Staged Reconstruction of an Acquired Equinovarus Deformity Secondary to Nerve Injury and Lumbosacral Plexopathy

Case Report

Dr. Shane M Hollawell¹, Dr. Christopher M Heisey²* and Dr. Brendan J Kane²

¹Doctor of Podiatric Medicine, Adjunct Professor, Department of Orthopedics, Rutgers University Medical School, Robert Wood Johnson, New Brunswick, NJ, USA
²Doctor of Podiatric Medicine, Resident, Jersey Shore University Medical Center, Neptune, NJ, USA

*Corresponding Author: Dr. Christopher M Heisey, Doctor of Podiatric Medicine, Resident, Jersey Shore University Medical Center, Neptune, NJ, USA.

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Abstract

Neurologic damage from pelvic ring and sacral fractures is a well-documented injury. We report the case of a 70-year-old male with neurologic sequelae of a pelvic ring and sacral fracture affecting the function of the lower extremity causing an acquired drop foot and subsequent equinovarus foot deformity. We present the staged surgical correction including multiple soft tissue balancing procedures, ligament stabilization and tendon transfer, in combination with realignment osteotomy and joint arthrodesis procedures.

Keywords: Equinovarus; Neurologic Sequelae; Tendon Transfer; Drop Foot

Introduction

Neurologic injuries from pelvic ring and sacral fractures is a well-documented sequelae. Most of the literature regarding pelvic injuries has focused on the nerves affected, the motor/sensory findings, and the recovery prognosis. The most frequently associated nerve injuries involve the L5 or S1 nerve roots [1]. Injury to the deep branch of the peroneal nerve or to the L5 nerve root results in primary peroneal muscle weakness and diminished dorsiflexory and eversion strength [2]. This enables the actions of the tibialis posterior and long toe flexor muscles to be unopposed, resulting a varus hindfoot and forefoot contracture [2]. With damage to the L5 and S1 nerve roots, other muscles in the distal leg can be affected and significantly weakened by the proximal nerve injury.

Given the specific pelvic and sacral fracture pattern, the nerves involved and residual motor deficits are consistent with previously published orthopedic literature. Reilly, et al. reviewed 90 patients with unstable fractures of the pelvic ring [1]. Neurologic injuries were seen in 21% of patients [1]. According to Reilly, et al. 37% having sensory deficits and the remaining 63% had motor and sensory deficits. In the patients with motor dysfunction, the majority involved L5 or S1. L5 function was least likely to progress to full recovery [1]. After recovery from pelvic girdle trauma, 21% of the neurological deficits persisted [3]. Injury to the lumbosacral trunk is predominant in fractures of the pelvis and the most frequent sequelae are paresthesia of the hallux extensor and gluteus medius muscles [3]. Denis, et al. classified sacral fractures by the location of injury. Three different zones were identified as having characteristic presentations: Zone 1, in the region of the ala, which was associated with partial damage to the fifth lumbar root and had an incidence of 5.9% [4]. Zone 2 fractures occurred in the region of the sacral foramina led to injuries the ventral roots of L5, S1, S2 and had an incidence of 28.4% [4].
Zone 3 which occurred in the region of the central sacral canal, had a 56.8% incidence of injury to L5 and/or S1 [4]. Kabak, et al. retrospectively reviewed the outcomes of 40 patients with unstable pelvic fractures and 7 sustained neurologic injury [6]. Two out of these patients required a posterior tibial tendon transfer for a residual foot deformity [6].

In this case study, we detail the surgical techniques utilized for the staged reconstruction of drop foot and acquired equinovarus foot deformity that resulted from a pelvic ring and sacral fracture.

Case Report

A 70-year-old male fell approximately 20 feet sustaining a severe vertical shear pelvic fracture, severely comminuted zone 3 sacral fracture, left 5th MPJ dislocation, and L5-S1 nerve injury. Upon presentation, he was noted to have neurologic compromise with documented L5-S1 nerve injury. The patient was initially placed in distal femoral traction pending stabilization of the pelvic ring. The patient had severe comminution of the sacrum and sacral ala with significant instability in a vertical translation of the left hemipelvis. Open treatment of the sacral fracture and posterior lumbosacral fusion with posterior spinal fusion L4-L5, L5-S1 was performed. Several days after the injury, a percutaneous left iliosacral screw was placed and open reduction, internal fixation of the pubic symphysis was performed.

After fixation of the multiple orthopedic issues, the patient subsequently developed a left ankle drop foot and a left foot equinovarus contracture (Figures 1 and 2). The patient had significant difficulty with ambulation secondary to his weakness and foot position. Manual muscle testing revealed grades of 0/5 eversion or peroneal strength, 0/5 strength to the extensor hallucis longus muscle, and 1/5 strength to the tibialis anterior muscle. Electromyography testing revealed abnormal results, most consistent with axonal motor lumbosacral plexopathy at the L5-S1 nerve roots. Denervation was seen throughout the L5-S1 myotomes in the left limb. Magnetic resonance imaging of the foot and ankle showed a chronically torn anterior talofibular ligament and calcaneofibular ligament. The peroneal and extensor tendons, however were intact.

