

EXTREMITY CASE STUDIES, PEARLS, TRICKS, AND TECHNIQUES

Jill Sommerset RVT

PeaceHealth SW Thoracic & Vascular Surgery
Elson S. Floyd College of Medicine
Washington State University
Vancouver, WA

DISCLOSURES

- CSI CONSULTANT
- PHILIPS CONSULTANT

Site	Velocity	Waveform
EIA D		
CFA	1.0	RF
PFA	2.6 L	
SFA P	0.2	0
SFA M	0	0
SFA L	0	0
SFA D	4.0	RF
POP P	2	MC
POP M	1.2	MC
POP D	1.2	MC
TPT	11	MC
ATA M	1.6	MC
ATA D	1.1	MC
PTA M	1.2	MC
PTA D	1.0	MC
PER M	1.2	MC
PER D	1	MC

Duplicate inferior bilaterally

Site	Velocity	Waveform
EIA D		
CFA	1.4	RF
PFA	2.1	30°
SFA P	0	0
SFA M	0	0
SFA L	0	0
SFA D	1.8	MC
POP P	2.0	MC
POP M	2.2	MC
POP D	1.9	MC
TPT	2.1	MC
ATA M	1.0	MC
ATA D	0.5	MC
PTA M	1.4	MC
PTA D	1.4	MC
PER M	1.2	MC
PER D	1.2	MC

ABI

Plantar Acceleration Time (ms)					Right CFA	Left CFA
Site	Anterior	Medial	Lateral	Distal		
RT	5.6	13.6	13.5		2-2-2-2-2	1.5-1.5-1.5
LT	5.2	14.4	14.3			
IT	5					

TBI

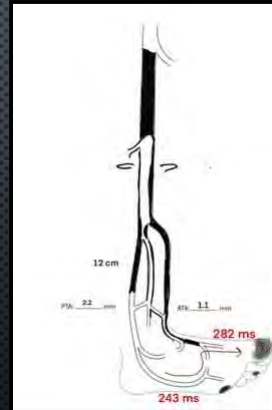
TCPO2

ARTERIAL DUPLEX ULTRASOUND

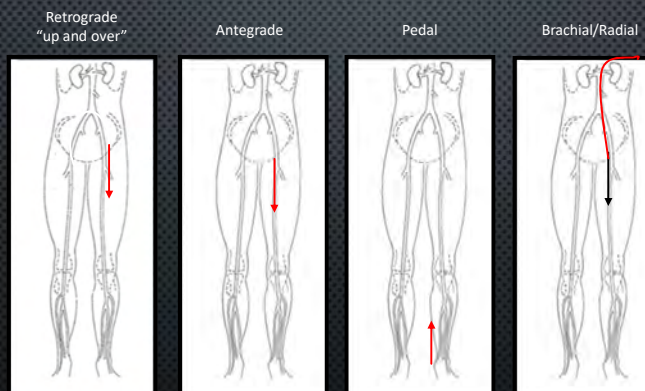


8 KEY ELEMENTS

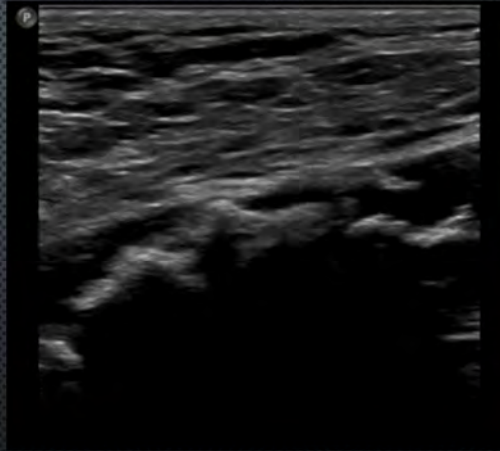
- 1) Access options for endovascular intervention
- 2) Additional information of the Profunda
- 3) Details of the SFA occlusion (CTO cap morphology)
- 4) Level of SFA reconstitution
- 5) Runoff details and options for Pedal Access
- 6) Communicating Arteries
- 7) Pedal Acceleration Time (PAT)
- 8) Pedal Flow Hemodynamics



ACCESS OPTIONS



- Plaque characteristics
- High SFA/PFA bifurcation
- Aneurysmal



CFA plaque

Endovascular options:

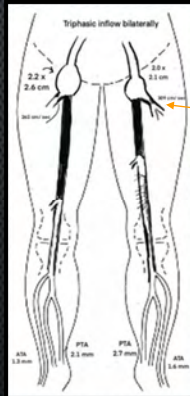
- Pedal
- CFA
- Radial/Brachial

Open surgery options:

- Fem to above knee Popliteal bypass graft-
Can use vein or synthetic material (propaten)
- Fem to below knee Popliteal bypass graft-
Use vein – low patency rate with synthetic material

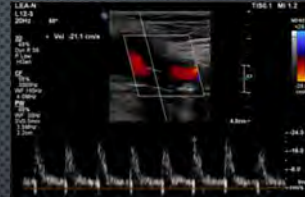


PROFUNDA EVALUATION

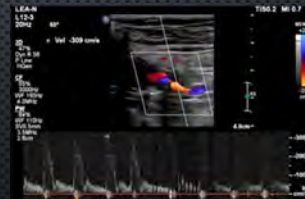


Profunda: 306 cm/sec

(*) CLTI patients - scan to the 1st or second order branch

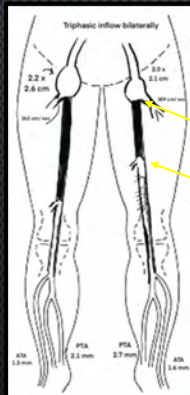


Origin



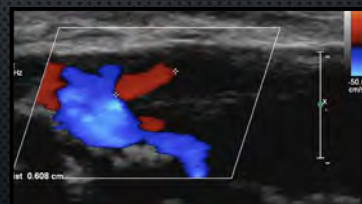
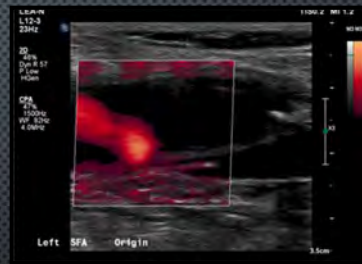
★ 1st Order branch
309 cm/sec

SFA OCCLUSION

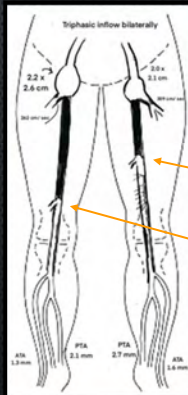


Flush Occlusion

Concave cap from the foot

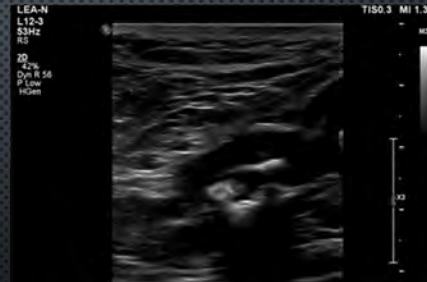


LEVEL OF SFA RECONSTITUTION



- Long CTO to cross?
- Is there vein for a conduit?
- PTFE or Composite?

