VASCUPEDIA

Postischemic compartment syndrome of lower extremity

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Background of compartment syndrome

- It occurs when the tissue pressure within a closed muscle compartment exceeds the perfusion pressure
- It results in muscle and nerve ischemia
- Most often after significant trauma (particularly involving long bone fractures). Also possible after minor trauma or from non traumatic causes

Pathophysiology of the compartment syndrome

- In general, the increased compartment pressure restricts local tissue perfusion by reducing the arteriovenous pressure gradient

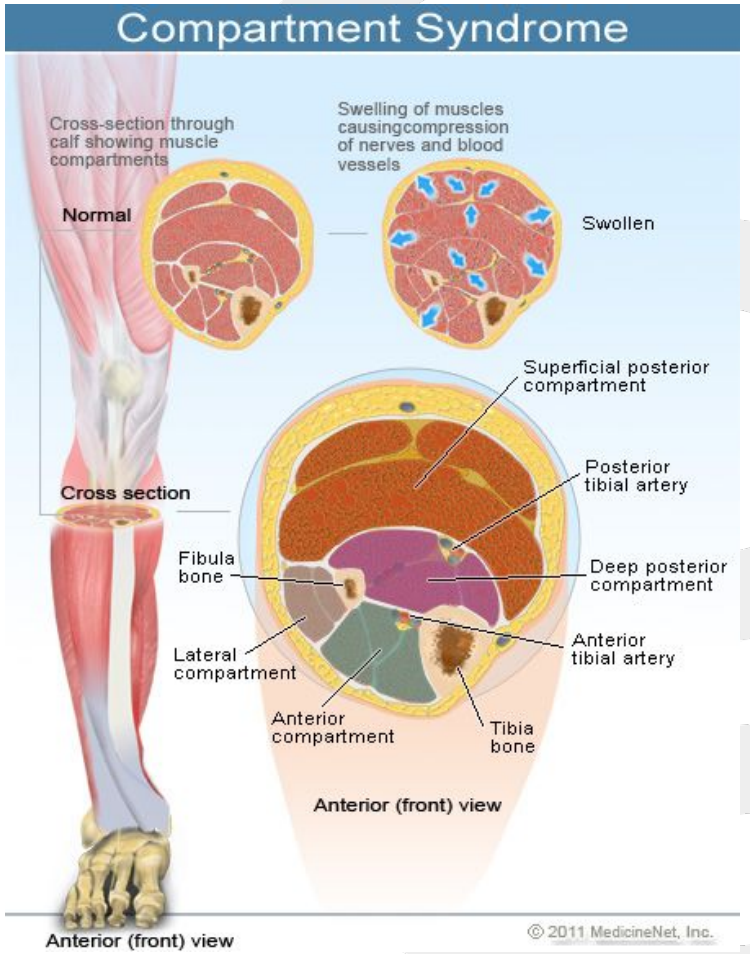
- That leads to cellular anoxia and to muscle and nerve damage thereafter

Pathophysiology of the postischemic compartment syndrome

- The muscle ischemia due to limb ischemia causes progressive interstitial edema by increasing capillary permeability
- The acutely ischemic muscle is prone to injury once flow is restored (reperfusion) and can become worse if tissue pressure is elevated
- Reperfusion causes microvascular obstruction and increases capillary permeability by free radical production, exacerbating the edema

