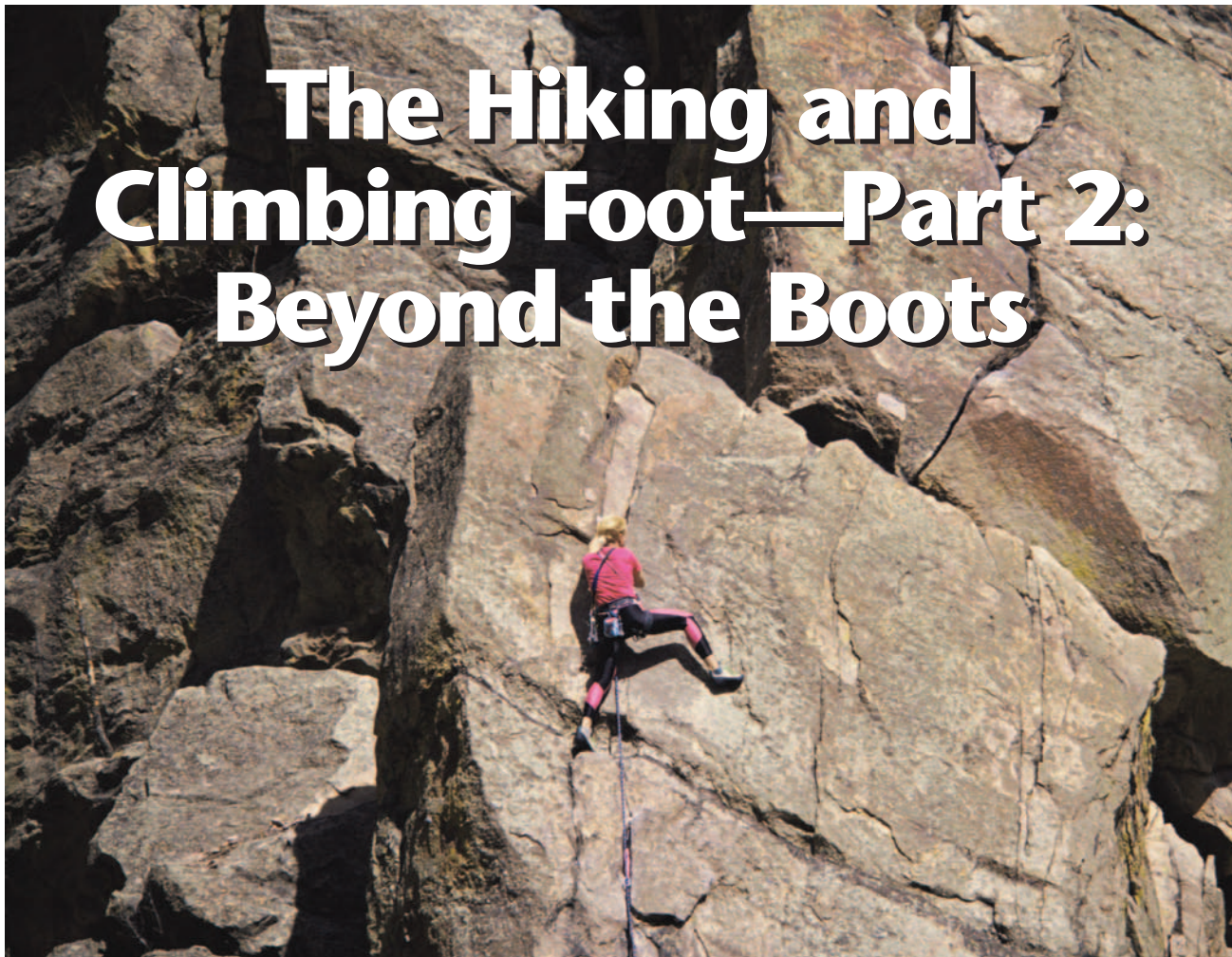




# The Hiking and Climbing Foot—Part 2: Beyond the Boots



*These athletes require special socks and orthotics, and are prone to a host of lower extremity injuries.*

**By Perry H. Julien, D.P.M.**

*Editor's note: In the September issue of Podiatry Management Dr. Julien discussed the role of footgear in hiking and climbing. This month he discusses the importance of socks, the use of orthotics, and many of the common foot conditions that affect hikers and climbers.*

*This article is the sixth in a seven-part sports podiatry series written by members of the American Academy of Podiatric Sports Medicine. This sport-specific series is intended as a practical "how-to" primer to familiarize you with the specific needs of patients who participate in these sports, and the types of*

*injuries and treatment challenges you're likely to encounter.*

## **Socks**

Most climbers do not wear socks with their climbing shoes so that they may get a better fit and a more precise feel on the rock. Beginning climbers, however, may wear a thin sock to provide more comfort.

