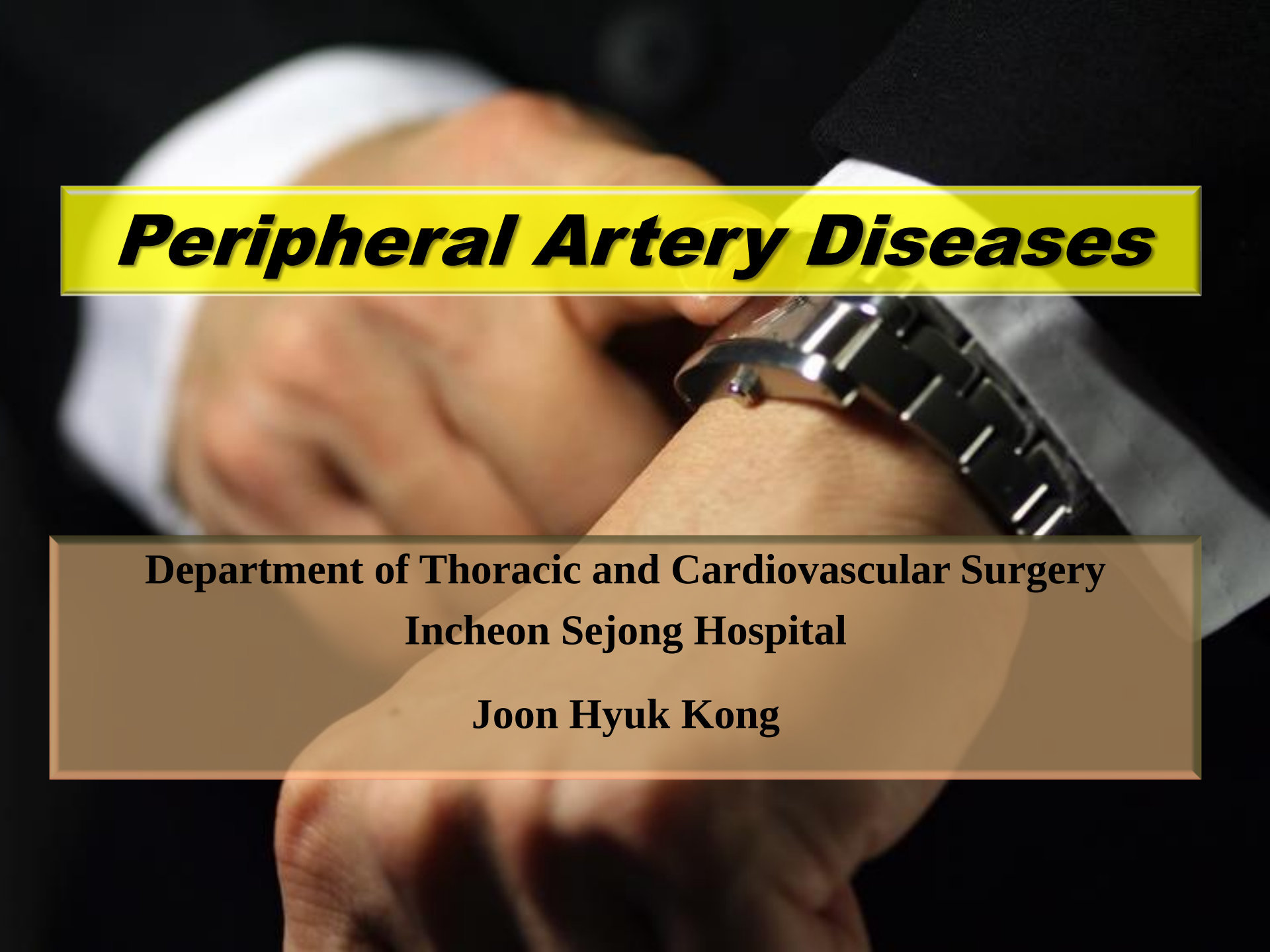


Peripheral Artery Diseases

Department of Thoracic and Cardiovascular Surgery

Incheon Sejong Hospital

Joon Hyuk Kong

Titles

- **I. Overview**
  - Atherosclerosis
  - Trend of Endovascular treatment
  - Technical Issue
  - Endovascular Tool introduction
  - Endo vs Open Surgical Repair (OSR)

- **II. Pathophysiology**
  - Section 1: What is Peripheral Artery Diesease (PAD)
  - Section 2: Diagnosing PAD
  - Section 3: Aggressive risk management of PAD

- **III. Treatment**
  - Acute Limb ischemia
  - Chronic Limb ischemia

- **IV. Future & Conclusion**
  - New devices & New Concepts

I. Overview

Lower Extremity Disease

- Iliac artery disease
- SFA ds – long occlusion, femoropopliteal disease
- Below the Knee

Renal, Carotid, Subclavian Artery Stenosis

Venous disease – SVC, DVT, Vein occlusion

Aorta Disease – Aortic dissection, aneurysm, AAA

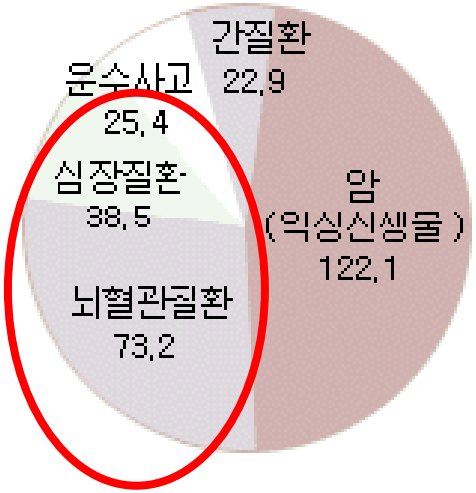
Adult congenital and structural heart disease (TAVI, ASD closure, percutaneous MVP)

1. Atherosclerosis

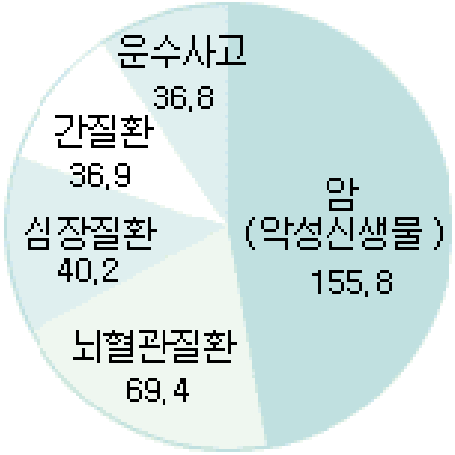
Cause of Moratlity in Korea

* 국내사망원인 (인구십만명당)

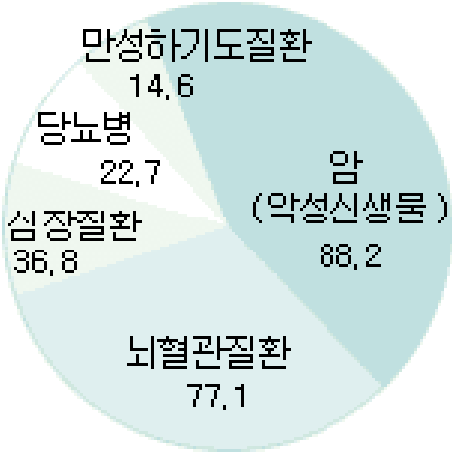
전체 사망원인 통계

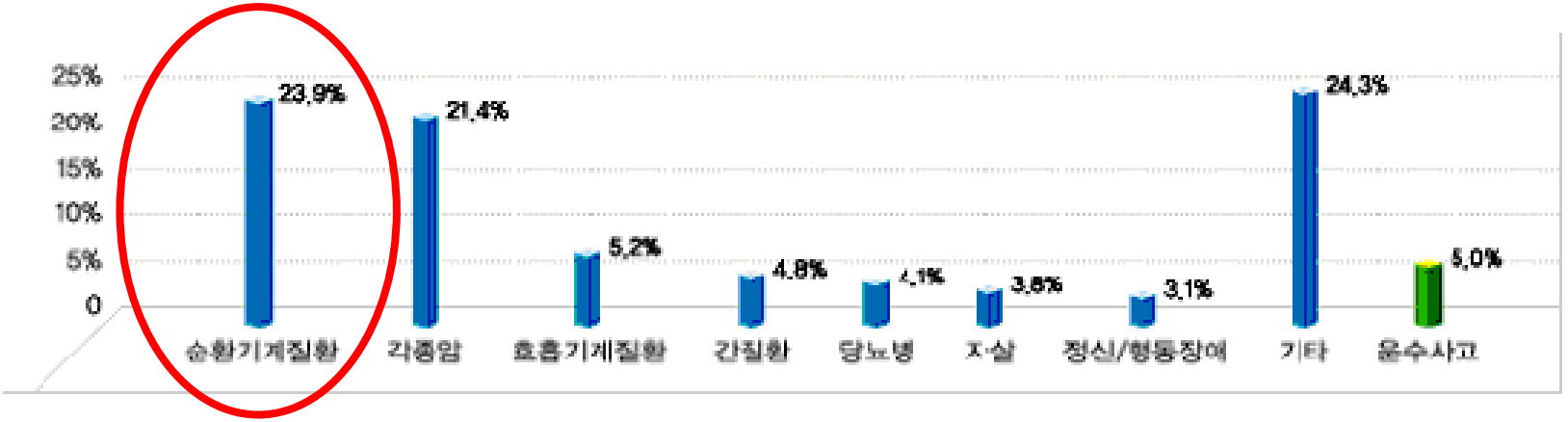


남자 사망원인 통계



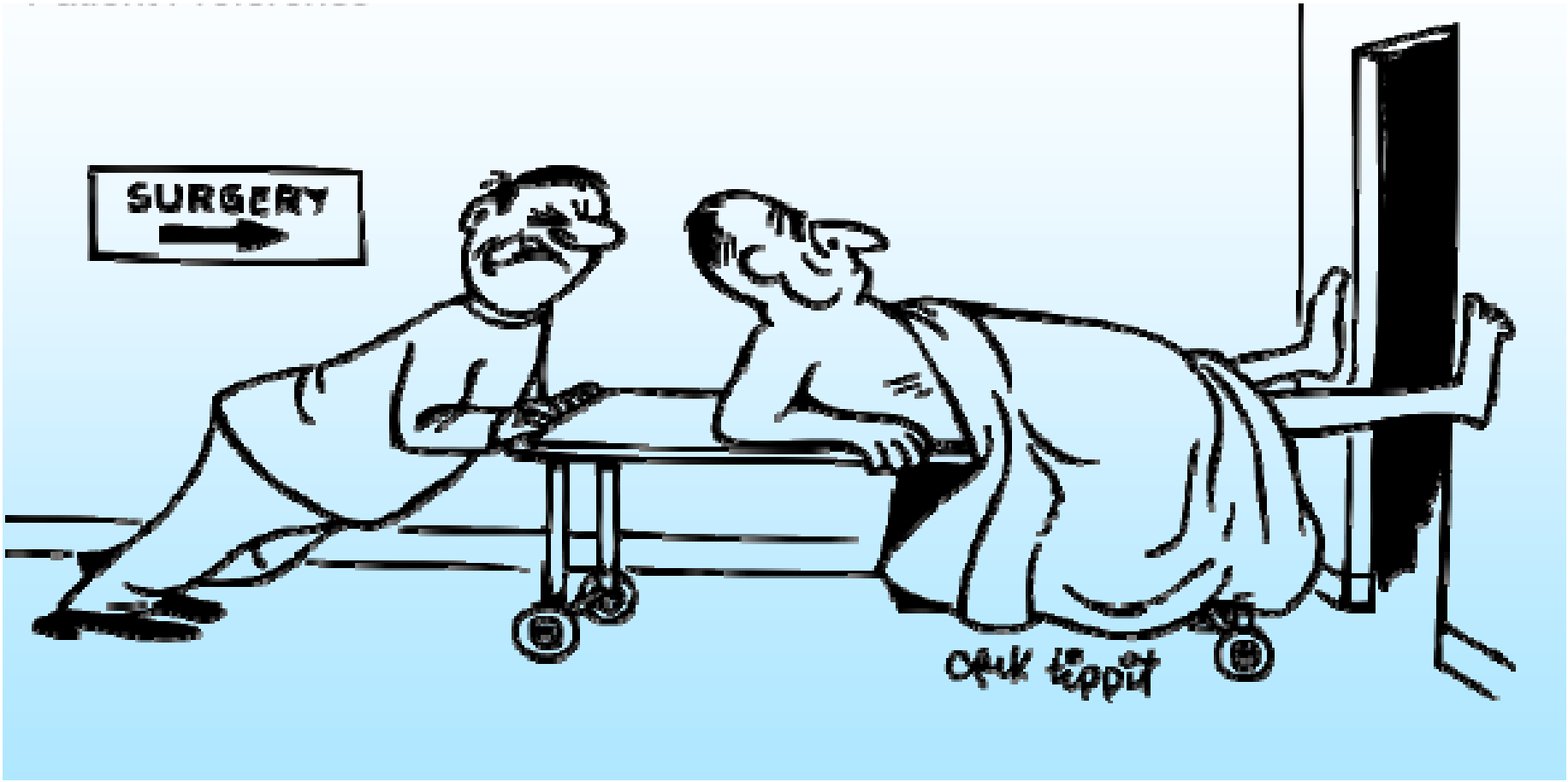
여자 사망원인 통계





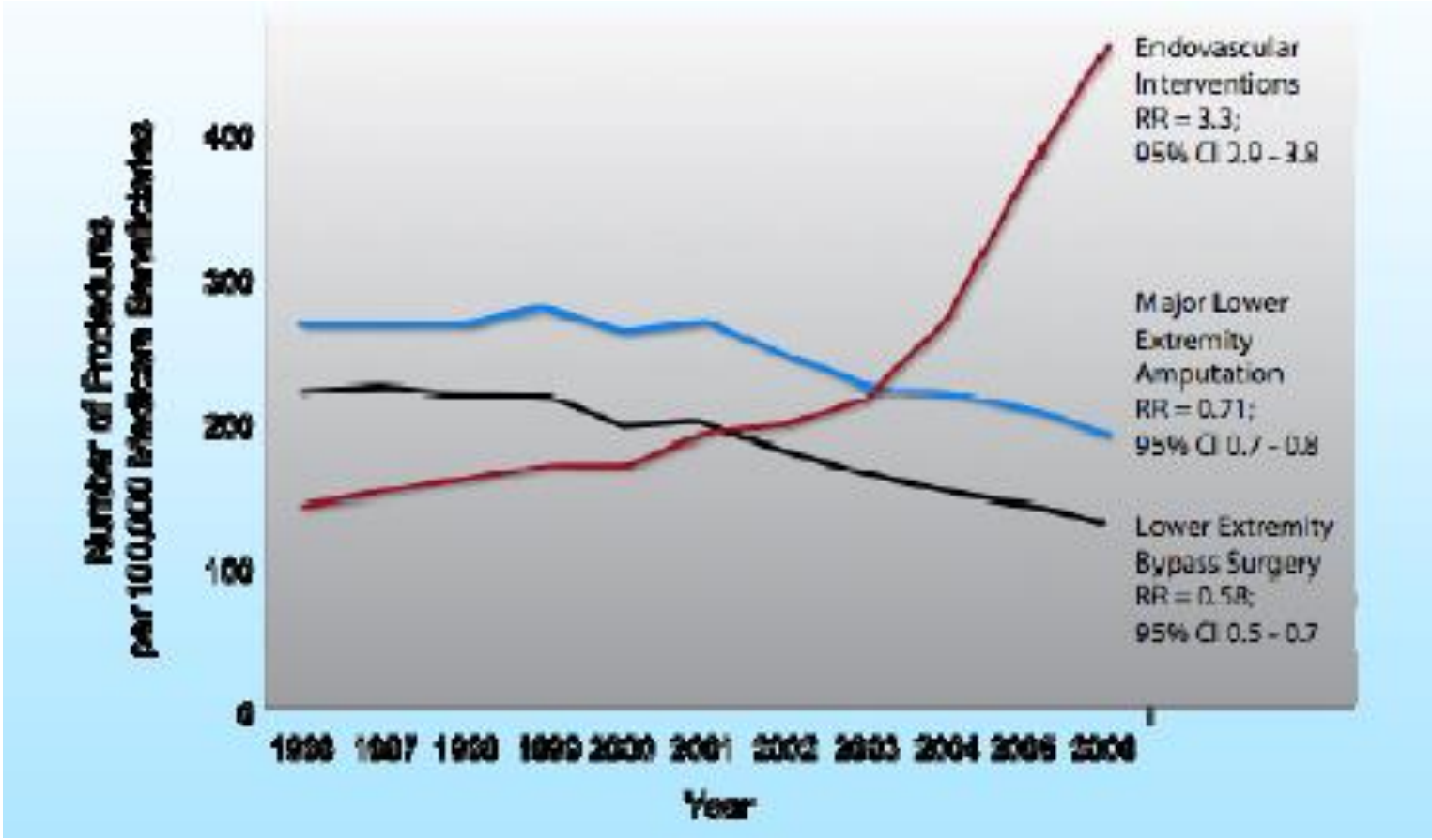
2. Trend of Endovascular Treatment

Patient Preference



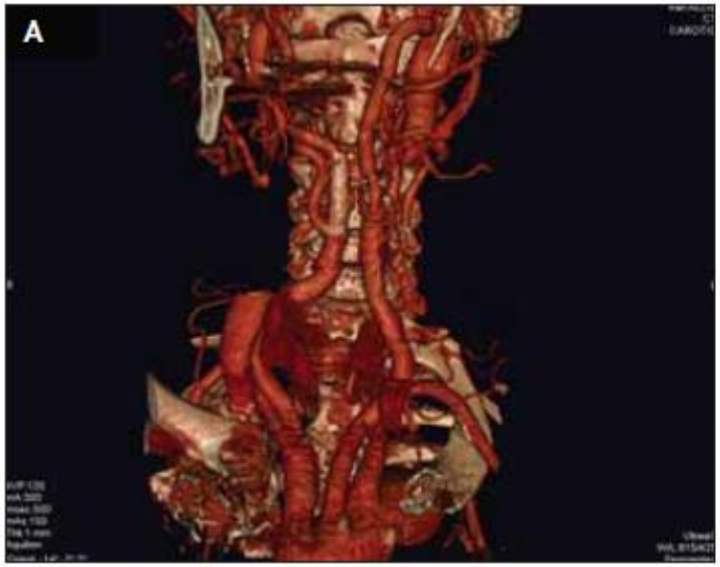
Trend in Lower Extremity Revascularization in USA

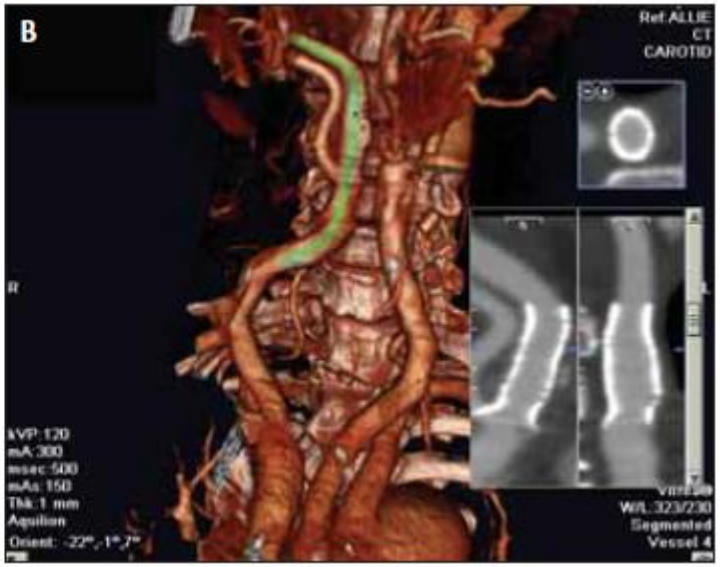
: Exponential Rise in Endovascular Intervention

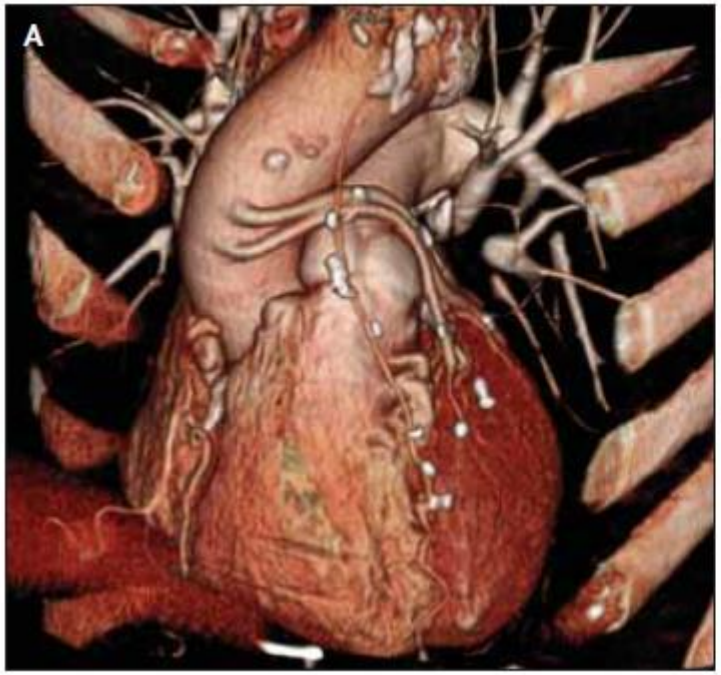


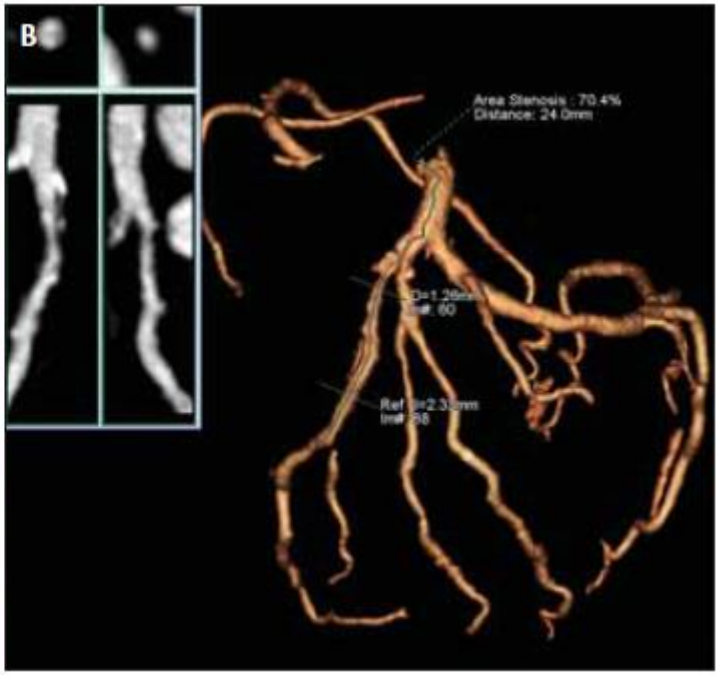
Goodney PP et al. J Vasc Surg 2009;50:54-60

3. Technical Issue

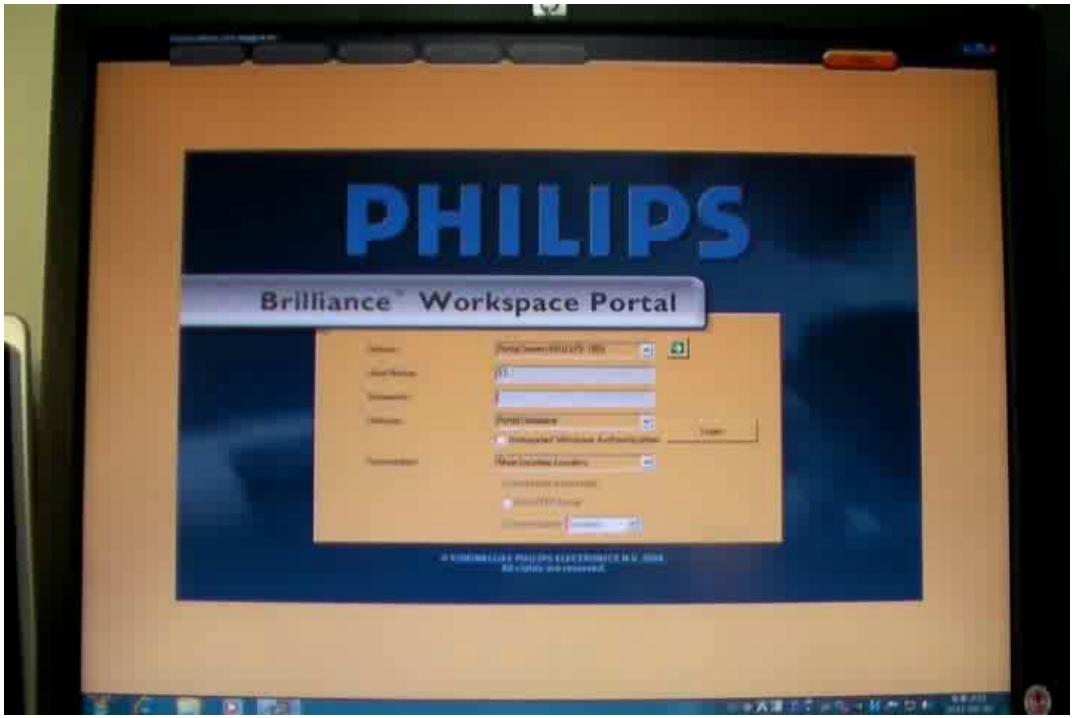

A


B
Ref:ALLIE
CT
CAROTID
kVP:120
mA:300
msec:500
mAs:150
Thk:1 mm
Aquilion
Orient: -22°,-1°,7°
WIL:323/230
Segmented
Vessel 4


A


B
Area Stenosis : 70.4%
Distance: 24.0mm

3D WorkStation: Detailed Case Planning



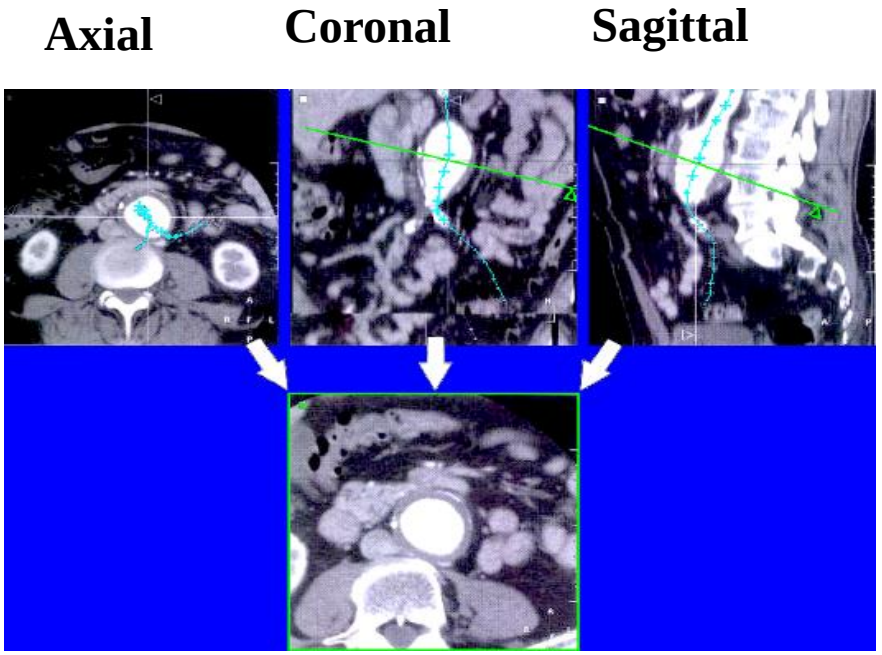
Central Lumen Line (CLL) reformatting

- **MPR loaded into workstation (Philips Easy Vision)**

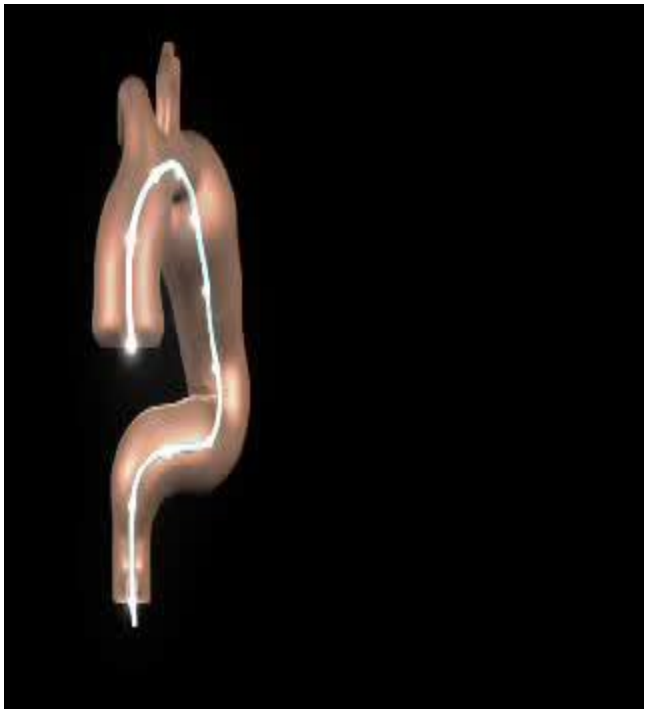
- **Manually placed markers (in 3 dimensions) to determine the central lumen line**

  (= proposed axis of how the prosthesis will eventually be placed)

- **Curved linear reformat is calibrated:**
  - **CLL continuously in centre of projection**
  - **cross-sections perpendicular to the axis of the CLL**



Central Lumen Line (CLL) Flow Analysis

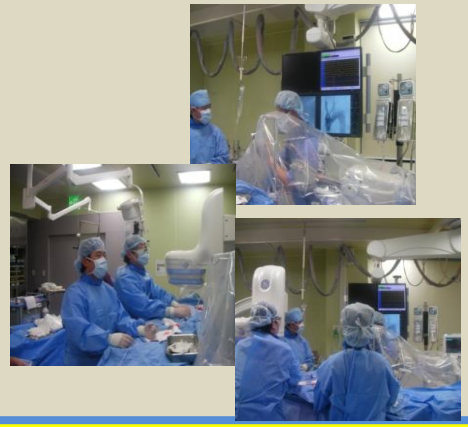


4. Endovascular Tool Introduction

5. Endo vs OSR ?

Hybrid-room

Cath-room



C-arm based

CLI is not a single group of patients

Bypass vs Angioplasty

	Bypass Surgery	Balloon Angioplasty
Pros	Superior long-term anatomic patency and clinical durability	Low morbidity and mortality and requirement for urgent surgical intervention Low cost Quick to perform Shorter hospital stay Can be repeated Failed angioplasty has been said not to jeopardize subsequent surgery Preserves collaterals so that even if the angioplasty site occludes symptoms may not return and tissue loss may remain healed
Cons	Significant morbidity and mortality Significant resource utilization (theater time and personnel, prolonged hospital stay) Graft surveillance, often leading to repeated prophylactic reintervention, required to optimize patency Vein as a conduit often unavailable, inadequate in length or poor quality Use of prosthetic material associated with poorer patency and risk of graft infection	Limited anatomic and hemodynamic patency and clinical durability Only a minority of patients may be suitable, especially with the transluminal technique The technique, particularly using the sub-intimal approach, is technically demanding and satisfactory results may not be widely achievable

BASIL trial (Bypass versus Angioplasty for Severe Ischaemia of the Leg)

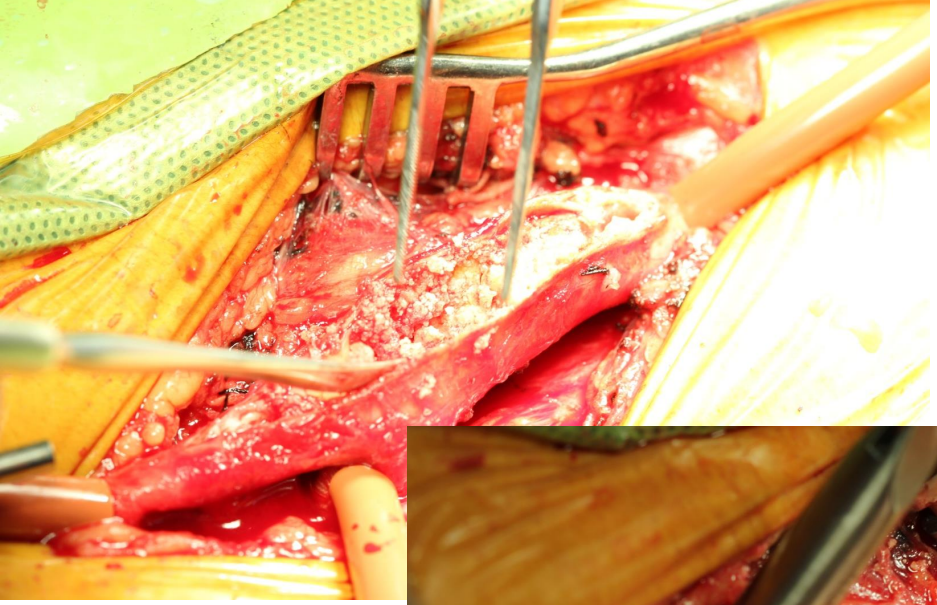
When should open surgery be the initial option for CLI ?

