ATYPICAL CLAUDICATION: EXTERNAL ILIAC ENDOFIBROSIS; POPLITEAL ENTRAPMENT

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No disclosures.

External Iliac Arteriopathy (EIA)

Dos Santos:

"Vascular surgery ... the surgery of ruins"

Cyclists:

"Greek gods"

External Iliac Arteriopathy (EIA)

Occurs in elite bicyclists

1 in 5 elite cyclists will develop EIA (Dutch studies)

External Iliac Arteriopathy (EIA)

External Iliac Artery Endofibrosis (EIAE)

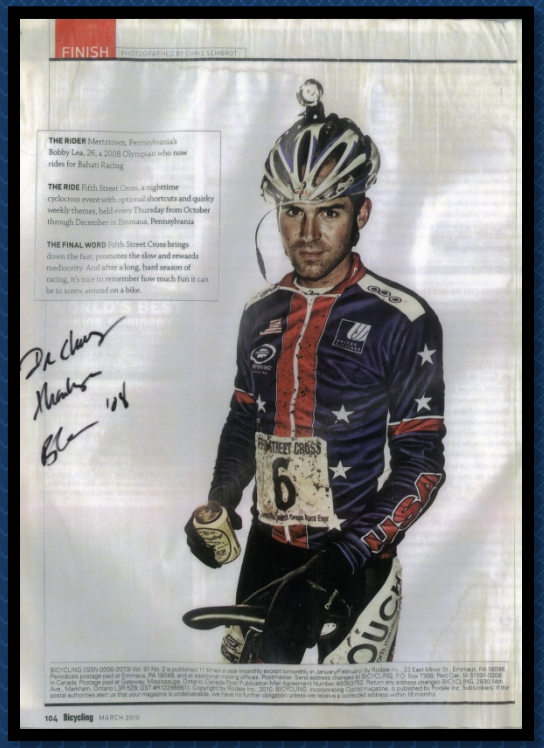
- **Full-thickness** alteration of the external iliac artery in high-performance athletes, primarily bicyclists.
- Narrowing of the artery with decreased blood flow
- Distinct disease from atherosclerosis or fibromuscular dysplasia
- Presents as **claudication** during **maximal exertion**
  - Numbness, weakness, pain, inability to perform at maximum power
  - May cause athletes to stop competitive activities

External Iliac Arteriopathy (EIA)

- A **'young'** disease
  - First described in 1985[1,2]
  - Occurs in young, fit athletes, most commonly **high-performance cyclists**, endurance runners, speed skaters, and other athletes
  - **Commonly missed** diagnosis

- Incidence:
  - **1 in 5 cyclists** will develop EIA[3]
  - Average distance cycled 150,000km
  - >350 miles/week[4]

- Ford et al 2003[5]:
  - 90% External iliac artery
  - 5% Common iliac artery
  - 5% Common femoral artery



[1]Walder J, Mosimann F, Van Melle G, Mosimann R. Helv Chir Acta 1985;51:793-5.
[2]Chevalier JM, Enon B, Walder J, Barral X, Pillet J, Megret A, Lhoste P, Saint-Andre JP, Davinroy M. Ann Vasc Surg 1986;1:297-303.
[3]Bender MH, Schep G, de Vries WR, Hoogeveen AR, Wijn PF. Sports Med. 2004;34(7):427-42.
[4]Kral CA, Han DC, Edwards WD, Spittell PC, Tazelaar HD, Cherry KJ Jr. J Vasc Surg. 2002 Sep;36(3):565-70.
[5]Ford SJ, Rehman A, Bradbury AW. Eur J Vasc Endovasc Surg. 2003 Dec;26(6):629-34.

External Iliac Arteriopathy (EIA)

- Professional cyclists
  - 35,000 km/year = 21,700 mi/year
  - Hip flexion 8,000,000 times/year
  - Blood flow 10 liters/min = 2.7 gal/min

- Bicycles
  - Intimate shoe-pedal connection
  - Increases contribution of hip flexors (pulling pedals up)

- Walder, et al 1985. Iliac artery stenosis due to intimal thickening in 2 competitive cyclists: ‘endofibrosis’

- Largest series: Schep, et al 2002. 80 athletes
  - 85% unilateral
  - 90% cyclists
  - 4.5% runners
  - 3% tri-athletes
  - 0.5% skiers

Clinical Features

- Majority have normal pulses, some bruits after exercise/flexion
- Normal resting ABI common
- Normal or only subtle abnormalities in exercise ABI, with very quick recoveries
- Claudication at maximal effort, difficult to reproduce in test conditions (weakness/loss of power/ swelling/ paralysis)
- Inconsistent vascular risk factors

Proposed Etiology

- Repeated stretching at hip: cyclists' aerodynamic position worsens it
- Supra-physiologic flow endothelial damage
- Kinking due to tethering by branches
- Extrinsic compression:
  - Psoas muscle hypertrophies by pulling pedals up
  - Ext oblique hypertrophies: inguinal ligament

External Iliac Arteriopathy (EIA)

Demonstrates the typical long-neck bottle appearance of the artery.