Proper sock selection not only contributes to boot comfort, but also acts as a layer of insulation to keep the feet warm and to help reduce blister formation.

In moderate weather, hiking socks will help reduce friction between the foot and the insole/boot

interface. The fabric composition of the sock helps to accomplish this. Most hiking socks are now made of wool or a synthetic blend. In addition to reducing friction, these fibers also help wick moisture away from the foot, lessening the potential for blister formation.

The most important characteristic of a mountaineering sock used in cold conditions is its ability to wick away moisture. Water is over 30 times more conductive than air, and moisture that forms as a result of perspiration can be a major contributing factor in the development of cold injuries.

Wool has long been the materi-

*Continued on page 62*

## Hiking/Climbing...

al of choice for climbers due to its insulating and comfort characteristics along with its ability to absorb



**Left to right: wool mountaineering socks, wool hiking socks and acrylic blend mountaineering socks**

up to 30% of the sock's weight in moisture. Synthetic socks do provide cushioning; however, they do not absorb moisture as well as wool. Cotton socks should never be worn when there is even a remote chance that cold conditions may be encountered. Changing socks daily will allow the retained moisture in the sock to dry out, decreasing the likelihood of developing frostbite.

A thin synthetic or wool liner

*The most important characteristic of a mountaineering sock used in cold conditions is its ability to wick away moisture.*

sock is sometimes utilized under a heavier weight climbing sock to provide additional protection from blister formation. In colder conditions two or three layers of climbing socks may be used to provide increased insulation. If this combination of socks takes up too much space in the boot, the pedal micro-circulation may be compromised, resulting in a greater risk of devel-

oping cold injury. When multiple sock layers are used, one should purchase boots large enough to accommodate this increased volume.

### Vapor Barrier Liners

Another option in helping to prevent cold injuries of the foot is the use of a vapor barrier liner (VBL). A VBL is a thin waterproof sock usually made from coated nylon that fits between a liner sock and thicker wool or synthetic fiber-blend sock. This combination theoretically keeps the feet warmer because no evaporation or condensation

can take place. The VBL also prevents the outer sock and boot liner from getting wet.

Vapor barrier liners do, however, have their drawbacks. It is necessary to change the liner sock closest to the skin daily to prevent the development of trench foot. Also, the warm and moist environment created by the use of a VBL can predispose the foot to tinea pedis, onychomycosis or bacterial infection. The occurrence of these problems can be lessened by the prophylactic use of antifungal powders or antiperspirants.

It is important that attention is paid to fitting socks properly. The socks should not constrict the foot excessively or bunch up at the toes. Different brands of socks may have different sizing systems and their proper fit can help prevent many of the same problems that can occur from improperly fitting hiking and climbing boots.

### Orthotics and Insoles

Many models of hiking and climbing boots utilize proprietary insoles designed to help improve the fit and comfort of the boots.

Depending on specific foot morphology and biomechanics, the use of prefabricated arch supports or custom functional orthotics may be used in place of these insoles.

When evaluating someone for orthotics to be used in hiking or climbing boots, consideration must be given not only to the desired biomechanical effect that one hopes to achieve, but also to the integration of any foot supporting device into the boot.

An ideal orthotic device for a hiking or climbing boot should be full-length to provide adequate forefoot cushioning and to prevent movement of the orthotic in the boot. The top cover material should have some wicking capability to limit moisture buildup in the boot and should be able to dry quickly when removed from the boot. The heel seat should not be too high in order to avoid irritation to the posterior aspect of the calcaneus from occurring. When determining the appropriate amount of posting, be careful not to over-correct in varus. This can lead to lateral instability on uneven terrain. Posting height,



**Common location of boot-induced blisters**

especially in the forefoot, may also change the fit of the boot, compressing the forefoot and resulting in neuroma-like symptoms or impeded circulation.

