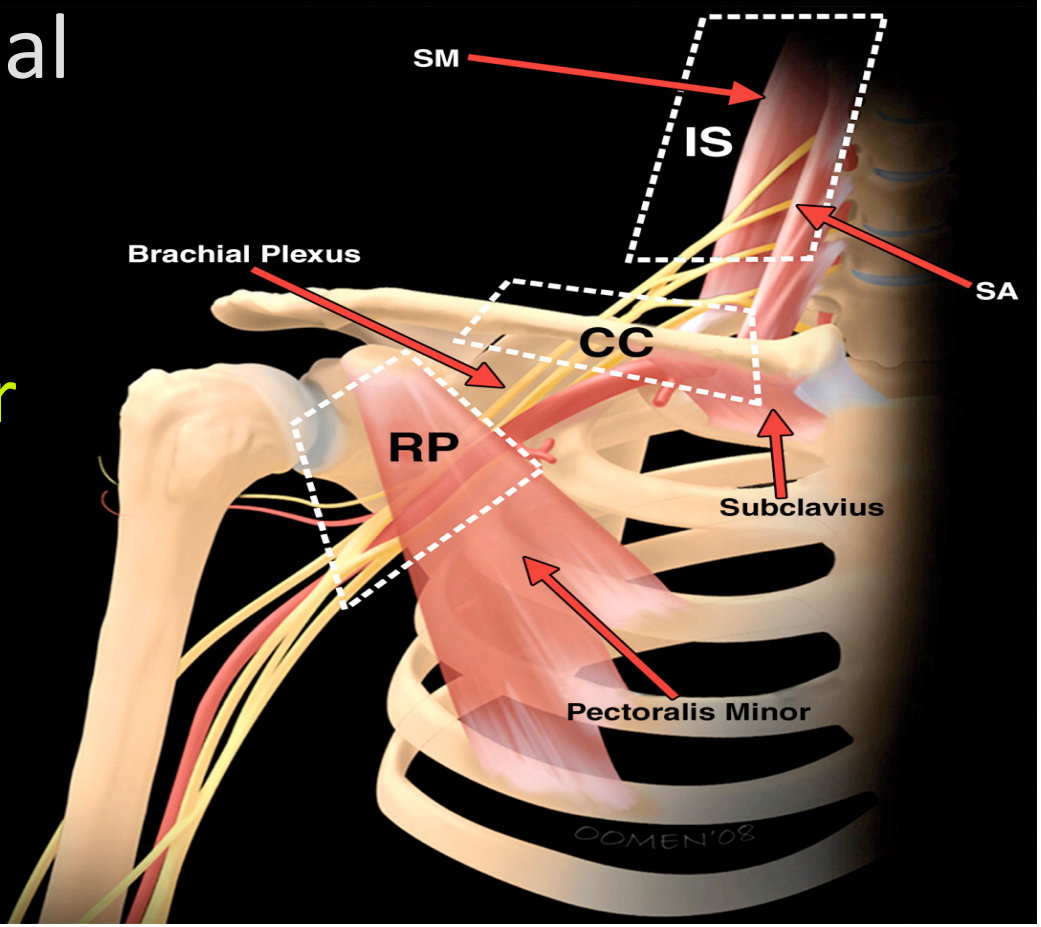
- Interscalene Triangle: #1 site of compression
- Costoclavicular Space: #1 site vascular TOS
- Retro-pectoralis minor space: #1 site for masses



Linda D D et al. Radiographics 2010;30:1373-1400

Components of Cervico-Axillary Canal

- IST: #1 site of compression
- CCS: #1 site vascular TOS
- RPS: #1 site for masses



Linda D D et al. Radiographics 2010;30:1373-1400

RadioGraphics

3 Types of TOS

- Neurogenic: 90%, F>M
  - May be post-traumatic, compression, post-XRT
  - Parasthesias, pain → worse with ABduction
  - motor weakness in 10%
  - Usually responds to PT, NSAIDs, massage, postural change, etc
  - MRI → brachial plexus distortion, muscle atrophy, etc.
- Vascular: 10%, M>F
  - Arterial
  - Venous

Demondion X, et al. Radiographics 2006 vol. 26 (6) pp. 1735-50

Arterial TOS

- Less common than venous TOS
- Overhead athletes: Baseball, swimming, volleyball, weight-lifting
- Cause: Repetitive compression injury
  - Anatomic predisposition (tight CCS)
  - Post-traumatic, bony callus
  - Scalene hypertrophy
- Sx:
  - cool, weak, easy fatigability arm & hand, diffuse arm pain (ischemic neuritis of brachial plexus)
  - Thrombosis / Distal emboli / pseudoaneurysm

Venous TOS: "Effort Thrombosis"

- Paget-Schroetter syndrome (PSS)
- "axillo-subclavian venous thrombosis"
- Overhead athletes
- SX:
  - Edema, venous congestion, arm heaviness, cyanosis of hand and arm
  - PE in up to 1/3!! *
  - Post-thrombotic syndrome (later)

* Perlowski AA. Vasc Med (2010) vol. 15 (6) pp. 469-79

Vascular TOS: Workup

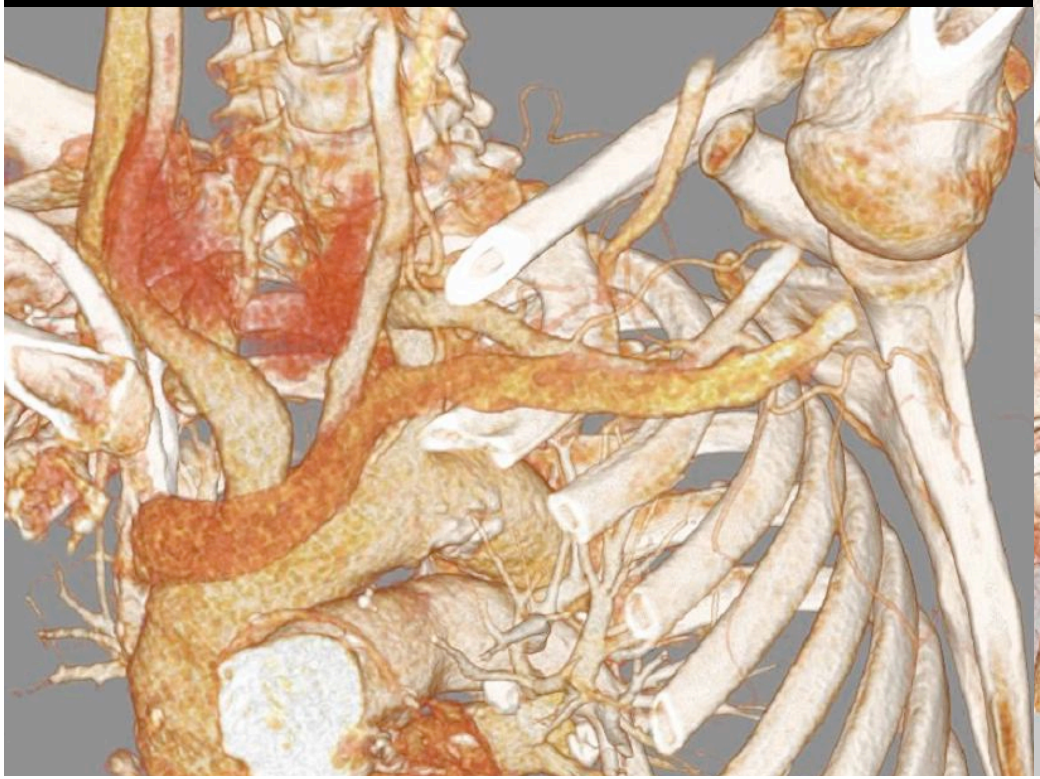
- Clinical Tests (Adson, Roos, etc)
- Plain films
- Ultrasound
- CTA / MRA
- Catheter angiography

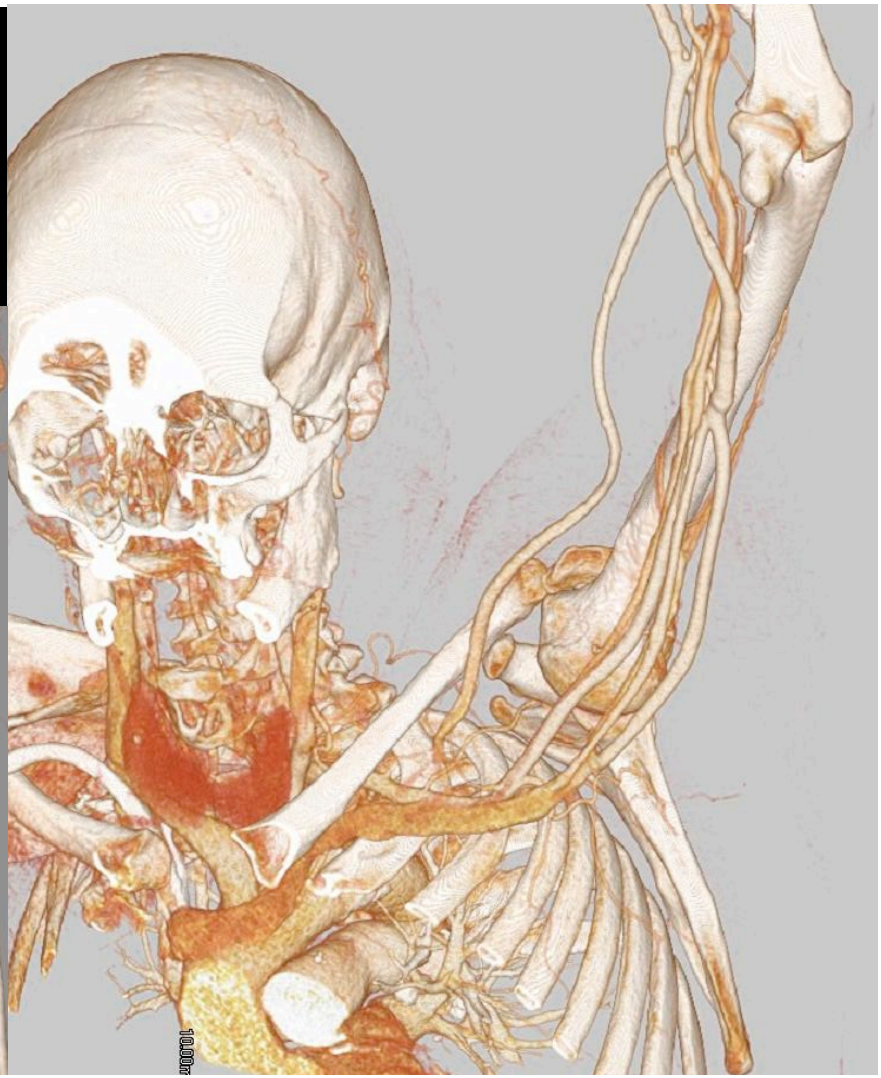
DYNAMIC EVALUATION IS IMPORTANT !!

