

Diabetic Foot Ulcer : Vascular Management

Practical Point in Holistic Diabetic Foot Care
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Supapong Arworn, MD

Division of Vascular and Endovascular Surgery
Department of Surgery, Chiang Mai University Hospital

Email: supapong.arworn@gmail.com



Chiang Mai University Hospital 2538-2549



**Division of Vascular Surgery
Department of Surgery
Siriraj Hospital 2549-2551**



Diabetic Foot Ulcers

- The prevalence of vascular complications in the patients with diabetic foot ulcers (DFUs) is 46-65%.
- The annual mortality rate is 22% in those with a history of lower extremity amputation.
- 5-year adjusted mortality rate after a major limb amputation is 46%, which is higher than for many forms of cancer.

DFUs associated with PAD in Thai Population

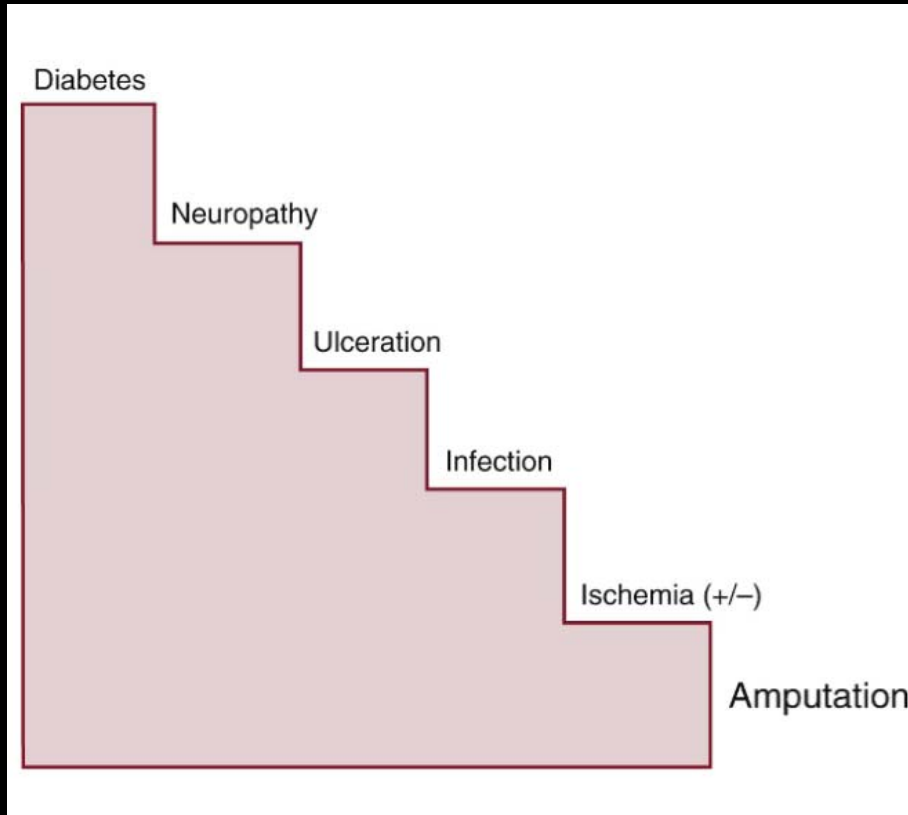
- Delayed in diagnosis & treatment
- Consequence

↓ Possibility of revascularization

↑ Major amputation

↑ Overall mortality

DFUs-related Lower Limb Amputation



It is imperative that the ulcerated diabetic foot be free from

Infection

Inadequate blood flow

Up to 85% of complications, such as amputation, may be preventable.

DFUs Classification

Wagner		University of Texas	
Grade	Details (Depth/Penetration, Osteomyelitis, Gangrene/Necrosis)	Grade	Details (Depth/Penetration, Infection, Ischemia)
0	No open foot lesion	0	Presence of pre-ulcer or post-ulcer epithelialization
1	Presence of superficial ulcer, partial or full thickness	1	Superficial ulcer not penetrating tendon, bone, or joint
2	Ulcer extends to ligaments, tendon, joint capsule, or deep fascia without abscess or osteomyelitis	2	Ulcer penetrating through to tendon or capsule
3	Presence of deep ulcer with abscess, osteomyelitis, or joint sepsis	3	Ulcer penetrating to bone or joint
4	Gangrene localized to the forefoot or heel	A	Noninfected and nonischemic ulcer
5	Extensive gangrene	B	Infection present
		C	Ischemia present
		D	Both infection and ischemia are present

Critical Limb Ischemia

Inadequate arterial blood flow to accommodate the metabolic needs of resting tissue

- Rest pain, Ulceration, gangrenous foot/ toe
- Ankle systolic pressure <50 mmHg
- Toe systolic pressure <30 mmHg



Fate over 1 years

After primary treatment

- 25% CLI resolved
- 20% Continuing CLI
- 30% Alive amputated
- 25% Dead 3/4 CV caused

Peripheral Artery Disease

: Diagnostic Tools

History taking

- Walking problem
- Back pain

Physical examination

- Sign of chronic PAD
- Pulse exam.

