Winter Sports Medicine and the Podiatrist

Alpine and Cross Country Skiing and Snowboarding are all sports with which DPM's should be familiar.

BY JEFFREY A. ROSS, DPM, MD

For DPM's, alpine skiing, cross-country skiing, and snowboarding have become another area where podiatric lower extremity expertise can be focused. The sports podiatrist can become involved at a variety of levels. Understanding the individual sports, knowing their biomechanics, as well as the patient's special needs, can enhance your overall sports practice. Many skiers and boarders who might not find the answers at the ski shop will look to you for the right solutions. Whether it's for canting boots and skis or prescribing and fabricating footbeds and orthoses, you can help to prevent injuries and provide more comfort for your patients during their winter exercise season.

The skier can be a very challenging patient. Be aware of his/her numerous concerns, whether due to biomechanical imbalances leading to poor ski technique, or performance problems related to foot or boot-fit discomfort. One must understand the concepts of lower extremity biomechanics related to skiing, boot design, boot fitting, as well as the relation between a ski orthotic and the boot in which it sits.

Unlike the average runner who has a small bag of running shoes, the skier who makes the trip to your office has a big bag filled with ski boots, as well as foot beds and orthotics. The skier's visit to your office may be because of chronic foot pain due to the boots, or his/her performance being affected by the inability to be totally comfortable in the boot while initiating and completing turns. Whatever the reason, you may be the skier's last hope after attempting to correct the situation first at the ski shop or with the boot fitter.

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Alpine Skiing Biomechanics

Alpine or downhill skiing is a complex skill that requires controlled pronation, setting the foot, ankle, and lower extremity on the inside edge. Pronation sets the inside edge of the downhill (control) ski and allows for the skier to lean inward against the ski, which holds a skid-less arc throughout the turn. While balanced on a beam of flexible composite (6.3 cm wide), the skier drives the shin forward against the stiff boot cuff and swings the hips

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PhotoDisc

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to the opposite direction. The ski rolls onto its sharp steel edge and bites the snow, creating an arc across the hill (Ross & Subotnick, 1999). Skiing is analogous to ballet on snow, where the skier encounters many centrifugal as well as g-forces during the turns, while simultaneously attempting to keep the center of gravity in line over the center of the ski. Any change in the normal biomechanical balance can alter the skier's ability to develop a controlled turn, thus predisposing the skier to injury if the abnormality is significant enough.

Variable factors, such as structural biomechanical deformity, functional deformity or dynamic imbalance of muscle groups can also have an influence on a skier's performance, and help predict potential injury. Skiers who have biomechanical abnormalities will compensate by obtaining pronatory forces from other joints, for example, the hips and knees, in order to ski effectively. Using the Electro-Dynogram (EDG), Ross (1985) showed that forces are transmitted from both the forefoot and the rearfoot, which the skier utilizes in up-and down-weighting, as well as in the completion of turns. Abnormalities which were observed included: excessive foot pronation, shortened heel contact with excessive propulsive phase on the toes, extreme forward lean of the boot, as well as asymmetry between the two feet. These combined affected the skier's effectiveness and overall performance. The sports medicine podiatrist can assist skiers to overcome some of these lower extremity abnormalities, including poor skiing style, poor edge control, as well as foot imbalances (e.g., rearfoot varus/valgus, forefoot varus/valgus, pronated or supinated subtalar joint) by prescribing a variety of orthotics for control in their ski boots.

For many years custom insoles (molded to the foot in the ski shop) have been effective for mild foot and lower leg imbalances, particularly for the overpronator skier (Figure 6). However, for the more severe rearfoot and forefoot abnormalities, prescription orthoses can be a valuable way to provide proper foot bed balance, and to improve ski performance and efficiency (Ross & Cohn, 1984). Boots today typically will have easy-to-customize liners and removable full-length soft support systems within the inner boot. The pre-existing insole may be substituted with a custom insole or prescription orthotic.

Ski Fitters and DPM's

The foot specialist or sports medicine specialist should have a basic understanding of the ski boot design (just like an understanding of the running shoe), as well as skiing biomechanics and performance. You should know the sport before you treat the athlete. It is essential for the foot specialist to establish a working relationship with the boot shop, as well as the ski boot fitter (Figure 9). These individuals have a working understanding of basic biomechanics in relation to boot performance, fit, and comfort; but they also understand their own limitations in addressing the more challenging foot and lower leg problems and they generally prefer to

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Figure 1: Ski boot that is reversible: after removing the shell, it can become a snowboard boot

Figure 2: Solomon ski boot overlapping with upper buckle posterior

Figure 3: Technica traditional ski boot with upper buckles anterior

Figure 4: Snowboard boots (harder shell and softer shell) on snowboard

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have experts assist them in diagnosis and treatment. This relationship can prove to be extremely satisfying and rewarding. The foot specialist can aid in the selection process for the "right boot" (similar to helping to choose the right running shoe) (Figures 2, 3).