CTA for TOS: Combo Direct / Indirect CTA

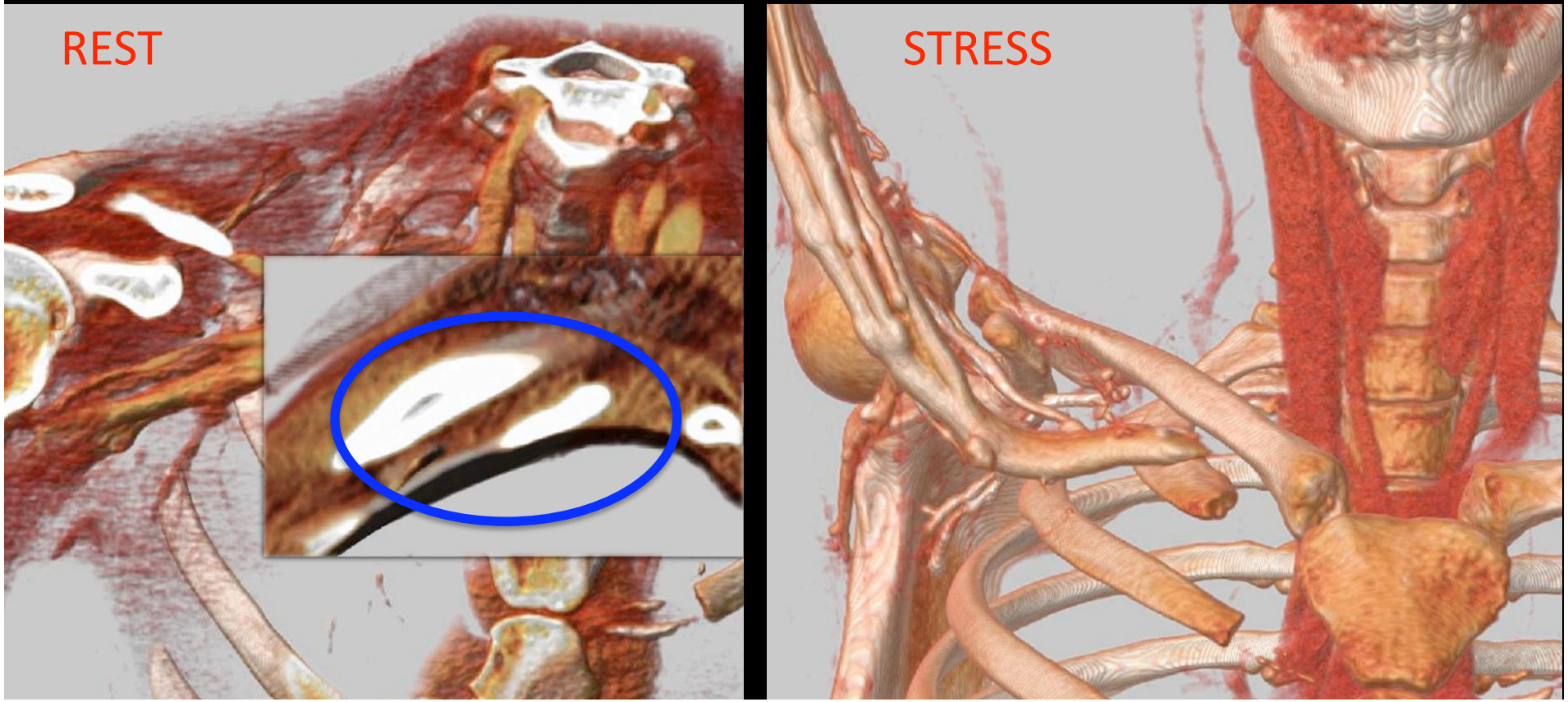
- Ipsilateral IV, arm over head w/ palm taped up
- Bolus: 120 mL full-strength @ 4ml/s
- Chase: 100 mL dilute (10%) contrast @2.5 ml/s
- 65 sec empiric delay, scan caudo-cranial
- Arm down, immediate re-scan cranio-caudal
- **Volumetric Review**

Combo Direct / Indirect CTA

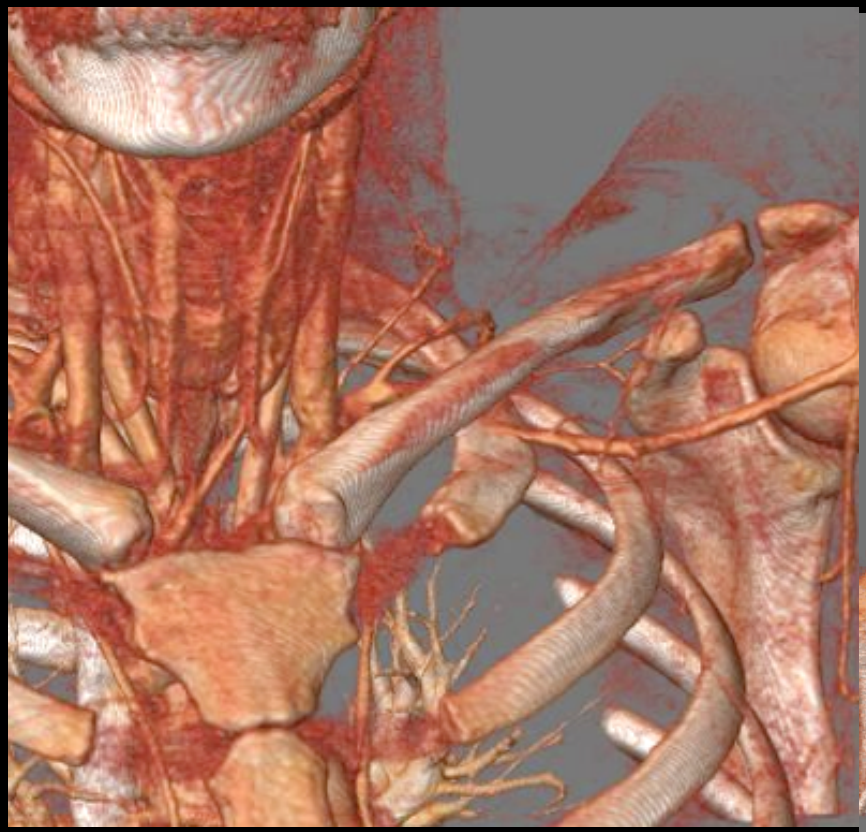


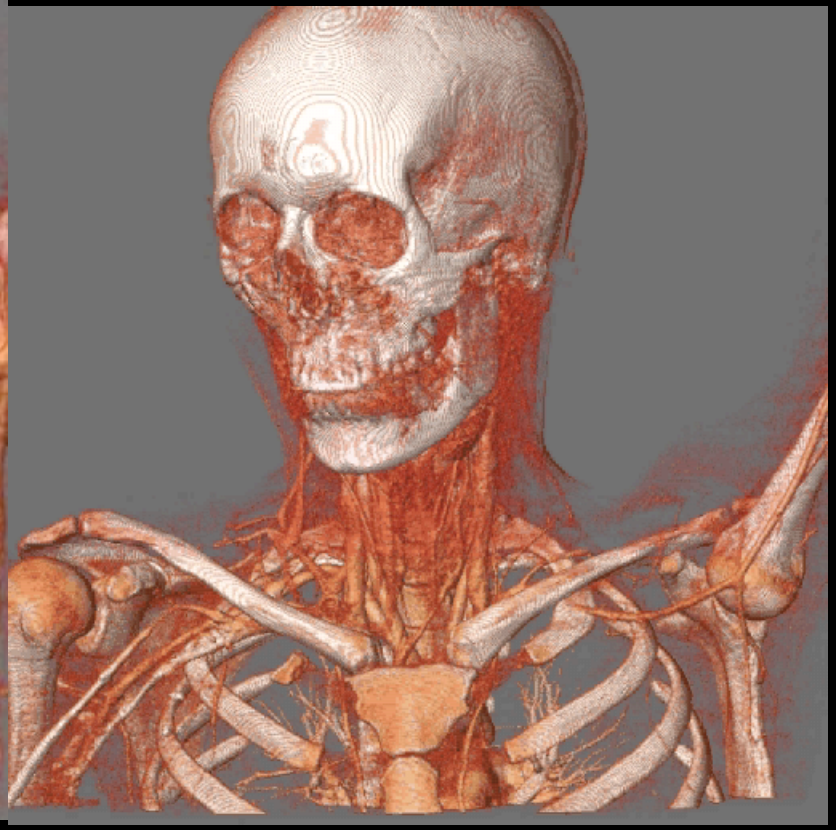


Arterial and Venous TOS: 16 YO Volleyball Athlete



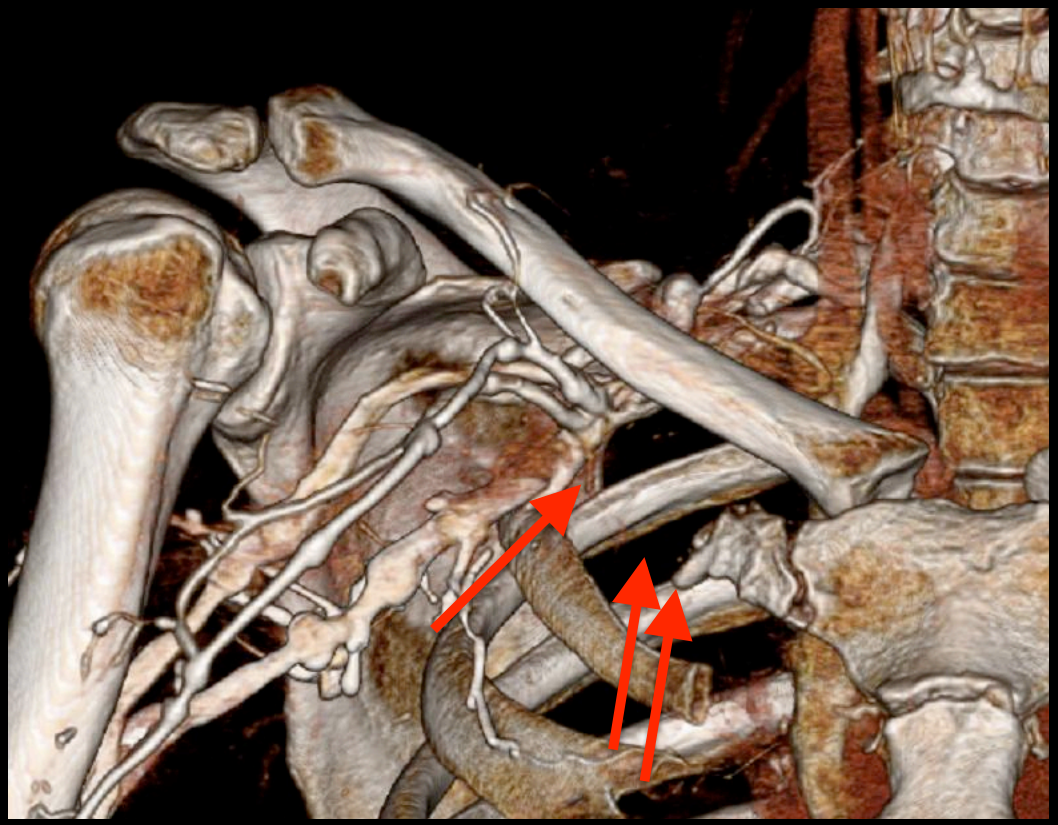
Arterial Compression





Effort Thrombosis: 36 YO weightlifter

Post-Op 1st rib resection



Vascular Diseases in Athletes

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Flow limitations in the Athlete's Pelvis