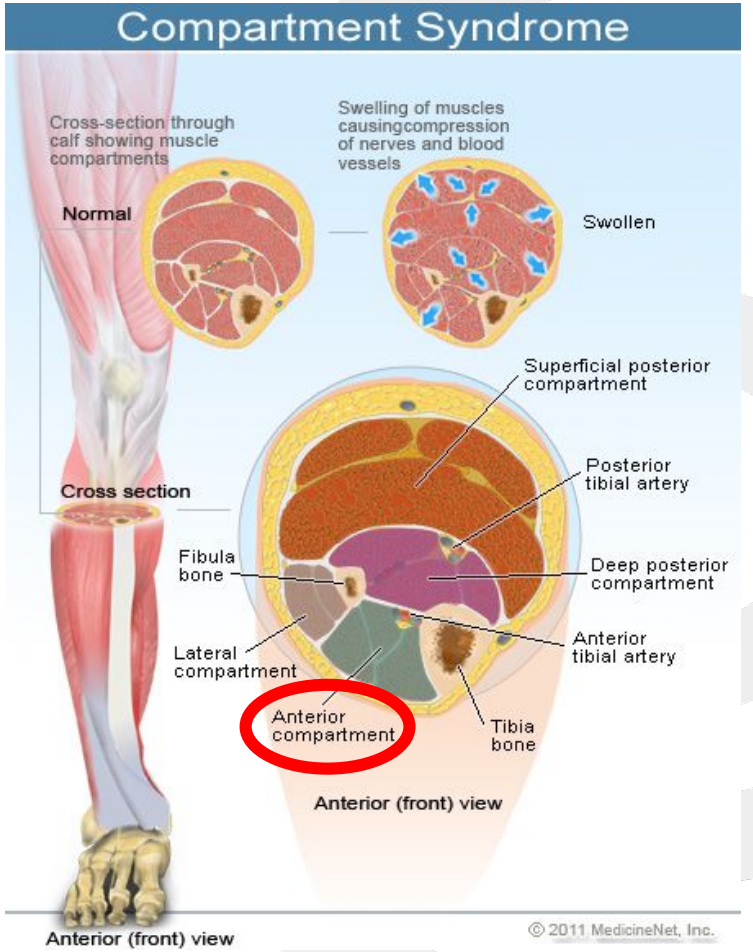
Anatomic compartments

- The lower leg is divided into 4 compartments
  - Anterior
  - Lateral
  - Superficial posterior
  - Deep posterior



Anterior compartment

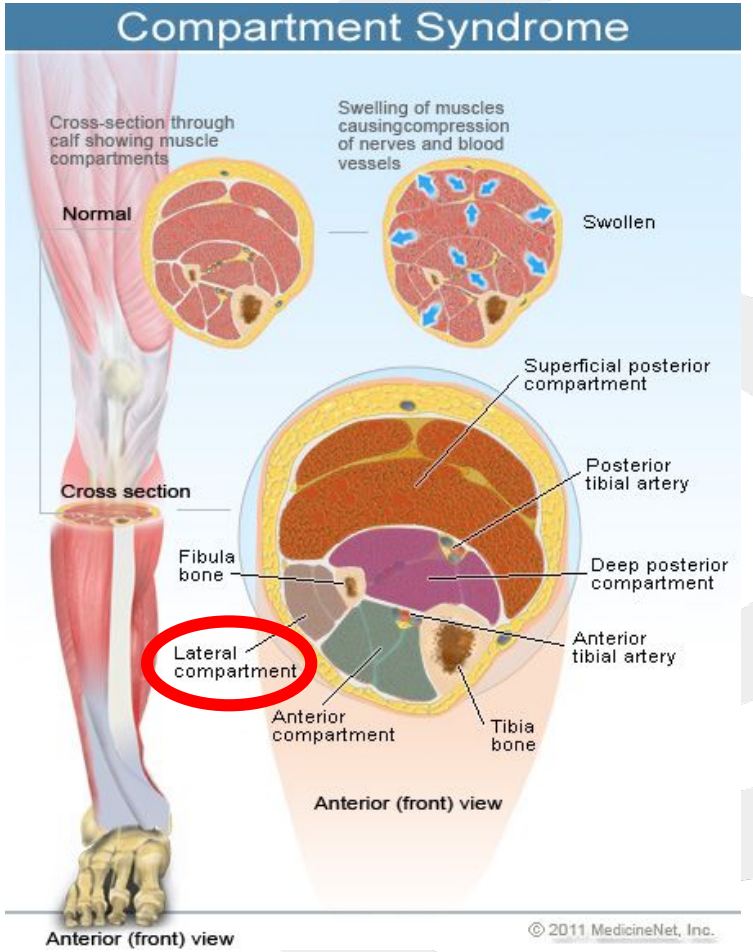
- Is the most common site for acute compartment syndrome
- Contains: four extensors muscles of the foot, anterior tibial artery, deep peroneal nerve
- Possible signs: loss of sensation between the first and second toes and weakness of foot dorsiflexion. Late sequelae include foot drop, claw foot, and deep peroneal nerve dysfunction



