

Vascular Diseases in Athletes

Richard L. Hallett, MD

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RSNA[®] 2012

Patients First

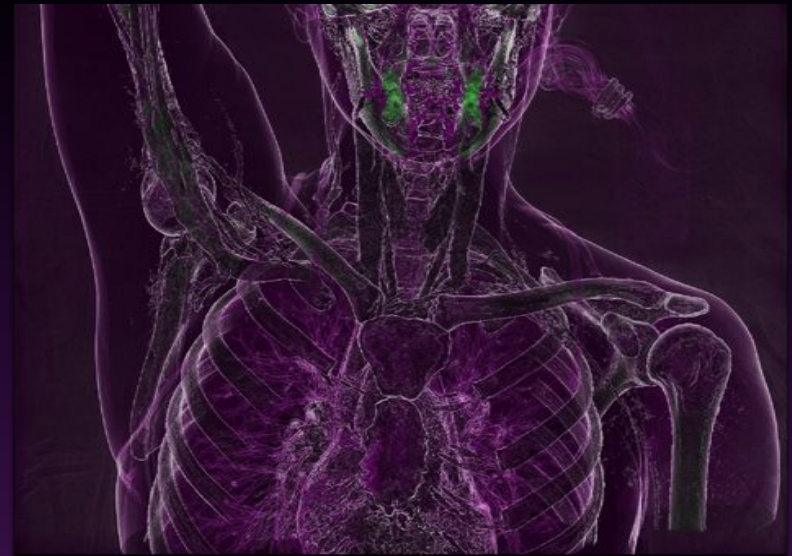


Vascular Diseases in Athletes

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Disclosures: None

Handouts Available:

www.stanford.edu/~hallett

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Background.....

- Vascular diseases are easily overlooked in athletes
- Deciding **WHEN (or IF)** to image vascular entrapment syndromes requires clinical judgment and multi-specialty coordination!!

Diagnostic Evaluation of Athletes

- Vascular H & P; Clinical Testing
- Plain films
- Ultrasound
- CTA
- MRI
- Catheter angiography

**DYNAMIC
EVALUATION
IS IMPORTANT !!**

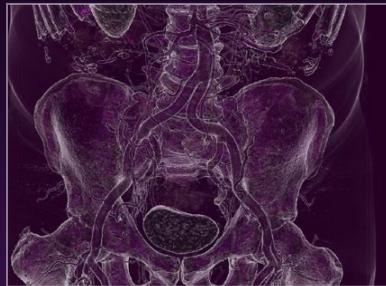
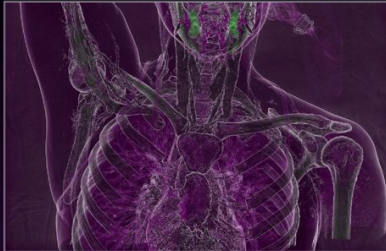
Dynamic Cross-Sectional Imaging

- **Principle**: simulate the predisposing motion / position and assess vascular response
 - “Stress” and “Relaxed” Imaging
 - Vary timing to assess arteries / veins

Caveats

- Don't be afraid to think outside the box
- Use anatomy and physiology to your advantage
- Blood pool agent for MRA → experience just beginning but could be very useful

Vascular Diseases in Athletes



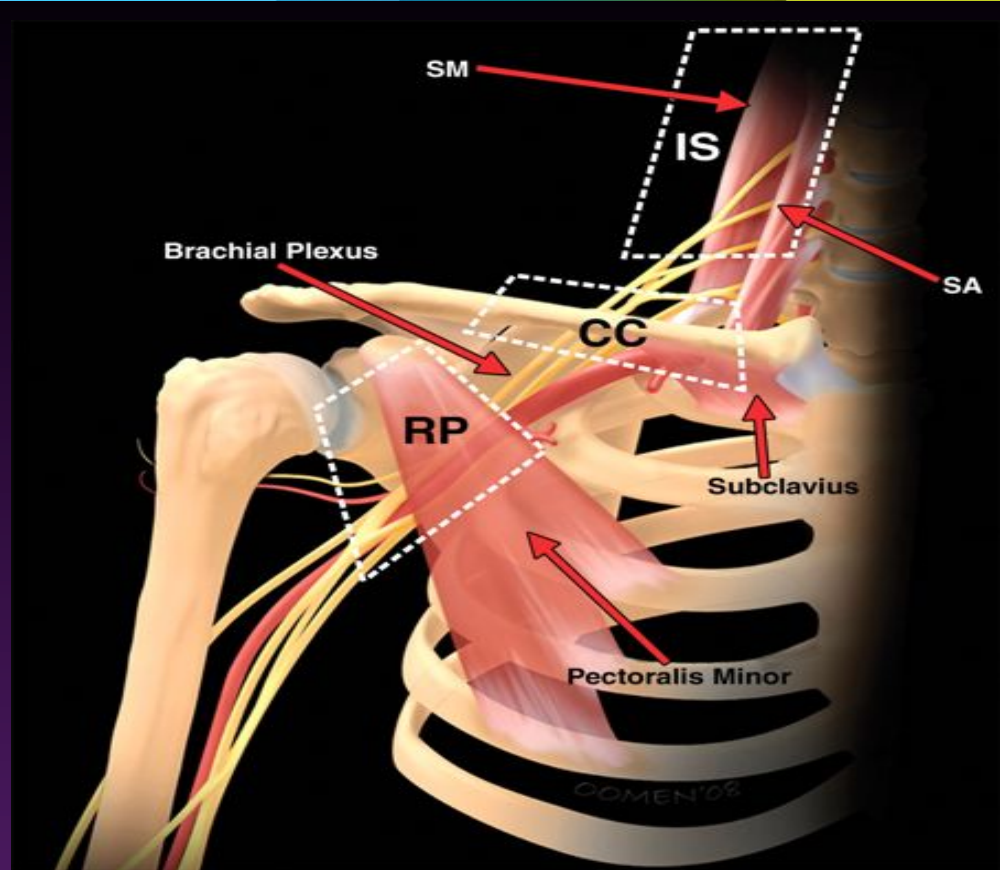
- **Upper Extremity**
 - Thoracic Outlet Syndrome (TOS)
- **Pelvis**
 - Iliac Endofibrosis
- **Lower Extremity**
 - Popliteal Entrapment Syndrome (PAES)