- We believe this results from both **mechanical** and **hemodynamic** forces acting on the artery:
  - Fixation between the iliac bifurcation and the inguinal ligament
  - Exacerbated by tethering of iliac branch vessels
  - Excessive length and kinking result from stretch injury
- Causing **prolonged and repetitive trauma** to the artery

Diagnosis of EIA

May be quite difficult in early cases,

with subtle arteriographic findings and equivocal vascular lab studies.

Diagnosis of EIA

- History
  - Claudication with **extreme exertion**
  - Difficult to reproduce
- Physical
  - Often no signs if early
  - Bruit if advanced
- Ankle Brachial Indices
  - **Post-exercise** values may be low (<0.5-0.66)
  - Difference of >0.18 between legs after 1 min rest
- Arteriogram
  - Done in **supine** and **flexed** position
  - Can show narrowing, inguinal ligament compression, or tortuosity
  - Pharmacologic dilators
  - Pressure gradient measurements
- MRA/CTA
  - Less sensitive than arteriography
  - Can detect advanced lesions

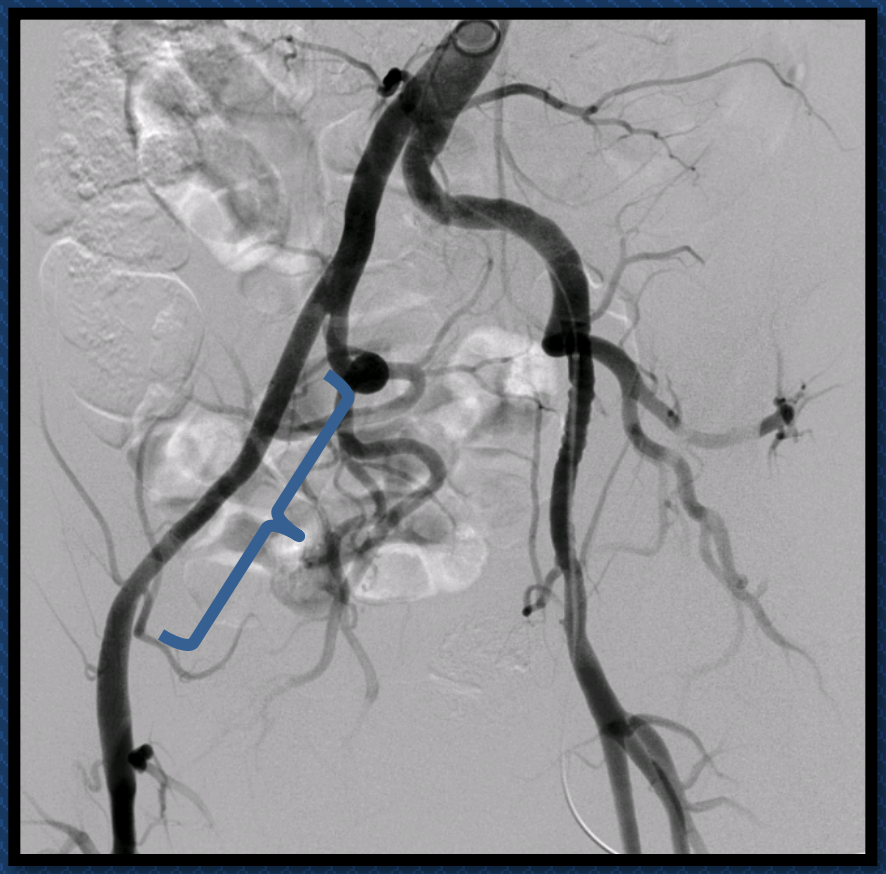
Physiologic Studies: Do Pertinent Exercise