Lateral compartment

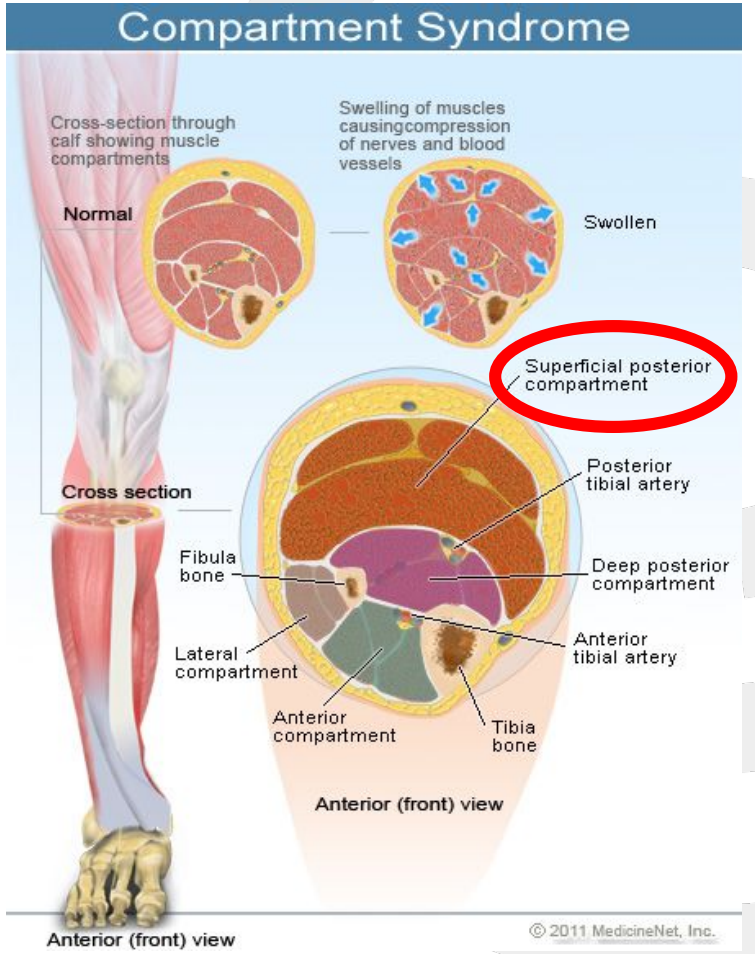
- Contains: muscles responsible for foot eversion and some degree of plantar flexion, the peroneal artery, the superficial peroneal nerve, and the proximal portion of the deep peroneal nerve

- Possible signs: loss of sensation between the first and second toes and weakness of foot dorsiflexion. Late sequelae include foot drop, claw foot, and deep peroneal nerve dysfunction



