FRONTLINE VASCULAR CARE 2025

SPECTRUM VASCULAR & GENERAL SURGERY 光谱外科与血管专科

FARRER PARK HOSPITAL

Acute Limb Ischaemia: Critical Interventions

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COMFORT · FAIRNESS · VALUE

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Overview

- Definition
- Clinical Presentation
- Etiology
- Classification
- Investigations
- Management

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Definition of Acute Limb Ischemia

- Sudden decrease in limb perfusion causing potential threat to limb viability
- 6Ps
  - Pain
  - Pallor
  - Paraesthesia
  - Pulselessness
  - Paralysis
  - Perishingly cold
- Time is tissue

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Etiology

- Arterial Thrombo-embolism
  - AF
  - LV thrombi post AMI
  - Proximal aneurysms/plaque
- Acute thrombosis
- Endovascular stent/bypass graft occlusion
- Iatrogenic
- Aortic dissection

Box 8.1 • Aetiology of acute lower limb ischaemia

Thrombosis
- Atherosclerosis
- Popliteal aneurysm
- Bypass graft occlusion
- Endovascular stent or stent graft occlusion
- Iatrogenic (localised arterial dissection post endovascular intervention, e.g. arterial closure device failure)
- Thrombotic conditions

Embolism
- Atrial fibrillation
- Mural thrombosis
- Vegetations
- Proximal aneurysms
- Atherosclerotic plaque

Rare causes
- Dissection
- Trauma (including iatrogenic)
- Illicit drug use
- External compression
- Popliteal entrapment
- Cystic adventitial disease
- Iliac endofibrosis

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Etiology

Table 1. Uncommon causes of acute limb ischaemia[10–12]

Cause	Pathology	Signs to look for
Vasculitis	Inflammation of the arteries	Bilateral disease. Systemic symptoms (e.g., fever). Signs of connective tissue disease.
Popliteal entrapment syndrome	The popliteal artery is compressed by muscle or tendon during plantar flexion	Young active patient, no atherosclerotic risk factors. History of claudication pain.
Adventitial cystic disease	Cyst in the vessel wall, occluding blood flow	Acute arterial thrombosis (usually popliteal) in a young person. No atherosclerotic risk factors.
Paradoxical embolism	Atrial septal defect, venous thrombo-embolism (often with pulmonary hypertension)	Venous thrombo-embolism, cardiac bruit, and pulmonary embolism
Tumour embolism	Tissue like embolic material	Signs of tumour or malignancy (usually advanced) in heart or lung
Acute compartment syndrome	Swelling of tissues within fascial compartment (especially the anterior compartment of leg) compressing arteries	History of revascularisation or prolonged surgery. Pain on passive movement
Foreign body embolisation	Gangrene in multiple fingers or toes, often associated with infection or intravenous drug use	Intravenous drug users
Thrombophilia	Arterial thrombosis without risk factors	Young patients, often with a family history
Low cardiac output syndromes	Low blood flow to the extremities, worsened by devices. Common causes: hypotension, shock, and sepsis	Patients with severe cardiac failure, intra-aortic pump devices, extracorporeal membrane oxygenation (ECMO)

10 Darwood R. Acute limb ischaemia. Available at: www.rcemlearning.co.uk/references/acute-limb-ischaemia (accessed21 August 2019).
11 Enezate TH, Omran J, Mahmud E, Patel M, Abu-Fadel MS,White CJ, et al. Endovascular versus surgical treatment for acute limb ischemia: a systematic review and meta-analysis of clinicaltrials. *Cardiovasc Diagn Ther* 2017;7:264e71.
12 Howard DP, Banerjee A, Fairhead JF, Hands L, Silver LE,Rothwell PM. Population-based study of incidence, risk factors, outcome, and prognosis of ischemic peripheral arterial events:implications for prevention. *Circulation* 2015;132:1805e15.