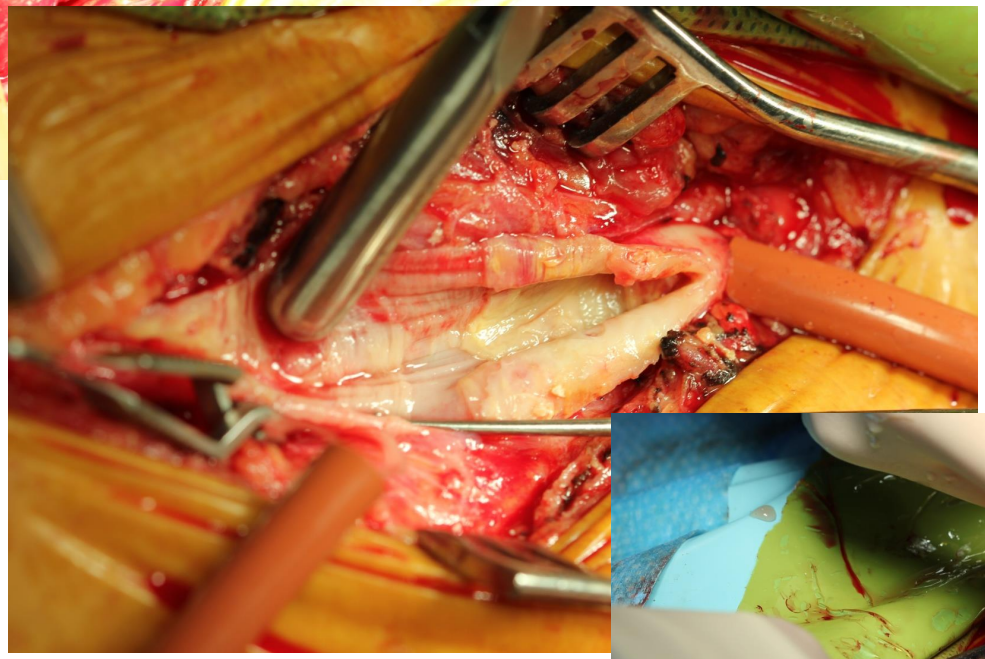
- *5 conditions for "open first" approach agreed by 'endo first' vascular surgeons*
  - *Common femoral artery pathology*
  - *Arterial occlusion by extrinsic compression pathology*
  - *Extensive foot gangrene / sepsis*
  - *Young patients and those requiring dependent-free soft tissue reconstructions where durability is paramount*
  - *Infrageniculate politeal and proximal tibial occlusion with single, distal tibial target vessel*

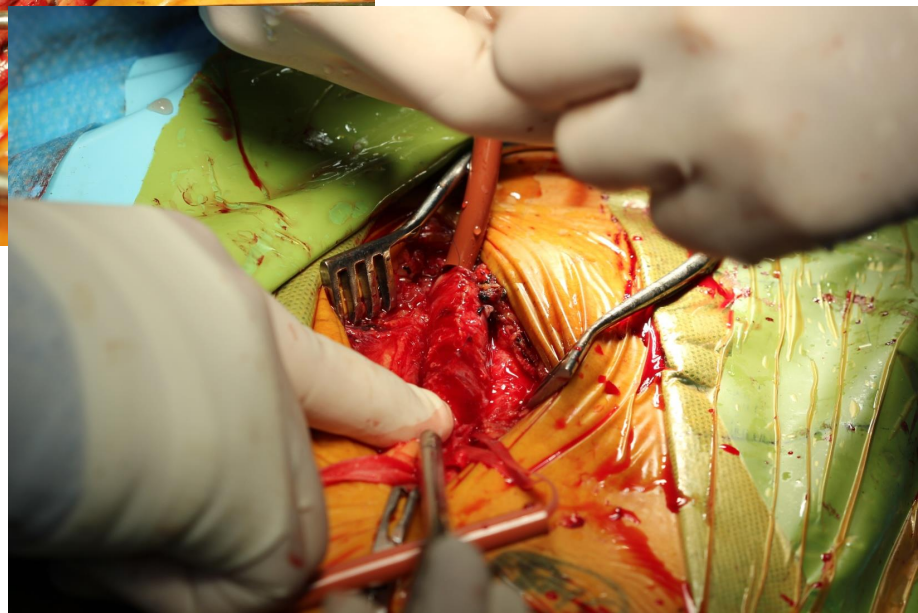
Lawrence & Chandra. EJVES 2010;39:S32

Common Femoral Artery

Field

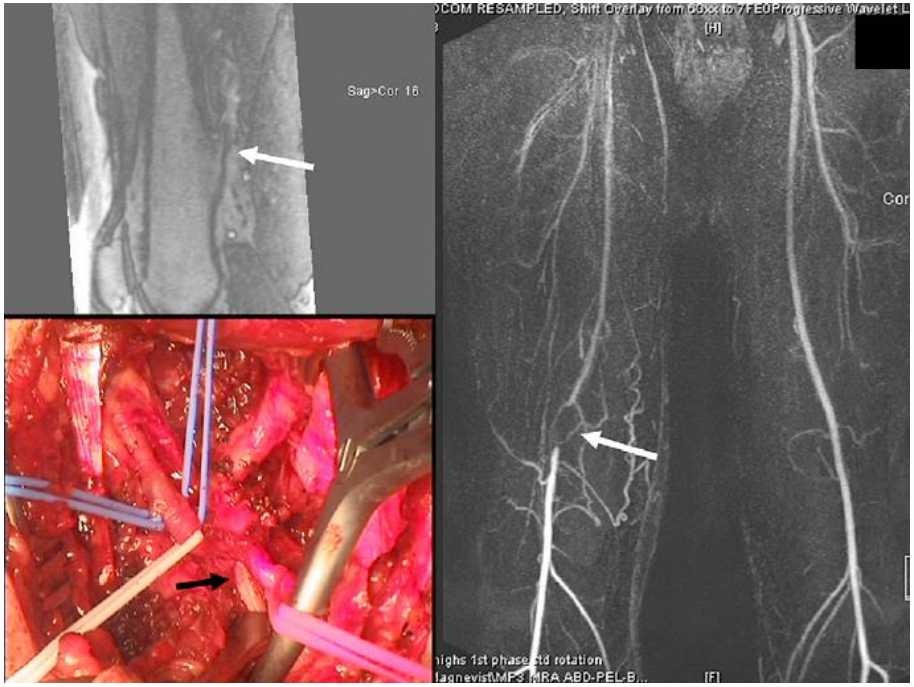






extrinsic compression

- Bony **exostosis**
- **Popliteal entrapment**, adventitial cystic dis



II. Pathophysiology

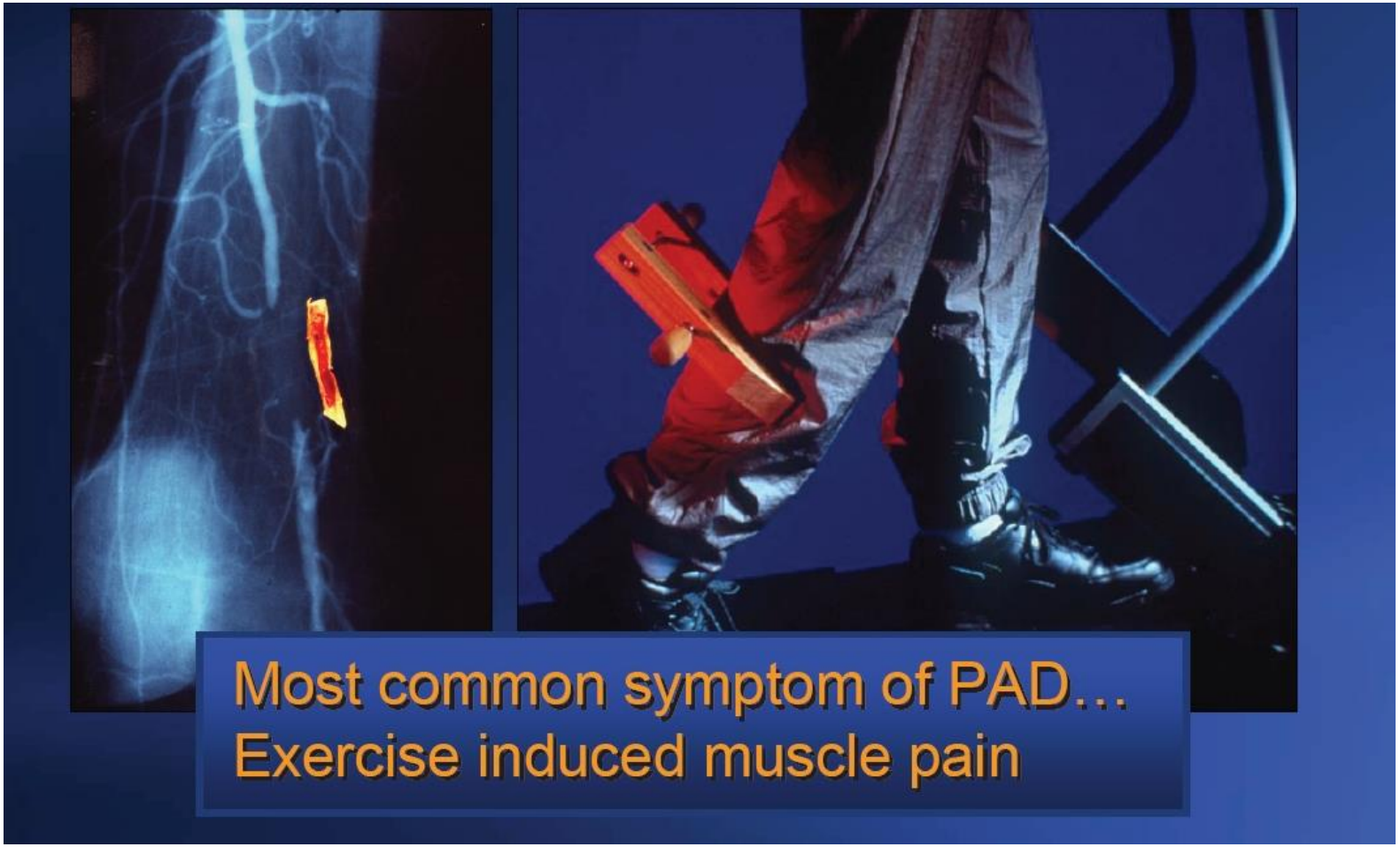
PAD: A Call to Action

Section 1	**What is peripheral arterial disease (PAD) and why is it so dangerous?**
Section 2	**Diagnosing PAD in the primary care setting**
Section 3	**The importance of aggressive risk management of PAD**

Section 1:

- **What is peripheral arterial disease (PAD) and why is it so dangerous?**

Man with calf cramping



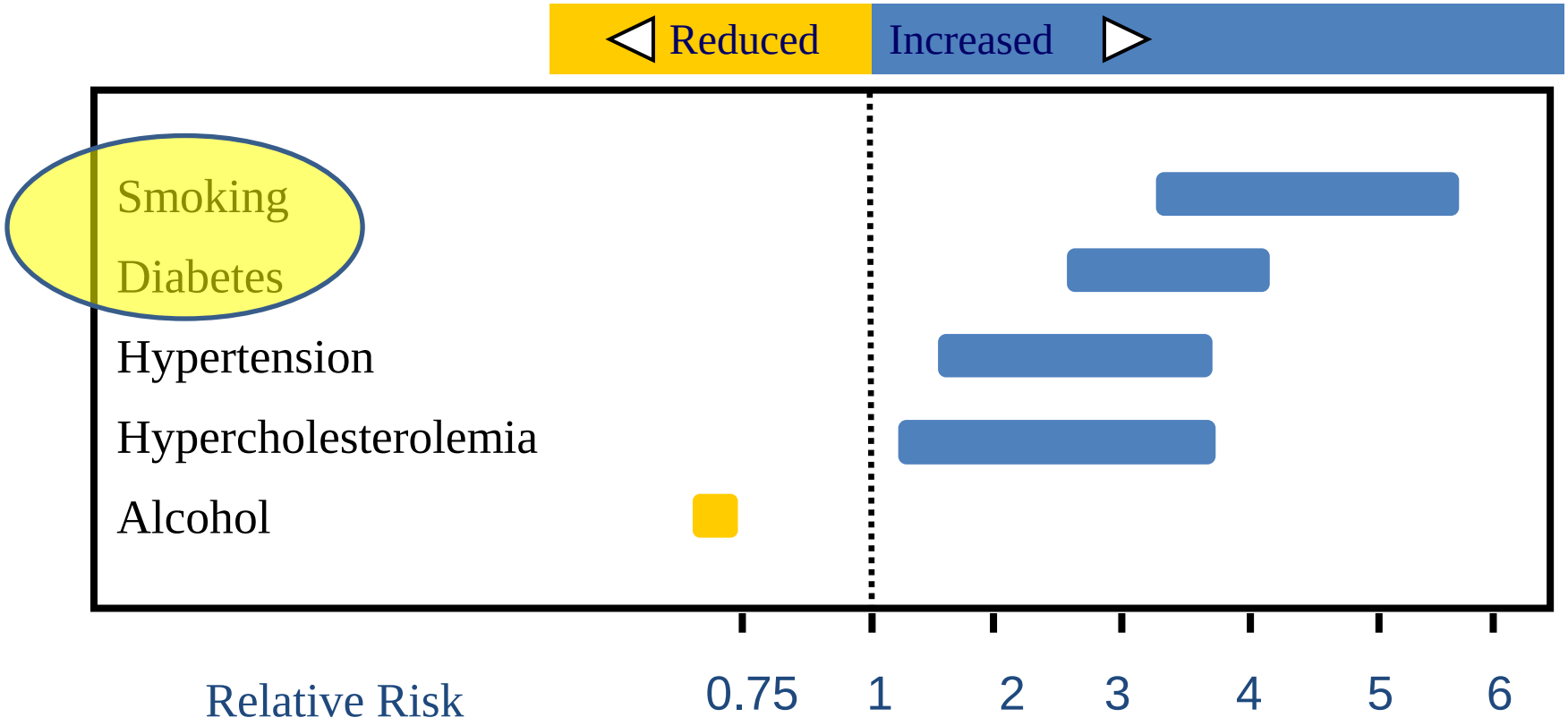
What is PAD?

- **PAD is an atherothrombotic disorder affecting the peripheral arteries and it is associated with a high risk of MI, stroke and vascular death[1]**

- **The major risk factors** for PAD are:2
  - **smoking**
  - **diabetes**
  - **age >55 years (men) or >65 years (women)**
  - **hyperlipidemia**
  - **hypertension**
  - **history of cardiovascular disease**

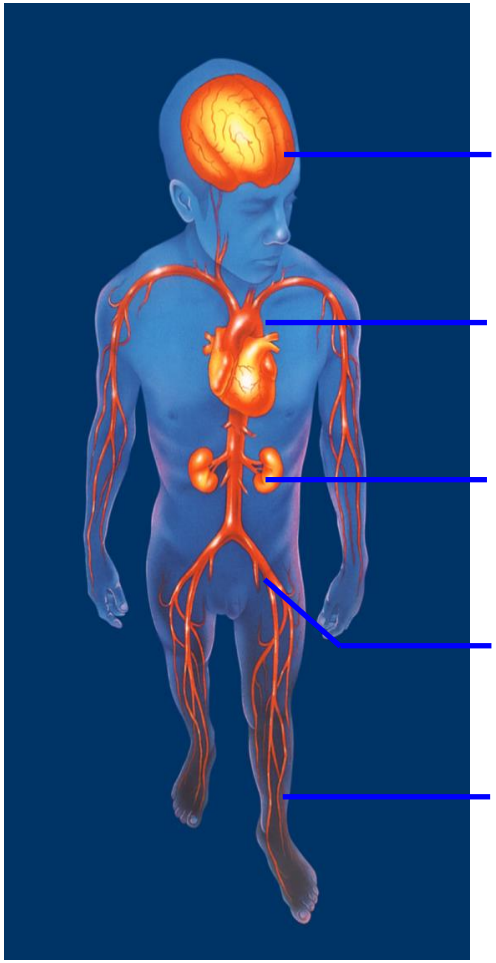
1. Hiatt WR. J Vasc Surg. 2002; 36:1283-1291.
2. Belch JJ et al. Arch Intern Med 2003; 163: 884- 892.

Risk Factors for PAD



Newman AB et al. Circulation 1993; 88: 837-845.
TASC Working Group. J Vasc Surg 2000; 31 (1, pt 2): S1-S288.
Djousse PM et al. Circulation 2000; 102: 3092-3097.

Major manifestations of atherothrombosis



Cerebrovascular disease

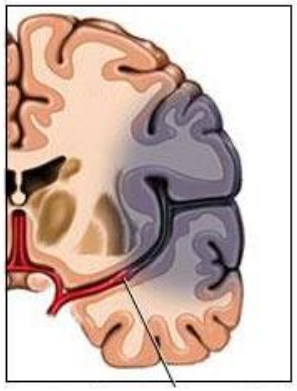
Coronary artery disease

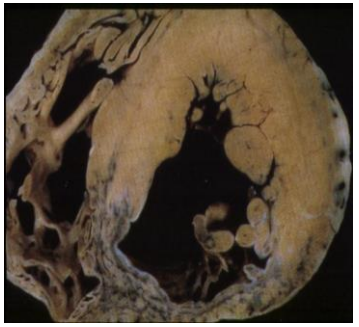
Renal artery stenosis

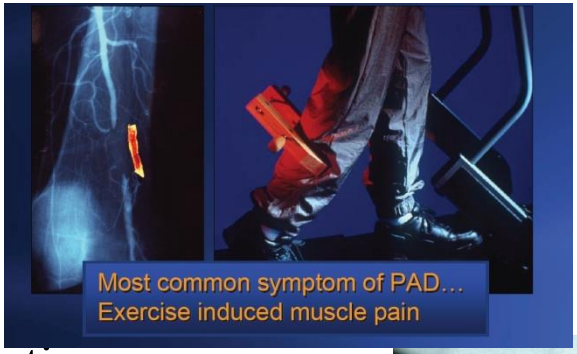
Visceral arterial disease

Peripheral arterial disease

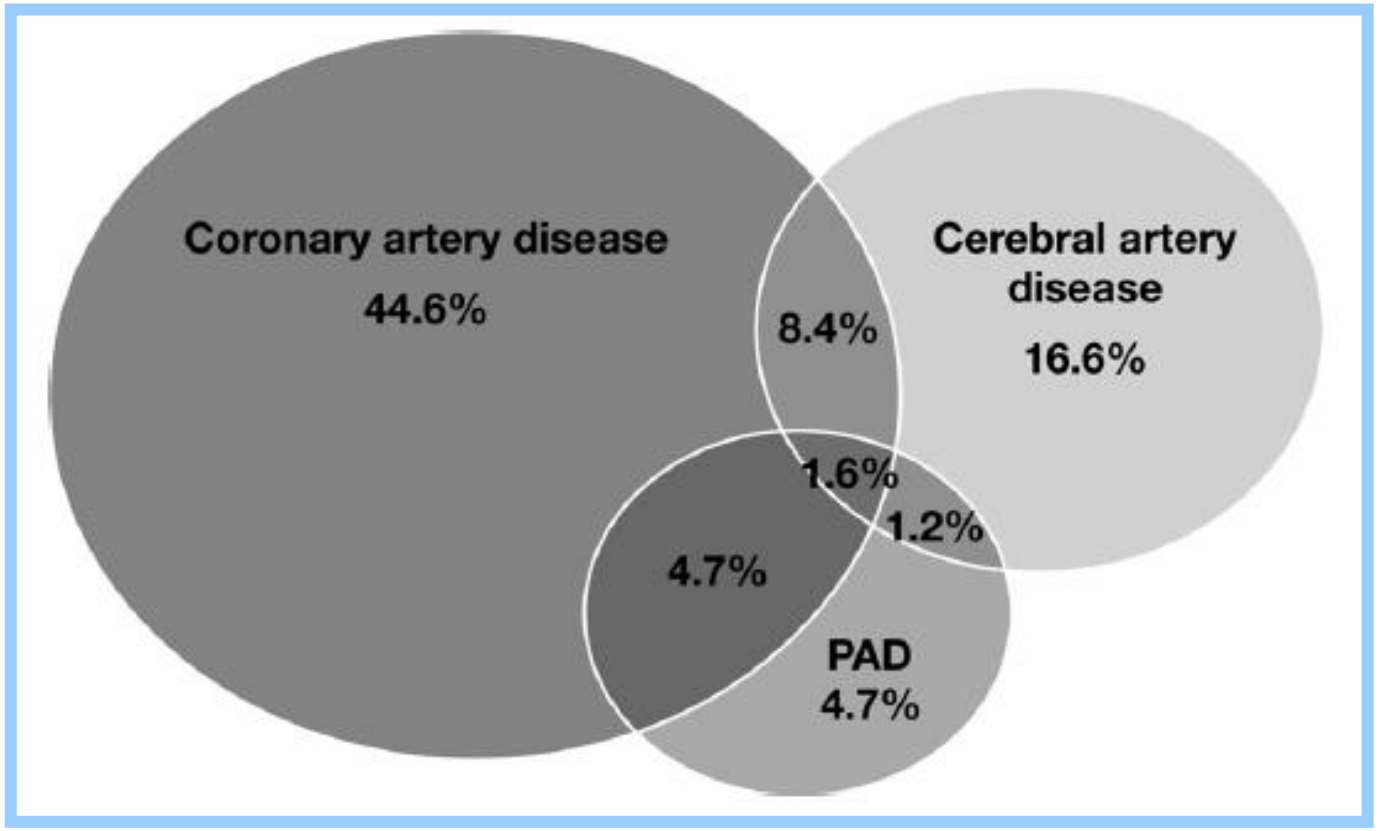
- Intermittent claudication
- Critical limb ischemia







Systemic Atherosclerosis



JAMA 2006;295:180-189.

Prevalence of PAD increases with age

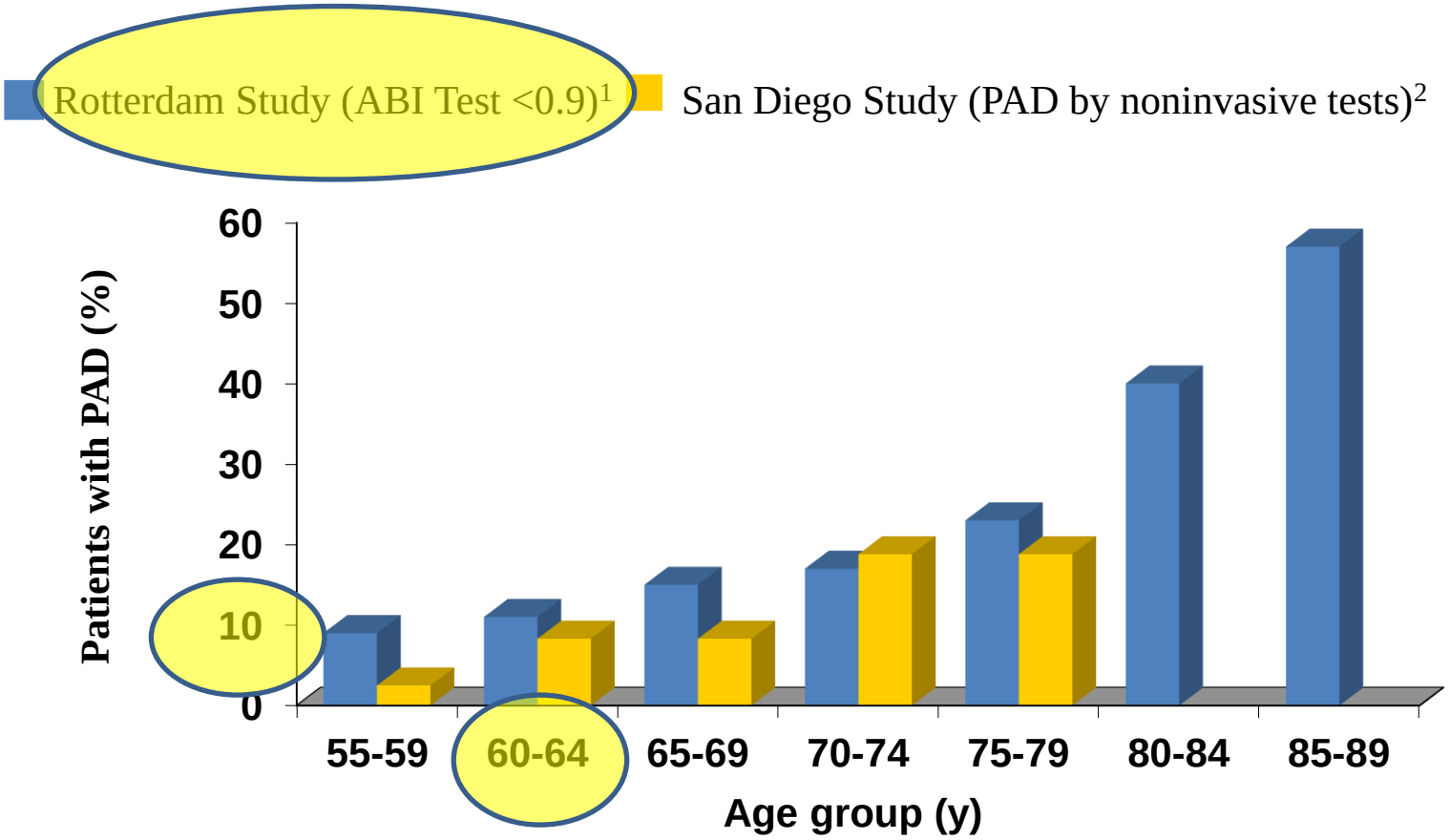
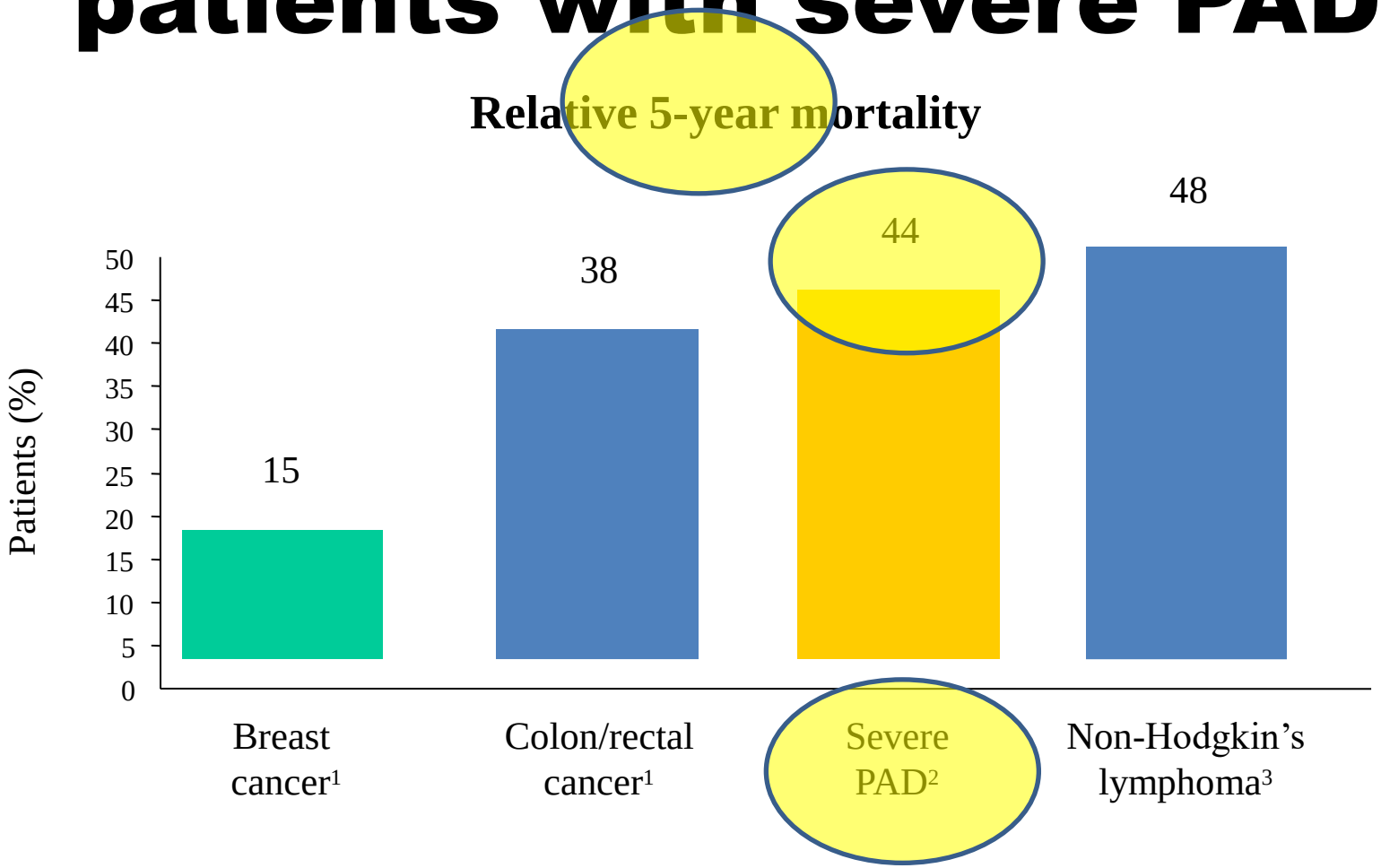


Figure adapted from Creager M, ed. Management of Peripheral Arterial Disease. Medical, Surgical and Interventional Aspects. 2000.

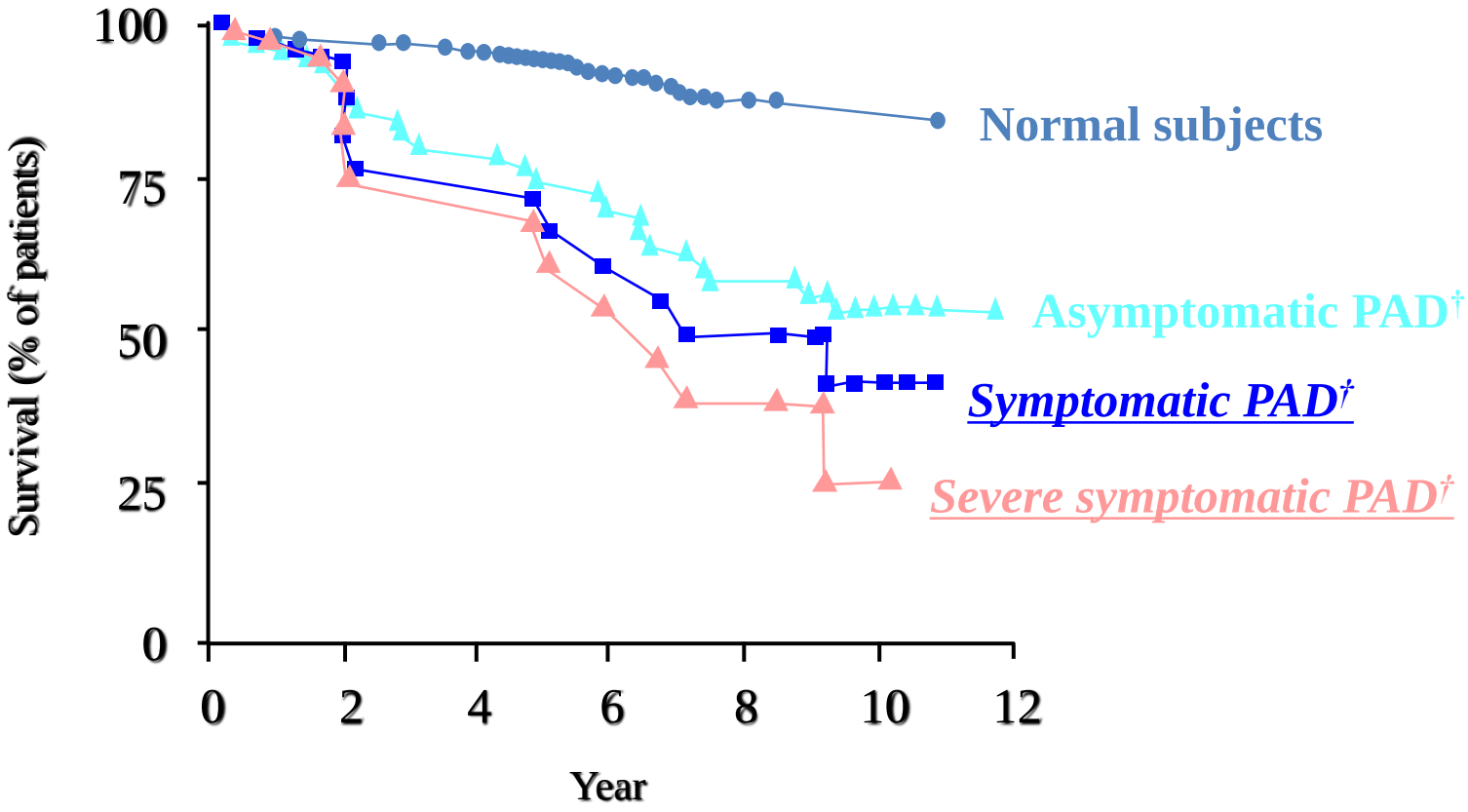
1 Meijer WT et al. Arterioscler Thromb Vasc Biol 1998; 18: 185-192.
2.Criqui MH et al. Circulation 1985; 71: 510-515.

Mortality is very high in patients with severe PAD



1. Criqui MH. Vasc Med 2001; 6 (suppl 1): 3–7.
2. McKenna M et al. Atherosclerosis 1991; 87: 119–28.
3. Ries LAG et al. (eds). SEER Cancer Statistics Review, 1973–1997. US: National Cancer Institute; 2000.

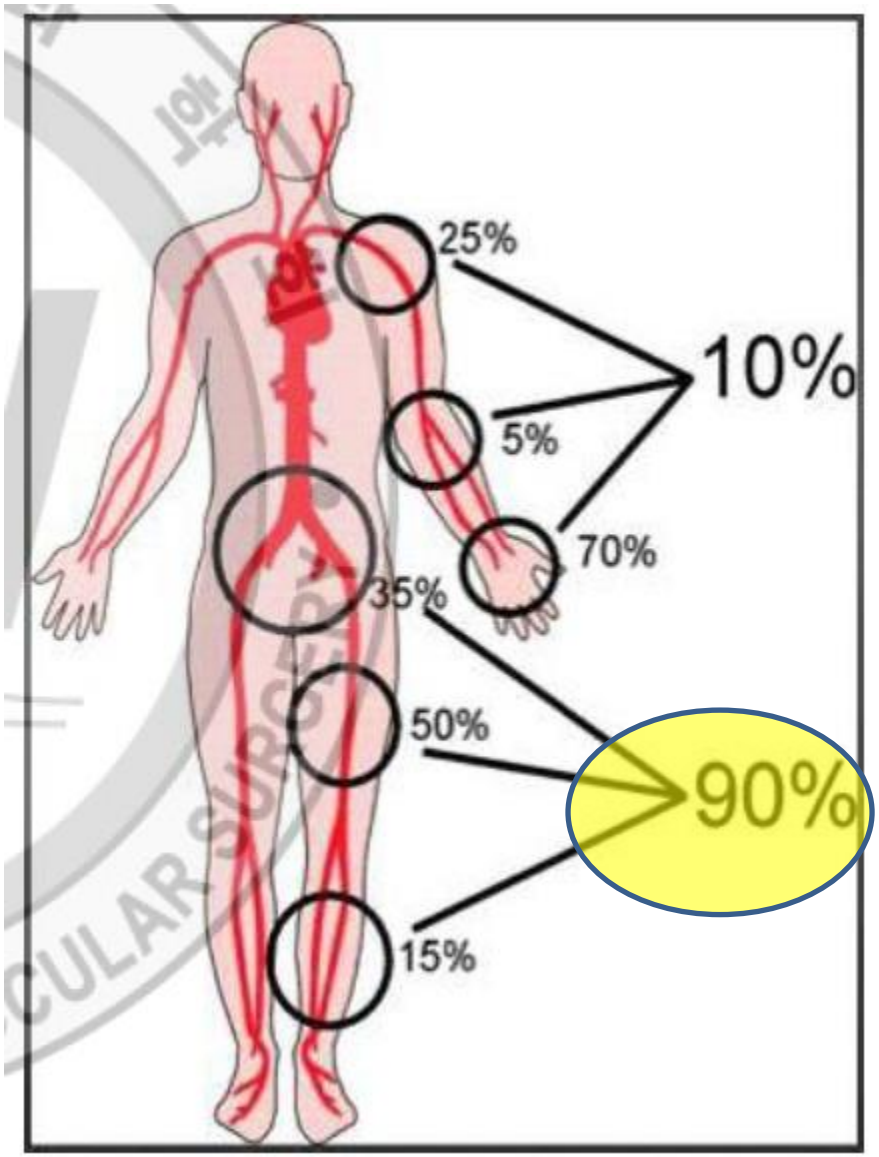
Risk of death is increased in patients with both *symptomatic* and asymptomatic PAD



*Kaplan-Meier survival curves based on mortality from all causes.
†Large-vessel PAD.

Criqui MH et al. N Engl J Med 1992; 326: 381-386.

Sites for PAD



Fate of patients with CLI

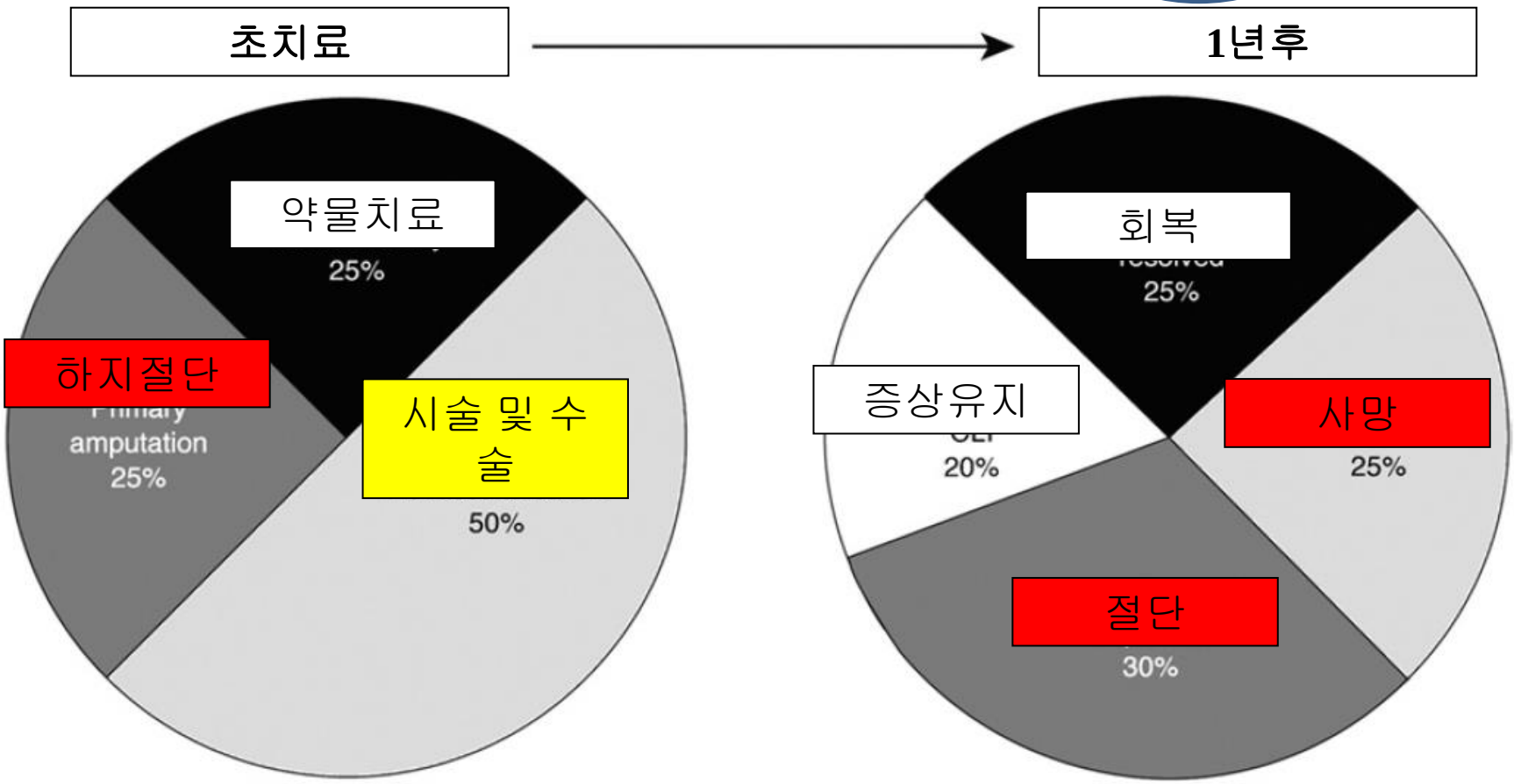
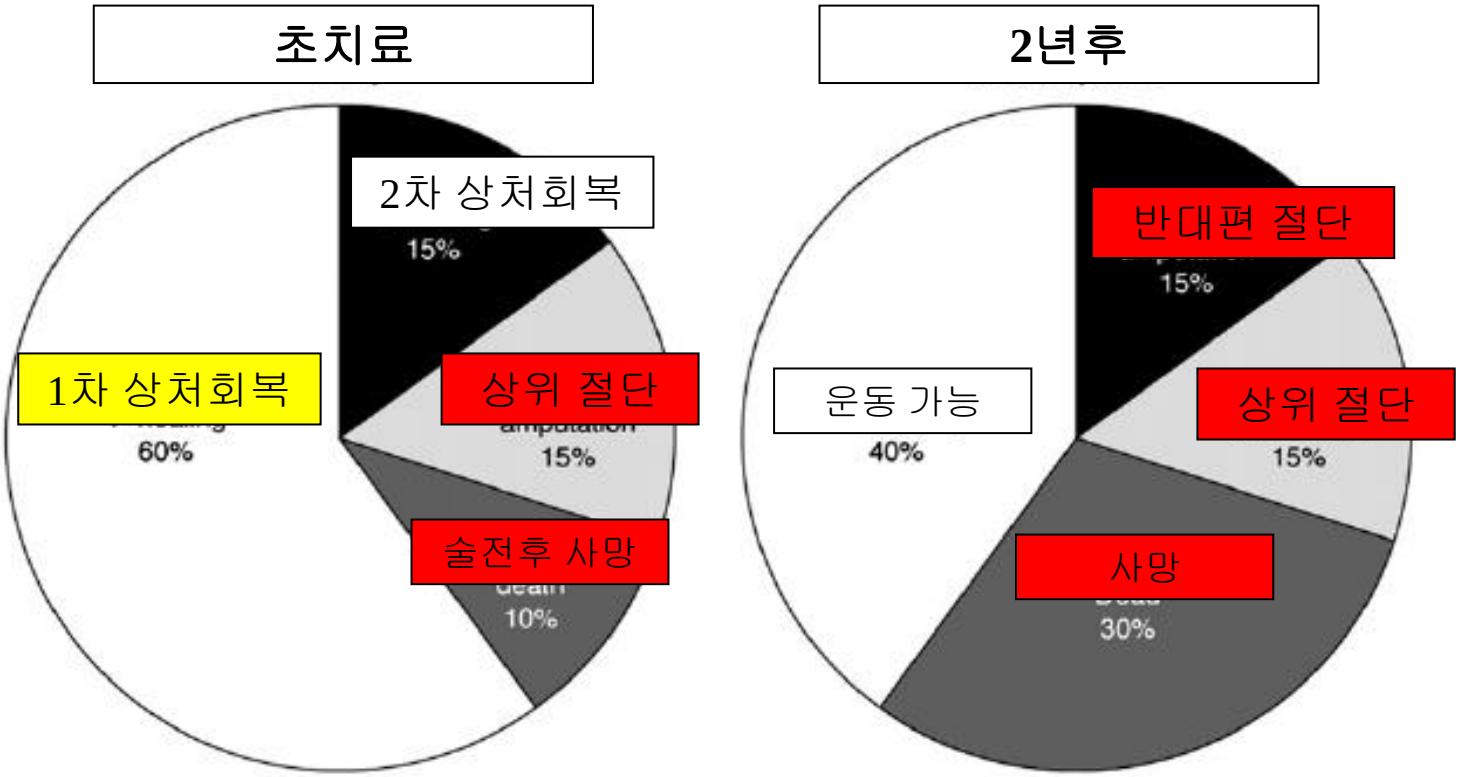


Fig. A5. Fate of the patients presenting with chronic critical leg ischemia. CLI – critical limb ischemia.