Superficial posterior compartment

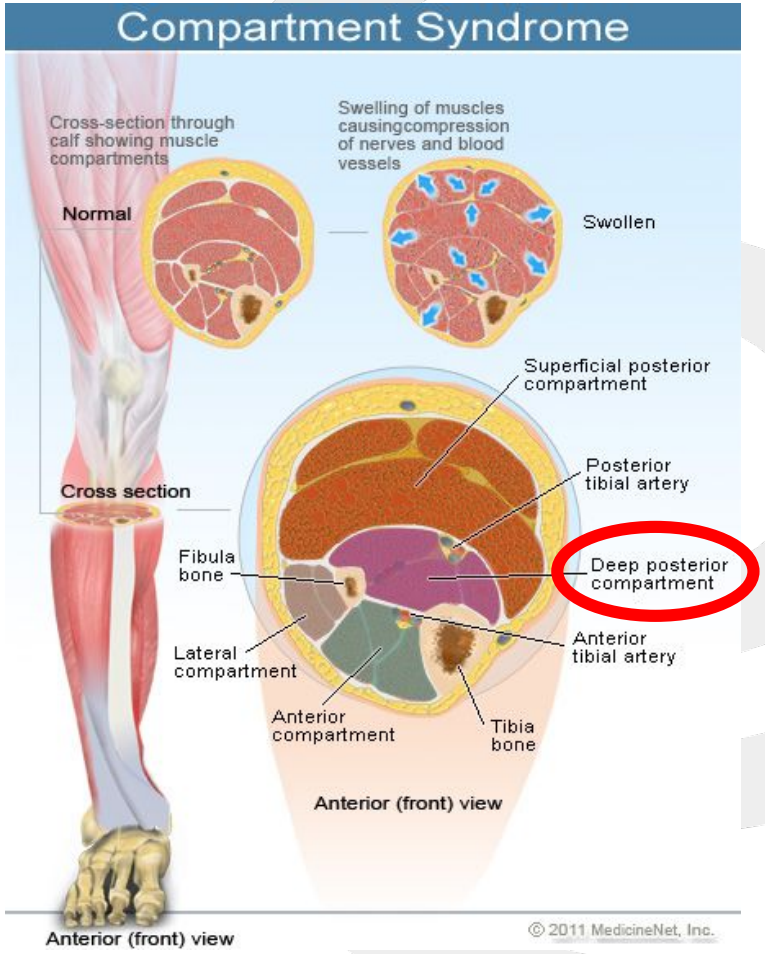
- Contains: major muscles of plantar flexion (ie, gastrocnemius, soleus)
- No major arteries or nerves travel in this compartment. Therefore, the superficial posterior is least likely to develop ACS
- Possible signs: pain and a palpably tense and tender compartment suggest the diagnosis



Deep posterior compartment

- Contains: muscles that aid in foot plantar flexion, as well as the posterior tibial artery, peroneal artery, and the tibial nerve

- Possible signs: plantar hypesthesia, weakness of toe flexion, and pain with passive extension of the toes



Clinical presentation

- pain out of proportion to clinical situation (early and common finding)
- Persistent deep or burning pain
- Pain with passive stretch of muscles
- Palpable swelling
- paresthesia and hypoesthesia (indicates nerve ischemia)
- Paralysis (late finding)
- Absence of peripheral pulses (late finding)

Laboratory studies

- The diagnosis of ACS is based on the clinical findings and on the measurements of compartment pressures in some cases. The laboratory results may help but should not delay the diagnosis and treatment of ACS

- CPK (serial measurements showing rising levels indicate ACS)
- Renal function studies
- Urine analysis (to identify causes of acute renal failure)
- Urine myoglobin (Myoglobinuria can develop within four hours of the onset of ACS)

Measurement of compartment pressures

- The direct compartment-pressure measurement is the gold-standard if the diagnosis is in question
- Normal pressure varies between 0 and 8 mmHg
- Capillary blood flow becomes compromised when tissue pressure increases to within 25 to 30 mmHg of mean arterial pressure
- Pain may develop as tissue pressures reach between 20 and 30 mmHg
- Ischemia occurs when tissue pressures approach diastolic pressure

