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Review zum Themenschwerpunkt

Foot compartment syndrome — a clinical review

Kompartment-Syndrom des Fußes — Eine klinische Übersicht

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Summary

Foot compartment syndrome is a serious clinical entity that typically results from high-energy fractures and crush injuries. Up to ten anatomic compartments may be distinguished in the foot, and foot compartment syndrome may be combined with compartment syndrome of the lower leg through a communication via the deep posterior compartment. The diagnosis of foot compartment syndrome is primarily a clinical one with increasing pain, exaggerated by toe stretching, swelling with loss of skin wrinkling, and neurovascular deficits later in the course despite rest and elevation. In unconscious patients multiple stick needle measurements are useful for establishing the diagnosis. Emergent fasciotomy is the treatment of choice and delay in diagnosis or missed compartment syndrome may lead to chronic pain, numbness, and deformities like rigid claw and hammer toes, plantar muscle atrophy, callus formation, and cavus foot.

Zusammenfassung

Das Kompartmentsyndrom des Fußes ist ein schweres klinisches Krankheitsbild, welches typischer Weise aus Hochrasanztraumata und schweren Quetschverletzungen resultiert. Bis zu zehn anatomische Kompartimente können am Fuß unterschieden werden, zudem kann das Kompartmentsyndrom des Fußes in Kombination mit einem Kompartmentsyndrom des Unterschenkels auftreten, da eine direkte Kommunikation zum tiefen posterioren Kompartiment des Unterschenkels besteht. Die Diagnose wird primär klinisch gestellt bei zunehmenden Schmerzen, verstärkt durch Zehenstreckung, sowie Schwellung mit Verlust der Hautfältelung und

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neurovaskulären Ausfällen im weiteren Verlauf trotz Ruhigstellung und Hochlagerung. Bei bewusstlosen Patienten ist die direkte, invasive Druckmessung in allen Kompartimenten nützlich zur Diagnosesicherung. Die sofortige Dermatofasziotomie ist die Therapie der Wahl und eine verzögerte Diagnostik und Therapie kann zu chronischen Schmerzen, Taubheit und Deformitäten wie rigiden Krallen- und Hammerzehen, plantarer Muskelatrophie, Kallusbildung und einem Pes cavus führen.

Foot compartment syndrome (FCS) typically is the result of high energy injuries to the foot [30,31,33,39]. A combination with lower leg compartment syndrome is not uncommon because of the communication between the deep posterior compartment of the leg and the calcaneal (deep central) compartment of the foot [4,23]. The most frequent etiologies of a FCS are Lisfranc fracture-dislocations, crush injuries to the foot, and high-energy fractures of the calcaneus. Few epidemiological studies report the incidence of FCS in foot and ankle injuries and therefore the numbers in the literature differ considerably. A FCS is seen in up to 20% in Lisfranc-fracture-dislocations and up to 10% of calcaneal fractures [1,30,32,34,37,40]. Many of these are combined or complex injuries to the foot (e. g. combined Chopart- and Lisfranc fracture-dislocations) while isolated fractures less frequently appear to lead to a FCS. On the other hand, the latter patient population may be undertreated and the diagnosis missed in a considerable amount of patients [5]. A recent study showed a 2% incidence of FCS in isolated foot injuries [40]. With complex trauma of the foot — an entity defined as multilevel fractures with high degree soft tissue damage [2,43] — the incidence of FCS rises to more than 50% [17,39].

Delayed treatment or untreated FCS regularly leads to stiffness, chronic disability, deformity, and pain [4,10,21,27,30—32,35]. Necrosis of the intrinsic foot muscles can lead to ischemic contractures that result in claw toe, hammer toe, and pes cavus. Neurovascular compromise due to elevated compartimental pressures can also cause chronic pain and an insensate foot with secondary neuropathic pathology (eg, chronic ulceration, joint destruction) [4,21,30,31].

Compartments in the foot and pathophysiology of FCS

Four main fascial compartments of the foot have been described in the anatomic literature of the first half of the 20th century [13,42]. Lindsay and Dewar, in 1958, found residual claw toes in 14 of 147 patients with calcaneal fractures [19]. However, compartment syndrome of the foot has not been recognized as a distinct clinical entity until the 1980s when orthopaedic surgeons increasingly became aware of the sequelae of elevated compartimental pressures after crush injuries [7,16,22,28,39].

There are nine foot compartments (Fig. 1):

(1) medial
(2) superficial (central)
(3) lateral
(4) adductor
(5-8) four interossei, and
(9) calcaneal (deep central).

Sometimes, the dorsal aspect of the foot is considered a tenth compartment [36].

The medial compartment contains the abductor hallucis and flexor hallucis brevis muscles, and is plantar-medial to the first metatarsal. The superficial compartment contains the flexor digitorum longus and brevis muscles. The lateral compartment contains the abductor digiti minimi and flexor digiti minimi brevis, and is on the inferiolateral surface of the fifth metatarsal. The adductor compartment is located in the plantar forefoot, containing the oblique head of the adductor hallucis muscle. The four interossei compartments are dorsally located between each of the metatarsals, and each includes dorsal and plantar interosseus muscles. The calcaneal compartment contains the quadratus plantae muscle. The dorsal compartment is confined by the dorsal skin and fascia. It contains the short extensor muscles which are not considered a separate compartment.

Of clinical importance is the communication that was demonstrated between the calcaneal compartment and the deep posterior compartment of the leg through the retinaculum behind the medial malleolus, following the neurovascular and tendinous structures [22,23]. Beware that a serious hindfoot/calcaneus injury might cause a compartment syndrome of the deep posterior compartment of the leg [25].