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Classification

Table 2. Clinical categories of acute limb ischaemia according to Rutherford[2]

Grade	Category	Sensory loss	Motor deficit	Prognosis	Doppler signals	
					Arterial	Venous
I	Viable	None	None	No immediate threat	Audible	Audible
IIA	Marginally threatened	None or minimal (toes)	None	Salvageable if promptly treated	Inaudible*	Audible
IIB	Immediately threatened	More than toes	Mild/moderate	Salvageable if promptly revascularised	Inaudible	Audible
III	Irreversible	Profound, anaesthetic	Profound, paralysis (rigor*)	Major tissue loss amputation. Permanent nerve damage inevitable	Inaudible	Inaudible

This is an identical replica of the table in the 1997 publication by Rutherford *et al.*,[2] with the exception of the asterisks (*).
* In the original 1997 classification it was stated that arterial Doppler sounds are never present in Stage IIA, and that rigor (mortis) is always present in Stage III. However, it is the opinion of the Writing Committee that exceptions to these rules do exist, and a slight modification of the Rutherford classification from 1997 may be appropriate in the future.

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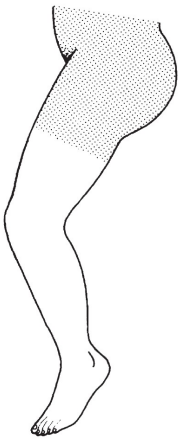
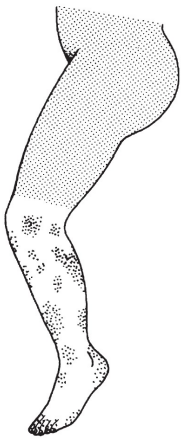
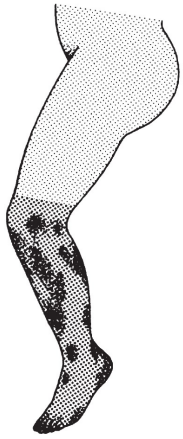
0–6 hours	6–12 hours	over 12 hours
		
Painful, marble white foot Neurosensory deficit	Mottled appearance due to capillary pooling Blanches on digital pressure	Fixed staining: mottled areas coalesce and no longer blanch to pressure Anterior compartment red and tender
Reversible	Partly reversible	Irreversible

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Investigation

- CT angiography is 1st line
- Alternatives:
  - US Arterial Duplex
  - MRA

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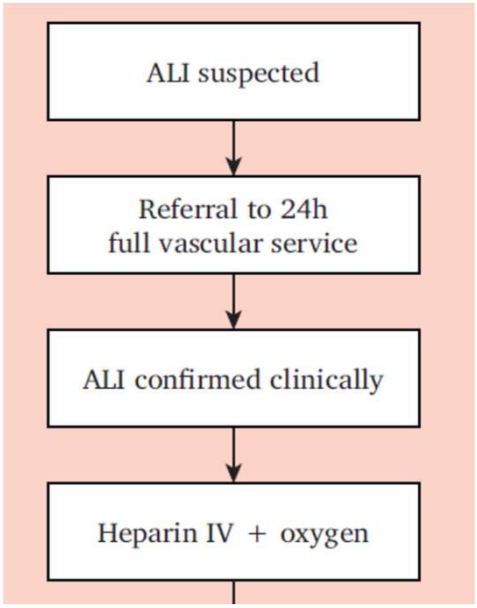
Management

- Resuscitate
- H2O2
  - IV Heparin
  - IV Hydration
  - Oxygen therapy
  - Opiate analgesia
- Call Vascular Surgery



