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Tips and Tricks in Vascular Imaging Lower Extremity CTA

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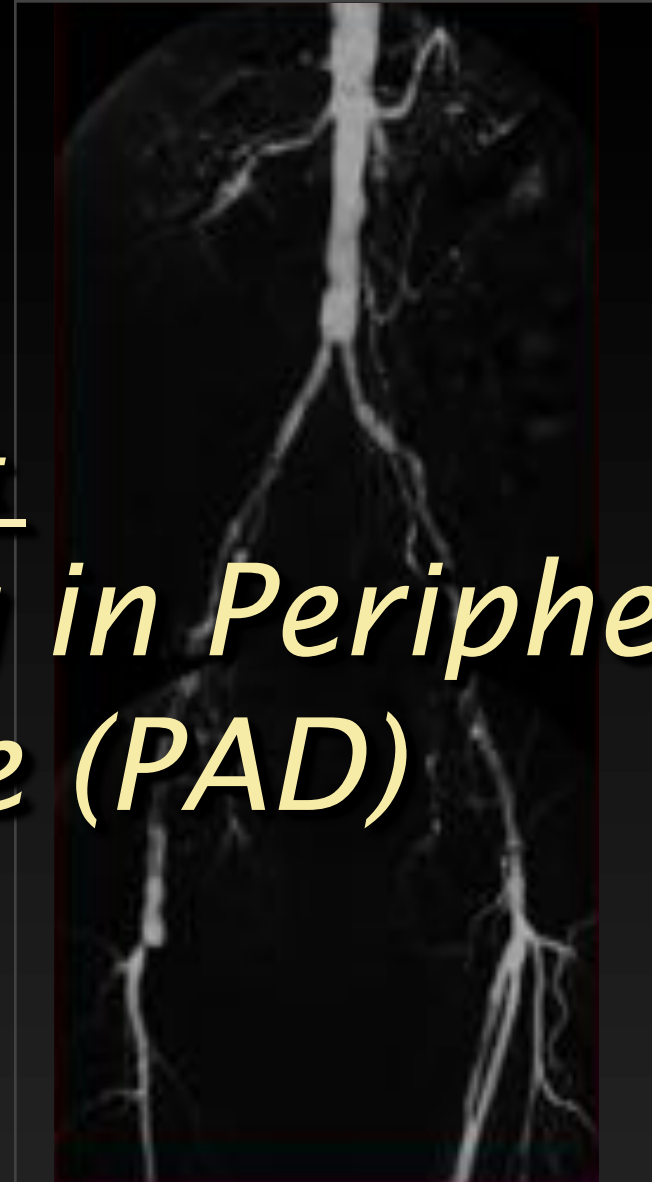
Tips and Tricks in Vascular Imaging
LOWER EXTREMITY CTA

- Clinical context
- Scanning and Contrast Technique
- Postprocessing
- Interpretation & Reporting

HANDOUT:
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Tip 1: Clinical Context

Role of Imaging in Peripheral Arterial Disease (PAD)



Peripheral Artery Disease (PAD)

- manifestation of atherosclerosis in arteries supplying blood to lower extremities

Clinical Symptoms:

- At stress: intermittent claudication
perfusion pressure (ABI<0.8) can't keep up with increased demand when walking;
ischemic tissue is muscle
- At rest: critical limb ischemia
perfusion pressure<baseline demand;
ischemic tissues are skin, nerve, connective tissue



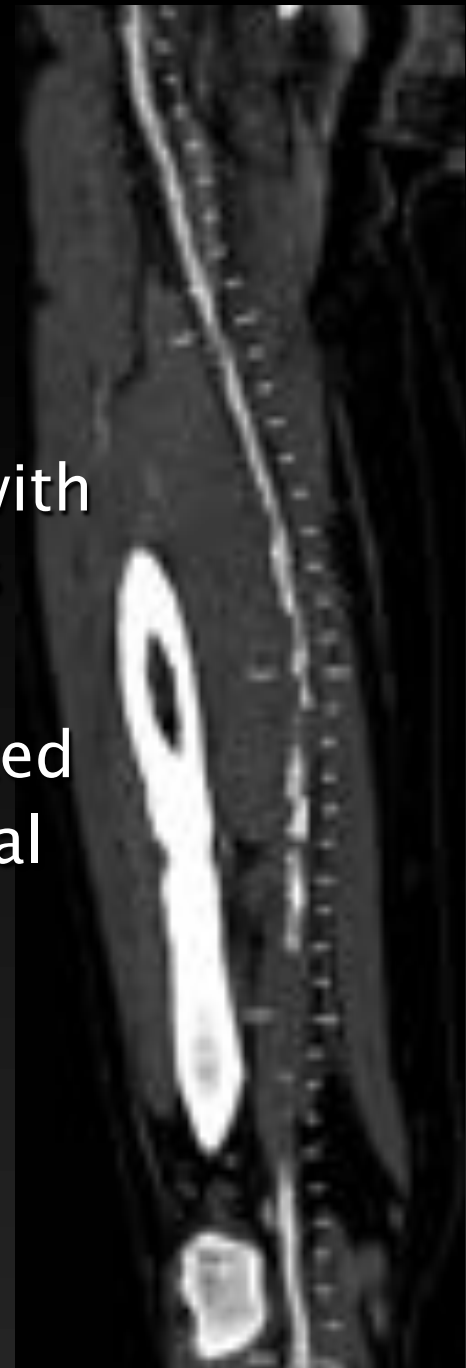
Diagnosis and Staging of PAD

- symptoms +
- ankle-brachial-index
- poor correlation of symptoms and ABI with number, location and severity of lesions

→ calf claudication can be caused by isolated vs a combination of iliac or femoropopliteal lesions

