Distal femur fracture
Patella fracture
Proximal tibia fracture
Compartment syndrome

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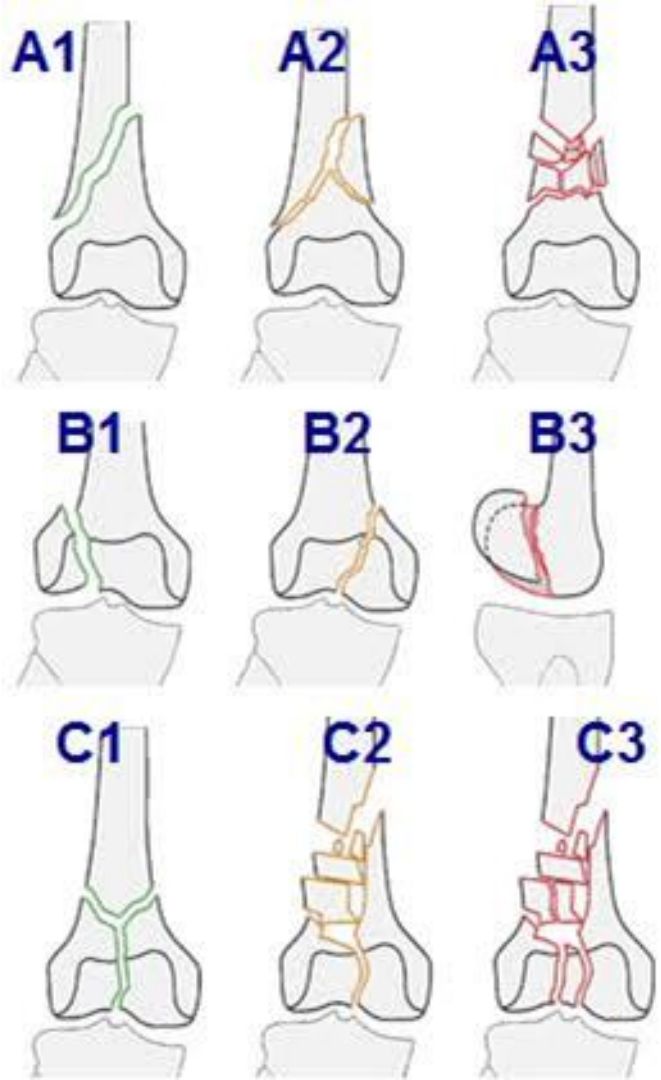
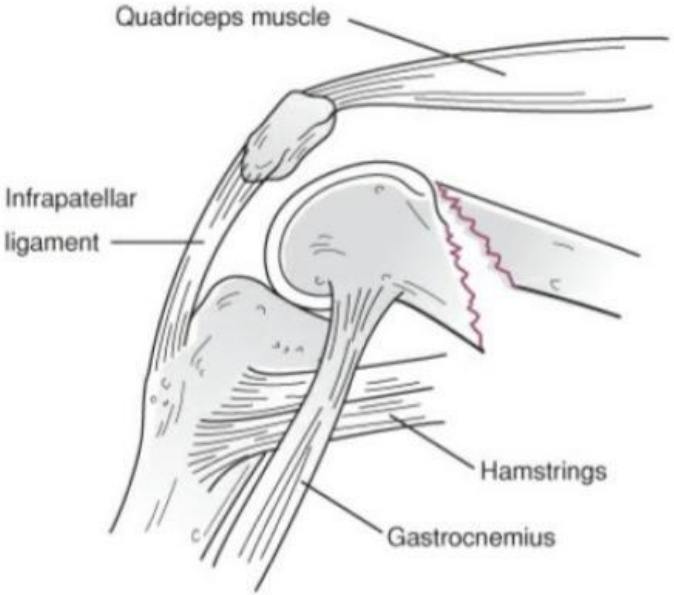
Distal femur fracture



Injury Considerations

- **Mechanism of injury**
  - **Young patient: high energy (MVC, fall from height)**
  - **Elderly: low energy fall on flexed knee**
- **Deforming forces**
  - **Quadriceps ➔ shortening**
  - **Hamstring ➔ shortening**
  - **Gastrocnemius ➔ apex posterior angulation, posterior displacement**
  - **Adductors ➔ varus**



(Collinge CA, Wiss DA. Distal Femur Fractures. In: Tornetta P, Ricci WM, eds. *Rockwood and Green's Fractures in Adults, 9e.* Philadelphia, PA: Wolters Kluwer Health, Inc; 2019.)

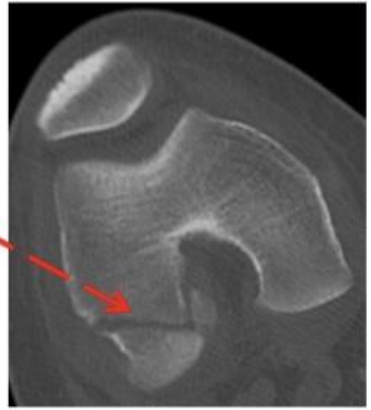
Injury Considerations

- **Workup**
  - **Orthogonal X-Rays**
    - **Double-density** on AP X-Ray: Hoffa fragment
    - **'Paradoxical notch view'** on AP X-Ray: articular fragment in recurvatum
  - **Image joint above and below**
  - **Low threshold for CT scan**
    - **Demonstrates intra-articular involvement**
    - **Reveals coronally oriented Hoffa fracture**
      - **38% incidence (Nork et al., JBJS 2005)**
      - **Lateral > medial condyle**
      - **Missed ~31% of the time**

Double density sign

Paradoxical notch view

Hoffa fracture

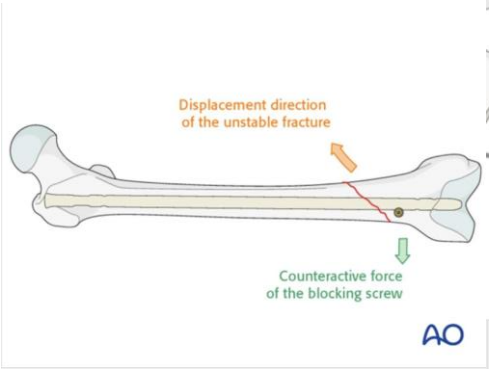


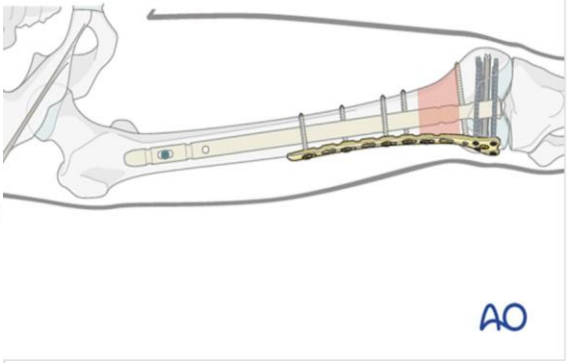
33 distal

33-A extraarticular fracture
33-A1 Simple
33-A2 metaphyseal wedge and/or fragmented wedge
33-A3 metaphyseal complex

33-B partial articular fracture
33-B1 lateral condyle, sagittal
33-B2 medial condyle, sagittal
33-B3 coronal