Thoracic Outlet Syndrome (TOS)

- Symptomatic compression/entrapment of neurovascular structures by bone and/or soft tissue as they pass through the cervicoaxillary canal
- 90% Neurogenic (PT, postural Tx, NSAIDs)
- 10% Vascular
 - Venous > Arterial

Components of Cervico-Axillary Canal

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

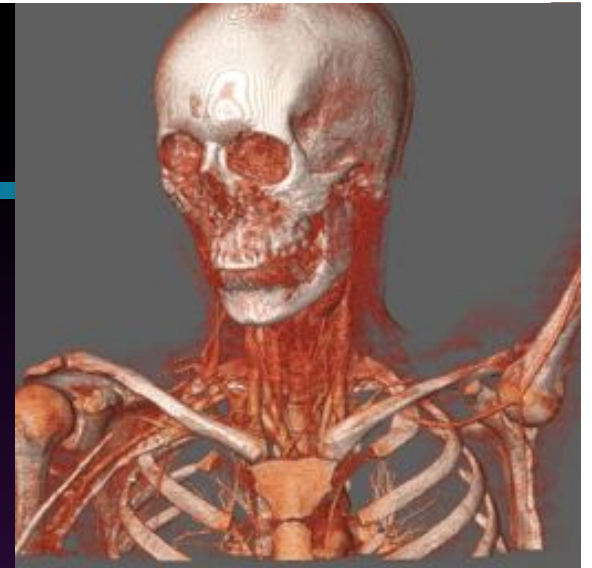


Venous TOS: “Effort Thrombosis”

- Paget-Schroetter syndrome (PSS)
- AKA axillo-subclavian venous thrombosis
- “Overhead” athletes
- PE in up to 1/3!! *
- Post-thrombotic syndrome (later)

Arterial TOS

- “Overhead athletes”
- SX: Coolness, weakness, diffuse arm pain (ischemic neuritis)
- Cause: Repetitive compression injury
 - Anatomic predisposition (tight CCS)
 - Post-traumatic, bony callus
 - Scalene hypertrophy

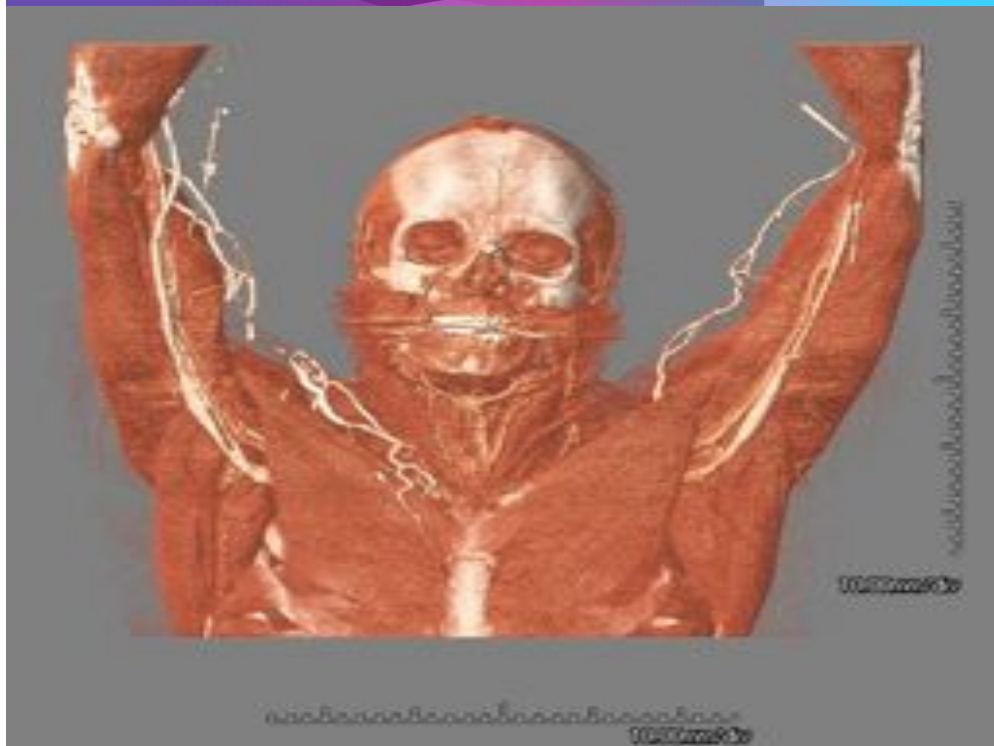


CTA for TOS: Combo Direct / Indirect CTA

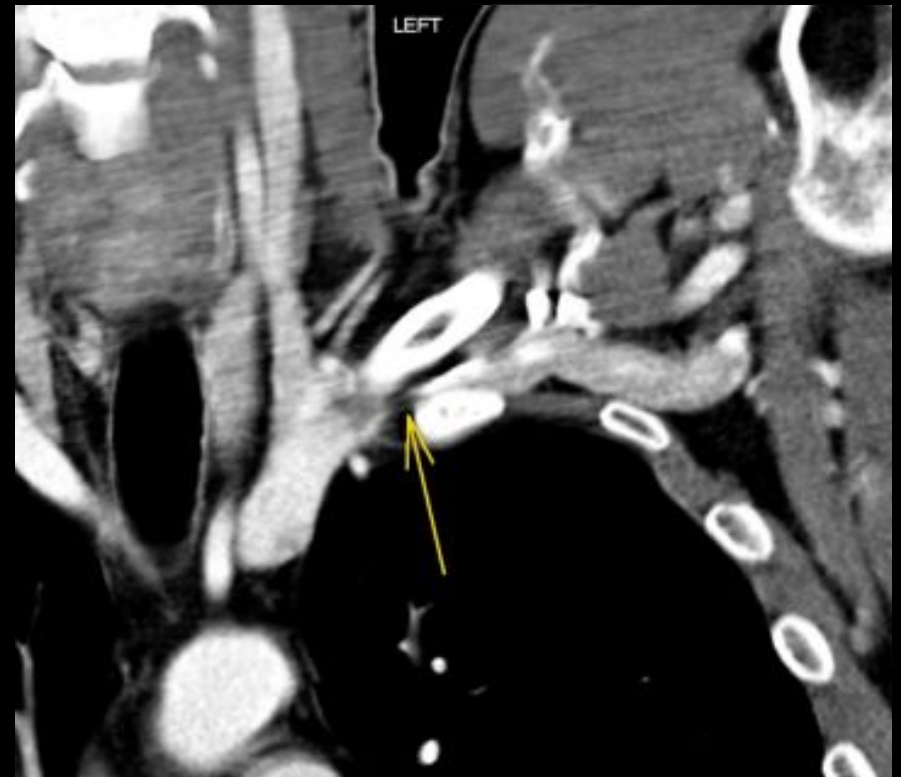
- Ipsilateral IV, arm over head w/ palm taped up
- Bolus: 120 mL full-strength @ 4ml/s
- Chase: 100 mL dilute (10%) contrast @2.5 ml/s
 - Can inject contralateral arm at same time (dilute)
- 65 sec empiric delay, scan caudo-cranial
- Arm down, immediate re-scan cranio-caudal
- **Volumetric Review**



