

What's Your Diagnosis?

Multiple Metatarsal Fractures, Severe Foot Pain, and Intact Pulses

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Can you guess why this patient, who was injured in a helicopter crash, demonstrated adequate toe movement but still experienced significant pain on dorsiflexion?

A 47-year-old, white, active duty man with an unremarkable medical history was brought to a U.S. aircraft carrier after his helicopter crashed in Indonesia. Upon his arrival, a primary trauma survey, conducted using strict cervical spine precautions, showed no abnormalities. A secondary survey revealed closed right third, fourth, and fifth metatarsal fractures.

Due to the ship's remote location and the stability of the patient's condition, transportation to a major treatment facility was delayed for several days. In the meantime, the patient was admitted to the ship's medical ward for pain control and monitoring.

On day two, the patient reported increasing right foot pain and gradually required higher and higher doses of morphine. Upon examination, the right foot and ankle were slightly more edematous than on initial presentation and the skin appeared shiny and tense (Figure 1). Distal pulses were intact and the patient could actively move all of his toes. He had significant pain with passive dorsiflexion that was out of proportion to the injury.

What's your diagnosis?

At the time of this writing, **LT Lane** was the general medical officer on the USS Abraham Lincoln, stationed in Everett, WA. He is now a general medical officer at the Regional Support Organization in San Diego, CA.

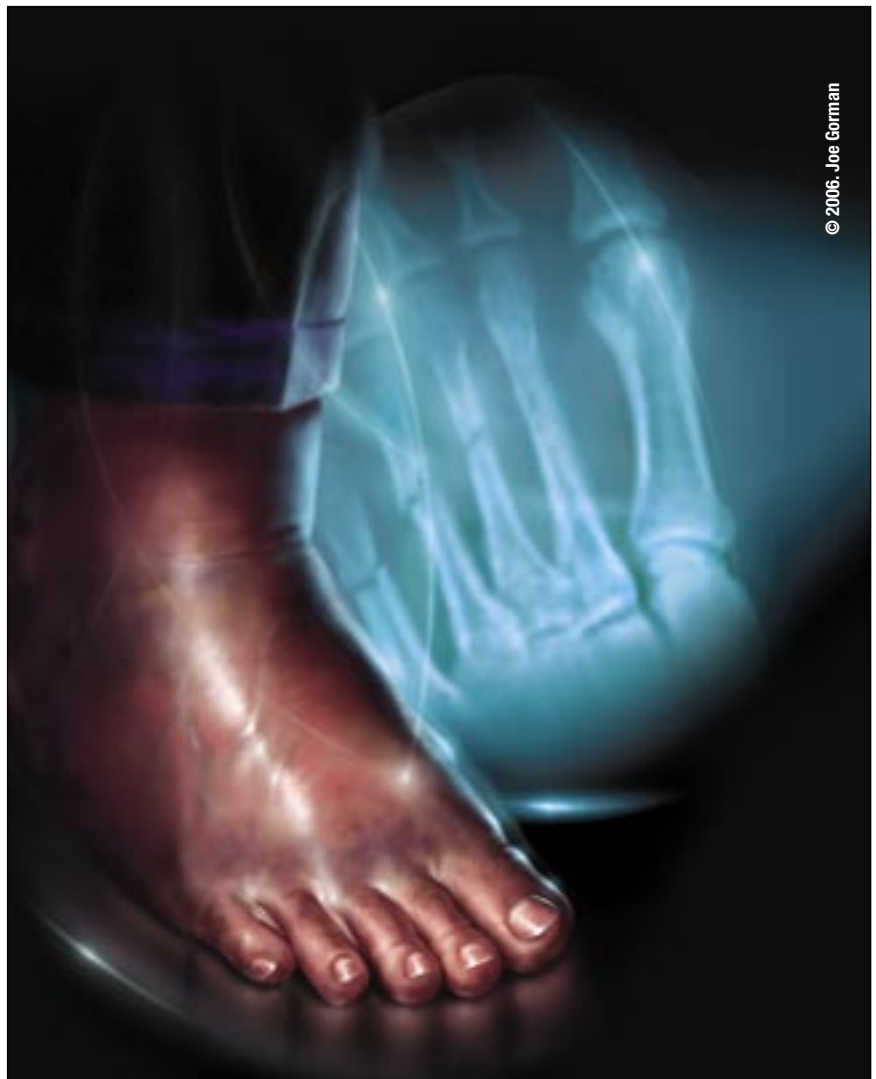


Figure 1. An edematous foot, with bruising and shiny, tense skin, following traumatic fractures to the third, fourth, and fifth metatarsal bones.

Continued on next page

WHAT'S YOUR DIAGNOSIS?

Continued from previous page

OUR DIAGNOSIS

Suspecting foot compartment syndrome, we used an arterial line transducer and an 18-gauge needle with a side port to measure the compartmental pressures of the patient's foot.¹ In order to avoid peroneal nerve injury, we avoided the first web space of the dorsal foot. Instead, we inserted the needle into the second web space of the dorsal foot and advanced it into the interosseous and adductor compartments. The pressure in the adductor compartment of the patient's foot was found to be 40 mm Hg.

This finding, in the context of the patient's other clinical signs and symptoms, strongly supported the suspected diagnosis of foot compartment syndrome. Because the patient had several metatarsal fractures, we performed an urgent fasciotomy using the dorsal approach (Figure 2). We administered cefazolin 1 g IV preoperatively. Using blunt dissection, we opened the fascia, allowing a reduction in the intracompartmental pressures. We noted that the muscle appeared pink and healthy. We left the skin and fascia open and covered the wound in a sterile dressing.

