

Compartment Syndrome

Introduction

- Compartment syndrome may occur with an injury to any fascial compartment. The fascial defect caused by the injury may not be adequate to fully decompress the compartment, and compartment syndrome may still occur.
- Mechanisms of injuries associated with compartment syndrome.
 - Open fractures.
 - Closed fractures.
 - Penetrating wounds.
 - Crush injuries.
 - Vascular injuries.
 - Injection injuries.
 - Infiltrated intravenous catheters.
 - Reperfusion following vascular repairs.
 - Burns/electrical shock.
- Early clinical diagnosis of compartment syndrome.
 - Pain out of proportion.
 - Pain with passive stretch.
 - Tense, swollen compartment.
- Late clinical diagnosis.
 - Paresthesia.
 - Pulselessness and pallor.
 - Paralysis.
- Measurement of compartment pressures: **If available, compartment pressure monitors (including improvised use of arterial line transducers) may provide additional information, especially in obtunded patients. Compartment syndrome, however, remains a clinical diagnosis, and prophylactic fasciotomies are indicated in high energy**

injuries, especially if prolonged transport times are anticipated.

- Diagnosis of compartment syndrome is made on clinical grounds, and the formal measurement of compartment pressures is generally not necessary.
- Compartment pressure measurement can be considered in obtunded patients with questionable exam findings. Measurement threshold of $\Delta P < 30$ mmHg ($\Delta P = \text{DBP} - \text{absolute compartment pressure}$) is an indication for fasciotomy.
- Consider **prophylactic fasciotomy for:**
 - Vascular repair/shunt and/or ligation independent of ischemia time. (See Chapter 25, Vascular Injuries.)
 - **High index of suspicion injuries and limited capacity for serial examination.**
 - ◆ Intubated, comatose, sedated.
 - ◆ Traumatic brain injury.
 - ◆ Prolonged transport.

Fasciotomy Technique

- **Upper extremity.**
 - **Arm:** The arm has two compartments: the **anterior flexors** (biceps, brachialis) and the **posterior extensors** (triceps).
 - ◆ Lateral skin incision from the deltoid insertion to the lateral epicondyle.
 - ◆ Spare the larger cutaneous nerves.
 - ◆ At the fascial level, the intermuscular septum between the anterior and posterior compartments is identified, and the fascia overlying each compartment is released with longitudinal incisions.
 - ◆ Protect the radial nerve as it passes through the intermuscular septum from the posterior compartment to the anterior compartment just below the fascia.
 - ◆ Compartment syndrome in the hand is discussed in Chapter 24, Injuries to the Hands and Feet.
 - **Forearm:** The forearm has three compartments: the **mobile wad** proximally, the **volar** compartment, and the **dorsal** compartment (Fig. 34-1). Both the superficial and deep fascial layers of the volar compartment must be released.

- ◆ A palmar incision is made between the thenar and hypothenar musculature in the palm, releasing the carpal tunnel as needed.
- ◆ This incision is extended obliquely across the wrist flexion crease to the ulnar side of the wrist and then arched across the volar forearm proximally to the ulnar side at the elbow (Fig 34.1a).
- ◆ At the elbow, just radial to the medial epicondyle, the incision is curved obliquely across the elbow flexion crease. The deep fascia is then released.
- ◆ At the antecubital fossa, the fibrous band of the lacertus fibrosus overlying the brachial artery and median nerve is carefully released.

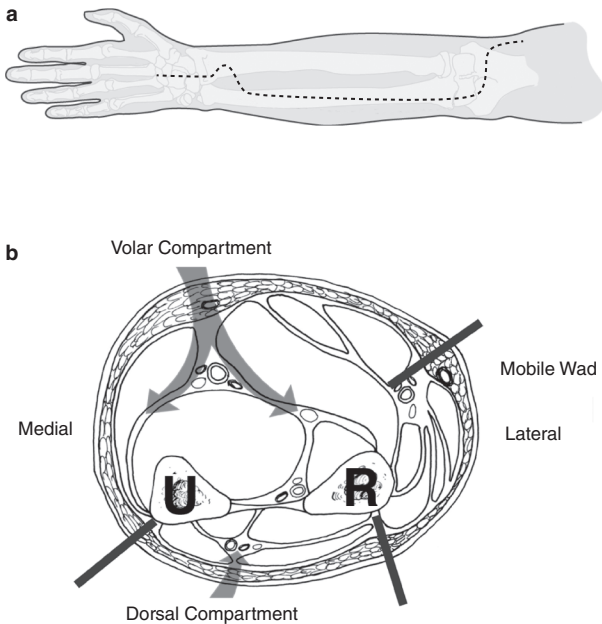


Fig. 34-1. (a) Fasciotomy incision for volar compartment. (b) Forearm compartments. R: radius; U: ulnar.