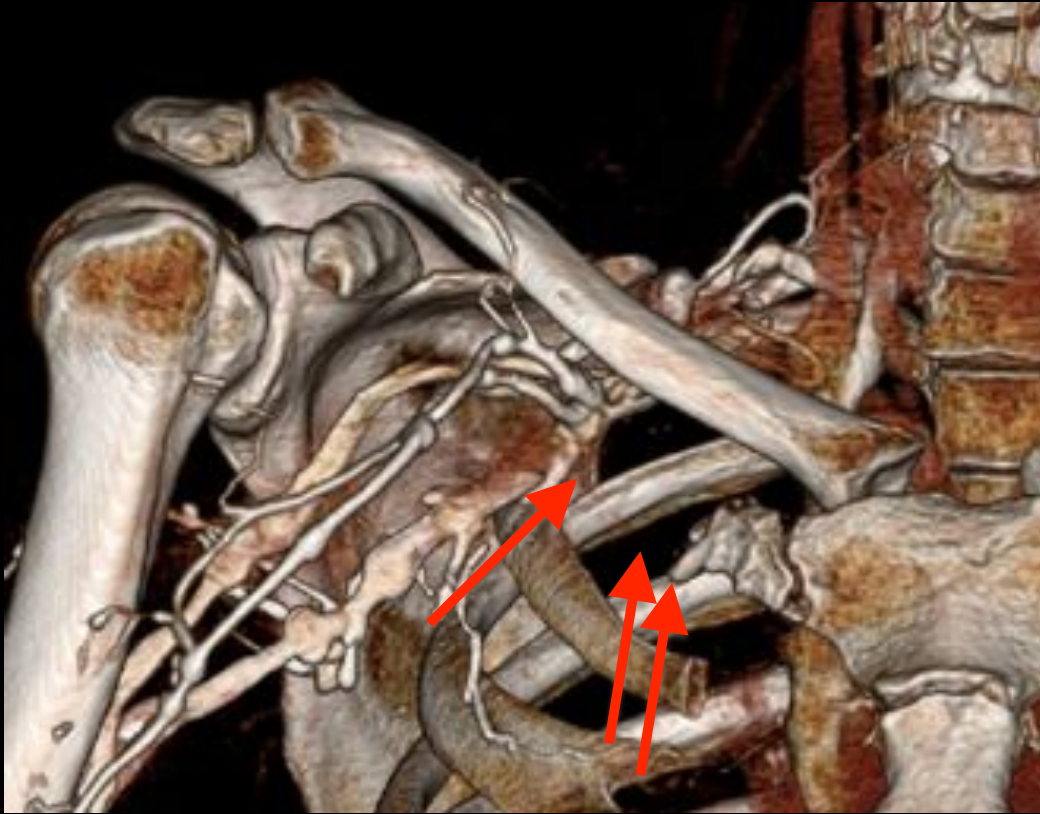
Bilateral Direct / Indirect CTA



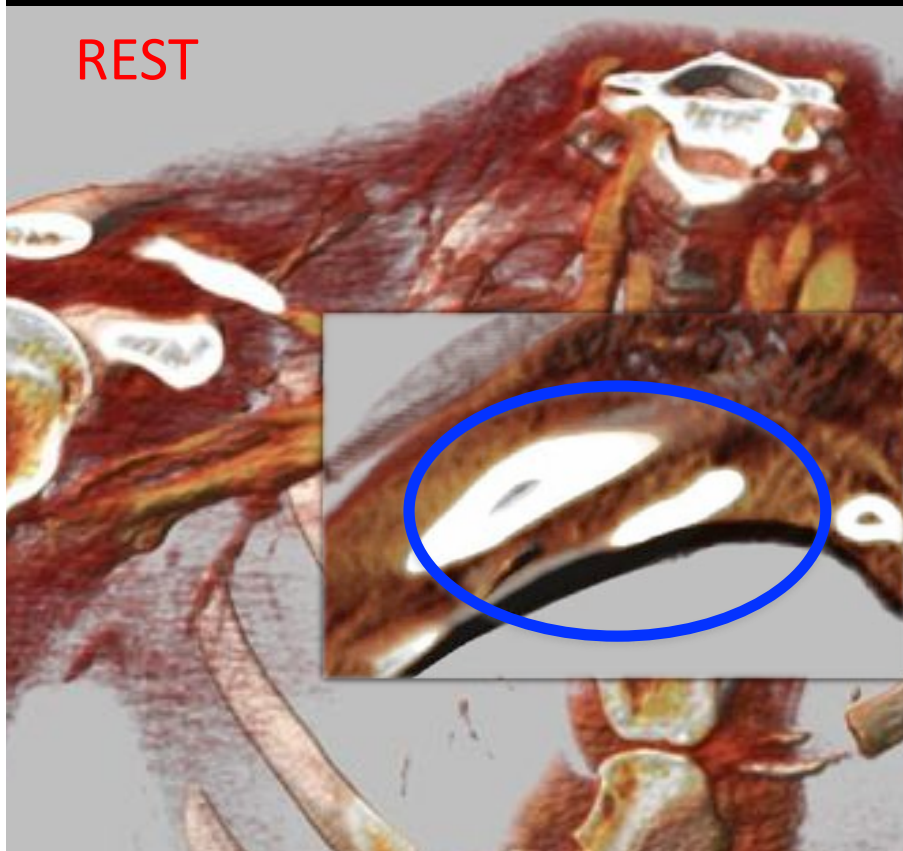
Effort Thrombosis: 36 YO weightlifter



Post-Op 1st rib resection

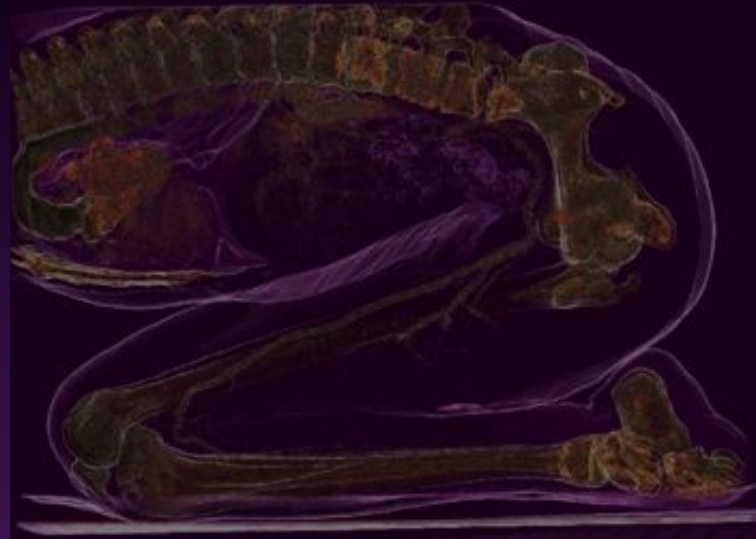


Arterial and Venous TOS: 16 YO Volleyball Athlete



Vascular Diseases in Athletes

Iliac Endofibrosis



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Flow limitations in the athlete pelvis

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

Iliac Endofibrosis

- **90% of pts are cyclists**
 - >10,000 km/yr or 150,000 km lifetime