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Flow limitations in the pelvis in athletes

- Dynamic:
  - Elongated / tortuous vessels
  - Kinking with or w/o stenosis (elongation/ tethering)
  - compression (psoas hypertrophy, ligaments)
- Static: Iliac endofibrosis

Lim CS, et al., Eur J Vasc Endovasc Surg 2009:38:180-6.

Iliac Endofibrosis

- Rare, M>F, average age : 25 years
- 90% of pts are cyclists (15 % professional, 48% top amateur)
  requires 8000-35000 km/yr or 150,000 km lifetime
- Also: speed skaters, runners, wt lifters, XC skiers, and rugby players
- 90% external iliac artery (EIE)
- Pathology: intimal fibroplasia, medial hypertrophy, and adventitial hyperplasia.
  Involved segments universally free from atherosclerosis.

Lim CS, et al. Eur J Vasc Endovasc Surg 2009:38:180-6.

Clinical evaluation of EIE

- SX: performance decline, weakness, lack of power
  - bilateral in up to 15%
- Exertional ABI: flat or drop (false negatives)

Imaging of Endofibrosis

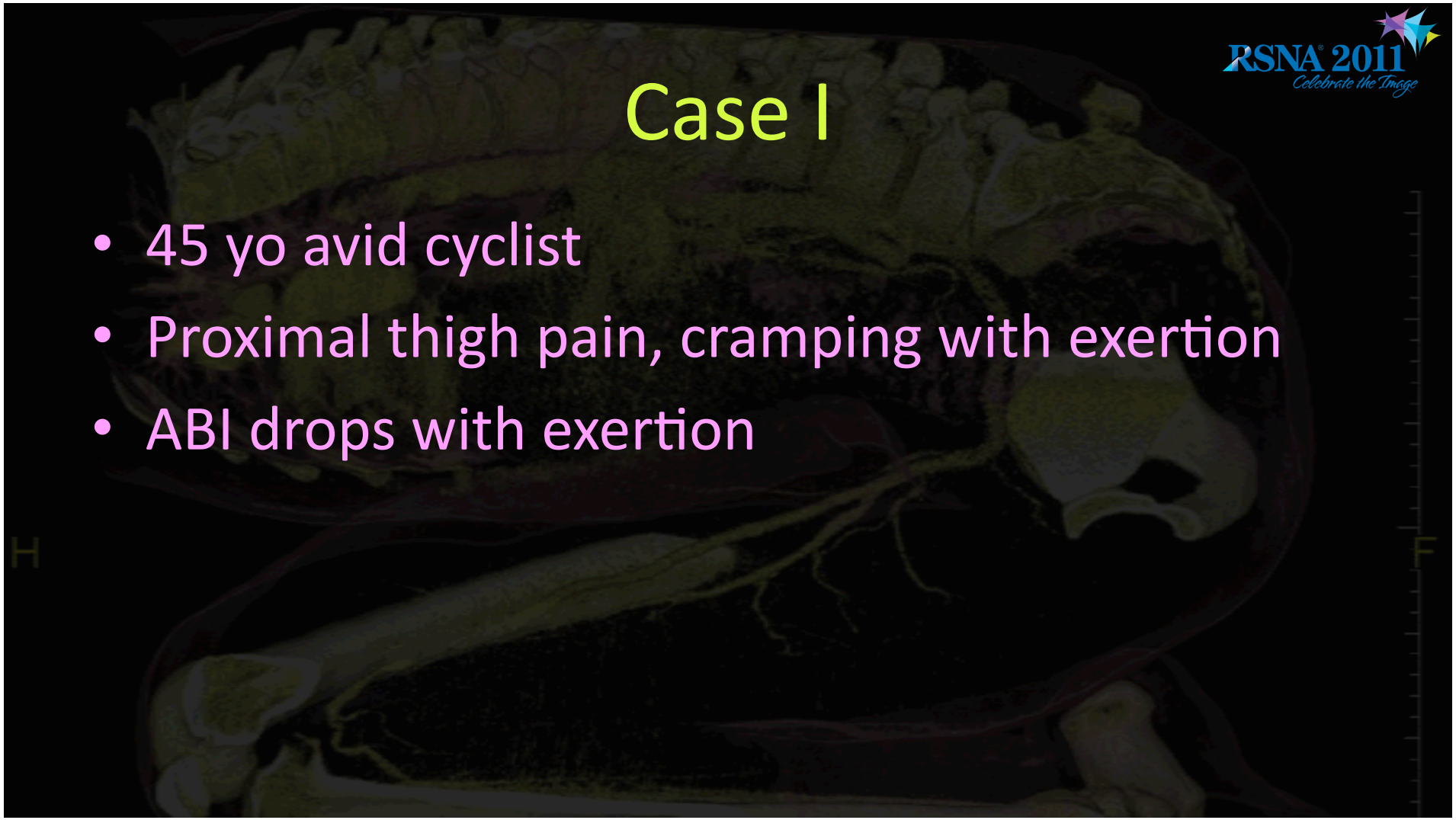
- Smooth, eccentric, non-calcified
- Imaging Options:
  - CTA
  - MRA
  - US
  - DSA (with IVUS)
- Provocative maneuvers useful

CTA: Imaging technique

- Try simulate cycling position as close as possible considering space within CT gantry (almost 90 deg)