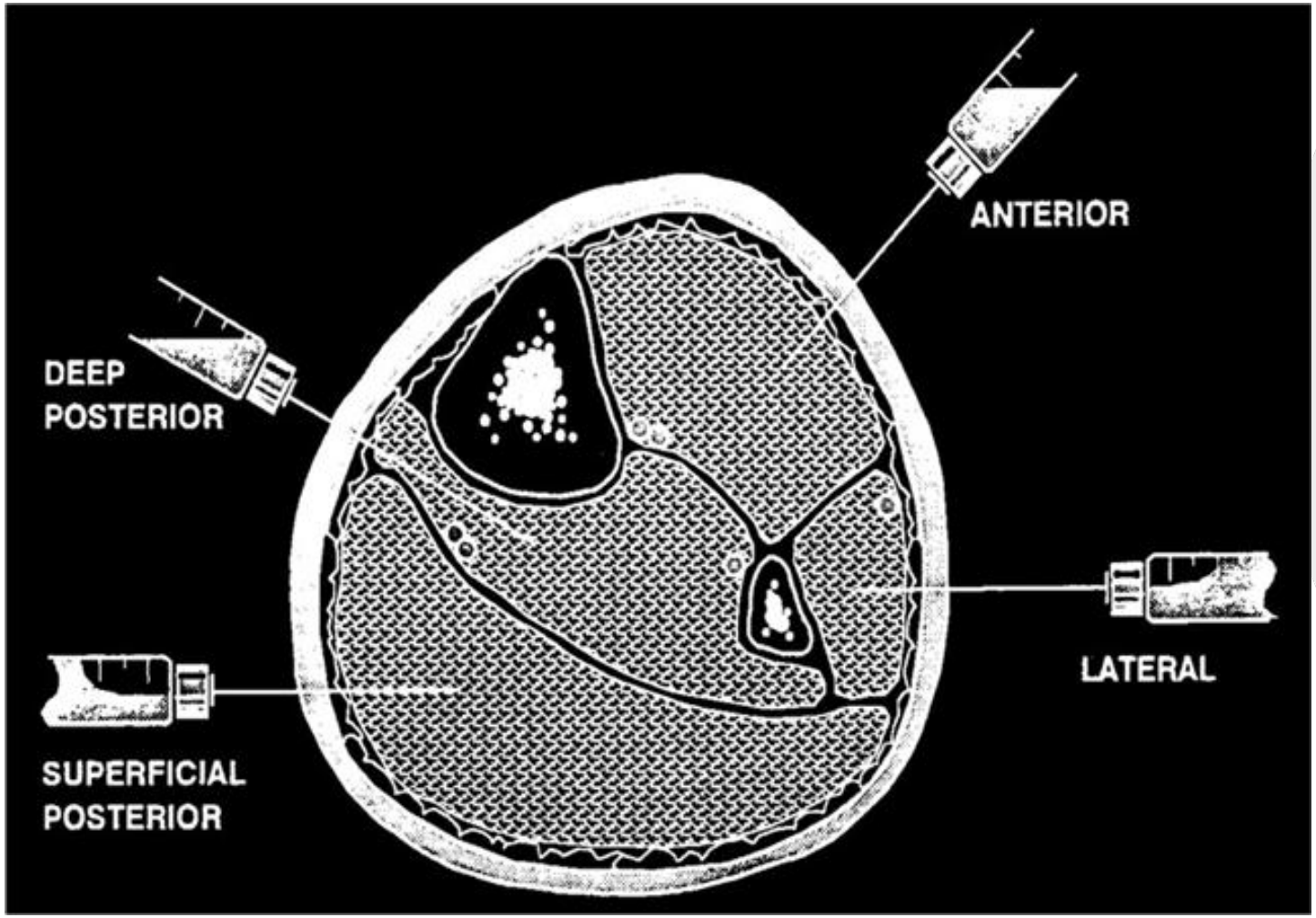
Measurement of compartment pressures

- ACS delta pressure = diastolic blood pressure – measured compartment pressure

- ACS delta pressure <20 to 30 mmHg indicates need for fasciotomy

Stryker STIC Monitor. Image courtesy of Stryker Corporation

Where to make the measurement



Where to make the measurement

- Anterior: entry point 1 cm lateral to anterior border of tibia, needle perpendicular to skin
- Lateral: entry point just anterior to the posterior border of fibula
- Superficial posterior: entry point middle of calf
- Deep posterior: entry point just posterior to the medial border of tibia, needle perpendicular to sking towards fibula