 - Also: speed skaters, runners, wt lifters, XC skiers, and rugby players
- **90% external iliac artery**
- Smooth, eccentric, non-calcified
- **Pathology:** intimal fibroplasia, medial hypertrophy, and adventitial hyperplasia. Involved segments universally free from atherosclerosis.



Endofibrosis 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

CTA: Positioning

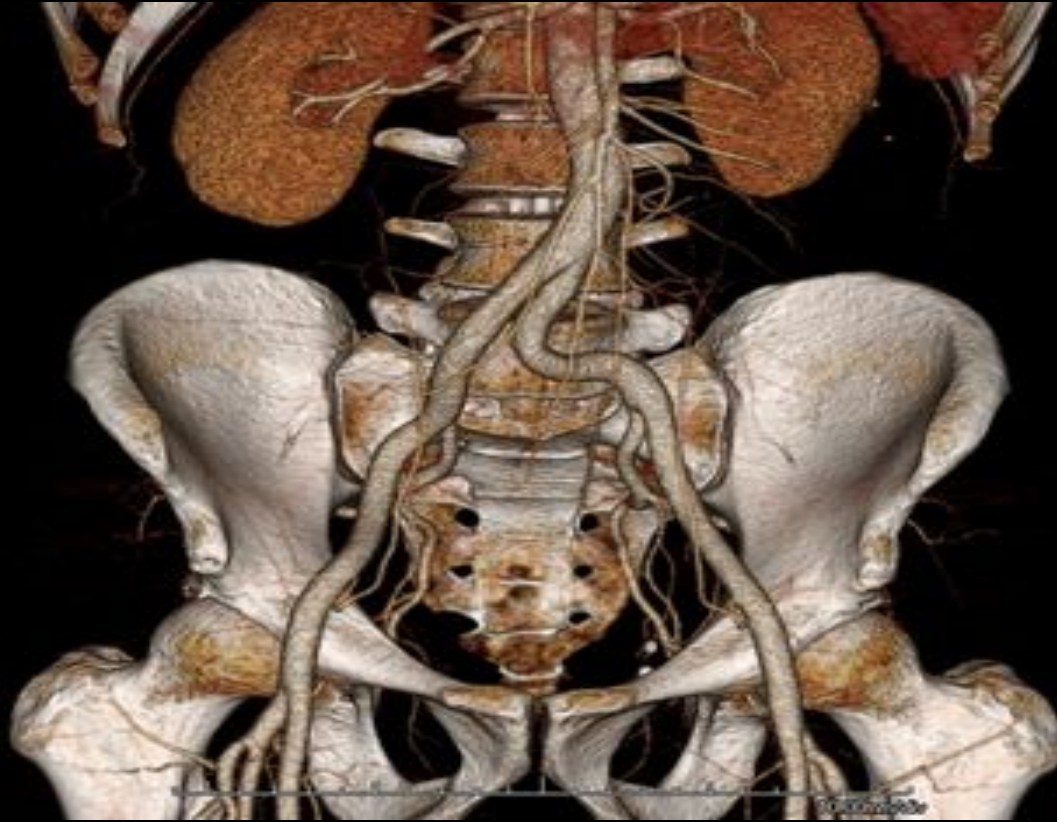
- Simulate cycling position as closely as possible considering space within CT gantry (almost 90 deg)



Case I

- 45 yo avid cyclist
- Proximal thigh pain, cramping with exertion
- ABI drops with exertion

