

# Cavovarus Foot

## OVERVIEW

Cavovarus foot refers to a foot that has both cavus (high arch) and varus of the heel (a heel that is turned inward). It is not as common in presentation as flatfoot. It can occur in very obvious forms in patients with Charcot-Marie-Tooth (i.e. hereditary motor sensor neuropathy) or can have a very subtle variant as well in otherwise normal patients. Hindfoot varus can also occur from calcaneal or talar fracture malunions and from the sequelae of compartment syndrome. In all cases it leads to stress on the lateral foot, commonly ankle instability or peroneal pathology and even stress reaction or fractures to the lateral bones of the foot and ankle.

## ANATOMY AND BIOMECHANICS

The foot works as a tripod. The three points that provide a stable base are the calcaneus, the first metatarsal head and the fifth metatarsal head. In patients with an inverted or varus calcaneus, the weight of the hindfoot is shifted inward. Patients can have a hyper-plantarflexed first metatarsal, occurring either as an anatomical variant or from overdrive of the peroneus longus tendon, that tilts the hindfoot into varus. This leads to less shock absorption, eccentric loads on the lateral bones of the foot and stress on the lateral structures such as the peroneal tendons. In addition, the foot is not allowed to go flat during gait, and the transverse tarsal joints therefore do not unlock. This can lead to stress on the anterior talofibular ligament, the peroneal tendons and bones such as the fifth metatarsal, cuboid or fibula.

## PATHOGENESIS

As noted above, there can be several causes of a cavovarus foot deformity. There are probably genetic cases that are underappreciated which lead to abnormal bone morphology and position that put the hindfoot in varus. It can also be acquired. The extreme example is that of Charcot-Marie-Tooth in which a relative overpull of the peroneus longus compared to the weak anterior tibial tendon and a strong pull of the posterior tibial tendon compared to

the weak peroneus brevis leads to the deformity. Literature has shown a relationship between cavovarus deformity and stress fractures, ankle sprains and peroneal pathology. There is currently no staging system known.

## **CLINICAL PRESENTATION**

Charcot-Marie-Tooth presents with a family history and progressive weakness and is always bilateral. In general, those without Charcot-Marie-Tooth will present with progressive pain or lateral symptoms depending on the problem. Those with ankle instability will complain of a history of multiple ankle sprains and weakness. Those with stress fractures may have lateral pain after increasing in training or changes in shoe wear. Peroneal pathology may present with progressive weakening or occur in the setting of multiple ankle sprains. Many of the symptoms present in athletes in their 20's or 30's. It is very important to note that it is also not uncommon to see cavovarus in the setting of previous failed surgery in which the deformity is not recognized. This includes a Brostrom lateral ligament reconstruction, peroneal tendon subluxation repair and ORIF of a fifth metatarsal fracture.

## **EXAM**

When examining a patient for a cavovarus foot, one must first look at the position of the hindfoot. If it is turned toward the midline of the body or in varus, it can be appreciated from a posterior view. From anteriorly, one can see more of the fat of the heel pad toward the center of the body otherwise known as a "peekaboo heel." The arch is not always seen high even in some patients with considerable varus. It is also important to look for callosities indicating increased stress and pressure under the first metatarsal and fifth metatarsal base. Gastrocnemius tightness can contribute as well to the hindfoot varus, and therefore a Silfverskiold test should be performed. The ability to correct the subtalar joint passively should be assessed as well. The most telling exam is that called the "Coleman block test". This is performed by putting an elevated wedge (i.e. block of wood, stack of papers, etc...) under the lateral foot and seeing if the hindfoot corrects out of varus. The presence of first ray plantarflexion and overdrive of the peroneus longus tendon should be tested as well. Other concomitant conditions such as ankle instability and peroneal tendon subluxation or pain should be assessed as well.

## **IMAGING STUDIES**

Standard radiographs are extremely helpful in assessing cavovarus foot deformity. The most telling is that of the Meary's angle (i.e. lateral talo-first metatarsal angle) which should be 0 or normal. An increased angle indicates cavus. A hindfoot alignment view either on a standing x-ray or a standing CT can show hindfoot varus. Signs of hindfoot varus on a lateral x-ray include a bell-shaped cuboid, posterior placed fibula, open sinus tarsi and double dome of the talus. MRI can be useful as well to address concomitant pathology including peroneal pathology, stress reaction, peroneal subluxation or tendinosis.

## **TREATMENT**

Nonsurgical treatment of the cavovarus foot consists first of physical therapy. Calf stretching and plantar fascia stretching can help particularly in a flexible deformity. Other pathology should be addressed accordingly. For example, ankle stability can be approached with peroneal strength and proprioception at therapy. Orthotics are extremely useful with the most common device being a "Coleman block or reverse orthotic." This has a recessed first metatarsal well, a lowered medial longitudinal arch and a lateral heel post. This works better in patients with a flexible deformity. Surgical treatment depends on the problem but is usually indicated for patients who have failed conservative therapy and have continued pain and poor function. The one exception may be Charcot-Marie-Tooth which, if addressed earlier, may lead to better results. Lateral ankle instability can be addressed with a Brostrom, a nonhealing fifth metatarsal fracture with an intramedullary screw and peroneal pathology with tendon repair, groove deepening or tenodesis. In all cases, the deformity must be addressed at the same time. In patients with a forefoot driven flexible deformity a dorsiflexion first metatarsal osteotomy can be extremely helpful. Dorsiflexion can also be obtained through a TMT fusion which brings the ray up. A lateralizing heel slide is extremely important as well and can be done either as a straight lateralization, a Dwyer which takes a lateral closing wedge, or a step cut. In cases with peroneus longus overdrive, the peroneus longus can be transferred to the brevis. It is extremely important to address both the deformity and the underlying problem at the time of the surgery, although the decision of which procedures to perform and how much can be very subtle and complex. For Charcot-Marie-Tooth, most commonly patients are treated with a plantar fascia release, peroneus longus to brevis transfer, lateralizing heel slide, posterior tibial tendon transfer to the top of the foot and dorsiflexion of the first ray.

## **CONCLUSION**

Cavovarus can be caused by Charcot-Marie-Tooth, but is more often subtle and more difficult to diagnose. It can lead to other pathology including peroneal tendon tears or degeneration, ankle instability and lateral bony stress fractures. Nonoperative treatment can be very helpful in the form of physical therapy, stretching and a reverse orthotic. Surgery depends on the problem, but both the pathology and the underlying deformity must be addressed concomitantly.

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*Last reviewed June 2015*