



# The Use of AFOs to Treat Sports Injuries

These devices are superior to walking boots.

BY DOUGLAS H. RICHIE, JR. DPM

*Note: All photos courtesy of Richie Technologies*

## Introduction

Prior to 1996, ankle-foot orthoses (AFOs) were rarely prescribed or dispensed by podiatric physicians. Today, podiatric physicians account for almost 40% of the total volume of all of these devices dispensed to Medicare beneficiaries alone.<sup>1</sup> Podiatric physicians prefer dispensing AFOs for disabling conditions such as adult acquired flat-foot, degenerative arthritis and drop foot, which are more likely to affect older, less active patients.<sup>2</sup> However, an overlooked application of AFO bracing is the treatment of common sports injuries of the lower extremity. Recognizing the potential benefit of AFOs to enhance the treatment of tendon, ligament, and bone injury, podiatric

categories: Lace-up or gauntlet-style braces, stirrup ankle braces, and articulated stirrup ankle braces. These are all pre-fabricated devices which are primarily used in the treatment and prevention of ankle sprains. These devices would not be considered to be ankle-foot orthoses, which are the focus of this article.

Ankle-foot orthoses appropriate for treatment of sports injuries can take the form of either pre-fabricated or custom fabricated designs. A “podiatric AFO” emerged in the late 1990s designed by a podiatrist to address the



Figure 1: Podiatric AFO

an ankle-foot orthosis can perform these functions with better efficacy, better patient compliance, and much higher patient satisfaction.

## Why Not Just Use a Walking Boot Instead of an AFO to Treat Sports Injury?

Walking boots are heavy, cumbersome and fix the ankle position, which leads to balance issues and progressive muscular atrophy. While walking boots are relatively cheap and

easy to implement for acute injury, their feasibility for long-term use by the patient poses serious challenges.

Many common foot and ankle sports injuries do not require rigid, strict immobilization of the ankle joint. Allowing dynamic motion is an important criterion for tendon and ligament healing. At the same time, the rigid immobilization of a walking boot prohibits driving an automobile if worn on the right lower extremity. The height of walking boots can cause a significant limb-length discrepancy which can lead to knee, hip, and low back pain. In short, most AFO devices circumvent these challenges of walking boots and should be considered, especially when treatment time is expected to exceed three to four weeks. For long-term treatment and successful healing, patients must be comfortable in order to be compliant with immobilizing devices.

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## Allowing dynamic motion is an important criterion for tendon and ligament healing.

physicians can enhance their status as the premier sports medicine specialists of the foot and ankle.

## Terminology

An ankle foot orthosis (AFO) is any orthosis that covers the lower leg, spans the ankle joint, and covers a substantial portion of the foot.<sup>3</sup> An ankle brace is an orthosis which covers a smaller portion of the lower leg, spans the ankle joint, and does not cover or support a substantial portion of the foot.<sup>4</sup>

Ankle braces basically fall into three

shortcomings of traditional AFO devices. This brace incorporated a custom balanced foot orthotic which mimicked the traditional design of a “Root orthotic”—addressing arch contour, molding of the heel cup, and posting of forefoot and rearfoot deformities (Figure 1).

Pre-fabricated walking boots are already used to a large extent in podiatric practice to treat a myriad of acute injuries including sprains, fractures, and tendinopathy. It is actually a recognition of this widespread application of walking boots to treat sports injuries which opens up discussion of why and how



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## Top Sports Injuries Treated with AFO Devices

### 1) The Ankle Sprain

The current standard of care in the treatment of the ankle sprain is weight bearing with protected immobilization of the ankle joint.<sup>5,6</sup>

Rigid immobilization has detrimental effects on ligament healing while devices which allow some range of motion appear to gain better outcomes when used to treat the acute ankle sprain.<sup>7</sup>

It is now recognized that ligaments around the ankle require a minimum of 12 weeks to achieve any degree of significant strength and that protection of the injured ankle should extend for three to six months after a Grade 2 or Grade 3 ankle sprain.<sup>8</sup>

It is also recognized that protection of the lateral collateral ankle ligaments requires more than simple restriction of ankle inversion.

Studies of the mechanism of the lateral ankle sprain have confirmed that inversion injuries are always accompanied by some degree of internal rotation of the foot along with external rotation of the ankle.<sup>9,10</sup>

Adequate protection of injured ankle ligaments requires support of the foot in both the transverse

and frontal planes. Pre-fabricated ankle braces provide almost no foot support, while ankle-foot orthoses can extend across the entire plantar surface of the foot to prevent inversion/eversion as well as adduction/abduction.