Supine, legs extended



Dynamid Hip Flexion Restriction



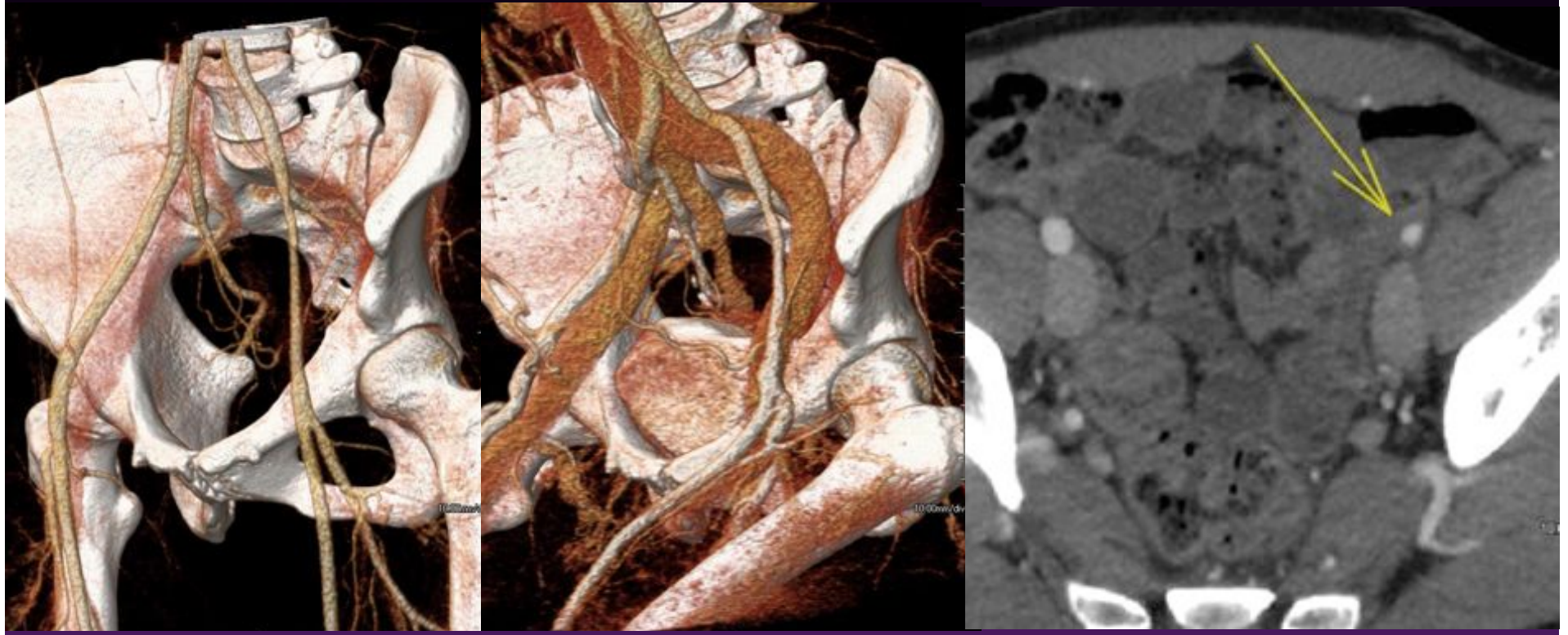
Case 2

- 26 yo elite female cyclist
- left thigh and buttock pain at high performance levels.

Case 2

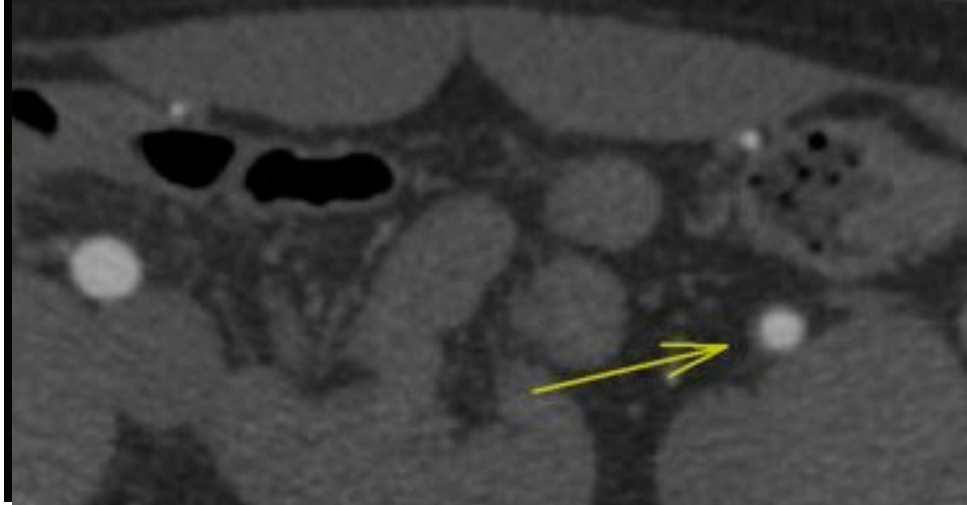
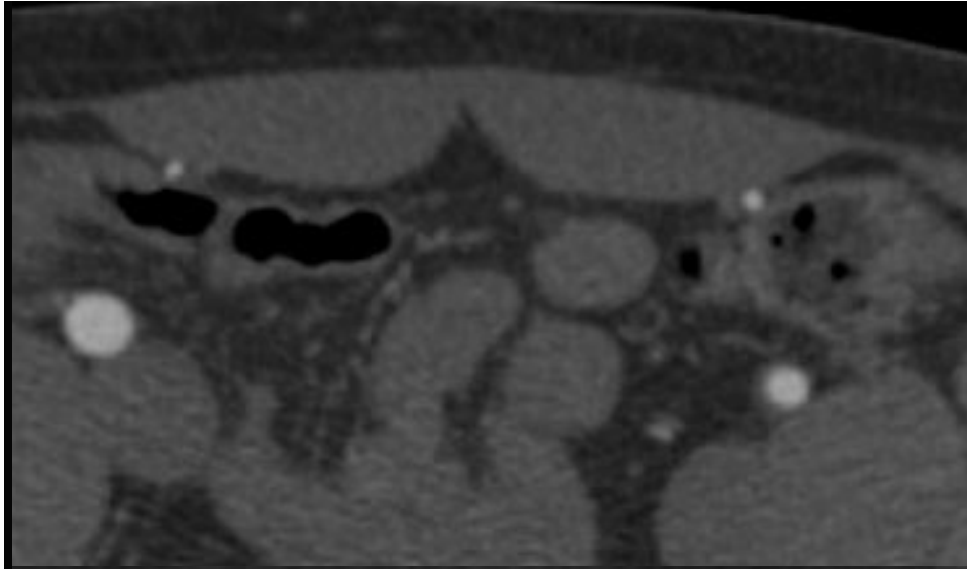
NEUTRAL