Norgren L, et al. TASCII, J Vasc Surg.2007

Fate of patients with CLI



Norgren L, et al. TASCII, J Vasc Surg.2007

PVD is not Benign!!!

- The diffuse nature and high association of PVD with **other medical conditions (ie, diabetes, renal disease, coronary disease, wound care)** demand **a multidisciplinary approach t**oward patient care at a PVD center of excellence.

- Every patient with PVD needs a multidisciplinary work-up and needs treatment.

- This treatment may be as simple as *risk factor modification* and *follow- up*, *medications*, or *complex treatments requiring interventional or surgical treatment.*

Establishing aPeripheral VascularCenter of Excellence. DAVID E. ALLIE, MD; CHRIS J. HEBERT, RT, R-CIS; AND CRAIG M. WALKER, MD. FEBRUARY 2005 I ENDOVASCULAR TODAY I 41

Multidisciplinary Team

- A true PVD center of exellence cannot exist without close cooperation and input from a **true multidisciplinary "team" approach**,
  - surgeon,
  - cardiologist,
  - peripheral interventionalists,
  - podiatrists, and
  - specialists in vascular medicine, diabetes, nephrology, neurology, wound care, and vascular imaging,
  - along with well-trained registered nurses, nurse practitioners, and physician assistants.

Establishing aPeripheral VascularCenter of Excellence. DAVID E. ALLIE, MD; CHRIS J. HEBERT, RT, R-CIS; AND CRAIG M. WALKER, MD. FEBRUARY 2005 I ENDOVASCULAR TODAY I 41

Section 2:

- **Diagnosing PAD in the primary care setting**

PAD can be silent or cause symptoms ranging from exertional pain to critical limb ischemia

Typical[1]	Atypical[1]
Intermittent claudication: pain, ache, cramp, numbness, muscle fatigue in calves, thighs or buttocks; exacerbated by exercise and relieved by rest	**Decreased walking ability:** (speed or distance) for reasons other than classical symptoms of intermittent claudication
Critical limb ischemia: rest pain, ulcers, gangrene	**Pain in other areas:** e.g. general aching

Differentiating *True Claudication* from *Pseudoclaudication*

	Intermittent Claudication	Pseudoclaudication
Charcter of discomfort	Cramping, tigahtness, tiredness	Same or tingling, weakness, clumsiness
Location of discomfort	Buttock, hip, thigh, calf, foot	Same
Exercise induced	Yes	Yes or No
Distance to claudication	Same each time	Variable
Occurs with standing	No	Yes
Relief	Stop walking	Often muse sit or change body positions

Guidance for PAD diagnosis

- **STEP 1**
  - Assess patient for **risk factors**
    - smoking
    - diabetes
    - age: men >55 years and women >65 years
    - hypertension
    - hyperlipidemia
    - history of cardiovascular disease
  - Assess patient for **leg symptoms**
    - intermittent claudication
    - critical limb ischemia
  - Tools: PAD checklist, Rose questionnaire, Edinburgh questionnaire
- **STEP 2**
  - If suspicion of PAD, perform an **ABI** to confirm diagnosis
  - Tool: **Doppler, CT, DITI**

How is Ankle-Brachial Index (ABI) measured?

$$\text{ABI} = \frac{\text{Ankle systolic pressure}}{\text{Brachial systolic pressure}}$$

- Measure ankle and brachial systolic pressures with Doppler[1,2]
- Use highest arm and each ankle pressures[1,2]

ABI Interpretation[3]

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

1. TASC Working Group. Int Angiol 2000; 19 (suppl): 5-34.
2. Vascular Disease Foundation, 2003. Available at:http://www.vdf.org/ABI.htm.
3. Hiatt WR. N Engl J Med 2001; 344: 1608-1621.

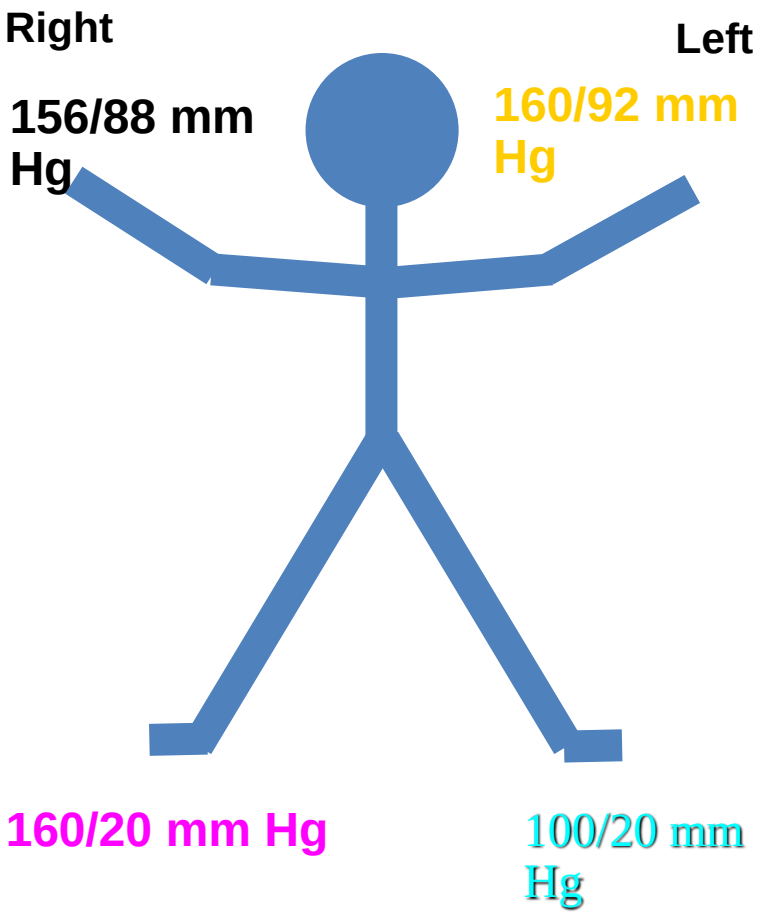
ABI Calculation

Physical Examination

- **Brachial blood pressure**
  - Right: 156/88 mm Hg
  - Left: 160/92 mm Hg

- **ABI performed in office**
  - Take the higher of the two arm pressures
  - Right:
    160/160 = 1.00
  - Left:
    100/160 = 0.63

Diagnosis:
moderate PAD in left leg



ABI Calculation

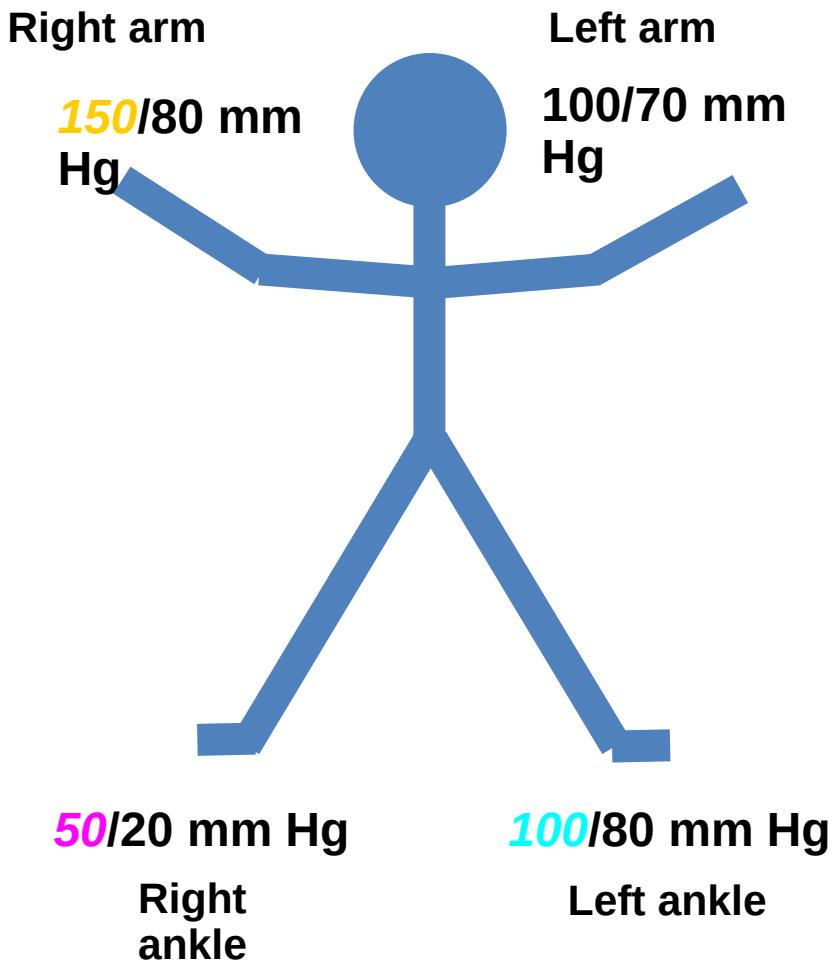
Physical Examination

- **Brachial blood pressure**
  - Right: 150/88 mm Hg
  - Left: 100/70 mm Hg

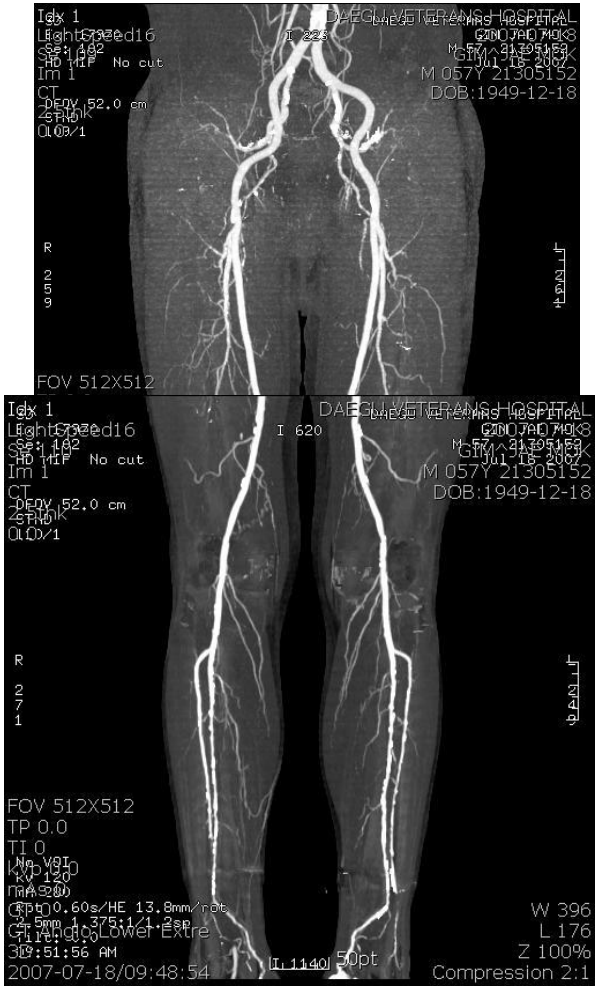
- **ABI performed in office**
  - Take the higher of the two arm pressures
  - Right:
    50/150 = 0.33
  - Left:
    100/150 = 0.66

Diagnosis:

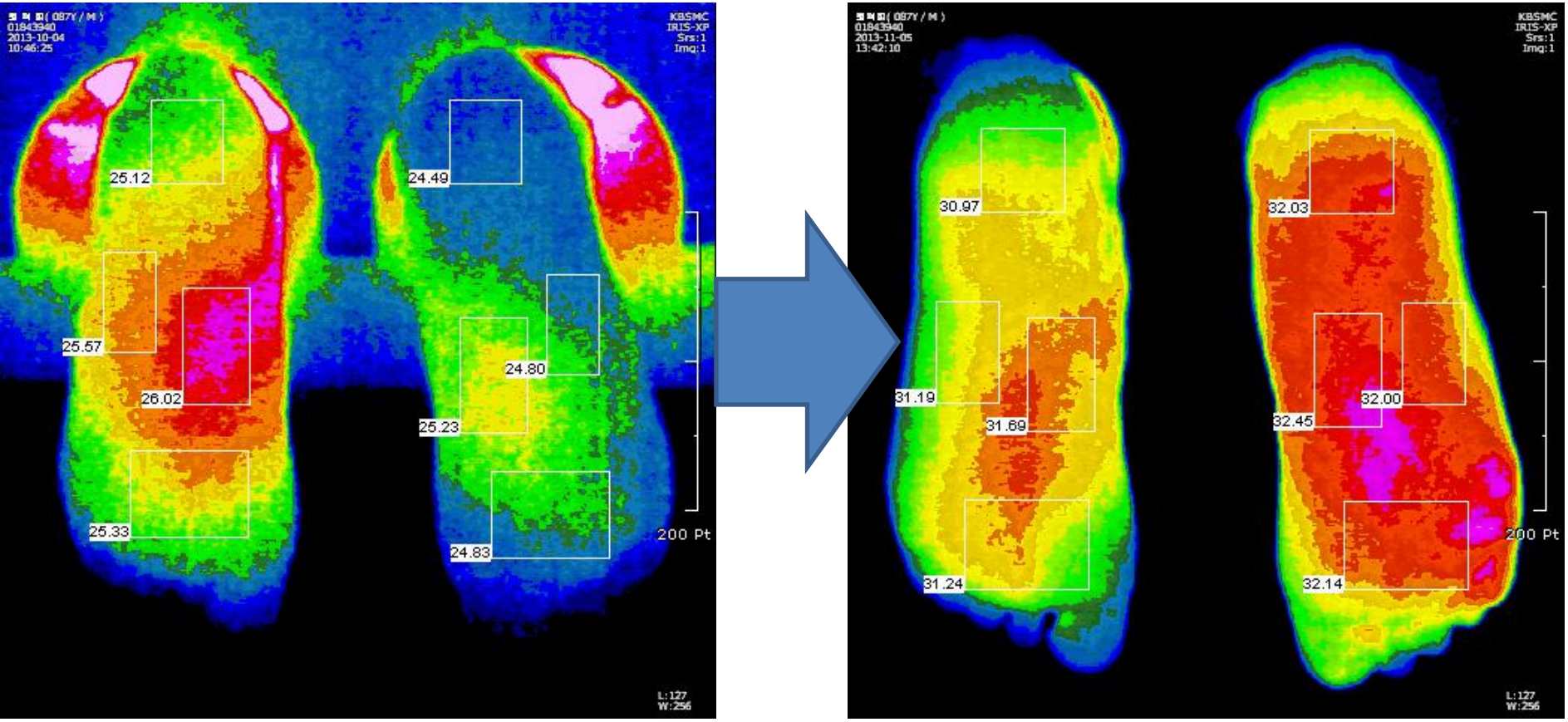
severe PAD in left leg



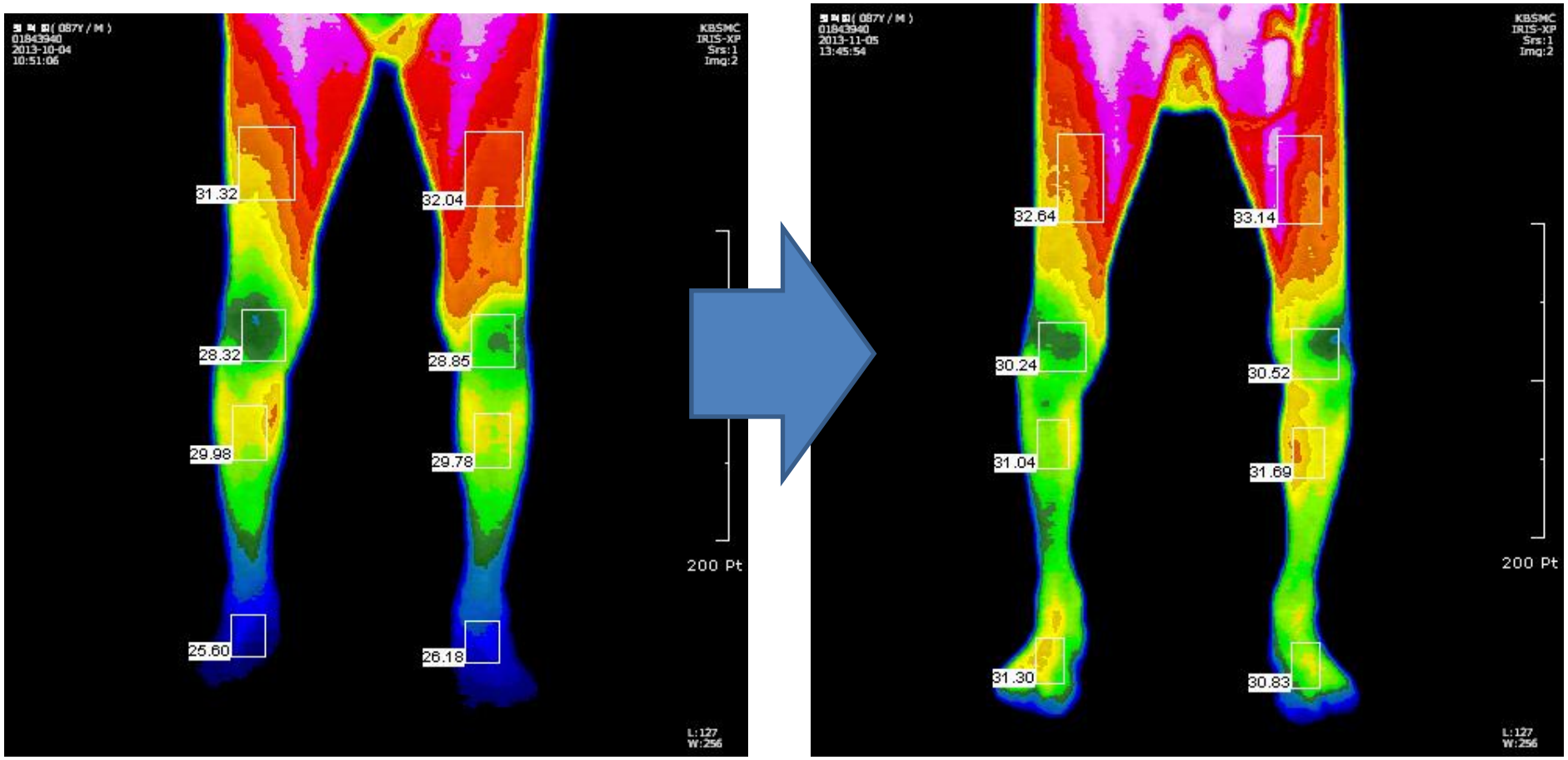
CT angiography



DITI: Digital Infrared Thermal Imaging



DITI: Digital Infrared Thermal Imaging



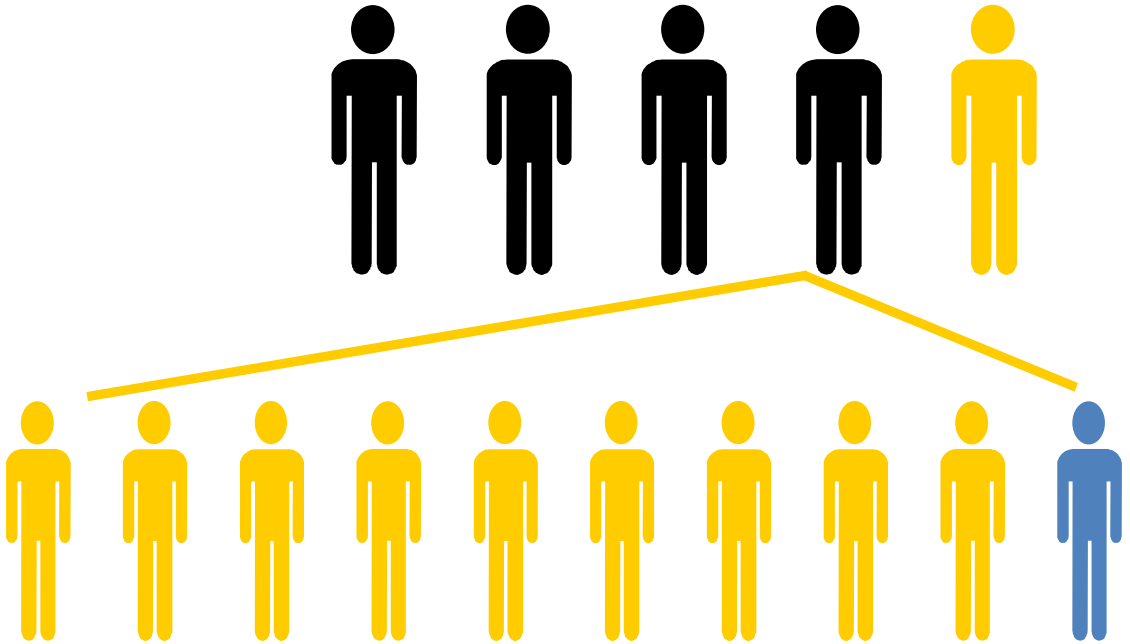
Section 3:

- **The importance of aggressive risk management of PAD**

Only 1 in 10 patients with PAD has classical symptoms of intermittent claudication

1 in 5 people over 65 has PAD†

Only 1 in 10 of these patients has classical symptoms of intermittent claudication (IC)



† ABI<0.9

Diehm C *et al*. *Atherosclerosis* 2004; **172**; 95-105.

The American Diabetes Association recommends screening for PAD in patients with diabetes

A screening ABI **should be** performed in patients **with diabetes**

Those >50 years of age

- If normal, an exercise test should be carried out
- The ABI test should be repeated every 5 years

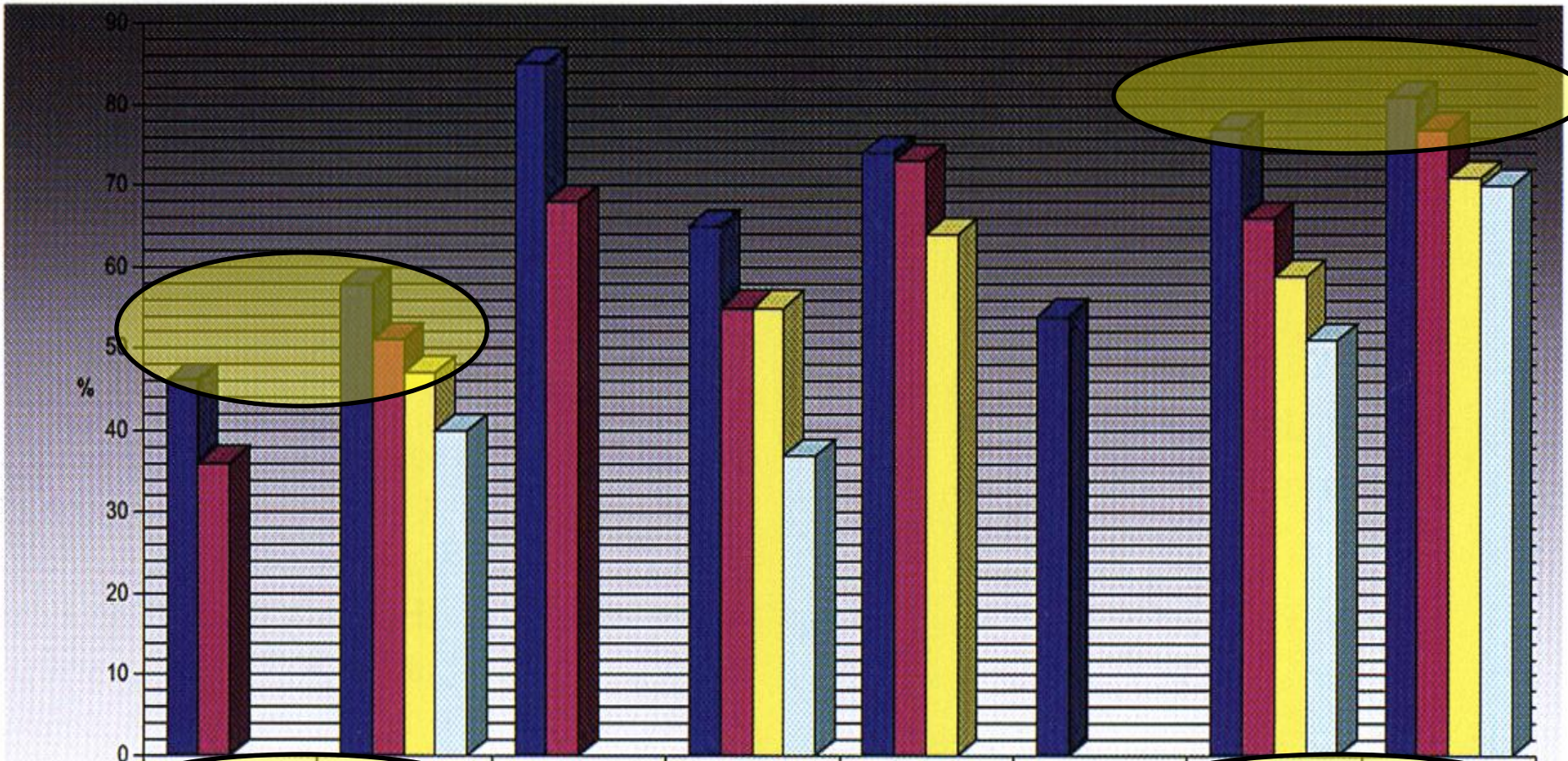
Those <50 years of age who have other risk factors associated with PAD

- Smoking
- Hypertension
- Hyperlipidemia
- Duration of diabetes >10 years

- Foot care is also important in diabetic patients as PAD is a major contributor to diabetic foot problems[2]

1. American Diabetes Association. *Diabetes Care* 2003; **26**: 3333–3341.
2. Estes JM, Pomposelli FB Jr. *Diabet Med* 1996: **13**: S43–S57.

III. Treatment

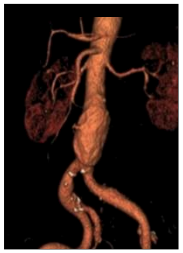


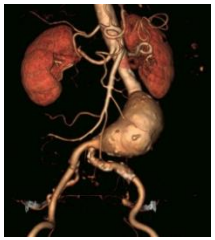
	Angioplasty (Subintimal)	Angioplasty (Primary)	Nitinol Stents	Stents (Excluding Nitinol)	Covered Stent (Hemobahn)	Covered Stent (Dacron)	Surgical bypass (Prosthetic)	Surgical bypass (Vein)
1 Year	46	58	85	65	74	54	77	81
2 Years	36	51	68	55	73		66	77
3 Years		47		55	64		59	71
4 Years		40		37			51	70

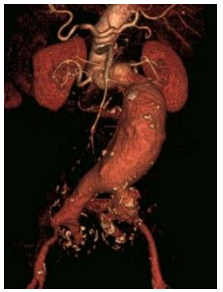
J Endovas Ther
2004;11(suppl II):II-107-II-127
Lower Extremity Endovascular Interventions
Bates and AbuRahma

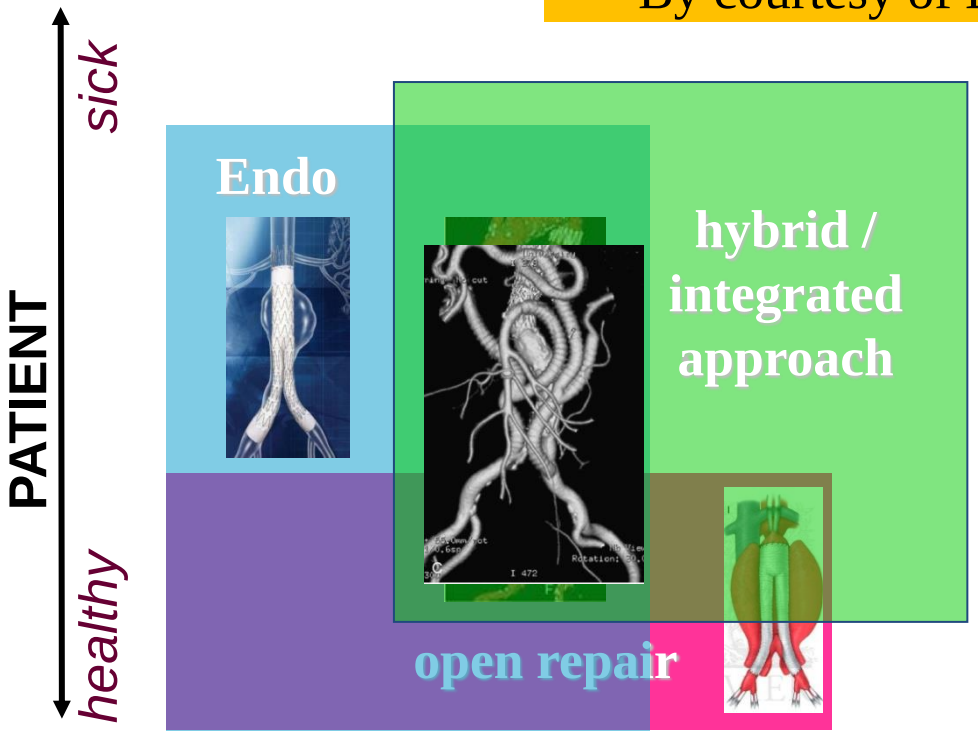
Endo. & OSR & Hybrid

By courtesy of Dr. Park (Kae Hyun)









Schema

- Acute limb ischemia : **Acute arterial occlusion**
  - Acute embolism
  - Acute thrombosis

- Chronic limb ischemia : **Chronic arterial occlusion**

II-1. Acute Limb Ischemia

Definition

- Sudden occlusion of an artery is commonly due to either **emboli** or **trauma** & it may also happen when **thrombosis** occur *on plaque pre-existing atheroma.*

Cause - Emboli

Origin of Acute Arterial Embolism:

Cardiac		**80%**
	Af	50%
	MI	25%
	Valve and Others	5%
Non-Cardiac	10%	
	Aneurysm	6%
	Prox. Artery	3%
	Paradoxical	1%
Unknown	10%	

Occlusion Site - Emboli

Sites of occlusion embloi to the lower limb:

Abdominal bifurcation	10-15%
Iliac artery branch	15%
Femoral artery branch	**40%**
Popliteal artery	10%
Upper extremity	10%
Cerebral artery	10-15%
Mesenteric & Intraabdominal	5%

Cause - Trauma

- It is important to determine a history of arterial trauma, arterial catheterization, intra-arterial drug induced injection, aortic dissection, limb fractures.

Cause - Thromosis

- Thrombosis usually occur on a pre-existing atherosclerotic lesion.

- Occasionally thrombosis occur on relatively normal artery in patients with hypercoagulabale states
  - ex: Pt with malignancy, polycythemia or pt taking high doses of oestrogen.

Clinical Features

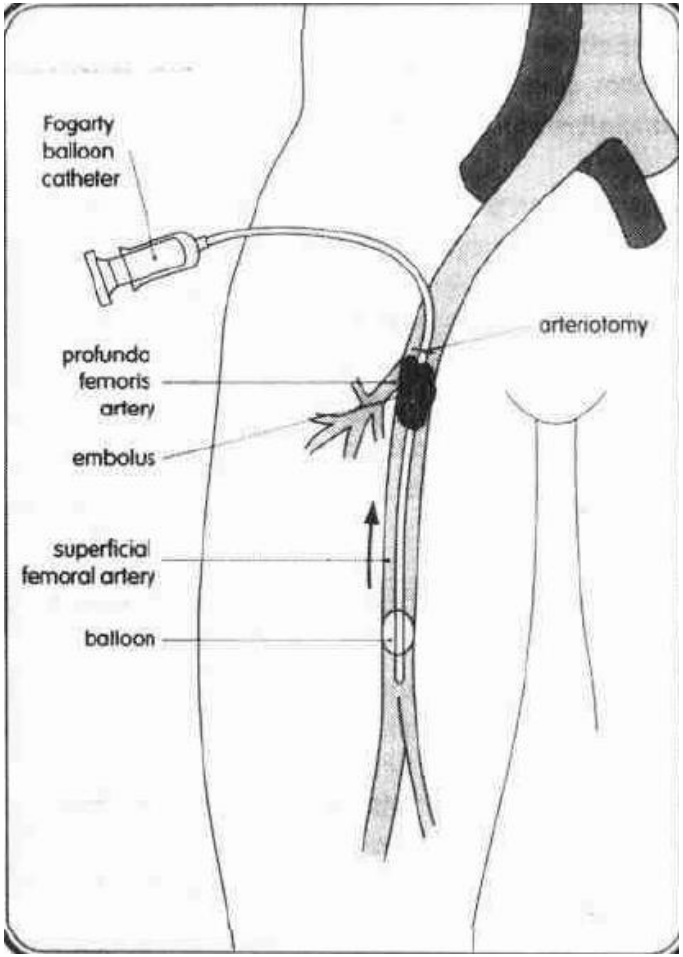
- The ***5 (6) P's***
  - **Pain.**
  - **Pallor.**
  - **Pulselessness.**
  - **Paraesthesia.**
  - **Paralysis.**
  - Perishing cold.