Diagnosis of EIA

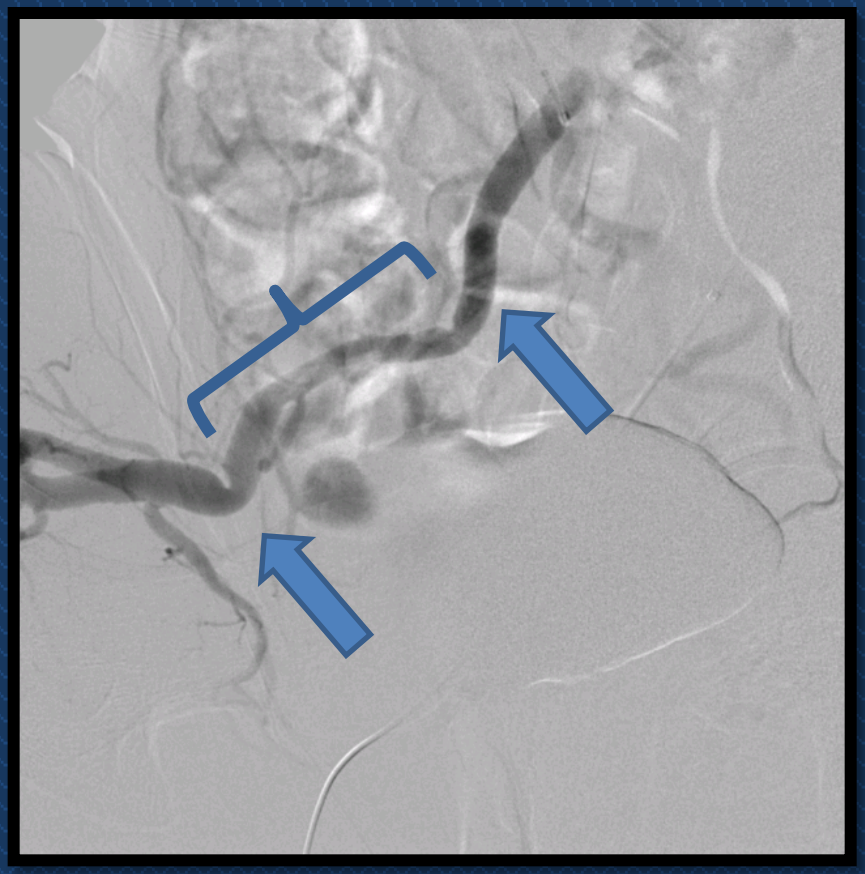
ARTERIOGAPHY our mainstay

- Pharmacologic dilators
- Pressure measurements
- “Stress” positioning

EIA: Full length narrowing accentuated by flexion