ESVS 2020 Management Guidelines for Acute Limb Ischemia

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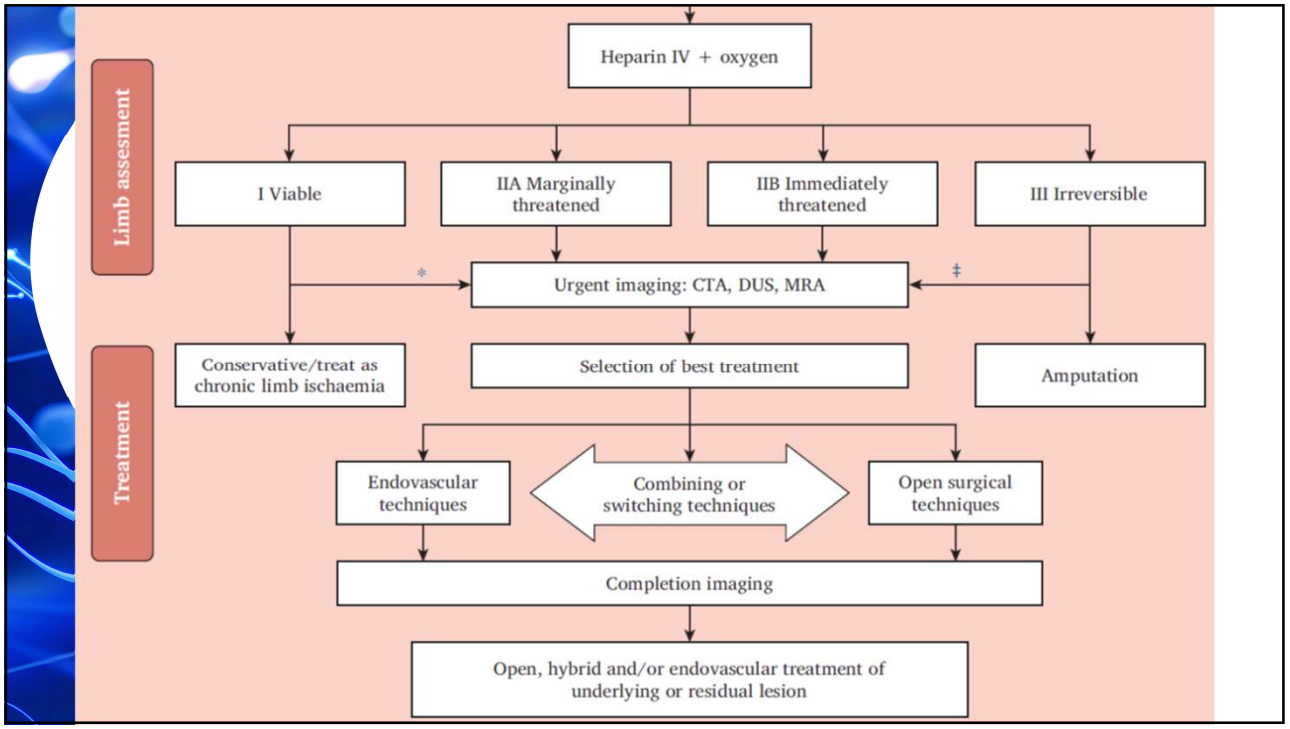

