

Foot Drop: Etiology, Diagnosis, and Treatment

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Received: November 21, 2019; **Published:** December 11, 2019

Introduction

Foot drop (sometimes referred to as “drop foot”) refers to an inability to lift the forefoot due to weakness of the dorsiflexors. This condition may be the result of a muscular, skeletal, or nervous system problem. To develop a treatment plan for foot drop, a full evaluation and determination of the cause must be completed for each patient. Just as foot drop can have many causes, foot drop treatment can take many forms [1,2].

Etiologies

1. **Compressive disorders:** Compressive etiologies are the most common cause of peroneal nerve palsies. These occur anywhere along the course of the nerve. Compression of the common peroneal nerve at the level of the fibular head is the most common site of entrapment. This is due to the presence of a bony prominence at the fibular head, as well as superficial positioning of the nerve at this level with frequent tethering of the nerve by the peroneus longus tendon in the fibular tunnel. However, peripheral compression can also occur at the hip or ankle.
2. **Trauma:** Traumatic injuries are the second most common cause of peroneal nerve palsy. These often occur in association with orthopedic injuries such as knee dislocations, severe ankle inversions, fractures, blunt trauma, as well as musculoskeletal injuries with nerve traction or direct nerve laceration.
3. **Compartment syndrome:** Compartment syndromes affecting the leg, either due to trauma or related to ischemia-reperfusion injury, can lead to peroneal nerve ischemia with subsequent foot drop.
4. **Iatrogenic:** Foot drop secondary to iatrogenic causes is seen most frequently due to surgical procedures or protracted positioning in anesthesia, although other causes such as prolonged bed rest, splinting, and even pneumatic compression devices have been implicated as a cause.
5. **Neurologic disorders:** Primary and secondary neurologic disorders are other causes of foot drop. Charcot-Marie-Tooth, a primary peripheral nerve disorder occurring in 1 in 2500 people, is the most commonly inherited peripheral nerve disorder. It affects both sensory and motor nerves. Presentation usually occurs during childhood or early adulthood, although it may present later in life.

Clinical features

Foot drop, which refers to an inability to lift the forefoot due to weakness of the dorsiflexion muscles in the foot, may be partial or complete, developing acutely or over a period of days to weeks. The presence of foot drop is associated with a number of etiologies.

Physical examination

The physical examination includes a full sensorimotor and vascular evaluation of the lower extremity, evaluating for signs of trauma, previous surgery, vascular insufficiency, ulcers, and edema. Familiarity with the sensory and motor innervation of the nerves in the leg is essential to accurately interpret physical examination findings.

Diagnosis

A diagnosis of foot drop is generally clinically apparent from the history and physical examination. Extremity imaging is useful for ruling out fracture or other anatomic abnormalities, to help identify a likely etiology. Most patients will undergo electromyography (EMG), unless there has been an obvious traumatic nerve transection.

Imaging: Extremity imaging (e.g. plain radiography or computed tomography [CT]) is useful to evaluate for fractures, masses, arthritis, or tumor if the medical history suggests one of these etiologies. Magnetic resonance (MR) imaging of the lumbar spine, knee, or ankle may be considered to evaluate for potential soft tissue lesions that may be compressing a nerve. Later-generation MR technology may even allow characterization of the nerve (e.g. increased nerve dimension, deformation of the nerve, or loss of nerve integrity).

Electrodiagnostic studies: EMG and nerve conduction studies (NCS) can also be helpful in localizing the lesion. Motor nerve conduction studies of the peroneal nerve and tibial nerve and sensory nerve conduction studies of the sural and superficial peroneal nerves are recommended.

EMG typically examines at least two muscles innervated by the deep peroneal nerve (e.g. tibialis anterior, extensor hallucis longus) and at least one muscle innervated by the superficial peroneal nerve (e.g. peroneus longus, peroneus brevis).

EMG studies may also be performed on the tibialis posterior, another muscle innervated by the tibial nerve (e.g. medial head of gastrocnemius) and the short head of the biceps femoris to identify more proximal lesions. If these findings are abnormal, further testing should be conducted on the more proximal muscles innervated by the sciatic nerve, gluteal muscles, and lumbosacral muscles to identify the level of lesion.

Treatment

1. **Approach to the patient:** A number of surgical and nonsurgical treatment options are available for the management of foot drop. The approach to the patient depends upon the etiology of foot drop and the localization of the lesions. Treatment plans are individualized based upon the evaluation and diagnostic findings.
2. **Conservative care:** The goal of conservative management is to stabilize the gait and prevent “after slap into”, as well as to prevent contracture of the denervated muscles [3]. Conservative care includes physical therapy and/or splinting, and pharmacologic therapy to manage neuropathic pain, as needed. Patients are followed for signs of possible improvement with interval electromyography (EMG).

Surgical intervention may be indicated if there are no signs of improvement or further deterioration is observed. Surgical treatment should be offered within three to six months after the onset of symptoms.

3. **Physical therapy:** Physical therapy focuses on stretching and strengthening both the muscles affected by the palsy, as well as the opposing musculature.

