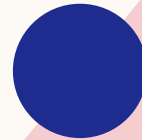


COMPARTMENT SYNDROME

Rana zaid

WHAT IS A COMPARTMENT

It is a closed area of muscle group
,nerves and blood vessels
surrounded by fascia



There are eleven separate compartments in the hand

Four dorsal interossei

Three volar interossei

The thenar

The hypothenar

The adductor

Mid palm

The lower limb is composed of 4 compartments

1. Anterior

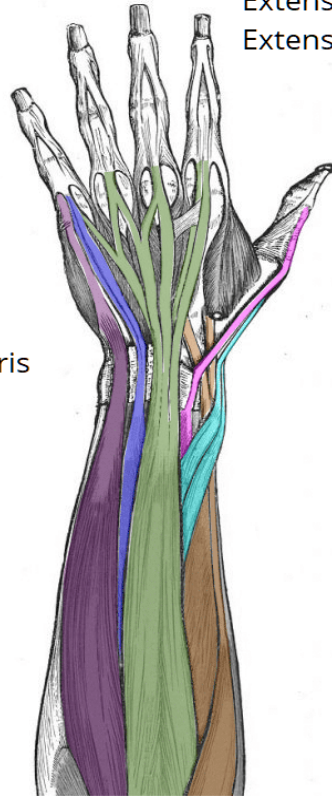
2. Lateral

3. Superficial posterior

4. Deep posterior

Compartment 5
Extensor digiti minimi

Compartment 6
Extensor carpi ulnaris

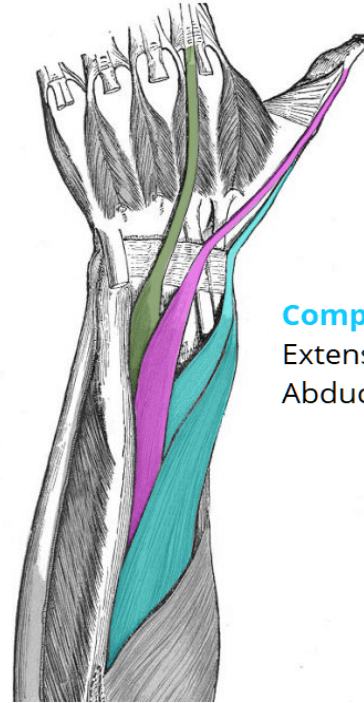


Superficial Compartment

Compartment 4
Extensor indicis
Extensor digitorum

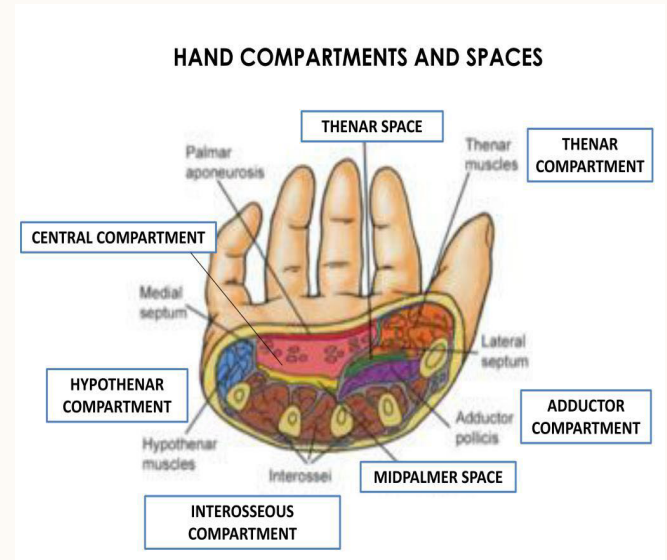
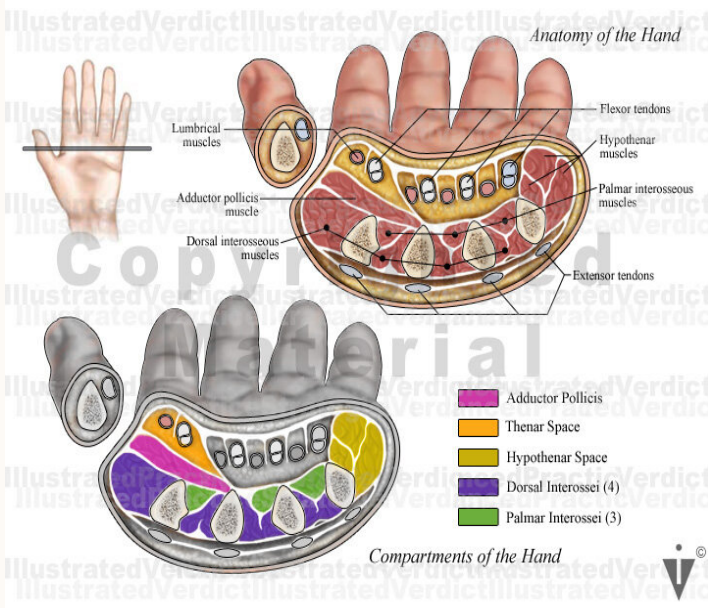
Compartment 3
Extensor pollicis longus