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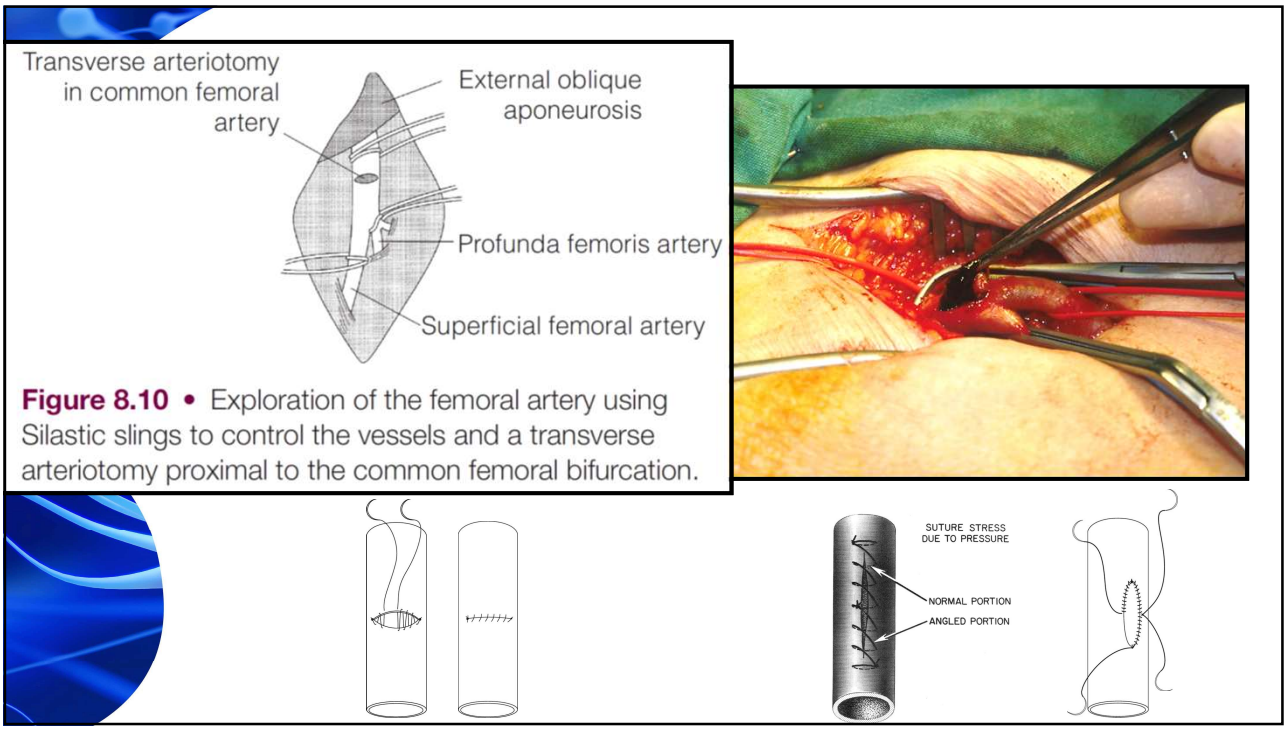

Figure 8.10 • Exploration of the femoral artery using Silastic slings to control the vessels and a transverse arteriotomy proximal to the common femoral bifurcation.

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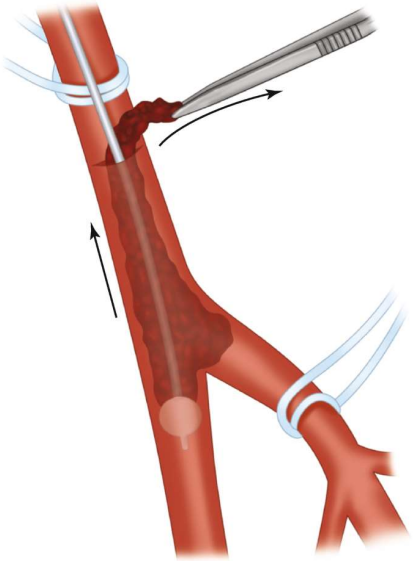
Balloon thrombo-embolectomy

- Femoral artery cutdown
  - Trawl iliac/SFA/Profunda
- Popliteal artery cutdown
  - Trawl SFA/Pop/Tibial vessels
- Brachial artery cutdown
  - Trawl axillary/brachial/radial/ulnar



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Endovascular Techniques

- Percutaneous thrombectomy
  - Pharmacomechanical
  - Mechanical
- Catheter directed thrombolysis
  - Continuous
- Angioplasty/Stenting of underlying lesions