4. **Splinting:** Splints and braces are used in conjunction with physical therapy to optimize treatment outcomes. Different types of footwear and splints are used, depending on the location of the nerve injury and the extent of physical manifestation of peroneal nerve dysfunction.
5. **Pain management:** Pain management may include topical analgesics, as well as selective serotonin reuptake inhibitors, antiepileptics, opioids, or μ -receptor agonists.

Surgical management

1. **Nerve repair:** A lacerated nerve may undergo direct primary repair if there is a minimal gap between the ends of the nerve. If primary repair is not possible due to a significant gap, using an autologous nerve graft (most commonly using the sural nerve) is recognized as the standard of care. If the nerve gap is less than 3 cm, a nerve conduit, which is an alternative to autologous nerve grafting, can be used with similar results.
2. **Neurolysis:** Cases of foot drop caused by compressive disorders should undergo decompression surgery based on the cause and location of the nerve palsy. Nerve decompression and neurolysis should be offered to relieve compression at the fibular head, fibular tunnel, or any other anatomic areas that are a source of pressure.
3. **Nerve or tendon transfer:** Nerve transfers and tendon transfers play an important role in improving dorsiflexion in cases of foot drop where there is significant nerve dysfunction, such as when nerve decompression or direct nerve reconstruction with primary repair or grafting has failed or would result in poor outcomes. Nerve transfer can restore ankle dorsiflexion with minimal morbidity. Patients with limited improvement after nerve transfer still have the opportunity to undergo tendon transfer. Some surgeons may also choose to perform a combined nerve transfer/tendon transfer procedure.
4. **Ankle fusion:** Ankle fusion, also known as arthrodesis, is reserved for patients who are not candidates for any of the above-mentioned treatments, or who have failed treatment. With this procedure, the ankle is fused in the 90-degree position relative to the tibia either through a tibiotalar fusion or a pantalar fusion. This procedure is considered the last resort in foot drop treatment as all motion is removed from the ankle joint.

Outcomes

Left untreated, foot drop leads to reduced mobility and overall functioning, which in association with chronic pain can severely impact a patient's quality of life.

When foot drop is confirmed to be due to compression of the common peroneal nerve, decompression surgery is very effective for improving motor strength, decreasing pain, and improving sensory impairment, with low associated morbidity. Although direct nerve repair is not always a feasible surgical treatment option for common peroneal nerve injuries, it can provide properly selected patients with significant functional improvements postoperatively. Direct repair of common peroneal nerve injuries achieves grade 3 or better functional outcomes in 84 percent of patients (grade 3: peronei muscles and anterior tibial muscles contract against gravity and some resistance; grade 4: peronei muscles and anterior tibial muscles contract against moderate resistance; grade 5: peronei muscles and anterior tibial muscles contract against great resistance).

A study that evaluated the long-term results of patients who underwent tendon transfers for foot drop correction found near-normal load distribution on gait analysis with almost all patients being able to walk without visible limping or the need for orthotic devices.

Patient satisfaction was high, and most patients reported a significant increase in quality of life, with greatest improvements noted in symptom-related quality of life, recreational activity, walking, private life, and fitness for work.

Nerve transfers also provide appropriately selected patients with significant improvements in range of motion and restored walking ability. In a review of patients who underwent nerve transfers of either the superficial peroneal nerve or the tibial nerve fascicles, significant clinical improvements in ankle dorsiflexion, eversion, and toe extension were identified in 80 percent of their patients. The remaining 20 percent of patients experienced good improvement in ankle eversion, but poor or no ankle dorsiflexion [4-10].

Summary and Recommendations

- Foot drop refers to an inability to lift the front part of the foot due to weakness of the dorsiflexion muscles in the foot. This may be the result of a muscular, skeletal, or nervous system problem. An understanding of the anatomy and innervation of the leg is essential for understanding the potential causes of foot drop.
- To ensure accurate diagnosis and proper treatment planning, the evaluation should include a review of medical history and physical examination, as well as lower extremity imaging and electrodiagnostic studies, when appropriate.
- The initial treatment approach for many cases of foot drop is nonsurgical and includes physical therapy, splinting, and pain management.
- Timing for surgical treatment varies depending on the etiology of foot drop. For nerve transection (traumatic, iatrogenic), surgical nerve reconstruction should ideally occur within 72 hours of the injury. For other etiologies, surgical intervention may be indicated if there are no signs of improvement, or if further deterioration is observed. When indicated, surgical intervention should be offered within three to six months after the onset of symptoms.
- Nerve reconstruction may be performed using primary nerve repair techniques, an autologous nerve graft, or nerve conduits, depending upon the severity of nerve injury. Nerve decompression and neurolysis should be performed for patients with a confirmed nerve compression. Nerve transfers, tendon transfers, and combined procedures play an important role in cases of significant nerve dysfunction. Patients who are not a candidate for or who do not improve from the above-mentioned procedures may experience pain relief and improved function following ankle fusion.

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Volume 11 Issue 1 January 2020

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