Orthotic Management of the Cavovarus Foot

Here's an overview of the assessments and recommended treatments indicated for this challenging condition.

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Introduction

The normally functioning foot is incredibly complex in that it becomes a flexible adapter to the terrain during the first rocker and transforms into a rigid propulsive lever arm in the 4th rocker. Of all the variations from normal, hi arch foot deformities (Figure 1) are perhaps the most challenging to treat. It is perceived as easier to manage excessive motion associated with over-pronation than managing the foot with significant lack of motion.

Figure 1
https://treadlabs.com

Hereditary motor and sensory neuropathies including cerebral palsy, myelodysplasia, peroneal nerve injury, but especially Charcot-Marie-Tooth (CMT) disease, are frequently expressed with an acquired cavusvarus foot which is characterized by a fixed increase of the plantar arch and hindfoot inversion.[1,2,3,4] Two-thirds of adults with symptomatic cavus foot have an underlying neurological condition, with Charcot–Marie–Tooth (CMT) disease the most frequently reported.[4]

Symptoms

Lower limb afflictions associated with CMT are often the earliest ones to arise, including distal muscle atrophy and weakness, which could result in foot drop, sensory loss, absent tendon reflexes, muscle cramps, and cavo-varus foot deformity.[5,6] A study involving 172 children found that symptoms included: foot pain in 66 (38%); leg cramps in 68 (40%); ankle instability during walking in 84 (49%); daily trips/falls in 82 (48%); sensory symptoms in 54 (31%). Foot drop was evident in 104 (60%) cases, difficulty heel walking in 146 (85%) and difficulty toe-walking was evident in 65 (38%) children. Sixteen (9%) children required Ankle-Foot-Orthoses to walk.[3]

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Prevalence

There is an estimated high arch prevalence of 10% among adults.[4,7] Others put the incidence a little higher at approximately 10% to 15%[8,9] of the population, with one reporting the incidence to up to 25%.[2] It has been suggested that the simple presence of bilateral cavovarus feet denotes a 76% chance of having CMT disease.[2]

Presentation

Pes cavus presents with an increase of normal plantar concavity, where the anterior and posterior weight-bearing areas of the foot are brought closer together. This is accompanied by a wide spectrum of foot deformities including a plantarflexed first ray, forefoot pronation and adduction, and hindfoot varus or high calcaneal pitch.[10]

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New Concepts and Studies

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These feet walk on the lateral border[11] and are incapable of absorbing shock or adapting to the terrain in advanced stages. The deformity can be mild, flexible, and painless, or severe, disabling, and rigid, with plantar calluses and lateral ankle instability.[1,10]

Global Observational Assessment

The deformities involved in cavus foot are complex and include the abnormal elevation of the medial arch, varus hindfoot, high calcaneal pitch, high-pitched midfoot, plantarflexed, claw toe, and adducted forefoot.[4,12] Hindfoot varus is confirmed through the 'peek-a-boo' heel sign, which is the clinical condition whereby the heel is visible on the medial side when viewing the patient from the front with the feet in neutral rotation.[10] Calluses are also usually present, mostly at the head of the first and fifth and base of the fifth metatarsals.[2]

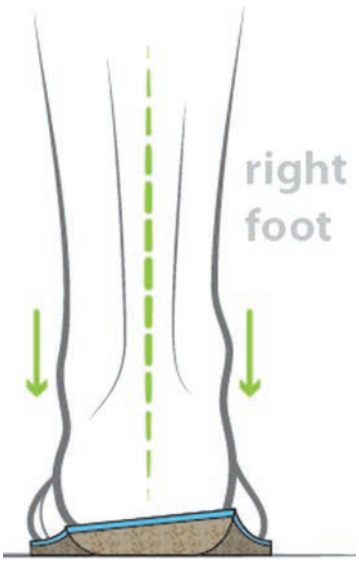

Figure 2
Orthobullets.com

Quantify Cavovarus Condition

In a study of all tests used to quantify the foot, the conclusion suggests the adoption of the six-item version of the Foot Posture Index scale (FPI-6) for foot assessment in the CMT population. FPI-6 is the only scale specifically developed for CMT patients being the most widely used scale assessing foot deformity and was employed in 27 studies included in the current review.[9] The total score can vary from -12 to 12, with 0 to 5 (normal foot), from 6 to 9 (pronated foot), from 10 to 12 (very pronated foot), from -1 to -4 (supinated foot) and from -5 to -12 (very supinated foot).[13]