- ◆ This incision allows for soft-tissue coverage of the neurovascular structures at the wrist and elbows, and prevents soft-tissue contractures from developing at the flexion creases.
- ◆ A second straight dorsal incision can be made from the dorsal wrist to the lateral epicondyle to release the dorsal compartment, reaching proximally to release the mobile wad, if necessary.
- **Lower extremity.**
 - **Thigh:** The thigh has three compartments: the **anterior** compartment (quadriceps), the **medial** compartment (adductors), and the **posterior** compartment (hamstrings).
 - ◆ A lateral incision is made from the greater trochanter to the lateral condyle of the femur.
 - ◆ Then, the iliotibial band is incised, and the vastus lateralis is reflected off the intermuscular septum bluntly, releasing the anterior compartment.
 - ◆ The intermuscular septum is then incised the length of the incision, releasing the posterior compartment.
 - ◆ This release of the intermuscular septum should not be made close to the femur, because there are a series of perforating branches of the profunda femoris artery passing through the septum from posterior to anterior near the bone.
 - ◆ The medial adductor compartment is released, if necessary, through a separate anteromedial incision starting slightly distal to the adductor origin on the pubis and extending to the distal medial thigh.
 - **Lower leg:** The lower leg has four compartments: the **lateral** compartment, containing the peroneus longus and brevis; the **anterior** compartment, containing the extensor hallucis longus, the extensor digitorum communis, the tibialis anterior, and the peroneus tertius; the **superficial posterior** compartment, containing the gastrocnemius and soleus; and the **deep posterior** compartment, containing the flexor hallucis longus, the flexor digitorum longus, and the tibialis posterior (Fig. 34-2).
 - ◆ Two-incision technique. (**CAVEAT:** The one incision technique **IS NOT APPROPRIATE** for compartment syndrome decompression in combat theater.)

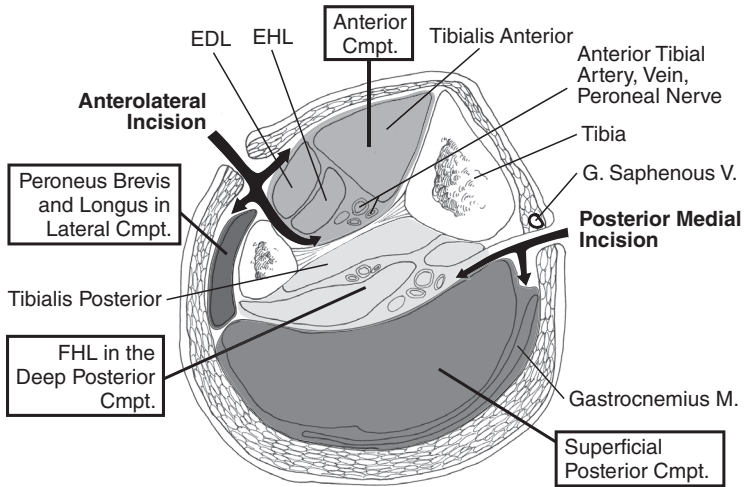


Fig. 34-2. Leg compartments.

Cmpt.: compartment; EDL: extensor digitorum longus; EHL: extensor hallucis longus; FHL: flexor hallucis longus; G.: greater; M.: muscle; V.: vein.

- ◇ Incisions must extend the entire length of the calf to release each compartment in its entirety (Fig. 34-3).
- ◇ A lateral incision is made centered between the fibula and anterior tibial crest.
- ◇ The lateral intermuscular septum and superficial peroneal nerve are identified, and the anterior compartment is released in line with the tibialis anterior muscle, proximally toward the tibial tubercle and distally toward the anterior ankle.
- ◇ The lateral compartment is then released through the same incision in line with the fibular shaft, proximally toward the fibular head, and distally toward the lateral malleolus.
- ◇ A second incision is made medially at least 2 cm posterior to the posteromedial and palpable edge of the tibia.
- ◇ A medial incision over or near the subcutaneous surface of the tibia is avoided, preventing exposure of the tibia when the tissues retract.