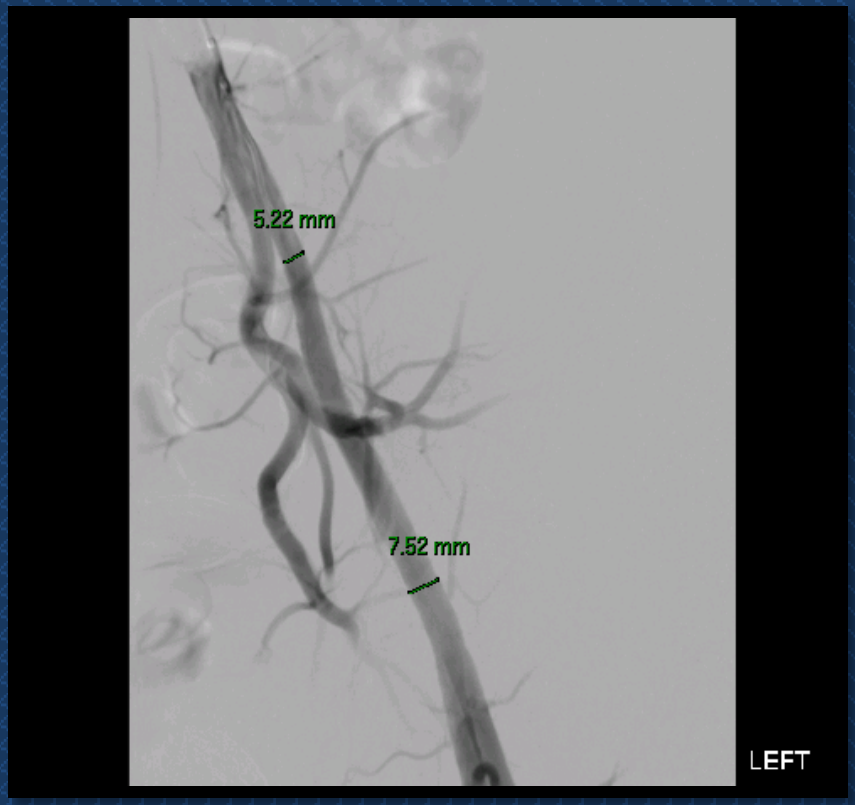
Arteriogram, supine



Arteriogram, flexed

EIA: Full length narrowing

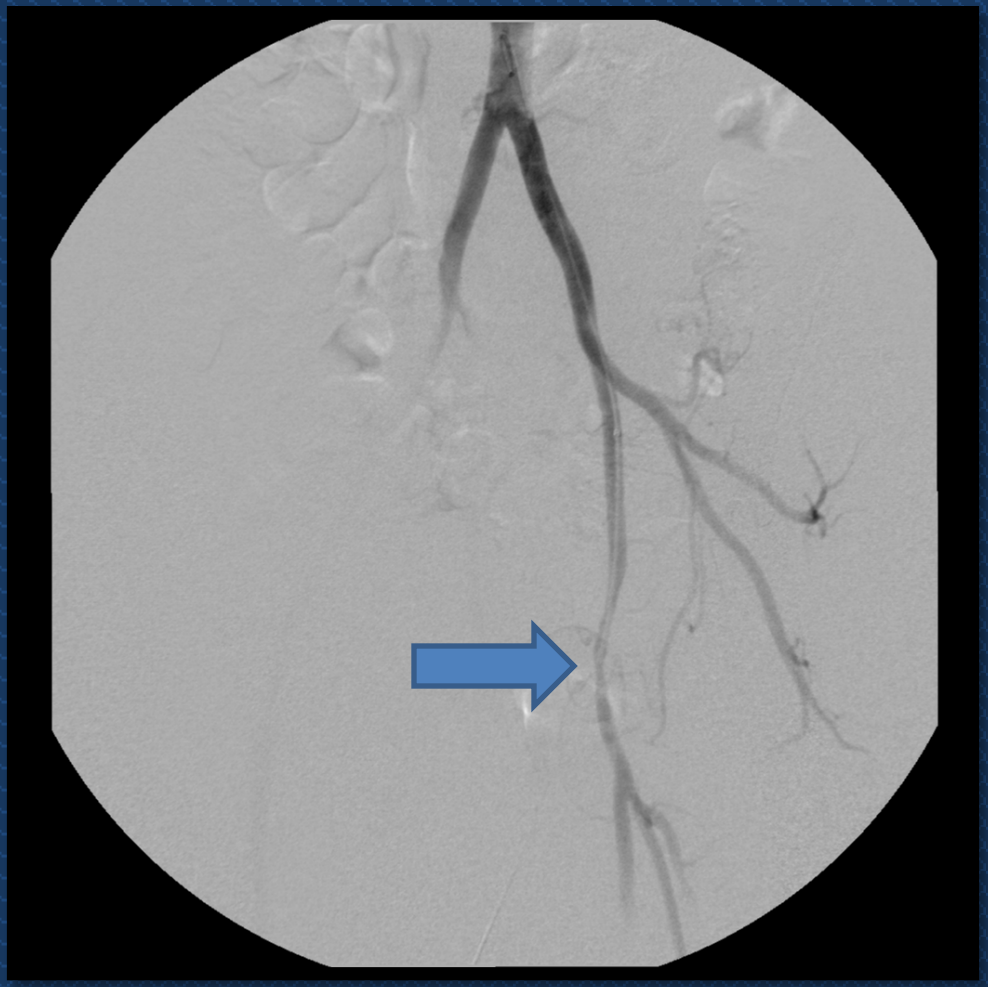
EIA: Proximal narrowing.



Arteriogram, supine

Arteriogram, flexed

EIA: Distal disease.



