Corrective Osteotomies Used in Cavus Reconstruction

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KEYWORDS

• Pes cavus • Osteotomy • Cavovarus • Arthrodesis • First metatarsal

KEY POINTS

- Cavus and cavovarus foot types may have various etiologies, and understanding the diagnosis will help guide the treatment algorithm.
- Cavus foot pathomechanics are complicated and require the utmost work-up.
- Reconstructive osteotomy options have been described in the forefoot, midfoot, and hindfoot and must be applied based on patient needs.
- A complete reconstruction will often include osteotomies as well as tendon work and limited arthrodesis, and must be specifically tailored to each unique patient.

INTRODUCTION

Cavus foot and ankle reconstruction is complicated and must take into account many aspects of the disease and reconstruction. The etiology, flexibility, and progression need to be clinically assessed, and a full imaging and diagnostic work-up must be undertaken. Reconstructive options include soft tissue releases, lengthenings, and transfers, and most often these are accompanied with osseous correction. Depending on the needs of the patient and the pathologic features, osteotomies and arthrodeses will need to be considered. This article reviews reconstructive options, focused on the various osteotomies that can be utilized. Various options have been described in the forefoot, midfoot, and hindfoot, and often a combination or arthodesis adjunct will be performed as well.

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ETIOLOGY

Pes cavus or cavovarus foot types may typically present in a foot and ankle surgeon's office with or without a previous diagnosis of a neuromuscular condition or similar etiology. Therefore, it is paramount to determine the underlying etiology to understand the pathology and most predictable treatment. The typical etiology for a pes cavus foot type is one of neurologic, traumatic, or idiopathic origin. Common neuromuscular disorders associated include Charcot-Marie-Tooth disease (CMT), cerebral palsy, muscular dystrophy, and other peripheral sensory motor disorders.[1,2] Traumatic cases are more easily identifiable but may result from a multitude of injury patterns in adults and children.[3]

Understanding the etiology helps determine which surgical procedures to choose based on the disease. For instance, CMT is the most common hereditary motor sensory neuropathy and causes peroneal muscle atrophy and imbalance. There are 17 types of CMT, and the most common subtype is CMT1A, which is caused by a mutation or duplication in the peripheral myelin protein-22 (PMP22) gene. Progressive weakness of the peroneus brevis and tibialis anterior myotendinous units causes a cavovarus foot type noted by an overpowering tibialis posterior and peroneus longus, respectively. The recruitment of extensor hallucis longus as tibialis anterior weakens also creates a marked increase in arch height. The symptoms of foot drop and clawtoes also will develop as the disease worsens, and a high steppage gait is noted.[4,5]

When cerebral palsy is the key diagnosis, the physician must be aware of the spastic deformities, which occur as the most common form of the nonprogressive condition. Pes cavus and cavovarus foot deformities are usually accompanied by ankle equinus as well. Muscular imbalances are a critical component and involve the gastrocnemius–soleal complex, tibialis posterior, and tibialis anterior. Beyond the scope of this article, but prudent to understand, are the orthopedic deformities present in a patient diagnosed with cerebral palsy. The key is getting the diagnosis early in childhood and treating these patients with soft-tissue releases and tendon transfers. If the disease is in its later stages and becomes more rigid, oftentimes large osseous procedures and arthrodeses are performed.

Many forms of trauma can result in a cavovarus attitude of the foot and or ankle depending on the severity and level of incident. A subtle history of repetitive ankle sprains can result in significant injury to the peroneus brevis, which would in turn, allow compensation of the peroneus longus and increase in a forefoot deformity. Compartment syndrome in the deep compartment of the lower leg can result in a contracture of the tibialis posterior and flexor digitorum longus and flexor hallucis longus causing an irreducible cavovarus deformity at multiple levels. One complication related to talar neck fractures is a varus malunion, which locks the midtarsal joint and supinates the hindfoot significantly, causing forefoot compensation with a plantarflexed first ray.[3]

CAVUS BIOMECHANICS

Understanding the biomechanical component of each individual deformity is paramount and often difficult in a cavus foot or an ankle varus with a compensatory hindfoot. Biomechanically, a cavus foot type can be categorized into several different categories, and this helps the surgeon delineate the procedure of choice.

The common breakdown of cavus foot types is anterior, posterior, and mixed. Anterior cavus foot types may be flexible or rigid, and the apex of the deformity is seen at the tarsometatarsal or lesser tarsal joints. An associated pathology is metatarsus adductus, whereby all 5 metatarsals are in a valgus orientation and may present with a skew or Z-type forefoot. The first ray is also seen at a greater inclination to the