



The Hiking and Climbing Foot— Part 1

This popular recreational sport requires specialized footwear.

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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.

It could be someone preparing to climb Himalayan peaks, a family planning a hiking vacation to the Grand Canyon, or an elderly couple

setting out for an hour on the community nature path. Minutes, hours or days into their journey they start to experience foot or ankle pain. Is it due to the footwear they have been meaning to see their podiatrist or is it the old hiking shoes they have recently taken out of storage? Or could it be a combination of some underlying lower extremity condition and a pair of newly purchased boots? Regardless of the reason, foot pain in hikers and climbers can at the very least make a trip less enjoyable, and in instances where one is far from medical care can make for a dangerous situation if ambulation becomes difficult.

Hiking and climbing have seen a surge in popularity over the last several years. People are hiking as part of their overall fitness programs and teenagers are participating in programs such as Outward Bound that involve extensive wilderness travel. Families are also taking “adventure travel” vacations in the United States and abroad, and planning guided expeditions to places such as the 19,344 foot Mt. Kilimanjaro. Technical hiking and climbing have also grown tremendously despite the inherent risks in these activities.

The obvious effect of the increased participation in these activ-

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ities is the proportional increase in the number of foot and ankle problems that are occurring. These injuries can result from aggravation of pre-existing lower extremity pathology, injuries resulting from the foot-boot interface, or the added biomechanical demands placed on the lower extremity as a result of terrain, footwear and additional weight from backpacks that can sometimes weigh over 60 pounds. It is important, therefore, for the sports medicine podiatrist to be familiar with the types of hiking and climbing in which their patients may be participating, the proper assessment of hiking and



Lightweight, midweight, heavyweight backpacking and mountaineering boots

tained, level nature paths to rugged wilderness terrain in remote regions of the world. Hikers and trekkers may carry daypacks with food and water for short excursions to expedition-style backpacks that can hold up to 70 pounds of

g e a r .
Footwear needs and the predisposition to lower extremity injuries are dependent

on the type of terrain, the distance and length of time spent hiking, and the amount of gear that needs to be carried.

Mountaineering

Mountaineering is a form of hiking that involves mountain ascents using techniques derived from all forms of climbing. Hikers and trekkers can be faced with challenging weather conditions; mountaineering often involves traveling in harsh conditions that include cold weather and travel over rock, snow, ice, and glaciers. These conditions necessitate proper boot selection and an understanding of the body's response to cold. Climbing expeditions can be days away from specialized medical care and therefore must be self-suffi-

cient in the wilderness and take appropriate steps to prevent injuries from occurring.

Ice Climbing

Ice climbing is a form of climbing that involves ascending frozen waterfalls or ice formations using ice axes and crampons which attach to climbing boots. Crampons fit securely to the bottom of "crampon compatible" boots and have special-



Double plastic mountaineering boot

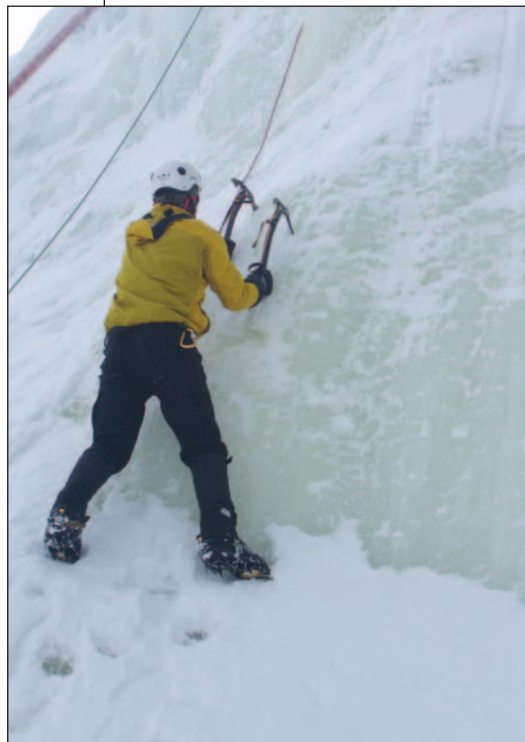
climbing footwear and the types of foot and ankle problems commonly encountered in hikers and climbers. In this way the podiatrist will be better equipped to treat the hikers and climbers seeking care.

Into the Wilderness

To understand the biomechanical demands placed on the lower extremity when hiking and climbing, one needs to first appreciate the different disciplines that fall under the broad category of hiking and climbing. This knowledge is helpful when evaluating and recommending footwear and when assessing and treating injuries that may result from these outdoor adventures.