33-C complete articular fracture
33-C1 articular simple, metaphyseal simple
33-C2 articular simple, metaphyseal multifragmentary
33-C3 articular multifragmentary


Displacement direction
of the unstable fracture
Counteractive force
of the blocking screw
AO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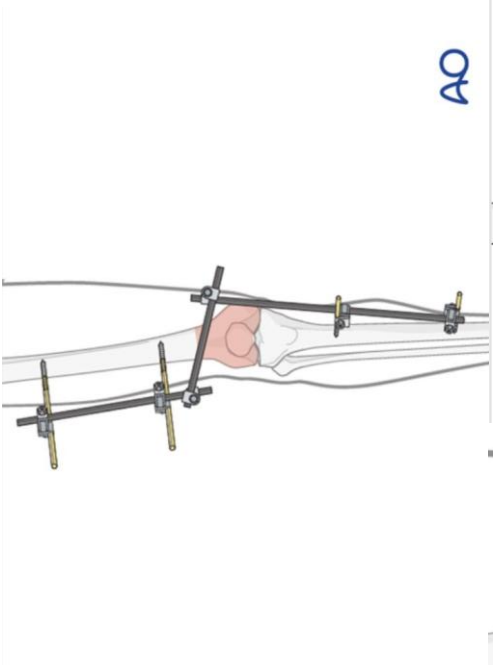
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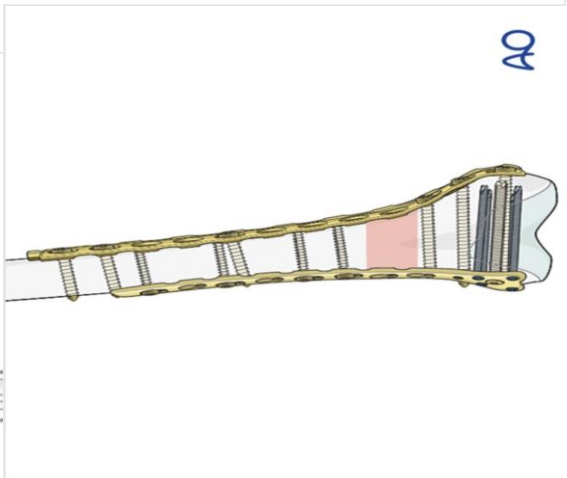
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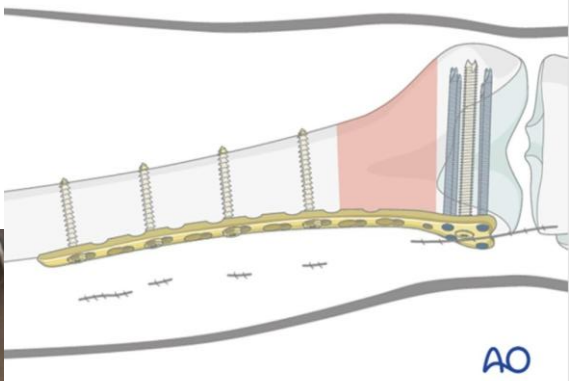
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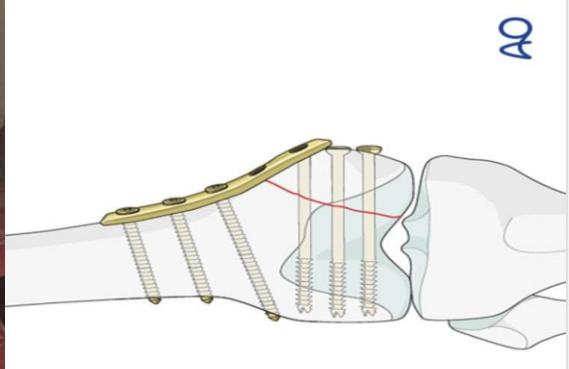
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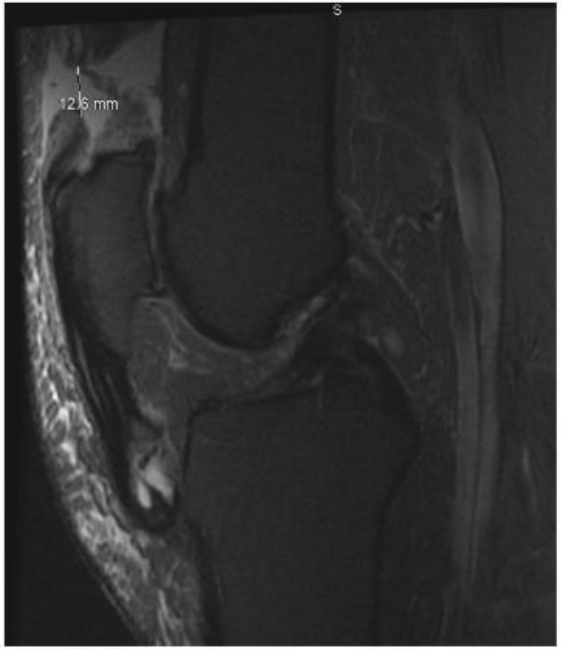
Patella fracture

Epidemiology & Mechanism of Injury

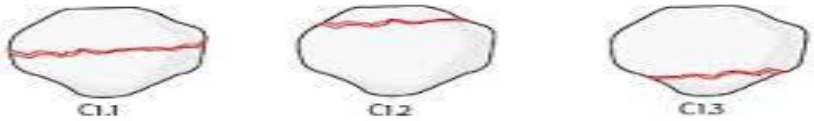
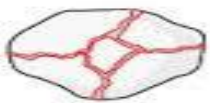
- **Patella Fractures:**
  - **~1% of all fractures**

- **Mechanism of Injury:**
  - **Direct impact (fall, dashboard)**
  - **Indirect (forceful quadriceps contraction)**
    - **Frequent cause of patella tendon/quad tendon ruptures**
  - **Combined (impact + quad contraction)**