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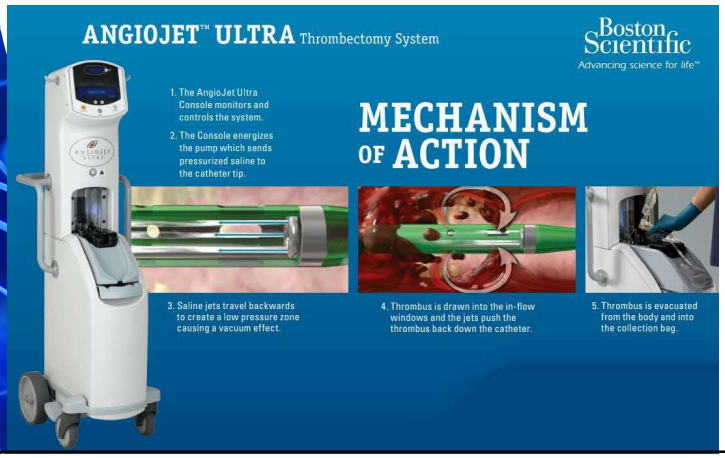
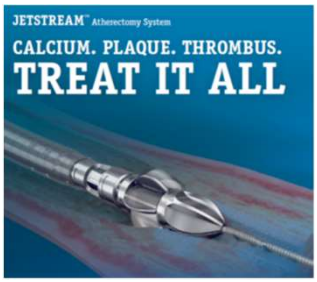
Percutaneous thrombectomy devices

- Boston Scientific AngioJet Peripheral Thrombectomy System
- Boston Scientific Jetstream Atherectomy System
- Penumbra Indigo Aspiration System





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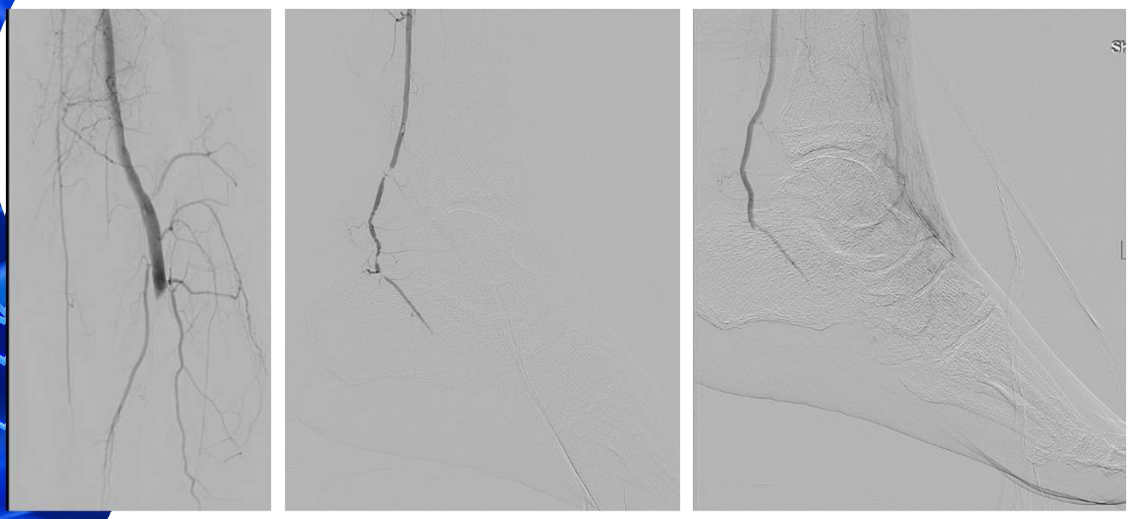
Acute Limb with CDT