Role of Imaging NOT diagnosis / staging

- mapping of lesions to symptoms for treatment planning

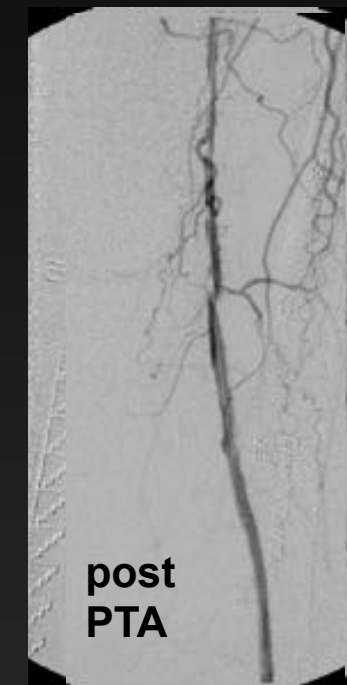
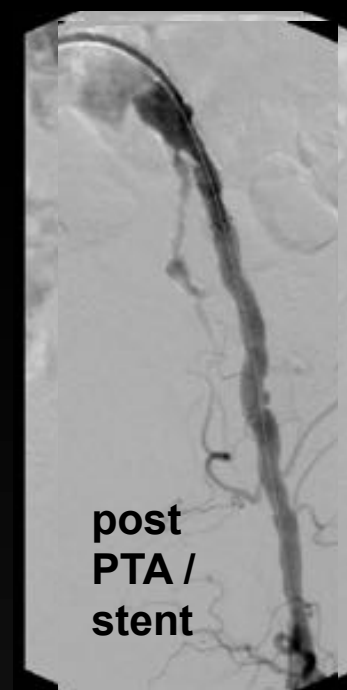


16 x .75mm
2.0mm/1.0mm

MIP

multipath
CPR

73 year old woman with
intermittent claudication
bilaterally



TASC II Criteria

Transatlantic Society Consensus (2007)

Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II)

L. Norgren,* W.R. Hiatt,* J.A. Dormandy, M.R. Nehler, K.A. Harris, and F.G.R. Fowkes on behalf of the TASC II Working Group, *Oslo, Sweden and Denver, Colorado*

INTRODUCTION

The Trans-Atlantic Inter-Society Consensus Document on Management of Peripheral Arterial Disease (TASC) was published in January 2000¹⁻⁴ as a result of cooperation between fourteen medical and surgical vascular, cardiovascular, vascular radiology and cardiology societies in Europe and North America. This comprehensive document had a major impact on vascular care amongst specialists. In subsequent years, the field has progressed with the publication of the CoCadin document⁵ and the American College of Cardiology/American Heart Association Guidelines for the Management of Peripheral Arterial Disease.⁶ Aiming to continue to reach a readership of vascular specialists, but also physicians in primary health care who see patients with peripheral arterial disease (PAD), another consensus process was initiated during 2004. This new consensus document has been developed with a broader international representation, including Europe, North America, Asia, Africa and Australia, and with a much larger distribution and dissemination of the information. The goals of this new consensus are to provide an abbreviated document

Process

Representatives of sixteen societies from Europe, North America, Australia, South Africa and Japan were elected from their respective society and were called together in 2004 to form the new Working Group. Specialists in health economics, health outcomes and evidence-based medicine were also included to elaborate on the text for the following sections: history, epidemiology and risk factors; management of risk factors; intermittent claudication; critical limb ischemia; acute limb ischemia; and technologies (intervention/revascularization and imaging).

The Working Group reviewed the literature and, after extensive correspondence and meetings, proposed a series of draft documents with clear recommendations for the diagnosis and treatment of PAD. Each participating society reviewed and commented on these draft consensus documents. The liaison member from each society then took these views back to the Working Group, where all of the amendments, additions and alterations suggested by each participating society were discussed, and the final Consensus Document was agreed.

TASC II Criteria

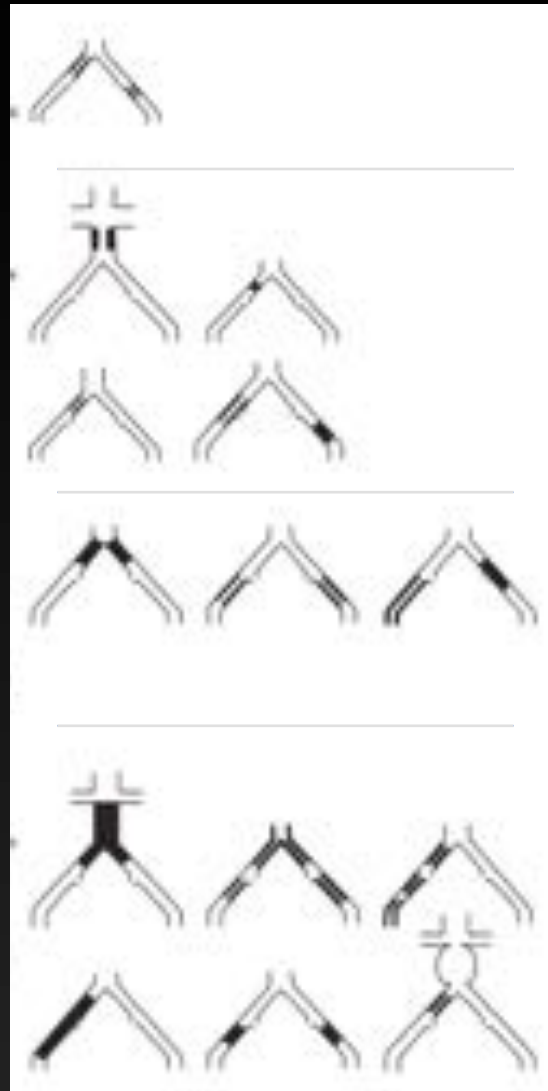
Transatlantic Society Consensus (2007)