Treatment

- Conservative:
  - Best medical therapy (no smoking, anti-platelet, statins) and posture change for recreational athletes: poor results
- Percutaneous Angioplasty:
  - Consensus against it: risk of dissection, not durable, unfavorable histology, little symptomatic improvement (Ford et al 2003)

Treatment

- Surgery:
  - Overall 80% response rates
  - Arterial release without breaching arterial integrity arterial: branches, fascia, scars released if luminal narrowing excluded
  - Shortening of artery if redundant
  - Resection of fibrotic segment and vein interposition
  - Endarterectomy and vein patch

EIA Treatment

- Release of iliac arteries
- Incision of inguinal ligament
- Patch angioplasty with or without endarterectomy
- Graft replacement of external iliac artery (and common femoral)

Graft Material

Dutch:

Advocate vein

Mayo, UVA:

Advocate prosthetic

Durability

Mid-Term Results of External Iliac Artery Reconstruction in Avid Cyclists: Analysis of 25 Patients

Amani D Politano, MD, MS[1], Margaret C Tracci, MD, JD[1], Naren Gupta, MD[3], Klaus D Hagspeil, MD[2], John F Angle, MD[2], and Kenneth J Cherry, Jr, MD[1]

[1]University of Virginia Division of Vascular Surgery and [2]Department of Radiology, Charlottesville, VA and [3]Brigham and Women's Hospital Division of Vascular Surgery, Boston, MA

Results

- **25 cyclists** (31 limbs) underwent revascularization procedures
  - **22 patients** (26 limbs) received Dacron **patch angioplasty**
  - **4 patients** (5 limbs) received Dacron **interposition graft**
  - 15 left-sided, 8 right-sided, 4 bilateral

- Prior to symptoms, patients averaged 253 miles per week (range 100-400)
- Post-symptoms, patients averaged 186 miles per week (range 0-350)

- 28 limbs underwent concurrent ipsilateral inguinal ligament release
- 12 limbs underwent contralateral inguinal ligament release
- 2 limbs underwent isolated inguinal ligament release

- Mean length of stay was 2.4 ± 0.1 days

EIA: Post-Op Intimal Hyperplasia.

Results

20/25 still cycling

80-85% success

September 2010 - Present

24 additional patients

In contradistinction to reported group,
most of these **with graft** rather
than patch angioplasty reconstructions

Why More Grafts?

- Patches good for very localized disease
- Seeing more full-length disease
- Less inclined to perform long angioplasties (e.g., entire external iliac) than previously
  - Less suture line at risk

Results

- Two major problems of reconstruction

- **Intimal hyperplasia**
  - (graft too short)

- Graft (or artery) **kinking**
  - (graft too long)

Reconstruction

- Length of graft critical with small margin of error.

- **CURRENT PRACTICE**
  - Prep entire lower extremity
  - Measure supine
  - Measure flexed
  - Divide difference
  - Remeasure post repair
  - Re-do if necessary
  - Use **LMW Dextran** to reduce thrombosis and embolization

Summary

- Anticipated and desired results ***much harder to achieve*** in these active, healthy, young patients who stress their repairs much more than asymptomatic patients do.
- **Patency per se is not enough.**

- With ***supra-physiologic flow rates***, post-operative **stenoses** which would be insignificant in asymptomatic patients ***assume hemodynamic significance*** in these athletic patients.

- They need **physiologic as well as anatomic patency**.

Case Series: Anatomic Popliteal Entrapment Syndrome is Often a Difficult Diagnosis

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Division of Vascular and Endovascular Surgery
University of Virginia Health System

Midwestern Vascular Surgical Society
17 September 2011

Popliteal Artery Entrapment

- Clinical presentation:
  - Calf or foot **claudication**
  - Usually young, athletic
  - Precipitated by physical activity
- Diagnosis:
  - Doppler or duplex ultrasound
  - MRI/MRA
  - **Angiography** (gold standard)
- Treatment
  - Surgical myotomy to release the neurovascular bundle
  - Excision of abnormal bands or muscle slips
  - Reversed vein bypass grafting if arterial degeneration is present

Popliteal Artery Entrapment

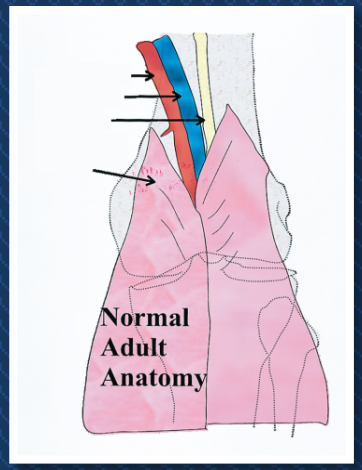
Functional

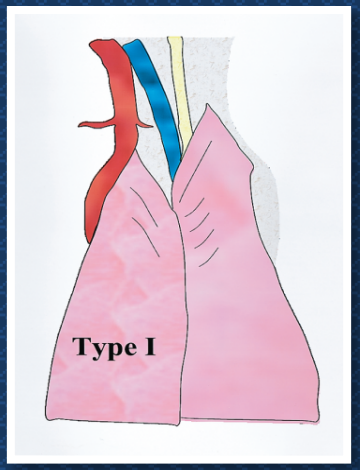
- Normal anatomy, but muscular contraction causes vessel compression during **certain movements**
  - May occur with forceful movements in 30-50% of the general population
- Occurs at the level of the soleal sling