Ankle-foot orthoses are gaining popularity in the sports medicine community to treat acute ankle sprains as well as treat chronic ankle instability. The benefits of custom hinged AFO devices over traditional sport braces are:

- Custom contoured footplate allows precise control of abnormal foot and ankle movements, particularly internal/external rotation.

- Limb uprights control internal and external rotation of the tibia.

- Full flexion ankle hinges allow pure sagittal ankle motion without compromising athletic performance.

- Custom contouring of the brace optimizes shoe fit compared to standard lace up sport braces.

fiber AFO device can adequately immobilize the ankle and protect the injured Achilles tendon.<sup>15,16</sup> A new system developed by Richie Technologies combines a pre-fabricated carbon fiber AFO brace with a custom foot orthosis and graduated heel raise which is designed to protect the healing Achilles for long

## A podiatric AFO which combines a custom balanced foot orthotic with an ankle brace is an ideal solution for treating peroneal tendon injuries.

### Prescription Criteria for Ankle Sprain and Chronic Ankle Instability

Podiatric AFO, cast with neutral suspension technique to capture foot deformity

14-16 mm Heel Cup if worn in Cleated Shoe, otherwise: 35mm

3-5 mm forefoot valgus sulcus wedge

### 2) Tendon Injuries of the Foot and Ankle

There is a growing movement in the sports medicine community to consider non-operative treatment of the acute rupture of the Achilles tendon.<sup>11</sup> Even when surgery is performed, the standard of care for post-operative management of the acute Achilles tendon rupture is early weight-bearing with mobilization of the ankle joint.<sup>12,13</sup>

Therefore, the use of a cast in the treatment of the injured Achilles is favored over removable immobilizing devices such as walking boots.<sup>14</sup>

The time of treatment of the surgically repaired vs. non-surgically treated Achilles rupture is a minimum of four months in a walking boot. The challenges of wearing this bulky device for a long period of time include gait disturbances, knee pain, and low-back pain. Patient compliance with wearing walking boots for this long period of time can be very poor and can significantly affect treatment outcome.

There is evidence that a carbon

periods of time while optimizing normal gait and activity (Figure 2).<sup>17</sup> This system incorporates an adjustable heel rise wedge which can be lowered as the patient recovers and the Achilles strengthens.

Patients can run with a carbon fiber anterior strut AFO. Therefore, this brace can be worn during the critical weeks that the injured athlete begins a running program, when tendon repair might not be totally complete. Dynamic loading during recovery is essential to assure adequate tendon repair.<sup>12-14</sup>

### Prescription Criteria for Achilles Injury or Rupture

Carbon fiber AFO with anterior strut

Custom balance foot orthosis, 22 mm heel cup

30 mm heel wedge with graduated reduction

Peroneal tendinopathy has increased in incidence over the past 20 years.<sup>18,19</sup> As with all tendinopathy conditions of the foot and ankle, off-loading is the mainstay of treatment, but choice of devices which will assure patient compliance for long-term treatment is quite limited. Patients with any type of tendinopathy do not want to be immobilized for weeks or months in a walking boot.

A podiatric AFO which combines a custom balanced foot orthotic with an ankle brace is an ideal solution for treating peroneal tendon injuries. This brace can balance intrinsic forefoot valgus deformities which strain the peroneals and can limit external rotation of

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Figure 2: Carbon fiber AFO-foot orthotic system for Achilles offloading



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the tibia, which supinates the foot and further loads these injured tendons.

#### Prescription Criteria for Peroneal Tendinopathy

Podiatric AFO with restricted hinge, cast with neutral suspension technique to capture forefoot valgus deformity

6mm lateral heel skive

3-5 degree valgus sulcus wedge

Tibialis anterior tendinopathy is also becoming a common sports injury, particularly among female fitness walkers.<sup>20</sup> Often misdiagnosed as “arch strain” or “plantar fasciitis”, patients with tibialis anterior tendon tears will demonstrate focal tenderness on the dorsal aspect of the medial cuneiform. Treatment is focused on off-loading the injured tendon by assisting active dorsiflexion and controlling passive plantarflexion of the ankle. A podiatric AFO which incorporates dorsi-assist ankle joints is an excellent intervention to achieve this treatment effect (Figure 3).

This brace fits perfectly into athletic shoes and adequately replaces the need for the tibialis anterior to dorsiflex the foot during swing phase of gait, and decelerates plantar flexion of the ankle during contact phase. Many patients can return to fitness walking while recovering from the injury.

