Peroneal Nerve Injury with Foot Drop Complicating Ankle Sprain
A Series of Four Cases with Review of the Literature

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Abstract

Foot drop has many etiologies. One rarely mentioned and often neglected reason for foot drop is an acute inversion sprain of the ankle. Over the past 14 years, a collection of 32 cases of foot drop have been compiled in our orthopaedic and physiatric practices. All cases had appropriate evaluations, including electrodiagnostic studies (electromyography and nerve conduction studies) to determine the location and type of injury. Treatment and follow-up are also discussed. Of the 32 case studies, four were caused by a straightforward acute inversion sprain of the ankle. These cases are described with the electrodiagnostic evaluations, treatments, and outcomes. Proposed mechanisms for this type of foot drop are discussed, including traction and compression of the common peroneal nerve as it winds around the neck of the fibula, and possible compression by hematoma. Surgical versus conservative treatment is described. The functional impairment associated with foot drop is detailed.

Foot drop may present a serious functional impairment. Often associated with common peroneal nerve (CPN) dysfunction, it is caused by paresis of the ankle dorsiflexor, the tibialis anterior, and the toe dorsiflexors, the extensor digitorum brevis and extensor hallucis longus. Clinically, foot drop can be seen with the characteristic “steppage gait,” in which hip and knee flexion are increased; “hip hiking” can occur to allow the weak ankle to clear the floor during the swing phase of gait. Less noticeable dysfunction associated with drop foot includes paresis of foot eversion and sensory impairment on the dorsum of the foot and lateral leg.

A brief review of the anatomy can easily elucidate the dysfunction an injury to the CPN will carry. In the posterior thigh, the sciatic nerve divides into two parts at the proximal popliteal fossa: the CPN laterally and the posterior tibial nerve medially. The CPN continues to proceed laterally, where it passes behind the fibular neck. At this point, the CPN passes under a fibrous edge of the peroneus longus muscle origin, and then proceeds distally, dividing into superficial and deep peroneal branches. The superficial peroneal nerve gives off branches to the peroneus longus and brevis, ankle evertors, then distally supplies sensation to the lower anterolateral leg and most of the dorsum of the foot. The deep peroneal nerve runs anteriorly, supplying motor branches to the tibialis anterior, extensor hallucis longus and extensor digitorum brevis, ankle and toe dorsiflexors, and finally the peroneus tertius, a minor ankle evertor. It also supplies a small patch of sensation to the dorsal surface of the web space between the hallux and second toe. In summary, lesions of the CPN will cause foot drop, weak or absent ankle eversion, and sensory deficits over the anterolateral leg and dorsum of the foot.

The CPN is the most frequently injured nerve in the lower extremity and the most common cause of foot drop. Nevertheless, ankle sprain, albeit rarely, also has been cited as a cause of foot drop. Few reported cases have been documented and a review of the literature turned up only 16 cases of foot drop attributed solely to ankle sprain. Fewer cases still, only six, have been examined by electrodiagnostic evaluation. Nitz and colleagues report a series of 66 patients who had a diagnosis of inversion ankle sprain and subsequently underwent electromyography (EMG) evaluation. Although 17% of grade II sprains and 86% of grade
III sprains sustained common peroneal nerve abnormalities electrophysiologically, none were described with foot drop.

The purpose of the present study is to report a series of four cases seen in the combined practices (orthopedic surgery and physiatry) of the investigators over 14 years, with the primary diagnosis of foot drop caused by inversion sprain. Twenty-eight different cases of foot drop from other etiologies were also seen in these same practices. All foot drop cases that resulted from ankle sprain were evaluated with EMG and nerve conduction studies (NCS). Clinical outcomes are reported as well as probable mechanisms of common peroneal nerve injury from inversion ankle sprains.

Case Descriptions

Thirty-two patients with a primary diagnosis of foot drop were referred to our offices from 1993 to 2007. Of the various etiologies for foot drop among our patients, four appeared to have resulted from a simple inversion ankle sprain. Three other sprains had additional injuries. Two of these were accompanied by fractures. The third case included a tear of the Achilles tendon, a tibial nerve injury, and complex regional pain syndrome. The 25 remaining cases of foot drop unrelated to ankle sprain had an assortment of etiologies. A summary of this series of four patients with foot drop resulting from ankle sprain were evaluated with EMG and nerve conduction studies (NCS). Clinical outcomes are reported as well as probable mechanisms of common peroneal nerve injury from inversion ankle sprains.

Case 1 presented as a chronic foot drop from a severe ankle sprain 4 years earlier. EMG and NCS showed axonotmesis of the CPN. Following surgical intervention and decompression of the nerve, partial motor but no significant sensory function returned. Finally, Case 4, which had significant axonotmesis of the CPN, underwent surgical decompression, and demonstrated improved sensation but little change in motor function.

Discussion

The most commonly injured joint of the lower extremities is the ankle.18,19 In the United States, 85% of acute ankle trauma is described as sprain,20 the vast majority of which are of the plantar flexion-inversion type.19 Few studies, however, have described foot drop as a sequela of ankle inversion sprain. Oppenheim 21 first reported a case of peroneal palsy complicating ankle sprain nearly 100 years ago. Since that time, at least 53 documented cases have associated CPN injury with ankle sprain. However, only 16 patients had foot drop and only six of these underwent electrodiagnostic evaluation to localize the site of the neuropathic lesion at the neck of the fibula.7,13-16 Besides paresis or paralysis of ankle dorsiflexion (foot drop), common peroneal injuries will also affect foot eversion. In addition, paresthesias occur in the lateral leg and over the dorsum of the foot. There is often marked tenderness at the fibular neck as well.