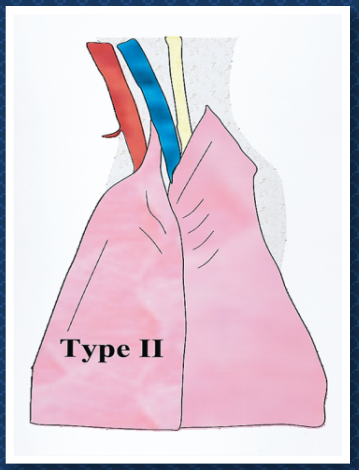
Anatomic

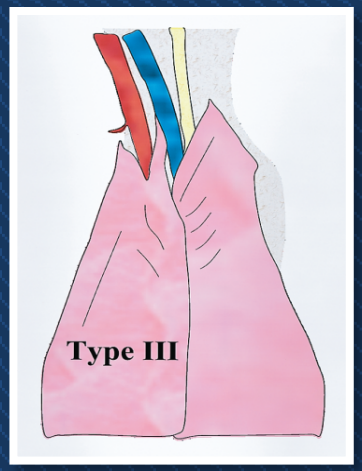
- **Abnormal anatomy** compresses neurovascular structures in the popliteal fossa
  - Delayed or incomplete migration of the medial head of the gastrocnemius muscle
- Five classifications are recognized (type I to V)

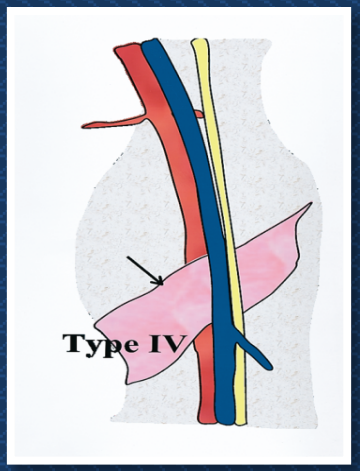
Anatomic Popliteal Entrapment

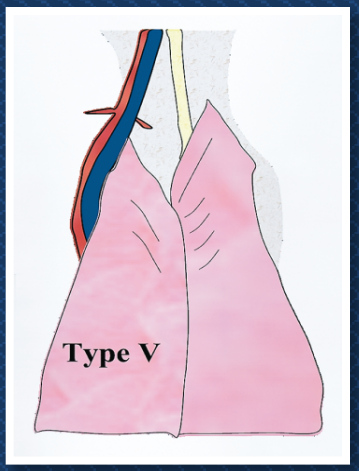












Elias DA, White LM, Rubenstein JD, Christakis M, Merchant N. Clinical evaluation and MR imaging features of popliteal artery entrapment and cystic adventitial disease. AJR Am J Roentgenol. 2003 Mar;180(3):627-32

Case 2

- A 15 yo female high school athlete with an 8 month history of **right** lower extremity pain and paresthesia on exertion
- Initially seen by orthopedics, treated for stress fracture, then received a 4-compartment **fasciotomy** for exertional compartment syndrome
  - Provided temporary relief; symptoms returned within 3 months
- Referred to vascular surgery
- On exam, right pulses only dopperable, ABI 0.76
- **MRA** revealed popliteal artery occlusion at the gastrocnemius, with collateral flow consistent with **type I entrapment**