CTA: Imaging technique

- Two phases: relaxation and hip flexion
- Coverage ~ 40 cm
- Relaxation – 100 kVp, flexion – 120 kVp
- ~ 80 mL of IV contrast at 4 -5 mL/s for each phase (20 sec injection).
- Saline flush at same rate
- Scan time 10 - 12 sec
- Volumetric Review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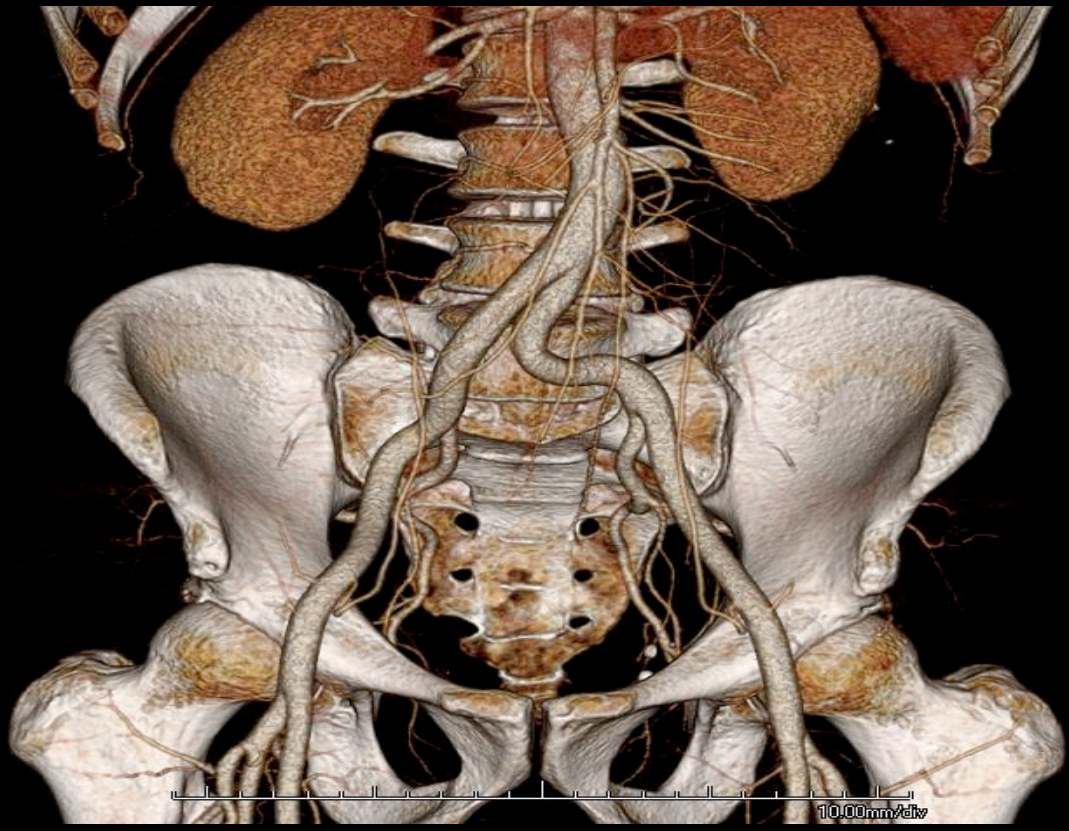
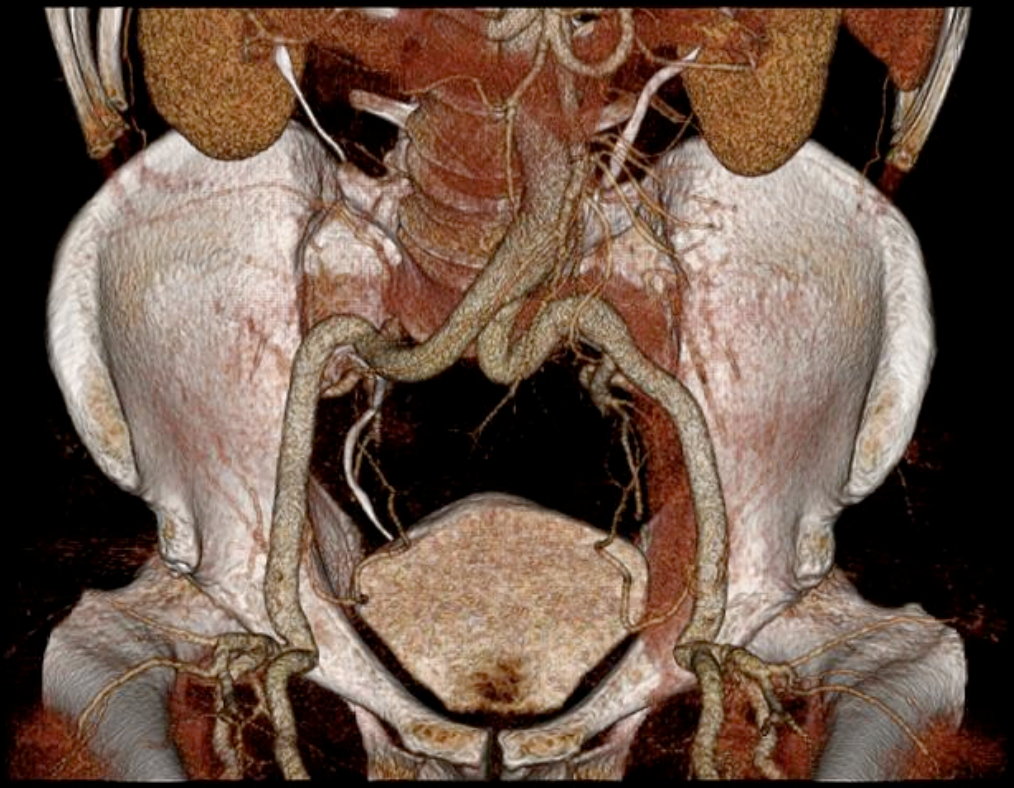
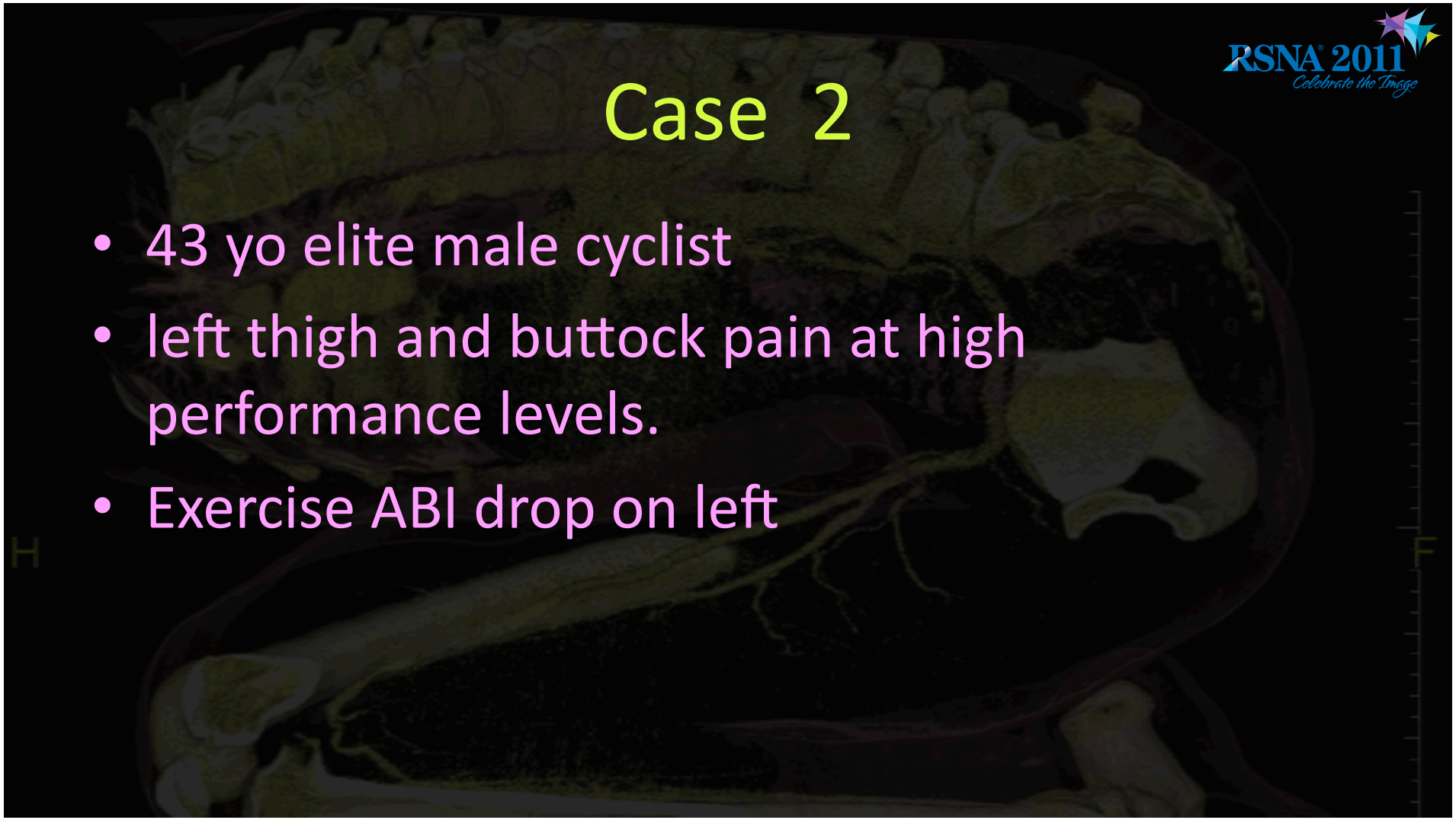
Celebrate the Image
Case I
• 45 yo avid cyclist
• Proximal thigh pain, cramping with exertion
• ABI drops with exertion
H
F

Supine, legs extended



Dynamic Flow Restriction

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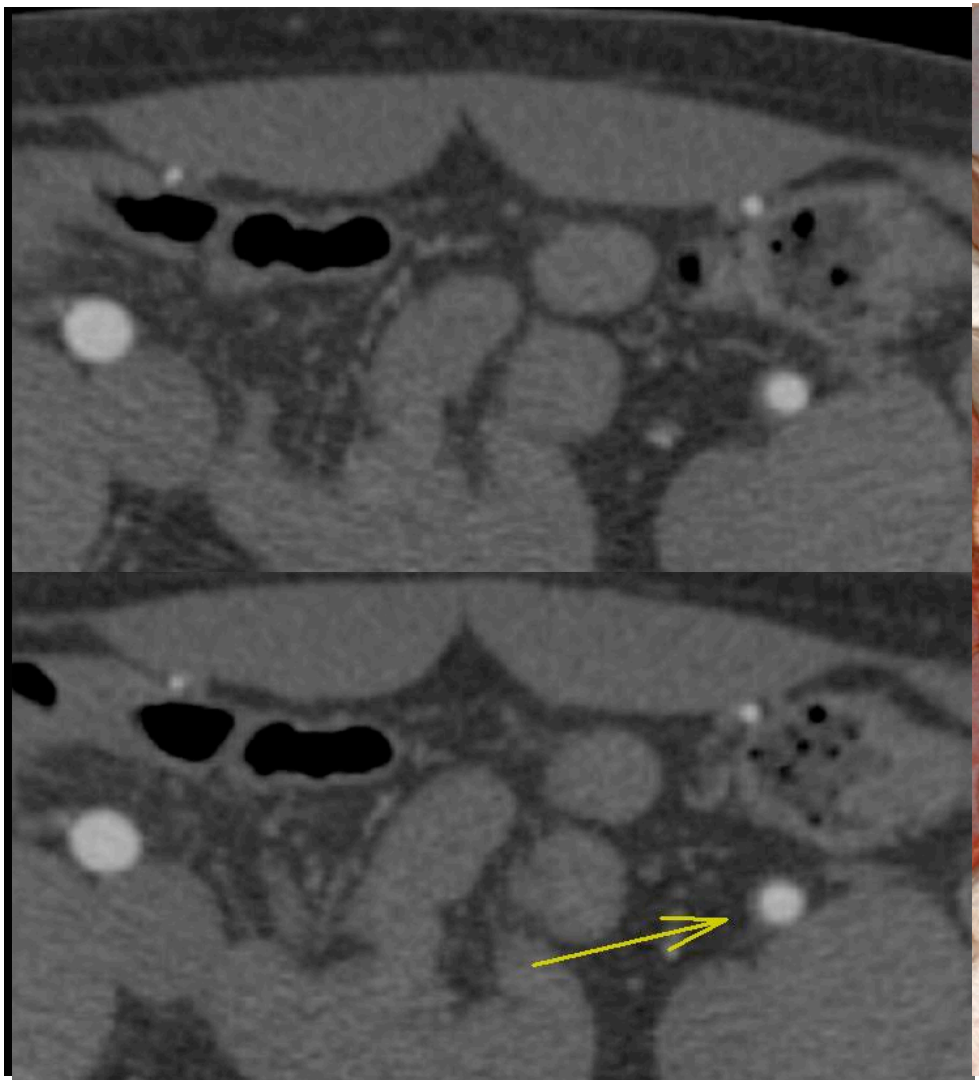
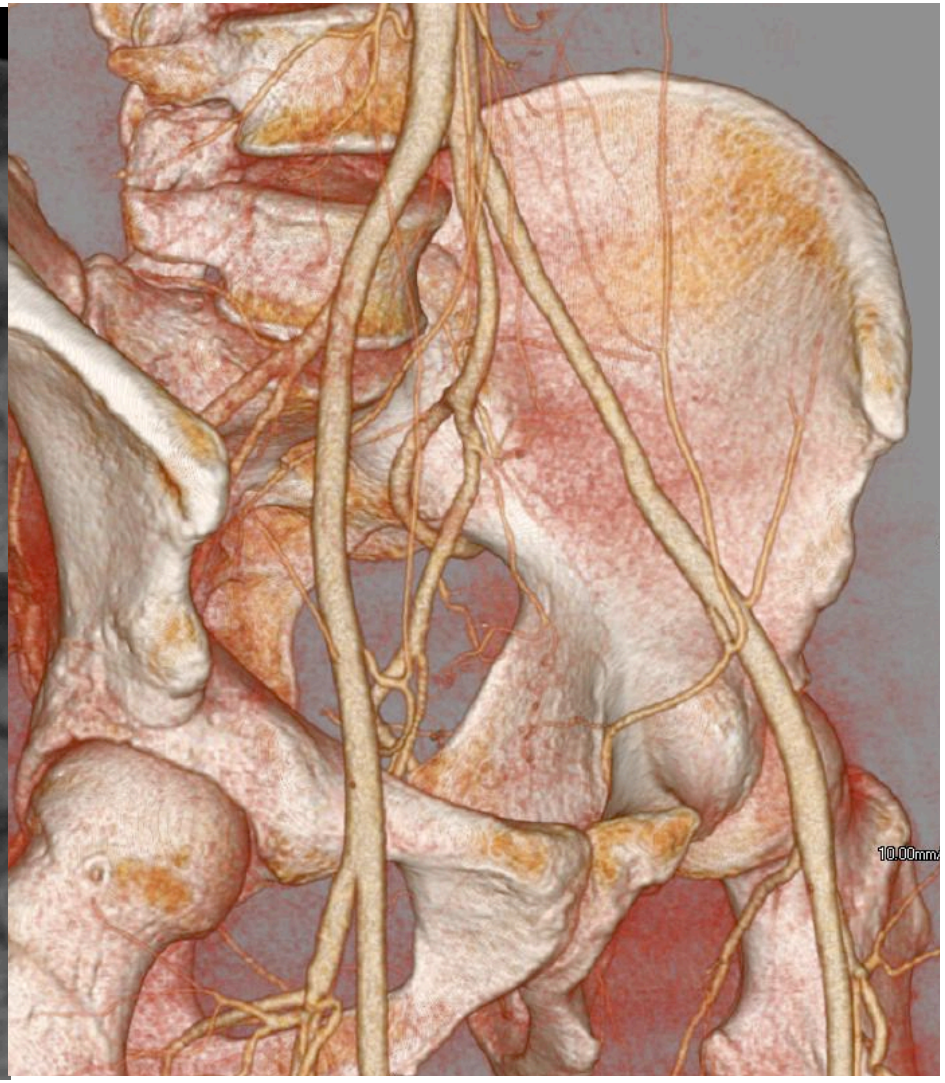
Celebrate the Image
Case 2
• 43 yo elite male cyclist
• left thigh and buttock pain at high performance levels.
• Exercise ABI drop on left
H
F