FLEXION



Case 3

- 43 yo elite male cyclist
- left thigh and buttock pain at high performance levels.
- Exercise ABI drop on left

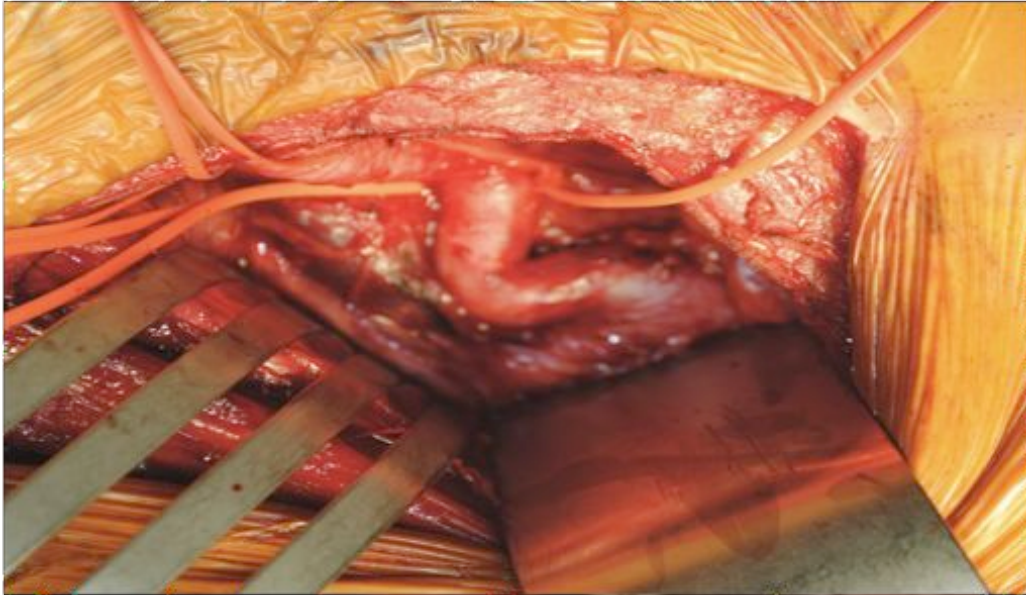


Case 4

- 49 yo avid cyclist x 30 yrs
- left thigh and buttock pain at high performance levels.
- Pain described as a “deep burn”

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

CTA at Rest

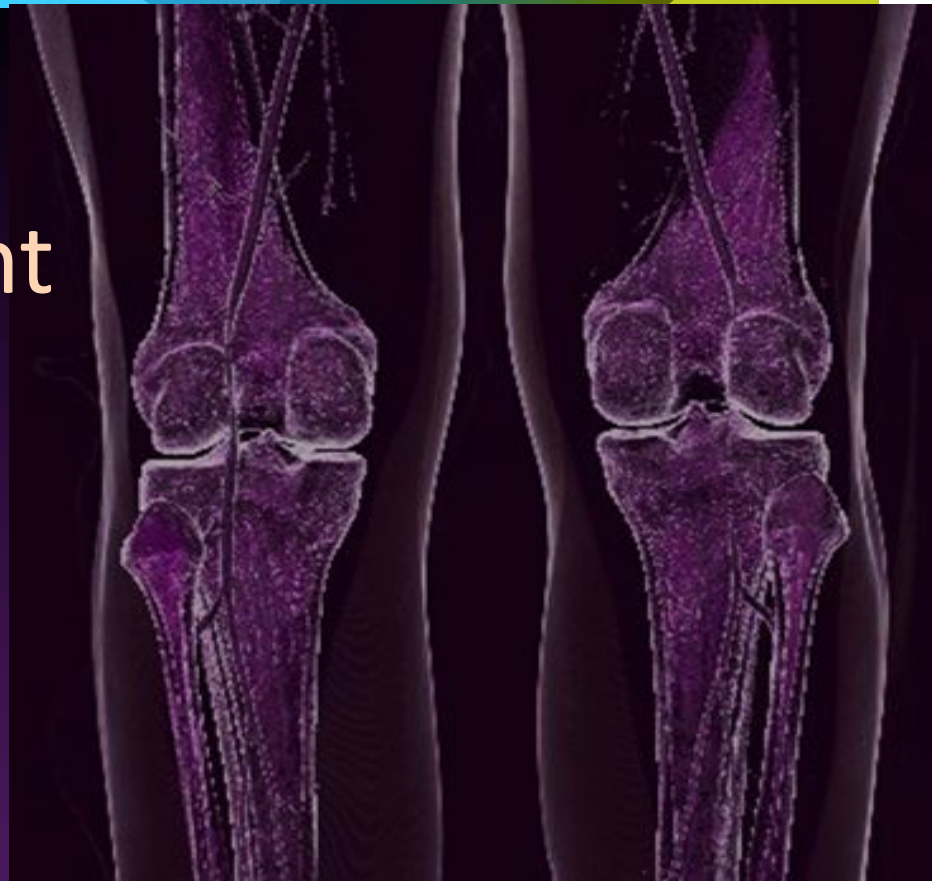


- Pathology: intimal thickening and fibrosis
- No inflammatory change



Vascular Diseases in Athletes

- Lower Extremity
Popliteal Entrapment
Syndrome (PAES)

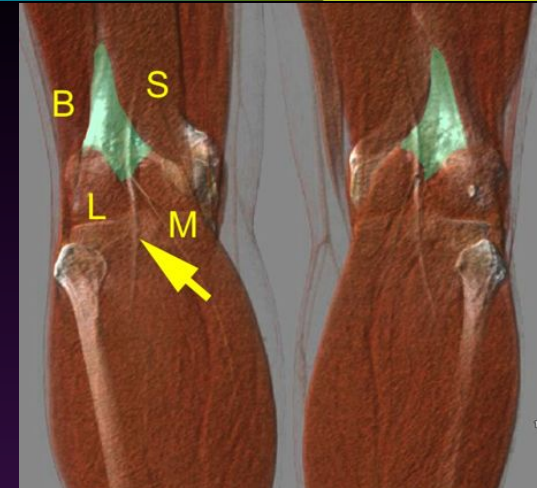


Popliteal Fossa Anatomy



Popliteal Space - Embryology

- *In utero*: competition between popliteal neurovascular bundle and migrating muscles (medial head gastrocnemius) for space
- If delayed or abnormal migration
→ **MHG too far lateral**
 - space is limited, thus compression can result