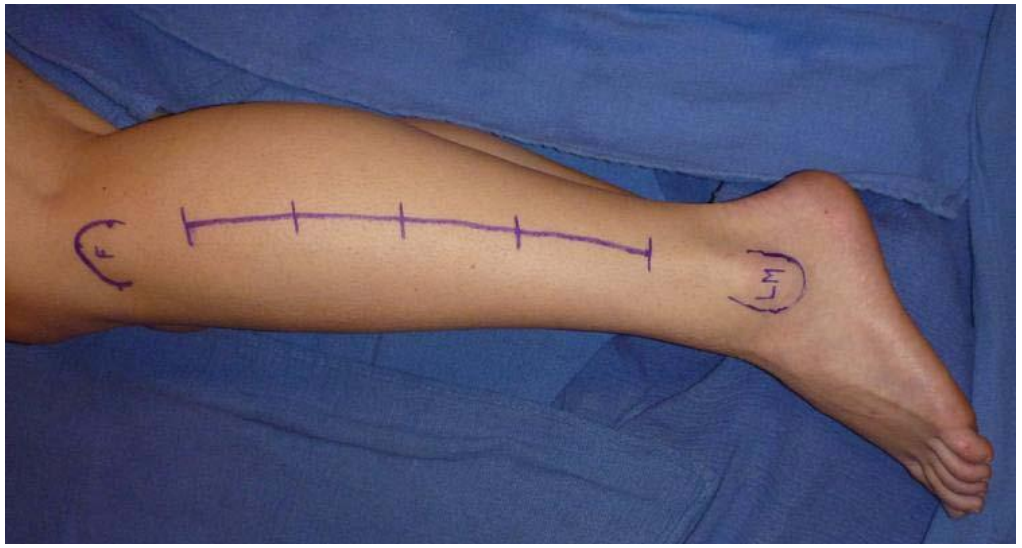
Treatment options

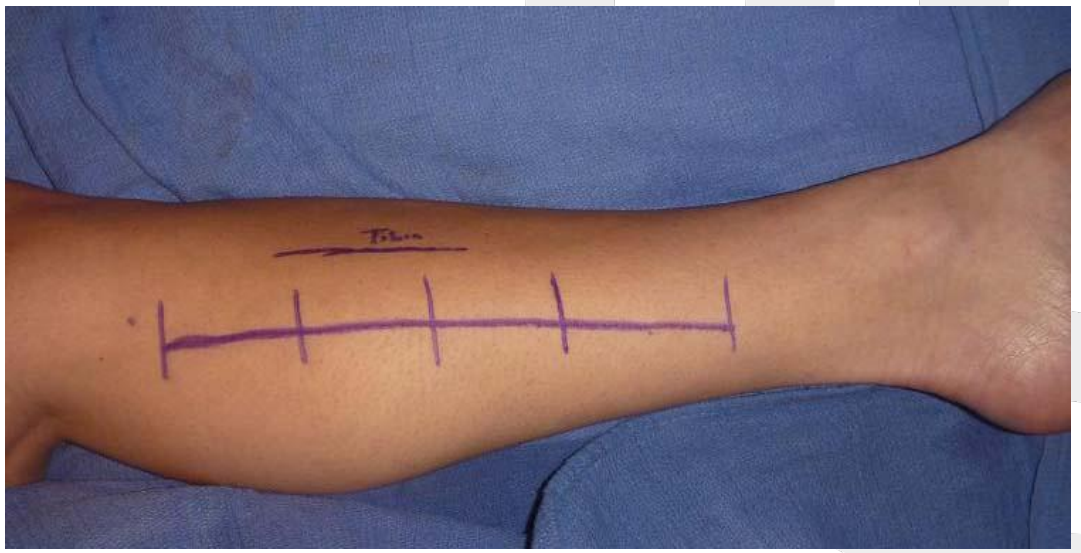
- **Nonoperative**
  - ➢Observation: delta pressure > 30 mmHg
  - ➢Hyperbaric oxygen therap: in oder to increase the oxygen difussion gradient