Embolism vs Thrombosis

	Acute arterial embolism	Acute arterial thrombosis
Cause	AF, MI, MS etc	Atherosclerotic lesion
Sx.	More sudden	Pre-existing claudication
Angio.	1. Clear cut off lesion 2. No or minimal collateral 3. No or minimal arterial calcification 4. Normal opposite leg artery	1. Irregular 2. Well developed collateral 3. Arterial calcification 4. Diseased opposite leg artery
Tx.	Embolectomy + Anticoagulation	Thrombolytic therapy + Bypass op (or endovascular intervention)
Prognosis ampu. mortality	 Lower Higher	 Higher (x 2) Lower

By Courtery of Prof. WY Kim

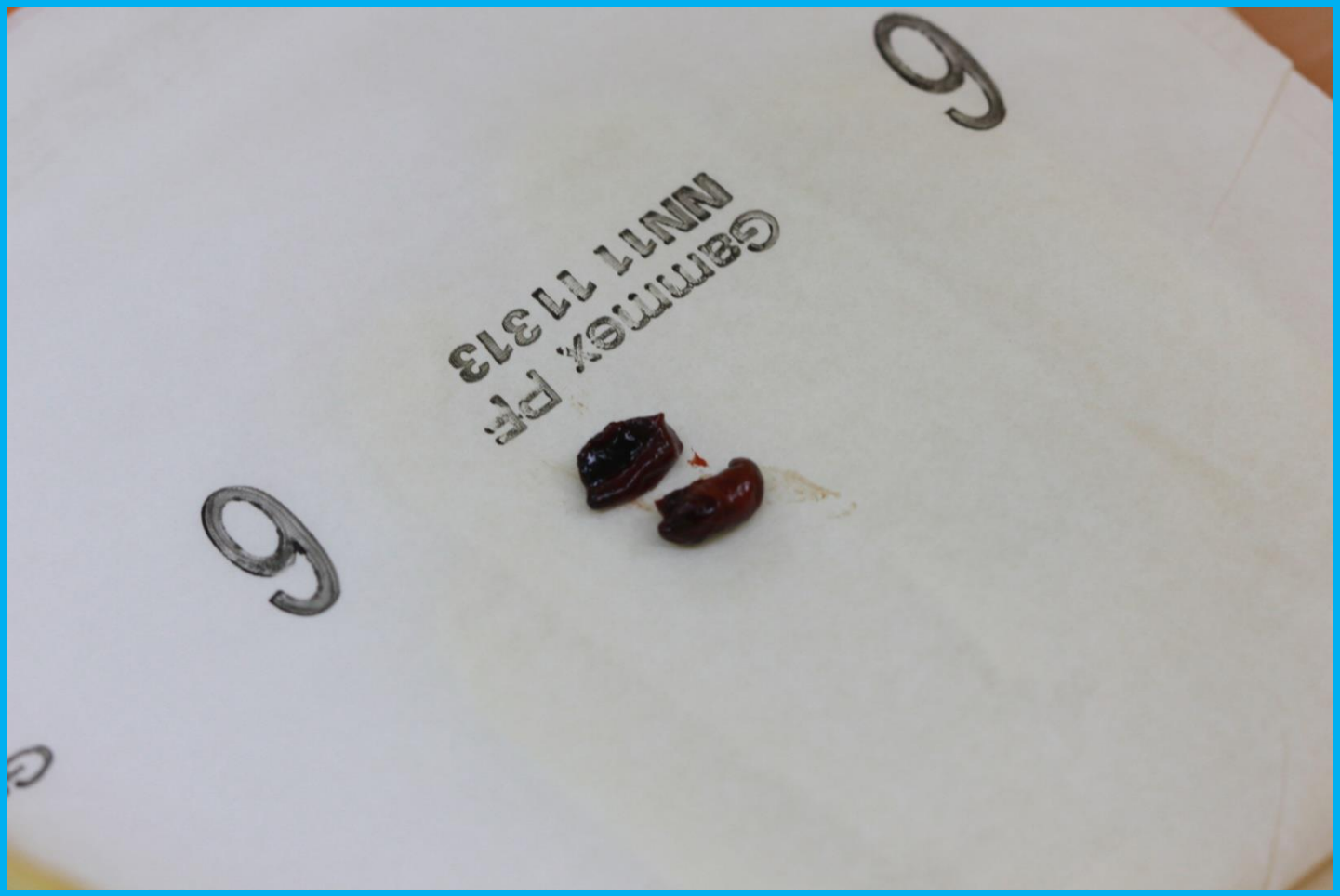
Embolectomy



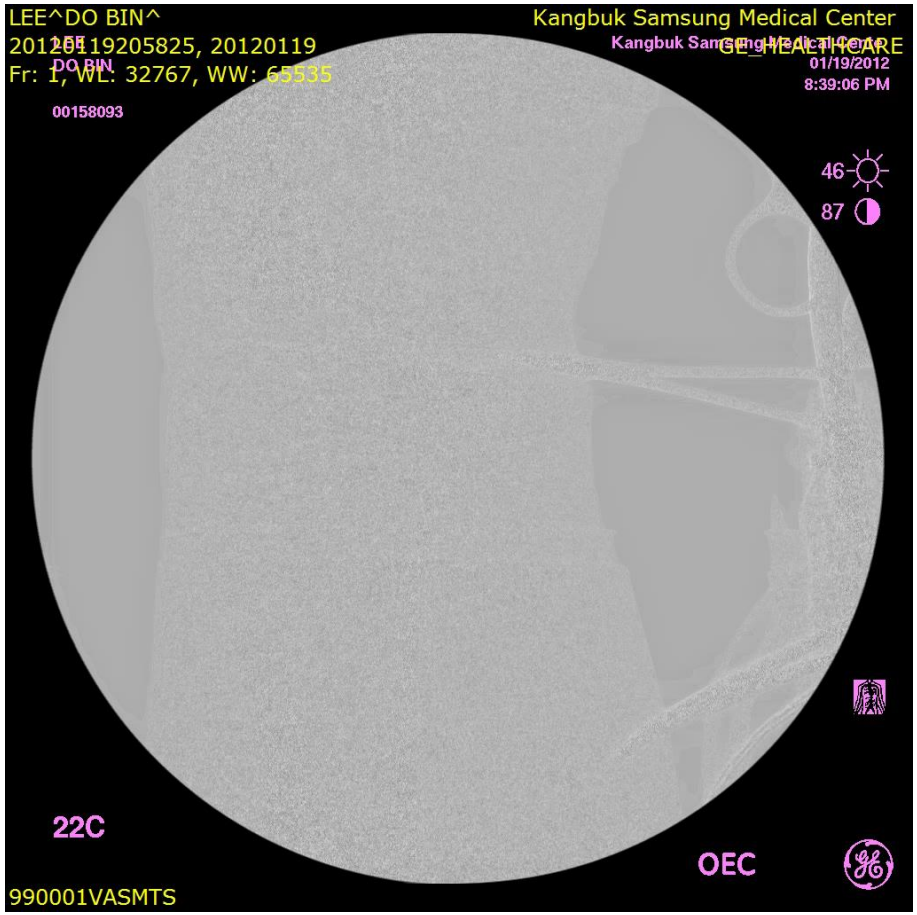
Fogarty's balloon catheter

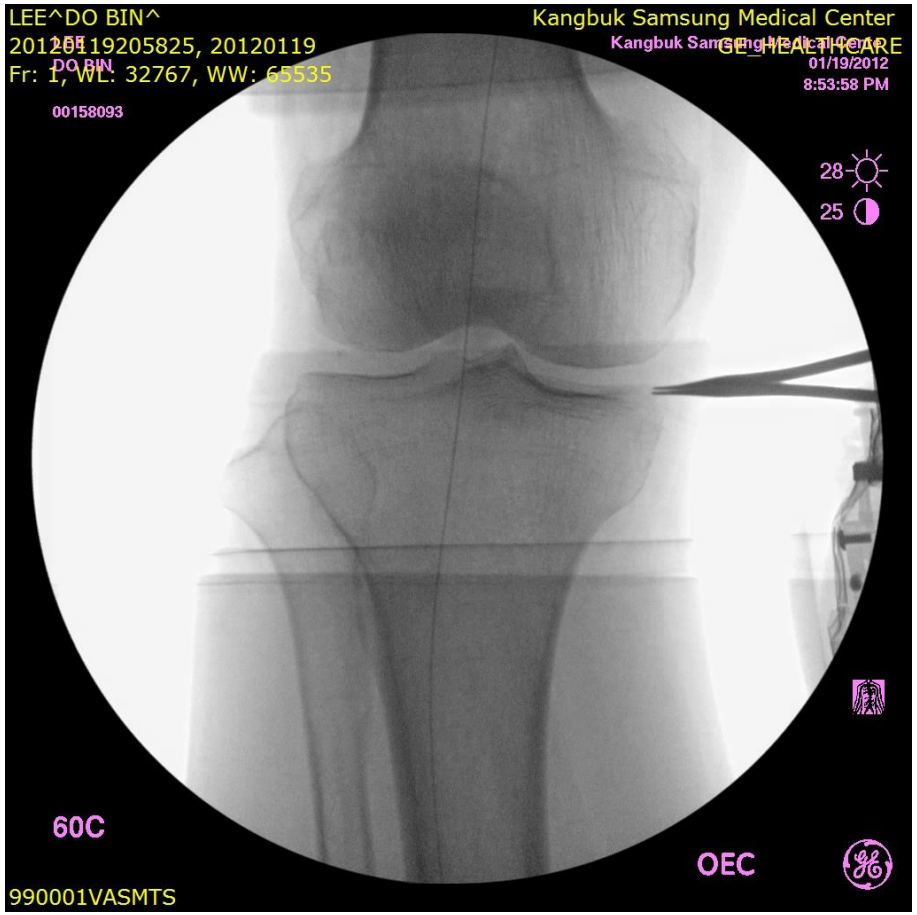
Case Presentation

- **Embolectomy:** antegrade approach at Rt CFA



Completion Angio





II-2. Chronic Limb Ischemia

Definition

- It is the decrease in arterial blood supply to the tissues **due to partial occlusion of arteries**.

- **Stenosis or occlusion** produces symptoms & signs that are related to the organ supplies by the artery.

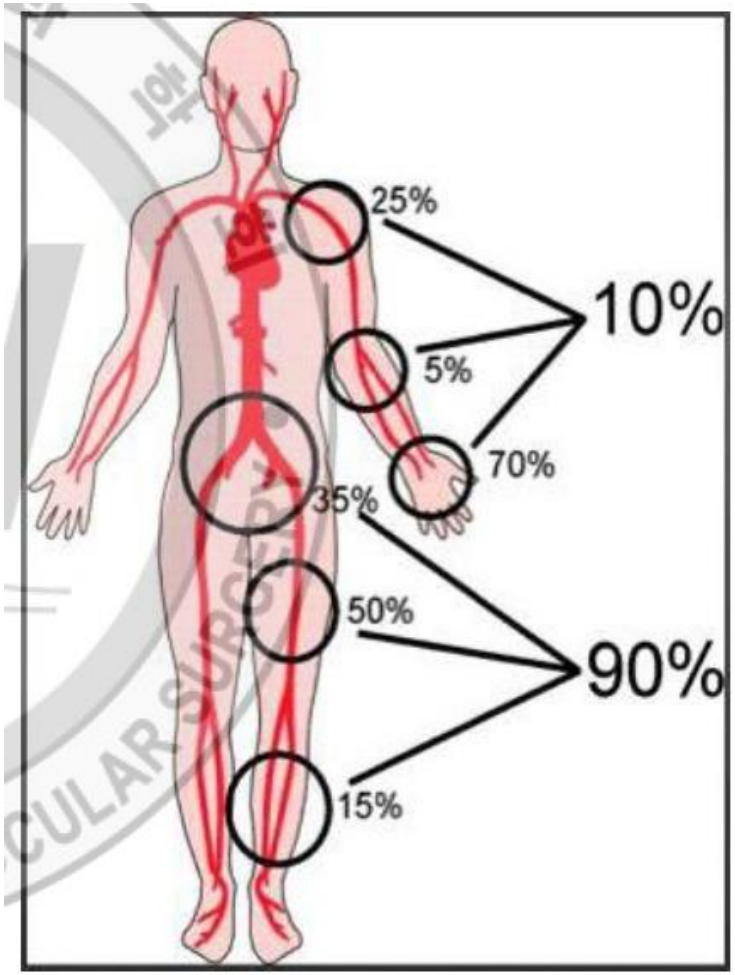
- The severity of symptoms is related to **the size of the vessel occluded** & **alternative routes (collaterals) available for blood flow**.

Causes

- Atherosclerosis (ASO)
- Burger’s disease
- Raynaud’s disease
- Others

Common sites of plaque formation in arteries

- Branch points.
- Tethered sites like in superficial femoral artery in Hunter's canal in the leg.



Clinical Manifestation

- Non- **Critical Limb Ischemia**

- **Cricial Limb Ischemia (CLI)**

Non- Critical Limb Ischemia

- **Intermittent claudication:**
  - ABI: 0.5-0.9
  - Cludication distance
  - Calf is the most common

Critical Limb Ischemia

- **Rest Pain**
  - Worst at night,lying, relieved by putting the leg in dependent site
  - Coldness
  - Numbness
  - Parasthesia
  - Color change
  - Differentiated from night cramps

- **Ulcer**
- **Gangrene**

Definitions of Critical Limb Ischemia

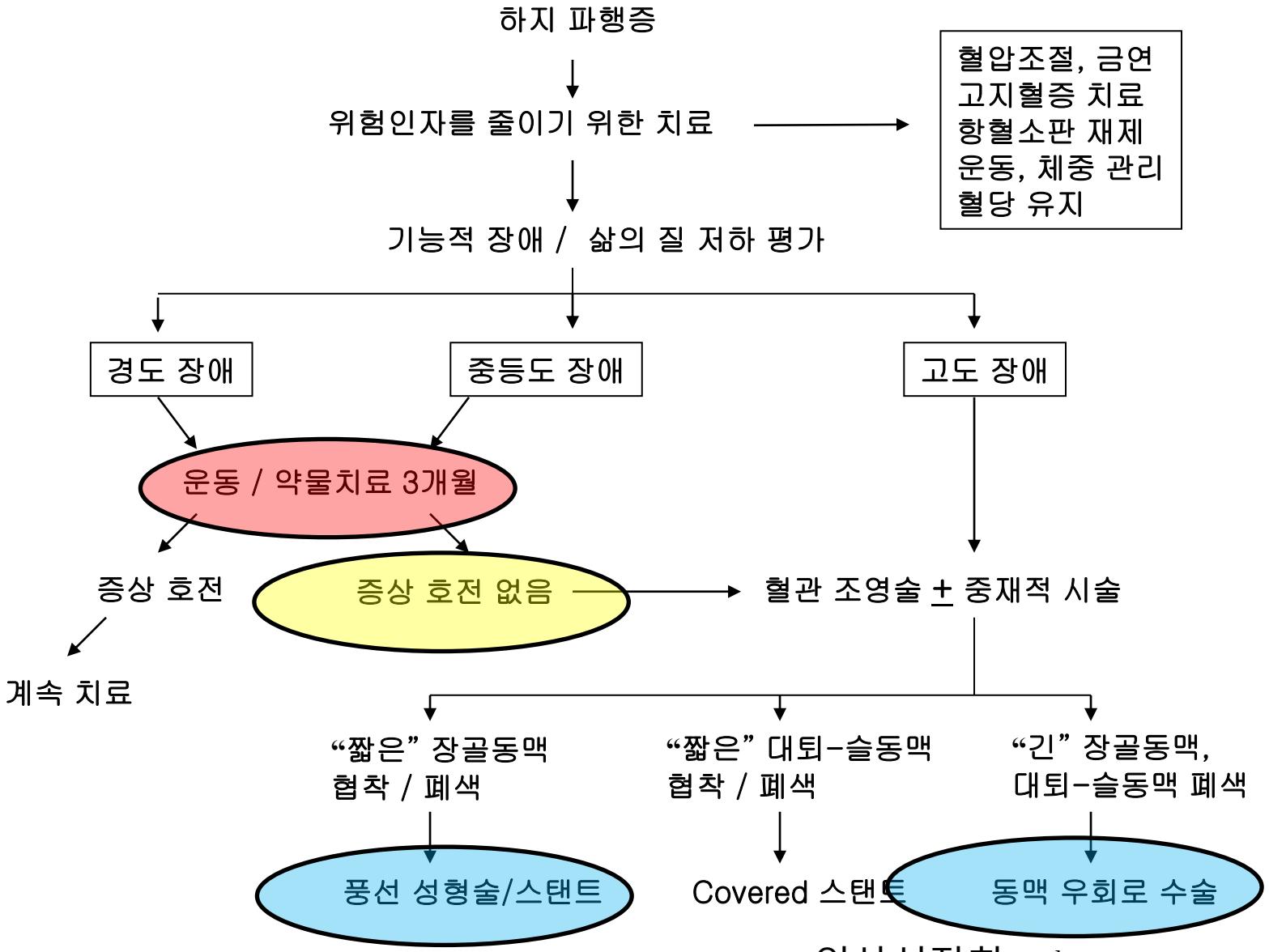
(TASC II Inter-Society Consensus)

Classification of PAD

Fontaine		Rutherford	
Stage	**Clinical**	**Category**	**Clinical**
I	Asymptomatic	0	Asymptomatic
IIa	Mild claudication	1	Mild claudication
IIb	Moderate to severe claudication	2	Moderate claudication
		3	Severe claudication
III	**Ischemic rest pain**	4	**Ischemic rest pain**
IV	**Ulceration or gangrene**	5	**Minor tissue loss**
		6	**Major tissue loss**

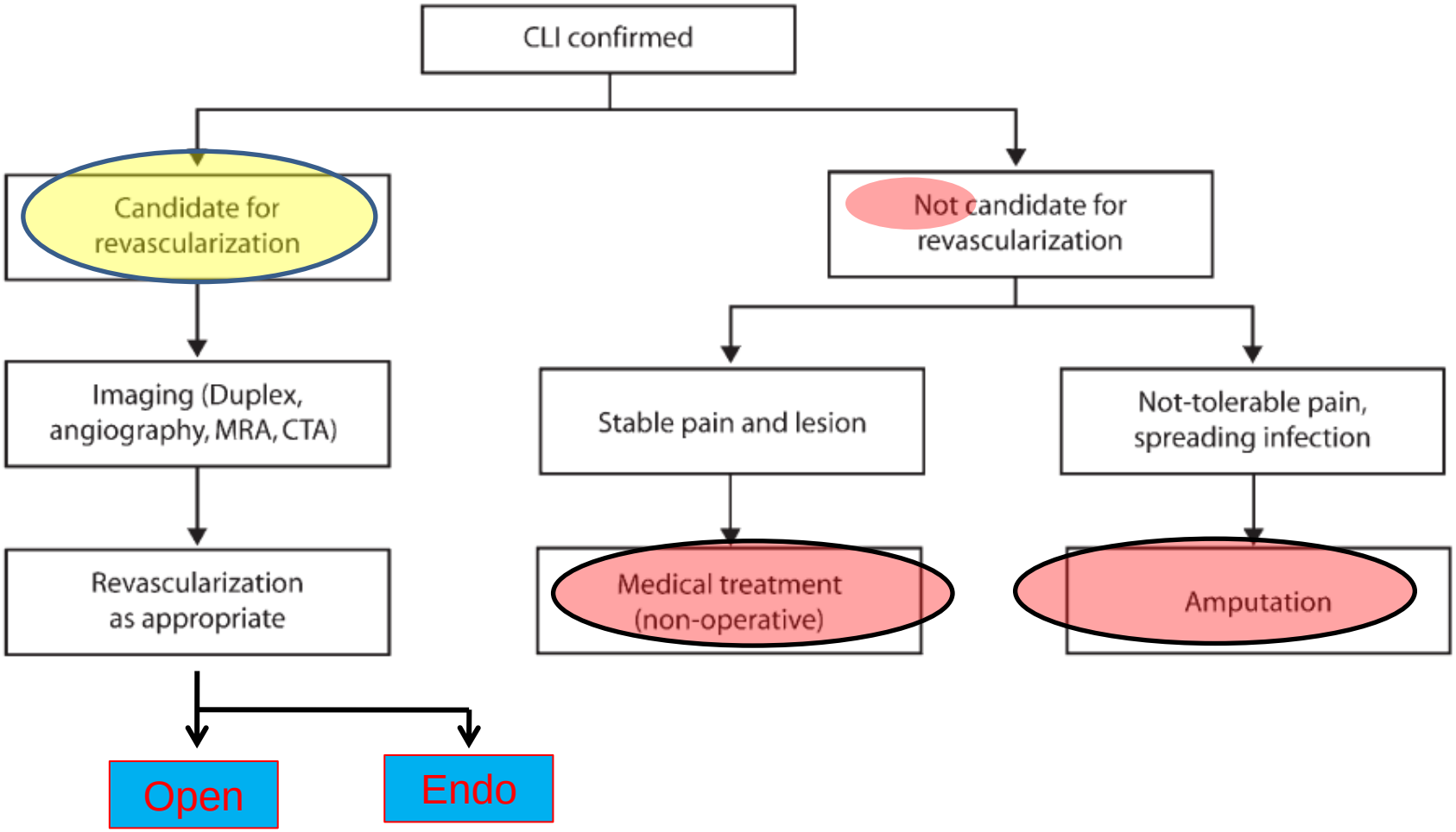
* CLI should only be used in the presence of symptoms for more than 2 weeks.

Algorithm for Non-CLI (claudication)



임상심장학 2nd edition

What is the Optimal Treatment for CLI?



Amputation as a primary therapy

- **How to interpretate the preexisting data**
  - Physician-oriented view of success
    ; Graft patency, limb salvage, and survival
  - Patient-oriented outcomes
    ; Quality of life

- **Ischemia-reperfusion syndrome**
  - might jeopardize patient survival

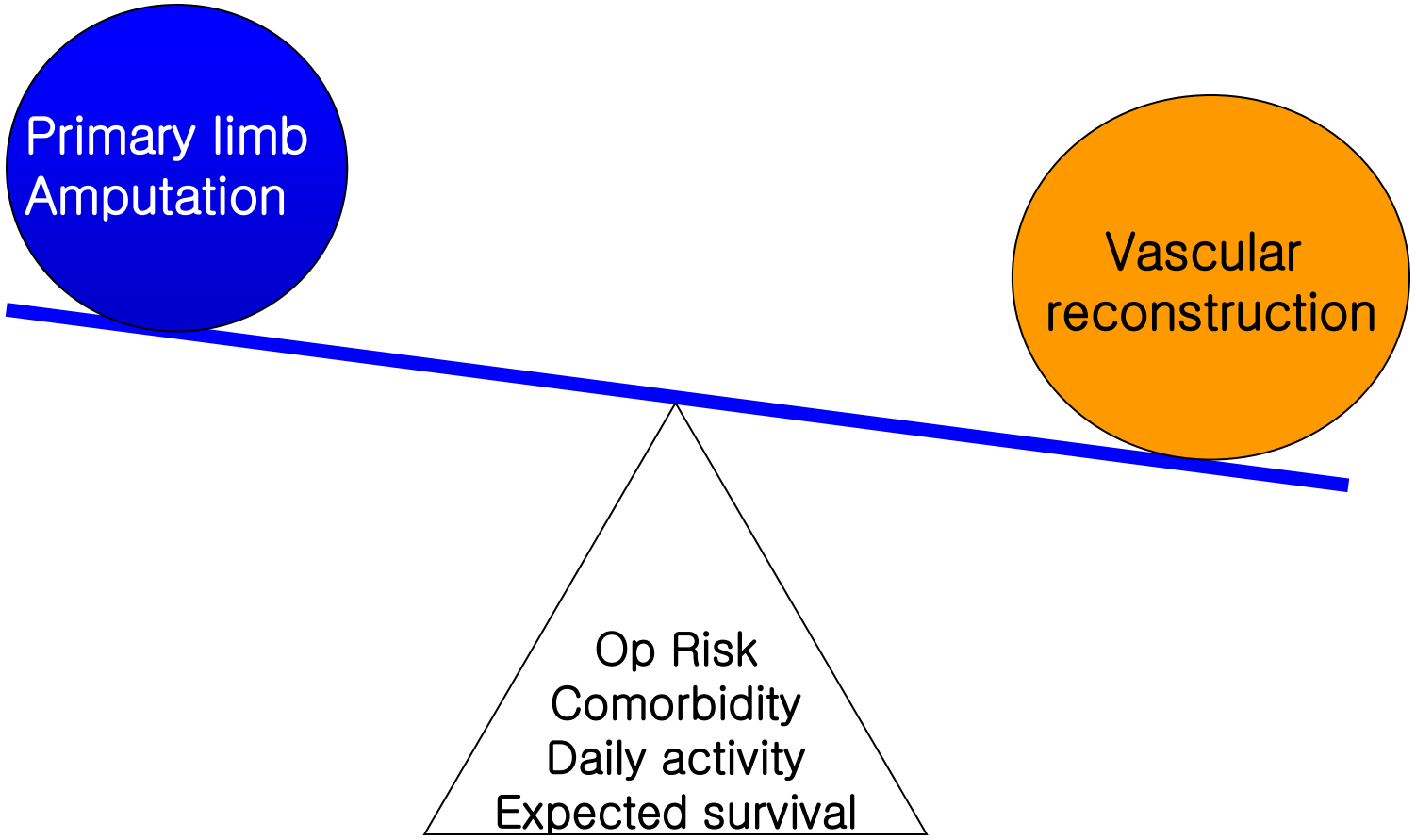
→ Limb amputation may actually improve QOL in select patient population

Revascularization in CLI

- **Methods**
  - **Open first**
  - **Endo first**
  - **Hybrid**

- **How to select optimal treatment?**
  - **Hospital resources**
  - **Operator's preference (VS vs IR)**
  - **Evidence-based practice, Treatment guideline**

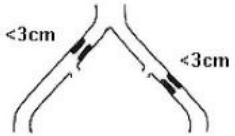
Preop. Risk-Benefit Analysis



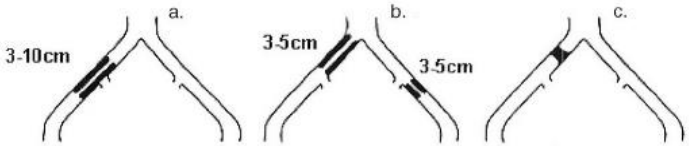
By Courtery of Prof. WY Kim

TASC 2000 and TASC II 2007

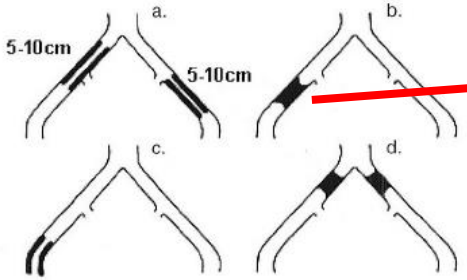
Type A lesions



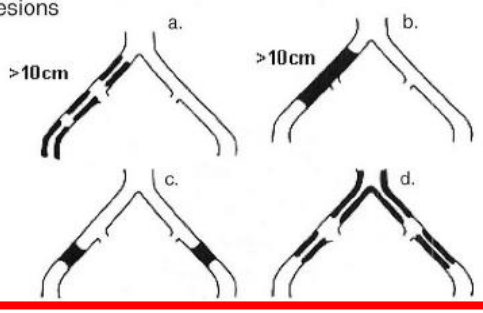
Type B lesions



Type C lesions



Type D lesions

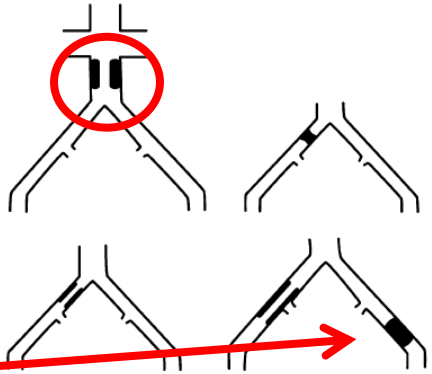


Type A lesions

- Unilateral or bilateral stenoses of CIA
- Unilateral or bilateral single short (≤3 cm) stenosis of EIA

Type B lesions:

- Short (≤3cm) stenosis of infrarenal aorta
- Unilateral CIA occlusion
- Single or multiple stenosis totaling 3–10 cm involving the EIA not extending into the CFA
- Unilateral EIA occlusion not involving the origins of internal iliac or CFA

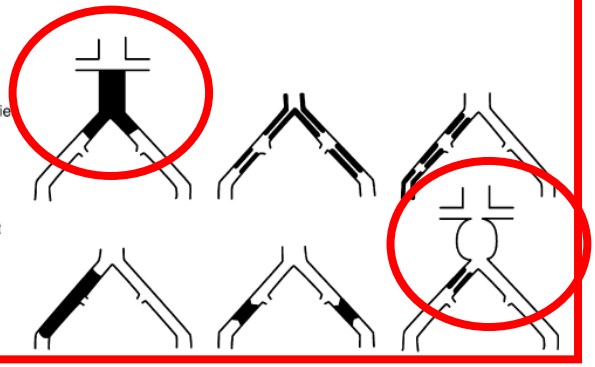


Type C lesions

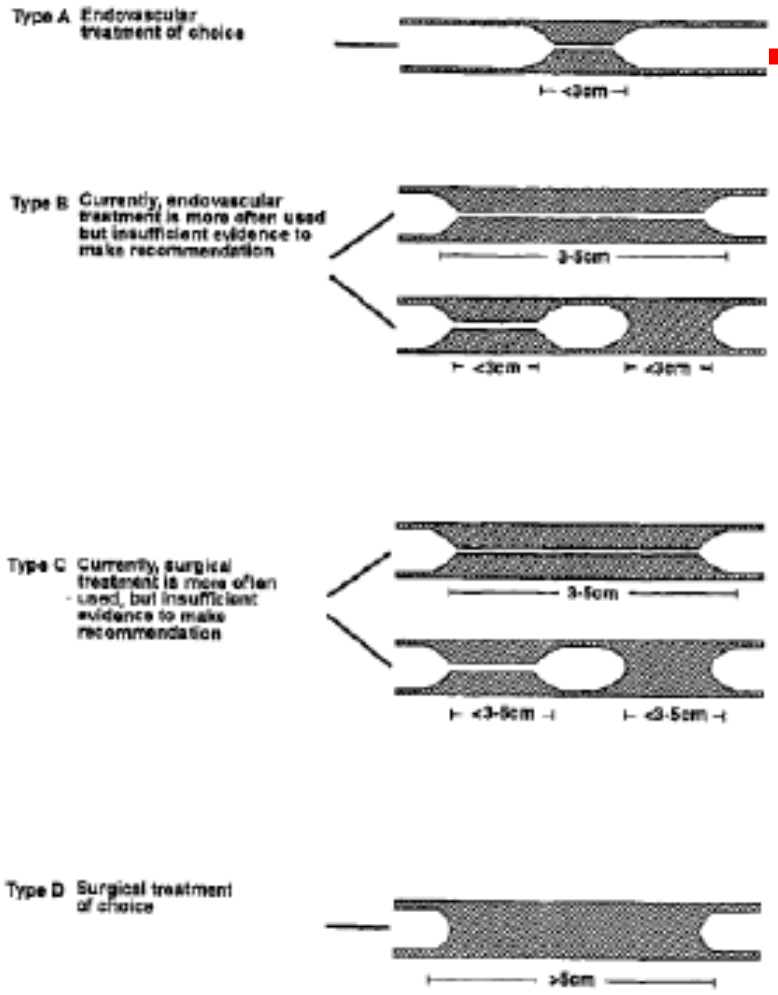
- Bilateral CIA occlusions
- Bilateral EIA stenoses 3–10 cm long not extending into the CFA
- Unilateral EIA stenosis extending into the CFA
- Unilateral EIA occlusion that involves the origins of internal iliac and/or CFA
- Heavily calcified unilateral EIA occlusion with or without involvement of origins of internal iliac and/or CFA

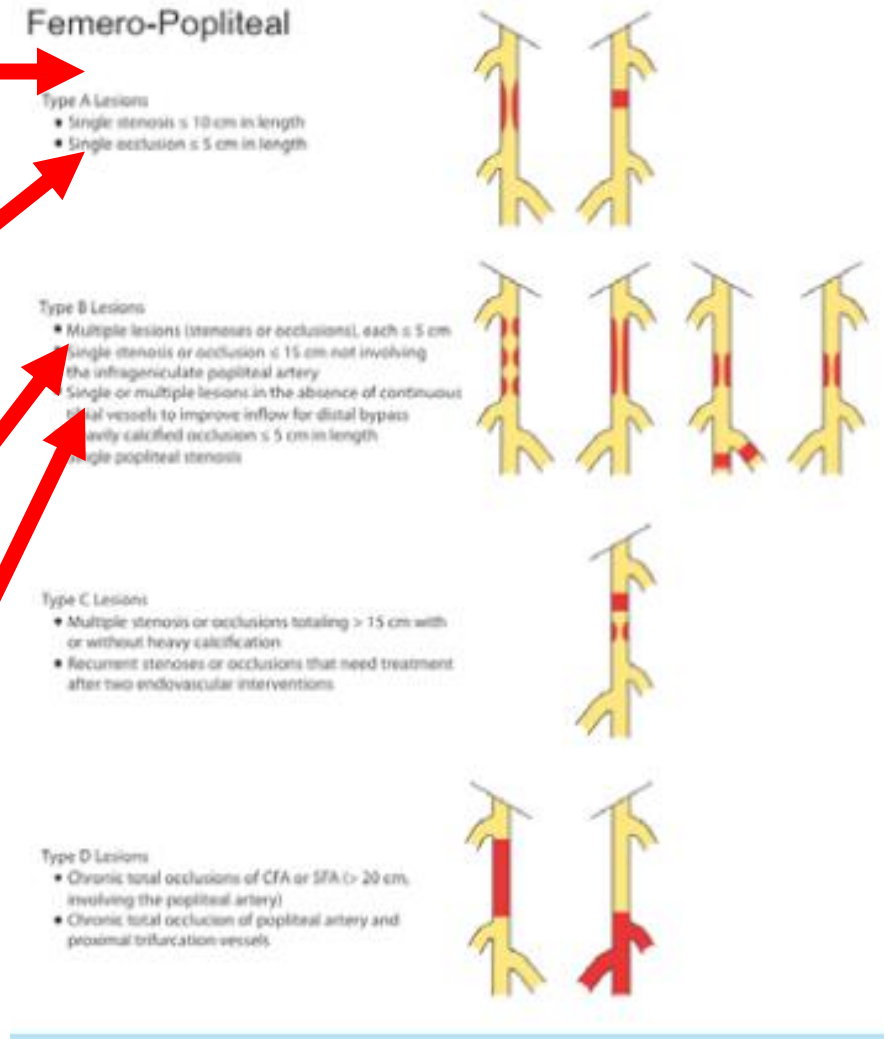
Type D lesions

- Infra-renal aortoiliac occlusion
- Diffuse disease involving the aorta and both iliac arteries requiring treatment
- Diffuse multiple stenoses involving the unilateral CIA, EIA, and CFA
- Unilateral occlusions of both CIA and EIA
- Bilateral occlusions of EIA
- Iliac stenoses in patients with AAA requiring treatment and not amenable to endograft placement or other lesions requiring open aortic or iliac surgery



TASC 2000 and TASC II 2007

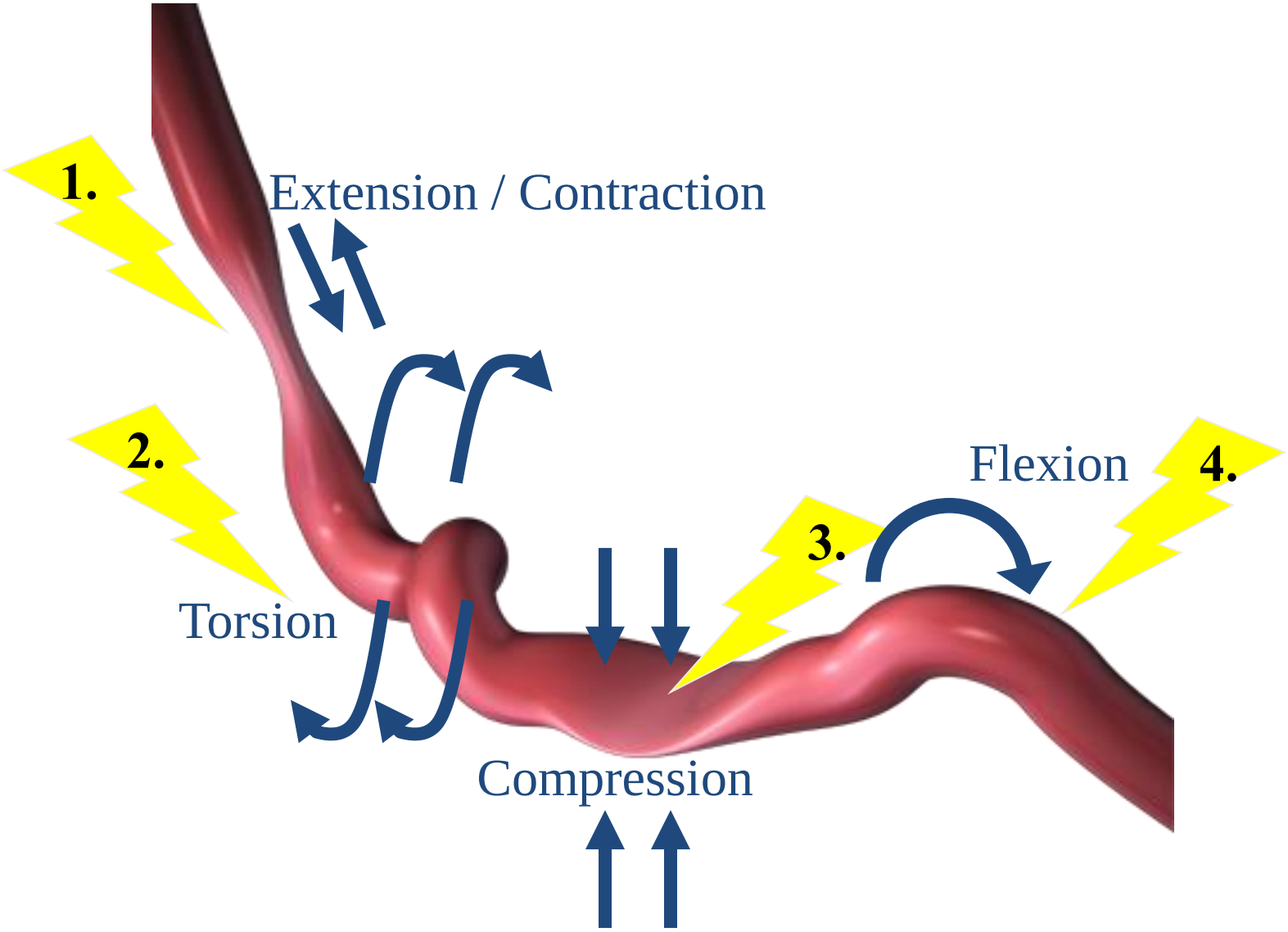




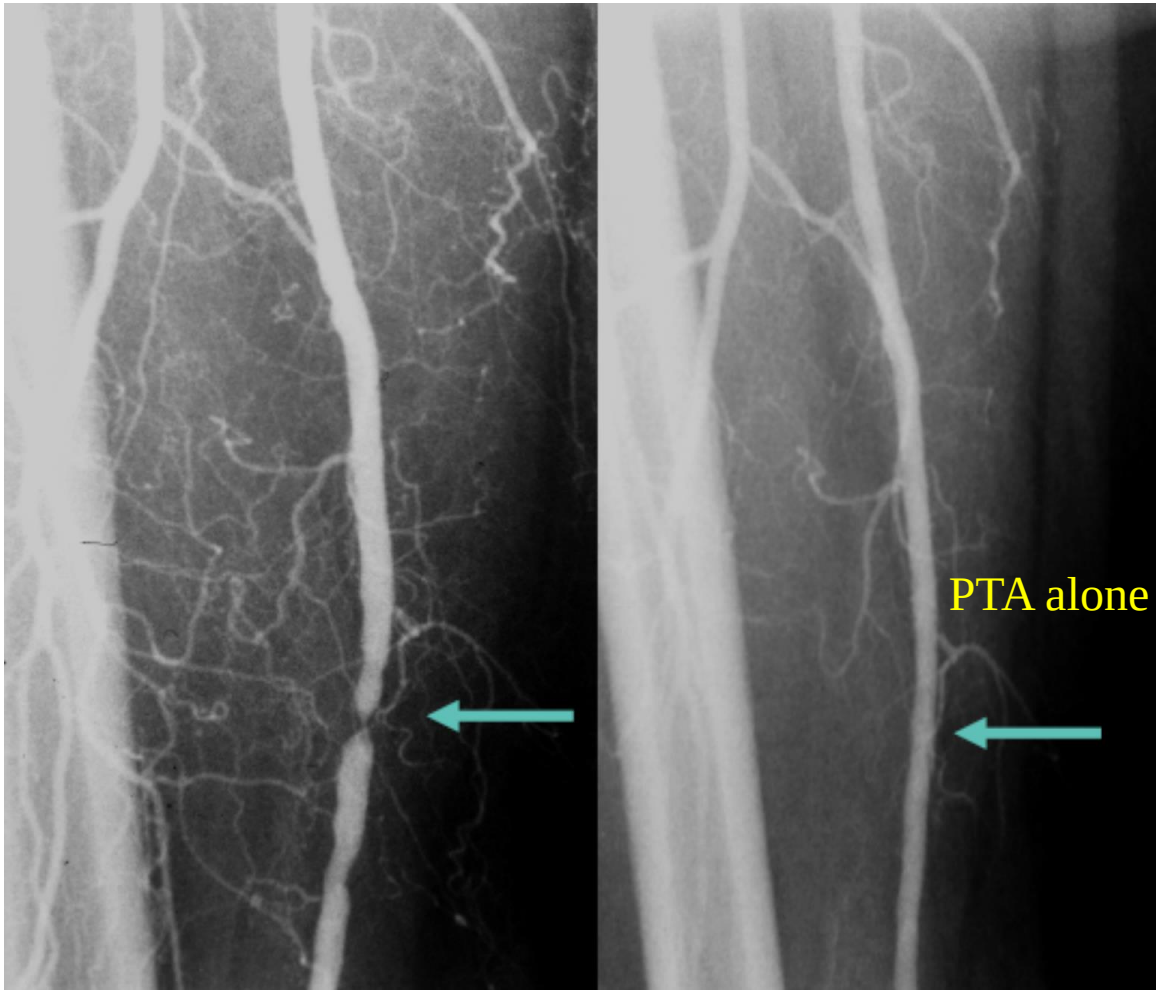
Treating more complex lesions

TASC 1 (2000)		TASC II (2007)
Stenosis <3cm	A	Stenosis ≤10cm Occlusion ≤5cm
Stenosis 3-5cm Occlusion <3cm	B	Stenosis/occlusion ≤15cm Calcified occlusion ≤5cm Single popliteal stenosis Multiple lesions, each ≤5cm
Stenosis/occlusion >5cm Multiple stenosis/occlusions 3-5cm	C	Stenosis/occlusion >15cm Recurrent restenosis
Occlusion >5cm	D	Occlusion >20cm involving Pop Popliteal occlusion