Approximately 4 months after the patient’s initial injury, reconstructive surgery for correction of his equinovarus foot type was performed. The posterior tibial tendon (PTT) was transferred by releasing it at the insertion of the navicular tuberosity. The tendon was then rerouted through percutaneous incisions made overlying the medial malleolus, distal tibial-fibular joint, and the dorsum of the foot. A channel was created in the interosseous membrane to transfer the PTT anteriorly. The PTT was securely transferred to the lateral cuneiform with a tenodesis screw. The flexor digitorum longus (FDL) tendon was released at the Master Knot of Henry. The FDL tendon was then transferred into the navicular tuberosity with a bone anchor. A percutaneous triple-hemisection of the Achilles tendon was performed.

Figure 1: Pre-operative clinical appearance of the foot deformity.
also performed. A repair of the lateral ankle ligament complex was performed with a modified Brostrom-Gould procedure. Additional reduction was necessary and further manipulation of the foot and ankle was performed gradually over time via a medial and lateral external fixator device. The external fixation devices allowed the foot to be corrected acutely and then more gradually in a more rectus alignment (Figure 3).

The patient’s complete loss of peroneal muscle power persisted. An ankle foot orthosis (AFO) device with lateral suspender was trialed for loss of eversion power. Slight rearfoot varus and adduction in the midfoot/metatarsus adductus persisted. In order to further reduce this residual deformity, a secondary procedure was performed at 12 months after the initial injury. A lateralizing calcaneal slide osteotomy was performed in combination with a calcaneocuboid arthrodesis (Figure 4). At a final follow-up of 26 months, after the initial injury, the patient is ambulating pain free with continued use of an AFO brace with a lateral suspender. He has a rectus foot type with a mild residual metatarsus adductus deformity (Figure 5). He continues to have loss of peroneal and EHL muscle power but is able to actively dorsiflex his ankle to 5 degrees as a result of the posterior tibial tendon transfer.

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Figure 4: Post-operative radiographs.

Figure 5: Post-operative clinical appearance of the foot/ankle.

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Discussion

Our experience with the correction of the equinovarus foot deformity is similar to the existing literature. Nonsurgical treatment for equinovarus deformity includes static stretching, dynamic splinting, and serial casting to correct the deformity [8]. Patients with muscle weakness often benefit from a full-length custom ankle-foot orthosis to prevent foot drop [2]. However, this patient in particular was unable to obtain a walkable plantigrade foot with conservative treatment.

In 1954, Watkins., et al described posterior tibial tendon transfer through the interosseous membrane between the tibia and fibula to the dorsum of the foot to treat a number of neurologic disorders [5]. A posterior tibial tendon transfer has been used successfully to correct equinovarus deformity in spastic disorders, leprosy, clubfeet, and polio. This transfer removes the deforming force and additionally assists dorsiflexion during the swing phase of gait [5].

Most of the literature regarding correction of the equinovarus deformed foot is in patients with cerebrovascular disease or cerebral palsy. Children who have cerebral palsy commonly have a spastic equinovarus deformity of the foot. The adducted position of the forefoot and varus position of the heel decreases the available weight bearing surfaces of the foot which leads to significant difficulty with ambulation [7]. Overactivity of the posterior tibial muscle is considered the primary cause of the varus position of the heel and the adducted forefoot [7]. However, in our case the deformity was a direct result of 0/5 graded muscle/tendon strength to unopposed posterior tibial tendon. Root., et al found good or excellent results in 41 of 57 feet in patients treated with posterior tibial tendon transfer in CP patients [7].

In the equinovarus foot, contractures affect the structures of the plantar and medial foot [2]. A tight heel cord can be addressed with either a gastrocnemius recession or heel cord lengthening. A tendoachilles lengthening on its own is rarely sufficient because the tight tibialis posterior tendon will worsen the varus heel position [2]. Soft tissue surgery is aimed at balancing the strength of the invertors and evertors of the foot and may include split/whole transfer or lengthening of the anterior and/or posterior tibialis tendons [9]. Appropriate releases or tendon transfers allow the foot to be brought into a neutral position improving the effectiveness of bracing and in this case gave the patient the ability to actively dorsiflex the ankle again.

The correction of rigid varus deformities requires osseous procedures such as hindfoot and midfoot osteotomies, or combination of those procedures or arthrodesis, [9]. The laterализing calcaneal osteotomy can effectively reduce the varus moment arm of the Achilles tendon at the ankle during stance phase and reduce the contribution of the Achilles tendon toward tibialis posterior in favor of the peroneus brevis during toe off [2]. An osteotomy is indicated for a mild to moderate fixed deformity that persists after appropriate tendon releases in a patient without arthritic changes in the surrounding joints [2]. The calcaneal-cuboid arthrodesis assisted heavily in reducing the persistent midfoot adduction deformity and was performed to provide a permanent correction.

Rapid restoration of an equinovarus foot to a neutral position surgically can increase skin and neurologic complications. Philbin advocated for use of a multiplanar external fixator to correct the deformity in a controlled progressive manner, helping prevent skin breakdown and further neurologic issues [10]. Redfern., et al. reported on managing patients with a fixed equinovarus deformity by an Achilles lengthening with posterior tibial tenotomy and immediate weightbearing [8]. All patients in their article had significant improvement in ambulatory status that allowed for postoperative weightbearing to a plantigrade foot [8].

Conclusion

In this case study, we present our surgical techniques involving a staged reconstruction with multiple soft tissue and osseous procedures for an acquired equinovarus foot deformity and associated drop foot secondary to an L5-S1 nerve injury. The patient was treated successfully and now has a balanced, plantigrade foot with improved ambulatory and pain status.
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Bibliography


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