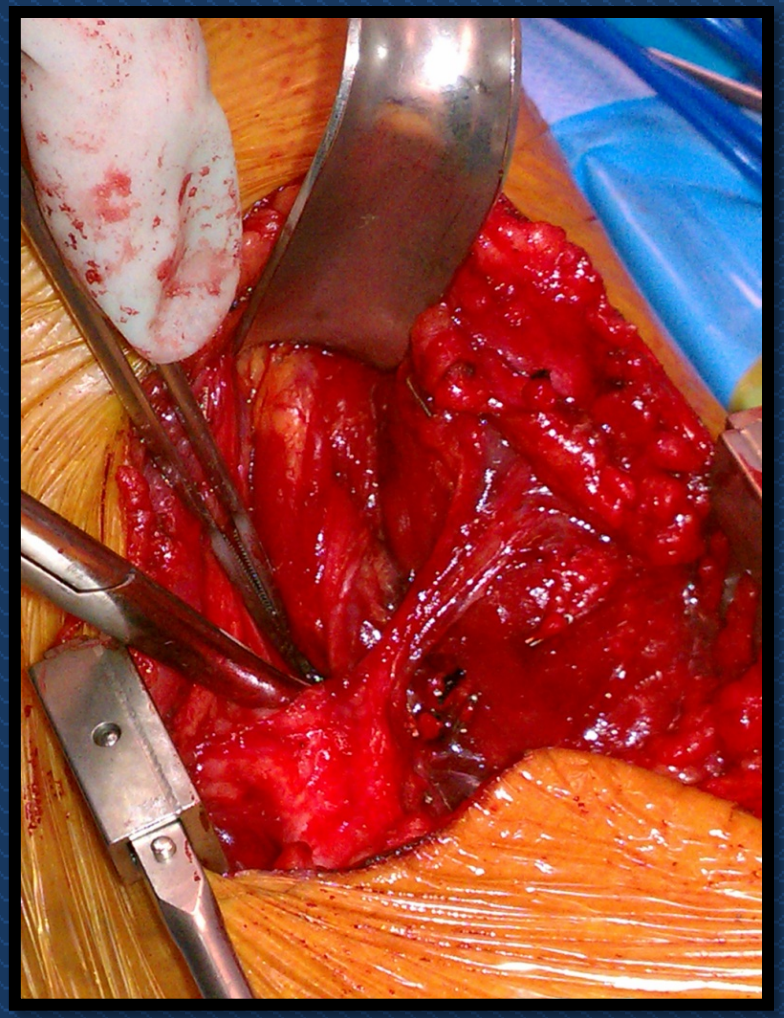
Case 2 cont'd

- Surgical intervention
  - Posterior approach
  - Division of the medial gastrocnemius head
  - **Interposition vein graft** of the popliteal artery
- Post-operative exam revealed palpable right pulses
- Patient has had continued relief of all symptoms at 18 months

Case 4

- 30 yo male with a 2-yr history of pain upon weight bearing and claudication with walking
  - Medical therapy with β-blockers did not provide relief
- Bilateral 4-compartment **fasciotomies** were unsuccessful
- Initial angiogram at UVA showed slow flow in the popliteal arteries bilaterally, but no change with active or passive plantar flexion
- Physical exam demonstrated decreased posterior tibial pulses bilaterally
- Patient underwent a right-sided functional popliteal entrapment release elsewhere but continued to have bilateral leg pain

Case 4 cont'd



- Repeat **angiography** at UVA 8 months later showed bilateral popliteal occlusions with forced **plantar flexion against resistance**
- Staged surgery identified bilateral **type III popliteal entrapment** and a right-sided fibrous band from the lateral head of the gastrocnemius

Conclusions

- The diagnosis of anatomic popliteal entrapment can be elusive
- Often a prior diagnosis of compartment syndrome or functional popliteal entrapment has been made
- Angiographic imaging during forced **plantar flexion against resistance** may be valuable in making the diagnosis