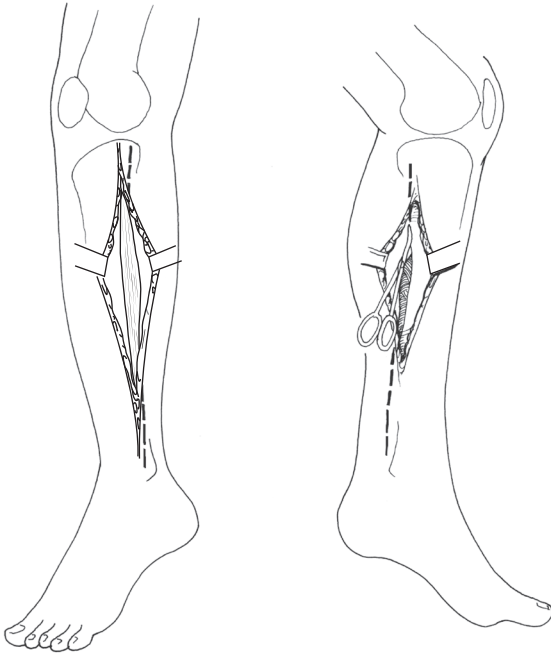


Fig. 34-3. Anteromedial incision of the calf.

- ◇ The saphenous vein and nerve are retracted anteriorly.
- ◇ The superficial compartment is released through its length, and then the deep posterior compartment is released by the gentle dissection of the septum off of the posterior aspect of the tibia.
- ◇ The direct visualization of the tendons and their associated muscle bellies can assist in ensuring the complete release of each respective compartment.
- **Foot.**
 - ◆ See Chapter 24, Injuries to the Hands and Feet.
 - ◆ Compartment release of the foot is rarely indicated and not routinely recommended in combat surgery.
- Fasciotomy wound management.

- As with all war wounds, the fasciotomy is initially left open and covered with sterile dressings or NPWT.
- Following fasciotomy, the wound should be treated with delayed primary surgical closure and standard wound management, removing debridement of all devitalized tissue.
- The vacuum wound closure system is an important adjunct to modern combat wound care and may be considered at higher echelons of care.
 - Sterile perforated IV bags.
 - ◆ For wounds of the **soft tissue and extremities**, layer laparotomy sponges with JP drains sandwiched between the sponges and covered with Ioban. Apply Benzoin to the skin edges to prevent leaks.
 - ◆ Attach the JP drains to the standard vacuum pump adjusted to 125 mm Hg suction. This dressing eliminates the need for skin traction in amputations.
 - ◆ For **skin grafts**, staple the graft to the edges of the wound. Apply nonadhering gauze and apply to field-expedient vacuum dressing. Do not remove for 3 days. Grafts can be dressed with Silvadene when the field-expedient vacuum dressing is removed.
 - ◆ For **open abdominal wounds**, place sterile perforated IV bags on the bowel and sew the IV bag to the fascia, or underlay the fascia with the IV bag. Place laparotomy sponges on the IV bags and layer with JP drains. Apply Benzoin to the skin edge and cover with Ioban. Attach the drains to suction. This dressing prevents leaking of abdominal fluids during transport.

Many surgeons consider the use of vacuum systems an important part of wound management because their use may improve and accelerate wound healing in a variety of conditions, including:

- pressure ulcers,
- partial thickness burns,
- orthopaedic wounds with large soft-tissue defects,
- open abdominal wounds, and
- skin graft viability.

Treatment of soft-tissue injury is the most common denominator in the management of war wounds.

Pitfalls

- Delay in diagnosis and treatment of suspected or impending compartment syndrome.
- Inadequate fascial incision length.
- Failure to open deep posterior and anterior compartments.
- Failure to locate lateral leg intermuscular septum and perform both lateral and anterior release.

**For Clinical Practice Guidelines, go to
http://jts.amedd.army.mil/index.cfm/PI_CPGs/cpgs**