Type A
endovascular

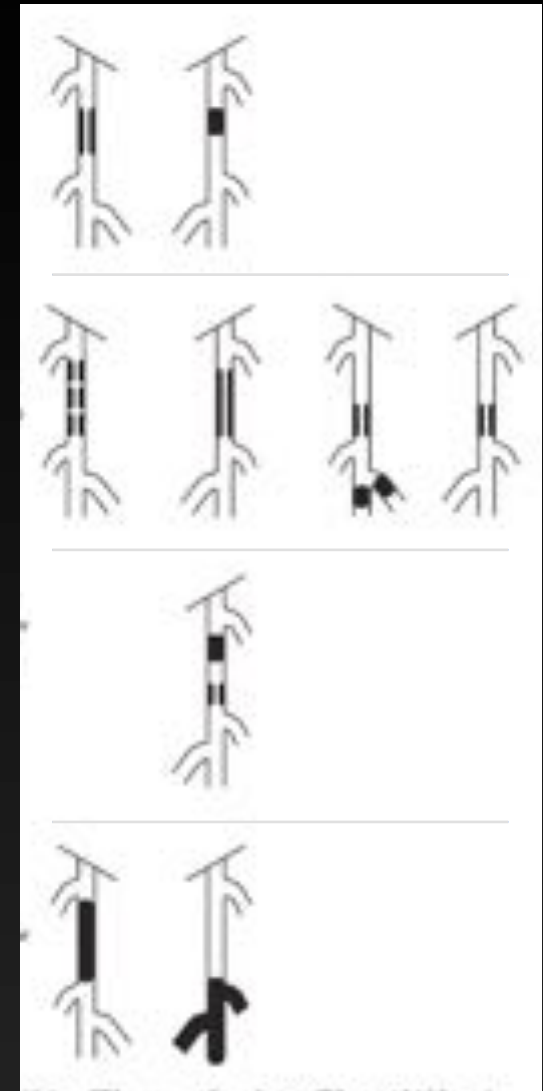
Type B

Type C

Type D
surgical



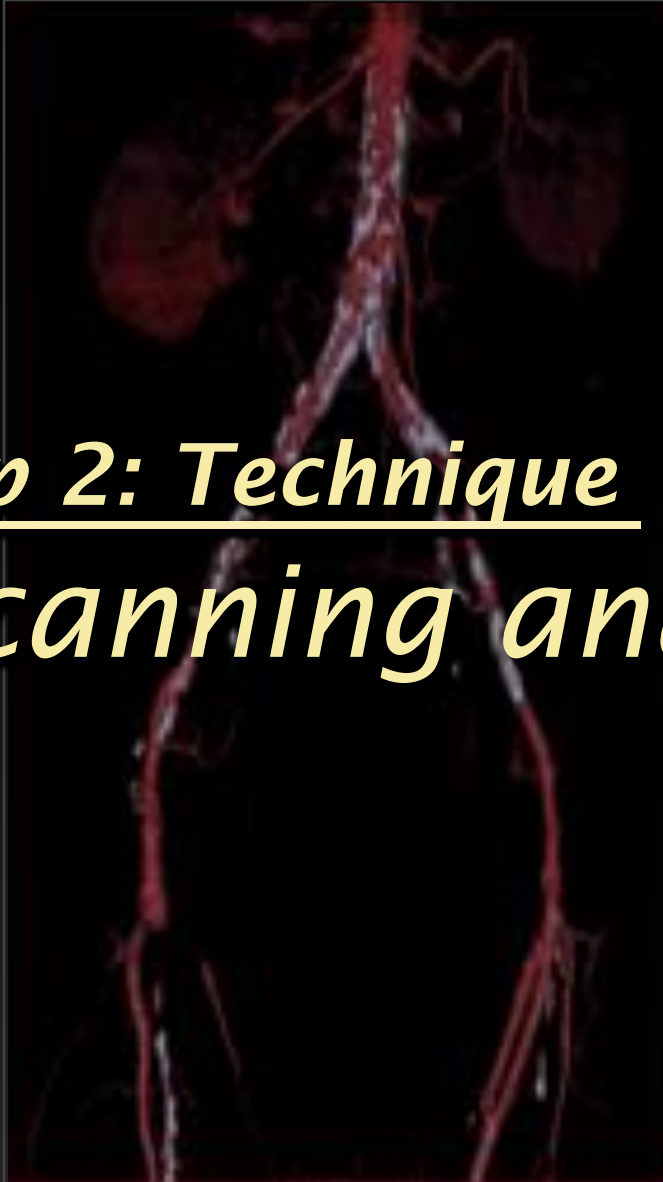
aortoiliac



femoropopliteal

Tip 2: Technique

Scanning and CM Injection



Scanning and CM Injection

- no fancy scanner needed: any CT scanner with ~ 1 mm thickness (≥ 16 -slice MDCT);
- ideally isotropic resolution (sub-millimeter)

Account for slow bolus transit in diseased arteries:

- long injection (~ 35 s)
- scan slow (40s)
- add delayed acquisition, if needed

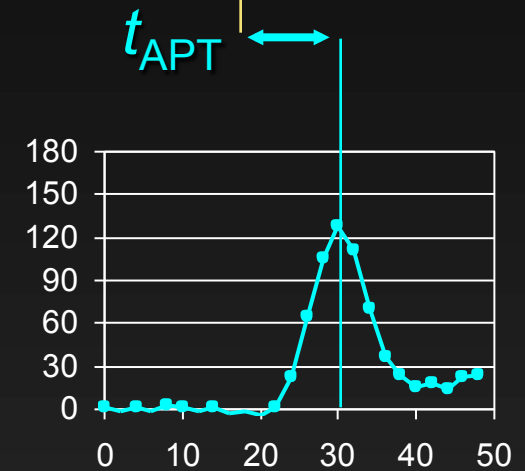
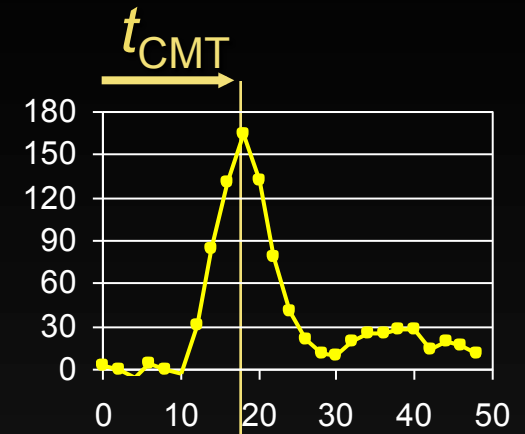
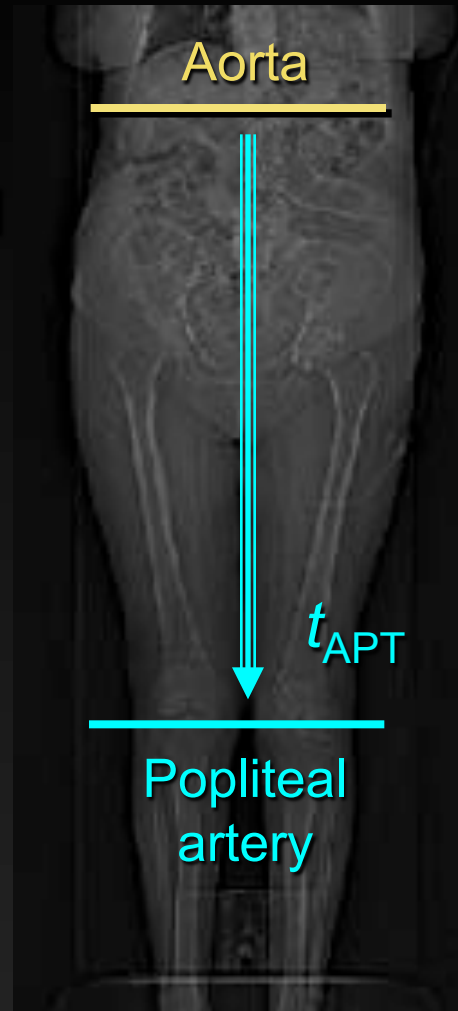
Peripheral Arterial Enhancement

(20 patients with PAOD)

Aorto-popliteal ..

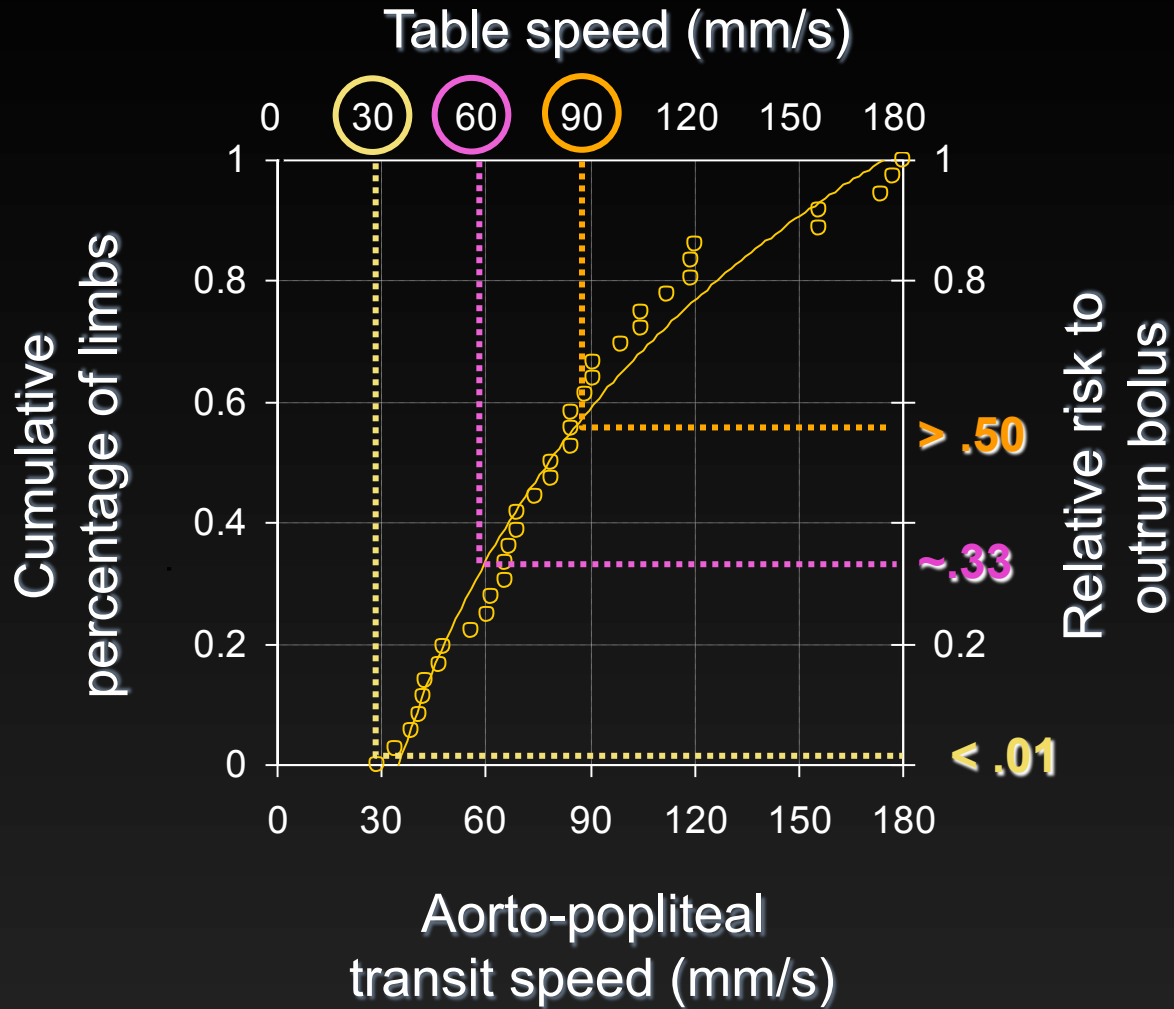
Transit time Transit speed

mean: 10 s	65 mm/s
min: 4 s	177 mm/s
max: 24 s	30 mm/s



t_{APT} = aorto-popliteal transit time
 t_{CMT} = contrast medium transit time

Peripheral arterial bolus propagation





64 - channel Lower Extremities

Scantime: 40s for ALL patients (pitch variable)
(automated tube current modulation)