Podiatrists help to determine the foot type, biomechanical weakness and areas of weakness and stress. DPM's diagnose bony deformities, biomechanical imbalances, areas of the foot where the boot might cause friction and irritation, as well as those skiers who may suffer from circulatory impairment, nerve entrapment, and metabolic disorders. With this information, a ski boot fitter can then determine if the skier needs a boot designed for a flat or high arched foot, a narrow or wide foot, a boot with high volume, a pure forward entry boot, or possibly a hybrid (with both overlap and rear entry design), or a boot with a narrow heel pocket.

Tibial Varum

Tibial varum is one of the more common lower extremity biomechanical abnormalities that can have a negative impact on a skier's performance. Tibial varum is a result of an uncompensated varus deformity of the tibia, which transmits instantaneously to the ski-snow interface, and causes the skier to ride excessively on the outside edge of the ski. Those skiers who have greater than 8 to 10 degrees of tibial varum will have a great deal of difficulty initiating a parallel turn without "catching" the outside edge of the ski (Figure 5).

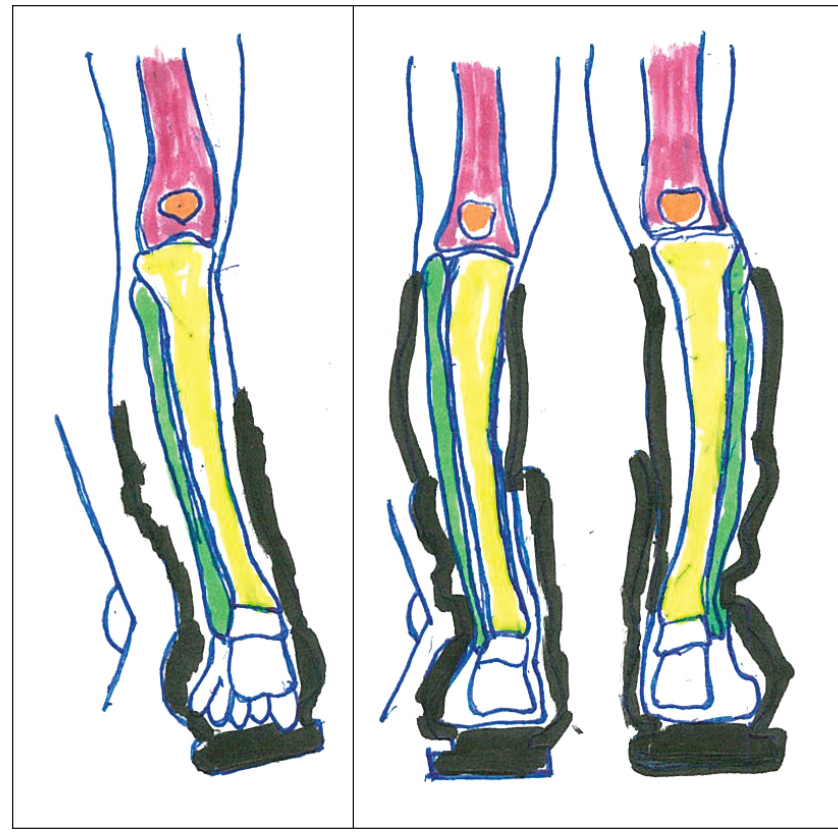

Figure 5: (Left) Uncompensated Tibia Vara in the Ski Boot: The boot cuff does not compensate adequately for the tibia vara, predisposing the skier to ride on the outside ski edge.

(Right) Tibia Vara—Measurement: The skier is standing on the baseboard of the boot with the liner removed, and has assumed the functional skiing position. The cuff can then be aligned to the longitudinal axis of the lower leg. Note that if the skier uses a footbed or corrective orthotic, the device must be placed on the baseboard of the boot before correction

By keeping the orthotic as thin as possible, there will be more volume for the foot and toes to function.