Diagnosis – Patella Fractures

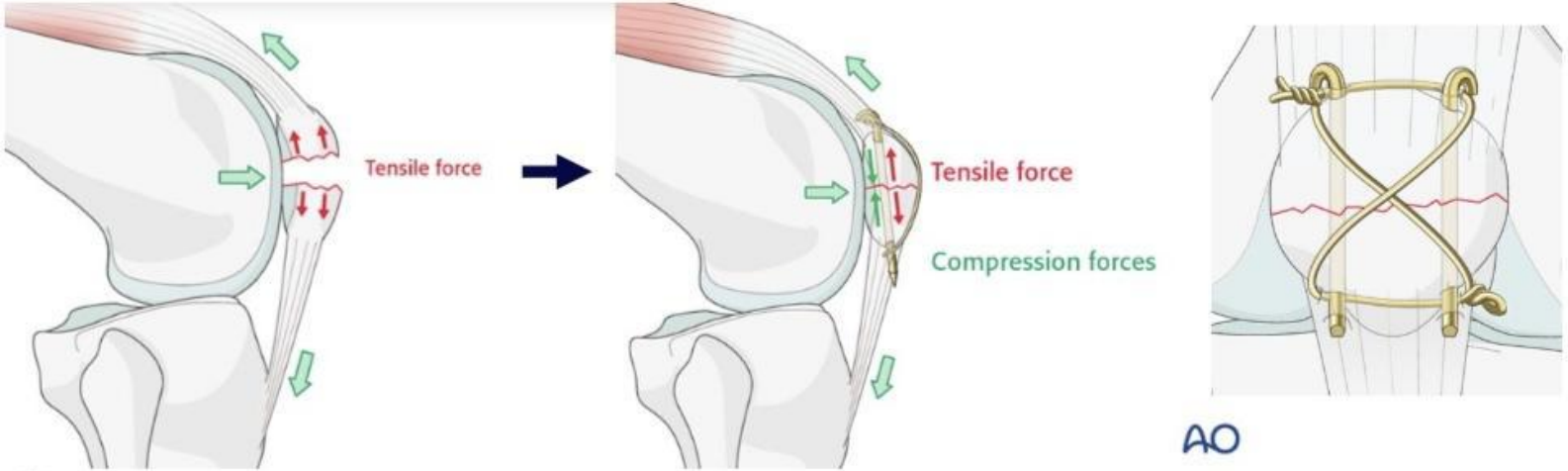
- X-rays (AP/Lateral)
  - Typically sufficient to confirm diagnosis
  - Lateral view:
    - degree of displacement
  - AP view:
    - fracture obliquity & degree of comminution
  - Sunrise view:
    - Additional fracture characteristics

34A	34A1	 A1
34B	34B1	 B1.1 B1.2
	34B2	 B2.1 B2.2
34C	34C1	 C1.1 C1.2 C1.3
	34C2	 C2.1
	34C3	 C3.1

34A1 Patella, extraarticular, **avulsion fracture**
34B1 Patella, partial articular, sagittal, **lateral fracture**
34B2 Patella, partial articular, sagittal, **medial fracture**
34C1 Patella, complete articular, frontal/coronal, **simple fracture**
34C2 Patella, complete articular, frontal/coronal, **wedge fracture**
34C3 Patella, complete articular, frontal/coronal, **multifragmentary fracture**

Operative Treatment – Transverse Fractures

- Tension Band Wire (TBW) – Concept:
  - Converting *tensile* forces (extensor mechanism) into *compressive* forces (at the fracture site)