Atrophic skin change

Leg & foot muscle atrophy

Prominent foot tendons



Right ABI	Higher right-ankle pressure
	Higher arm pressure
Left ABI	Higher left-ankle pressure
	Higher arm pressure

Interpretation of ABI

> 1.30
0.91
0.41
0.00

Interpretation of ABI

> 1.30	Noncompressible
0.91–1.30	Normal
0.41–0.90	Mild-to-moderate peripheral arterial disease
0.00–0.40	Severe peripheral arterial disease

Right-arm
systolic pressure

systolic pressure

Right-ankle
systolic pressure

DP
PT

Left-ankle
systolic pressure

DP
PT





Interpretation of ABI

> 1.30	Noncompressible
$0.91 - 1.30$	Normal
$0.41 - 0.90$	Mild-to-moderate peripheral arterial disease
$0.00 - 0.40$	Severe peripheral arterial disease

Medial wall calcification

- : Non-compressible
- : False elevated ankle pressure
- : Need alternative measurements

40 VOI
v 120
mA 352
Rot 0.90s/HE+ 20.6mm/rot
I 2mm 0.516 1/1 0sp
Tilt 0.0
17.50.00.00

Velocity Waveform

: Measurement of blood flow velocity using Doppler ultrasound turns a signal to sound or a graph pattern to determine the degree of arterial stenosis

A Triphasic Pattern

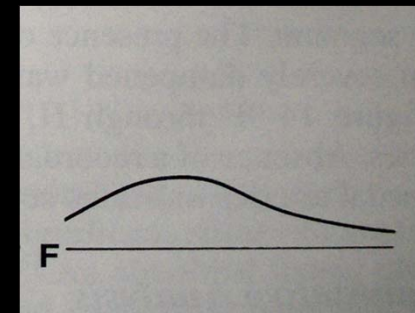
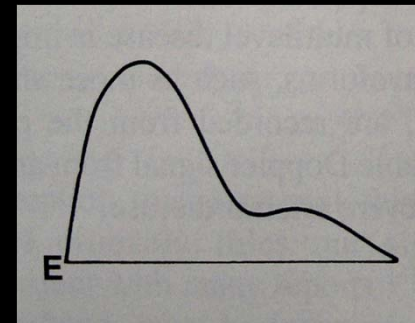
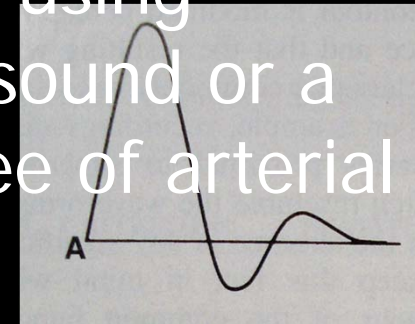
- Normal