Flexibility Assessment

The cavus may present as an isolated deformity of the forefoot, hindfoot, or it may be a combination of both.[1] The most frequent anterior pes cavus is characterized by lowering of the forefoot in plantarflexion.[10] The posterior cavus or calcaneocavus is characterized by an isolated high calcaneal pitch of greater than 30.[10]

The Coleman block test is used to assess the flexibility of the hindfoot, i.e., whether the cavus foot is caused by the forefoot or the hindfoot, and to determine if it is flexible or fixed. A block is placed under the lateral aspect of the patient's foot while the first ray is allowed to hang

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over the side. If the hindfoot varus remains, then the deformity is fixed. However, if the hindfoot corrects to (or towards) physiologic valgus, then the deformity is flexible and driven by the forefoot deformity.[1,4,10,11] There is clinical evidence that hindfoot correction of as little as 10° towards neutral can benefit from orthotic intervention, resulting in higher levels of function with less pain.

Local (Foot Orthotic) Intervention

To manage the too-rigid foot, use higher durometer materials in a biomechanical custom foot orthosis (Figure 2) to mobilize the foot and therefore make it a better shock absorber. In a forefoot-driven cavus with a supple hindfoot, correction of the plantarflexed first ray will allow the hindfoot varus to correct by way of a first ray recess or cut-out associated with a metatarsal bar and lateral forefoot post. Furthermore, in front of a hindfoot-driven cavus, the appropriate orthosis includes a lateral hindfoot-to-midfoot heel wedge with a first metatarsal recess and *minimal or absent* (emphasis added) medial arch support.[10] In order to accomplish that, CFOs were made of a 3.2 mm thick polypropylene shell, cut proximal to the metatarsal heads. A straight extrinsic ethylene-vinyl-acetate (EVA, Durometer: 55) rearfoot post, commonly used in clinical practice, was glued under the 14 mm heel cup and a lateral bar was glued under the lateral part of the CFOs in the gap between the rearfoot post and the anterior edge.[2,9]

Figure 3
Allard USA

Global (AFO) Intervention

In managing the cavovarus foot that already lacks some mobility, using molded plastic AFOs is contraindicated in that they would further limit mobility of the foot/ankle complex and further decrease power crossing the ankle.

Carbon composite energy return AFOs (ERAFO) are considered to be superior to plastic AFOs in terms of energy return capacity, light weight, and durability. The overall satisfaction of users is high, as the appearance is more modern and the function is superior to the existing orthoses.[14] For management of the cavovarus foot, CMT-related or not, a more supportive version of an ERAFO is the Blue Rocker carbon composite ERAFO.

The Blue Rocker ERAFOs (Figure 3) assists with correcting foot drop during swing phase of gait for individuals with anterior tibialis weakness, but also assists stance phase by controlling the forward motion of the tibia for individuals with plantarflexion weakness and assists with push off at terminal stance, which can improve balance, stride length,

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and gait speed.[15] In this pilot study, there was an immediate improvement in dynamic balance during ambulation with the use of these ERAFOs.[18] The improved tibial progress can contribute to improved push off at terminal stance, improved balance, stride length, gait velocity, and overall improved gait efficiency. These spring-like ERAFOs can reduce walking energy cost[16], thereby increasing walking stability and distance capacity for most patients.

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Summary

Cavovarus foot can be challenging in that they generally lack mobility and concurrently present with muscle weaknesses and imbalances. The foot can present as mild, flexible, and painless, or severe, disabling, and rigid. It is the prior rather than the later that is usually appropriate for conservative management. Foot orthotic intervention is a bottom-up approach designed to help maintain or even increase flexibility of the foot, while Energy Return AFOs are designed to provide top-down support to augment weak plantarflexor muscles and provide enhanced proximal stability during gait.

For questions or to further the discussion on cavovarus feet, Bob can be reached at robert44meier@gmail.com. **PM**

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