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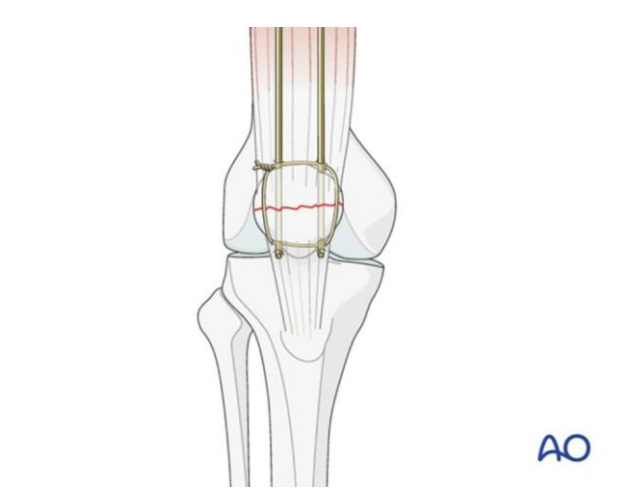
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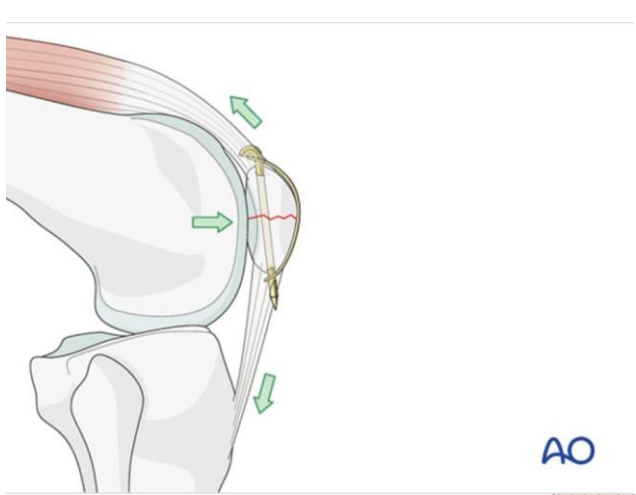
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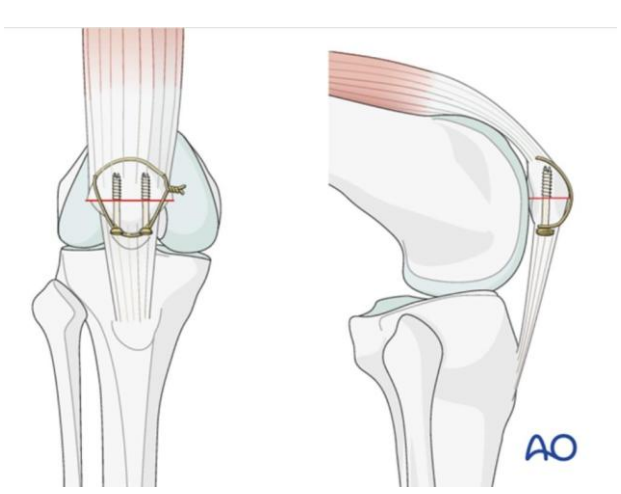
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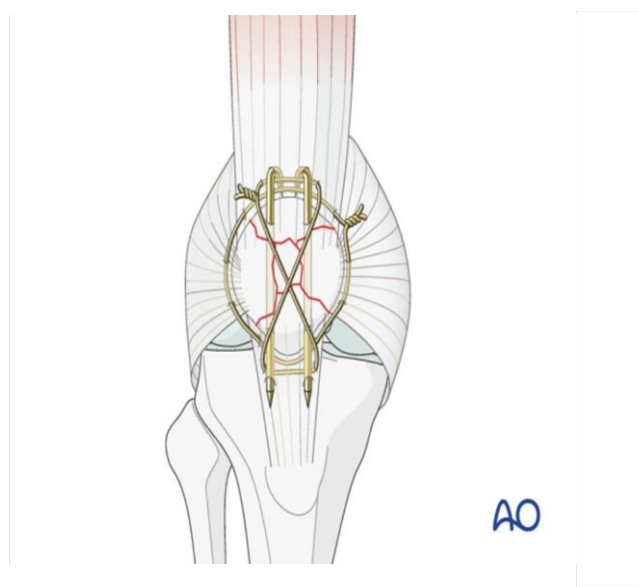
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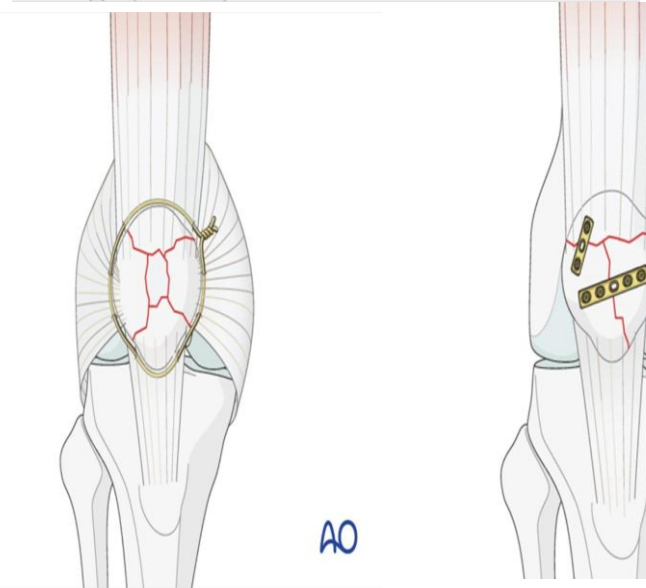
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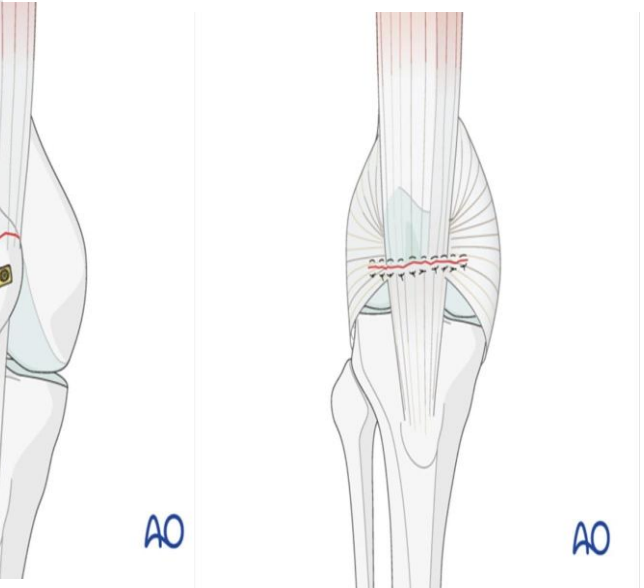
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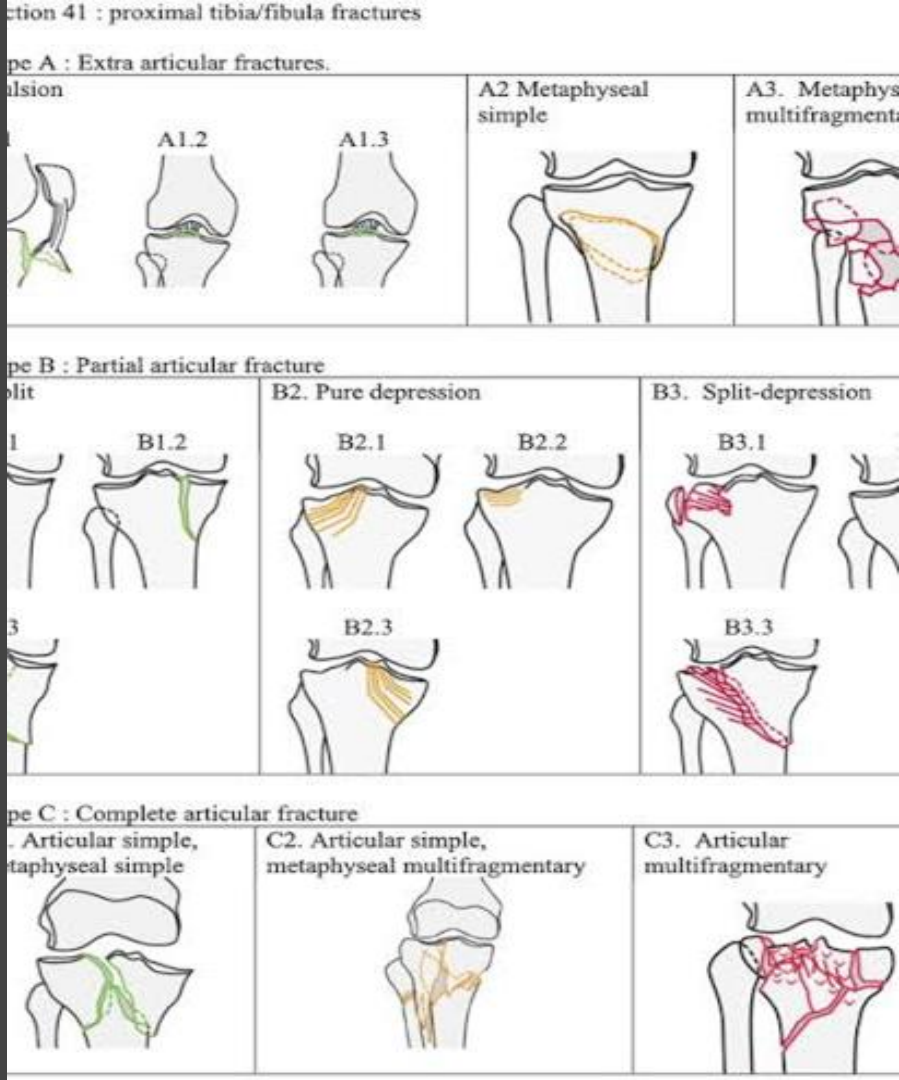
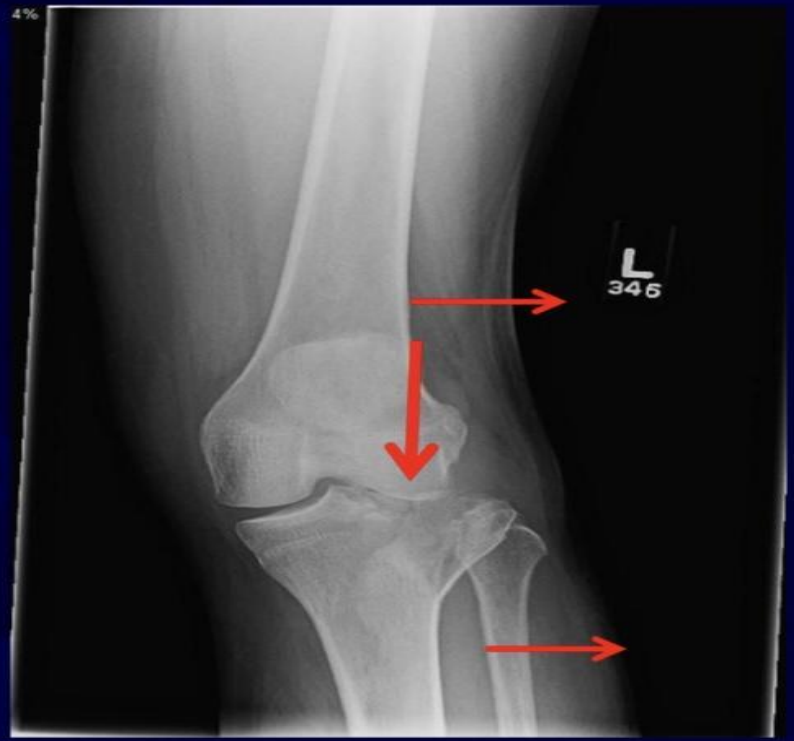
Proximal tibia fracture



Mechanism of Injury

- Valgus producing force
  - Lateral plateau
- Varus producing force
  - Medial plateau
- Axial compressive force
  - Bicondylar plateau
- Combination
  - High energy
  - Bicondylar plateau
  - Soft tissue injury