E Biphasic Pattern

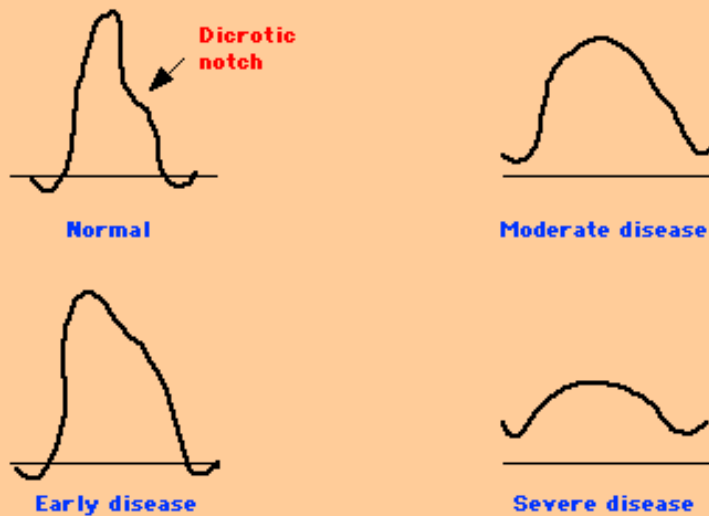
- Mild-mod degree occlusion

F Monophasic Pattern

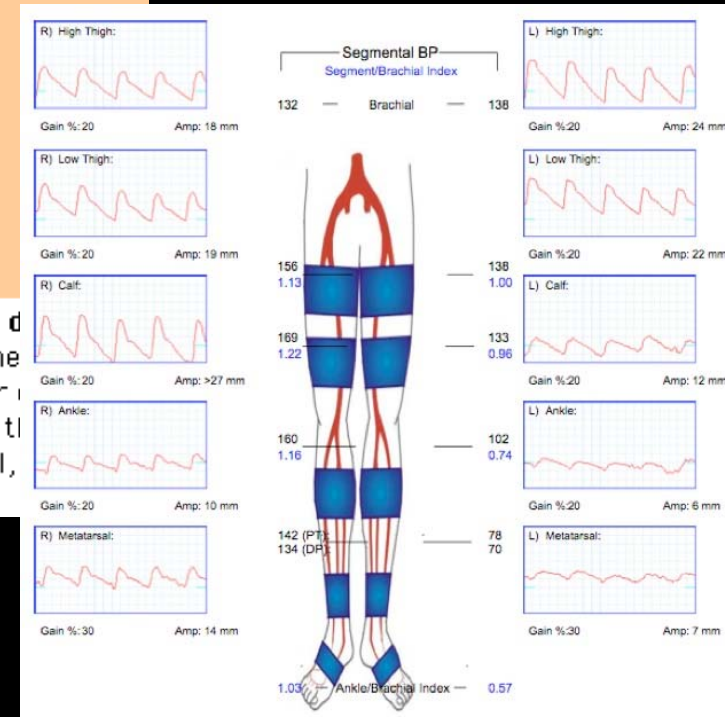
- Severe occlusion



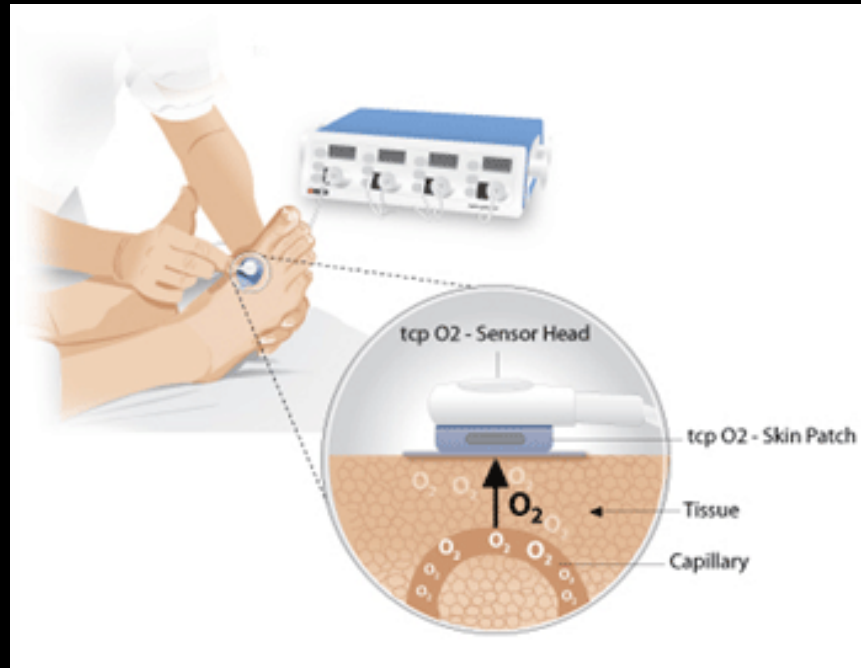
Pulse Volume Recording



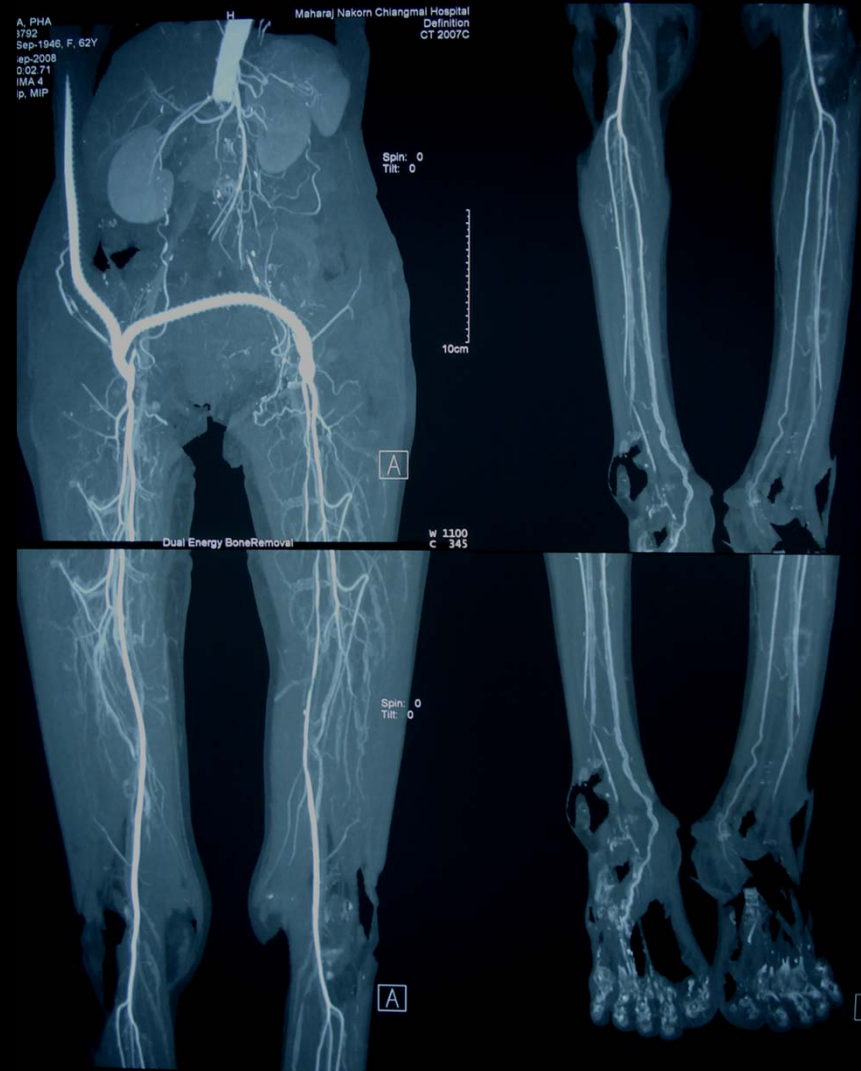
Segmental volume plethysmography in peripheral vascular disease
 Variations in the contours of the pulse volume recording with segmental volume plethysmography reflect the severity of peripheral vascular disease. Mild disease is characterized by the absence of a dicrotic notch. With progressive obstruction, the upstroke and downstroke become equal, and with severe disease, the amplitude of the waveform is blunted.