Causes of Popliteal Entrapment

- Anatomic Compression
 - Abnormal popliteal artery course
 - Abnormal muscle (MHG)
 - Both
- “Functional” compression

Classification of PAES

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

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

Functional Popliteal Entrapment (Type VI)

- Younger population, highly conditioned athletes)
- Neurovascular compression by hypertrophic gastrocnemius +/- soleal sling
- Longer segment involvement (vs. anatomic PAES)

PAES: CTA Imaging Technique

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

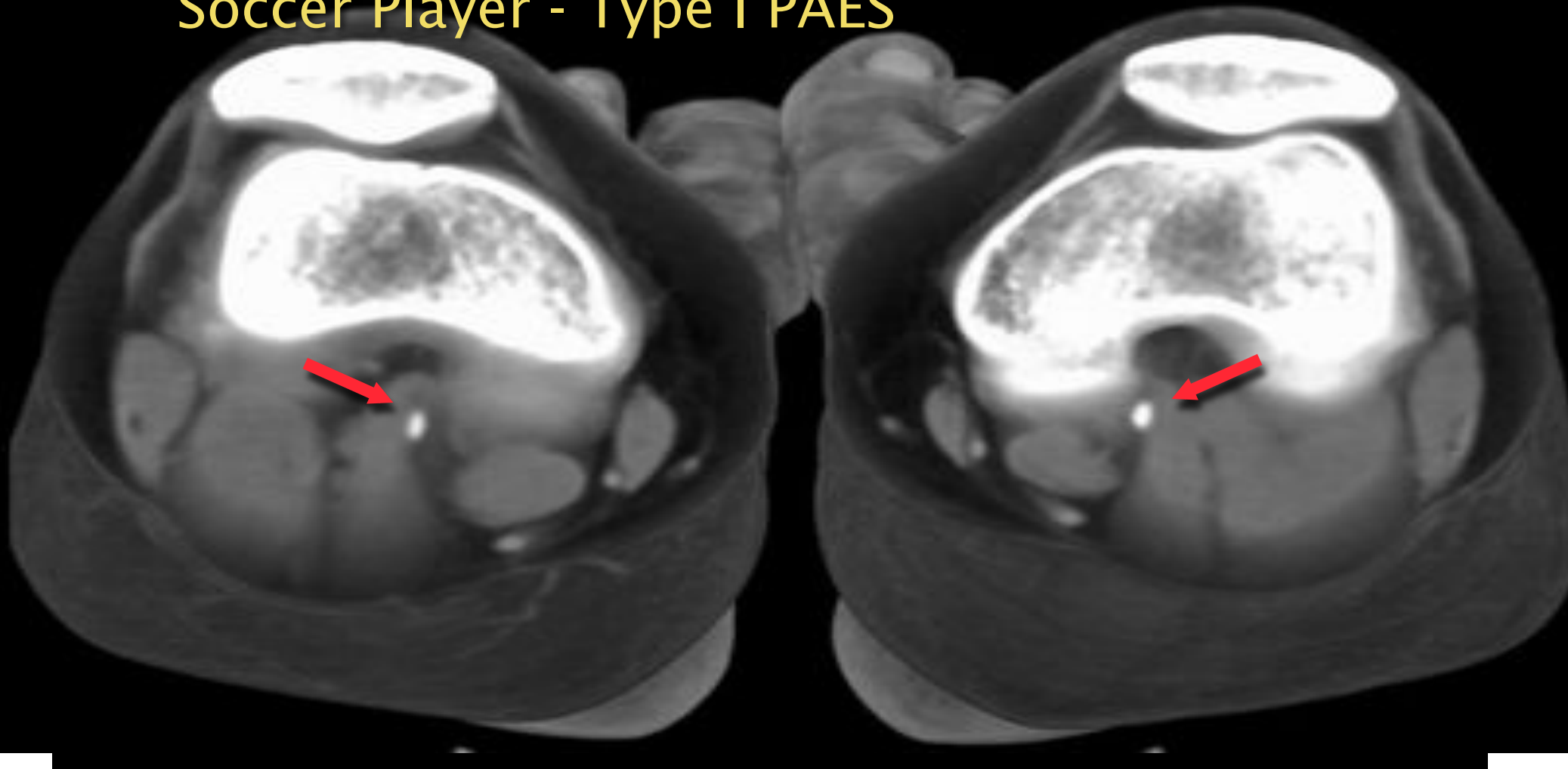
PAES: CTA Imaging Technique