Hiking and Trekking

Hiking and trekking usually involve walking on trails that may range from well-main-



Ice climbing

ly shaped metal spikes that can penetrate ice or hard snow. Crampons can also be used for general mountaineering to allow better traction on hard packed or icy slopes.

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Rock Climbing

Rock climbing involves ascending vertical or near vertical rock formations utilizing specialized footwear that incorporates “sticky rubber” to provide friction and various design shapes depending on the type of natural features on the rock being climbed. Techniques in rock



Outersole with embedded steel shank

climbing include “smearing” in which a climber utilizes the rubber on the outsole to provide friction and “edging” in which a part of the shoe contacts small features on the rock. As with other types of sports footwear, “hybrid” rock climbing shoes may have more versatility to use on a variety of terrain.

Indoor climbing gyms have also become popular over the last several years. These climbing facilities have artificial walls that incorporate plastic footholds and handholds in place of natural rock features. The indoor climbing gyms have made climbing accessible to more people and have helped increase the number of people participating in the sport. In 2002 it was estimated that 7.6 million people in North America have tried indoor rock climbing in over 600 public climbing gyms.

The Importance of Proper Footwear

Appropriate footwear is the most crucial piece of gear for any hiker or climber. Proper boot selection requires not only an understanding of foot type and lower extremity biomechanics, but an appreciation of boot construction and how it relates to the anticipated use of the boots.

Footwear companies and various outdoor and climbing periodicals have used several classifications in an attempt to categorize hiking and climbing boots. These categories provide the consumer, footwear retailer, and podiatrist with a general guide for recommending and selecting a range of boots that may be appropriate for the activity they are to be used for.

As is the case with most athletic footwear, hiking and climbing boots may fall between two or more categories. The categories described serve as a practical guideline based on the construction of the boot and its recommended use. Once the use has been determined the ultimate decision on what comprises the “best choice” is based on the boot that is best

matched to one’s unique foot size, shape and biomechanics.

Anatomy of a Hiking Boot

The innovations seen in hiking and climbing footwear over the last several years have taken place in the construction, materials, and fit components of the boot. Basic boot design, for the most part, has not changed dramatically, partly due to the fact that the biomechanics of the foot have not changed. The design changes that have taken place are undertaken to allow the boots to function more optimally in the environment that are to be used in. To understand boot function, one must first appreciate how the components of the boot relate to the boot’s intended use.

Last

The last is actually not a component of the boot itself, but rather the mold or shape that the boot is constructed from. The last is therefore one of the most important parts of the boot because it determines how the boot will fit on the foot. Each footwear manufacturer utilizes a proprietary last that determines the boot’s shape and volume, making it important for one to try on boots from different com-

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panies to determine the best fit for a specific foot type.

Outsole

The outsole is constructed out of rubber material such as Vibram, designed to protect the feet and offer a degree of shock attenuation. The outsole can also provide stability to the boot along with traction



Last

on the surfaces they are used. Most hiking and climbing boots incorporate various heights of lugged rubber treads that help improve grip in dirt, mud and snow. The outsole may be laminated separately to the midsole or may be incorporated into the midsole itself. The method of adhering the outsole to the upper of the boot can sometimes allow for resoling of the boot if the outsole becomes excessively worn.

Midsole

The midsole is a very important component of athletic shoes especially in sports such as running and tennis where shock attenuation is important. As in other types of athletic footwear, the midsole is incorporated between the outsole and the upper of the boot or shoe. In hiking and climbing, the use of shock absorbing midsole materials is not always as crucial as in high impact sports, where the outsole

can contribute to some shock absorption. One is more likely to find shock-absorbing midsoles used in lightweight hiking boots, which are often used on a variety of terrains, including less forgiving surfaces, such as asphalt and packed trails.

Shank

The shank of the boot can be incorporated into the outsole or midsole and adds further stability to the hiking boot. Mid-weight boots may have a half or full shank made of fiberglass or nylon to allow some flexibility when hiking. Heavy-weight and mountaineering boots usually incorporate a more rigid full shank that adds

more stiffness to the outsole/midsole. Full-length rigid shanks may impair walking comfort by limiting the normal flex pattern of the boot but will provide greater stability and help reduce leg fatigue when carrying heavy packs or hiking on technical terrain. The rigidity of the shank can sometimes be offset by



Cut away boot

incorporating a slight rocker bottom configuration to the outsole to make walking easier.

Upper

The upper is the part of the boot above the outsole/midsole.