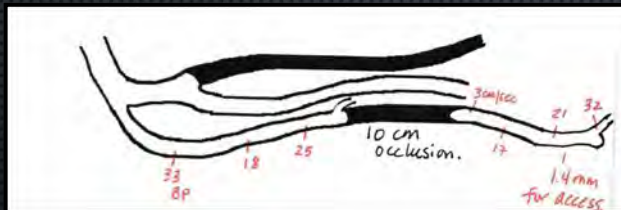
Above the knee bypass
Below the knee



Distal Target

RUNOFF DETAILS AND PEDAL ACCESS OPTIONS

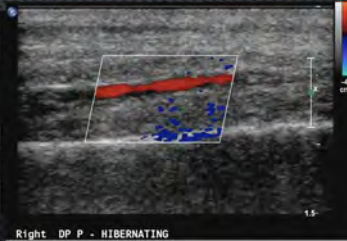
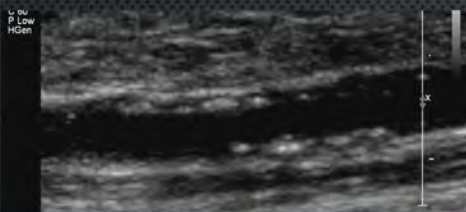
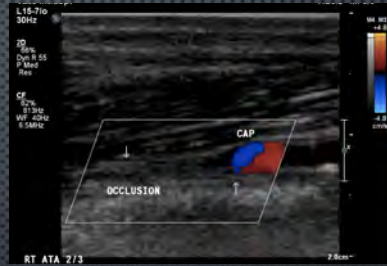
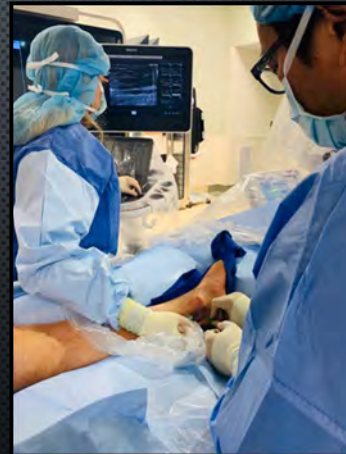
- Tibial stenosis
- Calcified ?
- Length of occlusion
- Pedal Diameters



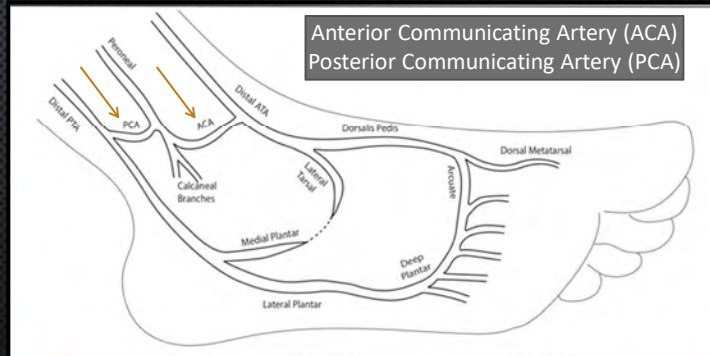
RUNOFF DETAILS AND PEDAL ACCESS OPTIONS



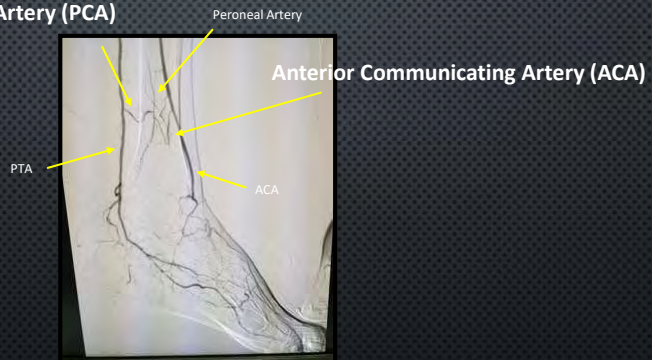
- AP Diameter
- Plaque Morphology



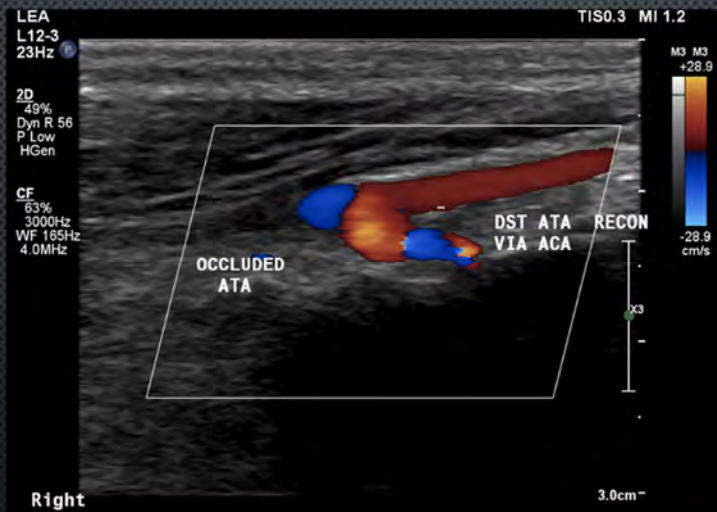
COMMUNICATING ARTERIES

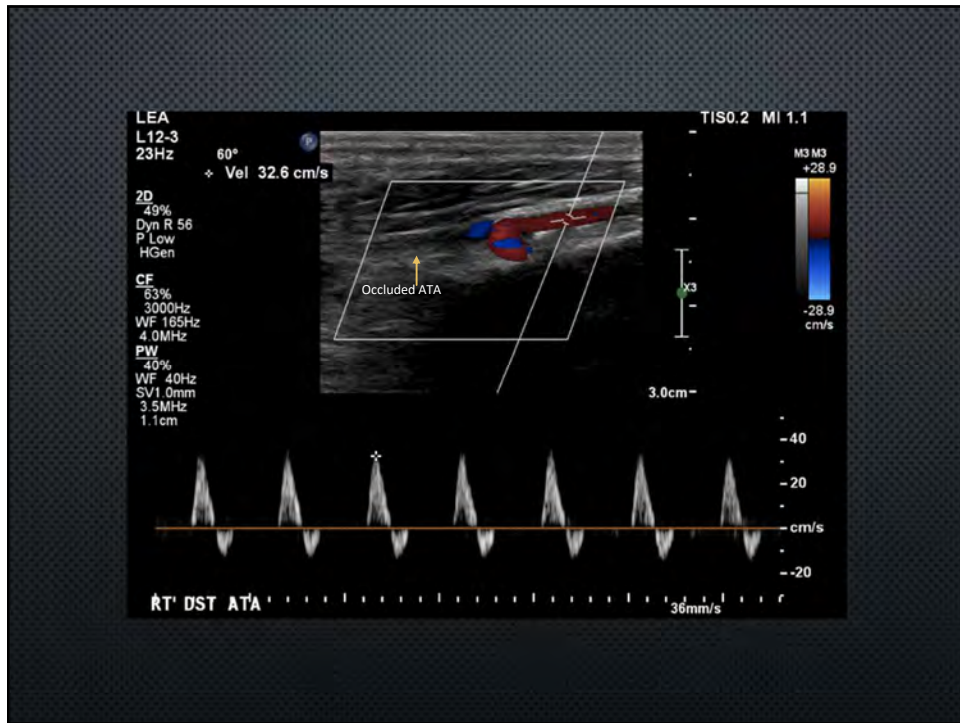
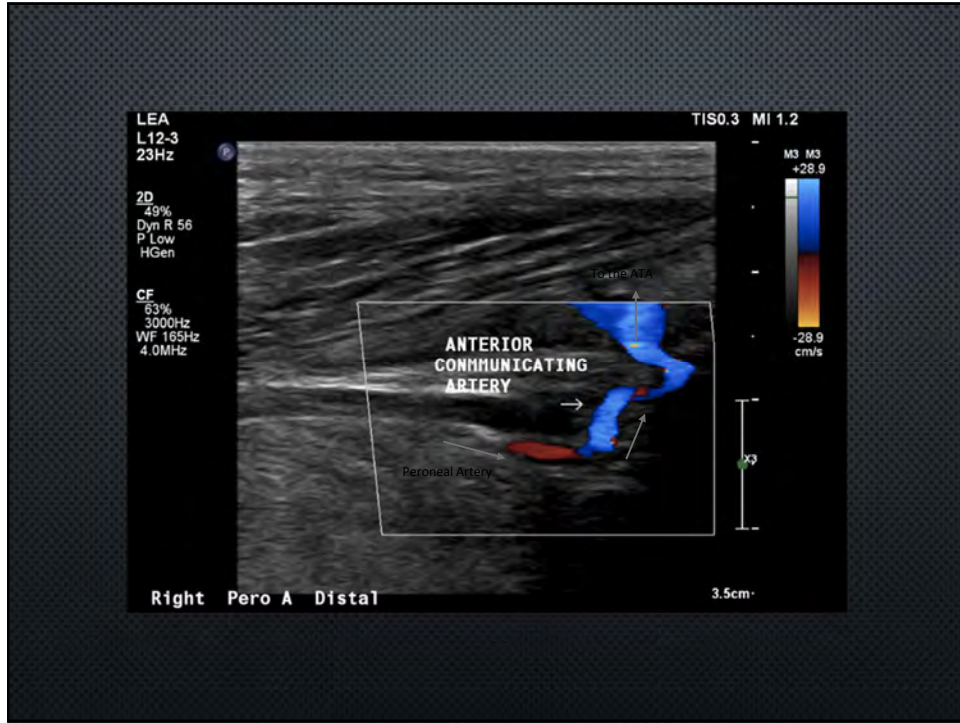