Examples - PAES



Soccer Player - Type I PAES



Type III PAES

Thrombosis of left popliteal artery

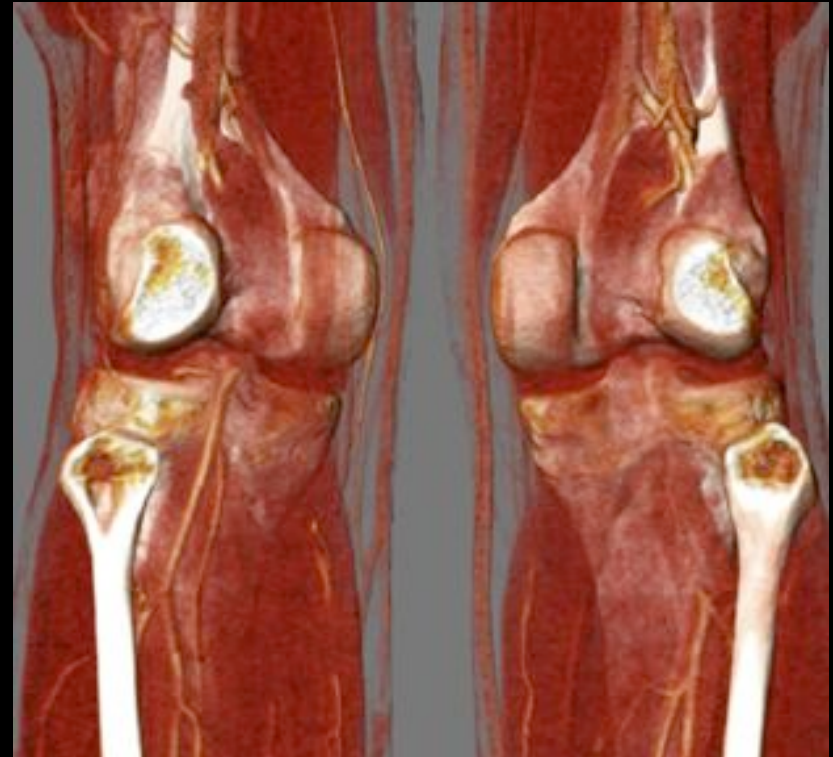
LEFT

RIGHT

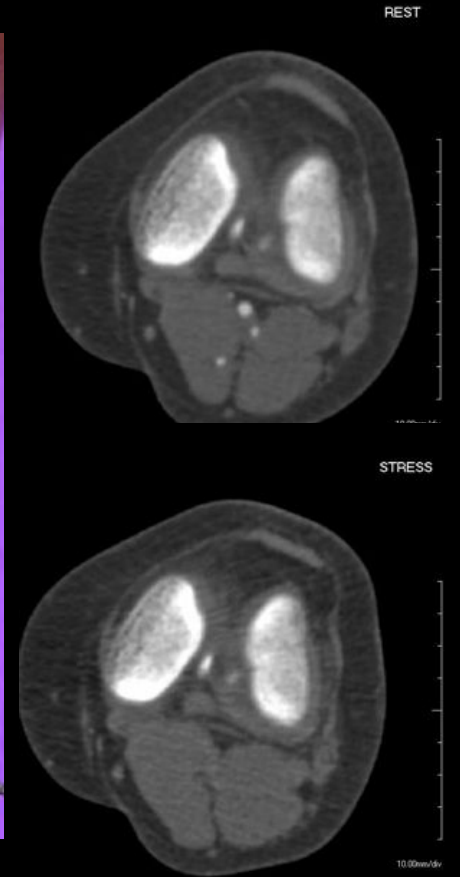
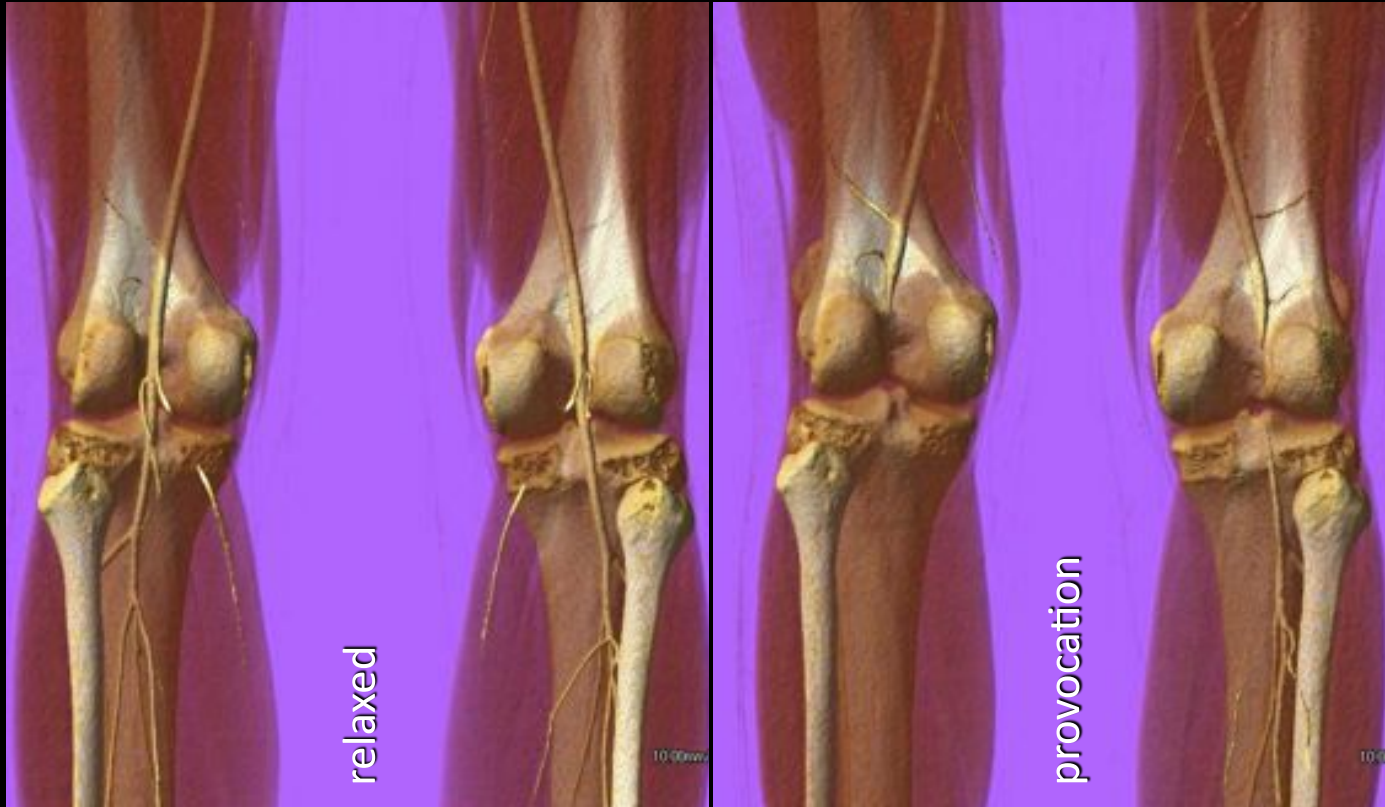
Relaxed –posterior view



provocation



Functional (Type VI) PAES



Conclusions

- Vascular diseases in athletes can be a significant source of disability and performance loss
- Functional imaging is paramount for accurate detection and characterization of vascular entrapment / stenotic syndromes
- CTA (MRA) allows rapid, functional evaluation

Thanks for Your Attention !!

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