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The materials used for the upper include full-grain leather, split grain leather, Nubuck leather, and synthetic fabrics. Full-grain leather is a full-thickness leather that is more durable but harder to break in. Split-grain leather is leather that the inner part of the hide has been stripped from, leaving the supportive, water-resistant leather intact. This upper material does not repel water and is not as durable as full-grain leather, but is easier to break in. Nubuck leather is full-grain leather that has been abraded to give it a suede-like appearance.

Synthetic uppers, such as Gore-Tex and other proprietary materials, have become more popular in climbing and hiking boots because of their lighter weight, water resistance and breathability.

The height of the upper also helps determine the ideal use for a specific boot. Above-ankle or high top boots generally provide increased stability for the foot and ankle, especially when on uneven or rough terrain and when carrying a heavy backpack. These boots, however, usually take longer to break in and can present fit problems around the malleoli.

Ankle-high or mid-cut boots end just above the ankle, keeping the foot and ankle more secure than a low-cut or below-ankle boot. The advantage of this boot height is the lighter

significant amount of stability on challenging terrain but have become popular due to their lighter weight.

Lining

The upper material of a hiking or climbing boot is usually lined with material to provide a smooth protective layer between the upper and the foot and ankle. These proprietary liners offer not only protection but help increase the water-resistance of the boot and can also provide a wicking mechanism to reduce moisture from the foot. This can aid in reducing blister formation as well as playing a role in keeping the feet warmer in colder environments.

Categories of Hiking and Climbing Boots

Hiking and climbing boots are often categorized by their intended use. As in other types of athletic footwear, these categories can overlap. From a sports medicine perspective, knowledge of these categories can help guide your patients towards the proper boot based on their planned activity, foot type and any underlying biomechanical or foot morphology concerns. Factors to consider include the appropriate boot design based on functional requirements including their anticipated use, the construction of the boot, and the fit criteria set forth by each manufacturer. The ultimate decision on the best boot to



Light-weight hiking shoe and boot

weight and easier break in time.

Low-cut boots are similar in height to running shoes and other below ankle athletic shoes. The stability in these shoes is usually provided for by the midsole/outsole, the upper material, and the shoe counter. These types of boots/shoes do not offer a

use, however, still depends on ensuring the best possible match of the foot to the boot.

Lightweight Hiking Boots/Shoes

Lightweight hiking boots also include hiking shoes. These shoes or

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boots are designed for short day hikes on maintained trails. The low-cut models may resemble running shoes but usually have stiffer soles, more stability in the upper, and better traction than most athletic shoes.

The upper of lightweight hiking boots are typically made with fabric and leather combinations or synthetic materials. They are usually low-cut to mid-cut, but do not have as much ankle stability as mid-

weight hiking boots. They provide tect feet from rocky surfaces and provide good midfoot stability, but still retain flexibility in the forefoot to allow for normal gait. When used for carrying backpacks with heavier loads, the mid-weight boot should be stiffer in the forefoot.

Mid-weight boots should also fit similarly to a running shoe. When trying these boots on, make sure you utilize a sock with the same thickness as the one you plan to hike with to help ensure proper fit.

Mid-weight hiking boots make up the largest category of hiking boots on the market today. Depending on the upper material and midsole/outsole construction, these boots are designed to function well when carrying backpacks weighing less than 35 pounds.



Mid-weight hiking boot

weight hiking boots.

These boots should fit similar to running shoes allowing around a 1/4 of an inch between the longest toe and the end of the boot.

Many people will use lightweight hiking shoes and boots for everyday walking as well as on hiking trails.

Mid-Weight Hiking Boots

Mid-weight hiking boots can be used for anything from hiking on well-graded trails to trekking on more challenging terrain that may take you on rocky areas and uneven surfaces.

These boots are often mid-height and may be made from fabric and

leather combinations, synthetic materials or split grain leather.

The outsole or midsole may incorporate half-length shanks or semi-rigid plastic midsoles to pro-

Heavyweight Backpacking Boots (lightweight mountaineering boots)

Heavyweight backpacking boots are designed to be used when carrying loads greater than 35 pounds or when traveling over rock, snow or ice. This category of boots also shares many of the same features as mountaineering boots.

The uppers on heavyweight hik-



Heavy-weight hiking boot

ing boots are typically made of full-grain leather that extends above the ankle to serve as protection for the ankle and leg while providing

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increased support and stability on rugged terrain. These boots have minimal seams to increase their water resistance and may incorporate an insulated lining for use in cold environments.

Heavyweight hiking boots usually incorporate full-length shanks or stiff nylon or composite midsoles to provide rigidity. As a result of this they can make full stride hiking a little difficult. Some boots in this category incorporate a rocker-bottom outsole to allow a more natural gait and minimize heel slippage.