Posterior Communicating Artery (PCA)

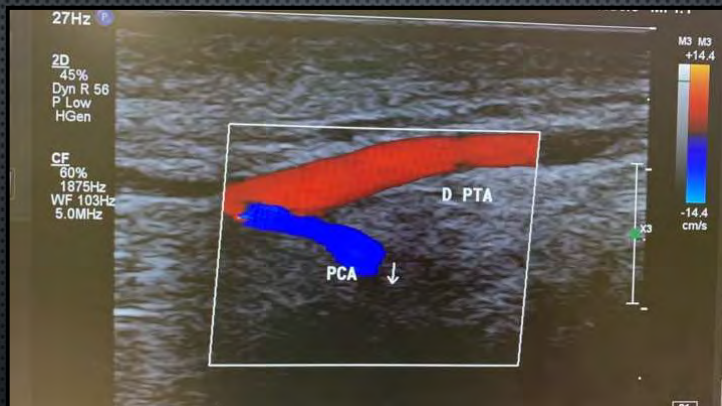


VIEW FOR THE ACA - LATERAL APPROACH

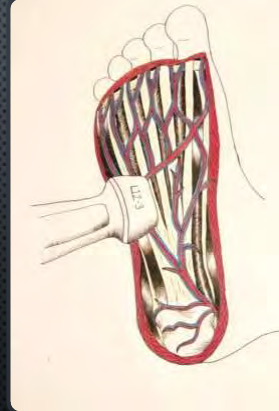




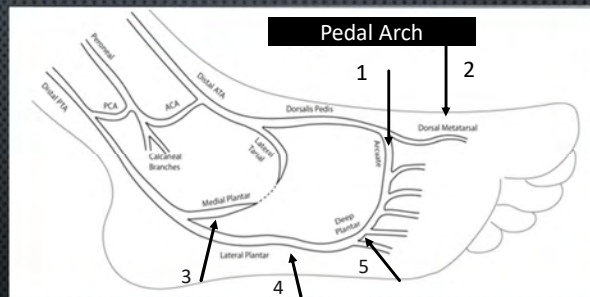
VIEW FOR THE PCA - MEDIAL APPROACH



PEDAL ACCELERATION TIME(PAT) AND PEDAL ARCH DUPLEX

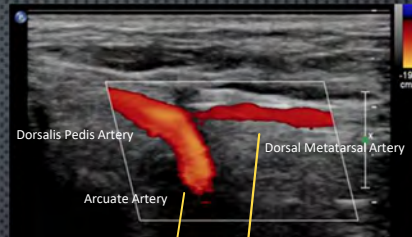


- 1) Arcuate Artery
- 2) Dorsal Metatarsal
- 3) Medial Plantar
- 4) Lateral Plantar
- 5) Deep Plantar

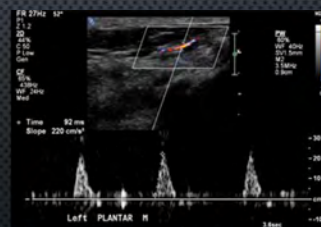
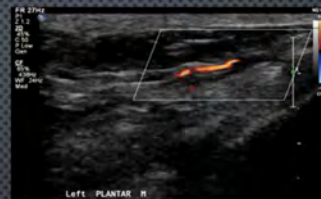


1) Arcuate Artery

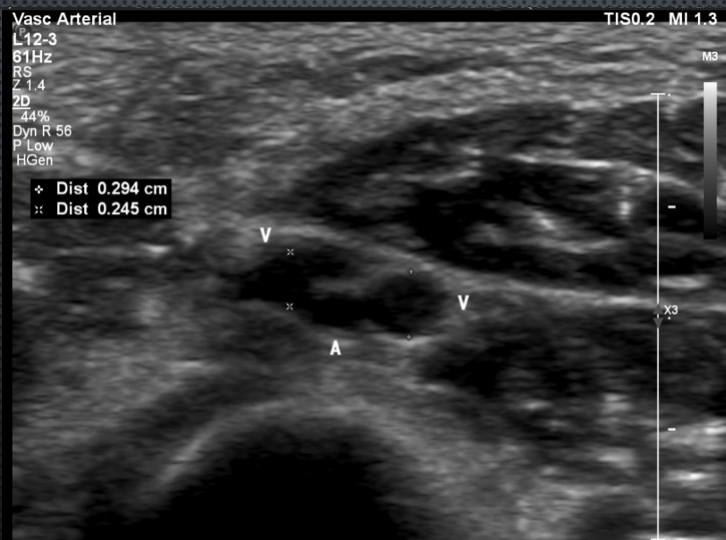
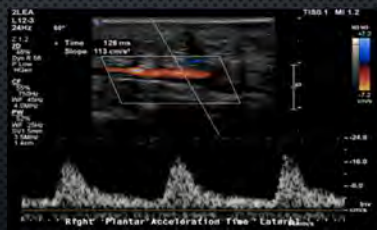
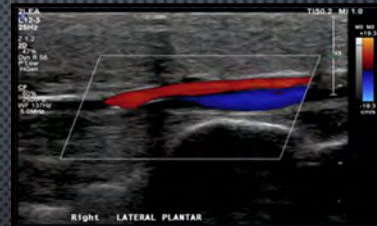
2) Dorsal Metatarsal Artery