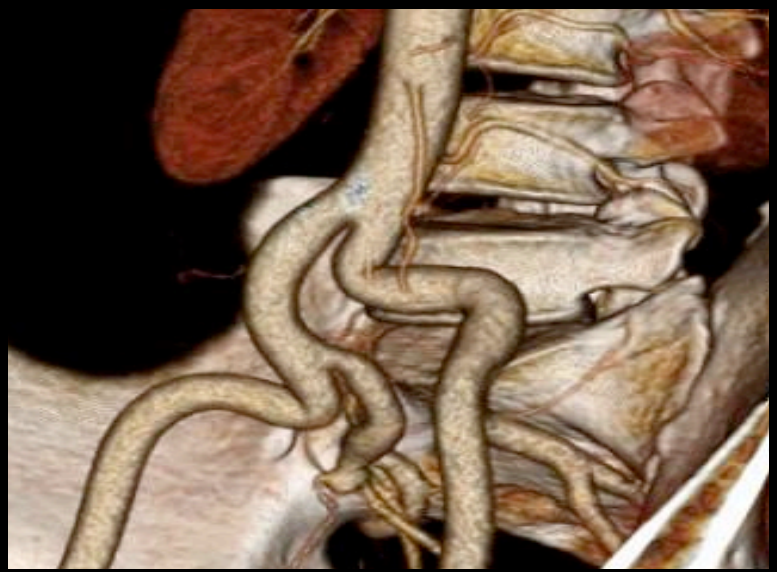

10.00mm

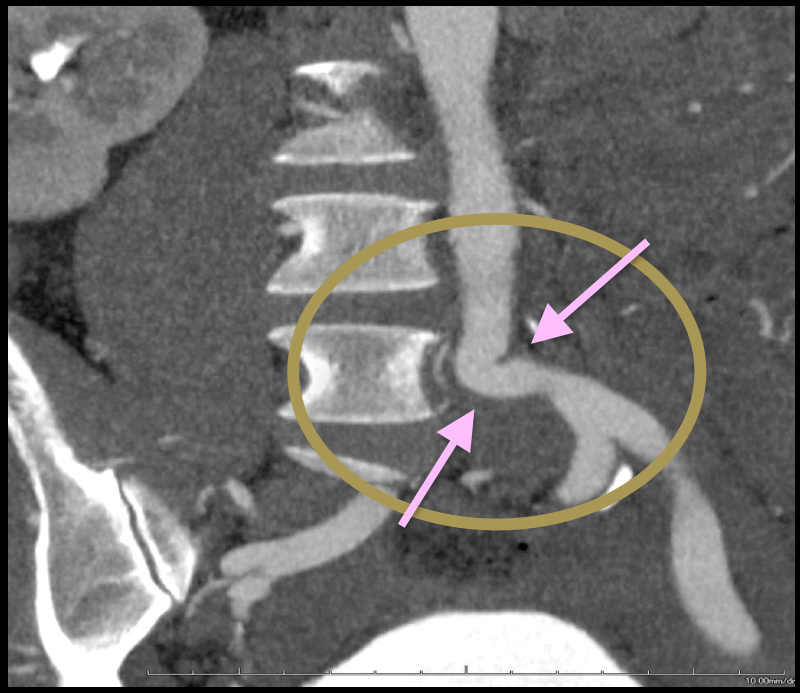
Case 3

- 49 yo avid cyclist since 1980's
- left thigh and buttock pain at high performance levels.
- Pain described as a "deep burn"
  - more frequent on flat surfaces as opposed to pedaling on an incline.

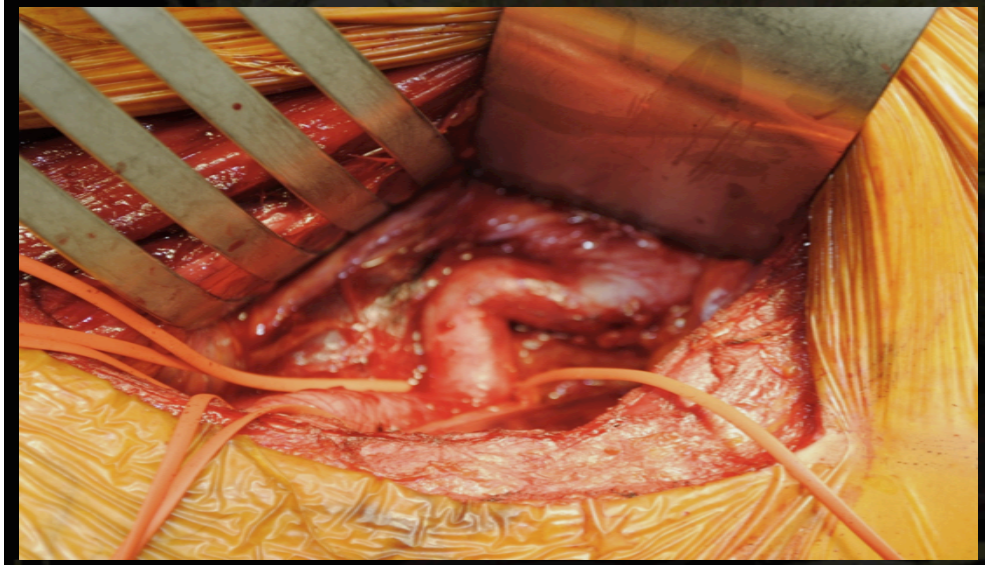
- ABI R/L: 1.3/1.2
- Exercise ABI R/L: 1.5/1.2

CTA at Rest



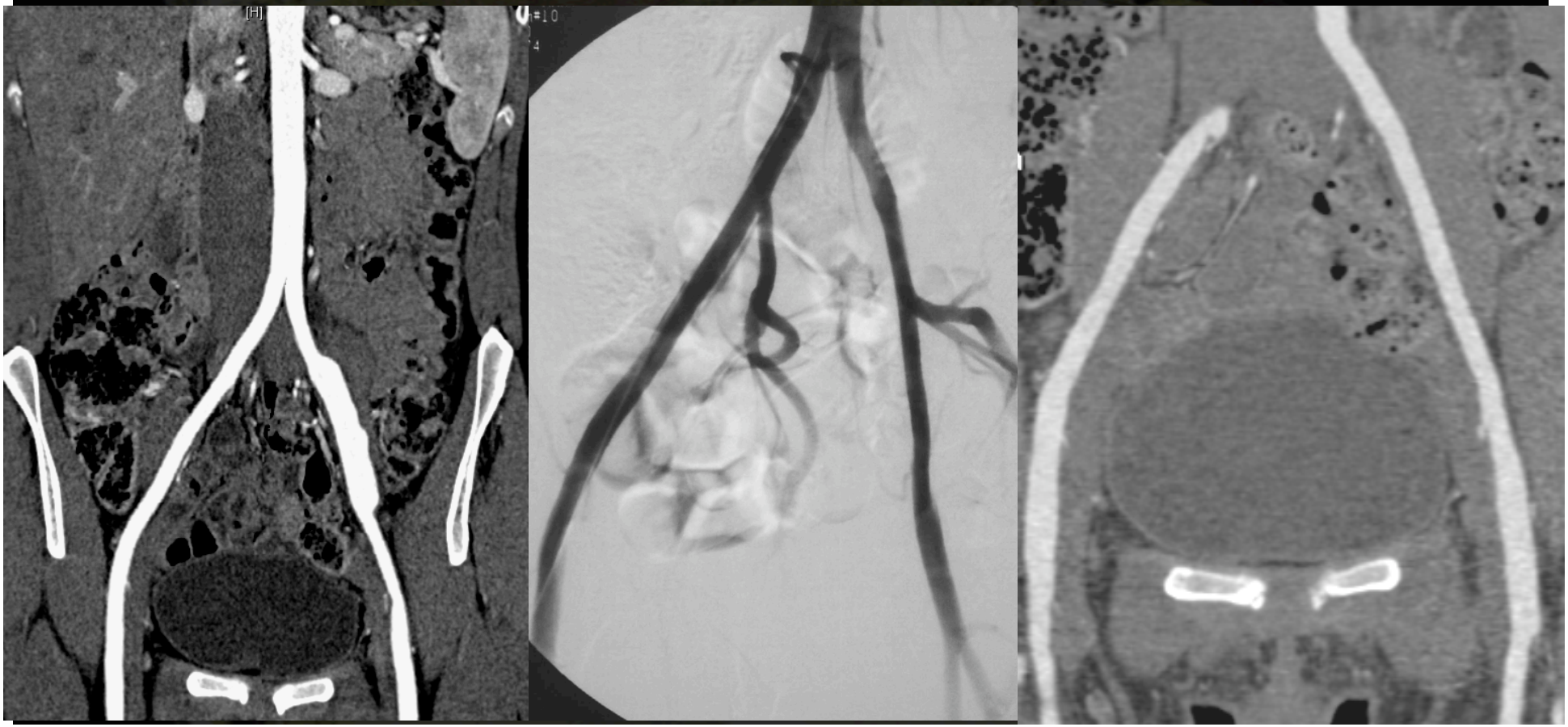


Operative Findings



- Pathology: intimal thickening and fibrosis
- No inflammatory change

30 FEMALE ELITE CYCLIST



Vascular Diseases in Athletes

- Lower Extremity
  - Popliteal Entrapment Syndrome (PAES)