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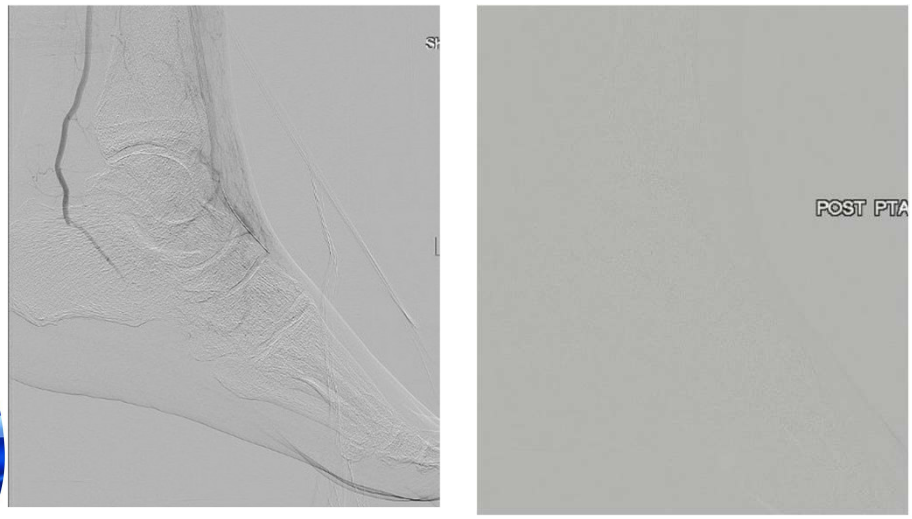
Acute Limb with CDT



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Open or Endovascular?

- No RCTs comparing these 2 approaches, older studies in 1990s compared open surgery with CDT

Endovascular Versus Surgical Revascularization for Acute Limb Ischemia

A Propensity-Score Matched Analysis

Dhaval Kolte, MD, PhD; Kevin F. Kennedy, MS; Mehdi H. Shishehbor, DO, MPH, PhD; Shafiq T. Mamdani, MD; Lars Stangenberg, MD; Omar N. Hyder, MD; Peter Soukas, MD; Herbert D. Aronow, MD, MPH

RESULTS: Of 10 484 (weighted national estimate=51 914) hospitalizations for ALI, endovascular revascularization was performed in 5008 (47.8%) and surgical revascularization in 5476 (52.2%). In the propensity-score matched cohort (n=7746; 3873 per group), patients who underwent endovascular revascularization had significantly lower in-hospital mortality (2.8% versus 4.0%; *P*=0.002), myocardial infarction (1.9% versus 2.7%; *P*=0.022), composite of death/myocardial infarction/stroke (5.2% versus 7.5%; *P*<0.001), acute kidney injury (10.5% versus 11.9%; *P*=0.043), fasciotomy (1.9% versus 8.9%; *P*<0.001), major bleeding (16.7% versus 21.0%; *P*<0.001), and transfusion (10.3% versus 18.5%; *P*<0.001), but higher vascular complications (1.4% versus 0.7%; *P*=0.002), compared with those undergoing surgical revascularization. Rates of any amputation were similar between the 2 groups (4.7% versus 5.1%; *P*=0.43). Median length of stay was shorter and hospital costs higher with endovascular versus surgical revascularization.

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Complications post revascularization

- Compartment syndrome
- Reperfusion injury
- Acute kidney injury
- Catastrophic bleeding – 8-10%
- AMI/CVA
- Limb loss – 6-16%
- Death – as high as up to 40%
- Reintervention rate 33%

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Post reperfusion compartment syndrome