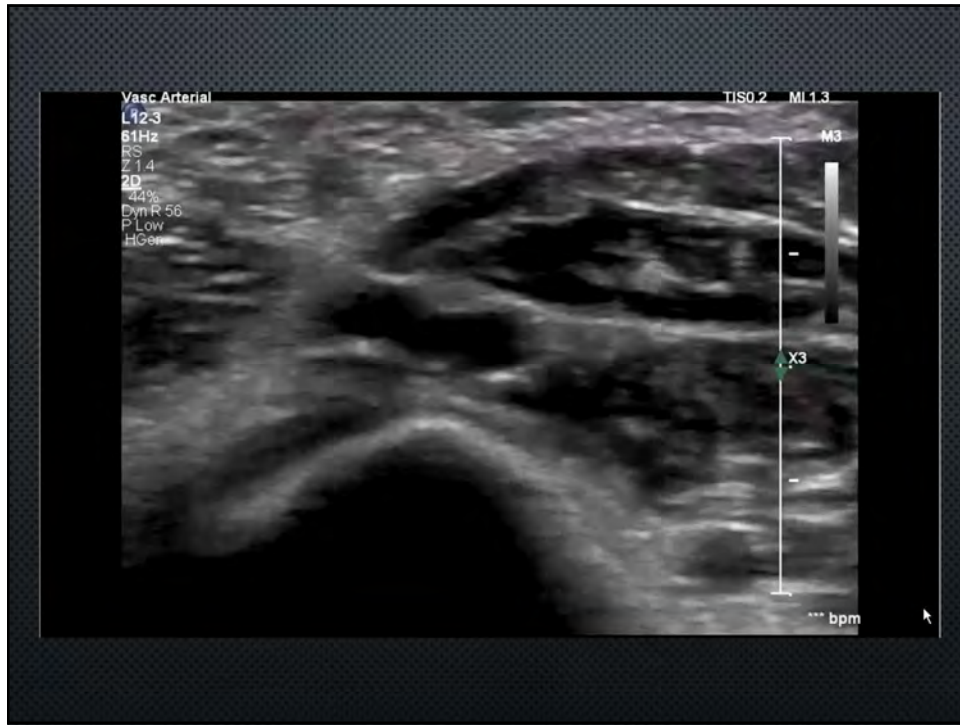


3) Medial Plantar Artery



4) Lateral Plantar Artery

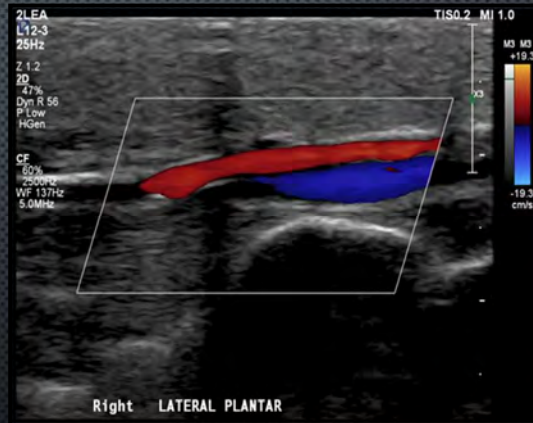




5) Deep Plantar Artery

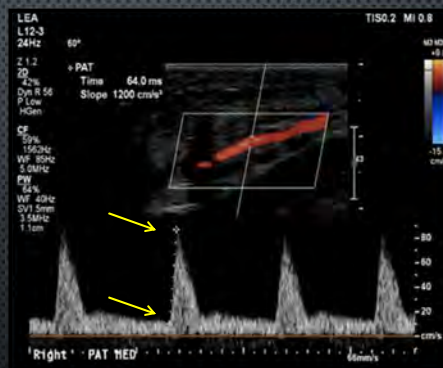


1. Correct probe orientation
2. Decrease color scale
3. Adjust the color box appropriately



CORRECT MEASURING TECHNIQUE

1. Medium sweep speed
2. Decrease scale to fill $\frac{3}{4}$ of the spectra
** very important
3. Time/slope
4. Onset of systole to the peak of systole



PAT CRITERIA

Clinical Symptoms	No Ischemia Class 1	Mild Ischemia Class 2	Moderate Ischemia Class 3	Severe Ischemia Class 4
PAT	20 – 120 ms	121 – 180 ms	181 – 224 ms	Greater than 225ms
ABI	1.3 – 0.90	0.89 – 0.69	0.68 – 0.50	0.49 – 0.00

Sommerset et al AVS 2019

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Articles in Press

Plantar Acceleration Time: A Novel Technique to Evaluate Arterial Flow to the Foot

Jill Sommerset¹, Riyad Karmy-Jones^{1,2}, Matthew Daily³, Denise Feliciano⁴, Yolanda Yee⁴, Desaron Teso⁴

JG, Plant Medica
DOI: <https://doi.org/10.1016/j.avsv.2019.09.002>

Background
Ankle duplex ultrasonography (ADU) and ankle brachial index (ABI) are accepted methods for assessing lower limb arterial perfusion. However, in a significant number of diabetic patients, medial wall calcification often precludes an ABI measurement. Direct, noninvasive duplex imaging of the pedal arch in the setting of peripheral arterial disease (PAD) has not been well established. Although plantar arch interrogation is new to vascular ultrasound, imaging the plantar arch appears to be a reliable angiographic technique for critical limb ischemia. We sought to define the utility of Plantar Acceleration Time as a surrogate for ABI.

Methods
Patients undergoing DUA including Plantar Acceleration Time for suspicion of PAD were retrospectively reviewed in a prospective database over a 1-year period. Two hundred fifty non-dialysis patients (89 limbs) with documented PAD were studied. Plantar Acceleration Time was calculated (reference range) in each limb in the lateral plantar arch. Statistical analyses were performed using linear regression and analysis of variance testing using Microsoft Excel database (version 2016, Microsoft Corp., Redmond, WA). Patients were then grouped into 4 classes based on their clinical symptoms and ABI. Plantar Acceleration Time was similarly