Foot drop has also been known to occur with deep peroneal nerve injury. This can be distinguished clinically from CPN etiologies in that reduced sensation is confined to the small patch of the first web space on the dorsum of the foot. Also, foot eversion is preserved. Gabison and Gentile22 describe a case of acute foot drop after ankle sprain, in which the peroneus longus muscle was ruptured. This resulted in a compartment syndrome from an expanding hematoma.

### Table 1 Summary of Patients with Foot Drop after Ankle Inversion Sprain

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age &amp; Sex</th>
<th>Complications</th>
<th>Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21 M</td>
<td>None</td>
<td>Casted 3 weeks, surgical decompression at 6 weeks, AFO</td>
<td>Full recovery at 14 weeks post-injury</td>
</tr>
<tr>
<td>2</td>
<td>39 M</td>
<td>None</td>
<td>AFO</td>
<td>Full recovery at 3 months</td>
</tr>
<tr>
<td>3</td>
<td>76 M</td>
<td>None</td>
<td>AFO, surgical decompression at fibular neck</td>
<td>Partial recovery of ankle dorsiflexion and leg sensation Unimproved foot sensation</td>
</tr>
<tr>
<td>4</td>
<td>44 M</td>
<td>None</td>
<td>AFO, surgical decompression at fibular neck</td>
<td>Partial recovery of sensation Dorsiflexion remains weak at 6 months</td>
</tr>
</tbody>
</table>

### Table 2 Electrodiagnostic Findings

<table>
<thead>
<tr>
<th>Patient</th>
<th>Electrodiagnostic Findings (EDx)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Neurapraxia of common peroneal nerve at fibular neck</td>
</tr>
<tr>
<td>2</td>
<td>Axonotmesis of common peroneal nerve at fibular neck</td>
</tr>
<tr>
<td>3</td>
<td>Axonotmesis of common peroneal nerve at fibular neck</td>
</tr>
<tr>
<td>4</td>
<td>Axonotmesis of common peroneal nerve at fibular neck</td>
</tr>
</tbody>
</table>
with elevated pressures in the anterior compartment as well as the lateral compartment distal to the CPN. The proximal deep peroneal nerve was affected. After fasciectomy, sensation and ankle motion were restored. Anterior compartment syndrome due to elevated pressures from excessive exercise or other soft tissue injuries has been reported. Any direct trauma or pressure upon the deep peroneal nerve can also result in foot drop.

Ankle sprains have also been associated with injury to the superficial peroneal nerve. The level of injury here, however, is thought to be at the ankle. The superficial peroneal nerve appears to be compromised via a traction mechanism, as noted in a recent cadaver study of ankles by O’Neill and coworkers. Redfern and associates found that 15% of ankle fractures suffer some type of superficial peroneal nerve injury. Ligamentous damage caused by inversion sprain, especially to the anterior talofibular ligament, produces additional risk of superficial peroneal nerve injury. Clinically, however, superficial peroneal nerve injury does not produce foot drop. It primarily causes persistent ankle pain and tenderness, as well as sensory impairment over the dorsum of the foot.

In the present series of four patients with foot drop and in similar previously cited cases, the level of nerve injury was at the neck of the fibula. As noted, the CPN is essentially tethered there by a thick fibrous band at the origin of the peroneus longus. Inversion of the ankle is therefore thought to produce a sudden forceful traction, leading to compression of the nerve between the bony fibular neck and this fibrous band. A delay in symptomatic foot drop after injury, however, has also been explained by a developing and expanding hematoma in the peroneal sheath at this level or due to rupture of the associated vas nervorum.

Electrodiagnostic evaluation of foot drop caused by CPN injury at the neck of the fibula can show neurapraxia (a temporary conduction block), axonotmesis (axonal loss) and reduced motor conduction velocity. Motor dysfunction can also be revealed as denervation of affected muscles distal to the point of injury, which is seen on needle electromyography.

Neurapraxic lesions have good prognoses, usually with full recovery of nerve function. With axonal loss, improved function is also seen, but the prognosis is less certain. Most uncomplicated cases show at least partial if not full recovery. Chronic lesions, lesions with severe axonal loss, and those with additional injury to the ankle fare less well.

Three patients in our series of four underwent surgical decompression. Surgical exploration with decompression and neurolysis of the CPN are most often performed for severe foot drop, progressive symptoms, or for those who show no improvement. We recommend that a foot drop which shows no sign of improvement after 4 to 5 weeks of conservative treatment should undergo surgical decompression and neurolysis.

Regardless of surgical treatment, however, patients with foot drop should be prescribed an ankle foot orthosis (AFO) to achieve a near normal, safe gait pattern. In addition, the AFO secures and stabilizes the ankle and expedites recovery from ankle sprains.

A recent study by deBruijn and colleagues, in which patients with foot drop were prescribed AFOs, revealed that AFO use eventually declined. This happened as clinical improvement occurred, due to brace discomfort, or substitute use of alternate orthopedic footwear.

Conclusions

An often overlooked cause of foot drop is ankle inversion sprain. Thirty-two cases with foot drop were evaluated, four of which were caused by injury to the common peroneal nerve at the neck of the fibula after ankle sprain. Medical personnel, such as orthopedic surgeons, physiatrists, podiatrists, emergency room physicians, primary care physicians, physician assistants, athletic trainers, physical therapists, and others who may see patients with ankle injuries, should be aware of possible associated nerve injury so that proper evaluation and treatment can proceed.

Disclosure Statement

None of the authors have a financial or proprietary interest in the subject matter or materials discussed in the manuscript, including, but not limited to, employment, consultancy, stock ownership, honoraria, and paid expert testimony.

References