#### Prescription Criteria for Tibialis Anterior Tendinopathy

Podiatric AFO, cast neutral suspension

Tamarack® Dorsiflex-assist ankle joints

Medial arch flange

While podiatric AFOs have enjoyed their greatest success in treating Posterior tibial tendon dysfunction (PTTD) in elderly patients, athletes are known to also injure the posterior tibial tendon with over-use. A well-contoured balanced orthotic footplate will control

pronation of the foot while the limb uprights of the AFO will limit internal rotation of the tibia. This brace fits ideally into athletic shoes and allows the athlete to ambulate comfortably while recovering from injury to the posterior tibial tendon, a process which requires many months.

#### Prescription Criteria for Posterior Tibial Tendon Injury

Podiatric AFO, cast neutral suspension to capture foot deformity

35 mm heel cup

6mm Medial Heel Skive

Consider lateral flange if severe forefoot abduction deformity is present



Figure 3: Podiatric AFO with Dorsi-assist ankle joints for drop foot

#### 3) Traumatic Nerve Injury, Drop Foot and other Neurologic Conditions

An emerging exciting area of sports medicine is returning the athlete to play after a serious common peroneal nerve injury which results in drop foot. Many dislocation injuries of the knee are accompanied by common peroneal nerve injury. While the ligamentous portion of that injury can be treated surgically, the nerve injury cannot. Many high level athletes have had their career cut short by this devastating injury.

Other active people who enjoy recreational sport and fitness can suddenly experience a stroke or suffer onset of neurologic conditions which leads to weakness of the lower extremity. These patients want to get back to activity and recreation, but are often limited due to foot deformity or gait disturbance.

Drop foot and other types of weakness of the ankle musculature can be effectively treated with podiatric ankle foot orthoses or with carbon fiber AFO devices. Podiatric AFOs which incor-

porate dorsiflexion-assist ankle hinge joints can restore normal walking and running gait in many patients with hemiplegia (Figure 3). A stroke patient or nerve-injured patient can now play tennis, jog, or hike as they did before their injury or accident. The results are among the most gratifying a podiatric physician can experience as they restore mobility to an otherwise disabled patient.

Some conditions such as posterior calf muscle palsy or severe drop foot from Charcot-Marie-Tooth disease require a carbon graphite AFO device to control contracture and restore dynamic push-off during gait. These conditions can affect athletic individuals who are struck down from a previous active lifestyle and continue to strive to return to sport activity. Often, a custom foot orthosis is combined with the carbon fiber AFO to address the varus foot deformity and muscular imbalance which often accompany these neuromuscular conditions (Figure 4).

#### Prescription Criteria for Dropfoot

Podiatric AFO, casted neutral suspension to capture foot deformity

Tamarack® Dorsiflex-assist ankle joints

#### Prescription Criteria for Posterior Calf Injury or Muscular Spasticity

Carbon fiber AFO with anterior strut

Custom balance foot orthosis, 22 mm heel cup

#### 4) Midfoot and Lisfranc Sprain

This is a common and devastating injury to the competitive athlete. When gross instability or fracture are

noted, surgical intervention is indicated. However, many athletes suffer a midfoot sprain without evidence of dislocation of the tarsometatarsal joints. The ligamentous structures are often damaged and will not heal without long-term immobilization (2-4 months).<sup>25</sup> A walking boot is commonly used to treat midfoot sprains, with considerable resis-

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Figure 4: Carbon fiber AFO-foot orthotic system for Lisfranc sprain



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tance from the athletic patient to comply with long-term treatment.

A new alternative to the treatment and immobilization of injured midfoot ligaments is the use of a dynamic ground reaction carbon fiber AFO combined

with a custom fabricated foot orthosis (Figure 4). This system can effectively offload the sagittal plane forces passing through the midfoot during gait and protect the injured ligaments for healing.

Compliance with this AFO offloading system can be expected to be far better than use of walking boots. The

brace and foot orthotic fit into standard athletic footwear. There is no length discrepancy and the brace can be loosened for driving an automobile. This brace system can also be worn during functional rehabilitation, including gradual return to running activities.

### **Prescription Criteria for Midfoot Sprain**

Carbon fiber AFO with anterior strut

Custom balance foot orthosis, 22 mm heel cup

Medial arch flange

Add 1/4 inch heel rise bilateral to foot orthosis

### **Summary**

Walking boots are the most popular devices used for immobilization and treatment of common athletic injuries of the lower extremity. However, the bulk and rigidity of these devices often contradict the new concepts of functional rehabilitation and dynamic loading of soft tissue structures. Functional, dynamic AFO devices offer a welcome improvement to walking boots with better patient compliance and improved patient outcomes in the treatment of sports injuries of the lower extremity. **PM**

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**Dr. Richie, Jr.** is a Fellow of the American Academy of Podiatric Sports Medicine. He is the Chairman of the Podiatric Medical Education Committee at the California School of Podiatric Medicine. Dr. Richie has authored over 50 original articles published in respected medical journals and medical trade magazines.