When prescribing and dispensing prefabricated or custom orthotic devices for use in hiking boots, encourage the individual to allow ample time to adjust to these devices to identify any potential areas of irritation that may require adjustment or modification before

*Continued on page 64*

## Hiking/Climbing...

using them on any strenuous outing.

### Lower Extremity Injuries in Hiking and Climbing

Hikers and climbers are prone to the same overuse injuries seen in other sports. These include patellofemoral pain, plantar fasciitis, Achilles tendonitis, medial tibial stress syndrome, intermetatarsal neuroma and stress fractures of the lower extremity. The development of these injuries is related to the forces incurred during repetitive motion activities and may be further compounded by the weight of a backpack and the varied terrain that may be encountered when hiking and climbing.

These factors, along with the added component of the foot/boot interface, make the hikers' and climbers' feet more susceptible to pedal injury. The proper selection of appropriate footwear is the first line of prevention in minimizing

the occurrence of these injuries, but despite using appropriate hiking and climbing boots, proper sock selection and other steps to prevent lower extremity problems, foot

*An ideal orthotic device for a hiking or climbing boot should be full-length to provide adequate forefoot cushioning and to prevent movement of the orthotic in the boot.*

problems still occur with frequency in this athletic population.

#### **Blisters**

Blister formation can occur from boots that are not properly fitted or not adequately broken in,

inappropriate sock selection, or skin stress as a result of walking on uneven terrain. Although not considered a "serious injury," a blister that becomes secondarily infected or significantly painful can limit a hiker's ability to ambulate, thus resulting in a difficult situation if medical care is not close by.

Blister prevention can be accomplished by ensuring proper boot fit and a gradual adjustment and break-in period prior to any extended hikes or climbs. Proper sock selection, including the use of a thin liner sock, can also help reduce friction between the skin and boot. In areas of the feet prone to blister formation, the use of moleskin or other skin protectants can reduce the incidence and severity of blisters.

When blisters develop, prompt decompression of the fluid without de-roofing the skin, along with good local wound care, can help reduce pain and prevent complica-

*Continued on page 65*

## Hiking/Climbing...



**Possible impingement of posterior tibial nerve from hiking shoe upper**

tions such as bacterial infection or ulceration.

### **Toenail Problems**

Ingrown toenails and subungual hematomas are the most common toenail injuries occurring in climbers. Ingrown toenails may result from tight fitting boots or socks or improper trimming of the nail plate. Subungual hematomas may form from the repetitive micro-trauma of the nail plate hitting the front of the boot. This often occurs when descending from a climb or hiking downhill. It is important during the boot fitting process that one walks up and down an incline board to make sure the distal aspect of the toes are not being compressed against the front of the boot.

Toenail injuries can be difficult to treat in the wild and therefore prophylactic measures should be considered to treat any potential nail problems before extended wilderness trips.

### **Metatarsalgia**

Plantar metatarsal pain may result from a direct injury such as stepping on a protruding rock, or may be due to the repetitive stress placed on the sub-metatarsal area when carrying a heavy backpack

over rugged terrain. The stress to the metatarsal region may be further compounded by heavy-weight hiking boots and mountaineering boots that incorporate stiff shanks and outsoles. Podiatric intervention for this type of metatarsal pain involves the use of a metatarsal pad proximal to the point of tenderness (PHOTO). These metatarsal pads can also be incorporated into a full length orthotic device.

A careful history and examination is important in evaluating metatarsal pain to rule out conditions such as intermetatarsal space neuroma or metatarsal stress fractures.

### **Tarsal Tunnel Syndrome**

Compression of the post tibial tendon nerve can occur from irritation to the tarsal canal from the cuff of a low or mid-height hiking boot. The internal shape of a mountaineering boot can also place pressure over the tarsal tunnel, resulting in an extrinsically induced tarsal tunnel syndrome.

It is important when examining the feet and ankles of a hiker or climber to take into consideration the possibility of boot compression causing nerve compression to the post tibial nerve or other superficial nerves in the foot and ankle.