Compartment 2
Extensor carpi radialis brevis
Extensor carpi radialis longus



Deep Compartment

Compartment 1
Extensor pollicis brevis
Abductor pollicis longus



HAND COMPARTMENT COMPOSITION

Muscle	Origin	Insertion
1st	The medial side of the proximal end of the first metacarpal and lateral side of the second metacarpal	Lateral side of the base of the second proximal phalanx and the extensor expansion (Extensor Hood)
2nd	Medial side of the second metacarpal and lateral side of the third metacarpal	Lateral side of the base of the third proximal phalanx and the extensor expansion
3rd	Medial side of the third metacarpal and lateral side of the fourth metacarpal	Medial side of the base of the third proximal phalanx and the extensor expansion
4th	Medial side of the fourth metacarpal and lateral side of the fifth metacarpal	Medial side of the base of the fourth proximal phalanx and the extensor expansion

Nerve Supply

The Dorsal Interossei muscles of the hand are all supplied by the deep branch of the [ulnar nerve](#) (C8, T1) ^[1].

Blood Supply

The Dorsal Interossei muscles of the hand are supplied by the dorsal and palmar interossei artery ^[1].

Function

The dorsal interossei muscles are muscles that abduct the second, third and fourth digits. The first digit and the fifth digit have their own abductor muscles in the [thenar and hypothenar eminence](#) and so do not have interossei musculature ^[2].

[^ Back to top](#)

Origin

- The **first** palmar interossei also known as pollical palmar interosseous and it originates at the medial palmar surface of the first metacarpal. It is often considered as rudimentary.^[2]
- The **second** palmar interosseous originates at the medial surface of the base of the second metacarpal.^[1]
- The **third** and **fourth** palmar interossei originate at the lateral aspect of the fourth and fifth metacarpals.

Insertion

- The 1st interossei inserts into the base of the proximal first phalanx
- The 2nd inserts onto the medial portion of the extensor hood of the first digit as well as the base of the first phalanx.
- The 3rd and 4th interossei inserts into the lateral aspect of their respective extensor hood.

Nerve

The palmar interossei receive nerve supply from the deep branch of the [ulnar nerve](#). The deep branch of the ulnar nerve arises from nerve roots of C8 and T1.

Artery

Palmar interossei muscles receive arterial blood supply from the palmar metacarpal arteries and drains into the palmar metacarpal veins.^[1] The palmar metacarpal arteries derive from the deep palmar arch, which is comprised of the terminal portion of the [radial artery](#) and the deep branch of the [ulnar artery](#).

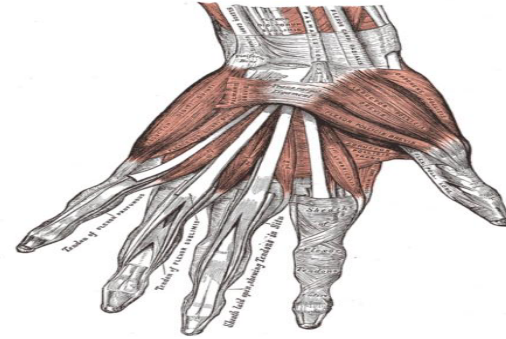
Function

Adduct fingers towards centre of third digit or middle finger. Flex metacarpophalangeal joint while extending interphalangeal joints.

Hypothenar Eminence (HE) Muscles

The HE muscles are^[3] -

- **Opponens Digiti Minimi**
 - **Origin** - the hook of **hamate** and associated transverse carpal ligament
 - **Insertion** - Ulnar border of 5th metacarpal
 - **Nerve** - Deep branch of **ulnar nerve** (C8, T1)
 - **Artery** - Ulnar artery
 - **Function** - flex and laterally rotate the 5th metacarpal about the 5th carpometacarpal joint
- **Abductor digiti minimi**
 - **Origin** - **pisiform** bone and the tendon of flexor carpi ulnaris
 - **Insertion** - the ulnar base of the proximal phalanx of the small finger
 - **Nerve** - Deep branch of ulnar nerve (C8, T1)
 - **Artery** - Ulnar artery
 - **Function** - abduction of the 5th finger, as well as flexion of its proximal phalanx
- **Flexor digiti minimi brevis**
 - **Origin** - the hook of hamate and associated transverse carpal ligament
 - **Insertion** - the base of the proximal phalanx of the small finger
 - **Nerve** - Deep branch of ulnar nerve (C8, T1)
 - **Artery** - Ulnar artery
 - **Function** - flexes the little finger at the metacarpophalangeal joint
- **Palmaris brevis**
 - **Origin** - the transverse carpal ligament
 - **Insertion** - on the skin of the medial palm
 - **Nerve** - Deep branch of ulnar nerve (C8, T1)
 - **Artery** - Ulnar artery
 - **Function** - tenses the skin of the palm on the ulnar side during a grip action and deepens the hollow of the palm