Evaluation - Radiographic

- Plain X-ray knee/tibia
  - AP
  - Lateral

  - Obliques of knee
  - Internal or external rotation

Type I
Split

Type II
Split-depression

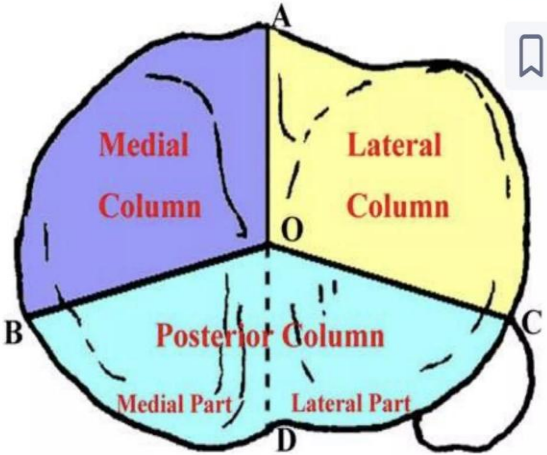
Type III
Central
depression

Type IV
Split fracture,
medial plateau

Type V
Bicondylar
fracture

Type VI
Dissociation of
metaphysis and
diaphysis

The three column classification

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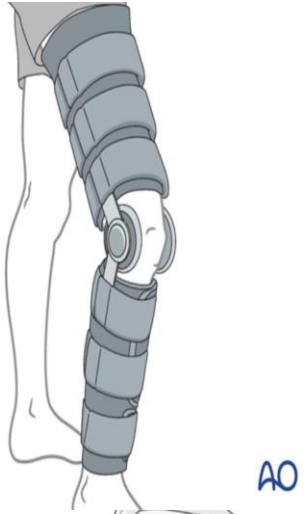
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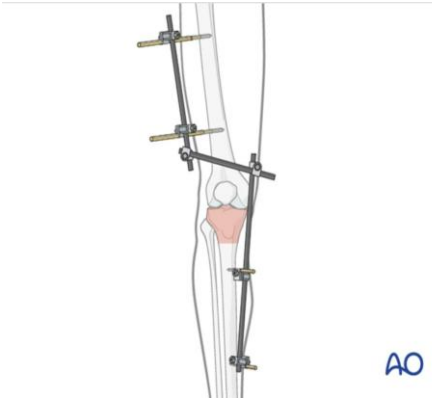
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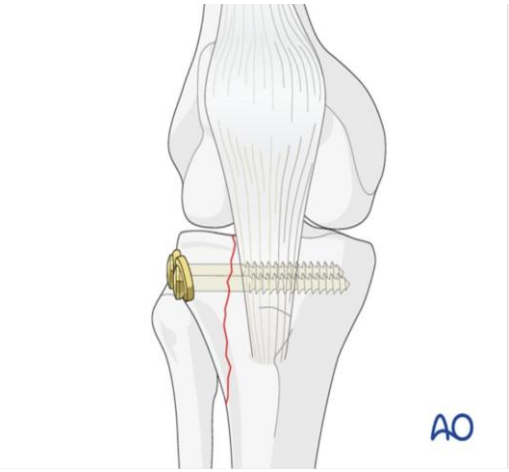
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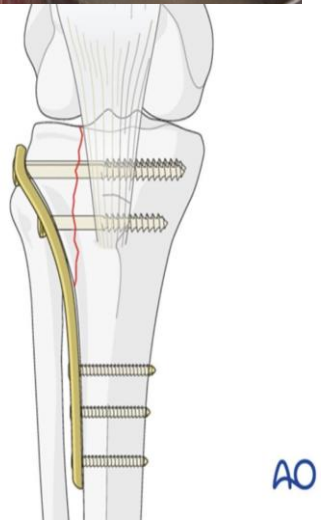
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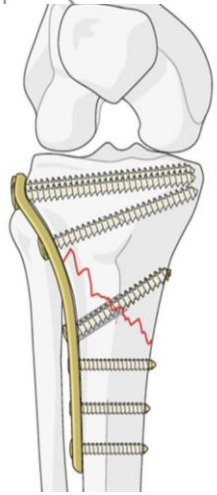

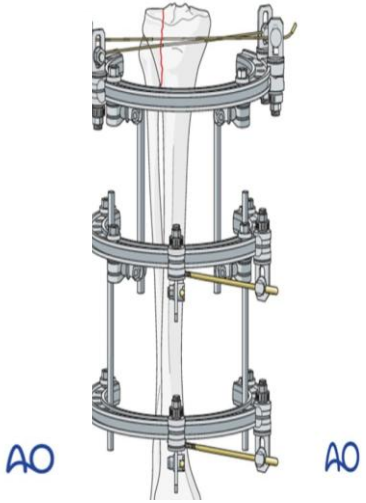
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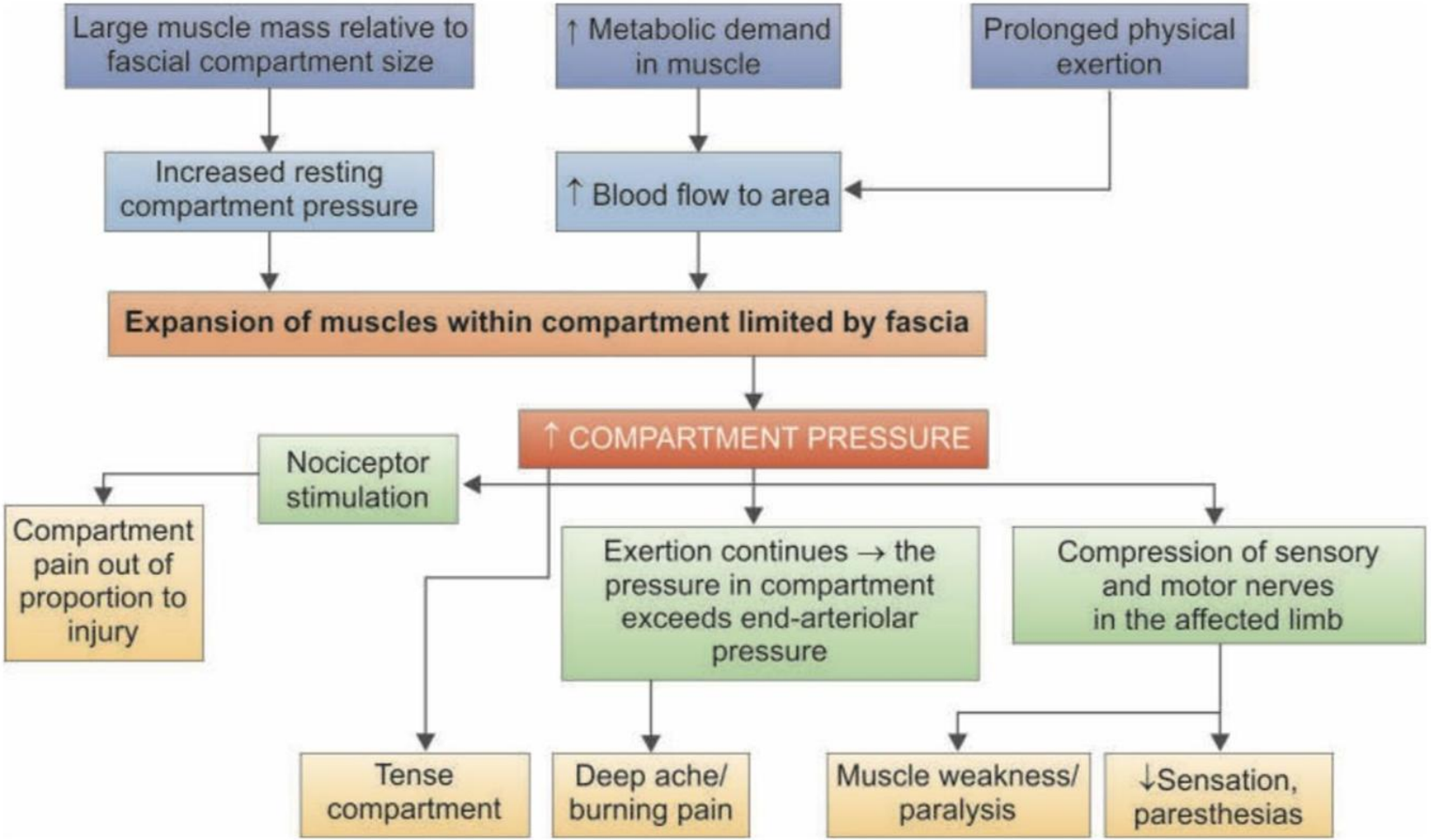
C
D