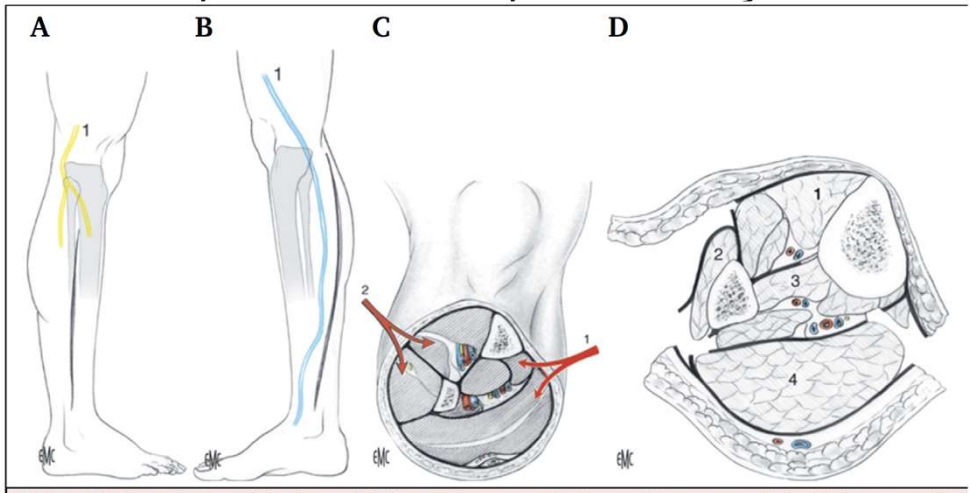

Figure 10. Fasciotomies of the leg: a full four compartment fasciotomy is recommended, which is typically achieved with two incisions. (A) Lateral incision (1 = peroneal nerve). (B) Medial incision (1 = great saphenous vein). (C) Fasciotomies of the superficial posterior and deep posterior compartments (1). Fasciotomies of the anterior and lateral compartments (2). (D) Four compartment fasciotomy, with the wounds left open (1 = anterior compartment; 2 = lateral compartment; 3 = deep posterior compartment; 4 = superficial posterior compartment). Reproduced with permission from Ricco *et al.*[202]

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Post surgical management

- Aggressive IV hydration
  - Urine may appear reddish brown due to haemolysis
- Analgesia
- Circulation charting
- Watch out for access site complications!
- Evaluate cause for acute limb ischemia
  - TTE/Holter
  - CT Aortogram
- Anticoagulation/Antiplatelet therapy

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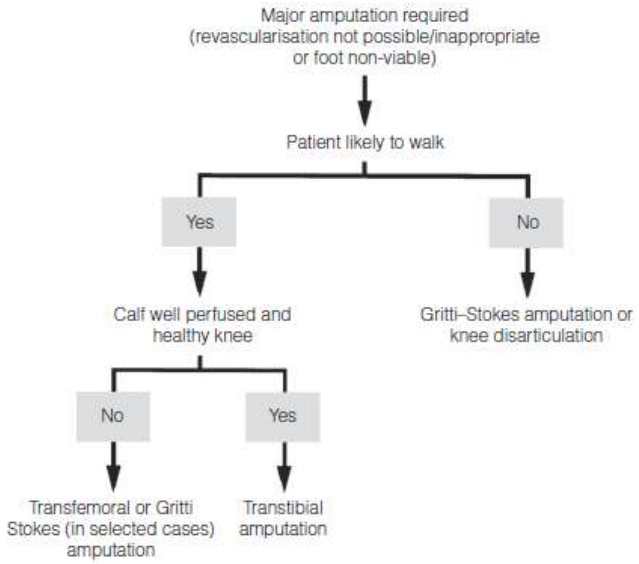
Amputations



- BKAs has higher potential to achieve prosthetic mobilisations vs. AKAs
- No fixed STO date!!

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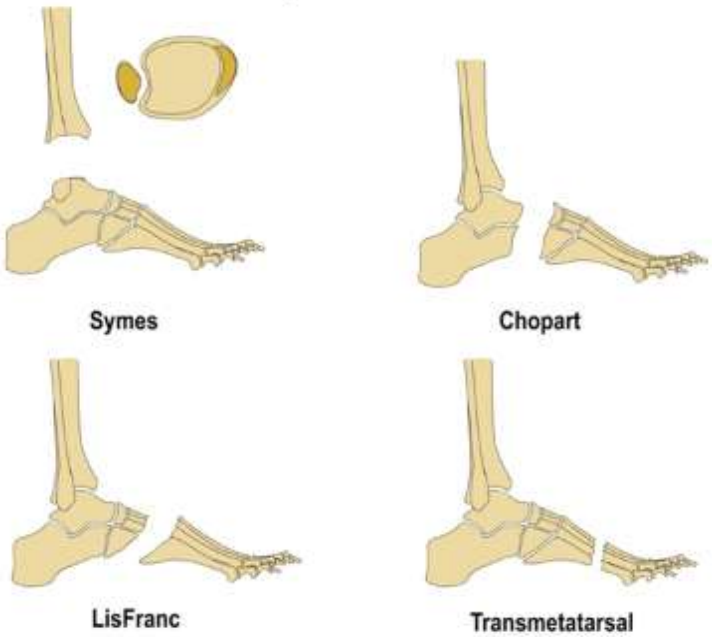
Foot Amputation Levels