Popliteal Entrapment Release 2013-2018

Dr. Derek de Grijs
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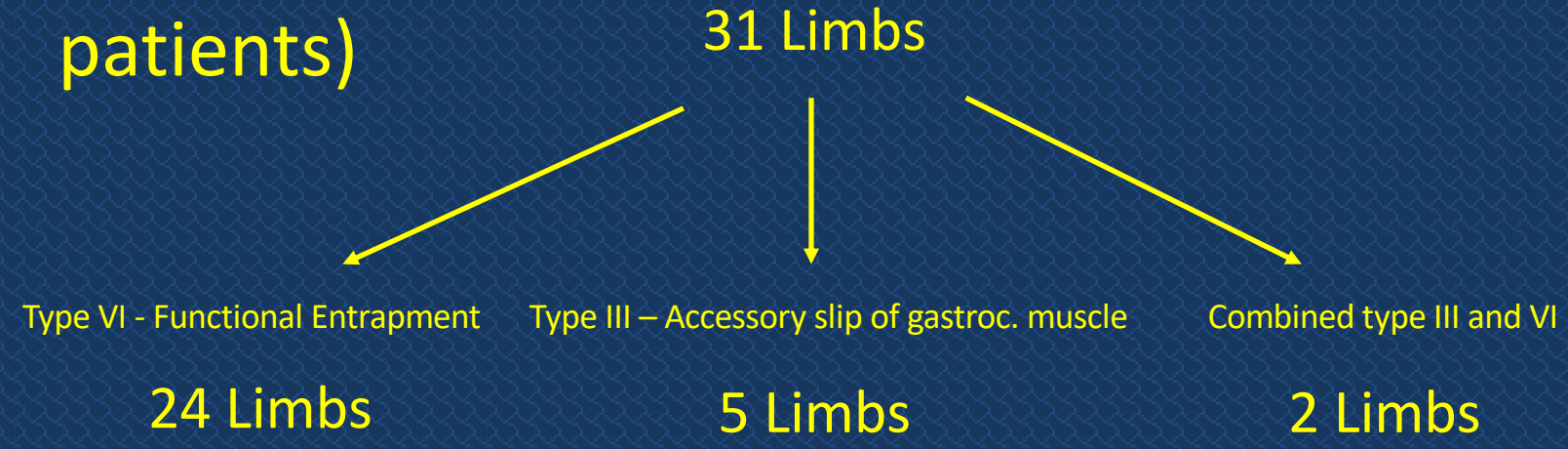
Patients

- 17 total (6 Male / 11 Female); Average Age 25.7
- Total of 31 limbs treated (Bilateral tx in 14 patients)



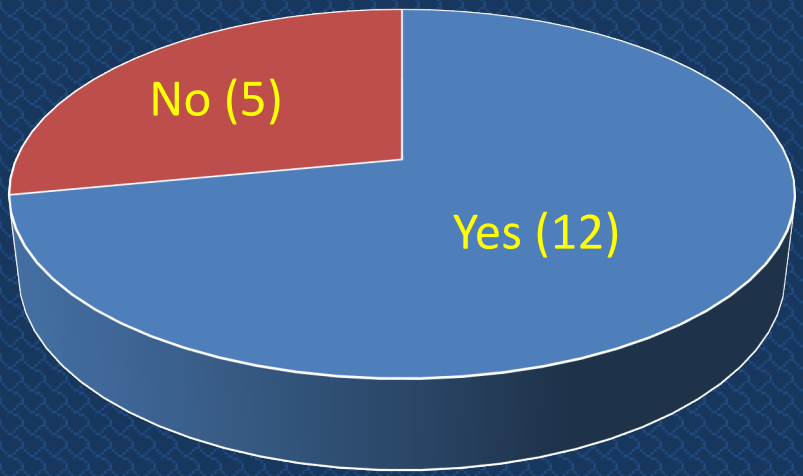
Patients

- 7/17 (41%) had been previously been diagnosed with compartment syndrome and underwent bilateral lower extremity fasciotomy without relief of symptoms

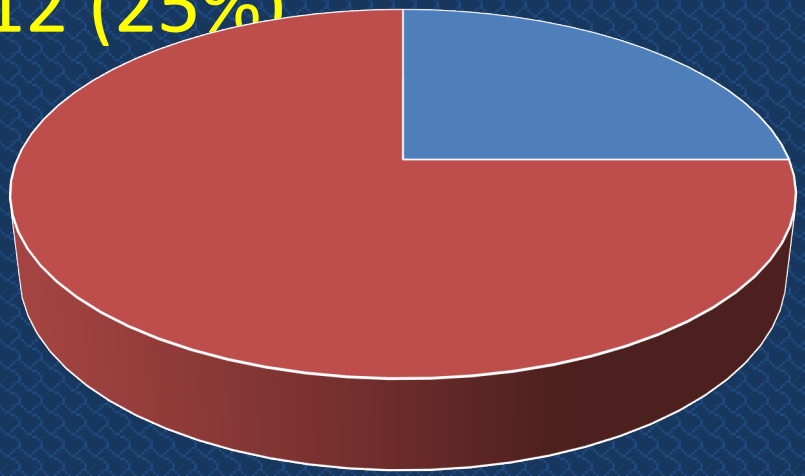
- 1/17 (6%) had undergone previous popliteal artery release

Results

Symptomatic Relief: 12/17 (71%)



Recurrence of Symptoms: 3/12 (25%)



Thoughts

- Imperfect treatment, especially for “functional” PAES
- Have to be willing to re-operate
- Prefer wide posterior approach to medial approach, but utilize medial leg to allow more medial exposure if necessary

Thank you.