Compartment syndrome

Introduction:

Compartment syndrome is the emergency condition in which the pressure within an osteofascial compartment rises to a level that exceeds the intramuscular arteriolar pressure, resulting in decreased blood flow to capillaries, reduced oxygen diffusion to the tissues and ultimately cell death.

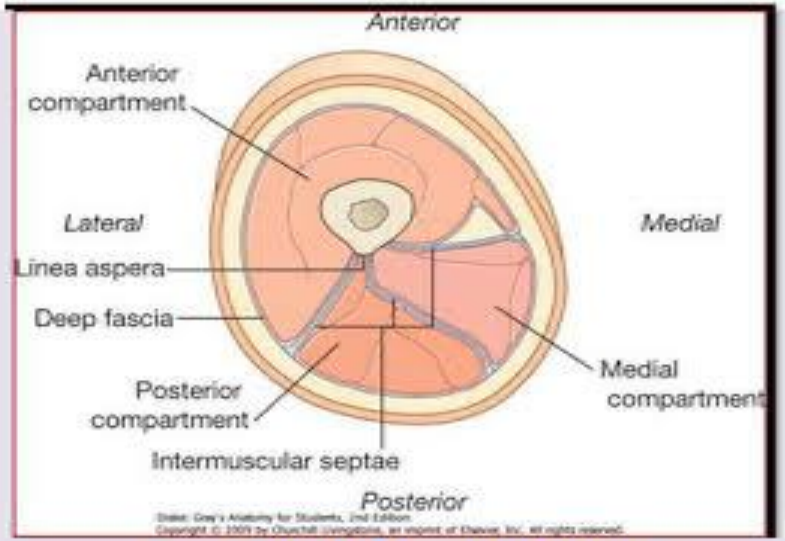
Flow chart 2: Etiopathogenesis of chronic compartment syndrome



The thigh is divided into 3 compartments by 3 intermuscular septa (extending from deep fascia into femur)

Anterior Compartment

- ❑ **Extensors of knee:**
  Quadriceps femoris
- ❑ **Flexors of hip:**
  1. Sartorius
  2. Pectineus
  3. psoas major
  4. Iliacus
- ❖ **Nerve supply:**
  Femoral nerve



Medial Compartment

- ❑ **Adductors of hip:**
  1. Adductor longus
  2. Adductor brevis
  3. Adductor magnus (adductor part)
  4. Gracilis
- ❖ **Nerve supply:**
  Obturator nerve

Posterior Compartment

- ❑ **Flexors of knee & extensors of hip:**
  Hamstrings
- ❖ **Nerve supply:**
  Sciatic nerve

Diagnosis:

- Normal intra compartmental pressure: 0-8 mmHg
- Intra compartmental pressure rises to :30mmHg
- Absolute difference of 30 mm Hg between patient's diastolic blood pressure and compartment pressure(This means that if the compartment pressure is 30 mmHg higher than the diastolic blood pressures

Clinical diagnosis:

Signs and symptoms:

PAIN

PARESTHESIA

PULSELESSNESS

PALLOR

PARALYSIS

PRESSURE

COMPARTMENT PRESSURE EVALUATION: STRYKER METHOD

Place the 18-gauge needle with a side port on the tapered stem of the diaphragm chamber.

Screw syringe prefilled with 3 mL of saline onto the back of the diaphragm chamber.

Place the diaphragm chamber assembly into the pressure monitor, black side down. Gently push the chamber until it is well seated in the device.

Snap the cover closed– *do not force it!* Listen for the latch to snap into place.

Hold the needle at a 45° angle up from horizontal and depress the plunger to force fluid through system and purge it of air.

Turn the pressure monitor on. It should read between 0 and 9 mm Hg.

Hold the pressure monitor at the intended angle of insertion and press the "ZERO" button to calibrate the unit. The device display should read "00."

Insert the device into the compartment being measured (after skin cleansing and administration of anesthetic). Slowly inject no more than 0.3 mL into the compartment and wait for the device to record and display the pressure.

Treatment of compartment syndrome

- Non-operative-

observation- Delta P more than 30 mmHg

no clinical presentation of compartment syndrome

- Operative-

emergency fasciotomy-Positive clinical presentation

CP=30-45 mmHg

Delta P less than 30 mmHG

- The single most effective treatment for ACS is Fasciotomy
- Other preliminary treatment-

1. Split and spread cast
2. Limb should not be elevated above the height of heart
3. Hypotension should be corrected
4. Oxygen therapy

Removal of Circumferential Casts

Figure 2. Clinical image of fiberglass long-arm cast following univalve with placement of two 10-mm cast spacers.

Compartmental pressure falls by 30% when cast is split on one side

Falls by 65% when the cast is spread after splitting.

Splitting the padding reduces it by a further 10% and complete removal of cast by another 15%

Total of 85-90% reduction by just taking off the plaster!