Hypothenar Muscles

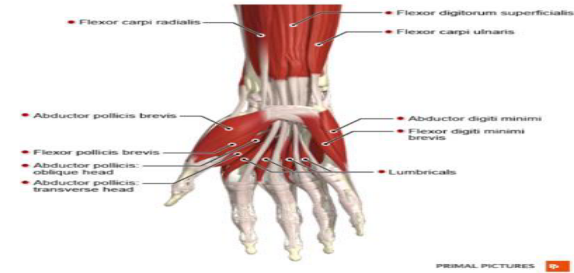
Thenar Eminence (TE) Muscles

The muscles of the TE are -[3]

- **Opponens Pollicis** the largest of the 3 muscles
 - **Origin** - at the tubercle of the trapezium
 - **Insertion** - lateral margin of the metacarpal of the thumb
 - **Nerve** - recurrent branch of the **median nerve**
 - **Artery** - Superficial palmar arch from the radial artery
 - **Function** - performs opposition by flexing and medially rotating the metacarpal on the axis of the trapezium.

- **Abductor Pollicis Brevis** positioned anteriorly to the opponens pollicis
 - **Origin** - tubercles of the scaphoid and trapezium
 - **Insertion** - lateral aspect of the proximal phalanx of the thumb
 - **Nerve** - recurrent branch of the median nerve
 - **Artery** - Superficial palmar arch from the radial artery
 - **Function** - primary muscle providing opposition. Also leads to abduction of the thumb which is drawing the thumb away from the midline

- **Flexor Pollicis Brevis**
 - **Origin** - tubercle of the trapezium via the deep head, and the associated flexor retinaculum via the superficial head
 - **Insertion** - lateral aspect of the proximal phalanx of the thumb
 - **Nerve** - dual innervation with fibers from both the median (superficial head) and ulnar (deep head) nerves
 - **Artery** - branches of the radial artery; superficial palmar artery, branches of the princeps pollicis artery and radialis indicis artery
 - **Function** - flexion at the metacarpophalangeal and carpometacarpal joints leading to opposition of the thumb and, if continued, produces the medial rotation of thumb



Thenar Muscles

Origin

- Oblique head originates from bases of 2nd-3rd metacarpals
- Transverse head originates from the shaft of 3rd metacarpal ^[1]



Insertion

The base of proximal phalanx of thumb on its medial aspect ^[1]

Nerve

Deep branch of **ulnar nerve**. It ends in this muscle ^{[1][2]}

Artery

Deep palmar arch

Main trunk of the radial artery passes into the palm between the oblique and transverse heads of the adductor pollicis to form the deep palmar arch ^{[1] [2]}

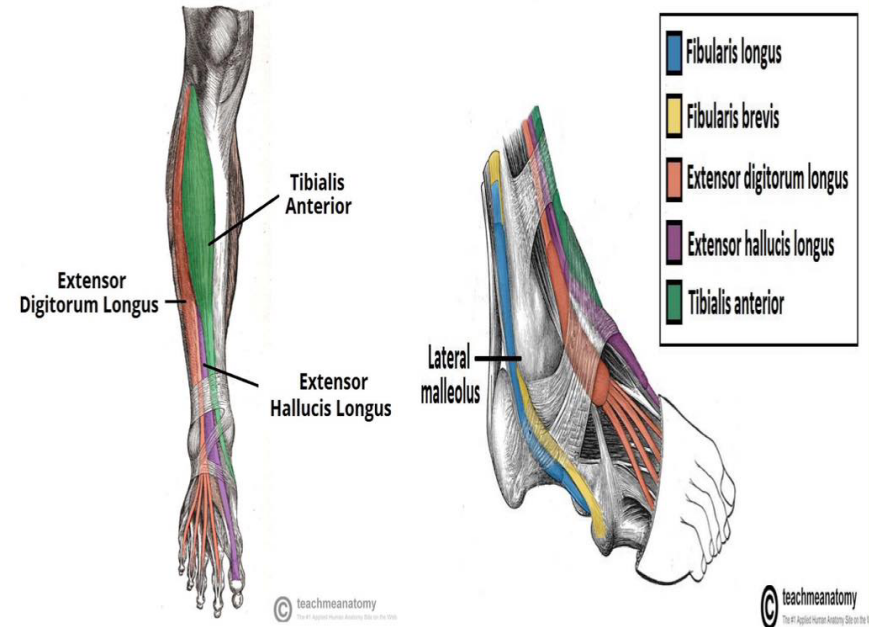
Function

Adduction of thumb

LOWER LIMB

Extrinsic Muscles of the Foot – 1-Anterior Compartment.