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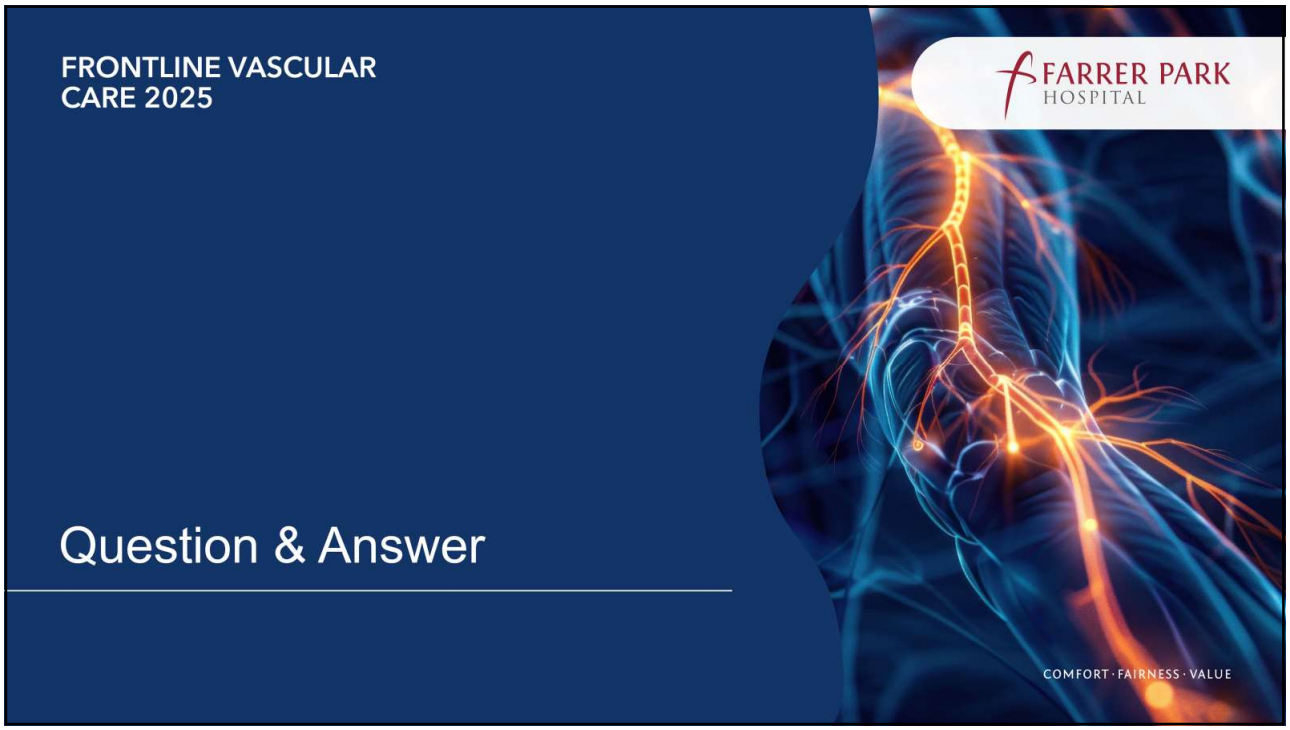
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