The patient eventually was sent to a major treatment facility in Singapore for orthopedic care. There, split-thickness skin grafts were applied over the open fasciotomy sites without internal fixation of the metatarsal fractures (Figure 3). When the patient presented at a U.S. Army facility in the United States, an incision was made laterally to address the metatarsal fractures. (The lateral approach was used in order to avoid disruption of the skin grafts.)

This patient recovered without functional deficits caused by compartment syndrome. He has residual limited range of motion secondary to the metatarsal fractures, however, and he



Figure 2. The dorsal approach to fasciotomy for treatment of foot compartment syndrome. Here, the surgeons used a blunt dissection, allowing a reduction in the intracompartmental pressures of the patient's right foot.

has had hardware subsequently placed in his foot. The patient reports that, when the weather is cold or when he must stand for prolonged periods, he experiences mild pain consistent with

ABOUT THE CONDITION

Compartment syndrome occurs when an elevated pressure within a closed osseofascial compartment causes muscle and nerve ischemia. In

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arthritis. Overall, though, he expresses that he is very pleased with the outcome. He has returned to the aircraft carrier to complete his tour of duty, and he continues to speak highly of the care he received overseas and in the United States.

the foot, compartment syndrome can develop in any one of the nine identified compartments.¹ Although it is more widely recognized as a complication of closed fractures, compartment syndrome can occur with an open fracture. It's important for the

clinician to keep a close watch on patients who have multiple metatarsal fractures or a crush injury to the foot. These patients are at greater risk for developing compartment syndrome.²

Signs and symptoms that may present with the condition include progressive pain out of proportion to the injury,^{3,4} paresthesias,⁵ and tissue swelling.⁶ On examination, the skin may appear shiny and tense.⁵ Although worsening pain on passive dorsiflexion is not in itself diagnostic of compartment syndrome, this symptom has been described as the most sensitive subjective clinical finding.² The presence of a vibratory sensory deficit may be useful in the diagnosis and has been shown to be a more reliable finding than a two-point discrimination or a sharp or dull discrimination deficit.⁷ Since loss of pulses or signs of poor perfusion are late findings,⁸ the clinician should not rely on their absence to make a diagnosis of compartment syndrome. In fact, this was illustrated in the case presented here: The patient continued to have palpable pulses despite an elevation in compartmental pressure.

Compartmental pressures can be measured objectively using an 18-gauge needle with a side port and an arterial line transducer.⁹ Compartmental pressure greater than 30 mm Hg (normal, 4 to 6 mm Hg⁹) is consistent with compartment syndrome and requires immediate decompression with surgical fasciotomy. Similarly, a fasciotomy should be considered if the compartmental pressure is more than 10 to 30 mm Hg below the patient's diastolic blood pressure.¹⁰ This is a consideration when treating hypotensive patients, who are at higher risk for developing compartment syndrome secondary to poor arterial perfusion. Even a slight increase in compartmental pressure can be too high for the pa-



Figure 3. Photograph of the patient's right foot one year after his initial injury, showing split-thickness skin grafts that were applied over the dorsal fasciotomy incisions.

tient's arterial and capillary pressure to overcome. Although compartmental measurements are useful, especially in an unconscious patient, they are not required. Compartment syndrome is a clinical diagnosis.

Managing foot compartment syndrome

Cases of suspected foot compartment syndrome should be managed aggressively and urgently. If the condition is not recognized and treated, irreversible ischemic necrosis can occur after only five to six hours of elevated intracompartmental pressure.³ In addition, fibrosis and forefoot contractures may occur if the condition is not treated in a timely and appropriate manner. The intrinsic muscles of the foot may atrophy, which can cause the remaining intact extrinsic toe flexors and extensors to dominate.^{2,8} The resulting foot deformities,

such as claw toe, lead to immobility, dysfunction, and chronic pain.

If possible, the patient should be referred urgently to the orthopedic department for a fasciotomy. As military personnel often find themselves in remote locations where orthopedic care may not be available, however, the general DoD clinician needs to be able to perform an urgent fasciotomy.

The fasciotomy can be performed using either a medial or dorsal approach. The medial approach involves making an incision below the medial malleolus to the proximal medial aspect of the first metatarsal. The incision below the medial malleolus is made approximately 3 cm above the arch of the foot. If the dorsal approach is used, as in our patient's case, two longitudinal dorsal incisions are made. One incision should be made medial to the second metatarsal and the other incision made lat-

eral to the fourth metatarsal. In both methods, blunt dissection is used to dissect through the compartments.

The medial approach releases intracompartmental pressures more quickly, but the dorsal approach is technically easier to perform and provides access for internal fixation and stabilization of metatarsal fractures. Both techniques have been shown to treat foot compartment syndrome adequately. The fascia and skin are not closed immediately. After the increased intracompartmental pressure (edema) has resolved, the fasciotomy incisions can be closed or, if needed, a split-thickness skin graft can be used. If the muscle and tissue appear gray and necrotic on fasciotomy, significant surgical debridement and possible amputation may be required. ●

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sarily reflect those of Federal Practitioner, Quadrant HealthCom Inc., the U.S. government, or any of its agencies. This article may discuss unlabeled or investigational use of certain drugs. Please review complete prescribing information for specific drugs or drug combinations—including indications, contraindications, warnings, and adverse effects—before administering pharmacologic therapy to patients.

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