Transcutaneous O₂ Measurement (tcpO₂)



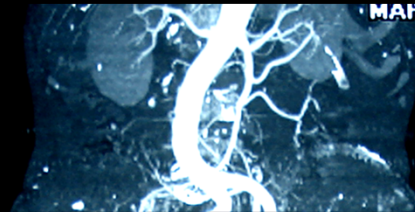
Axillo-bifemoral Bypass



Femoral-Posterior Tibial Artery Bypass

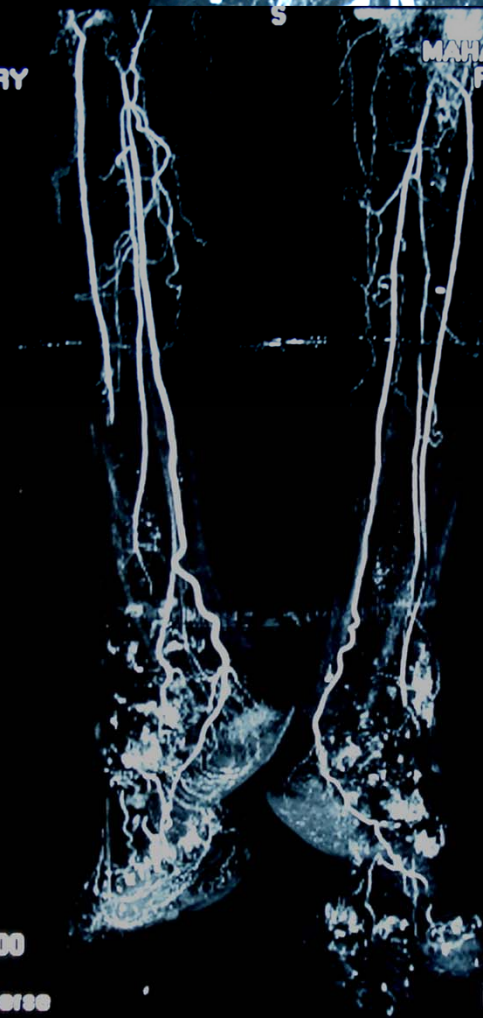


Im:10
DERIVED\SECONDARY
512x512



MAHARAJ NAKORN CHIANGMAI
RALUEKPRAIPANA BOEBLA
061Y M 3125698
Acc:46992
Ex:46992
2008/08/21
16:40

3D Color Volume
m:8
DERIVED\SECONDARY
512x512

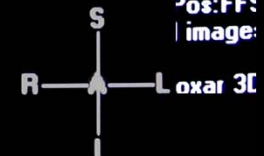


MAHARAJ NAKORN CHIANGMAI
RALUEKPRAIPANA BOEBLA
061Y M 3125698
Acc:46992
Ex:46992
2008/08/21
16:40

L



C1
Pos:FF!
Image:



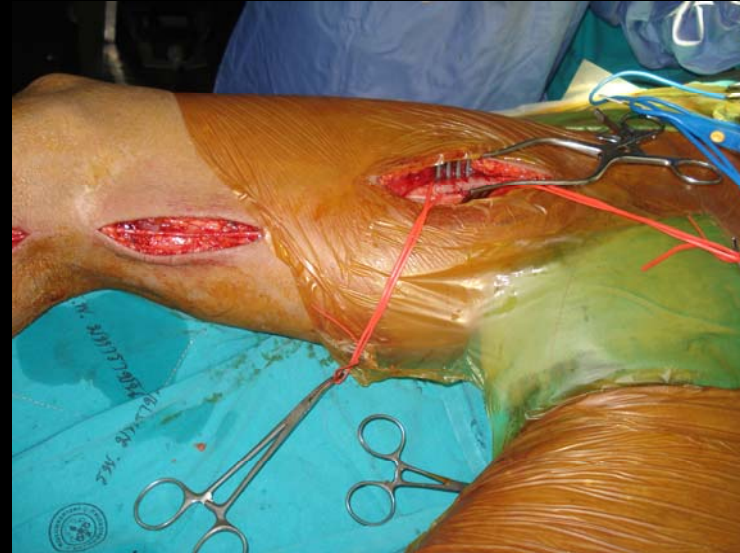
Vp:120 mA:250 ms:500

12x512x1043 Transverse

C1
Pos:FF!

