Lengthen, Alignment, and Beam Technique for Midfoot Charcot Neuroarthropathy

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KEYWORDS

• Charcot neuroarthropathy • Superconstructs • LAB technique • Osteomyelitis
• Hexapod • External fixation

KEY POINTS

- Charcot neuroarthropathy is a devastating and disabling pathology in the foot and ankle, particularly when affecting the midfoot.
- When the midfoot is affected, there is frequently development of a rocker-bottom deformity, owing to progressive subluxation and dislocation, primarily of the lateral column.
- Patients with midfoot Charcot neuroarthropathy, particularly those with current or prior ulceration, are at high risk for infection, amputation, and even mortality if the deformity is not addressed.

INTRODUCTION

Charcot neuroarthropathy is a devastating and disabling pathology in the foot and ankle, particularly when affecting the midfoot. Of the 30.3 million people in the United States currently diagnosed with diabetes, approximately 0.5% will develop Charcot neuroarthropathy at some point in their lives.[1,2] Sanders and Frykberg, as well as Brodsky and Rouse, classified the anatomic patterns of involvement in Charcot neuroarthropathy, and determined that the tarsometatarsal joint and/or midtarsal joints are most commonly involved.[3,4] The prevalence of the deformity at this anatomic location prompted Schon and Sammarco to each further classify midfoot Charcot in 1998.[5] When the midfoot is affected, there is frequently development of a "rocker-bottom" deformity, owing to progressive subluxation and dislocation, primarily of the lateral column. Additionally, the presence of an equinus deformity secondary to motor and sensory neuropathy and subsequent motor imbalance can increase forces in and on the midfoot, further

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contributing to collapse.[6] The Achilles tendon is also abnormal in diabetic patients secondary to glycation of the collagen fibers, causing increased stiffness and higher peak plantar pressures.[7] The abnormal plantar pedal pressure and shearing forces resulting from the midfoot deformity increases the risk of ulceration, osteomyelitis, and possible amputation.[8] A study by Sohn and colleagues[9] found that diabetic patients with Charcot neuroarthropathy alone had a risk of amputation 7 times greater than patients with neuropathic foot ulcerations and a risk of amputation 12 times greater if they had an ulcer secondary to the Charcot deformity. Thus, patients with midfoot Charcot neuroarthropathy, particularly those with current or prior ulceration, are at high risk for infection, amputation, and even mortality if the deformity is not addressed.

The goals in treating Charcot neuroarthropathy are to create a stable and plantigrade foot, with no open wounds or infection, that can be placed in a shoe or brace. However, these goals are not often achievable with conservative treatment in patients with midfoot pathology because of the propensity of the plantar tissue to break down, as well as the difficulty in finding shoe gear to accommodate the plantar prominence of the rocker-bottom deformity.[10,11] In these cases, surgical reconstruction of the foot is often required to restore function and decrease the risk of amputation secondary to ulceration and infection. There are many procedures that can be considered in treating midfoot deformities, ranging from plantar exostectomy and tendo-Achilles lengthening to realignment of advanced deformity with internal and/or external fixation. There is no available evidence in the literature that suggests the superiority of any proposed surgical intervention or fixation technique. In this article, we describe the approach we use in correcting midfoot Charcot deformities.

SURGICAL TECHNIQUE

Surgical correction of midfoot Charcot arthropathy is achieved via the 2-step lengthen, alignment, and beam (LAB) technique. The first step of the LAB technique involves acute correction of the equinus deformity and gradual correction of the deformity using computer-assisted hexapod external fixation. An Achilles tendon lengthening is performed first, to allow the rearfoot to be placed in a neutral position. This step is necessary to achieve anatomic correction of the midfoot. We generally prefer to perform an open tendo-Achilles lengthening. A percutaneous lengthening is indicated if there is a significant equinus deformity, owing to the ability to achieve a greater amount of lengthening.[12] The tendo-Achilles lengthening is performed via a medial incision to decrease the risk of complications to the neurovascular structures along the lateral aspect of the gastrocnemius aponeurosis.

Gradual correction and alignment is preferred, because it allows for the correction of significant multiplanar deformities while maintaining foot length and bone mass and reducing risk of neurovascular compromise. This approach can be used in either an acute or coalesced deformity; however, an osteotomy is required if the deformity is coalesced to allow for anatomic reduction of the bony segments. Ideally, the osteotomy should be placed at the apex of the deformity to allow for maximal correction. The type of osteotomy required depends on the deformity present and should be determined using preoperative radiographs. In actuality, the osteotomy can only be performed within the confines of the lesser tarsus, regardless of whether or not it corresponds with the deformity apex. It is our preference to perform open osteotomies in patients with a coalesced deformity, although percutaneous osteotomies can also be performed using a Gigli saw. Osteotomies are not typically required in cases where there is bony dissolution or nonunion of midfoot fractures, because the foot remains unstable and able to be manipulated. The hexapod external fixator is then applied