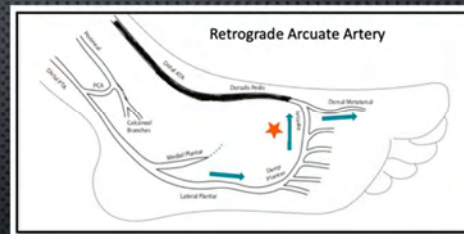
PEDAL FLOW HEMODYNAMICS

Article

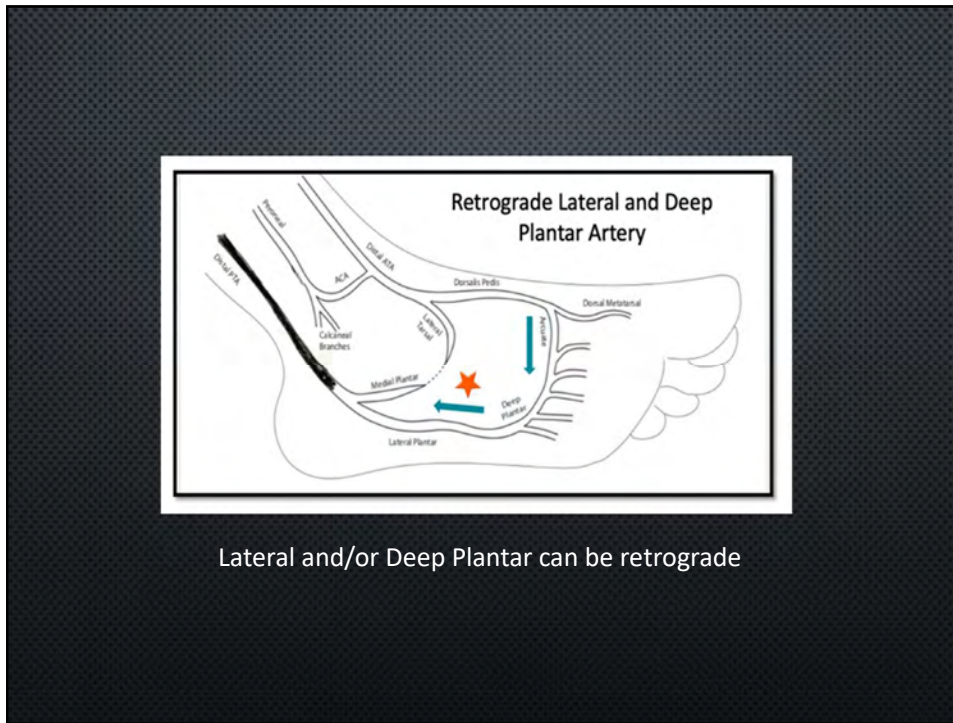
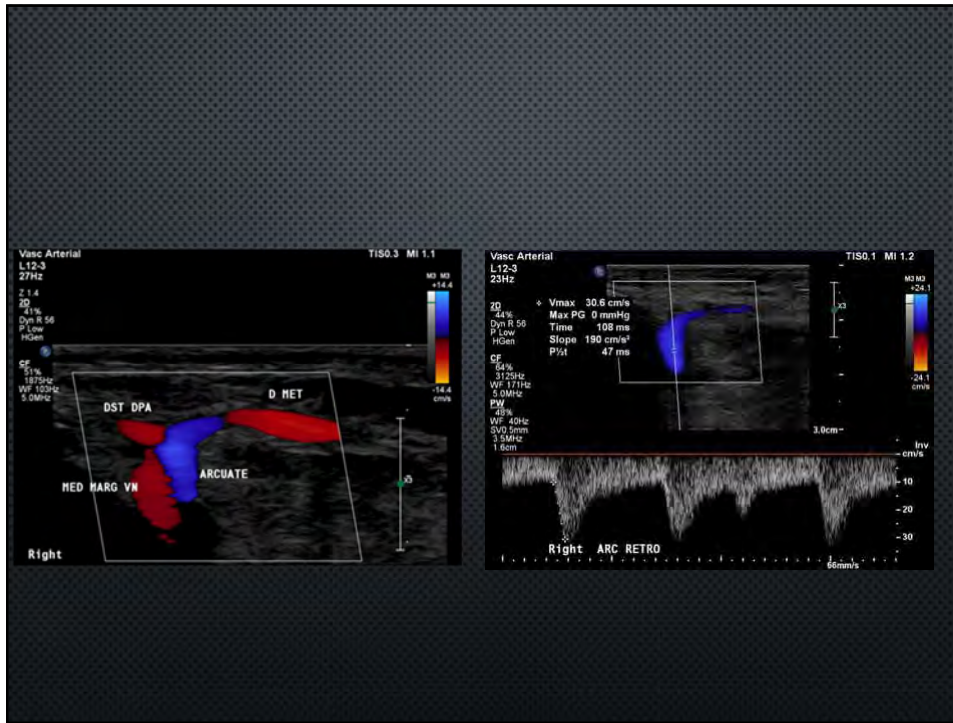
Pedal Flow Hemodynamics in Patients With Chronic Limb-Threatening Ischemia

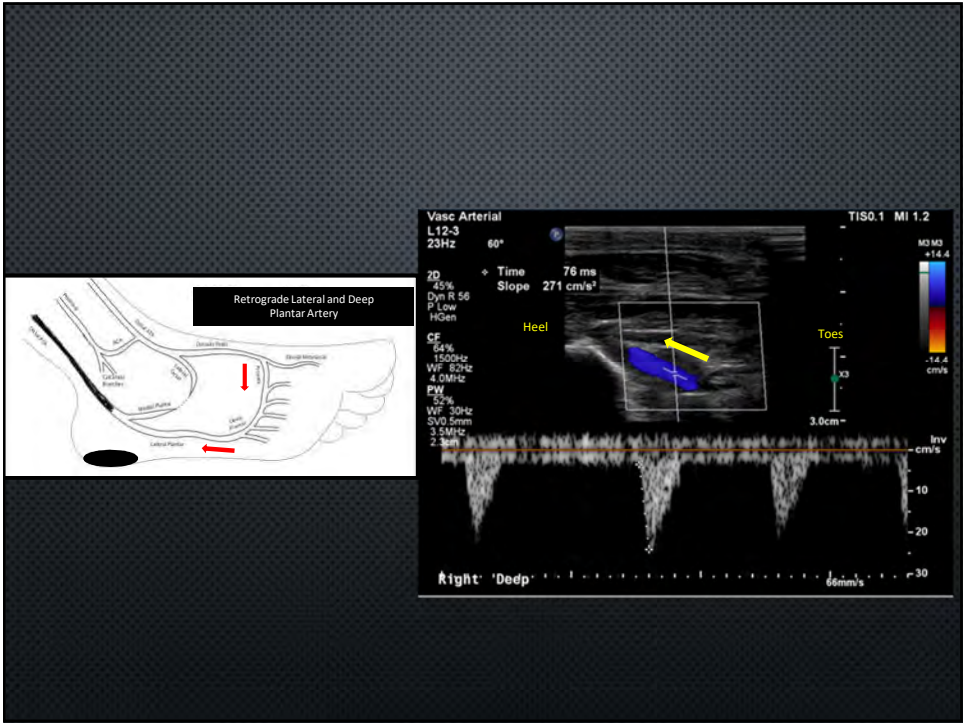
Jill Sommerset, RVT¹, Desaron Teso, MD¹, Riyad Karmy-Jones, MD¹, Yolanda Yee, MD¹, and Beejay Feliciano, MD¹

Abstract
Ankle-brachial index (ABI) and duplex ultrasonography (DUS) are accepted standardized tests performed on patients with suspected peripheral arterial disease in the lower extremities. However, ABI can be a variable test for disease above the level of the ankle. The lateral index (LTI) is also an accepted modality to test for small vessel disease. However, ABI and LTI fall short in providing a complete evaluation of arterial flow especially in pedal arteries in the setting of aortoiliac disease. Direct duplex ultrasonography (DUA) provides a comprehensive evaluation of arterial flow hemodynamics in the lower extremities. However, we remain to understand the role of arterial collateral flow to the foot in the setting of distal vessel occlusion. Using DUA, we sought to define the changes that occur in the arterial flow hemodynamics in the foot in relation to occlusion of specific distal