Indications for Fasciotomy

Unequivocal clinical findings

Pressure within 15-20 mm hg of DBP

Rising tissue pressure

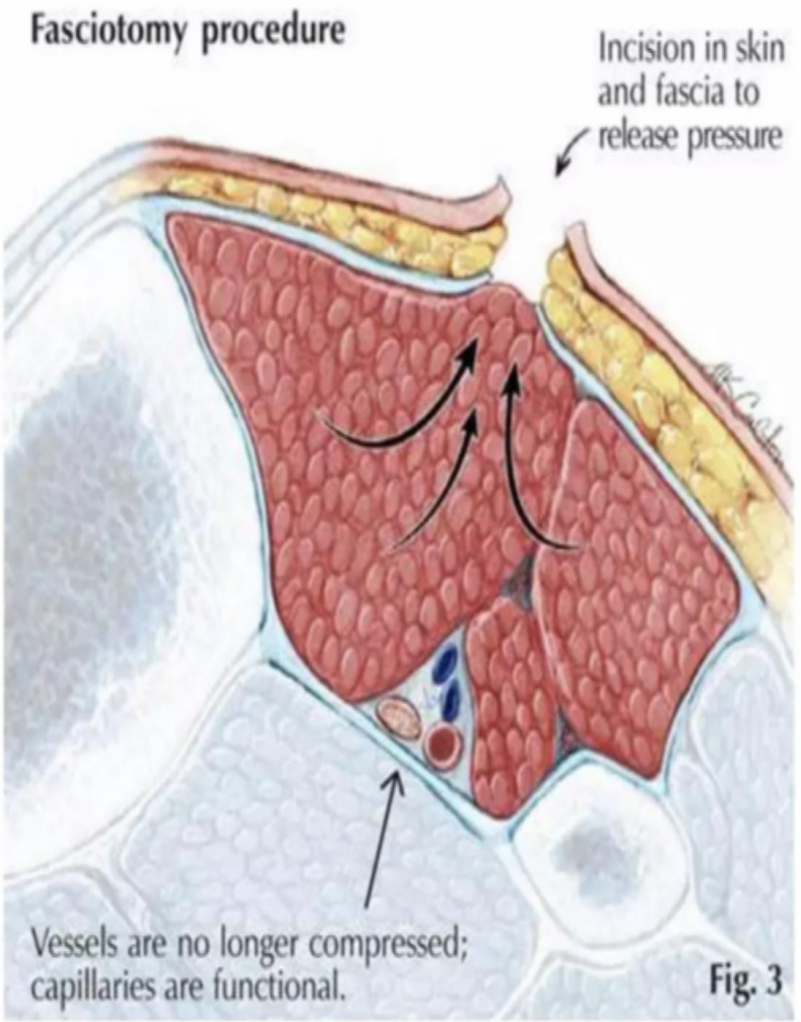
Significant tissue injury or high risk pt

> 6 hours of total limb ischemia

Injury at high risk of compartment syndrome

CONTRAINDICATION -

Missed compartment syndrome (>24-48 hrs)



Principles of fasciotomy

- Make early diagnosis
- Long extensile incisions
- Release all fascial compartments
- Preserve neurovascular structures
- Debride necrotic structures
- Coverage within 7-10 days

Fasciotomy,

Fasciotomy,

Fasciotomy,

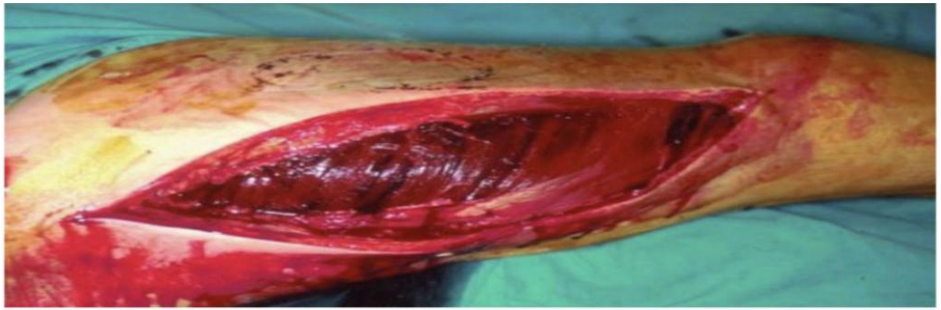
All compartments !!!

Surgical techniques

Thigh fasciotomy

Approach-anterolateral incision over length of thigh

Technique-single incision technique for anterior and posterior compartment. May add medial incision for decompression of adductor compartment



Fasciotomy of the thigh through a single lateral incision

Leg fasciotomy

- Dual medial lateral incision
- Single lateral incision

Figure 1:23 dual medial-lateral incision

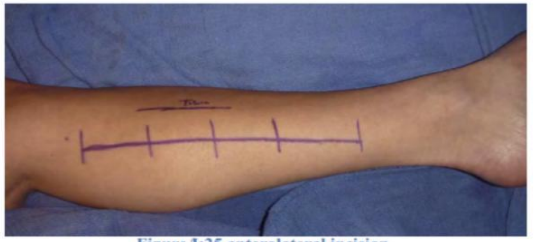


Figure 1:25 anterolateral incision

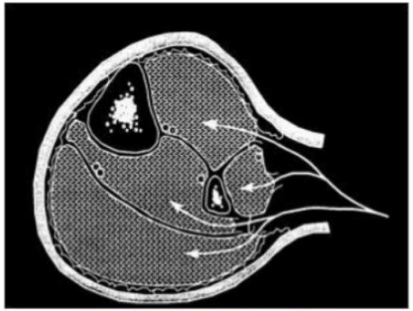


Figure 1:24 single lateral incision

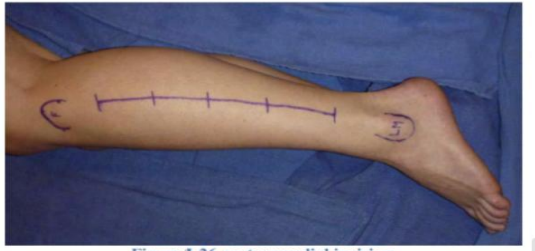


Figure 1:26 posteromedial incision

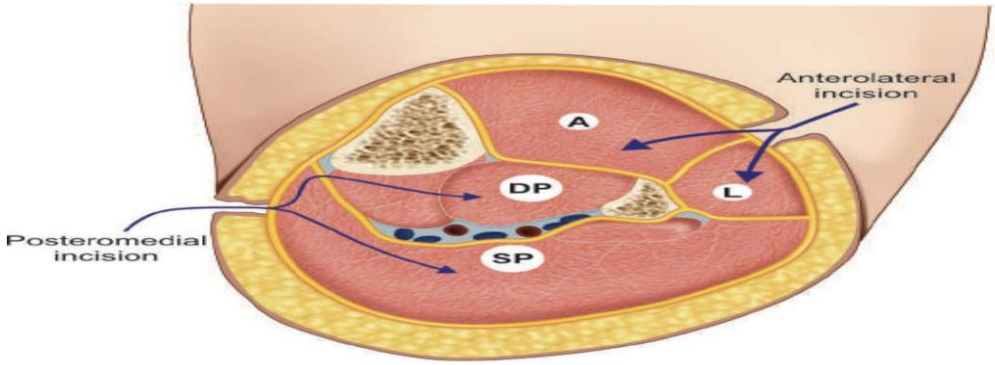


Fig. 10: Illustration depicting decompression of the various compartments of leg using combined two incision technique

Foot fasciotomy

- Dorsal
- Medial
- Calcaneal(uncommon)