Many of the heavyweight backpacking boots also include modifications in the outsole area to accept crampons that are utilized when traveling on snow or ice. Crampons attach to the bottom of the boot with straps or bales, and utilize metal spikes to increase traction on snow and ice.

As a result of the inflexible outsole and more substantial upper materials, heavyweight hiking boots often require longer break-in periods. It is not uncommon to develop blisters and irritation over bony prominences while adjusting to these boots.

Since heavyweight backpacking boots are often used in colder conditions, it is very important to fit these boots with the socks one is wearing while hiking or climbing. If you will be hiking or climbing above 6,000 feet one must also take into consideration the possibility of developing peripheral edema that occurs at altitude and therefore allow room for foot swelling when fitting these boots.

Mountaineering Boots

Mountaineering boots are specialized hiking boots designed for cold temperatures and travel over ice and snow. Many heavyweight hiking boots can be used for travel in the mountains. These should be insulated, compatible with crampons, and have an aggressive lug pattern on the outer sole to provide good traction. A significant disadvantage to heavyweight hiking boots, however, is that when the leather and synthetic uppers become wet from either perspiration, rain or snow, they can take a couple of days to dry out. This can increase the likelihood of developing lower extremity cold injuries. Be-

Lightweight Hiking Boots/Shoes

La Sportiva Venture Mid
Montrail Storm GTX
Salomon Solaris Low
Scarpa Helium
Vasque Sundowner

Mid-Weight Hiking Boots

La Sportiva Trango Trek
La Sportiva Thunder
Salomon Mega Trek 6
Montrail Torre GTX
Montrail Solitude (women specific)
Scarpa Vento

Heavyweight Hiking Boots (Lightweight Mountaineering Boots)

La Sportiva Glacier
La Sportiva Trango S
Soloman SM Lite
Montrail Olympus
Scarpa VG20

Mountaineering Boots

La Sportiva Nuptse (double-plastic boot)
Montrail Ice 9000 (double-plastic boot)
Koflach Arctis Expe (double-plastic boot)
Scarpa Inverno (double-plastic boot)
Salomon Pro Thermic
Scarpa Freney Pro
La Sportiva Nepal Extreme

cause of this concern, and the need for mountaineering boots to be as insulated as possible, double plastic boots are the most common climbing boots used on snow and ice, especially in colder environments.

Double-plastic boots refer to two-layer boots: the outer shell consisting of a molding plastic or composite shell with a removable insulated inner boot. The inner boot usually consists of closed cell foam such as EVA which is light and generally unaffected by moisture. The insulating materials in double-plastic boots eventually compress down, reducing their ability to keep the feet warm. Most boot manufacturers do sell replacement inner boots.

The plastic outer shell offers no significant insulating capabilities but is completely waterproof, limiting moisture build up from the outside.

The outsoles of plastic boots are

usually fairly rigid. This is beneficial when wearing crampons but decreases the boot's sensitivity and makes it somewhat more difficult to walk in. The stiffness of the outsole also helps reduce calf muscle fatigue when ice climbing on steep terrain that involves "front-pointing" which is the placement of the front points of a crampon directly into the ice. To compensate for the outsole rigidity, plastic boots uppers have become more flexible, allowing the ankle to flex forward. Most double-plastic boots also incorporate a rocker-bottom sole to allow a more natural gait when hiking.

Fitting

When fitting double plastic boots, they should feel comfortable "out of the box" because due to their construction, very little "breaking in" will

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occur. Care must also be taken to allow ample room in the toe box to avoid cramping of the forefoot, which could result in circulatory compromise and subsequent frostbite. Most climbers tend to "oversize" their plastic boots when fitting to allow for peripheral edema that can occur at high altitude and they use two or three pairs of socks for insulation in colder weather.

Rock Climbing Shoes

Rock shoes are designed to hold onto small ledges and provide friction on natural rock features when climbing. Rock shoes usually consist of a flexible upper made of soft leather combined with a flexible sole made from various formulations of "sticky" rubber. Various shapes of lasts are used in manufacturing rock shoes to match the specific types of rock climbing for which the shoes are to be used.

Rock shoes are fit very differently from climbing and hiking boots. Most rock shoes are designed to fit very snugly to allow precise movement when climbing. As a guideline, these shoes tend to fit about one size smaller than athletic shoes. Experienced climbers typically fit their shoes tighter, even to the point of discomfort. This can result in irritation to bony prominences such as bunions, hammertoes, Haglund's deformities and metatarsal-cuneiform prominences.

In part 2 the author will discuss socks, orthotics, and common injuries associated with hiking and climbing. ■

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