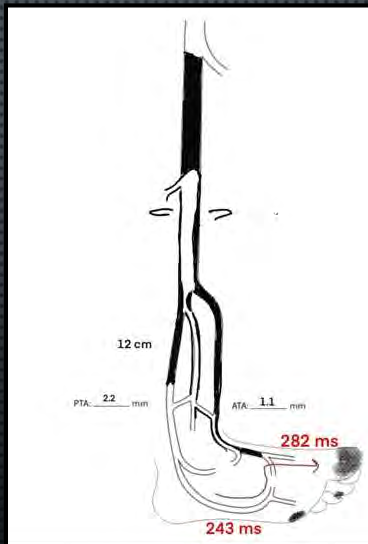


Arcuate can be retrograde






Put it all together



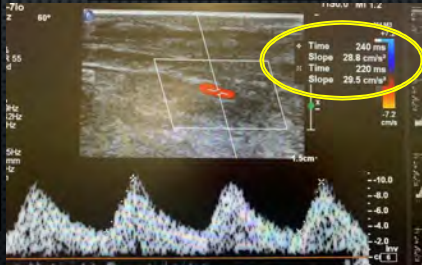
CASE ILLUSTRATIONS

VALUE IN DETAILED DUPLEX IN THE CLTI PATIENT

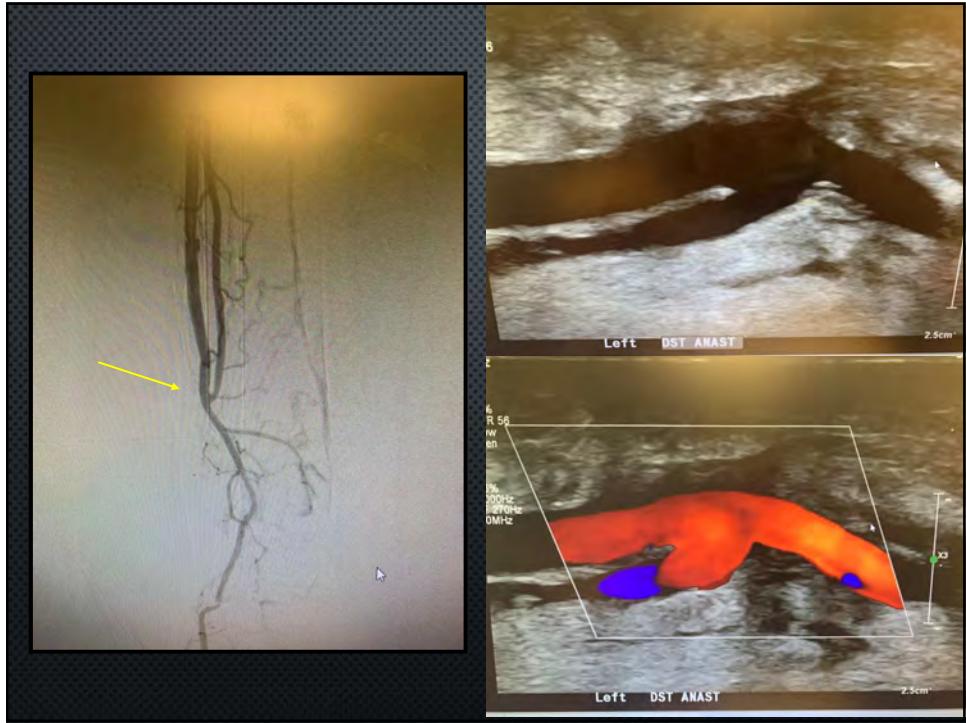


Pre op - PAT: 260ms class 4

LEFT ABI			
Brach	PTA	OPA	
TN:			
	Site	Velocity	Waveform
	EIA D		
	CFA		
	PTA		
	SFA P		
	SFA V		
	SFA M		
	SFA L		
	SFA D		
	POPP		
	POPM		
	POPD		
	TPT		
	P		
	ATA M		
	O		
	PTA		
	K		
	C		
	PER		
	I		
	M		
	DI		



Time 240 ms
Slope 28.8 cm/s²
Time 220 ms
Slope 29.5 cm/s²



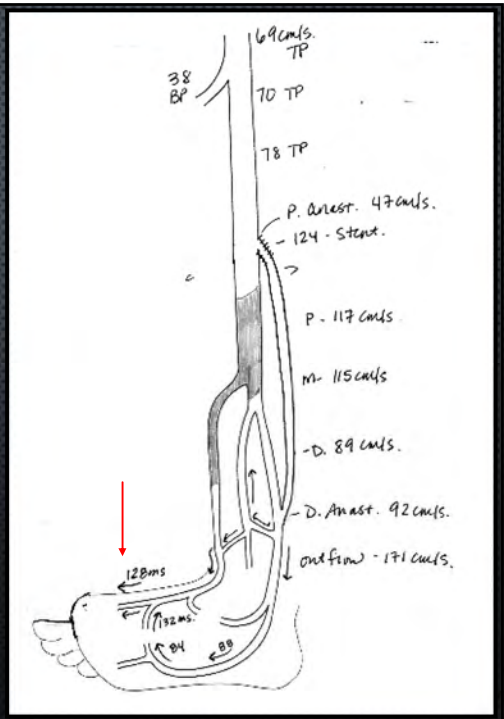
SFA – distal PTA bypass

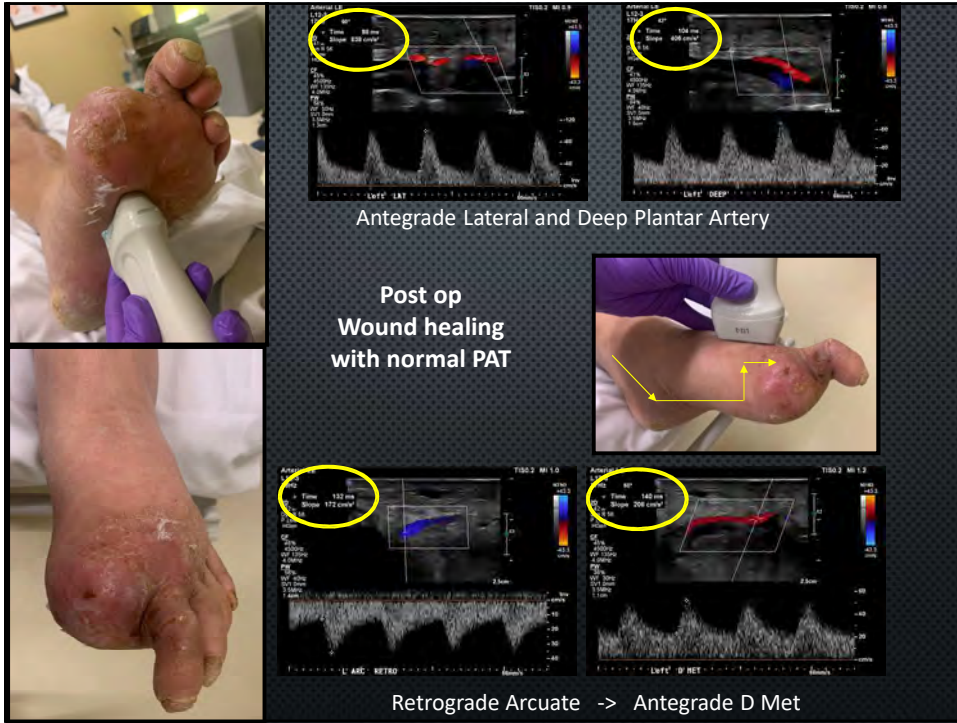
Pedal Flow Hemodynamics:

Antegrade lateral plantar -> deep plantar

Retrograde flow to the Arcuate Artery with antegrade flow in the Dorsal Metatarsal Artery.