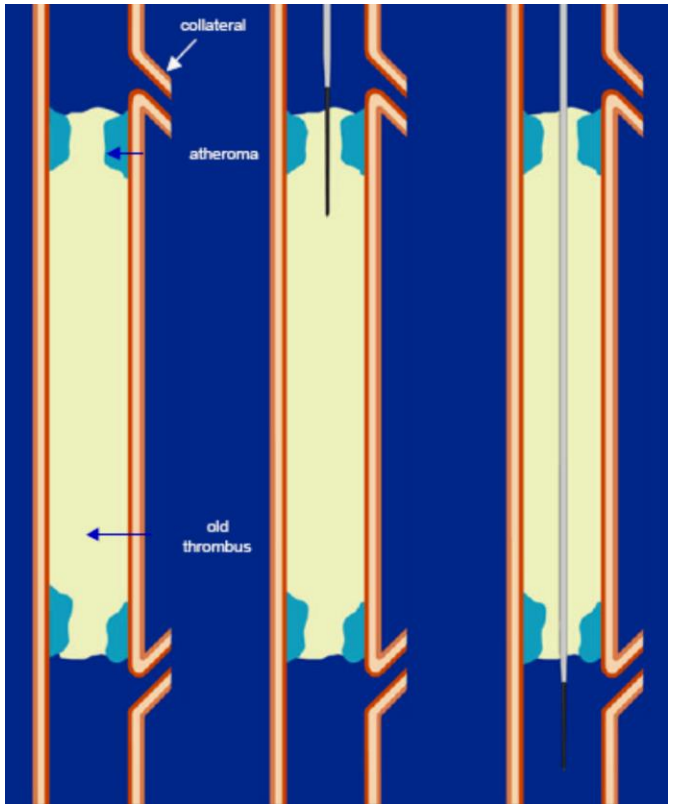
Forces Exerted On Stents In SFA

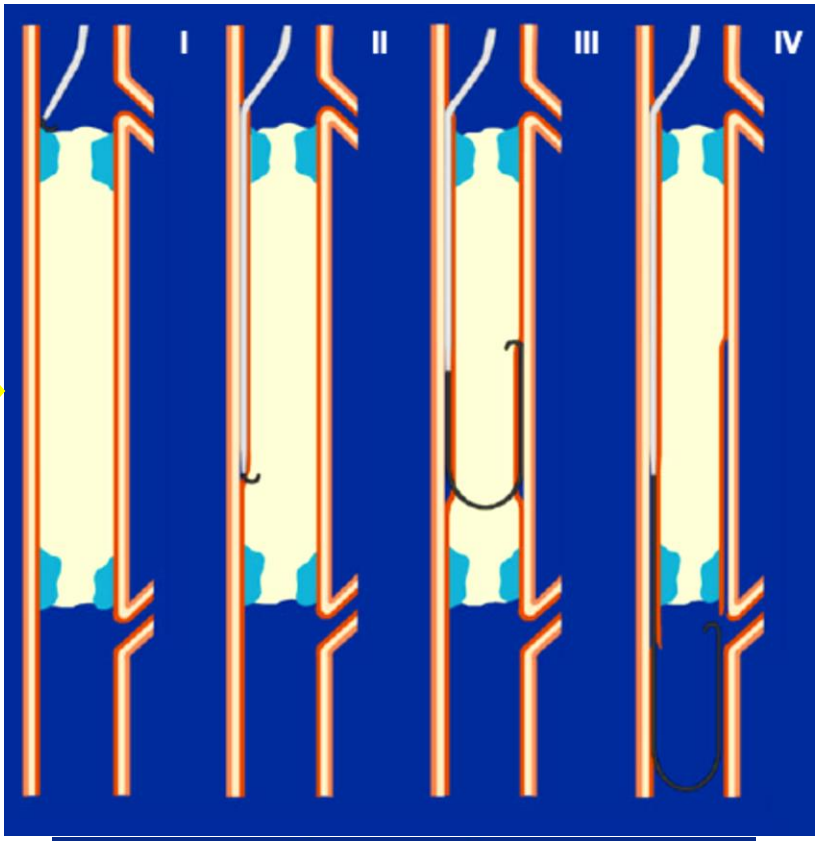


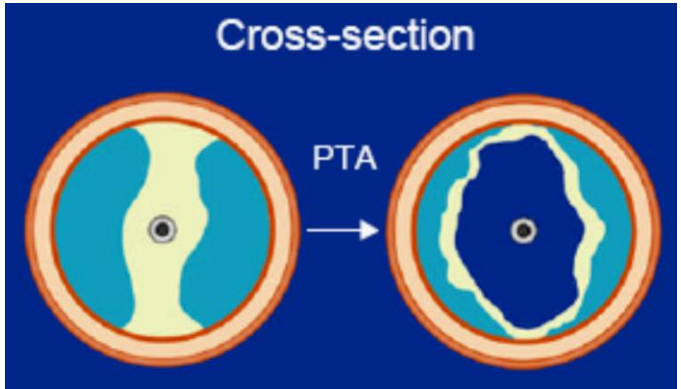
The Ideal SFA Lesion is Rare

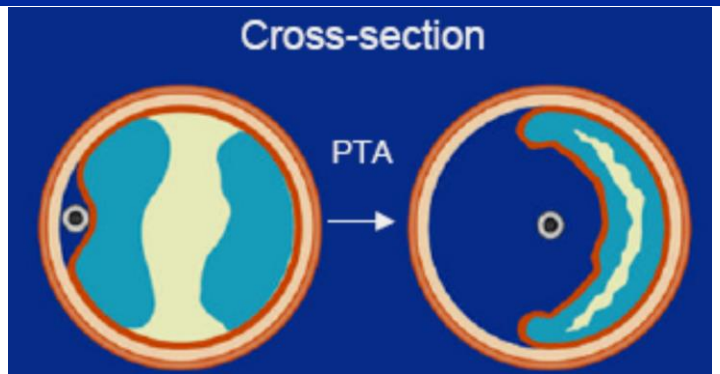


Intraluminal vs. Sub-intimal

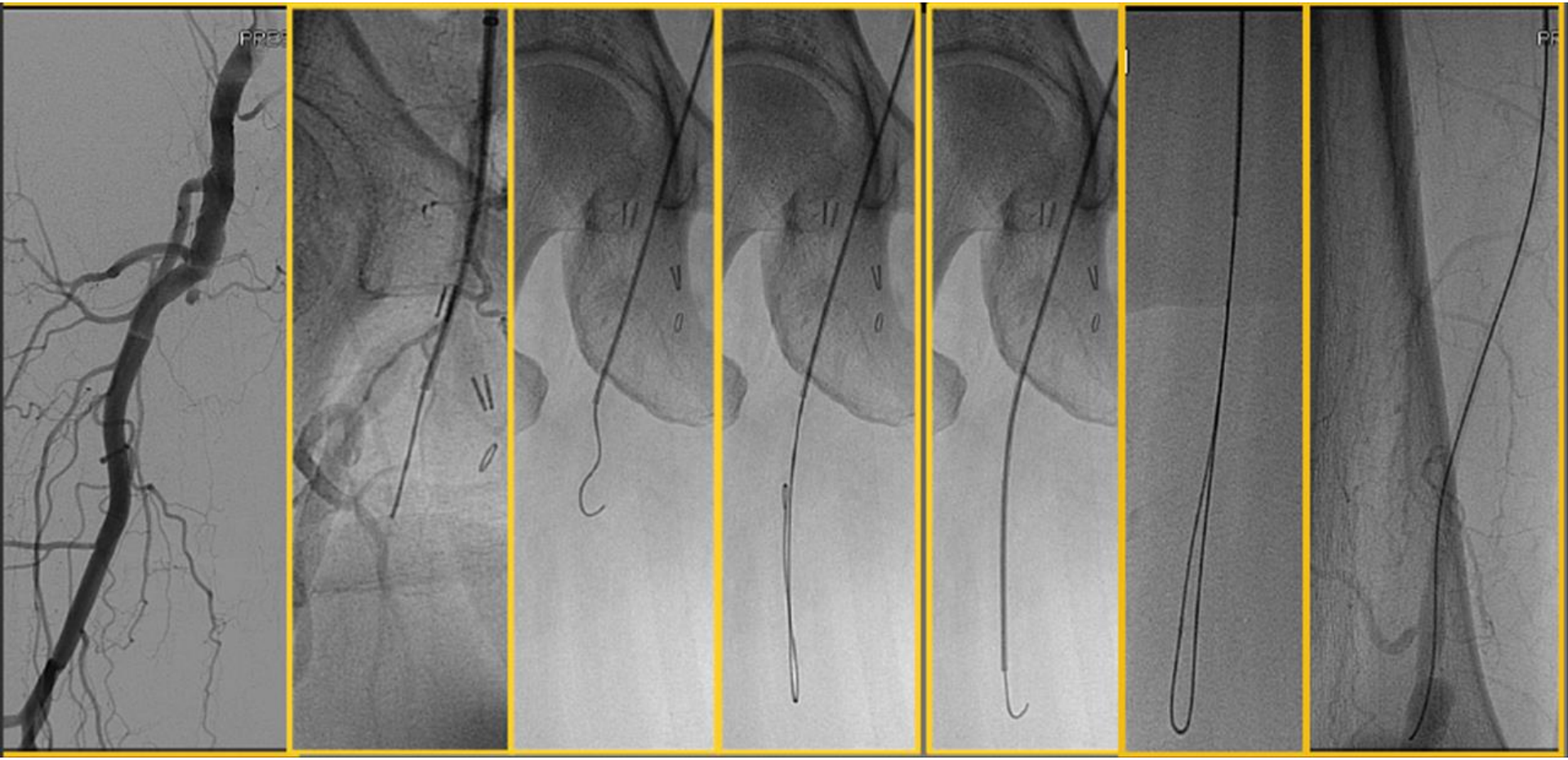




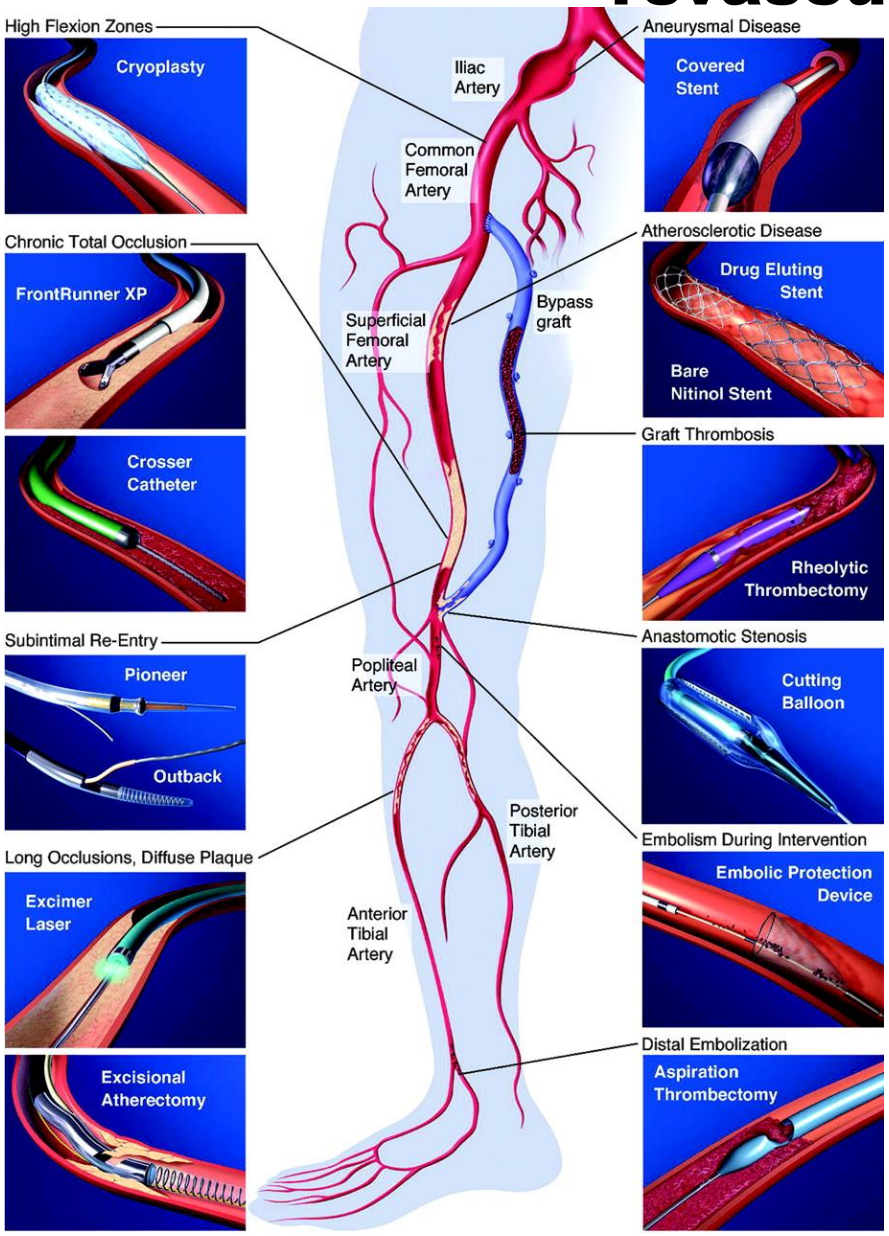




Standard SFA Subintimal Technique



New technologies for lower extremity revascularization



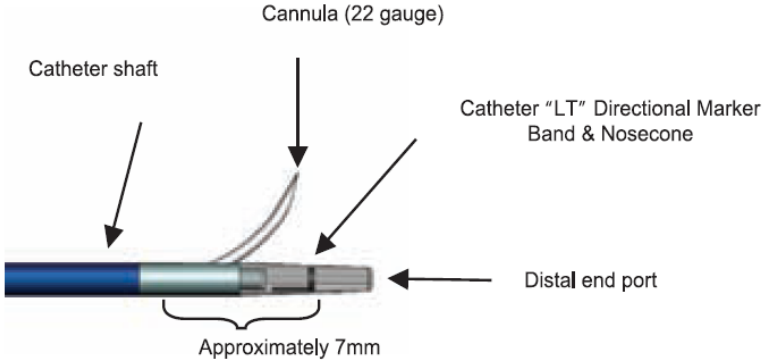
- Drugs
- Subintimal Angioplasty
- Bare Stents
- Covered stents
- Drug eluting Stents
- Drug eluting balloon
- Bioabsorbable Stents
- Brachytherapy
- Cryoplasty
- Cutting balloon
- Photodynamic therapy
- Debulking -artherectomy

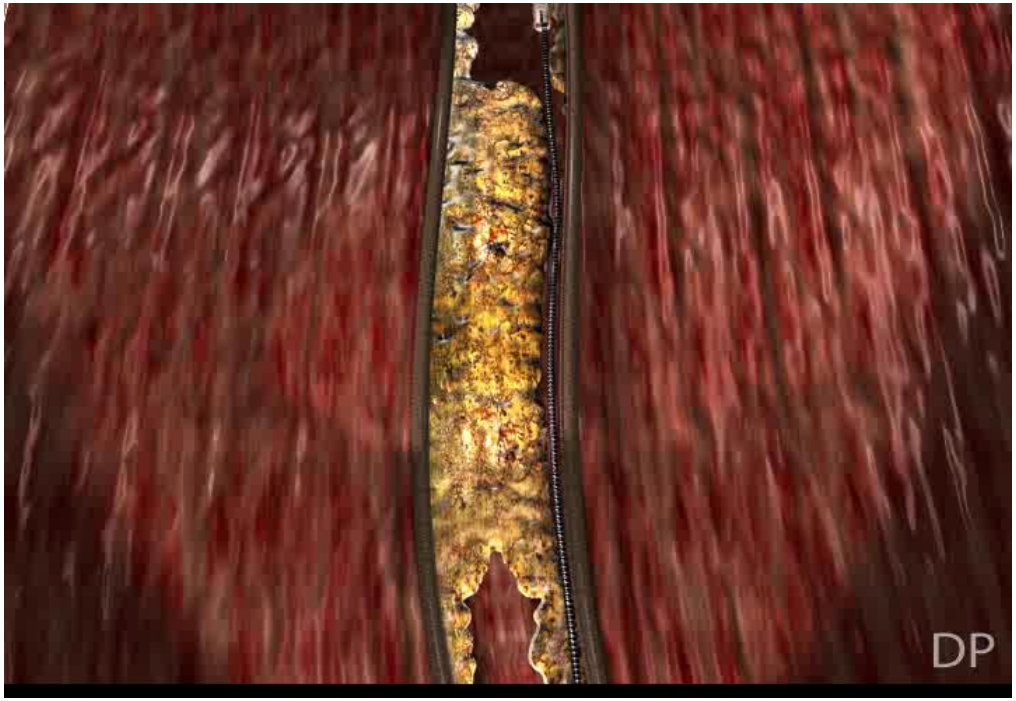
Rogers, J. H. et al. Circulation 2007;116:2072-2085

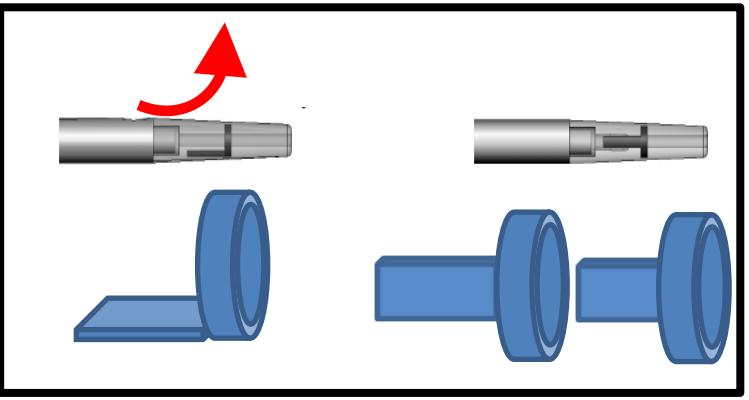
To solve passage or reentry problems

1. ***Reentry catheter***
2. **Retrograde approach**
3. **Bypass surgery**

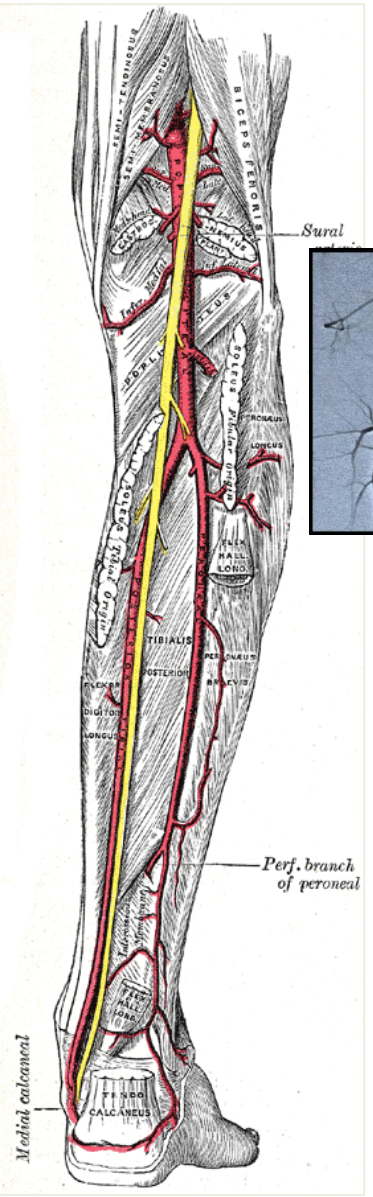
Distal Housing & Nosecone Assembly - Detail A







BTK / Infrapopliteal arteries



- Popliteal, and Trifurcation (tibial & peroneal): 2-4mm

Main issues

- Not Uncommon
- DM Occlusive Disease is more common in BTK
- Occlusion more common than stenoses: 2/3
- Critical Limb Ischemia > claudication
- Multilevel obstruction
- Need distal bypass surgery/major amputation
- Poor prognosis
- Low flow arteries
- Long segment disease: 50% >10cm

- Few randomized study
- Not good long term results
- No especially designed stent
  - 95% PTA,
  - 35% Stent,
  - 30% thrombolysis
- Savy balloon, long balloon

ASO vs DM

특징	신경병성 족부 궤양 (neuropathic ulcer)	허혈성-신경병성 족부궤양 (neuro-ischemic ulcer)
통증	없음	있음
동맥 맥박	정상	소실
궤양의 모양	"Punched-out lesion"	불규칙한 변연
궤양의 위치	발바닥 혹은 발의 가장자리	주로 발가락
피부 경결	있다	없다 혹은 흔치 않다
감각 소실	있다	다양함
혈류	증가	감소
발등의 정맥	확장	수축
발의 체온	따듯하다	차다
족부 변형	있다	없다
발의 피부 색깔	붉다	창백 혹은 청색증

By Courtery of Prof. WY Kim

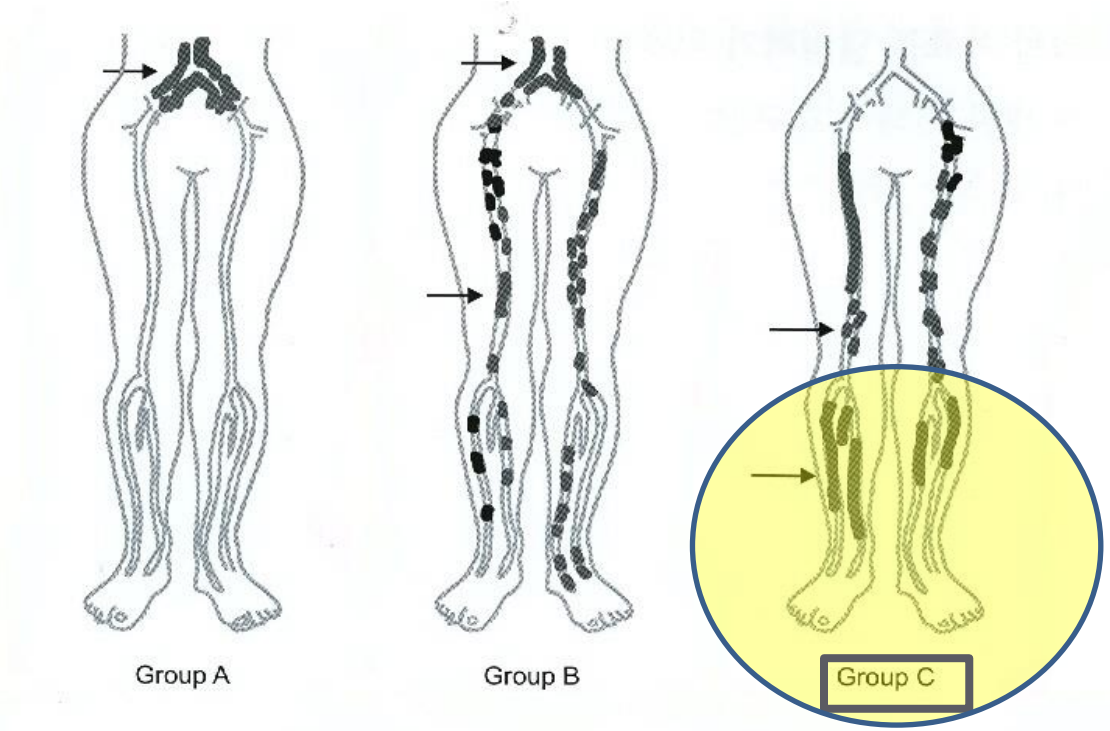
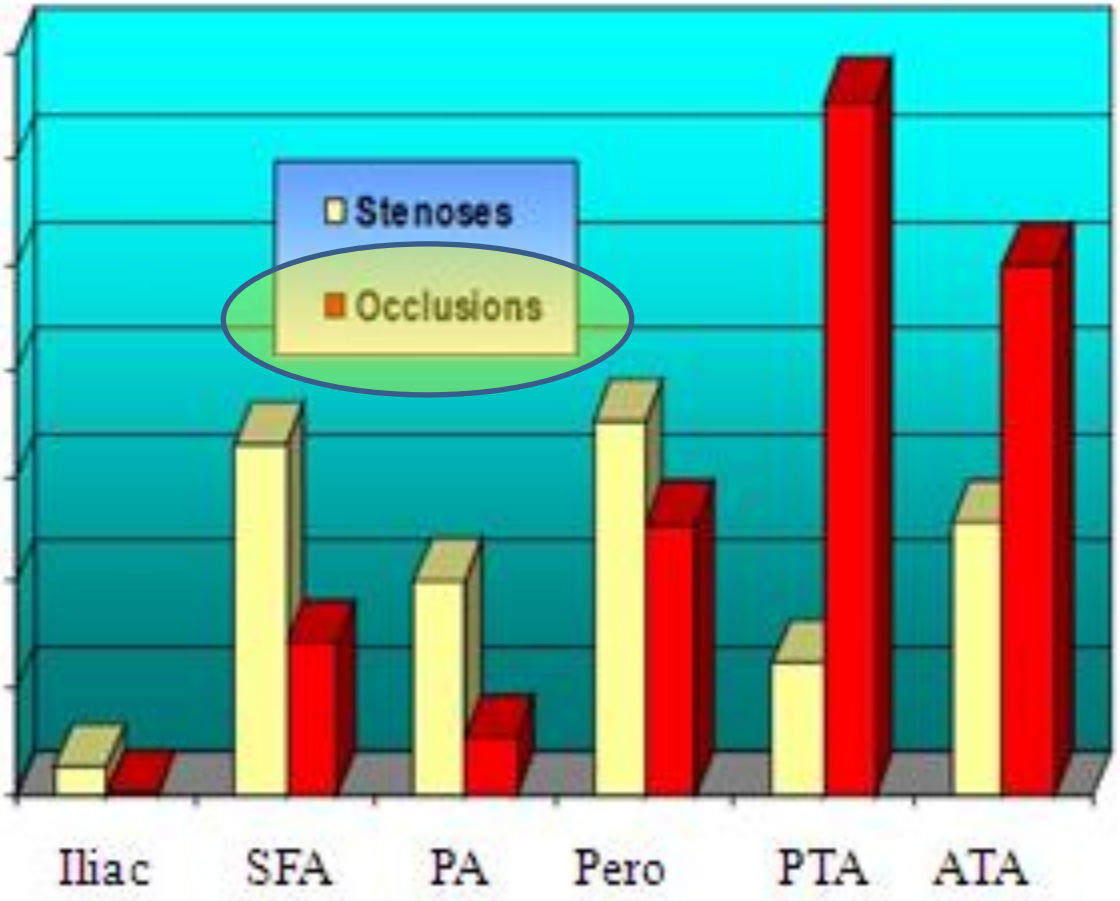


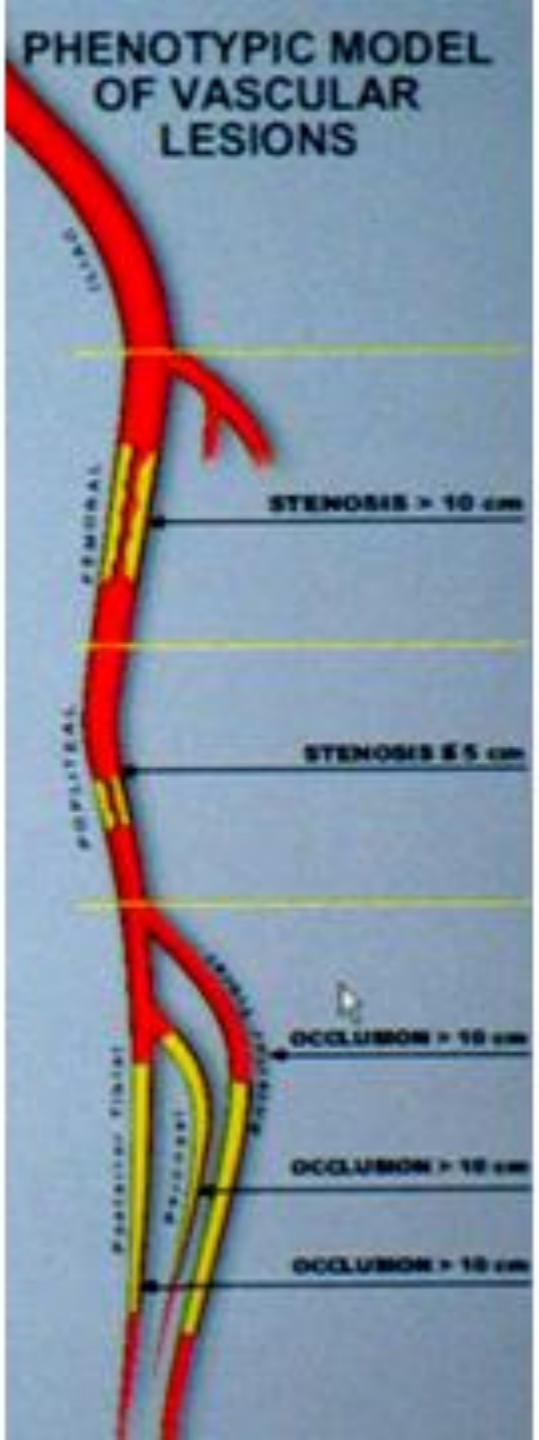
그림 2-2. 동맥경화증의 해부학적 위치. Group A: 대동맥 병변, Group B: 복합 병변, Group C: 하지 동맥 병변.

TYPE AND DISTRIBUTION OF **2,893** LESIONS in **417** Consecutive Diabetics with CLI and Ischemic Foot Ulcer:

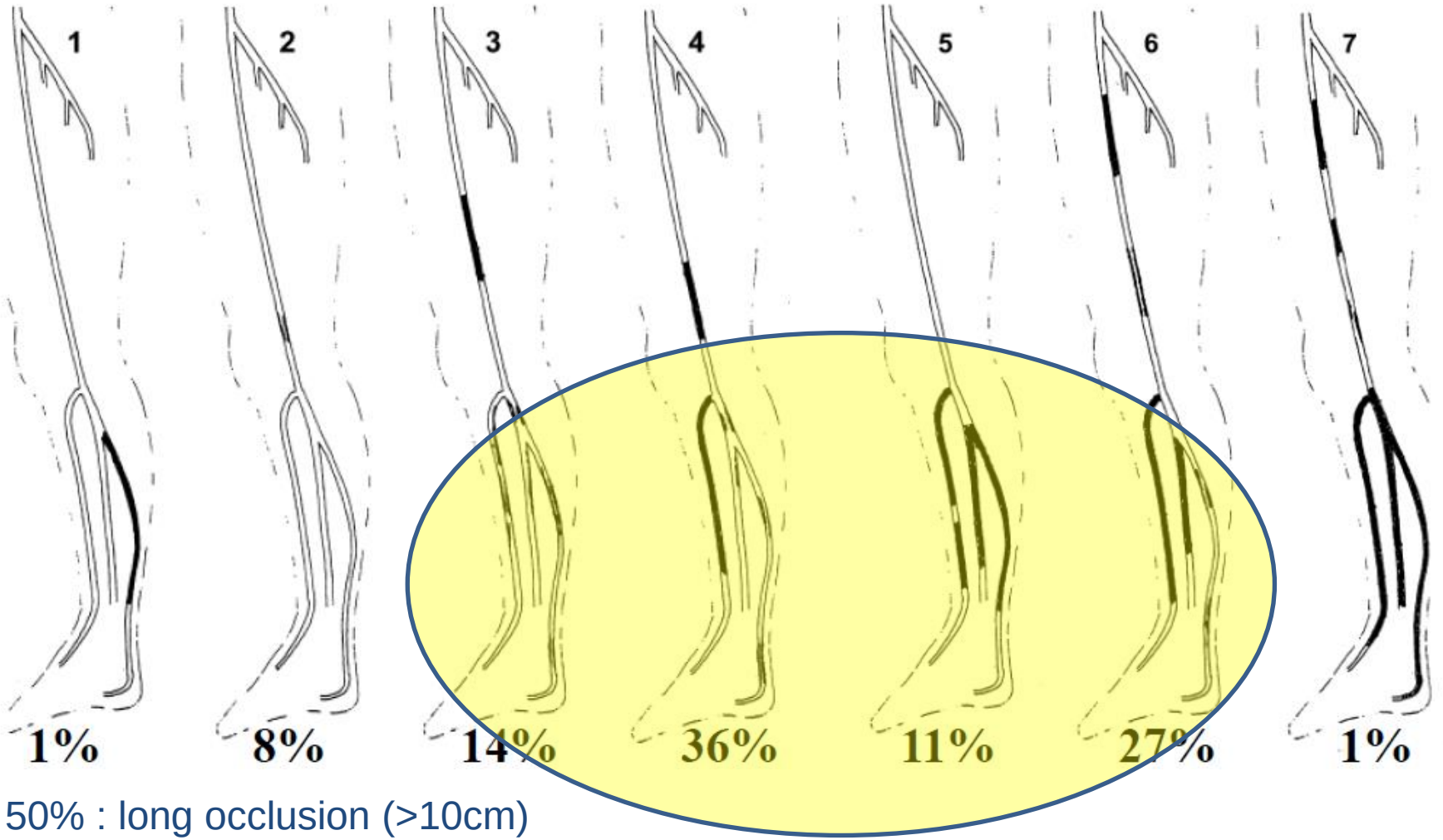
occlusions more common than stenoses !

Eur J Vasc Endovasc Surg 33, 453e460 (2007)





CLI : disease pattern



~ 50% : long occlusion (>10cm)
~ 30% : three-vessel occlusive lesions
~ 50% : at least one patent distal foot vessel

Graziani et al. Eur J Vasc Endovasc Surg 2007

Why PTA for Complex BTK lesions?