Inj.duration: 35s for ALL patients

Delay: bolus triggering

weight

Biphasic Injection

<55kg 20 mL (4.0mL/s) + 96 mL (3.2mL/s)

<65kg 23 mL (4.5mL/s) + 108 mL (3.6mL/s)

75kg 25 mL (5.0mL/s) + 120 mL (4.0mL/s)

>85kg 28 mL (5.5mL/s) + 132 mL (4.4mL/s)

>95kg 30 mL (6.0mL/s) + 144 mL (4.8mL/s)

82 y.o. woman

bilateral claudication re>lt

Scanner: 64 × 0.6mm

Scantime: 40 s

Injection

(biphasic): 35 s

20mL (4 mL/s) +
95mL (3.2 mL/s)

Delay: 'CareBolus'



Peripheral CTA Scanning Range

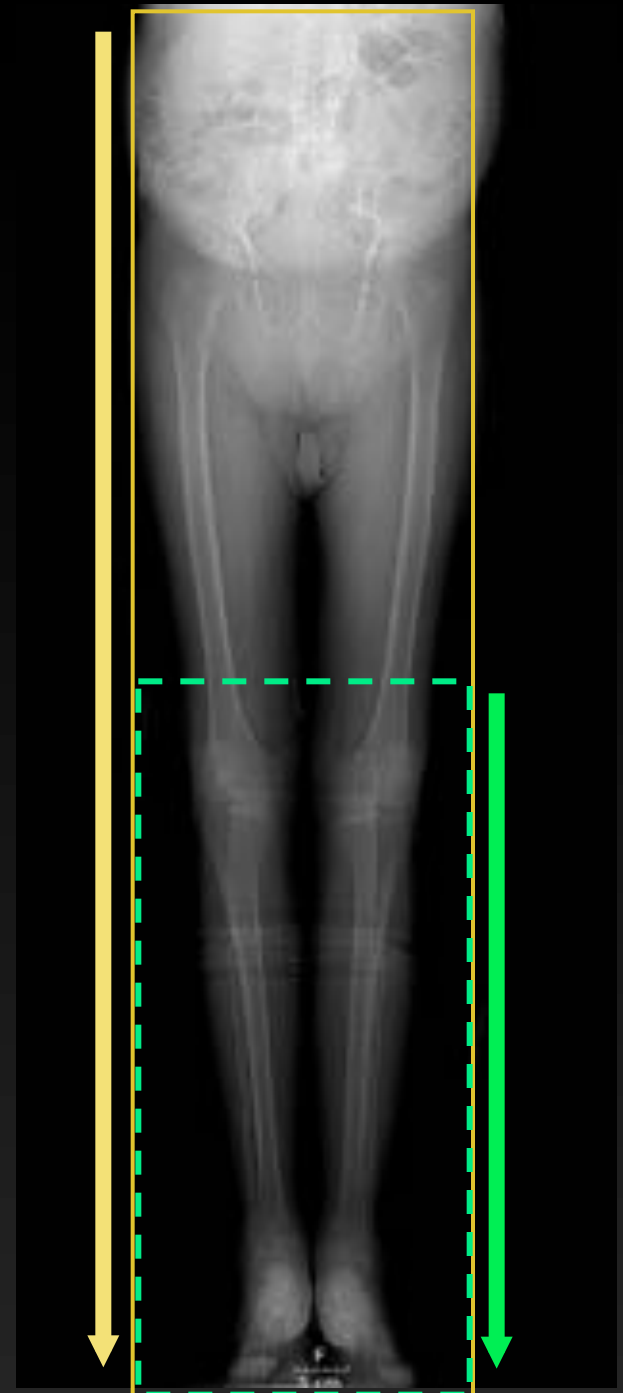
Scanning Range 1

celiac artery (Th12) → toes
(105 – 130 cm)