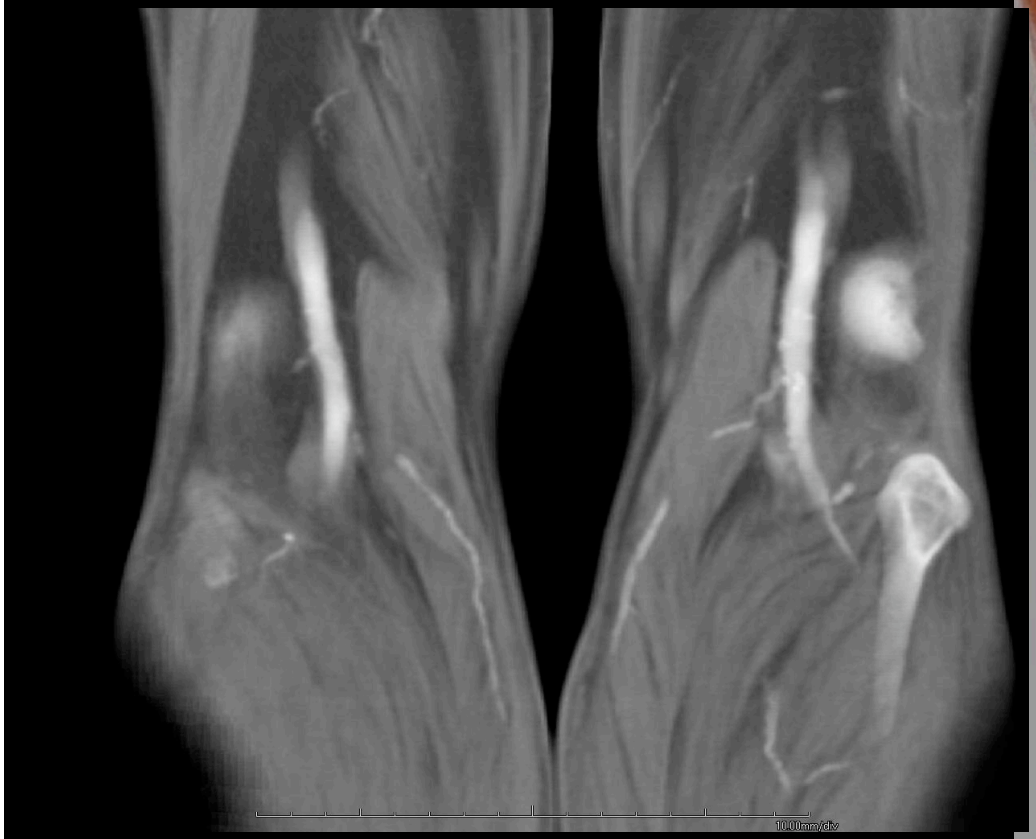
PAES – Background

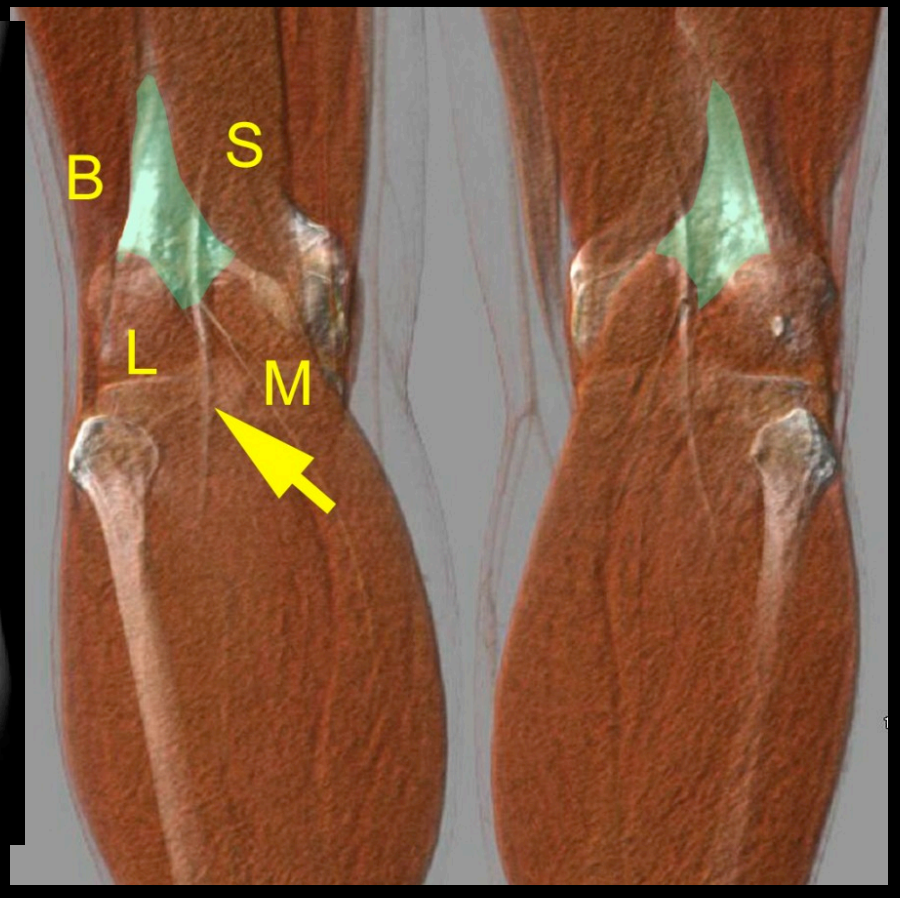
- Anatomic incidence up to 3.5%
- Clinical Sx in ~ 0.17% young, active adults
  - Claudication in 90%
  - Walking rather than running
- Acute / Chronic Limb Ischemia in 10%
  - Emboli, parasthesias, rest pain, tissue loss

Popliteal Space - Embryology

- In utero, medial head of gastrocnemius (MHG) migrates from lateral to medial across popliteal fossa
- The 3 segments of popliteal artery are fusing at same time
- If delayed or abnormal migration → **MHG too far lateral**
  - Pop fossa space is limited, compression can result

Popliteal Fossa Anatomy

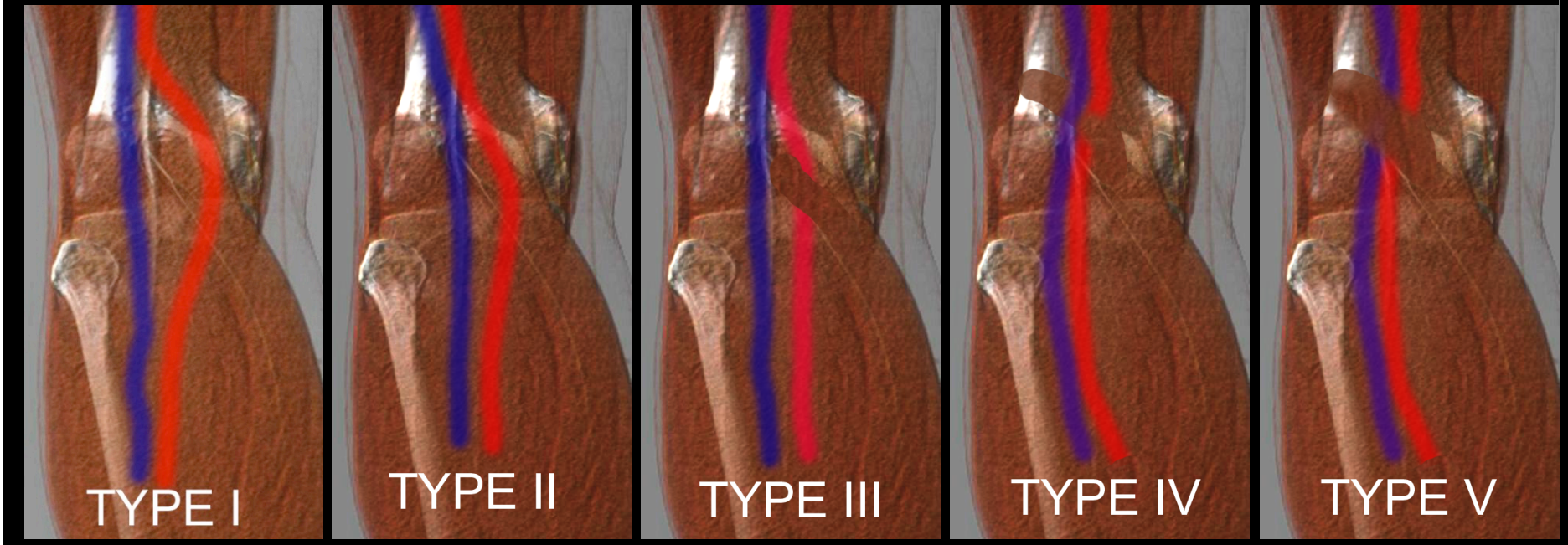




Causes of Popliteal Entrapment

- Anatomic Compression
  - Abnormal PA
  - Abnormal Muscle
  - Both
- "Functional" compression: Typical Sx in absence of anomalous musculotendinous structures

Classification of PAES



TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V
PA travels aberrantly, medial to normally positioned MHG	Anomalous lateral and inferior origin of MHG, PA displaced medially	Normal PA compressed by muscular slip or aberrant band from MHG	PA deep in popliteal fossa, entrapment from aberrant band or popliteus muscle	Any type of entrapment **involving popliteal vein**

* Whelan TJ. In: Haimovici H, Ed. Vascular surgery: principles and techniques. New York: McGraw-Hill, 1984: 557-67

Functional Popliteal Entrapment (Type VI)