- There **are four muscles in the anterior compartment of the leg:**
 1. Tibialis anterior.
 2. Extensor digitorum longus.
 3. Extensor hallucis longus.
 4. Peroneus tertius , **its function : dorsiflexion , eversion , stabilize the lateral arch** . (originate from anterior compartment which will join the peroneus brevis muscle from the lateral compartment and insert into the base of the 5th metatarsal bone.)
- Collectively, they **dorsiflex** and **invert** the foot at the ankle joint. **The extensor digitorum longus and extensor hallucis longus also extend the toes.**
- The muscles in this compartment are innervated by the **deep fibular nerve** (a branch of the common fibular nerve), and blood is supplied via the **anterior tibial artery**.



we feel empty area (no neurovascular bundles) , it's the ankle joint (so here we can aspirate the fluid inside the joint in case of septic arthritis) , then you face the tendon of tibialis anterior (the first structure in general) then , Extensor hallucis longus then dorsalis pedis artery , then Extensor digitorum longus

2-Lateral Compartment

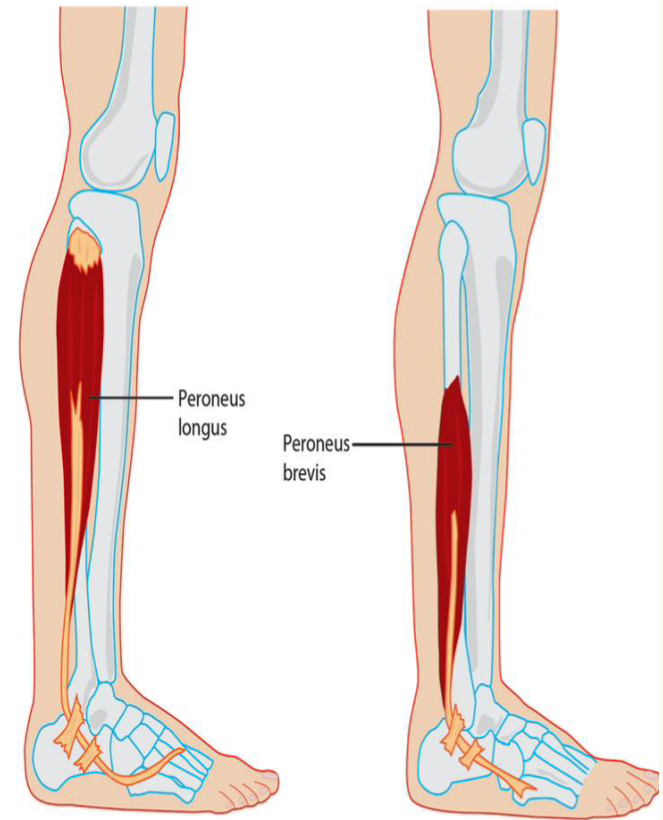
- There **are two muscles** in the lateral compartment of the leg; the **peroneus longus and brevis**.
- The common function of the muscles is **eversion**, turning the sole of the foot outwards. **They are both innervated by the superficial peroneal nerve**.

1. Peroneus Longus

- ❑ Originates from the superior and lateral surface of the fibula and the lateral tibial condyle.
- ❑ Attaches to the plantar aspect of the medial cuneiform and base of the 1st metatarsal bone.
- ❑ **Its function : stabilize the transverse arch (its pathway from lateral side o medial one) , eversion)**

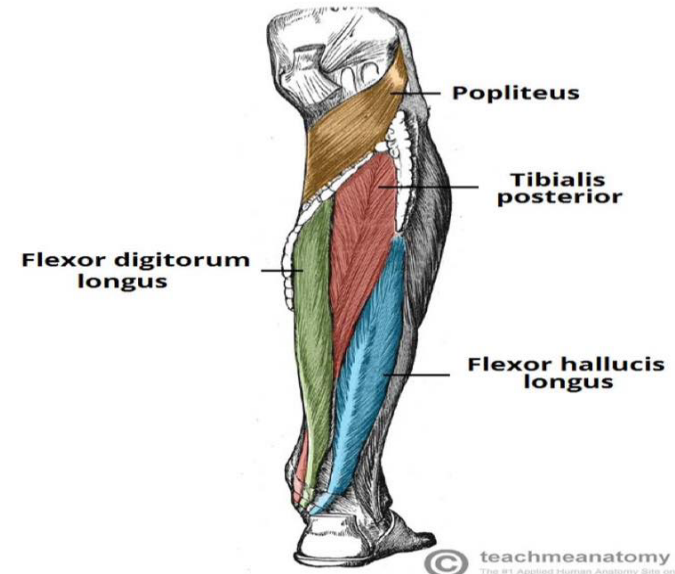
2. Peroneus Brevis

- ❑ Originates from the inferolateral surface (distal 2/3) of the fibular shaft.
- ❑ Attaches to the base of 5th metatarsal bone.