Optional Additional Scanning Range 2

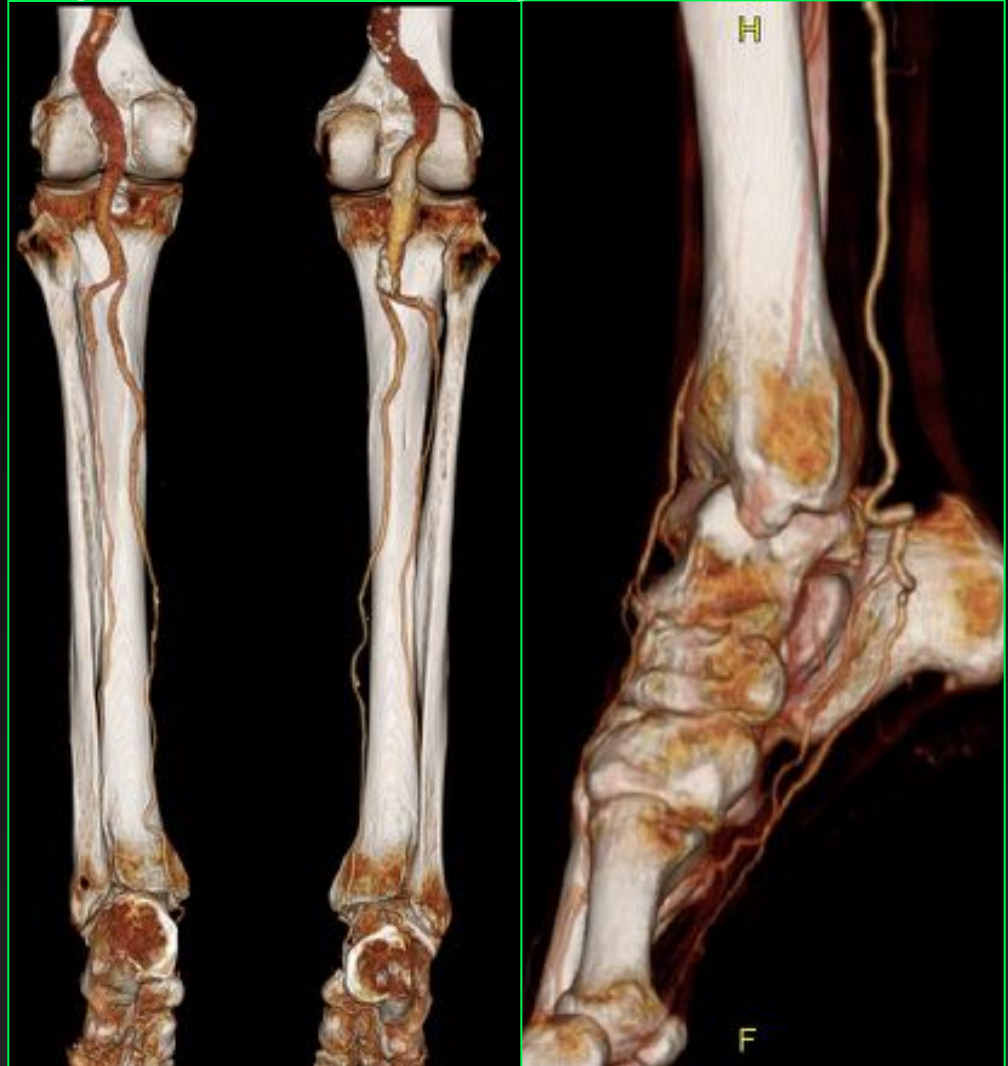
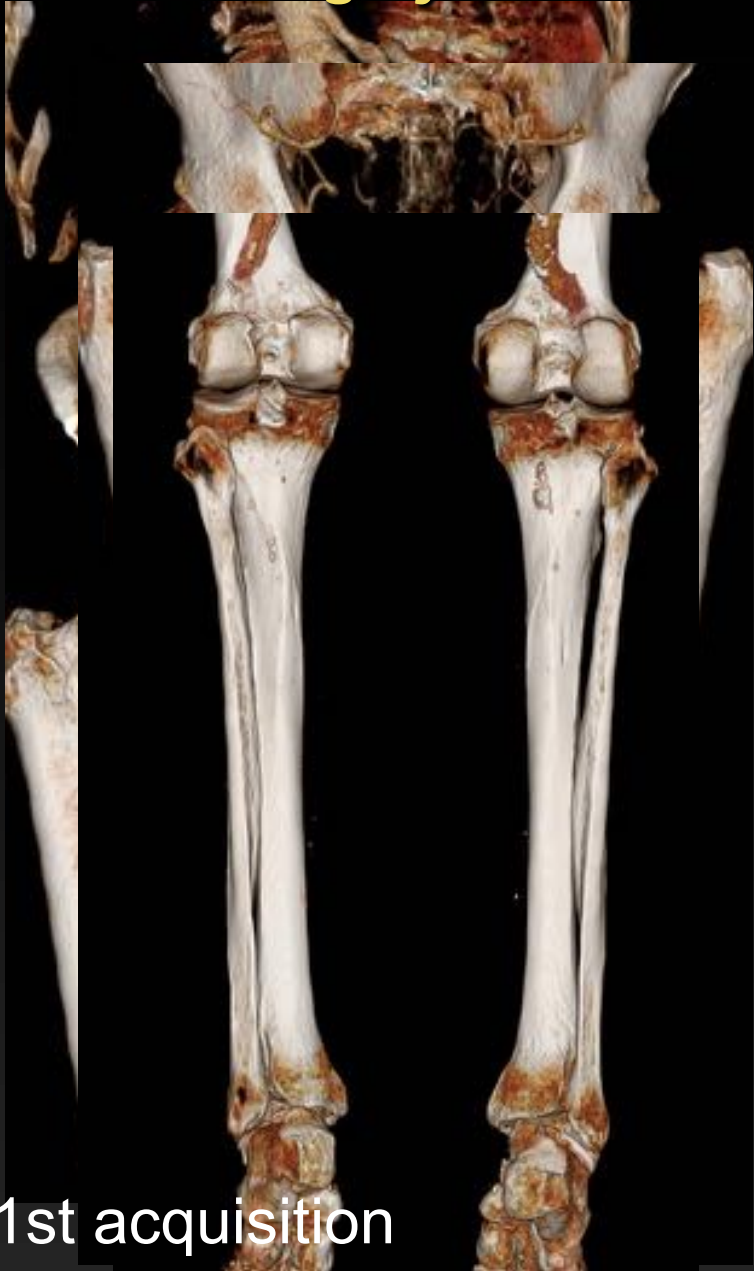
above the knees → toes

Always pre-programmed, but
only initiated by technologist if
no contrast in crural vessels