- Angiosome -

ATA

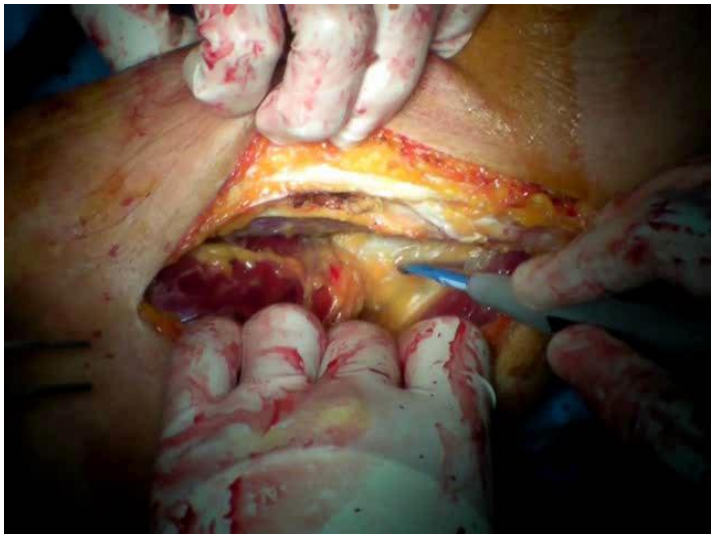
PA

PTA

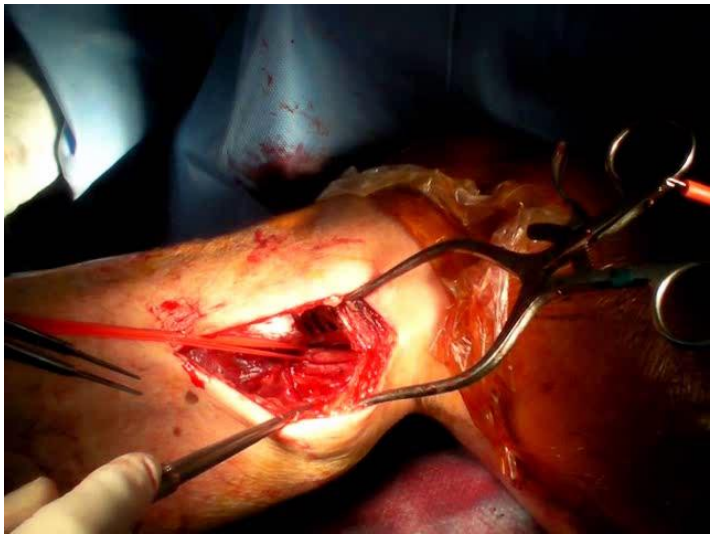
CFA Angioplasty

Exposure of Popliteal Artery

FP bypass

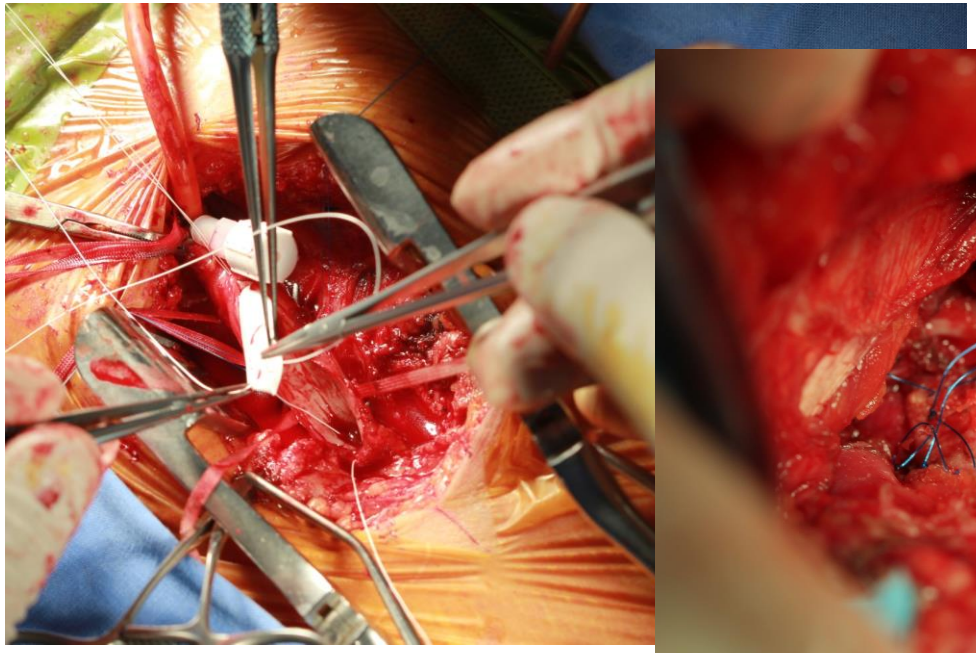


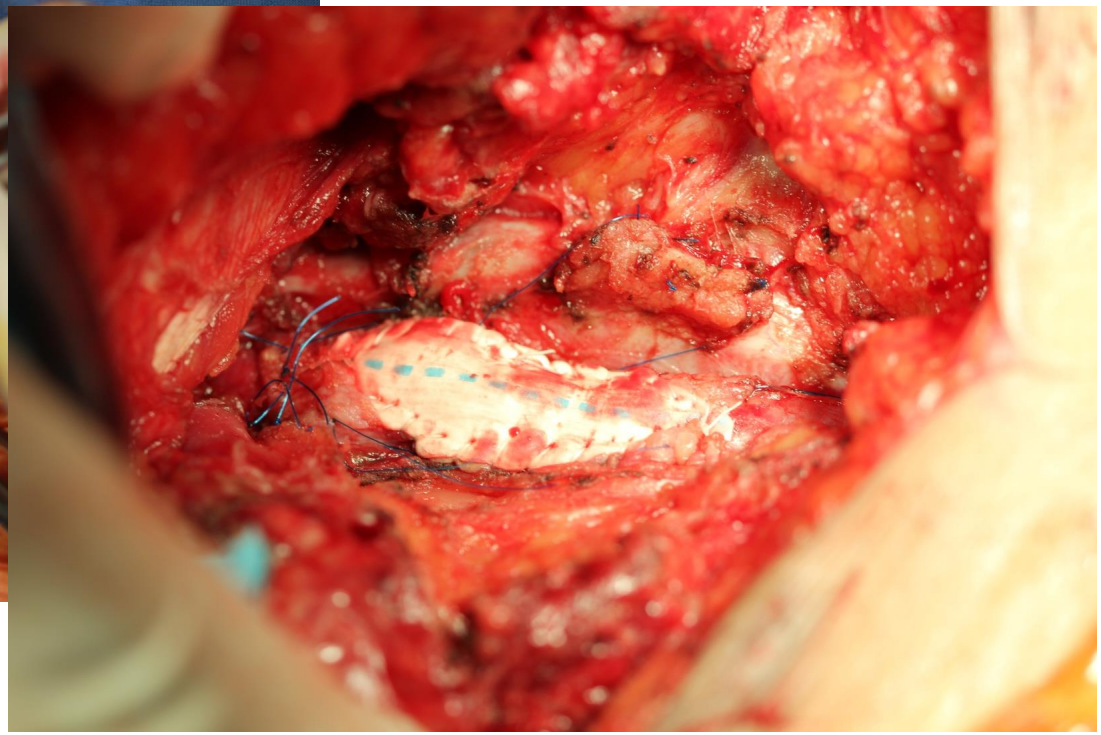
Retrograde approach



Angioplasty

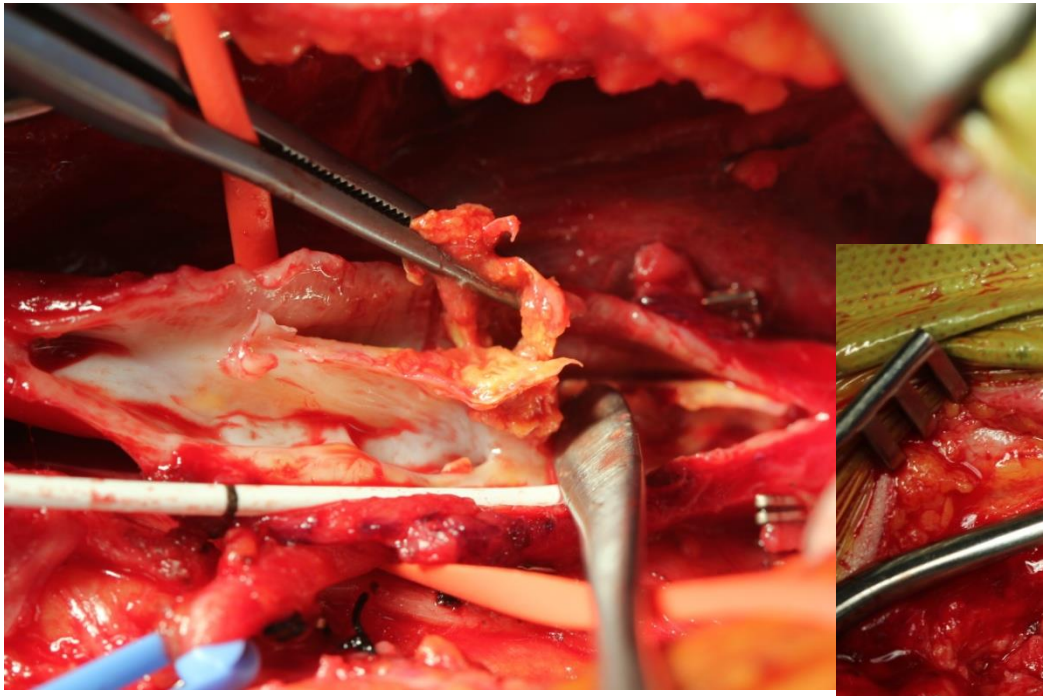
- Graft angioplasty

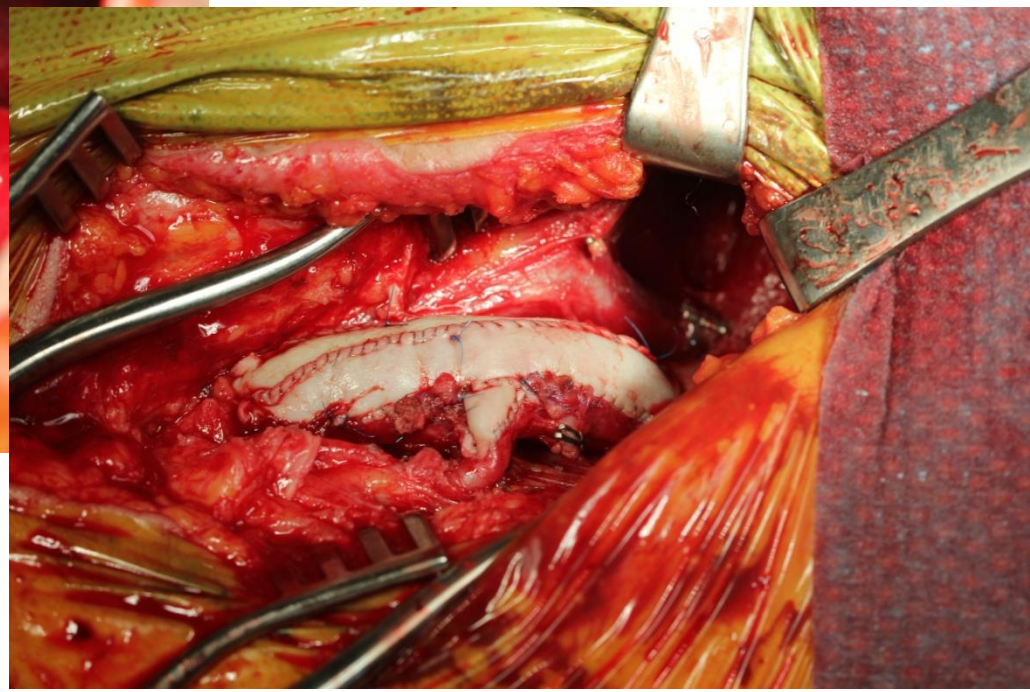




Angioplasty

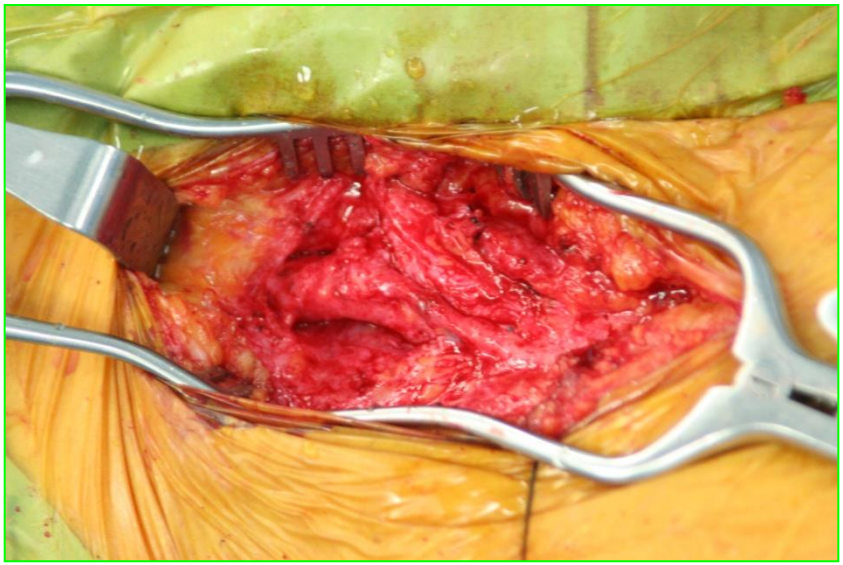
- Pericardial patch angioplasty

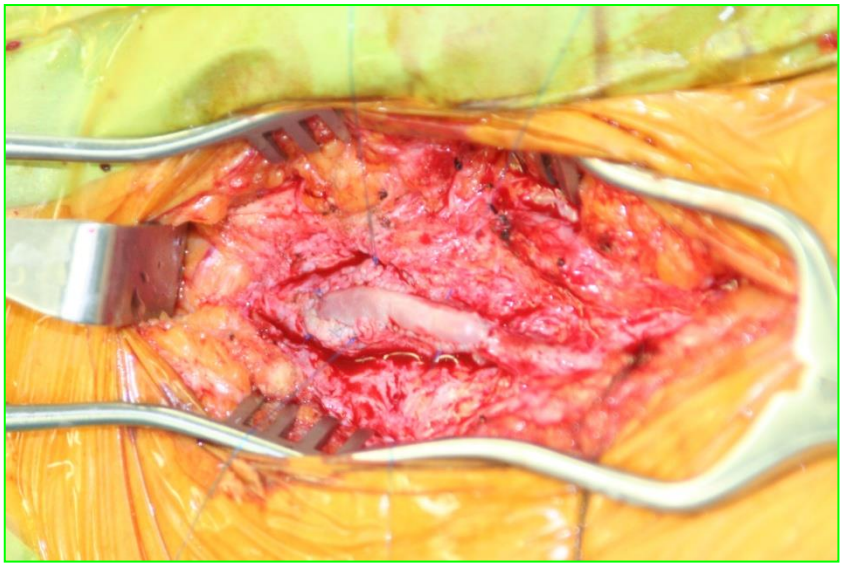




Angioplasty

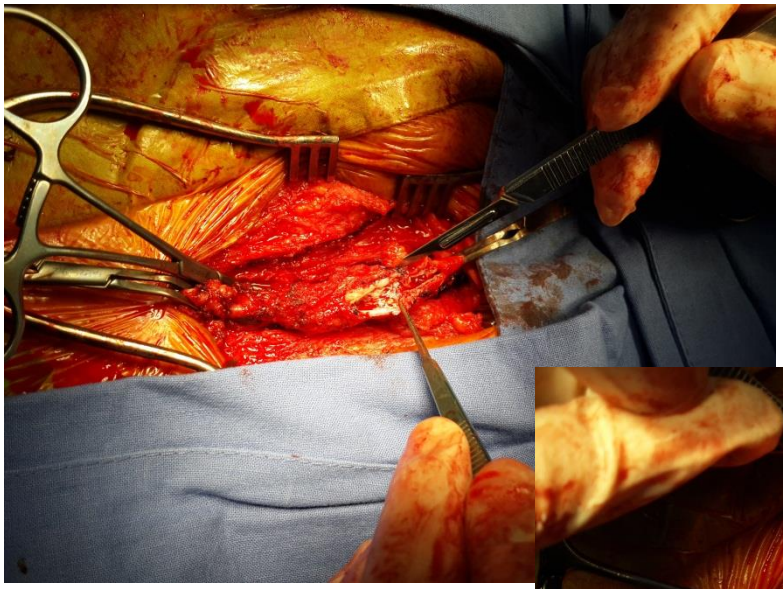
- Vein patch angioplasty

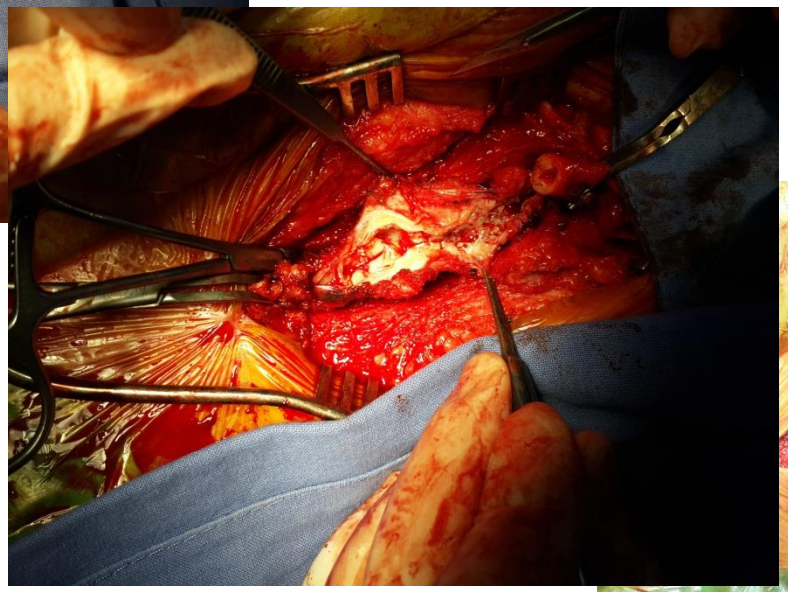




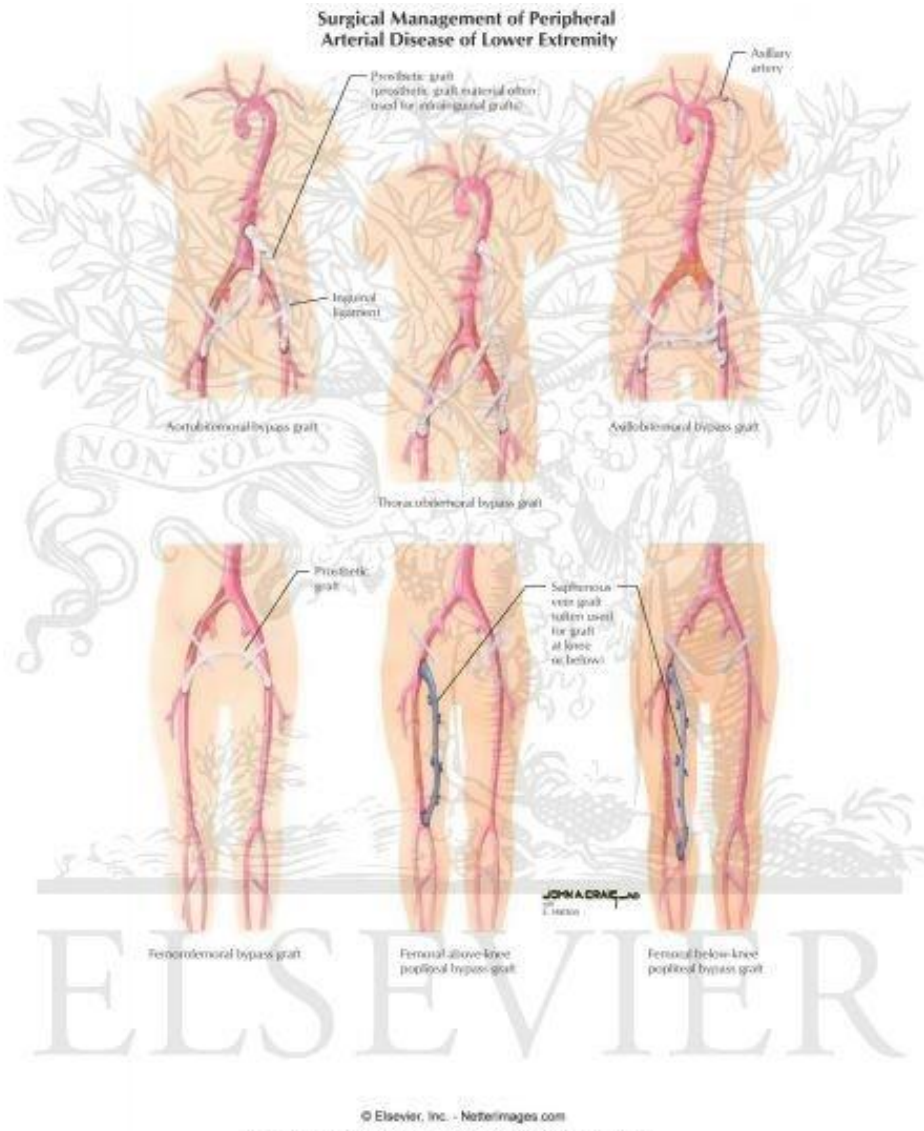
By Courtery of Prof. WY Kim

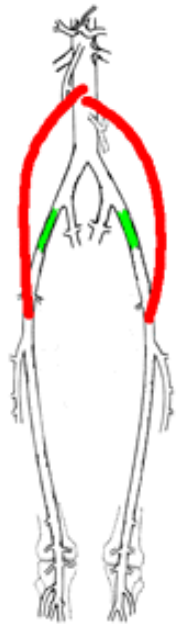
Graft Interposition



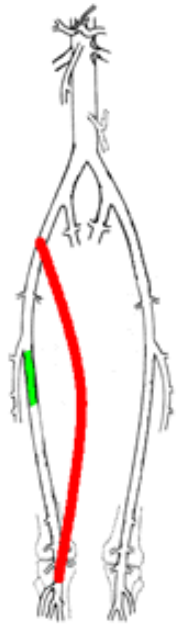


Bypass

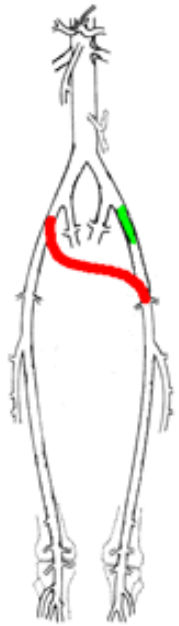




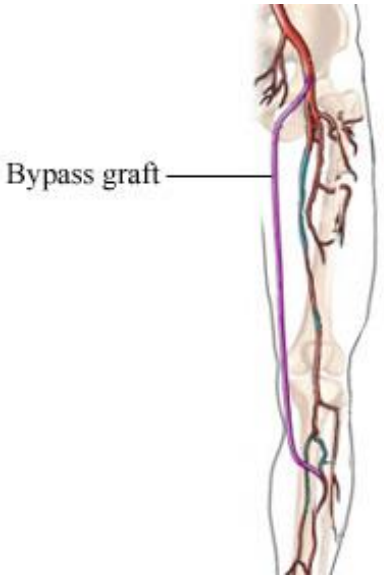
Aorto-Bifemoral Bypass



Femoral-Popliteal Bypass



Femoro-Fermoral Crossover



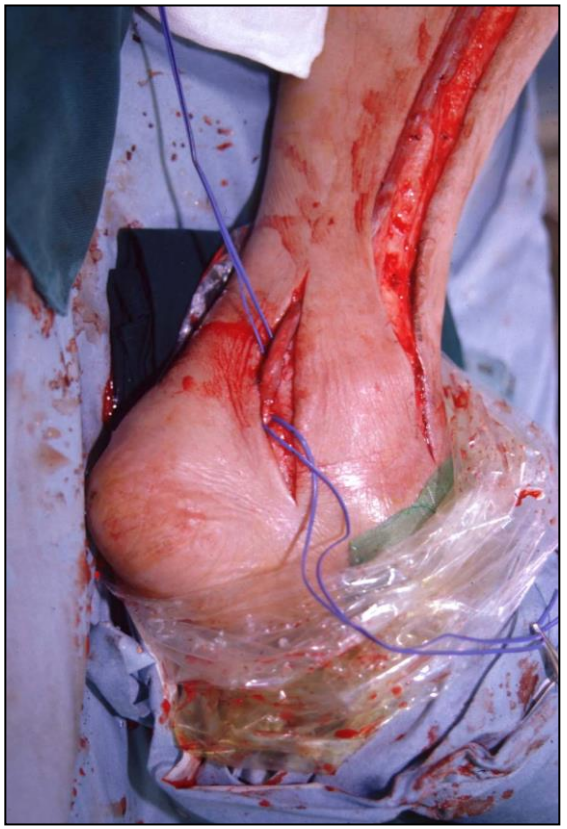
Bypass with Vein Graft

- Reversed vein
- In situ vein
- Non-reversed translocated vein
- Spliced vein

By Courtery of Prof. WY Kim

Bypass with Vein Graft

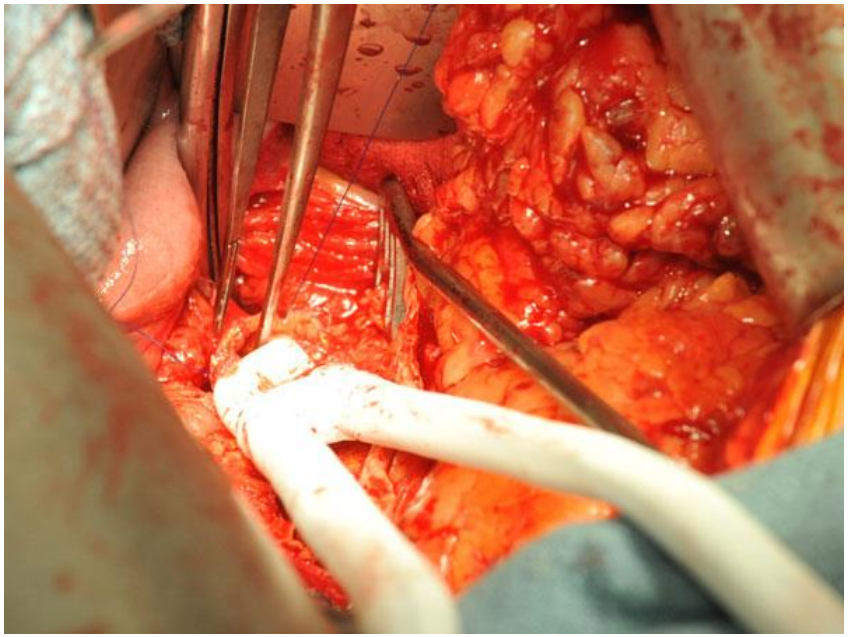
- Inframalleolar bypass



By Courtery of Prof. WY Kim

Graft

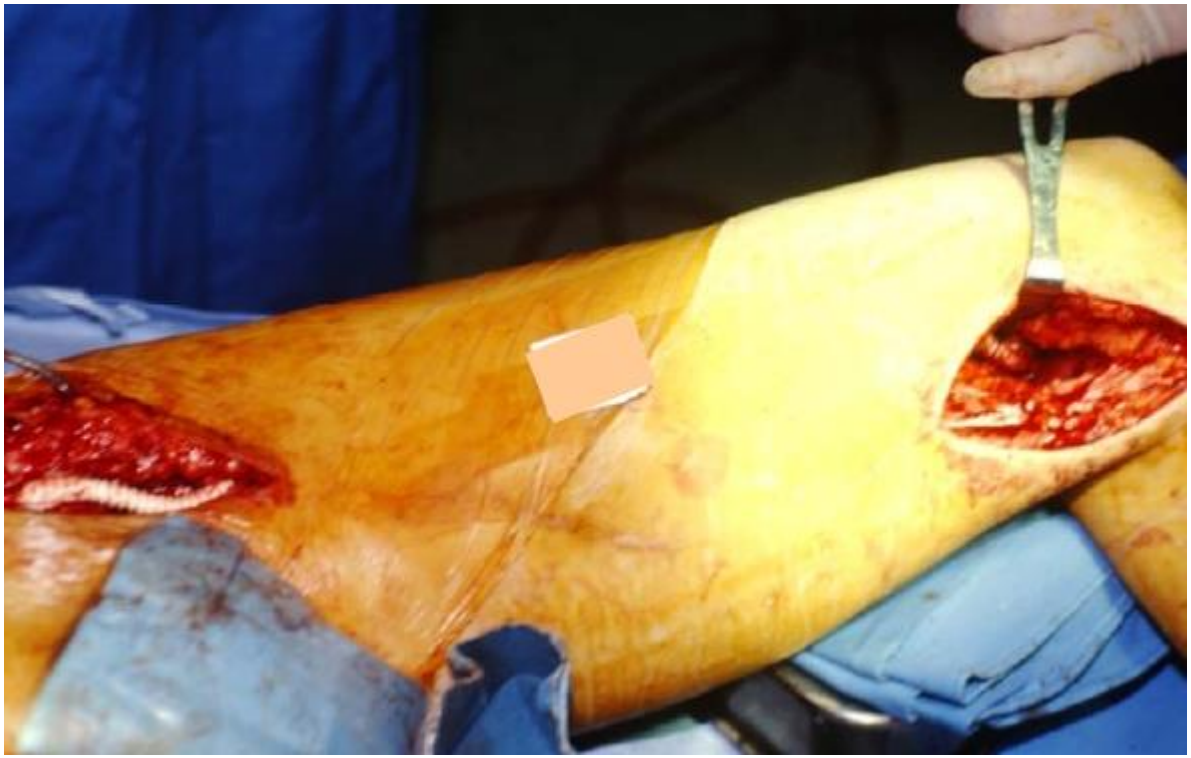
Dacron® graft



Goretex® graft

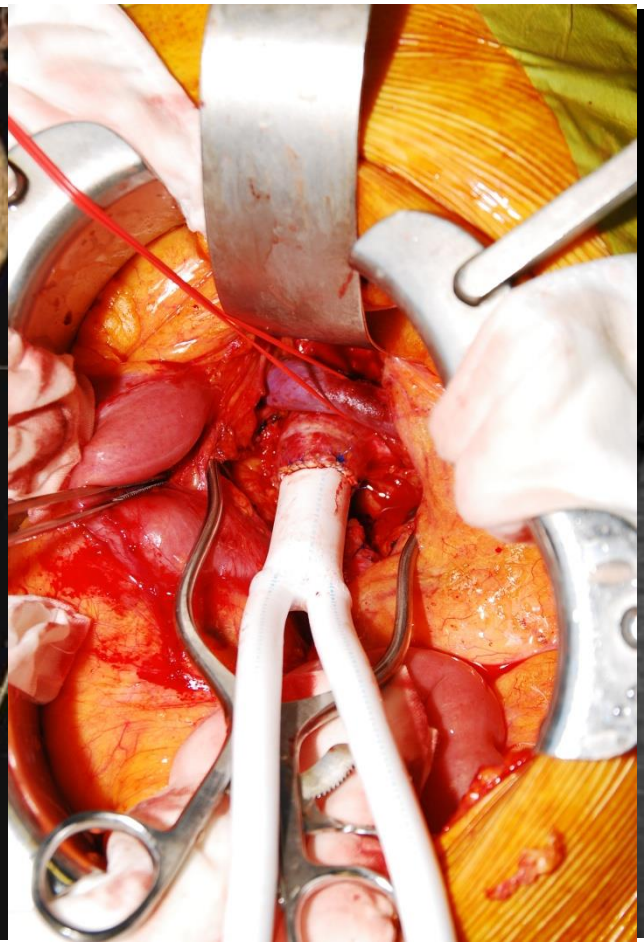
Bypass with Artificial Graft

- Femoropopliteal bypass



Bypass with Artificial Graft

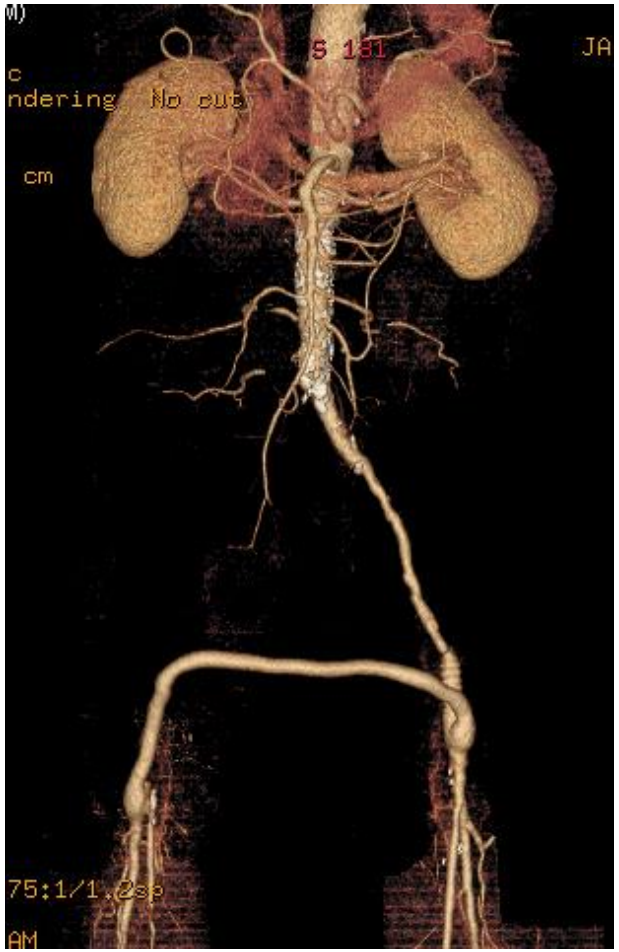
- Aorto-Bi-Fermoal bypass



By Courtery of Prof. WY Kim

Bypass with Artificial Graft

- Extra-anatomical bypass

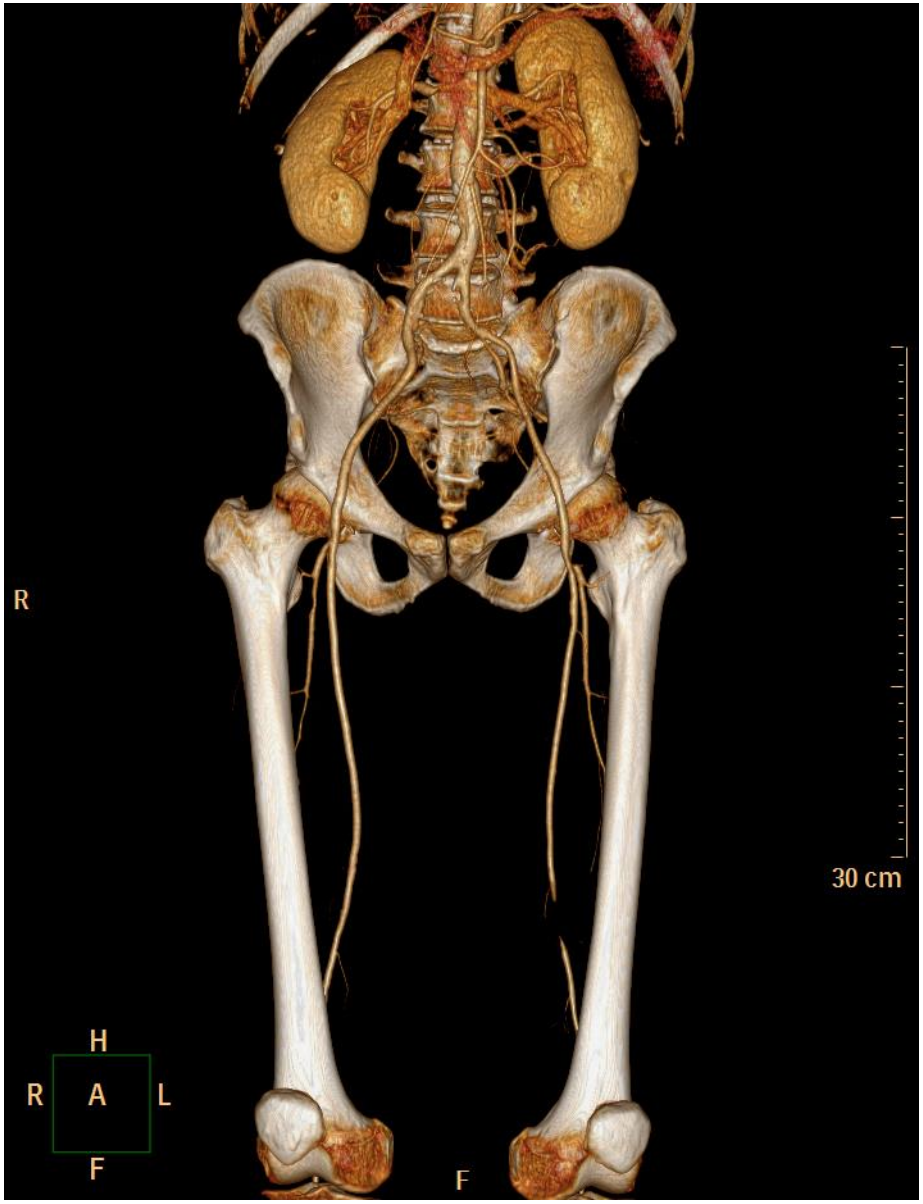


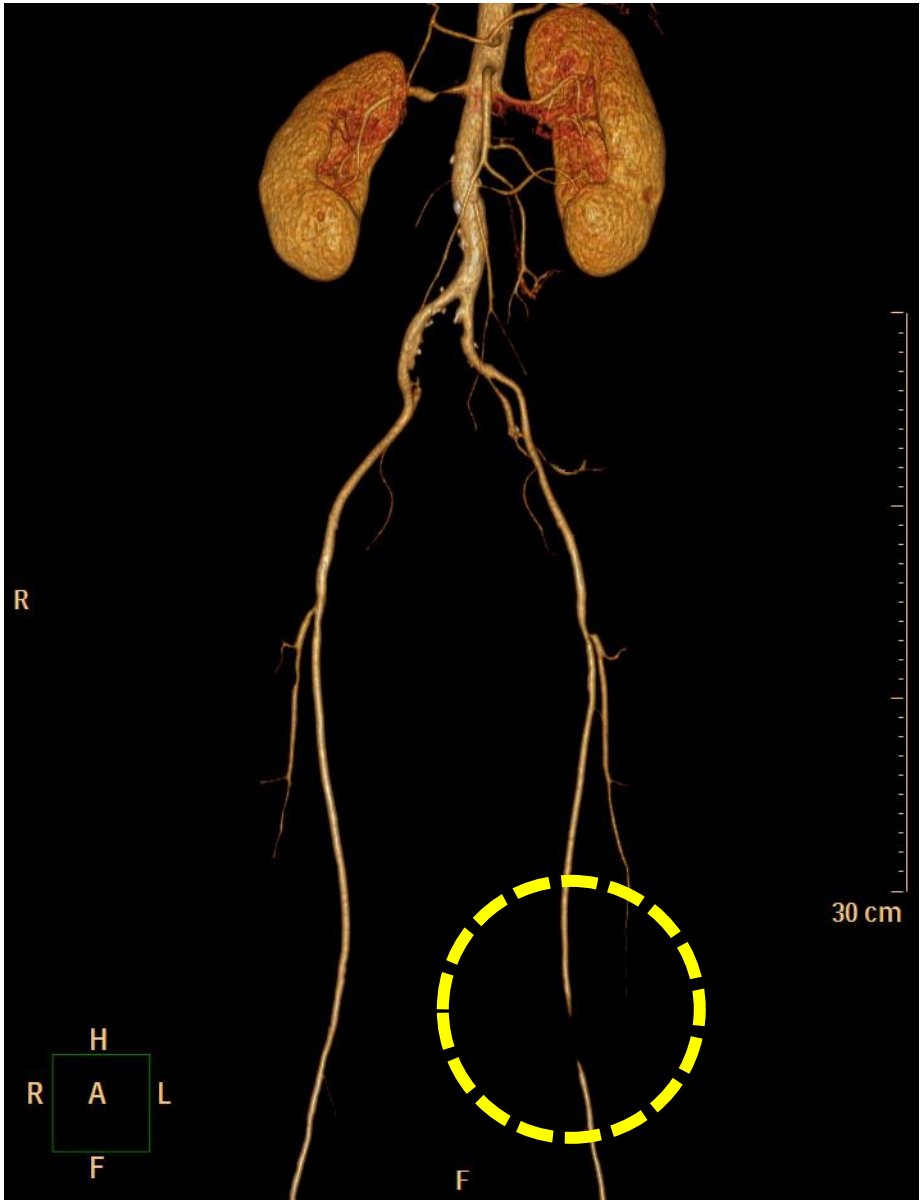
Fem-fem crossover bypass

Axillo-bifemoral bypass

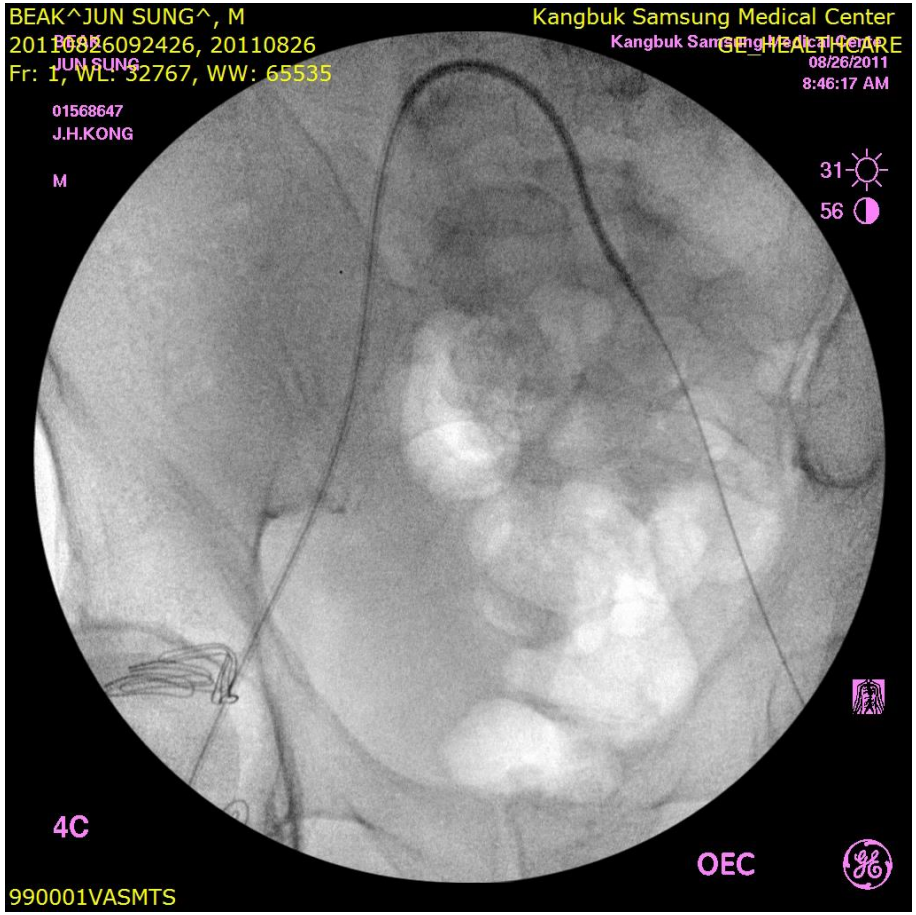
Case – SFA short CTO

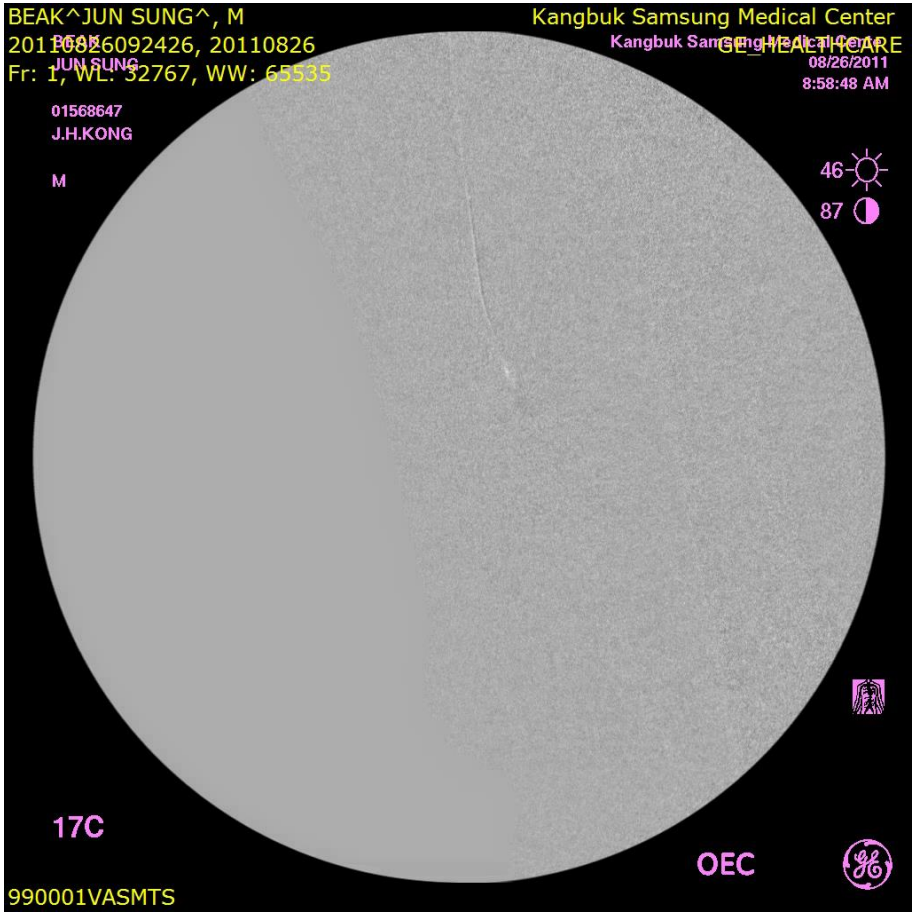
- Lt SFA Focal CTO: subintimal dissection