- Tends to occur in younger population
  - almost exclusively in highly conditioned athletes
- Compression by hypertrophic gastrocnemius +/- soleal sling
- Longer segment involvement (vs. anatomic PAES)
- Treatment:
  - Try conservative management first
  - Surgical release, debulking of muscle if needed

Testing for PAES

- Positional Stress Test (PST)
- Doppler US
- Cath Angio
- MRI
  - time-resolved imaging[1]
  - blood pool contrast agent[2]
- CTA

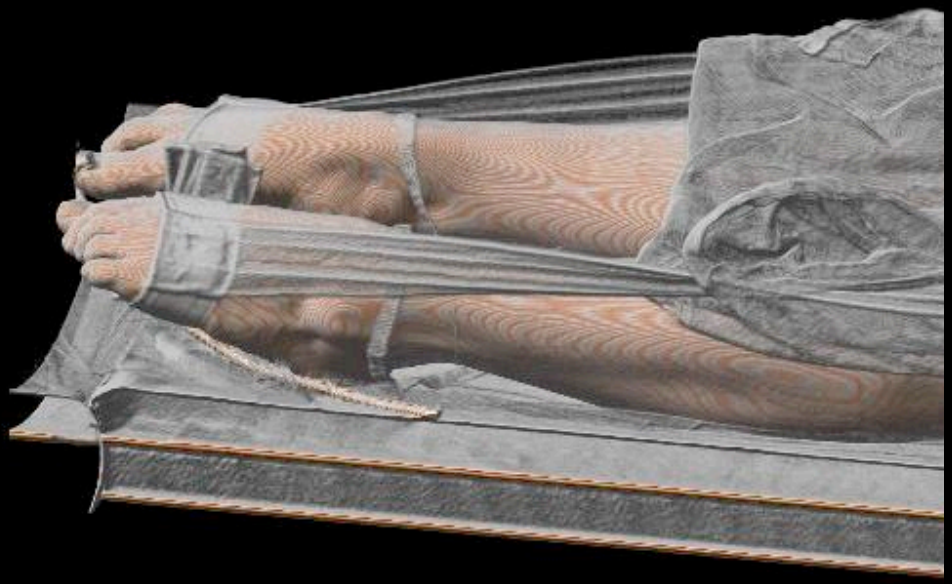
FUNCTIONAL EVALUATION NECESSARY!!

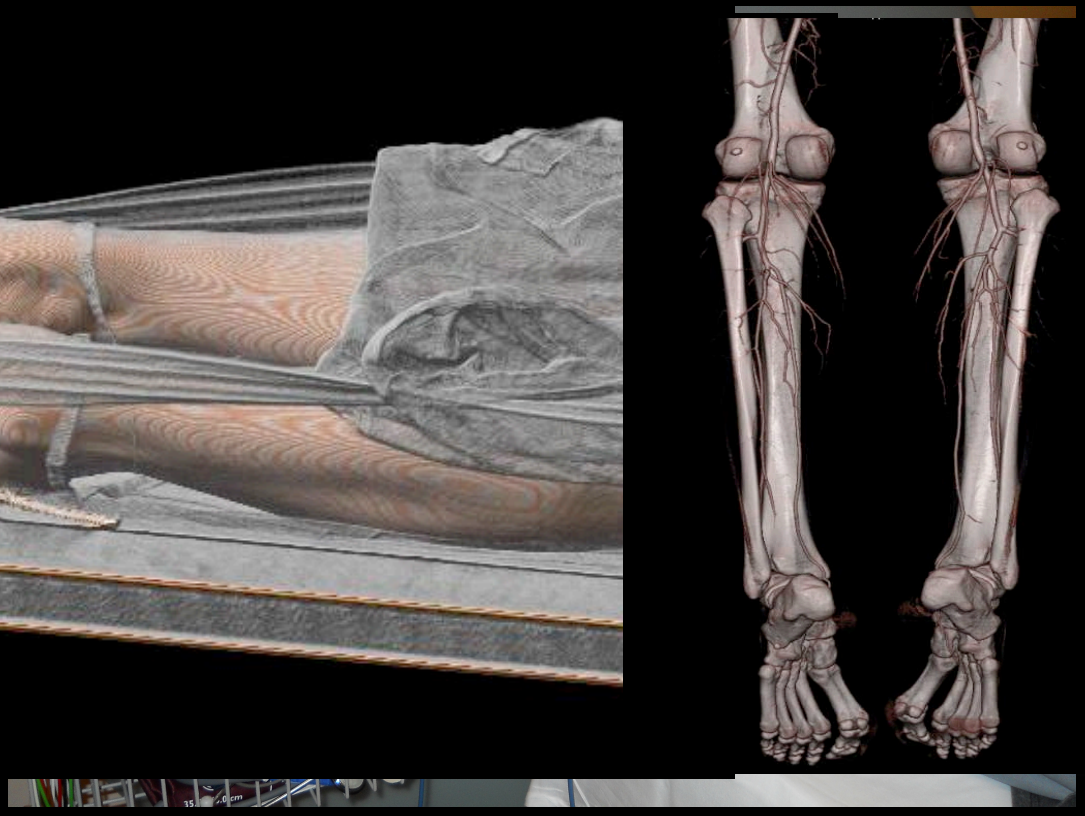
[1] Blackham, KA et al. Amer J Roentgen 2011. 196 (5) W613-20
[2] Beitzke, D et al. Cardiovasc Intervent Radiol 2011. 34 (Suppl 2) S12-6

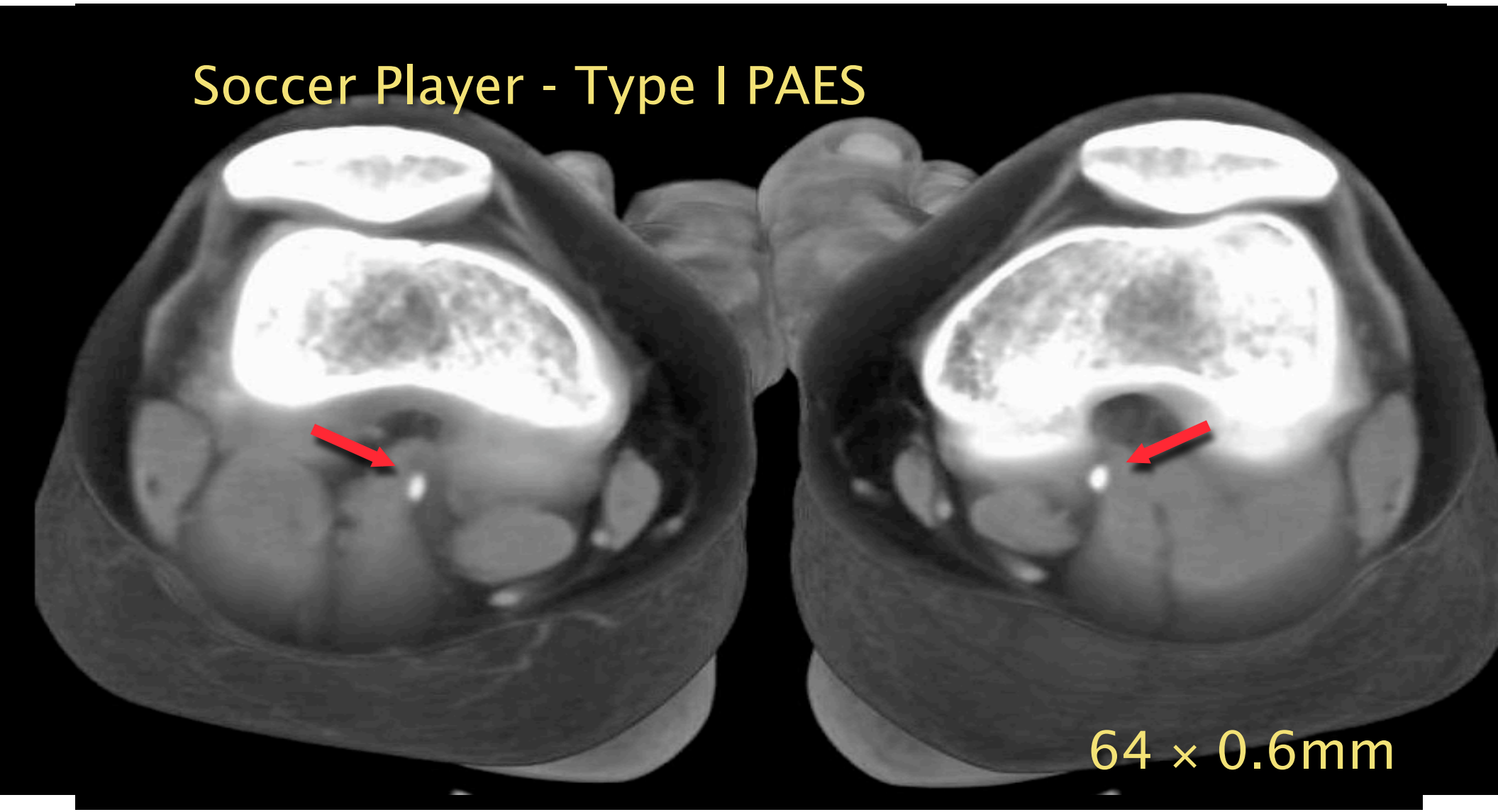
PAES: CTA Imaging Technique

- 2 phases – relaxed and active plantar flexion
- ~ 80 mL of contrast (4mL/s) for each phase followed by saline flush at same rate
- Bolus track distal SFA
- Scan time: 12-15 sec
- Pulse oximeter on symptomatic large toe
- Actively plantar flex without bearing down (straps)

PAES: CTA Imaging Technique

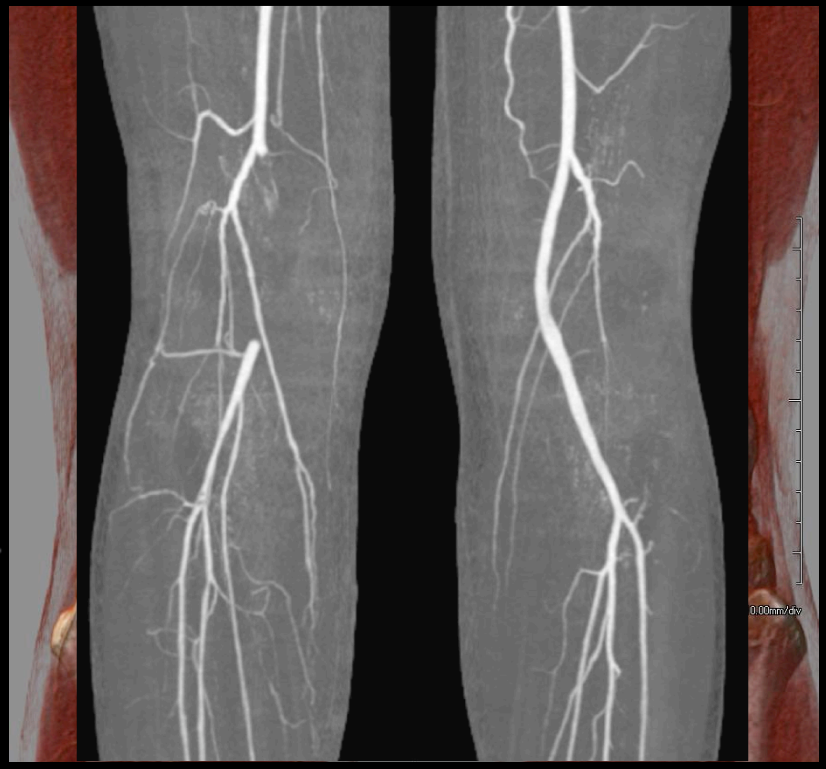





Soccer Player - Type I PAES
64 × 0.6mm

Type III PAES
Thrombosis of Left popliteal a.