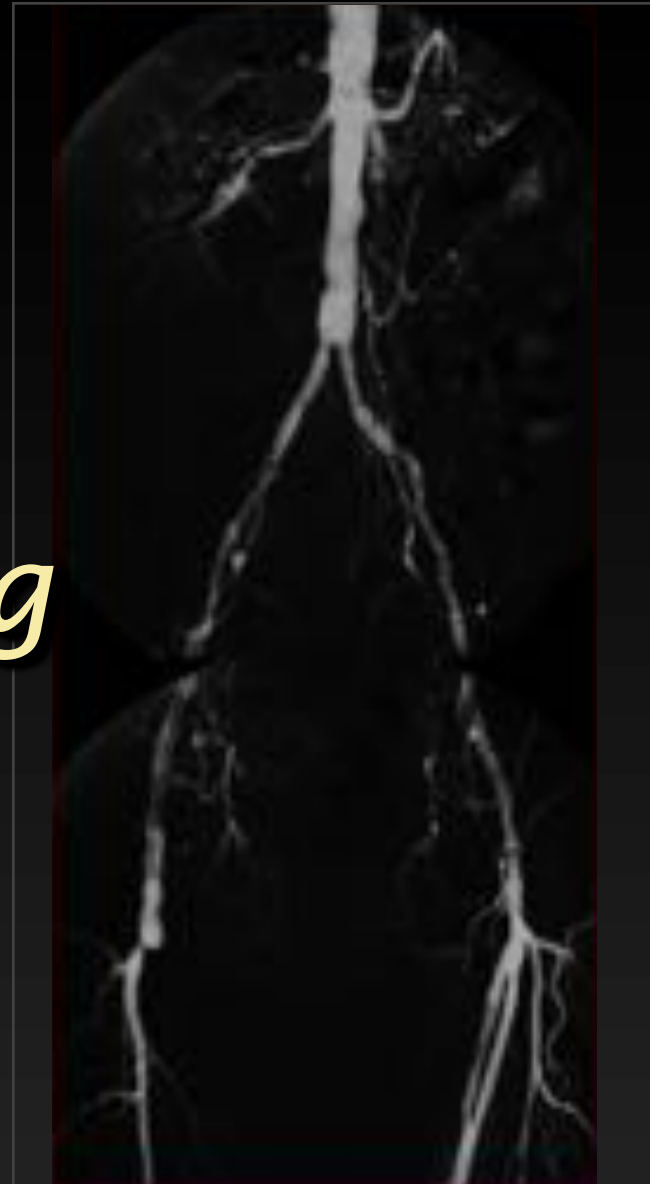
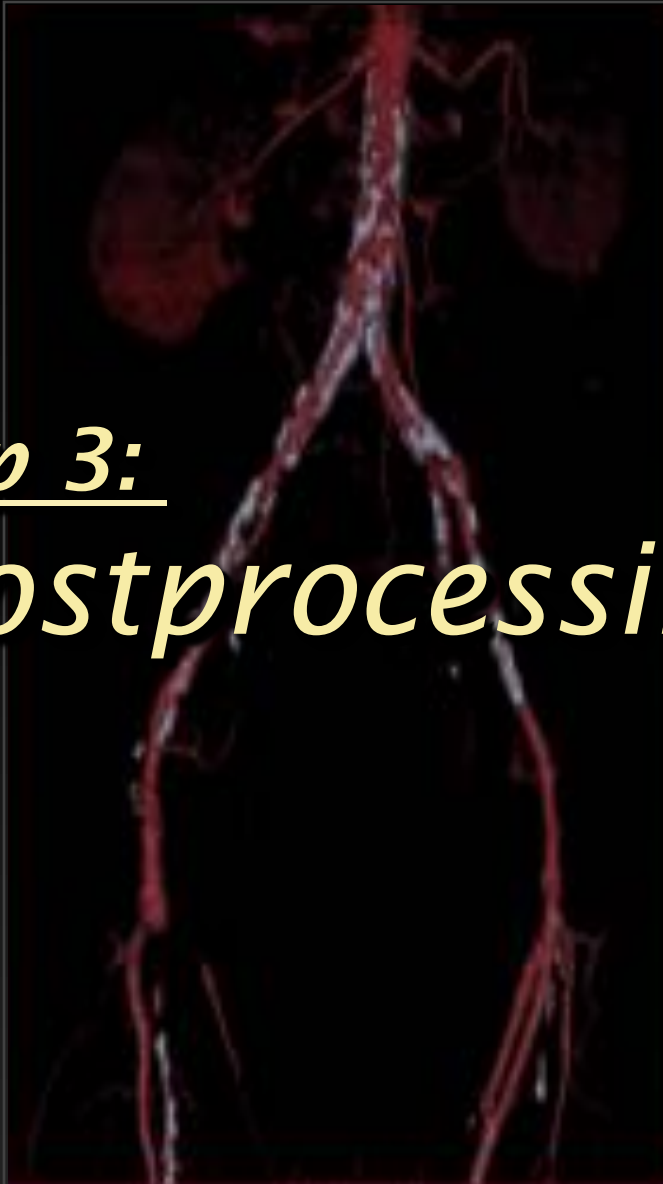


Arteriomegaly

preprogrammed,
optional 2nd acquisition



Tip 3:
Postprocessing



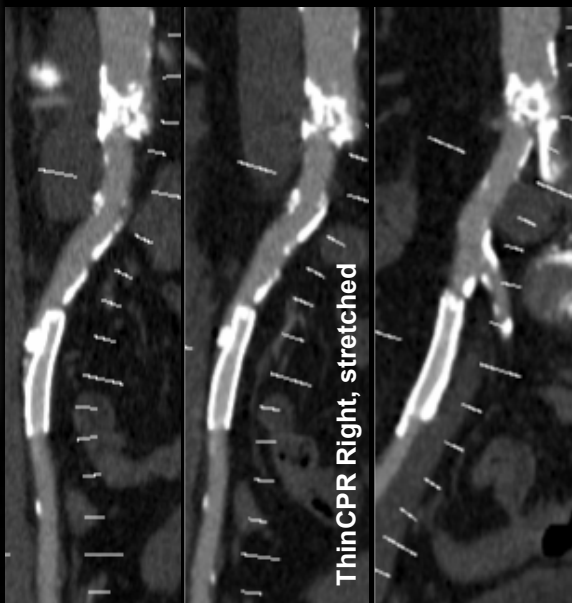
Tips and Tricks for Lower Extremity CTA Postprocessing

- greatest challenge in lower extremity CTA: difference between quick read vs. painful (literally) scrolling through images
- axial (transverse) images inadequate, except in acute ischemia (i.e. thromboembolic)
- need longitudinal cross sections (MPR/CPR)
- ideally, mapping of lesions needs a 'map': 'multipath curved planar reformations'
- try to delegate (3D-Lab, trained technologist) if routinely performing runoff CTAs