Figure 1:36 medial incision

Figure 1:37 dual dorsal incisions

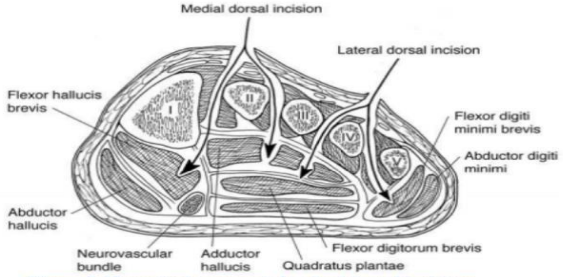


Figure 1:38 surgical approach for dual dorsal incisions

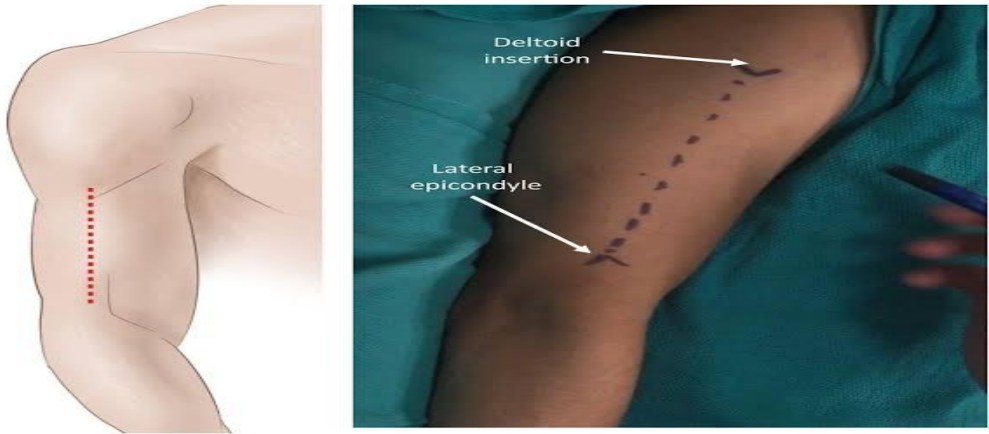
Figure 1:39 claw toes

Figs 11A to D: (A) Compartment syndrome of foot, managed with (B) dorsal and medial fasciotomy and decompression of large hematoma situated in the deep layers of foot muscles. (C) Bulky dressing was applied postoperatively. Note the bulge in plantar aspect of foot in the preoperative photographs (arrow). (D) The fasciotomy wounds were covered by split thickness skin grafts that went to heal uneventfully. Patient regained full function

Arm fasciotomy

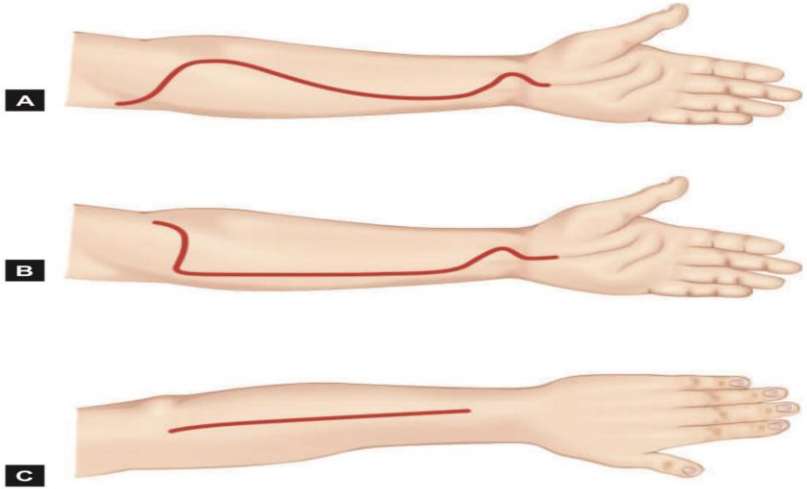
•Fasciotomy of the arm is performed through anterior and posterior incisions when the compartments are easily visualized.

• On rare occasions, the deltoid muscle should also be decompressed



Forearm fasciotomy

- The volar curvilinear approach of Henry and dorsal approach.



Figs 9A to C: (A and B) Illustration depicting forearm compartment decompression different incisions for volar decompression, (C) extensor compartment decompression

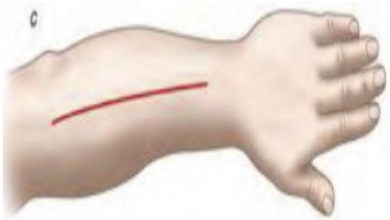


Figure 1:32 Dorsal incision

Figure 1:31 Volar incision

Hand fasciotomy

- Dorsal incision
- Volar incision

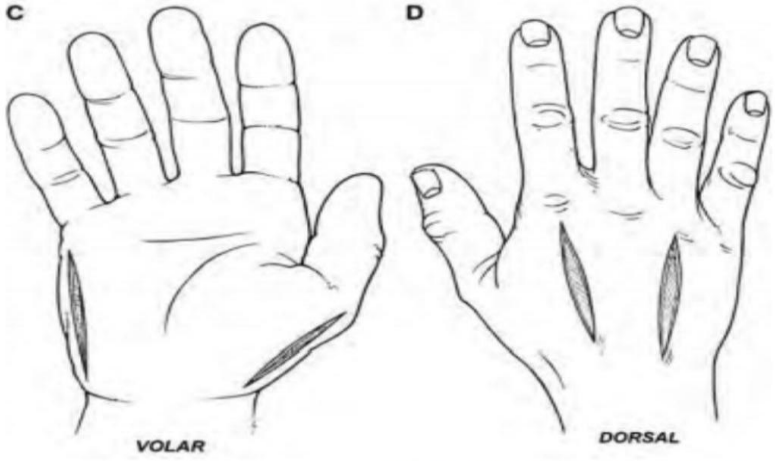


Figure 1:34 Hand incisions

Complications Related to Fasciotomies

Altered sensation within the margins of the wound (77%)

Dry, scaly skin (40%)

Pruritus (33%)

Discolored wounds (30%)

Swollen limbs (25%)

Tethered scars (26%)

Recurrent ulceration (13%)

Muscle herniation (13%)

Pain related to the wound (10%)

Tethered tendons (7%)

Complications related to CS

Late Sequelae

Volkmann's contracture

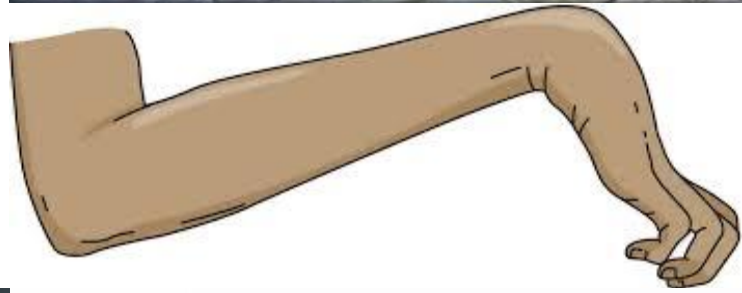
Weak dorsiflexors

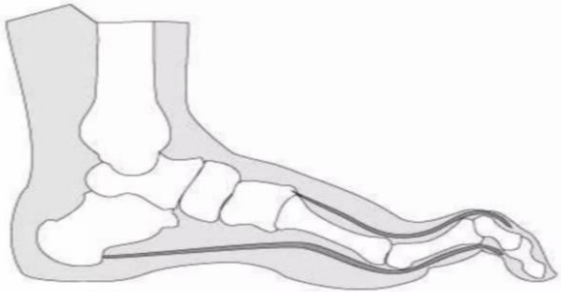
Claw toes

Sensory loss

Chronic pain

Amputation





Thank you.