R
30 cm
H
R
A
L
F
F

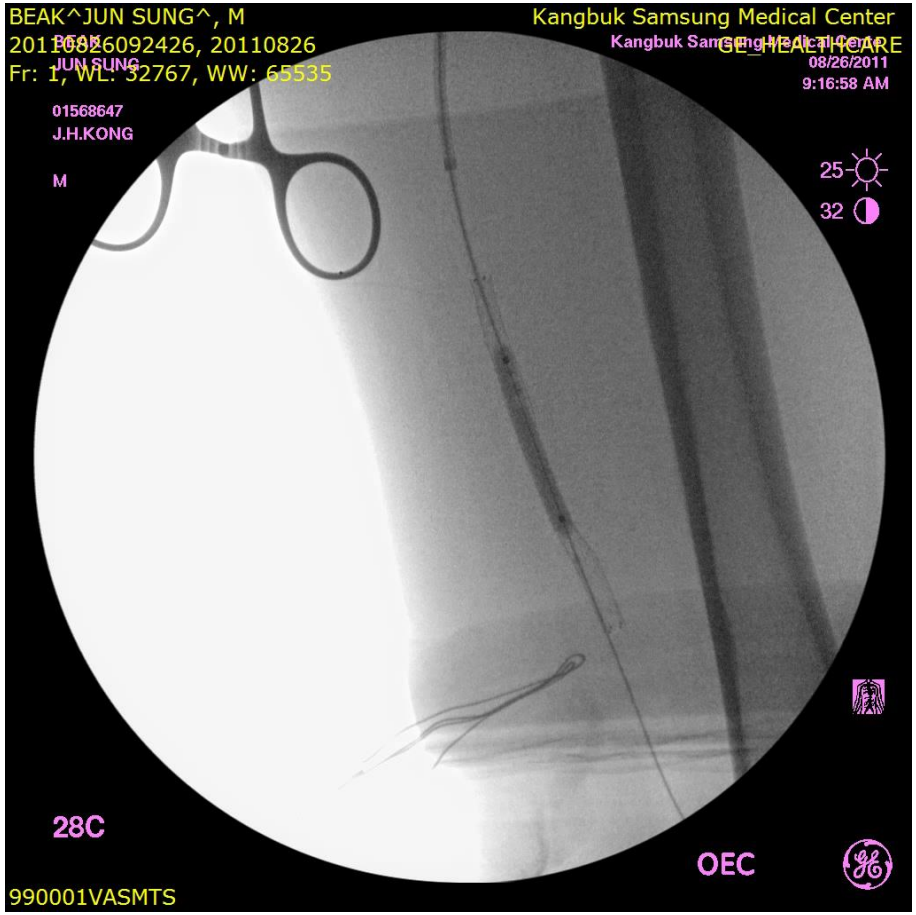

R
30 cm
H
R
A
L
F
F

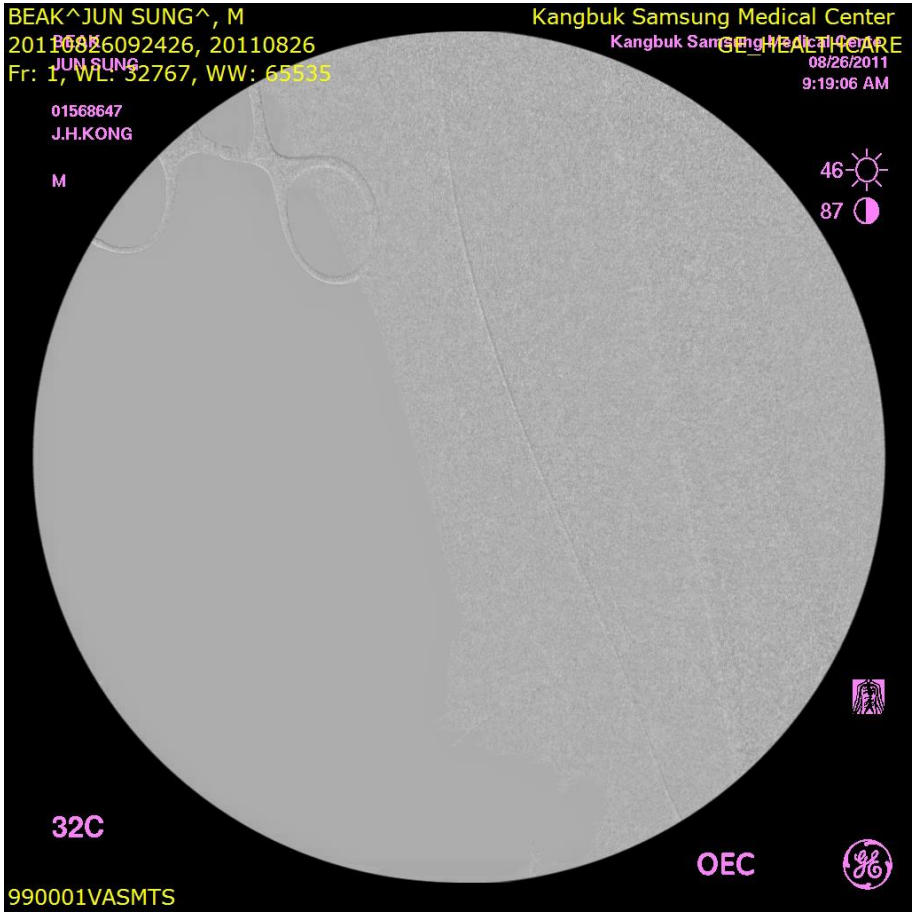
Simple PTA & Stent

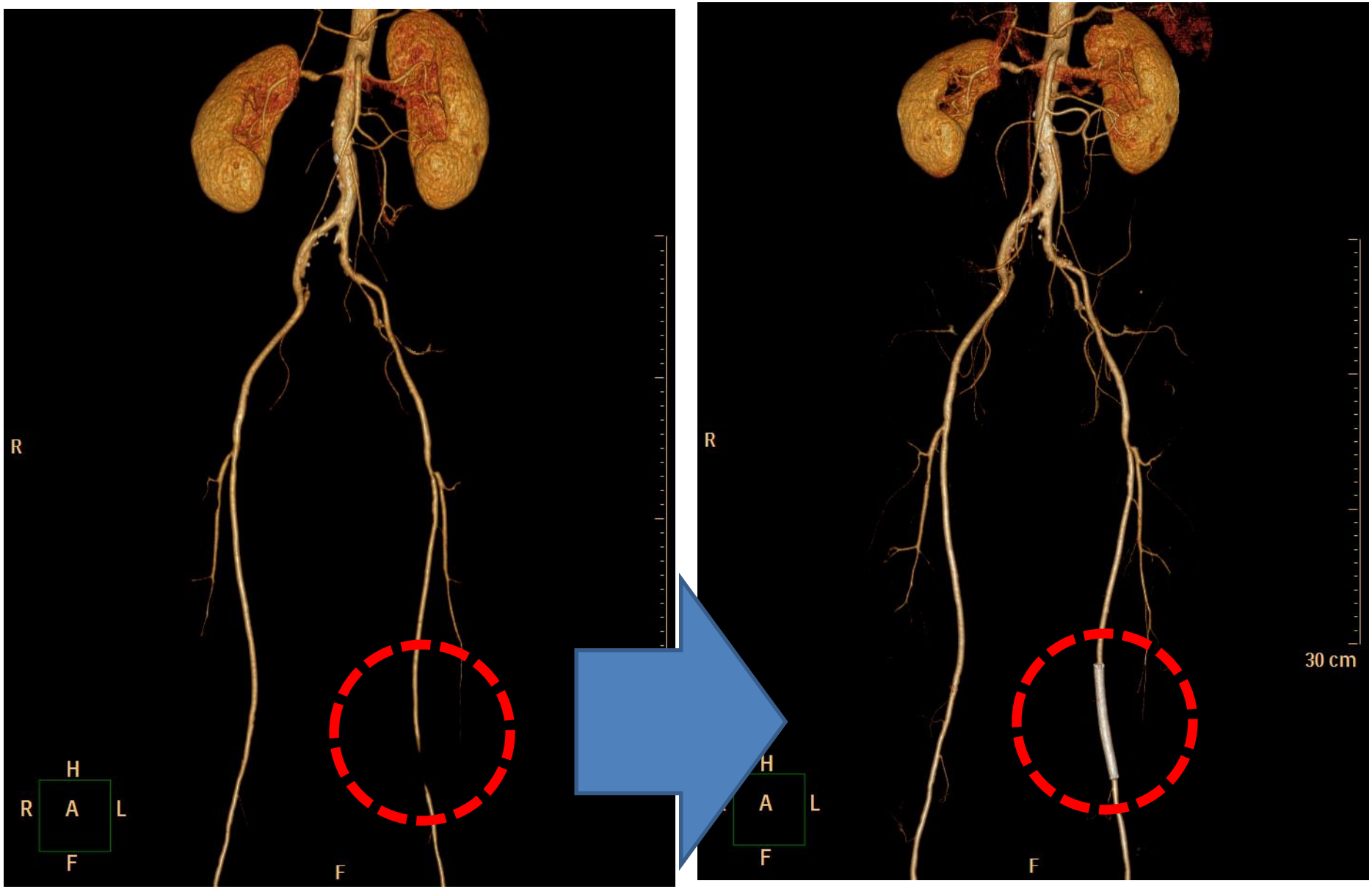




Simple PTA & Stent





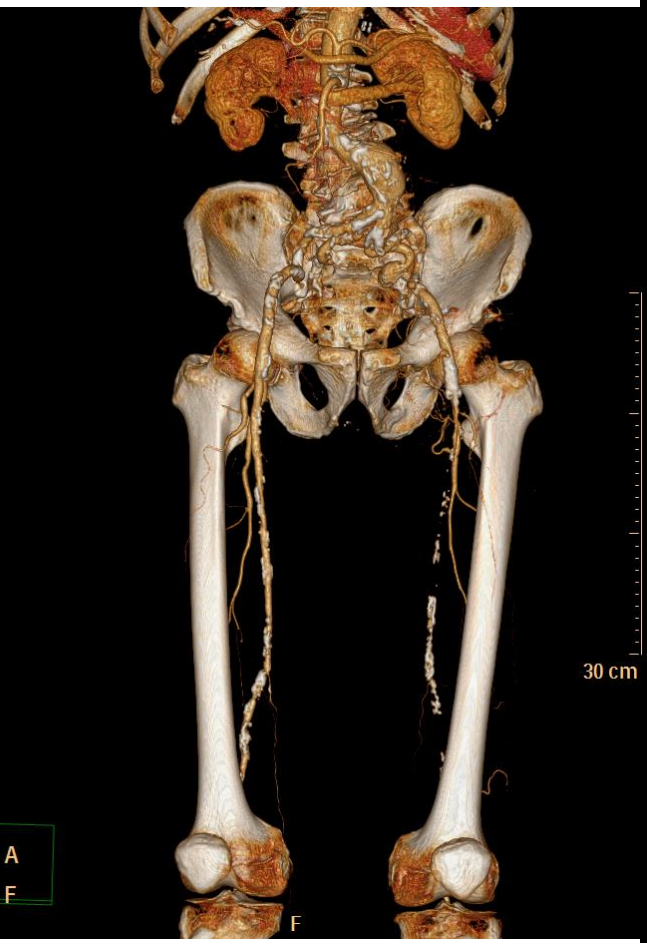

R
H
R
A
L
F
F
R
30 cm
H
A
L
F
F

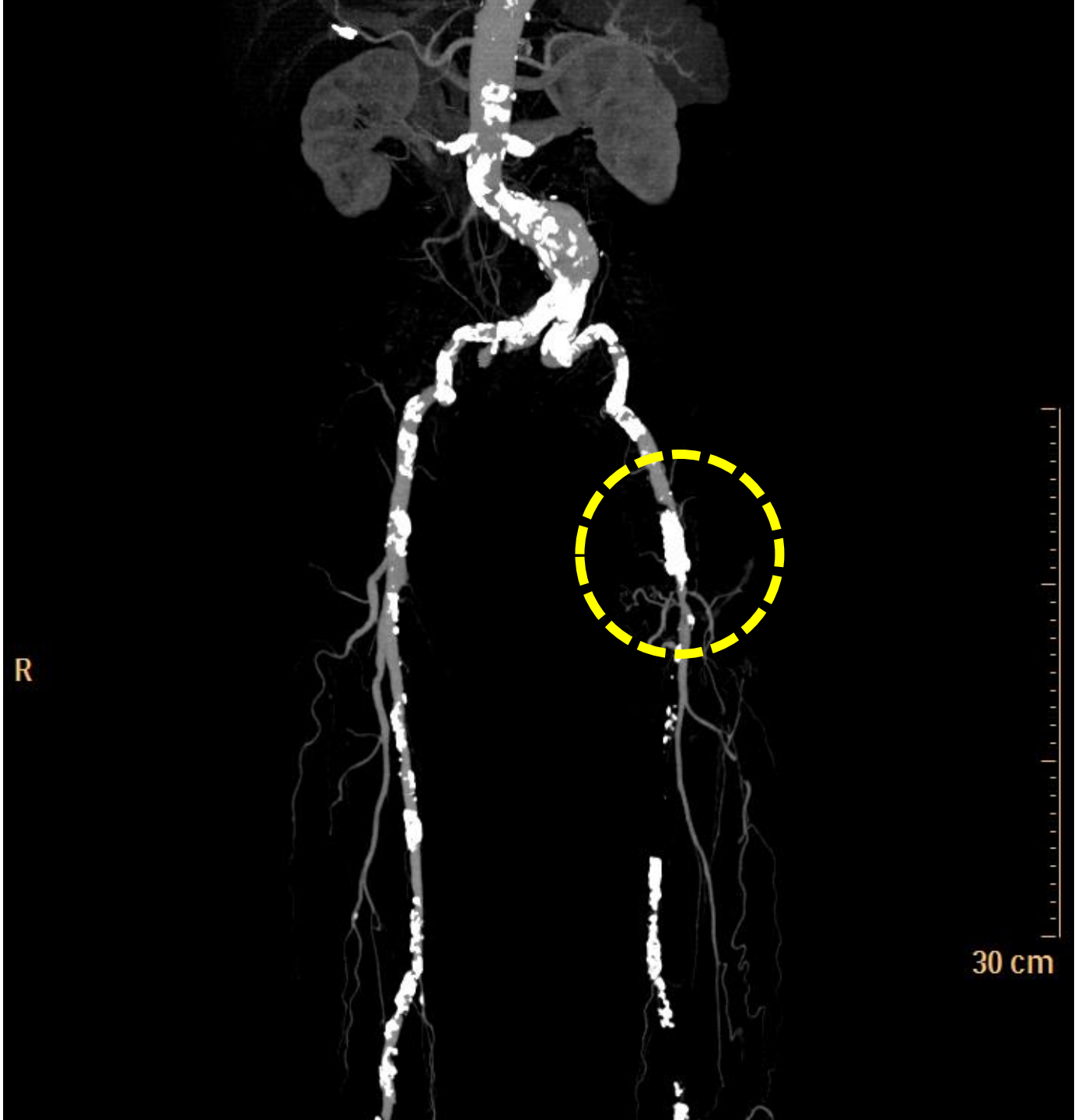
Case Presentation

- Both **CFA angioplasty** (Rt: Goretex patcha angioplasty, Lt: Endoarterectomy)

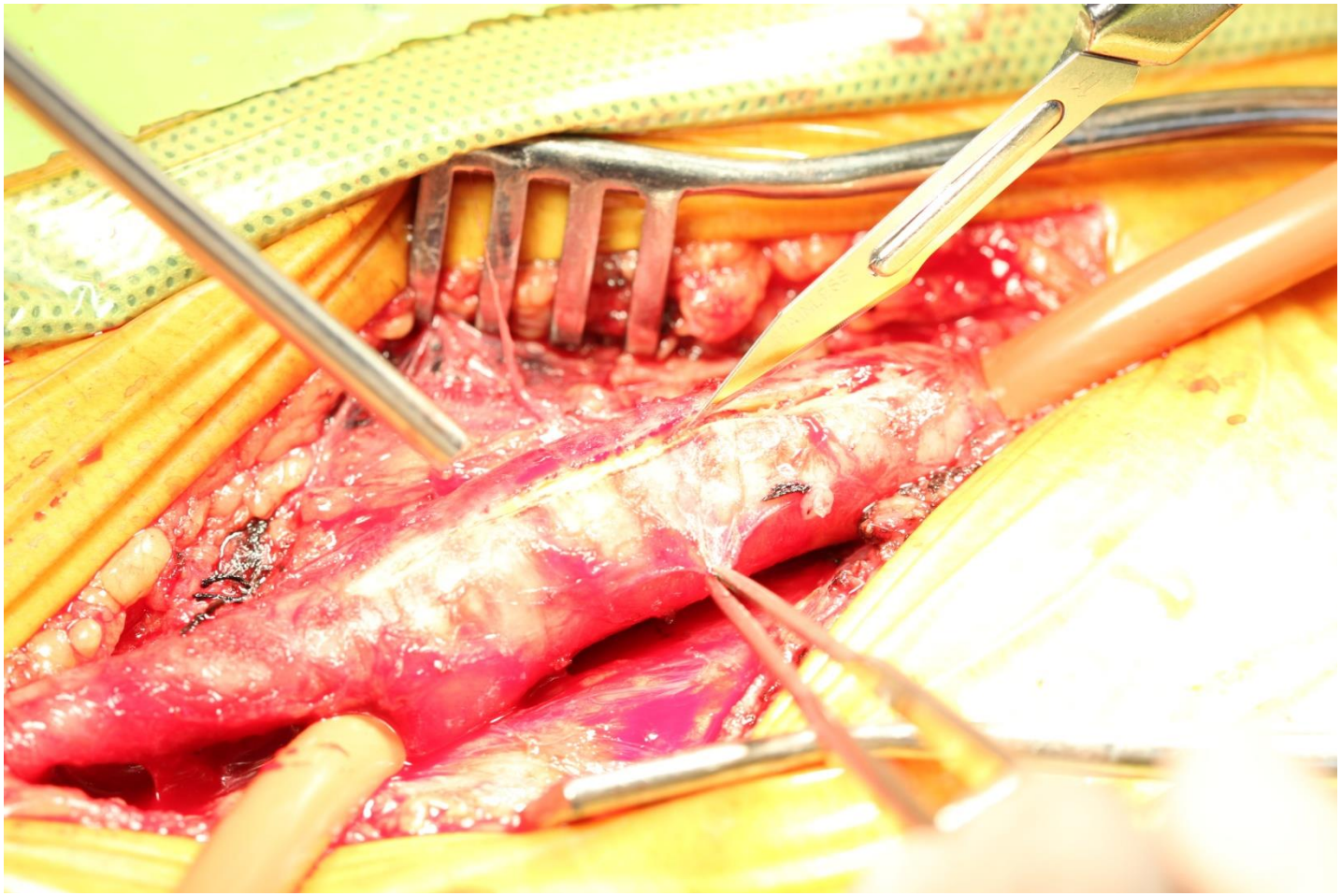
- Both **SFA PTA Stent**

Preop.