3-Deep Posterior Compartment

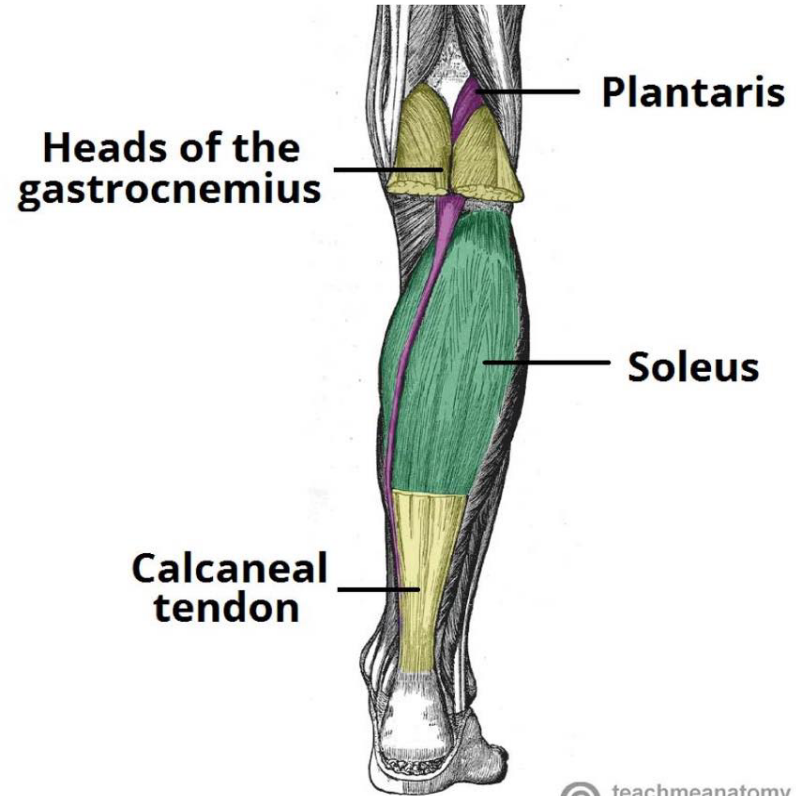
- There **are four muscles** in the deep compartment of the posterior leg.
 1. The popliteus, acts only on **the knee joint**.
 2. Tibialis posterior (**first structure behind the medial malleolus**) stabilize the medial arch , it's the most important muscle stabilize the most important arch .
 3. Flexor hallucis longus
 4. Flexor digitorum longus; the three of them act on the ankle and foot.
- **The posterior leg is the largest of the three compartments.** Collectively, the muscles in this area plantarflex and invert the foot.
- They are innervated by the **tibial nerve** , a terminal branch of the sciatic nerve.



From medial to lateral : Tibialis posterior then Flexor digitorum longus , then Flexor hallucis longus

4-Superficial Posterior Compartment

- Composed of three muscles:
 1. Plantaris
 2. Soleus
 3. Gastrocnemius
- All three are supplied by the tibial nerve.



DEFINITION

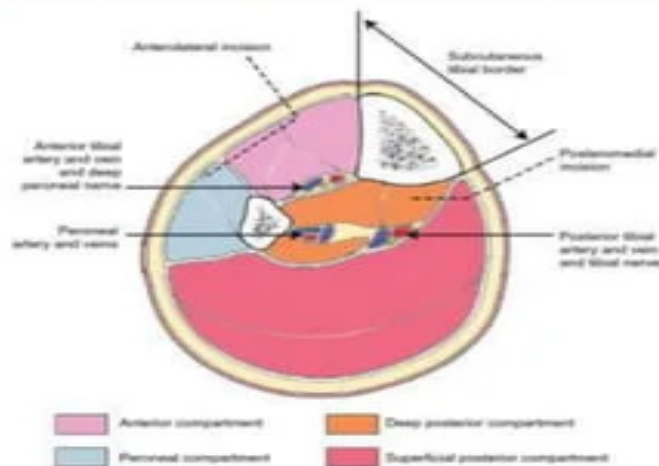
An elevation of interstitial pressure in a closed osteo-fascial compartment that result in microvascular compromise

It is a **TRUE** orthopedics emergency.

WHAT IS COMPARTMENT ?