- **Operative**
  - ➢Fasciotomy of all four compartments

Double-incision fasciotomy

- The two-incision four-compartment fasciotomy uses posteromedial and anterolateral longitudinal incisions that should be at least 12 to 20 cm in length separated by 8cm skin bridge





Images courtesy of www.orthobulltets.com

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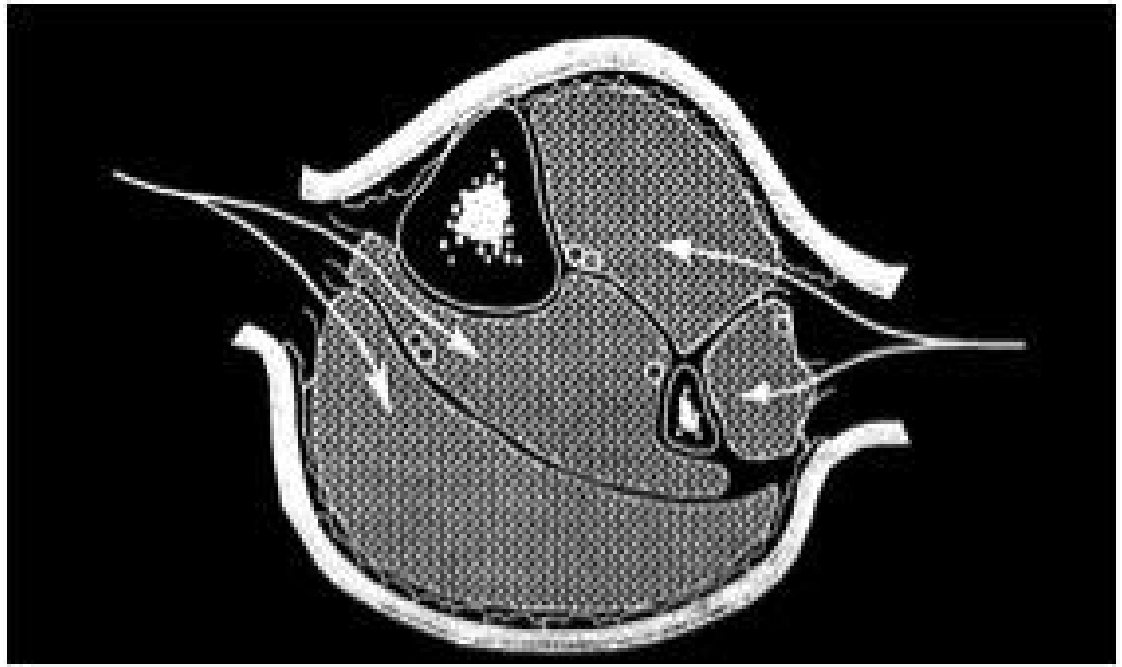

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Double-incision fasciotomy

- Anterolateral incision
  - identify and protect the superficial peroneal nerve
  - fasciotomy of anterior compartment performed 1cm in front of intermuscular septum
  - fasciotomy of lateral compartment performed 1cm behind intermuscular septum

- Posteromedial incision
  - protect saphenous vein and nerve
  - incise superficial posterior compartment
  - Detach soleal bridge from back of tibia to adequately decompress deep posterior compartment