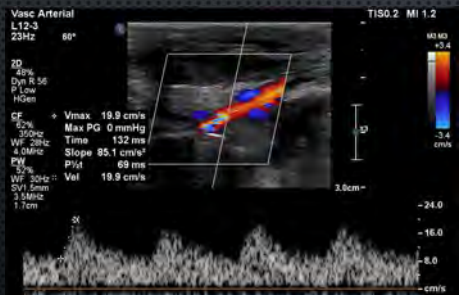
Normal PAT by indirect revascularization.





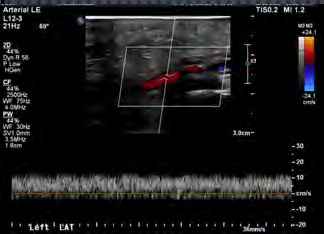
CASE ILLUSTRATION

- 72 YEAR OLD DIABETIC MALE PRESENTED WITH LEFT FOOT GANGRENE AND INFECTION.
- PREVIOUS RIGHT TRANSMETATARSAL AMPUTATION.
- IMAGING STUDIES SHOWED SEVERE LEFT ILIAC DISEASE AND SFA OCCLUSION.



Class 2 PAT – 132ms

ROUTINE SURVEILLANCE

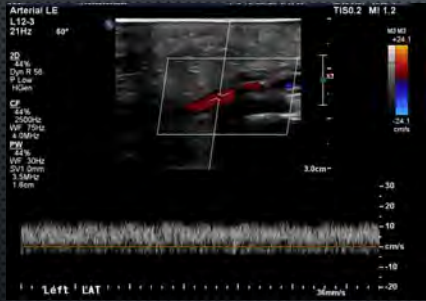


Interval change to Class 4 PAT

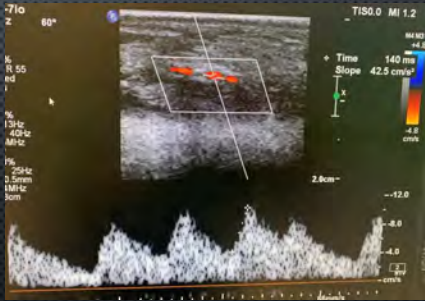




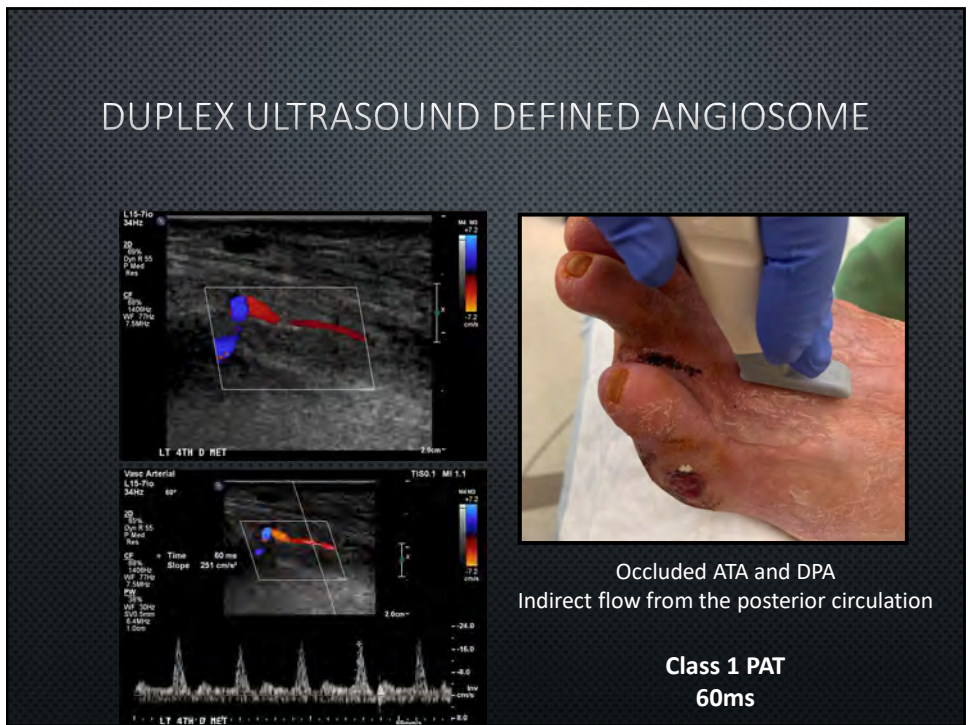
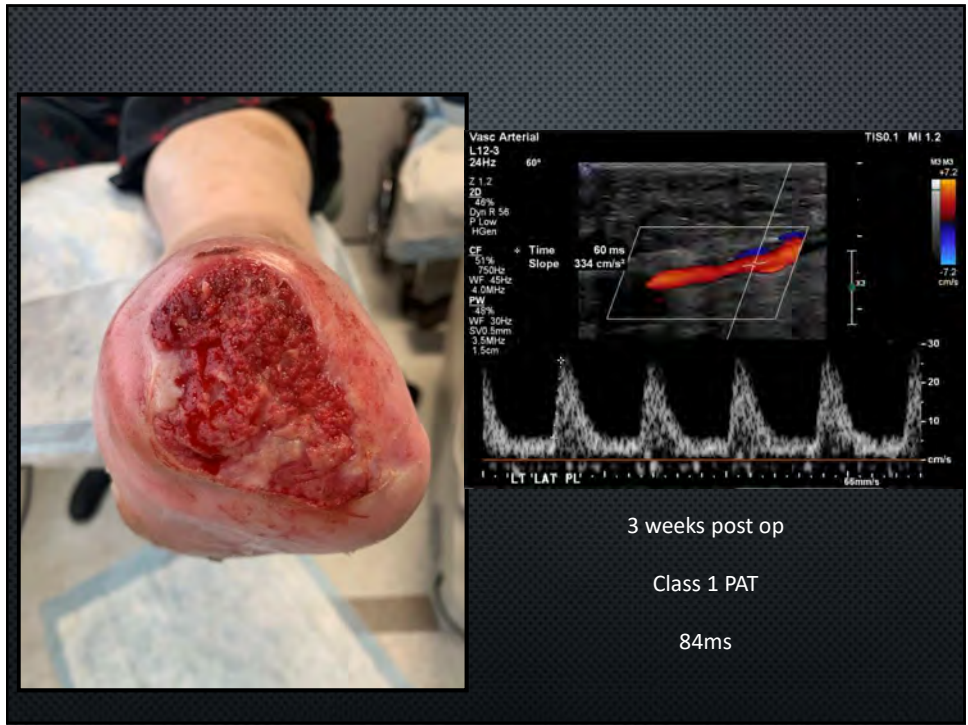
Pre procedure
Class 4