A closed area of muscle group, nerves and blood vessels surrounded by fascia

- Muscle are arranged in different compartments and surrounded by one fascia, this arrangement is called osteofascial compartment.
- Normal compartment pressure: 5 – 15 mmHg
- Intacompartmental pressure rises to 35 – 40 mmHg



AETIOLOGY

Any condition that reduces the volume of a compartment or increases the fluid content of the compartment can lead to an acute compartment syndrome.

Increased Fluid Content	Decreased Compartment Size
<ol style="list-style-type: none">1. Fracture of the bones (mainly tibia and femur fracture)2. Trauma3. Burns4. Hemorrhage5. Vascular disruption/puncture6. Snake venom	<ol style="list-style-type: none">1. Burns2. Cast3. Bandage

AETIOLOGY



Excessive & prolonged inflation of air splint



Tight cast



TYPES

Acute Compartment Syndrome

- **Medical emergency**
- Caused by severe injury
- The classic sign of acute compartment syndrome is **pain**, especially when the muscle within the compartment is stretched.
- The pain is more intense than what would be expected from the injury itself.
- Using or stretching the involved muscles increases the pain.
- There may also be tingling or burning sensations (**paresthesias**) in the skin.
- The muscle may feel tight or full.
- **Numbness** or **paralysis** are **late signs** of compartment syndrome. They usually indicate permanent tissue injury.

Chronic Compartment Syndrome

- Known as **exertional compartment syndrome**
- Not a medical emergency
- Most often caused by **athletic exertion**
- Chronic compartment syndrome causes pain or cramping during exercise.
- This pain subsides when activity stops. It most often occurs in the leg.
- Symptoms may also include:
 - Numbness
 - Difficulty moving the foot
 - Visible muscle bulging

TISSUE SURVIVAL RATE

MUSCLE

3-4 HOURS	Reversible changes
6 HOUR	Variable damage
8 HOUR	Irreversible changes

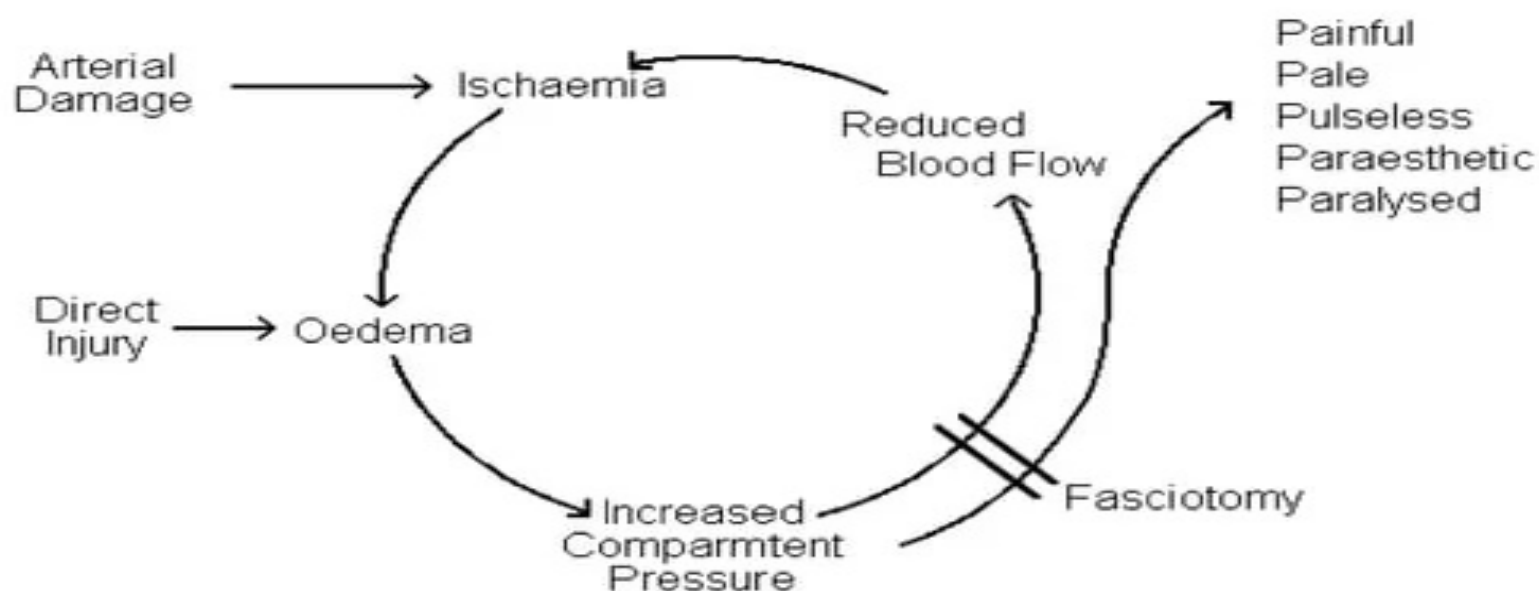
NERVE

2 HOUR	LOOSE NERVE CONDUCTION
4 HOUR	NEUROPRAXIA
8 HOUR	IRREVERSIBLE CHANGES

Delayed diagnosis will cause:

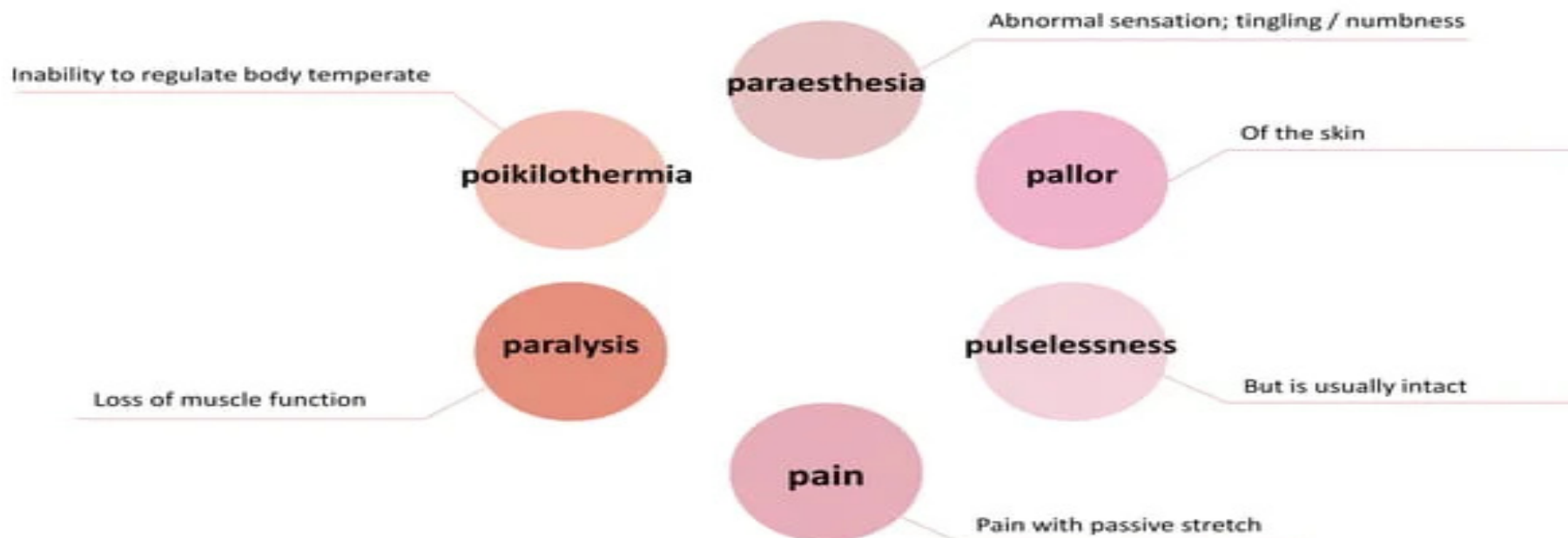
- Permanent sensory and motor deficit
- Contractures
- Infections & amputations

PATHOPHYSIOLOGY



DIAGNOSIS

HISTORY AND PHYSICAL



DIAGNOSIS

DIFFERENTIAL DIAGNOSIS

1. Cellulitis
2. DVT and thrombophlebitis
3. Gas gangrene
4. Necrotizing fasciitis
5. Peripheral vascular injuries

DIAGNOSIS

EVALUATION

A diagnosis of acute compartment syndrome is not always obvious. Therefore, serial examinations and frequent assessments are necessary to make such a diagnosis.

- Assess tenderness in the muscle compartment
- Evaluate motor and neurologic function
- Radiographs should be obtained if a fracture is suspected

In an appropriate setting, measurement of intra-compartmental pressure using a **solid-state transducer intra-compartmental catheter (STIC)** can aid in a diagnosis. This device allows monitoring up to **16 hours**.

The normal pressure within the compartment is between 0 mmHg to 8 mmHg (i.e., less than 10 mmHg). An **intra-compartmental pressure greater than 30 mmHg indicates compartment syndrome**



DIAGNOSIS

INVESTIGATIONS - LABORATORY

1. Full blood count
2. Coagulation profile
3. Creatinine phosphokinase
4. Urine myoglobin
5. X-ray
6. Ultrasound

MANAGEMENT

ACUTE COMPARTMENT SYNDROME (ACS)

Acute compartment syndrome is a **surgical emergency**, so a prompt diagnosis and treatment are important for an optimal outcome. Once the diagnosis is confirmed, immediate emergent **surgical fasciotomy** is important, since **surgical fasciotomy can potentially reduce intra-compartmental pressure**.