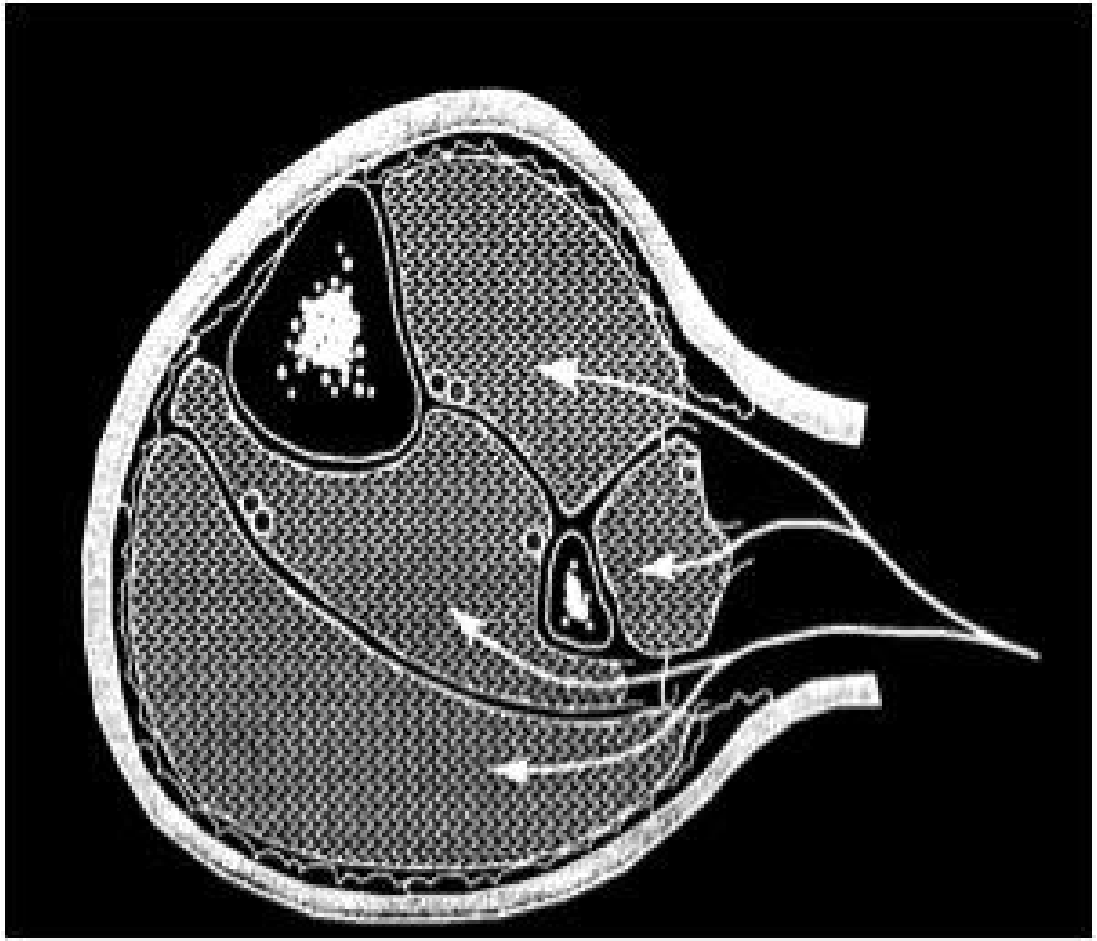
Single-incision fasciotomy

Single lateral incision from head of fibula to ankle along line of fibula

- Identify the superficial peroneal nerve
- perform anterior compartment fasciotomy 1cm anterior to the intermuscular septum
- perform lateral compartment fasciotomy 1cm posterior to the intermuscular septum
- identify and perform fasciotomy on superficial posterior compartment
- enter interval between superficial posterior and lateral compartment
- reach deep posterior compartment by following interosseous membrane from the posterior aspect of fibula and releasing compartment from this membrane

Single-incision fasciotomy

Single lateral incision from head of fibula to ankle along line of fibula



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Literature highlight

Predictive Factors for post-ischemic compartment syndrome in non-traumatic acute limb ischemia in a lower extremity

- Inadequate backflow
- high serum CPK level
- positive fluid balance
- advanced-stage of acute limb ischemia

Ann Vasc Dis. 2017 Dec 25;10(4):378-385. doi: 10.3400/avd.oa.17-00055.

Predictive Factors for Post-Ischemic Compartment Syndrome in Non-Traumatic Acute Limb Ischemia in a Lower Extremity.

Orrapin S[1], Orrapin S[2], Arwon S[2], Rerkasem K[2,3].