### **Pedal Prominences**

Bone deformities such as hallux valgus, hammertoes, and Haglund's

retrocalcaneal exostosis may become inflamed when subject to repetitive micro-trauma or shoe gear irritation. The modification of hiking footwear, the use of accommodative padding or orthotic devices, and surgery when necessary may help to alleviate stress from these prominences. The potential problems that can occur from these osseous deformities should be anticipated by both the hiker/climber and podiatrist, and appropriate intervention taken prior to any prolonged wilderness outings.

### **Cold Injuries**

Peripheral cold injuries can present significant problems for climbers and mountaineers. These injuries can be classified as non-

freezing and freezing disorders. Non-freezing problems include chilblains, trench foot, and immersion foot, and usually result from exposure to a cold and moist environment. Freezing injuries refer to frostbite and are commonly classified as superficial and

deep. Frostbite results from the actual freezing of tissue and can cause significant tissue destruction with possible loss of affected body parts.

Two significant factors contributing to cold injuries are moisture and impaired circulation. In cold conditions, wool or synthetic socks should be changed daily and a foot antiperspirant considered if hyperhidrosis is a problem. Proper fitting socks and footwear can prevent vascular constriction, which can reduce local circulation. Maintaining core body temperature is also important to prevent the need for shunting of blood from the extremities to the core of the body.

### **Trends in Hiking and Climbing Boots—Now and in the Future**

The trend in many fitness pursuits these days is "lighter and faster." This is a good philosophy if "lighter and faster" does not in-

*Continued on page 68*

***Peripheral cold injuries can present significant problems for climbers and mountaineers.***

***Ingrown toenails and subungual hematomas are the most common toenail injuries occurring in climbers.***

## Hiking/Climbing...

crease the risk of injury. This concept applies to hiking and climbing as well as any sport in which the foot-ground interface is an integral part of the activity.

United States Army treadmill tests in 1969 determined that one additional pound on the foot was equivalent in energy output to 3.5-5.25 pounds on the back. A similar study published in *Ergonomics* in 1986 concluded that increasing the weight on the foot by one pound was equivalent to 6.4 pounds of carried weight. Experienced climbers have always understood the significance of extra weight on their feet for extended periods of time and will make every effort to keep that additional weight to a minimum in climbing. This is equally applicable to the casual day hiker as it is to the more accomplished backpacker.

The increase in boot weight not only increases the energy output required to hike but can also increase the risk of developing repetitive motion overuse injuries to the lower extremities.

Hiking and climbing boot manufacturers continue their research

and development into material and designs that will decrease boot weight yet still provide adequate stability, cushioning and sensitivity when in the wilderness. Materials such as Pebax, Kevlar, and carbon fiber composites are now being incorporated in the construction of these boots. Although, in general, lighter weight boots are preferred when compared to their heavier

*One additional pound on the foot was equivalent in energy output to 3.5-5.25 pounds on the back.*

weight counterparts, it remains important that the boot construction does not sacrifice the other necessary characteristics of boot design that makes the boot appropriate for its intended use.

### Conclusion

Sports medicine is as much a treatment philosophy as it is a medical specialty. The practice of sports medicine podiatry goes beyond the treatment of lower extremity injuries that occur in the active person. The sports medicine podiatrist needs to be able to understand the nuances of the sports in which their patients participate. These include considerations in training, biomechanical demands of each specific sport, the sports-specific injuries that are likely to occur in that sport and appropriate footwear requirements.

In any sport or fitness activity

where the foot contacts the ground, the surface becomes an important consideration when assessing injuries, developing a treatment protocol and providing advice on injury prevention when footwear may play a contributing role.

Regardless of where you practice you are likely to encounter patients who will seek your medical expertise for various lower extremity injuries resulting from hiking and climbing pursuits. Knowledgeable staff at your local outdoor retailer, and periodicals such as *Backpacker*, *Climbing*, and *Rock and Ice* magazines can help you integrate your podiatric sports medicine training with an understanding of the demands placed on the foot and ankle in order to provide the highest level of podiatric sports medicine care. ■

**Perry H. Julien, D.P.M. is a past President of the American Academy of Podiatric Sports Medicine. He served as podiatric coordinator for the 1996 Summer**



**Olympic Games and is currently the co-medical director for the Peachtree Road Race and Atlanta Marathon. He is a member of the Wilderness Medical Society, The Explorers Club and has climbed extensively in the United States, including the summits of Mt. Rainier, Grand Teton, Mt. Whitney and Longs Peak.**