15 mmHg to 20 mmHg	Serial compartment pressure measurement
20mmHg to 30 mmHg	Surgical consultation and admit
Greater than 30 mmHg	Surgical fasciotomy

- Provide supplemental oxygen.
- Remove any restrictive casts, dressings or bandages to relieve pressure.
- Keep the extremity at the level of the heart to prevent hypo-perfusion.
- Prevent hypotension and provide blood pressure support in patients with hypotension.

MANAGEMENT

ACUTE COMPARTMENT SYNDROME (ACS)

- **Urgent decompression** is necessary to **reduce the increased compartment pressure**. The ideal timeframe for fasciotomy is **within six hours** of injury to ensure full recovery; it is **not recommended after 36 hours** following the injury. When tissue pressure remains elevated for that much time, **irreversible damage** may occur, and **fasciotomy may not be beneficial** in this situation.
- After a fasciotomy is performed and swelling dissipates, a **skin graft is most commonly used for closure**. Patients must be closely monitored for complications, such as infection, acute renal failure, and rhabdomyolysis.
- If **necrosis** occurs before fasciotomy is performed, there is a **high likelihood of infection** which may require **amputation**. If infection occurs, **debridement** is necessary to **prevent the systemic spread or other complications**. Renal failure may also occur.

MANAGEMENT

FASCIOTOMY

Fasciotomy or **fasciectomy** is a surgical procedure where the **fascia is cut to relieve tension or pressure** commonly to treat the resulting loss of circulation to an area of tissue or muscle. Fasciotomy is a limb-saving procedure when used to treat acute compartment syndrome. It is also sometimes used to treat chronic compartment stress syndrome.

The procedure has a very high rate of success, with the **most common problem** being **accidental damage to a nearby nerve**. **Complications** can also involve the **formation of scar tissue after the operation**. A thickening of the surgical scars can result in the **loss of mobility** of the joint involved. This can be addressed through occupational or physical therapy.

MANAGEMENT

FASCIOTOMY



MANAGEMENT

FASCIOTOMY



MANAGEMENT

COMPLICATION OF FASCIOTOMIES

1. Altered sensation within margin of wounds (77%)
2. Dry, scaly skin (40%)
3. Pruritis (33%)
4. Iatrogenic neurovascular injury
5. Swollen limb
6. Tethered scars
7. Recurrent ulceration
8. Pain related to wound

MANAGEMENT

CHRONIC COMPARTMENT SYNDROME

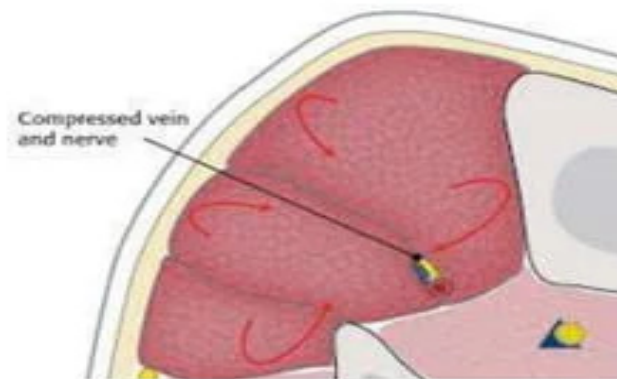
Chronic compartment syndrome in the lower leg can be treated **conservatively** or **surgically**. Conservative treatment includes **rest, anti-inflammatories,** and **physical therapy**. Elevation of the affected limb in patients with compartment syndrome is **contraindicated**, as this leads to decreased vascular perfusion of the affected region. Ideally, the affected limb should be positioned at the level of the heart.

If symptoms persist after conservative treatment or if an individual does not wish to cease engaging in the physical activities which bring on symptoms, compartment syndrome can be treated by **fasciotomy**.

Surgery is the most effective treatment for compartment syndrome. This decompression will **relieve the pressure** on the venules and lymphatic vessels, and will **increase blood flow** throughout the muscle. Left untreated, chronic compartment syndrome can **develop into the acute syndrome** and lead to **permanent muscle and nerve damage**.

COMPLICATIONS

- Permanent nerve damage
- Permanent muscle damage and reduced function of affected limb
- Rhabdomyolysis which will lead to acute renal failure
- Volkmann ischemic contracture (infarcted muscle replaced by inelastic fibrous tissue)
- DIVC
- Neurologic deficit
- Infection
- Amputation



AETIOLOGY

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THANK YOU

The background features a dark blue circle on the left and a larger light pink circle on the right, both overlapping a central white area. The pink circle contains several thin, white, concentric circular lines.