Individually captured image

Femoral-Posterior Tibial Artery Bypass



Femoral-Posterior Tibial Artery Bypass

Post-Operative Study

Im:10
DERIVED\SECONDARY
512x512

MAHAHAJ NAKUHN CHIANGMAI
RALUEKPRAIPANA BOEBLA
061Y M 3125698
Acc:46992
Ex:46992
2008/08/21
16:40

kVp:120 mA:250 ms:500

512x512x721 Transverse
(0.78x0.78x1.00mm)

S
R—A—L
I

CT
Pos:FF
Individually captured image:
Voxar 3E

Preoperative Study

RUEKPRAIPANA, BERBLA
5698
Sep-1947, M, 61Y
Sep-2008
7:50:56
IMA 4
ip, MIP

Maharaj Nakorn Chiangmai Hospital
Definition
CT 2007C

Spin: 0
Tilt: 0

10cm

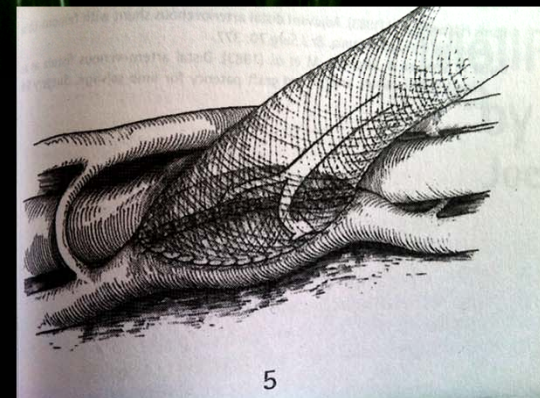
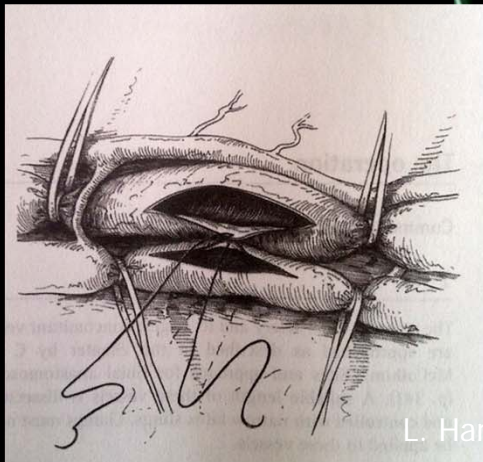
Dual Energy BoneRemoval

W 482
C 232

Spin: 0
Tilt: 0

A

Adjuvant AVF

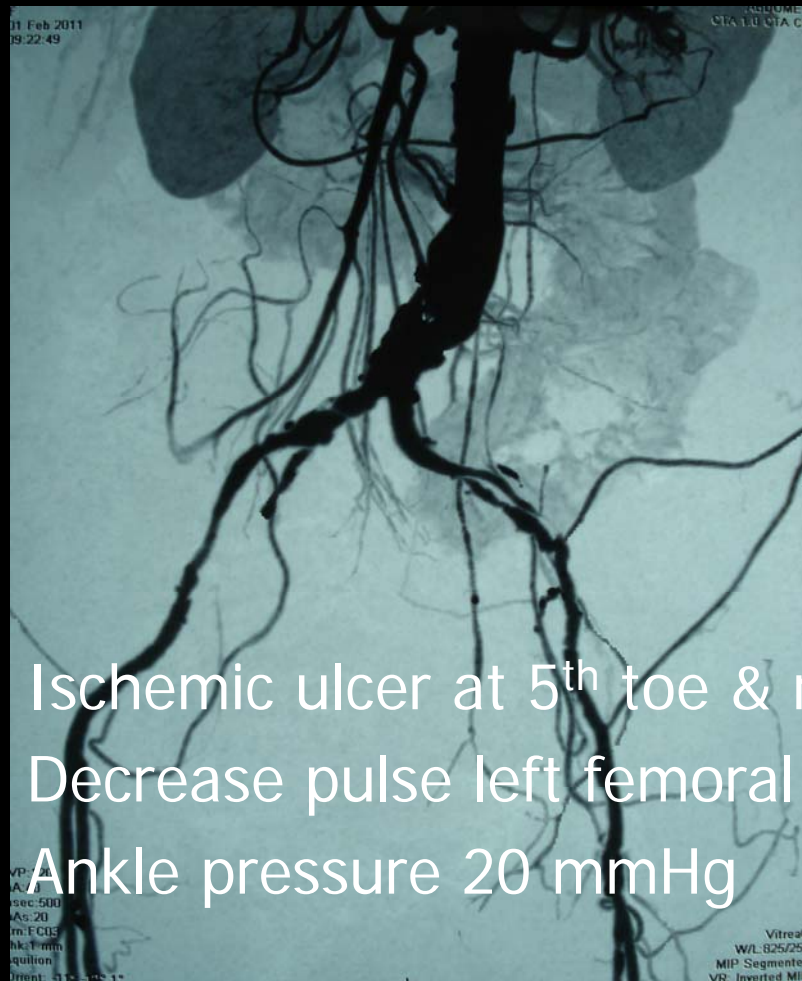


L. Harris. Adjuvant arteriovenous fistula at the distal anastomosis of a femorotibial bypass graft.
In: R. M. Greenhalgh, editor. Vascular and Endovascular Surgical Techniques. 4th ed. Philadelphia:
W.B. Saunders; 2001. p373-376

Femoral Artery- Posterior Tibial Vein Bypass



Iliac-femoral Artery : Angioplasty with primary stenting



Ischemic ulcer at 5th toe & rest pain
Decrease pulse left femoral artery
Ankle pressure 20 mmHg