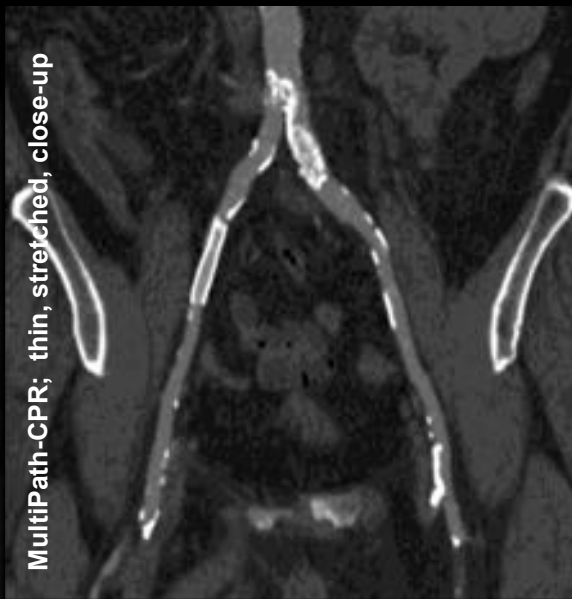
MIP



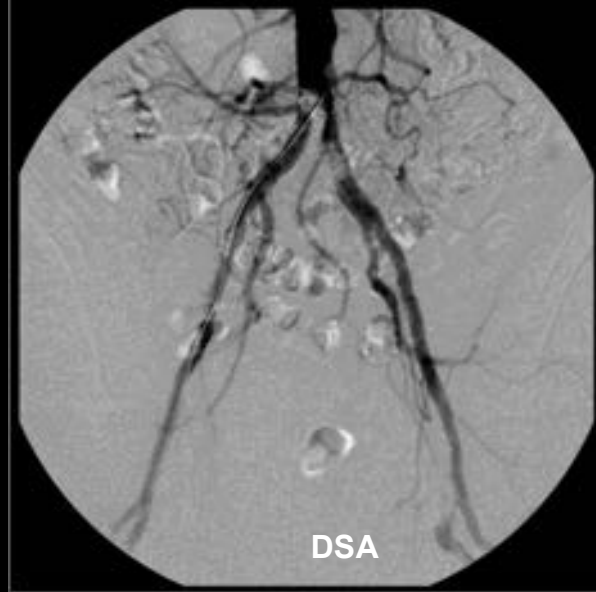
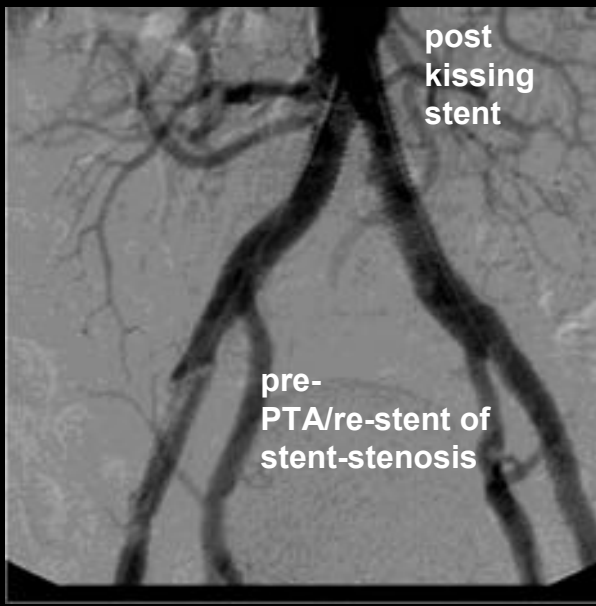
CPRs



MultiPath-CPR; thin, stretched, close-up



DSA



Display on PACS



MIP

Multi-Path CPR

single CPR

Tip 4:

Interpretation & Reporting



'Surgical (endovascular) Segments'

- aorto-iliac = 'suprainguinal' = 'inflow'
- common fem. a. important landmark;
bypass target/source
[Profunda fem. a.] [important collateral if SFA
occluded; post amput.]
- femoropoplital a. 'infra-inguinal' = 'runoff'
reconstitution of pop. a.
(pop.: P1, P2, P3) above (P1) or below (P3) knee
- below knee aa. only relevant in CLI,
can ignore in claudicants
- pedal arteries only CLI, bypass targets

Systematic Approach to Reading Lower Extremity CTA

answer clinical questions rather than listing lesions

- intermittent claudication?
critical limb ischemia ?
-- determines how you read scan
- organize first by leg, and then by station

Right/left lower extremity

- **aortoiliac** (inflow disease [above inguinal lig.])
- (common fem a.); - (deep femoral artery)
- **femoropopliteal** artery; SFA, P1, P2, P3
- **below knee** (infrapop.) runoff: 2 vessels cross ankle)
- (pedal)

Tips and Tricks in Vascular Imaging
LOWER EXTREMITY CTA: SUMMARY

- Clinical context
 - goal is to map lesions to clinical symptoms
 - 'stress' (claudication) vs. 'resting' (CLI) ischemia
- Scanning and Contrast Technique
 - inject long, and scan slow
- Postprocessing
 - curved planar reformats
- Interpretation & Reporting
 - don't read study without knowing symptoms
 - answer clinical question rather listing lesions

SAM Question

Which of the following statements regarding lower extremity CTA is correct ?

- A. the diagnosis of peripheral artery disease is fundamentally based on imaging
- B. symptoms and ankle-pressure-index (ABI) not only establish the diagnosis of peripheral artery disease, but also accurately localize the anatomic level of obstruction
- C. the role of imaging in peripheral artery disease is not making the diagnosis, but to map (localize) obstructive lesions for treatment planning
- D. in patients with calf claudication, evaluation of the distal below-knee arteries is important for treatment planning

SAM Question **ANSWER**

Which of the following statements regarding lower extremity CTA is correct ?

- A. the diagnosis of peripheral artery disease is fundamentally based on imaging
- B. symptoms and ankle-pressure-index (ABI) not only establish the diagnosis of peripheral artery disease, but also accurately localize the anatomic level of obstruction
- C. **the role of imaging in peripheral artery disease is not making the diagnosis, but to map (localize) obstructive lesions for treatment planning**
- D. in patients with calf claudication, evaluation of the distal below-knee arteries is important for treatment planning

Reference: Fleischmann D, Hallett RL, Rubin GD. CT angiography of peripheral arterial disease. J Vasc Interv Radiol. 2006;17:3-26



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Thank you...

*Special thanks:
Dominik Fleischmann, MD*

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