Immediate post bypass
Class 2







Cath lab



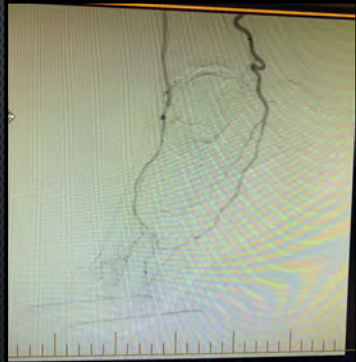
OR



Outpatient
Surveillance of
Wound
Healing

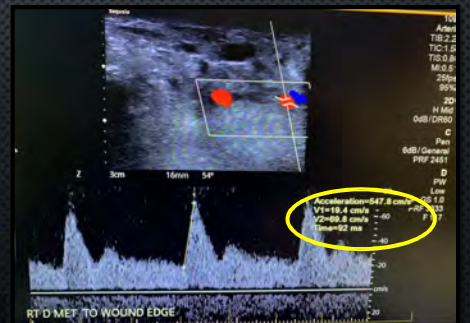
ROLE OF PAT IN DECISION MAKING

NEUROPATHIC NORMAL PAT

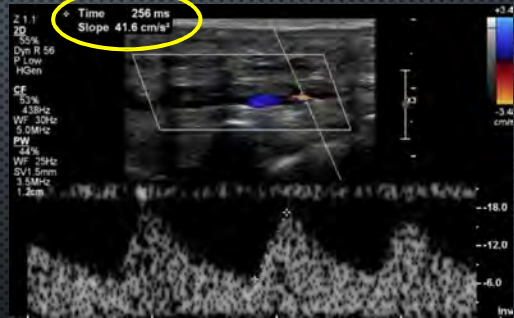


CLASS 1 - PAT 92ms

	No Ischemia Class 1	Mild Ischemia Class 2	Moderate Ischemia Class 3	Severe Ischemia Class 4
Clinical Symptoms	Asymptomatic	Greater than 2 block claudication	Less than 2 block claudication	CLTI (Tissue loss, rest pain)
PAT	20-120ms	121-180ms	181-224ms	Greater than 225ms
ABI	1.3 - 0.90	0.89 - 0.69	0.68 - 0.50	0.49 - 0.00



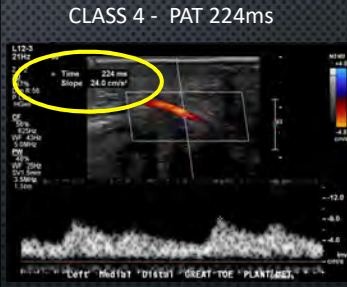
ISCHEMIC CLTI – ABNORMAL PAT



CLASS 4 PAT - 256ms

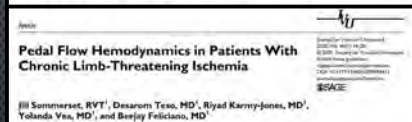
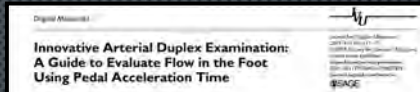
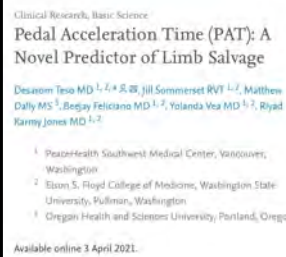
	No Ischemia Class 1	Mild Ischemia Class 2	Moderate Ischemia Class 3	Severe Ischemia Class 4
Clinical Symptoms	Asymptomatic	Greater than 2 block claudication	Less than 2 block claudication	CLTI (Tissue loss, rest pain)
PAT	20-120ms	121-180ms	181-224ms	Greater than 225ms
ABI	1.3 - 0.90	0.89 - 0.69	0.68 - 0.50	0.49 - 0.00

NEUROISCHEMIC ABNORMAL PAT

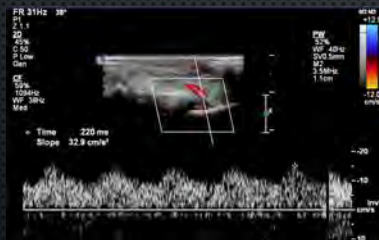


	No Ischemia Class 1	Mild Ischemia Class 2	Moderate Ischemia Class 3	Severe Ischemia Class 4
Clinical Symptoms	Asymptomatic	Greater than 2 block claudication	Less than 2 block claudication	CLTI (Tissue loss, rest pain)
PAT	20-120ms	121-180ms	181-224ms	Greater than 225ms
ABI	1.3 - 0.90	0.89 - 0.69	0.68 - 0.50	0.49 - 0.00

CURRENT STATE AND FUTURE OF PAT

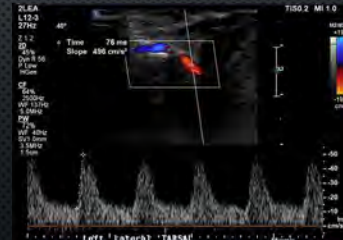


PRE PROCEDURE



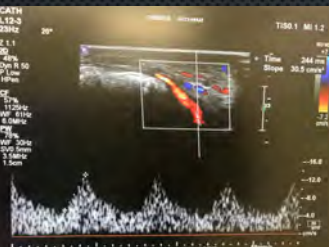
Class 3 - PAT 220 ms

POST PROCEDURE



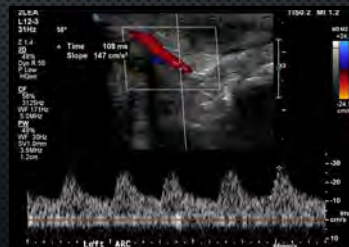
Class 1 - PAT 76 ms

PRE PROCEDURE

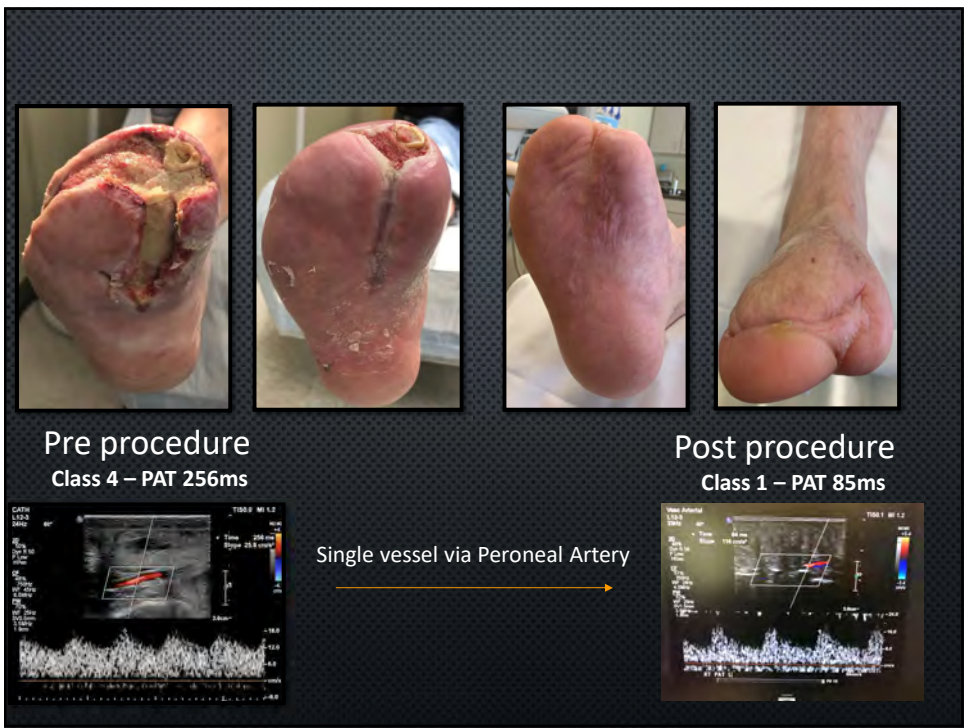


Class 4 - PAT 244ms

POST PROCEDURE



Class 1 - PAT 108ms



GLOBAL COLLABORATION



Ireland



USA



Australia



Argentina



Singapore



New Zealand



Canada



Mexico

THANK YOU