Iliac-femoral Artery : Angioplasty with Primary Stenting



Ankle pressure 60 mmHg

Ischemic ulcer & pain resolved

Fem-pop segment → No further treatment

Femoropopliteal Artery : Angioplasty with Stenting



Known case CAD S/P CABG 4 months ago
Ischemic ulcer at dorsum of R foot & rest pain
Decrease pulse right popliteal artery
Ankle pressure 0 mmHg

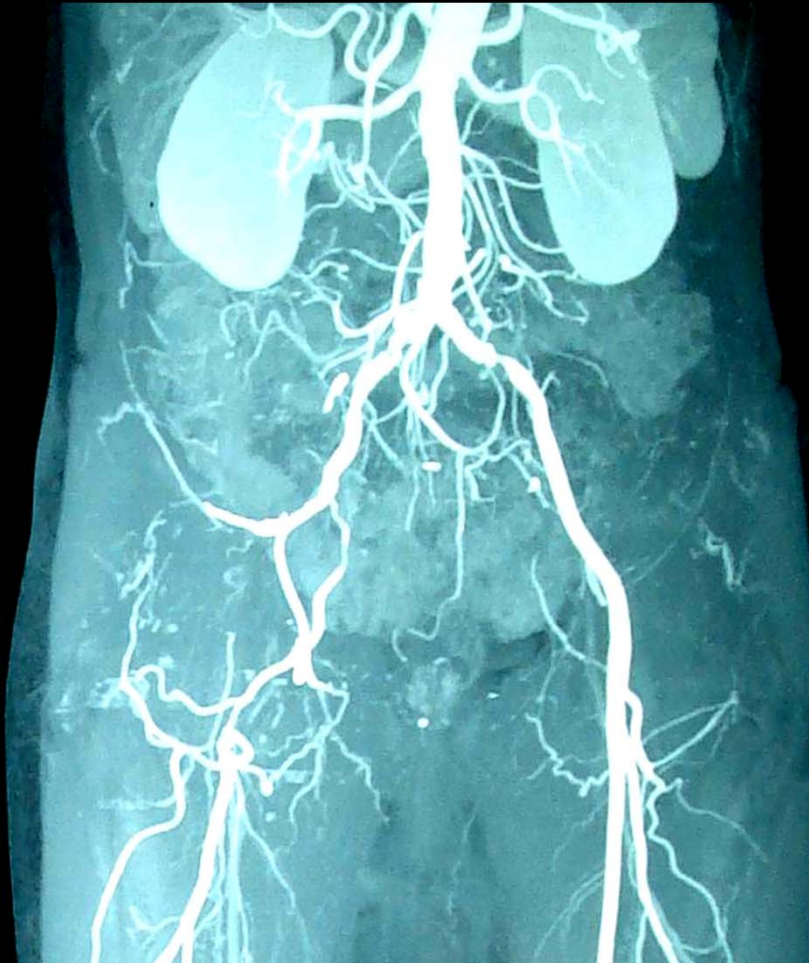
Femoropopliteal Artery : Angioplasty with Stenting



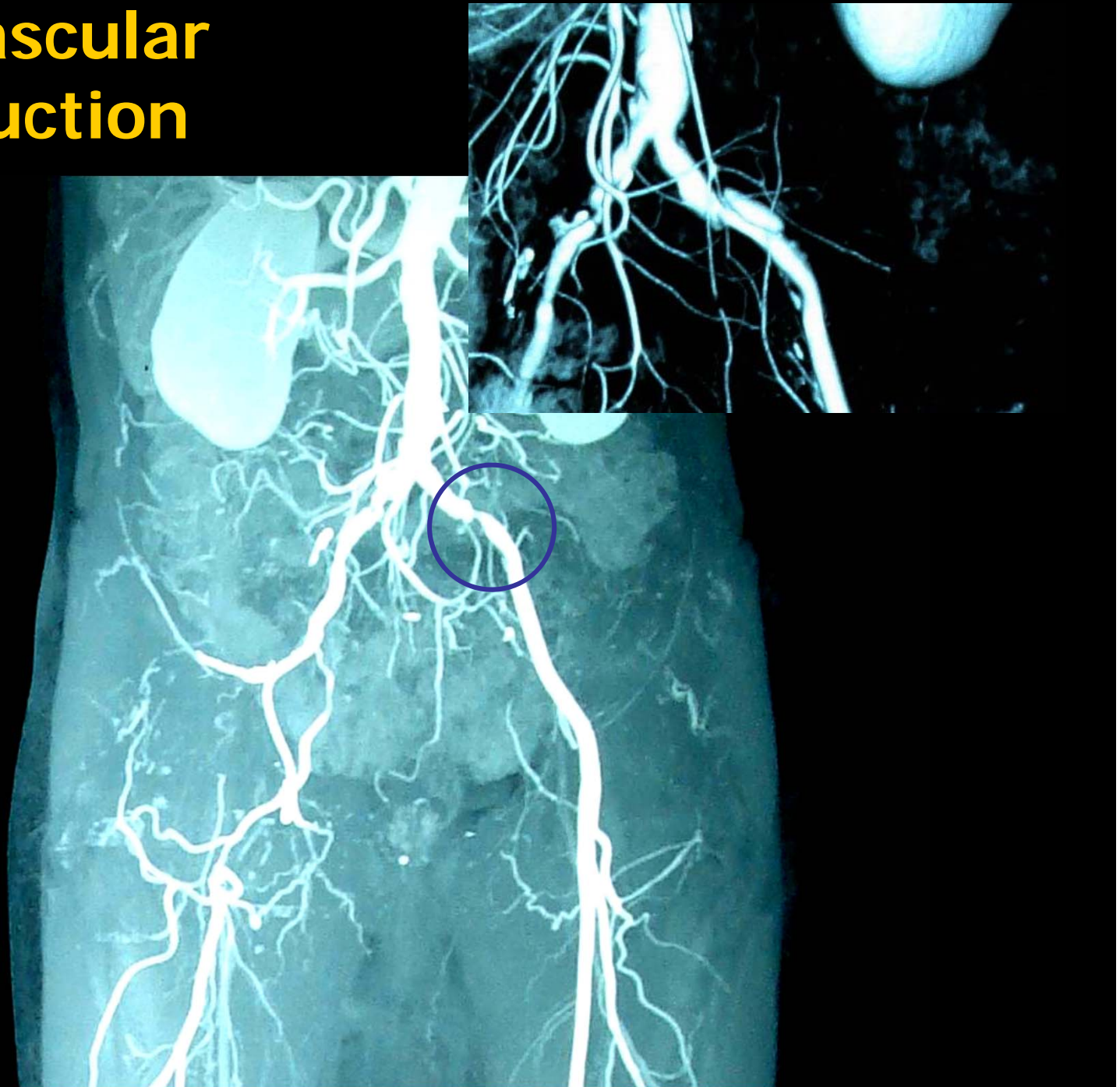
Ischemic ulcer & pain improved
Ankle pressure 50 mmHg