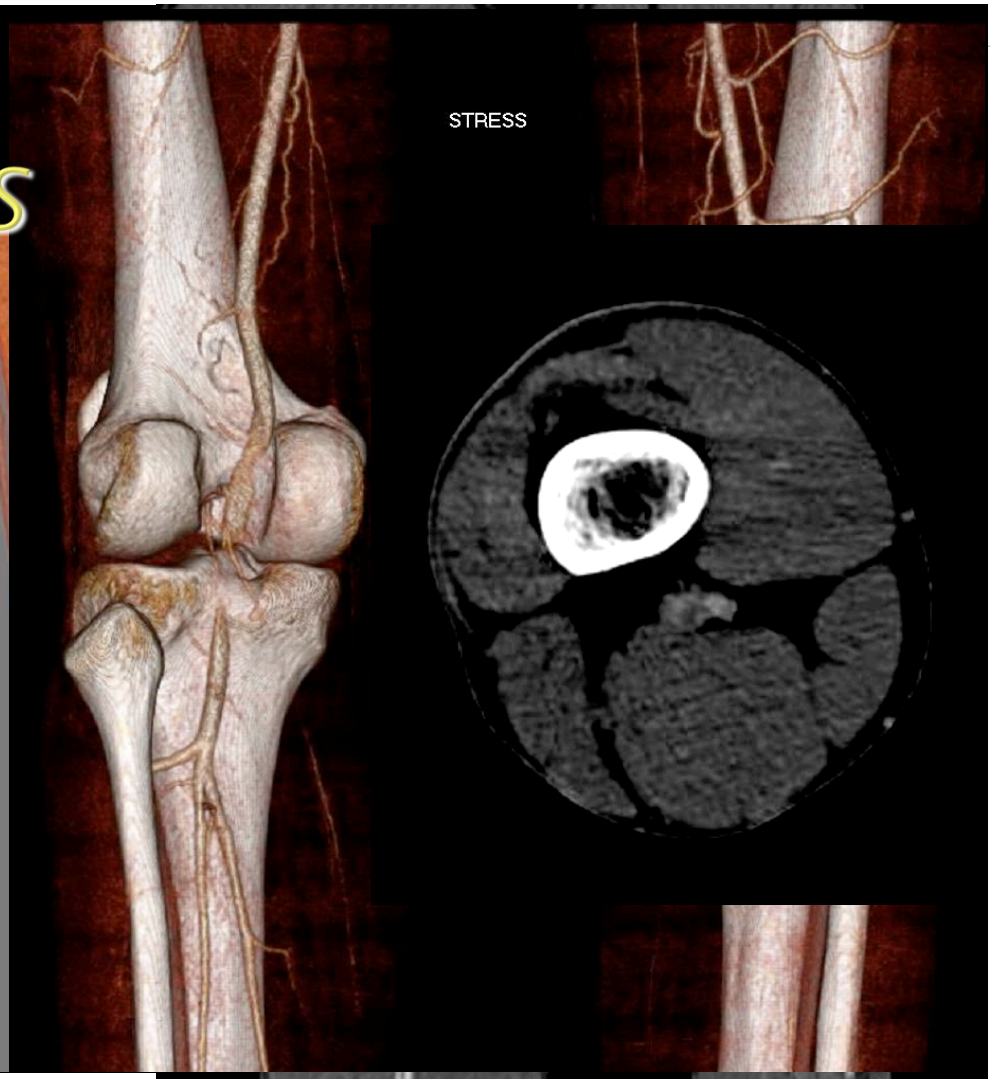
Relaxed –posterior view



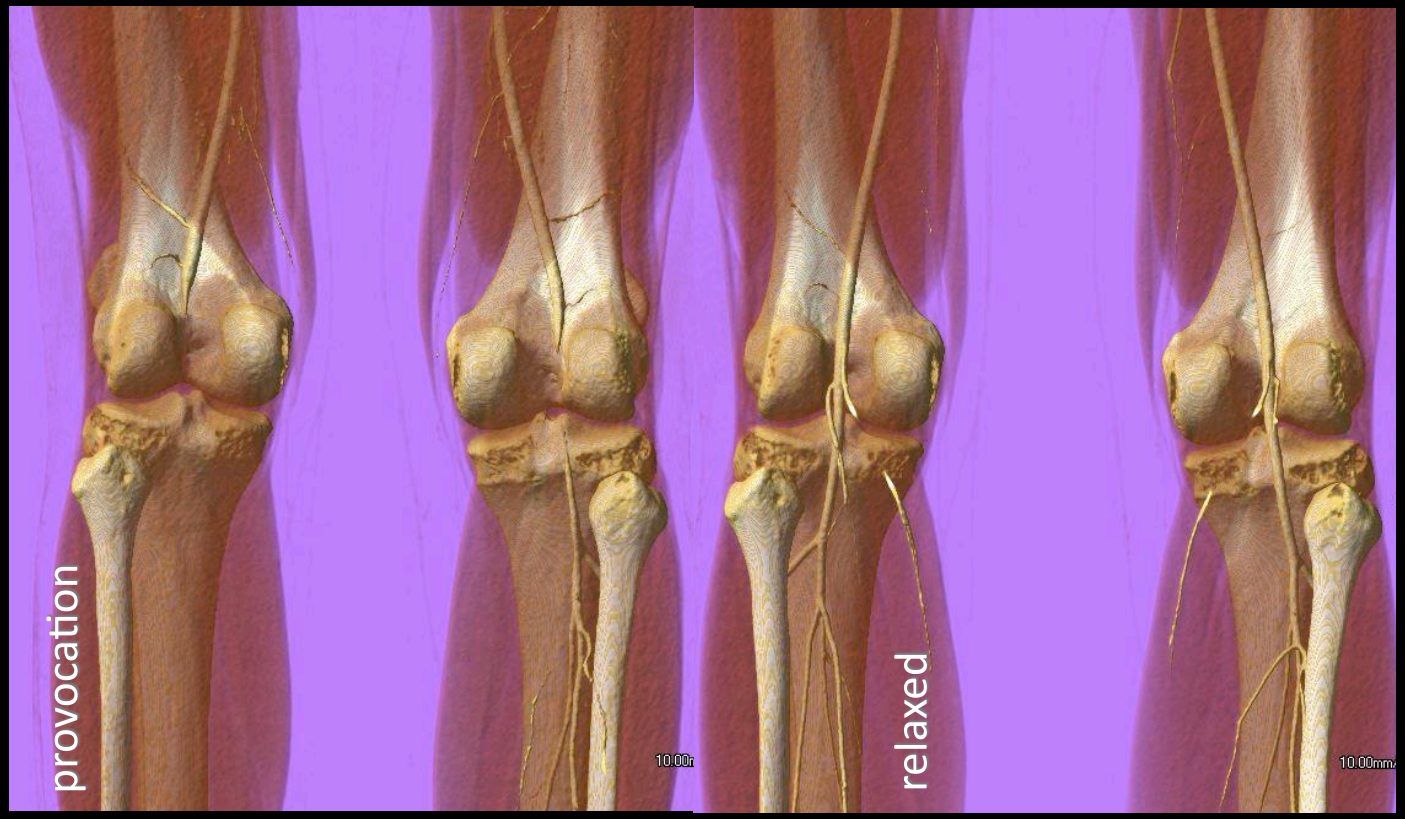
provocation

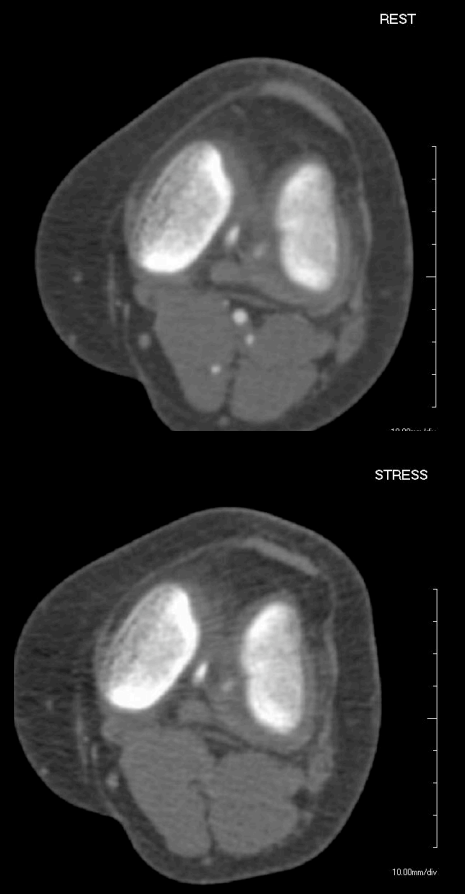
23 M Water Polo Athlete: Type V PAES

- Bilateral accessory slip MHG
- L popliteal a. occlusion @ rest
- Bilateral Popliteal v. thrombosis (Type V)



Functional (Type VI) PAES





Conclusions

- Vascular diseases in athletes can be a significant source of disability (need index of suspicion)
- Functional imaging is paramount for accurate detection and characterization of vascular entrapment / stenotic syndromes of the shoulder, pelvis, and lower extremities
- CTA allows rapid, functional evaluation of entrapment syndromes and endofibrosis

Thanks for Your Attention !!

Special Thanks to:

Dominik Fleischmann, MD
Deirdre Sheahan, MD
Lt. Cmdr. Scott Alexander, MD
Russ Dilley, MD

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