

Bedside Fasciotomy for Treatment of Compartment Syndrome

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INTRODUCTION

A compartment is an area of muscle groups and neurovascular structures enclosed by fascia. The leg consists of 4 compartments: anterior, lateral, superficial posterior, and deep posterior. The foot, although occupying less surface area than the leg, contains 9 compartments. The compartments are medial, lateral, 4 interosseal, calcaneal, and superficial and deep central compartments (1). Compartment syndrome is defined as a raised pressure within an enclosed area with the potential to cause irreversible damage to its contents. This ability to permanently damage these structures is what makes compartment syndrome a podiatric surgical emergency. Therefore, it is important to efficiently identify, diagnose, and treat a compartment syndrome. The authors will discuss the use of a bedside fasciotomy under local anesthetics in select cases in order to avoid delay in compartmental release.

Before treating compartment syndrome, one must be able to properly identify the condition. Common causes include but are not limited to trauma, hemorrhage, tight casting, or constrictive bandaging. If a patient presents with a cast or dressing, it is advised to remove the causative agent. Garfin and Mubarak reported an average reduction of 65% in compartmental pressures after removal of a cast, and then an additional decrease of 10-20% after the dressing was removed (2). The presence of an open fracture does not exclude the diagnosis of compartment syndrome. Although the affected area is open, the adjacent compartments are not necessarily spared. The historical symptoms of a patient with compartment syndrome are pain, pallor, parasthesia, paralysis, and pulselessness. However, these symptoms should not be considered a reliable finding. A patient with an early presentation will have pulses and an adequate capillary fill time. The vascular deficiency tends to be a late finding of compartment syndrome. Immediate symptoms that should warrant a compartment syndrome are allodynia and palpable tenseness in the involved compartment.

Compartment syndrome can only be accurately diagnosed with the use of a Wick's catheter. There are several different theories reported in the literature that can aid with the interpretation of the results. The first, being the absolute pressure theory presented by Mubarak (3) and Matsen (4), who suggested a fasciotomy be performed

when intracompartmental pressures reach or exceed 30 mm Hg (3) and 45mm Hg (4). Then, there is the perfusion theory of Whitesides (5), who revealed the relationship of tissue perfusion and diastolic blood pressure (DBP). He recommended surgical decompression when the tissue pressure is within 20 mm Hg of the DBP. McQueen (6) suggested a differential <30 mm Hg of the diastolic pressure and the intramuscular pressure as a threshold for release as being more reliable.

TECHNIQUE

When the physician has diagnosed an acute compartment syndrome, surgical decompressive fasciotomy should be performed urgently. There are various techniques for fasciotomy involving the leg that have been described. They include single incision fasciotomy without fibulectomy, single incision with fibulectomy, and the more common two-incision fasciotomy.

The single incision technique entails a longitudinal incision made over the fibula extending 5 cm distal to the fibular head and 5 cm proximal to the lateral malleolus. The anterior, lateral, and superficial posterior compartments are released first. These are then followed by release of the deep posterior compartment at the posterolateral fibular insertion site of the lateral intermuscular septum. This approach is less favorable due to the risk involved of damaging the peroneal nerves and vessels when entering the deep posterior compartment. Fibulectomy can be performed through this operative technique; however, this technique is rarely used due to the fact that the two-incision fasciotomies cause less morbidity (7).

In the two-incision technique, the anterolateral incision is made to approach the anterior and lateral compartments. This incision is placed between the tibial crest and the head of the fibula. The incision is very much the same one used for the single incision technique. One should be able to release the fascia of the anterior and lateral compartments through this incision. Care must be taken by the performing surgeon to avoid the superficial peroneal nerve, which can be encountered 10-12 cm proximal to the lateral malleolus. The second incision is the posteromedial incision. The incision is made 2 cm posterior to the medial border of the tibia. With this incision, the superficial and

deep posterior compartments can be assessed for any soft tissue compromise. Surgeons should avoid sacrificing the saphenous nerve and vein while performing this procedure.

The most common approach to compartment syndrome of the foot remains a combined dorsal and medial plantar incision (8). The medial incision starts at the medial side of the calcaneus just anterior to the abductor hallucis origin, extending distally, parallel to the plantar surface for 6 cm. Care must be taken to avoid damage to the medial and lateral plantar nerve and vessels through this incision. Next, 2 separate dorsal incisions are made. These incisions are placed medial to the second metatarsal and lateral to the fourth, running longitudinal to the respective metatarsals (9).

Closure of the aforementioned wounds by secondary intention is generally indicated 5-7 days after the fasciotomy (10). Skin grafting may be indicated in the event that skin closure cannot be performed. Due to the medial incision often times being difficult to close, open reduction internal fixation of the calcaneus should be attempted 10-14 days post fasciotomy. This prevents any risk of leaving exposed hardware that in turn can lead to infection.

ALTERNATIVE TREATMENT

Although a compartmental release in the operating room is the standard of care, in select cases a bedside fasciotomy can be performed to reduce the incidence of morbidity in a patient (11). This alternative method can be used in patients with a delayed presentation of compartment syndrome, or where a delay in surgery is anticipated. Antibiotic prophylaxis is appropriately administered and continued for 24 hours post fasciotomy. The affected extremity is then prepped and draped in the normal sterile fashion. Conscious sedation consisting of midazolam and fentanyl along with 1% lidocaine with epinephrine along the incisions is used to perform release of the compartments. A fasciotomy can then be performed using the above-mentioned techniques. Any subsequent procedures besides the fasciotomy can then be done in the operating room after the patient has been stabilized. Saline soaked wet to dry dressings on the site of fasciotomy can be applied postoperatively. Any further wound irrigation and debridements are done as needed.

Once the edema resolves, wounds are closed through delayed primary closure, negative pressure wound therapy assisted closure, or split-thickness skin grafting (12, 13). Ebraheim (11) reported this alternative method in 2012 and described a total of 34 cases in which it was used. He described immediate improvement in pain, with adequate wound healing and no cases of infection. The conventional release of compartments in the operating room continues to be the standard of care, however a bedside fasciotomy under local anesthesia is a viable, safe, and effective option for treating compartment syndrome in select cases.

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