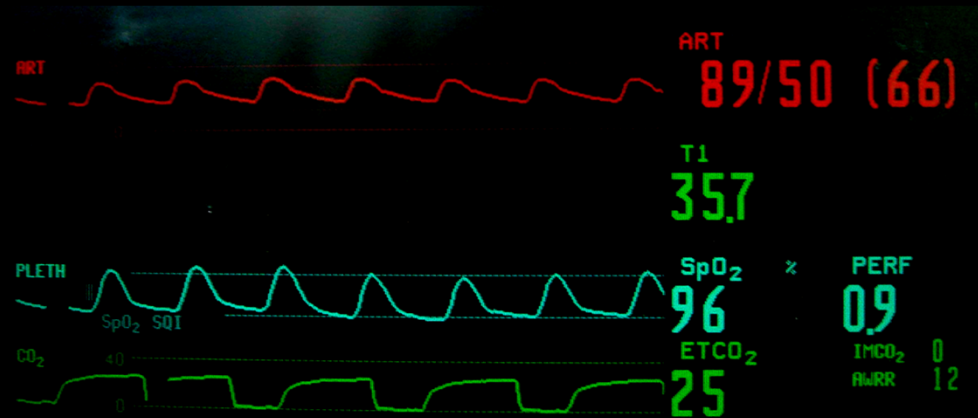
Hybrid Vascular Reconstruction



Hybrid Vascular Reconstruction



Hybrid Vascular Reconstruction



Chumpol W.
Vascular abdominal
04-12-2006 13:47

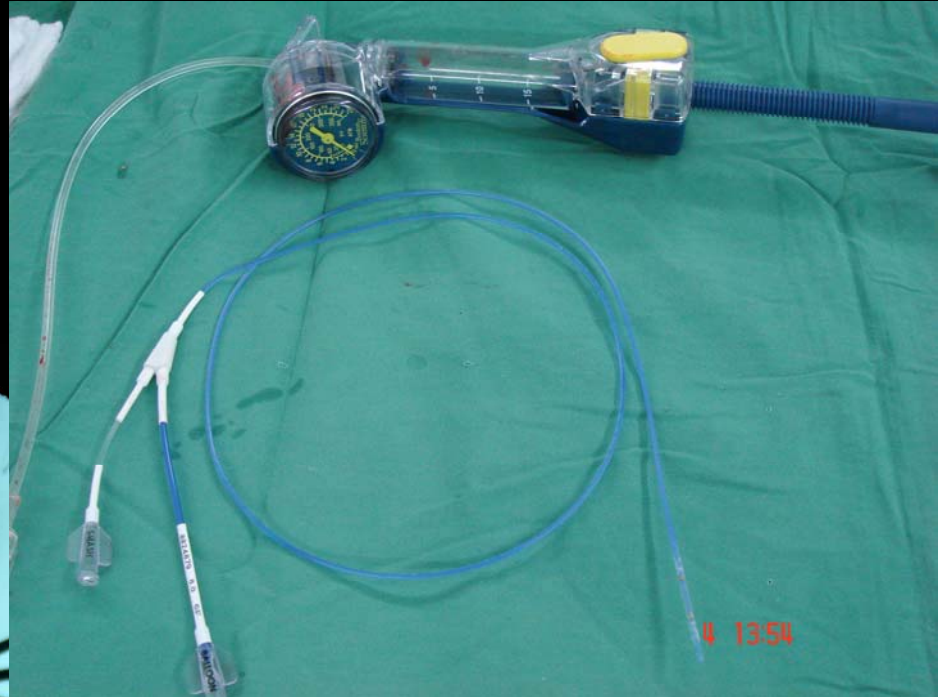
SUBTRACT

13
14-1
FILM TDC D11 D12 D13

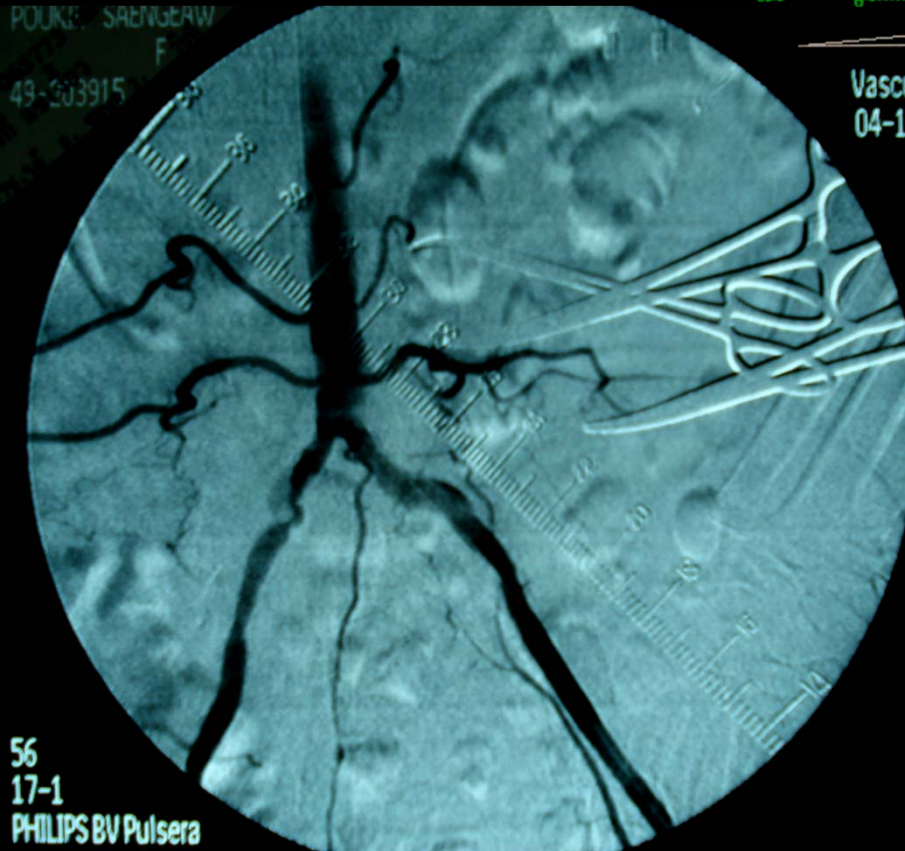
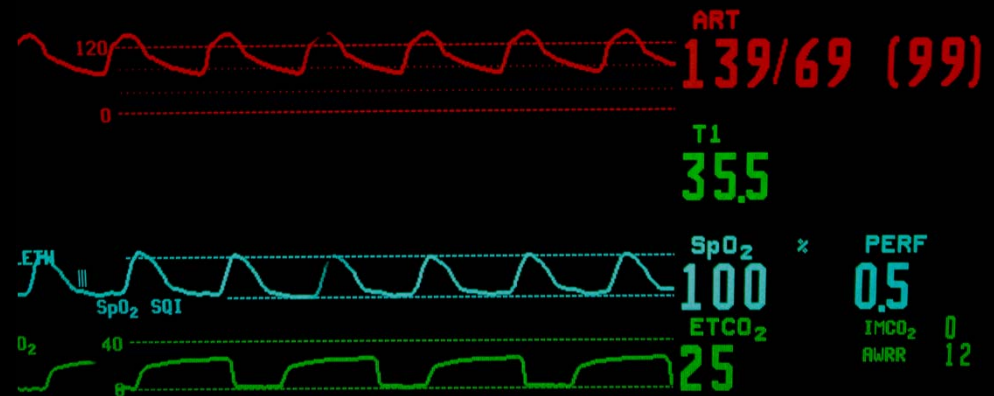
Hybrid Vascular Reconstruction

POUKIE SAENGEAW

PHILIPS BV Pulsera



Hybrid Vascular Reconstruction



Vascular abdominal
04-12-2006 14.46

SUBTRACT

56
17-1
PHILIPS BV Pulsera

Hybrid Vascular Reconstruction

Ex: 2 +c
olume Rendering No cut

FOV 50.9cm
TND/+



No VOI
kv 120
mA 351
Rot 0.60s/HE+ 20.6mm/rot
1.2mm 0.516:1/1.0sp
Tilt: 0.0
08:42:42 AM
W = 4095 L = 2048

m: 27 2006 HD MIP No cut

DFOV 50.9cm
STND/+

L R
S N
S N



No VOI
kv 120
mA 351
Rot 0.60s/HE+ 20.6mm/rot
1.2mm 0.516:1/1.0sp
Tilt: 0.0
08:42:42 AM
W = 4095 L = 2048

Key Points

- In Thai population, PAOD is under-diagnosed and under-rated.
- DFUs patients with vascular disease are associated with significant morbidity/mortality.
- Revascularization is the main stay treatment.

Endovascular Surgery

Bypass Surgery