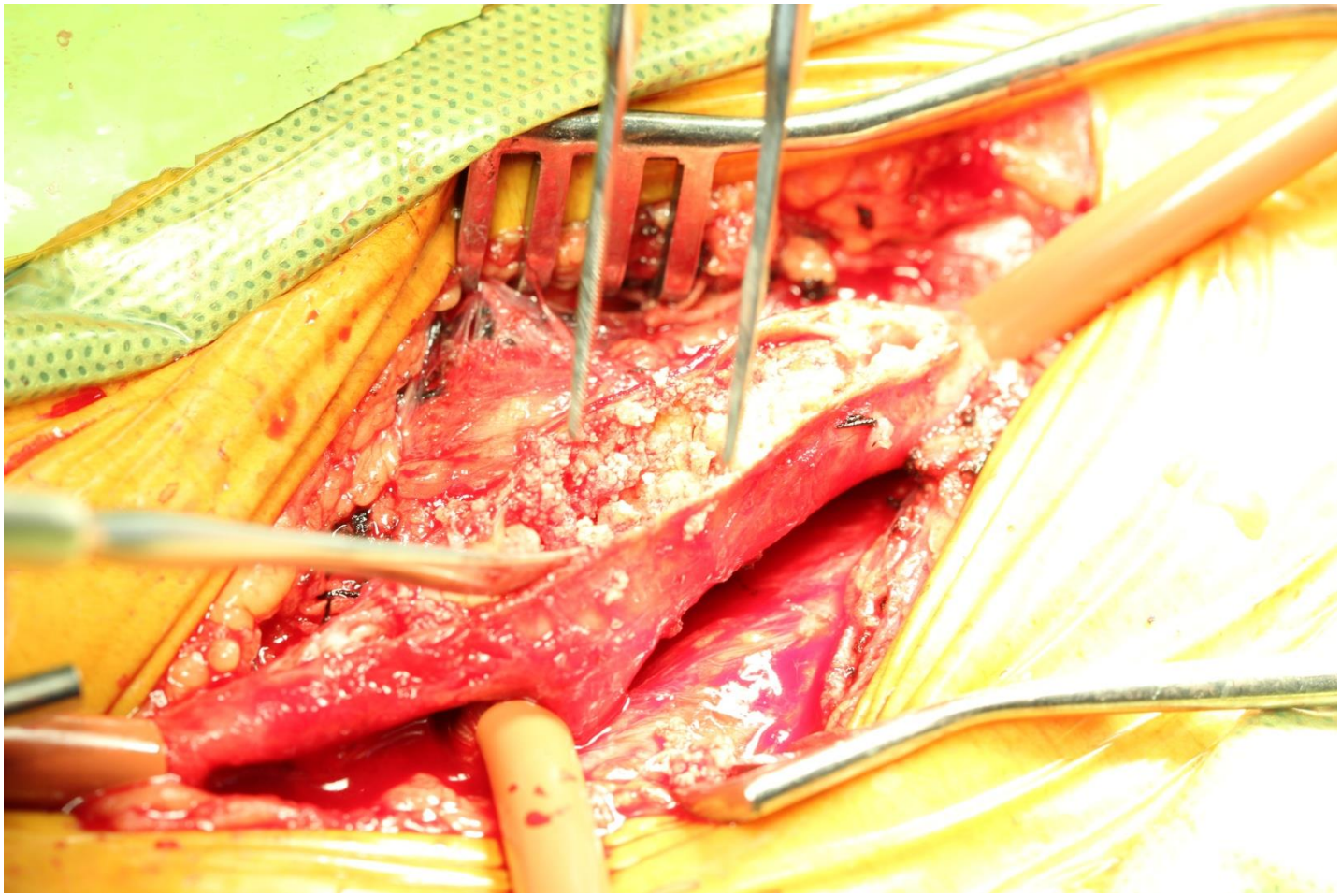



R
30 cm

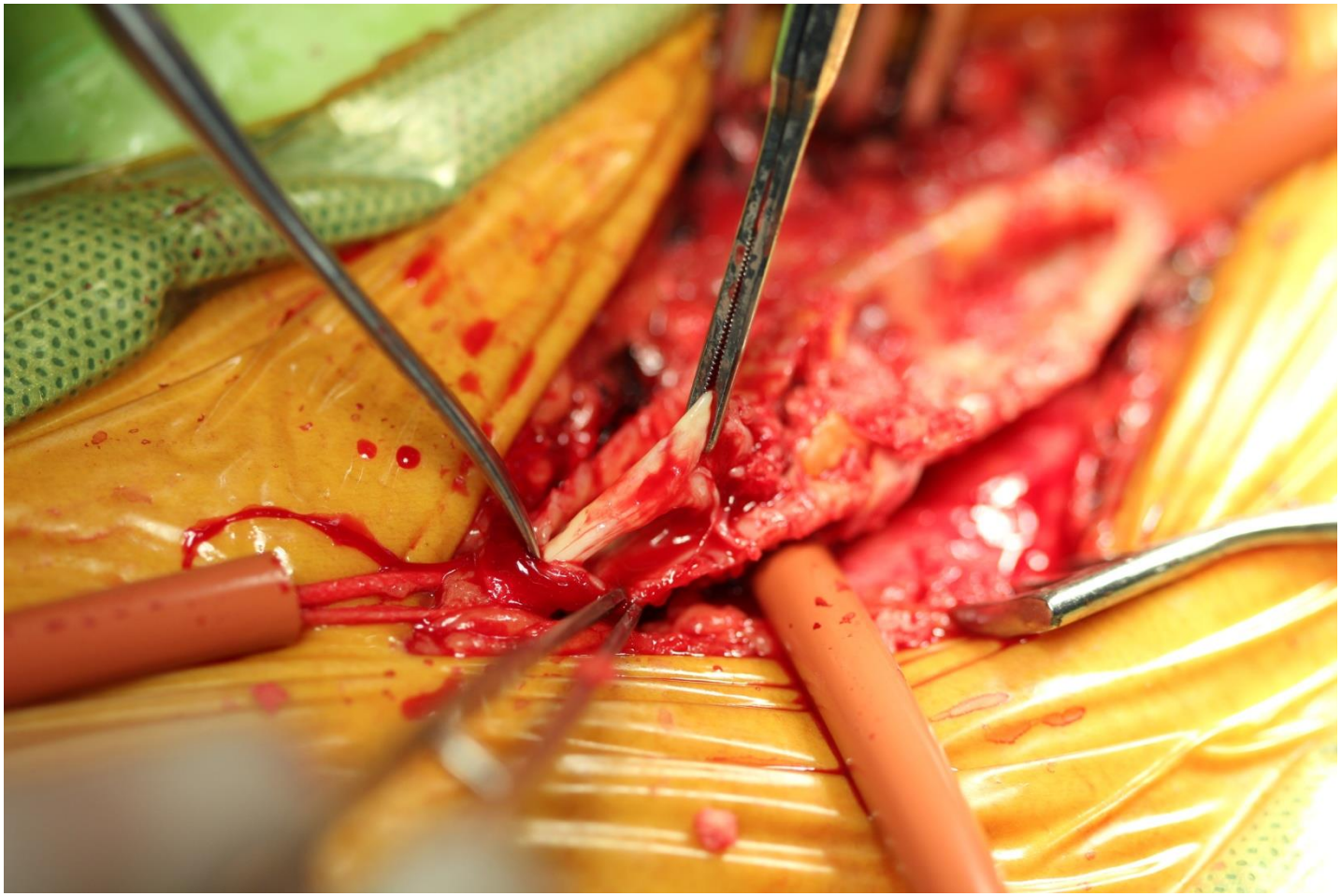
Op. Field



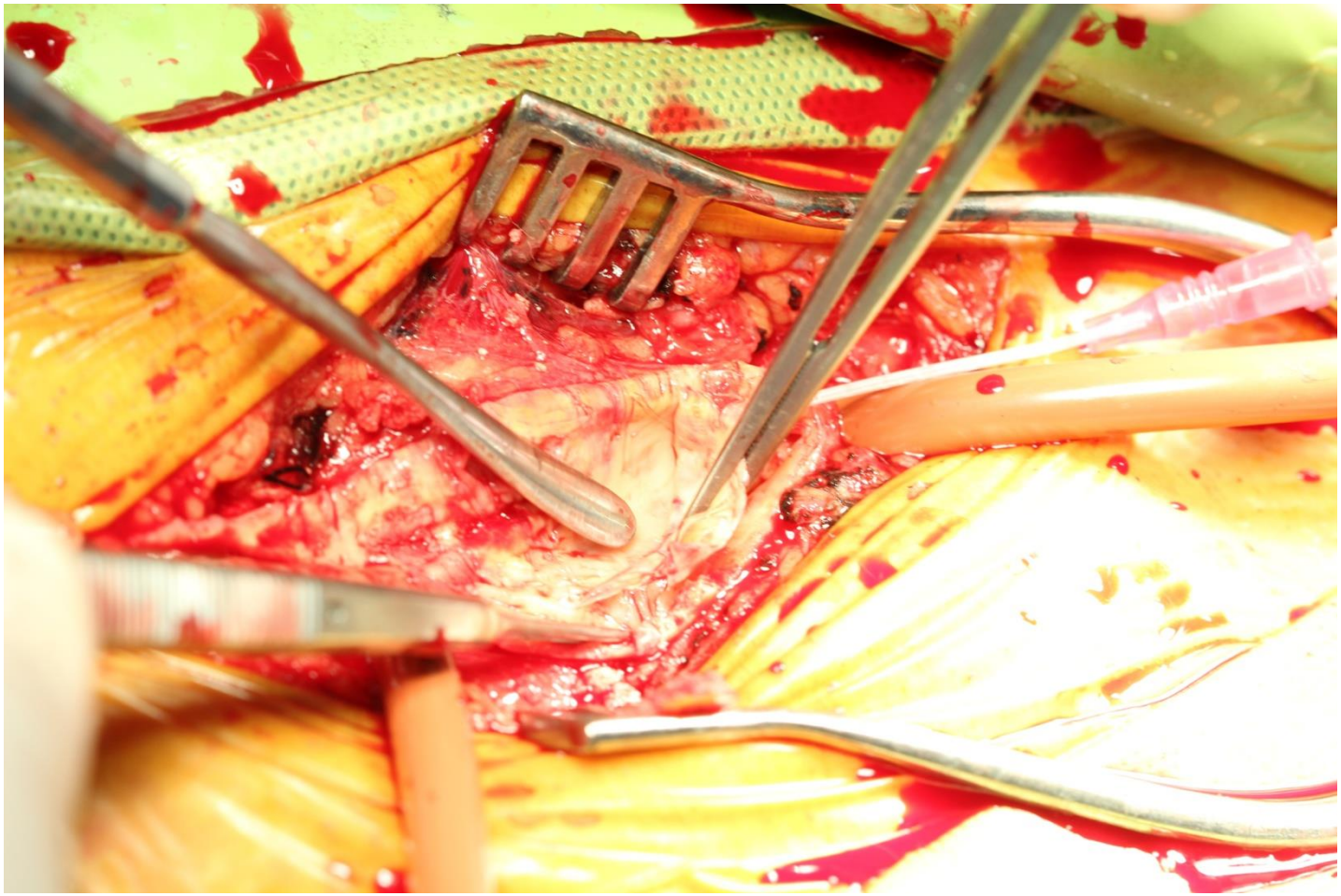
Op. Field



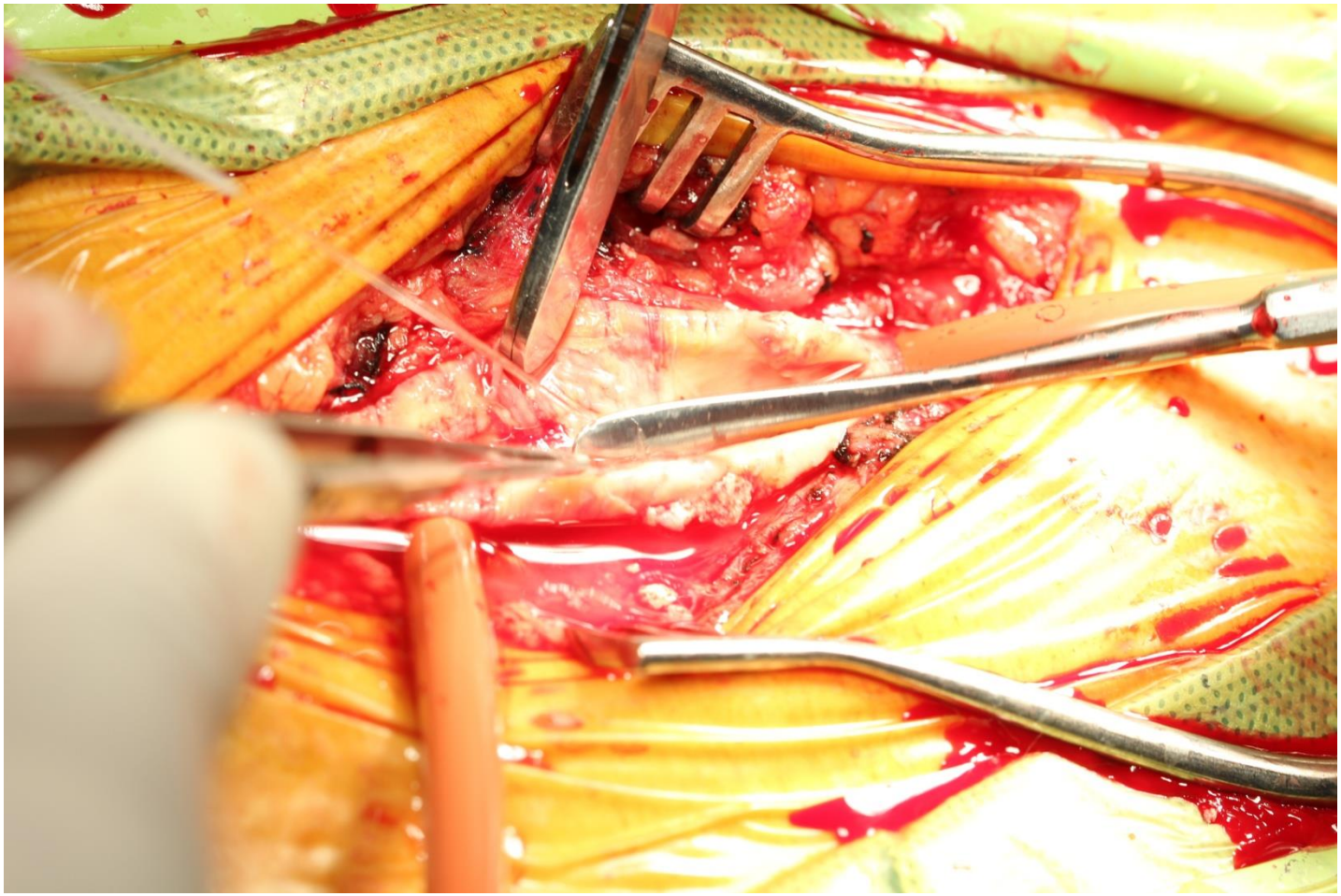
Op. Field



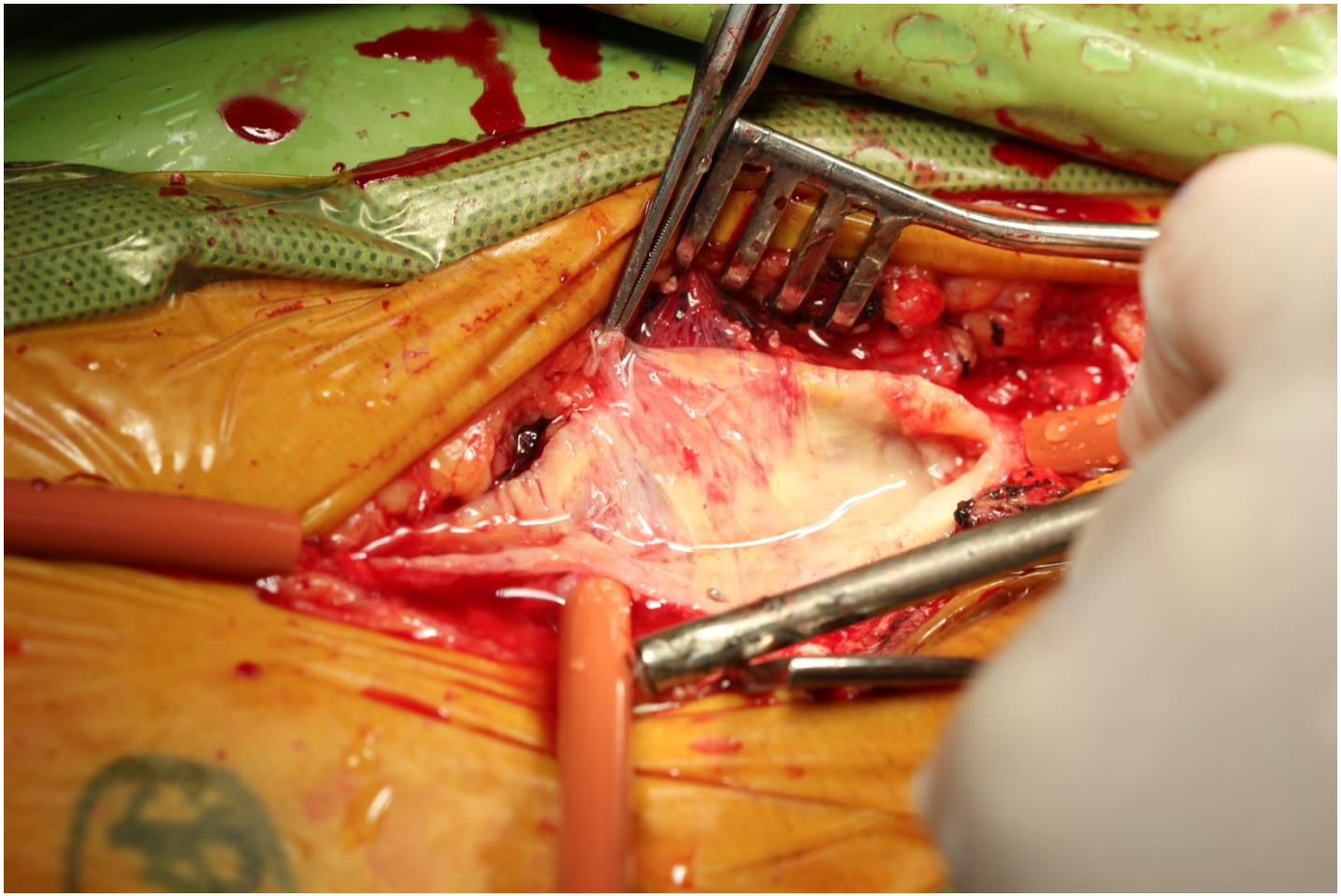
Op. Field



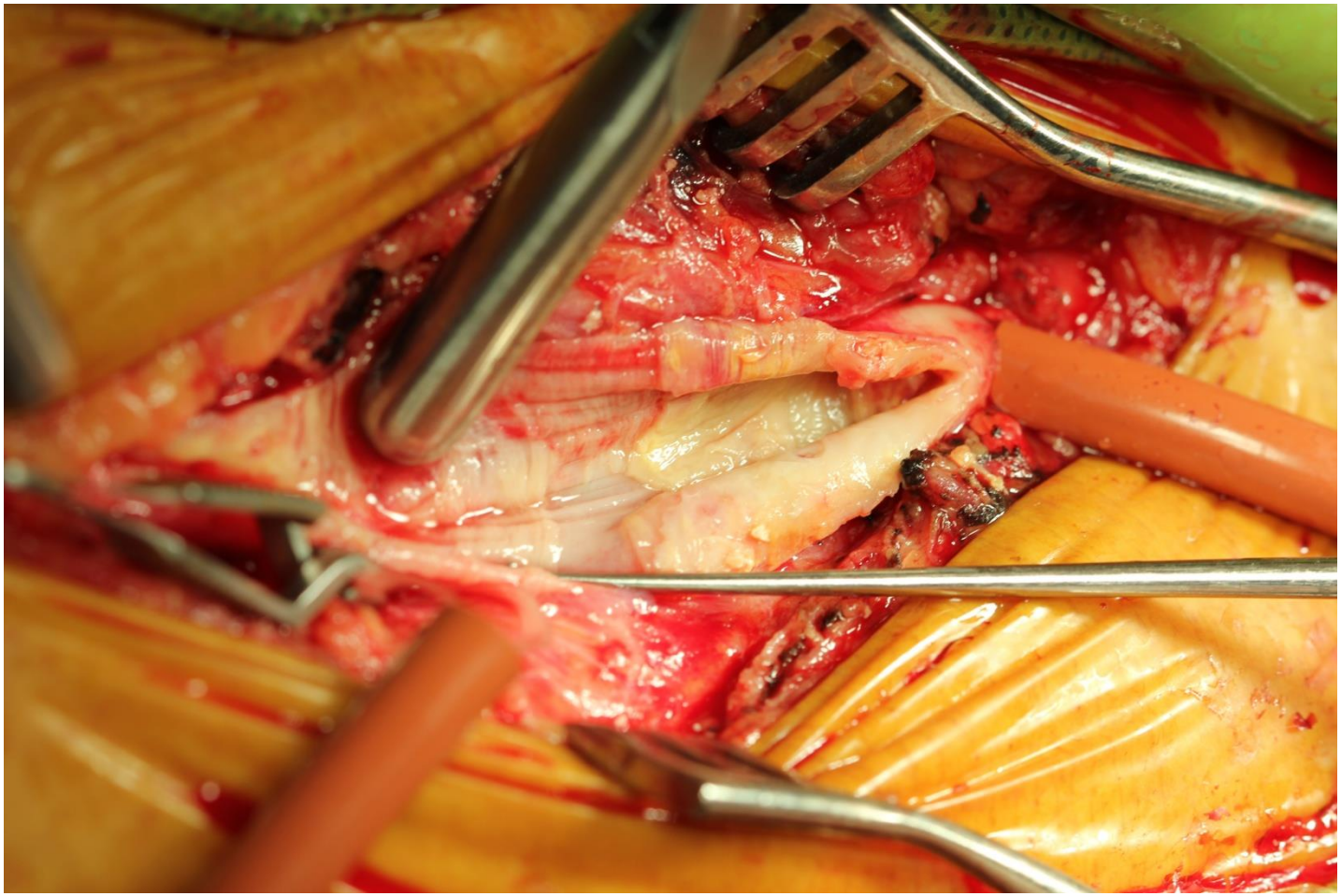
Op. Field



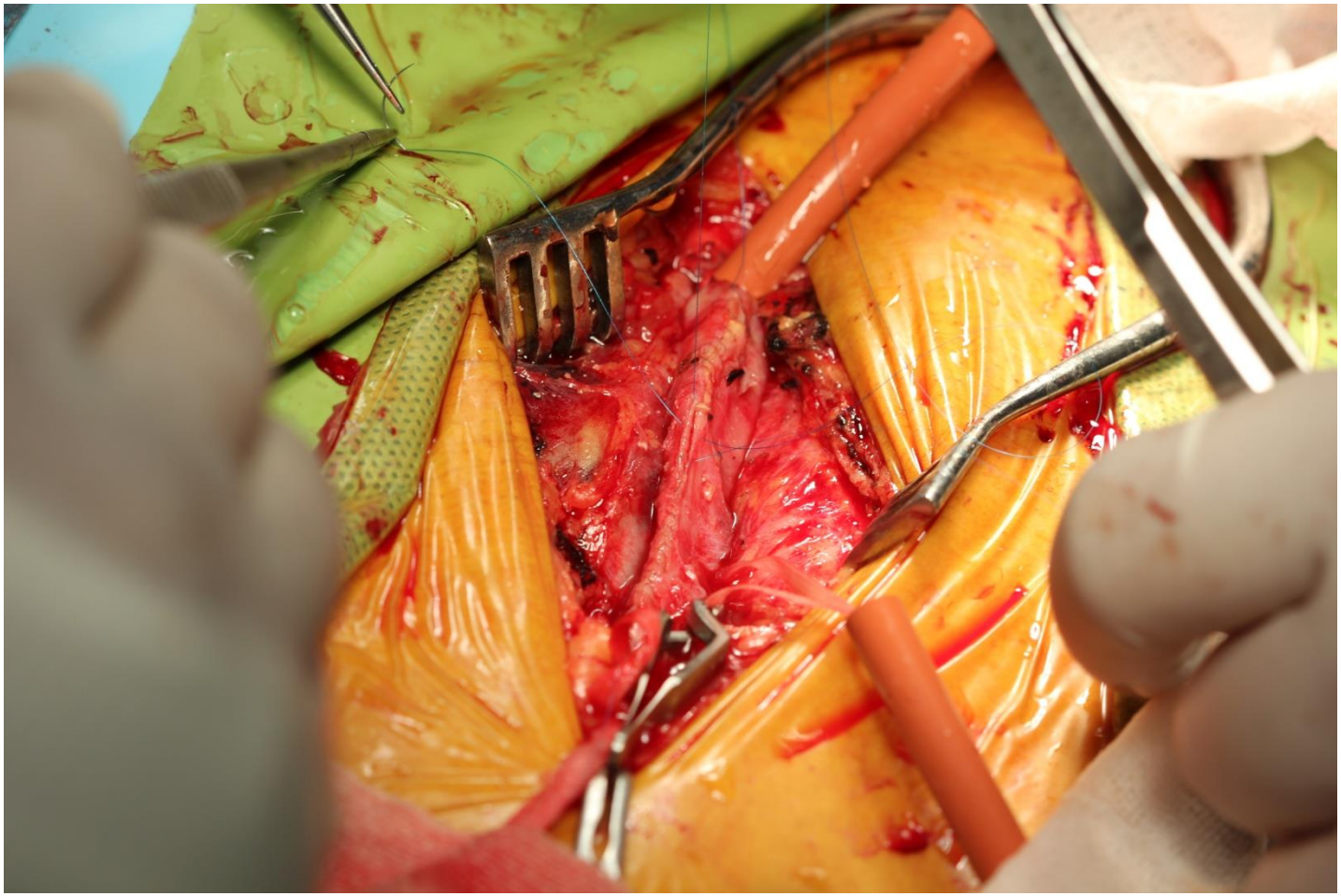
Op. Field



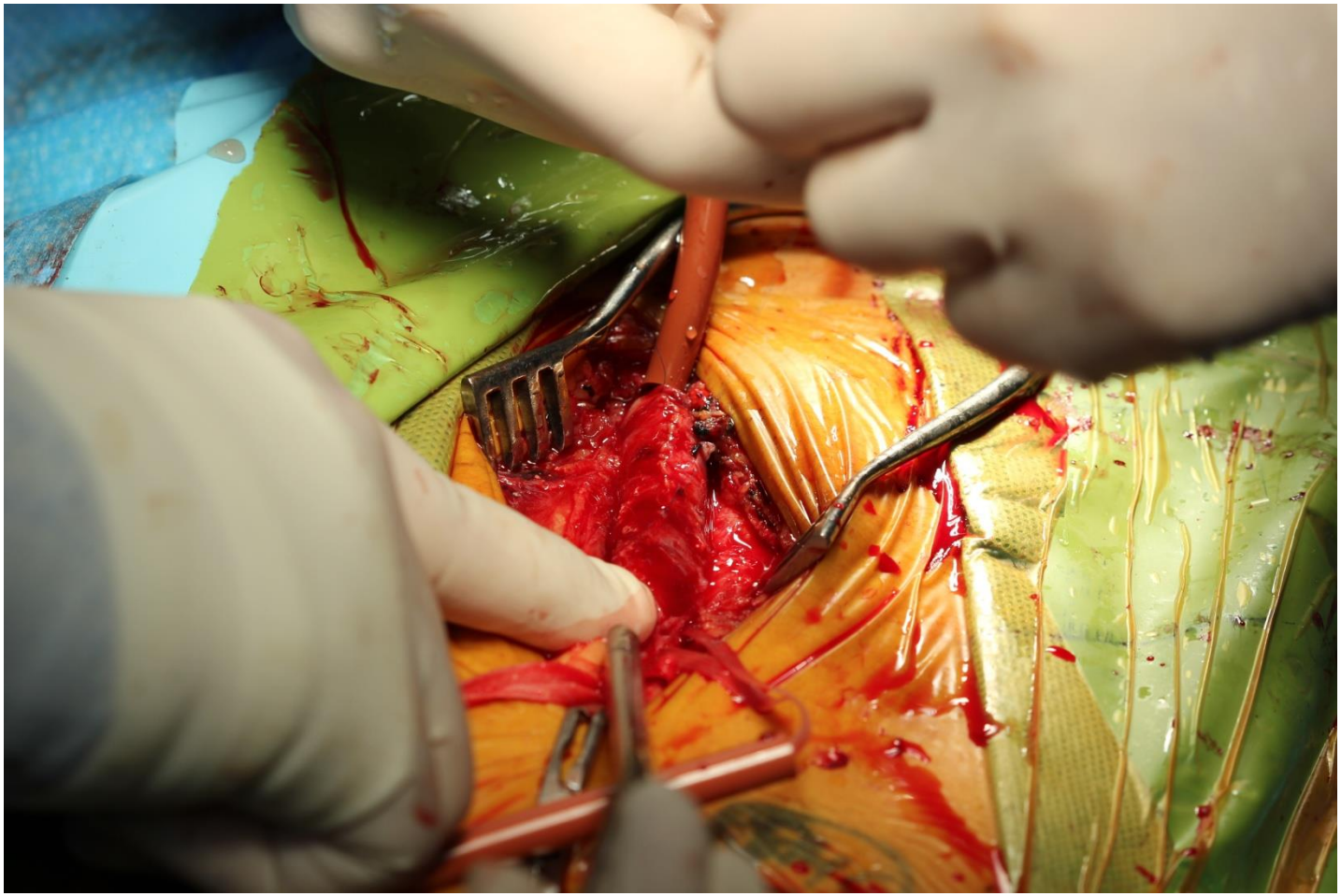
Op. Field



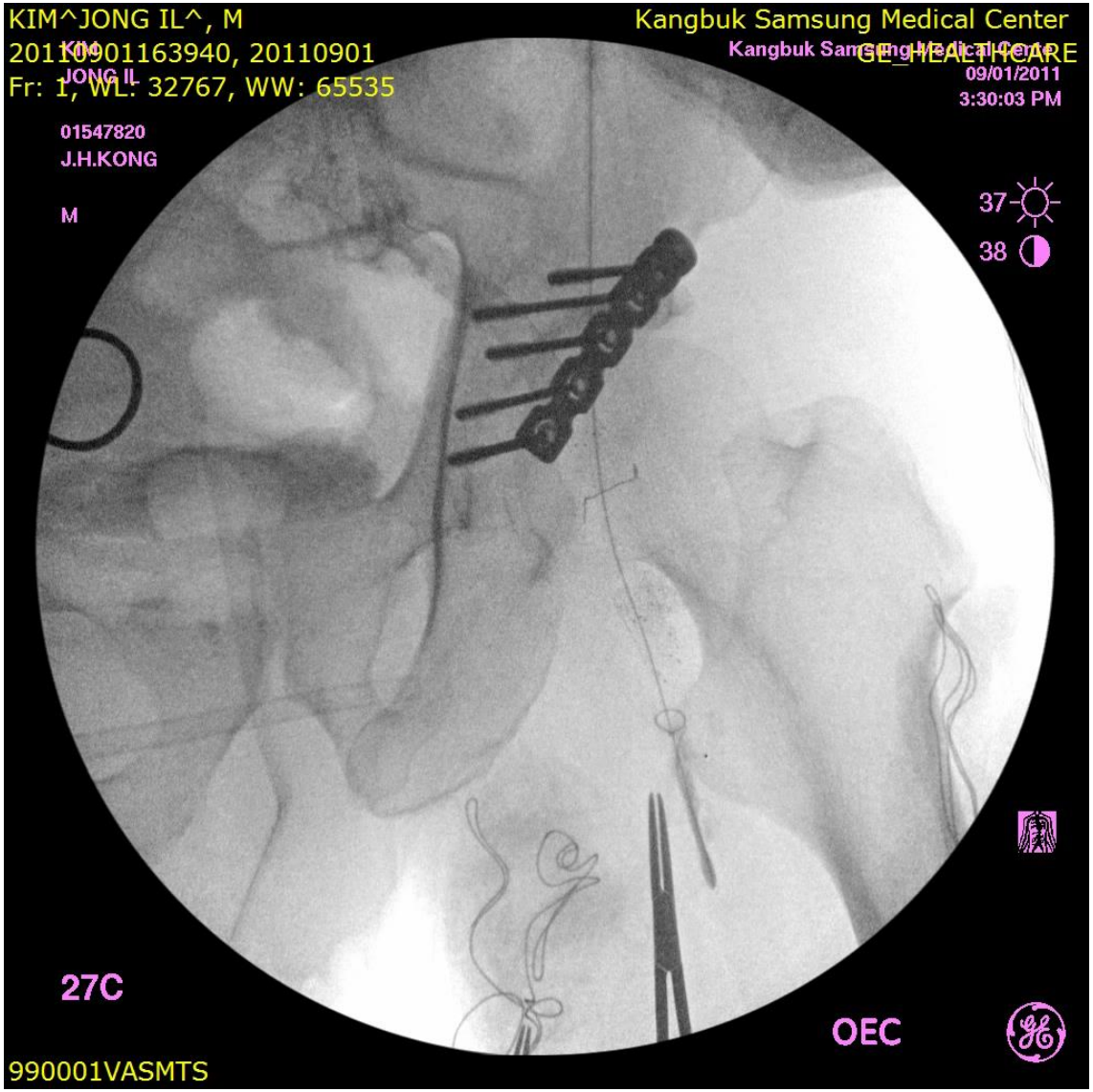
Op. Field



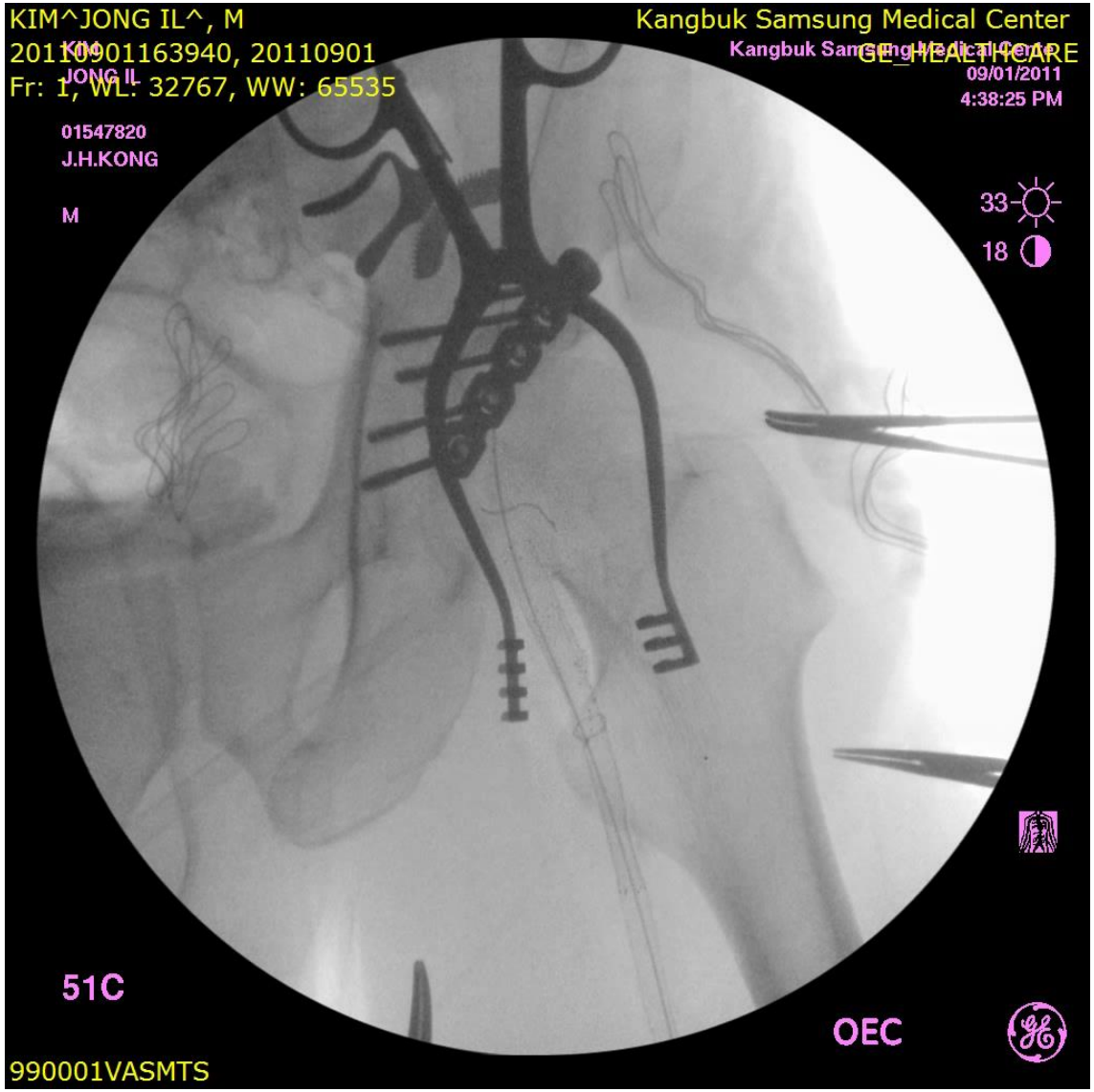
Op. Field



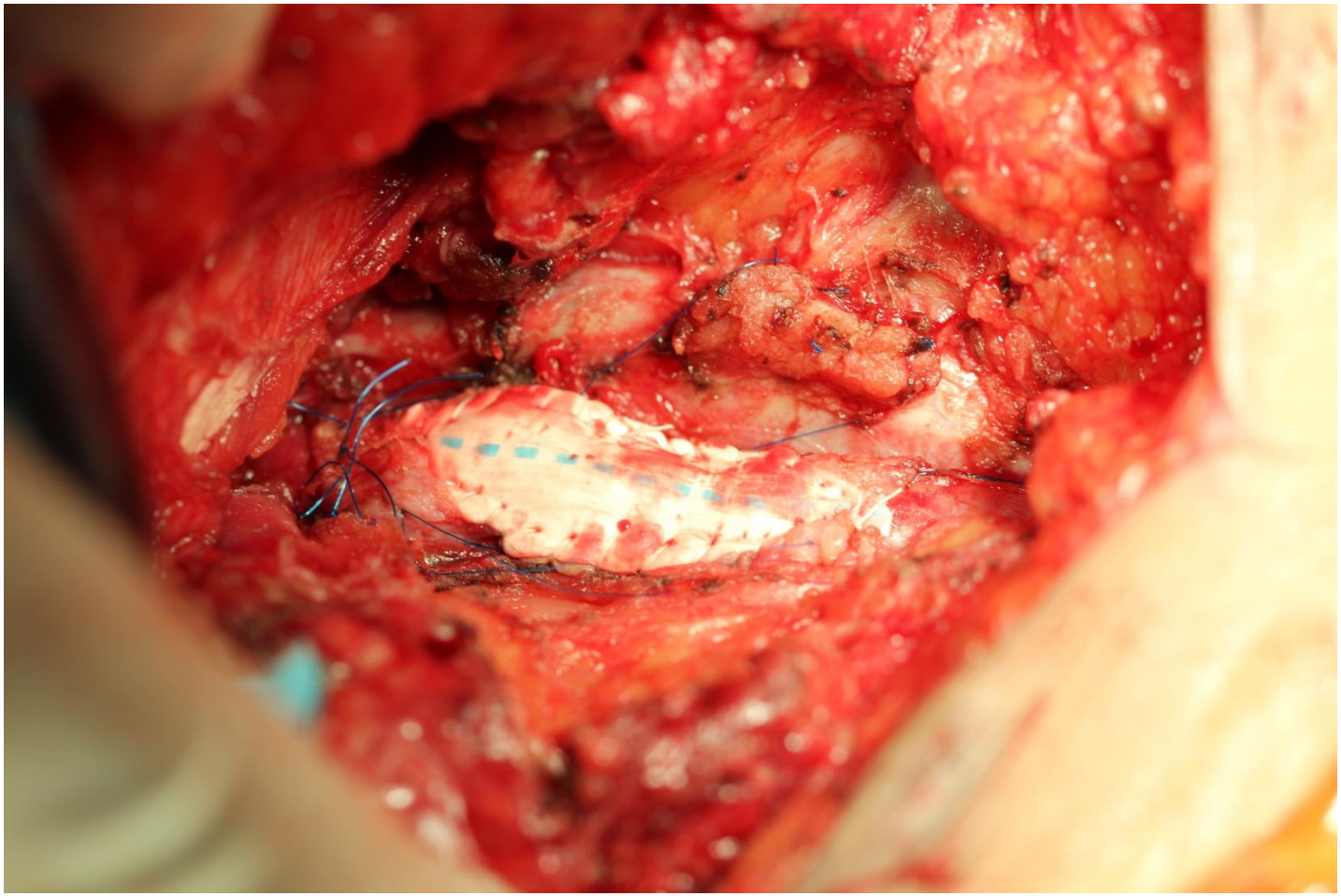
Endovascular Procedure



Endovascular Procedure



Op. Field at 2nd Op. (Right Side)



Postop.

IV. Future & Conclusion

- New Devices & New Concepts
- Nano Technologies

Translational Technologies in EVAR:Multimodality

Figure 1. Multimodality interventional translational suite: electromagnetic (EM) tracking, ultrasound, fluoroscopy, and computed tomography (CT) imaging during a preclinical nonsurvival procedure examining the accuracy of navigational paradigms using smart interventional devices enabled with the medical equivalent of GPS.

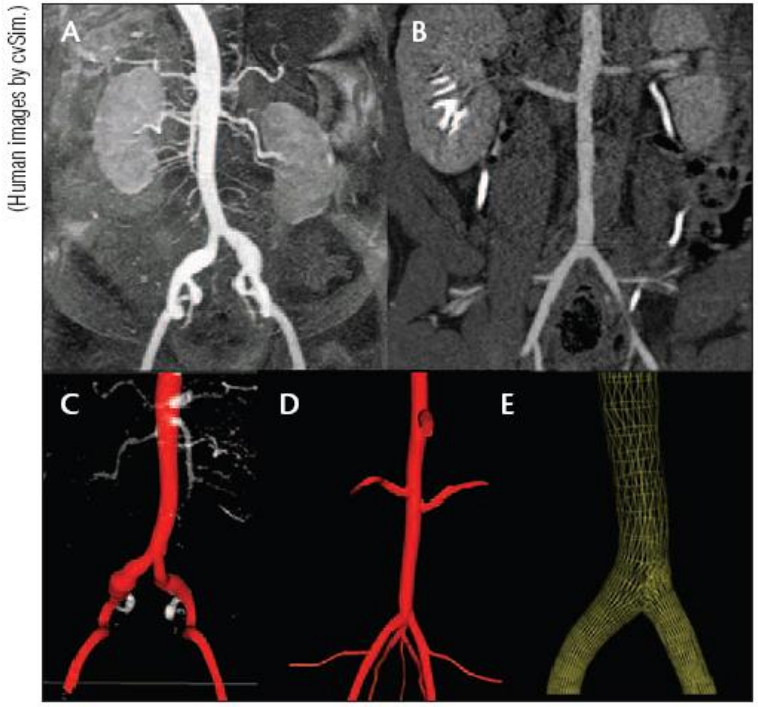


Figure 2. Human CT angiography (A), swine CT angiography (B), and 3D volume rendering of human (C) and swine (D) abdominal aortoiliac region. A simulation tool (cvSim, Cardiovascular Simulation, Inc., Stanford, CA) was used to generate 3D images (C,D) and computational grid for swine (E) that allows for flow and force evaluations.

JOHN W. KARANIAN, PHD; NADINE ABI-JAOUDEH, MD;
Translational Technologies in EVAR:Multimodality Interventions.
Endovascular toady 2009;March:15-18

Translational Technologies in EVAR:Multimodality

(Courtesy of Hansen Medical.)

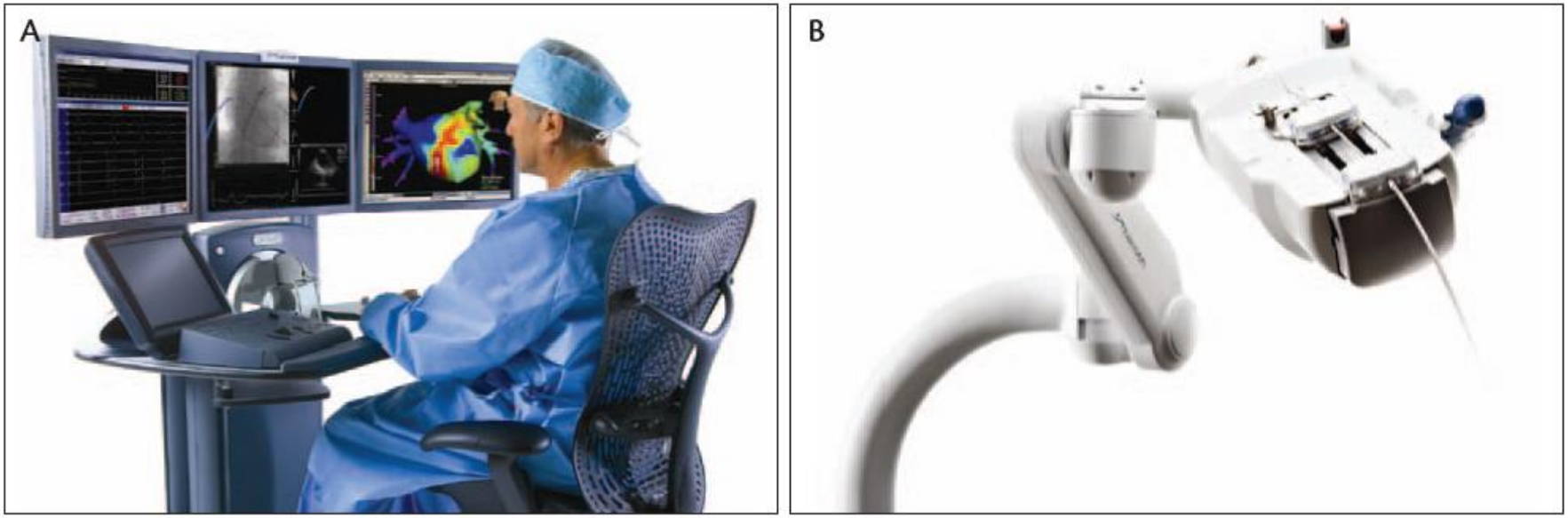


Figure 6. The Sensei control workstation (Hansen Medical, Mountain View, CA) allows the physician to control catheter positioning and provides force feedback (A). The mechanically positioned robotic drives the Artisan control catheter for manipulations within the vasculature (B).

JOHN W. KARANIAN, PHD; NADINE ABI-JAOUDEH, MD;
Translational Technologies in EVAR:Multimodality Interventions.
Endovascular toady 2009;March:15-18

Figure 1. The Sensei robotic system (Hansen Medical, Mountain View, CA) workstation is shown outside the angiography suite during cannulation of the short contralateral limb of an infrarenal Endurant stent graft (Medtronic, Inc., Minneapolis, MN).

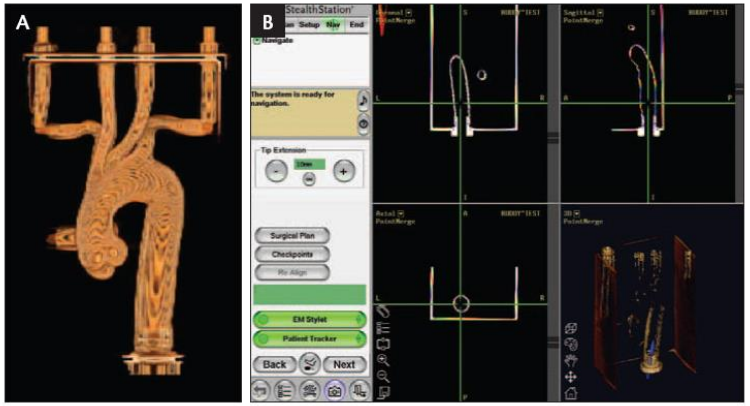


Figure 2. A pulsatile silicon arch model representing an angulated type III aortic arch (A). The Stealth electromagnetic navigation system (Medtronic, Inc.) combines cross-sectional ınetic tracking of microposition sensors located at the tip of an e operator can use the cross-sectional images to navigate through this pulsatile silicon model successfully and accurately with mini- ;el wall and without fluoroscopic guidance.

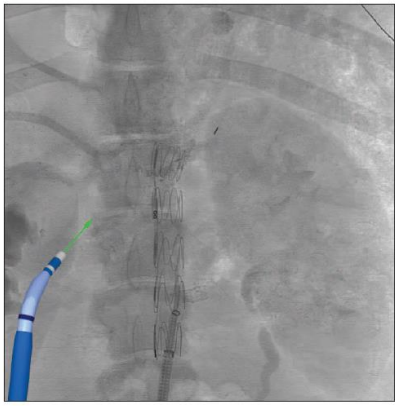


Figure 3. Successful antegrade in situ fenestration of an aortic stent graft (16-mm iliac extension covered stent; Endurant, Medtronic, Inc.) with subsequent stenting of the left renal artery in a porcine model. The robotic catheter can be seen in position, adjacent to the orifice of the left renal artery.

CELIA V. RIGA, BSC, MRCS; COLIN D. BICKNELL, MD, FRCS;
Navigation and Robotics for Endovascular Treatment of Aortic Disease
Endovascular toady 2009;March:19-23

Nano and the Future of Endovascular Medicine

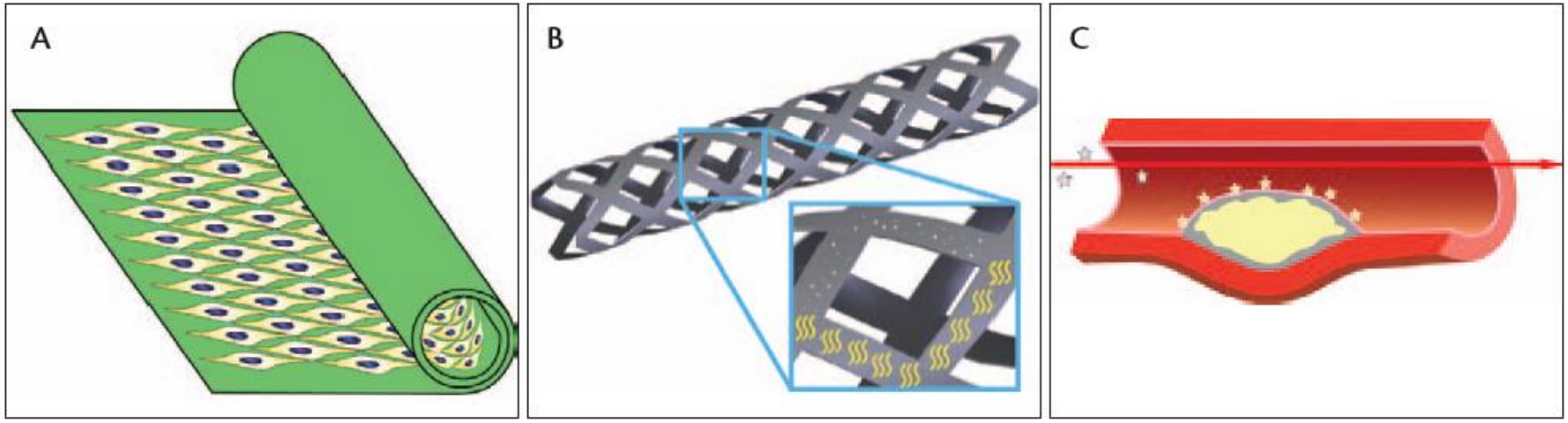


Figure 1. Technological innovations leveraging nanotechnology are expected in three categories with examples of anticipated or current technologies in engineered tissues assembling cells and proteins into physiologically correct microstructures (A). Hybrid stents combining nanotopography or functionalized surfaces to promote integration with native tissues and augmented for improved material properties (B). Medical tools that use nanostructures or devices for improved imaging and ablation of diseased tissues (C).

REBECCA TAYLOR, MS; JAMES J. NORMAN, PHD; CHELSEY SIMMONS, BS Nano and the Future of Endovascular Medicine
Endovascular toady 2009;March:27-

Human Technology => Human Philosophy

- Certainly, our patients have benefited greatly from new technologies, devices, and cardiovascular treatment strategies, and these are integral to improving outcomes, but they do not ensure a successful cardiovascular center of excellence.

- The creation of a true multidisciplinary team approach is at the very core of the center of excellence concept.

- Perhaps when creating any center of excellence, the first technology to get right is the “human philosophy.”

Establishing aPeripheral VascularCenter of Excellence. DAVID E. ALLIE, MD; CHRIS J. HEBERT, RT, R-CIS; AND CRAIG M. WALKER, MD. FEBRUARY 2005 I ENDOVASCULAR TODAY I 41