Boot Technology

Boot technology has improved so that high performance boots provide a boot cuff adjustment to accommodate for varying degrees of tibial varum and help to create a flat ski surface. One of the simplest ways of treating high degrees of tibial varum in the skier is to use a full-length, canted orthotic within the boot. The reason for its success is that you are providing total foot contact within the boot, correcting biomechanical foot imbalances within the foot and lower leg. There are a number of other foot and lower leg abnormalities that can contribute to a skier's difficulty in both edge control and performance. These include genu valgum, subtalar varus, forefoot valgum, transverse plane asymmetry, as well as leg length discrepancies.

The common complaint that boot fitters and foot specialists hear is, "my feet hurt in my boots!" In addition, skiers often complain that their feet are tight, that they are cold, and that they experience friction, irritation, and blisters. As we have seen, technological development of the ski boot has gone from a traditional overlap design to a skier-friendly rear-entry design. Now they have returned back to the front-entry and hybrid-designed performance boots. Ski boots have evolved biomechanically, as well, offering adjustable features, such as: internal or external canting systems, adjustable "spoilers" or shaft angle adjustments, boot flex, forward lean, internal/external heaters and custom heat-moldable liners made of ethyl-vinyl acetate (EVA).

DPM's should be aware that the ski boot removable foot bed may be replaced with custom-made orthoses. Many of these devices are made in the ski shop with a computer imprint of the skier, or by placing the foot in a semi-weight-bearing neutral po-

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sition, with a knee stabilizer apparatus built into the platform to accurately align the knee over the foot for a more complete lower leg correction. In the traditional method of making an in-boot cast, the skier assumes a neutral ski stance position, which will help achieve a greater degree of correction. It has been shown that controlling excessive pronation/supination and locking the midtarsal joint (stability) will greatly enhance edging and performance.

If you're looking to tinker with boots, I strongly suggest that you go to the shop, and spend a weekend in the tech's shop learning about the various components and complexities of the ski boot (Figures 7, 8). The boot fitter/tech will be very willing to share information with you, while attempting to pick your brain at the same time. The five areas of concern in the foot bed are: zone one—the foot bed, zone two—the tongue, zone three—the hindfoot, zone four—the shaft, and zone five—the forefoot.

Figure 9: Custom boot fitter Bob, a Pedorthist, checking the boot and bindings for proper release

Cross-Country Skiing

Most sports medicine podiatrists are familiar with alpine skiing, but when it comes to cross-country skiing, it's like speaking a foreign language. That is probably because many people have never even attempted the sport and thus have never discovered its incredible aerobic as well as muscle-strengthening advantages over alpine skiing. To begin with, the technique for cross-country skiing is entirely different. In downhill skiing, the heel and lower leg are locked in a rigid boot, allowing for more control to the skier's rearfoot, while the body's center of mass is located directly over the subtalar joint. This provides for compression forces to be properly aligned, while maintaining rearfoot neutrality. Comparatively, cross-country skiing involves a heel that is repeatedly lifted within the shoe from the ski surface and lowered again. This creates a more unstable situation for the skier. The technique that is used in cross-country skiing is referred to as a swing kick and glide. Longer ski poles are used to create upper body stability and propulsion, while the heel is kicked upward to maintain forward motion with a forefoot propulsion on the ski. When alternating the opposite arm, this creates a diagonal stride and leg forward movement, similar to walking or running. The difference between the alpine boot and the cross-country boot is that the trekking boot is a hybrid between the backcountry and a running racing flat in both design and support. In comparison, the cross-country boot has much more freedom of movement, while giving up some of the support that the alpine provides. In cross-country skiing, sagittal plane motion is the predominant direction of the foot and leg and it is not essential that the touring skier require stability in the shoe for exaggerated turns. Typically, the touring skier will be in a track on a course, except when skiing backcountry.

Biomechanical considerations are just as important as in alpine skiing. The patella should be properly aligned over the skis in a bent-knee skiing position. For the touring skier, a lighter weight, more flexible orthotic would be preferred for this type of boot. By keeping the orthotic as thin as possible, there will be more volume for the foot and toes to function.

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Figure 6: Measuring device for heating and custom fitting OTC (Superfeet) insole

Figure 7: Heating machine to expand the outer shell for custom fitting

Figure 8: Heating machine to soften the inner boot to custom fit to the foot

The AAPSM: the Heart and Soul of Sports Podiatry

The American Academy of Podiatric Sports Medicine serves to advance the understanding, prevention and management of lower extremity sports and fitness injuries. The AAPSM believes that providing such knowledge to the profession and the public will optimize enjoyment and safe participation in sports and fitness activities. Their aim is to accomplish this mission through professional education, scientific research, public awareness and membership support.

One of the unique benefits of membership in the AAPSM is their series of live cadaver videos covering the following topics:

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And the cadaver video series is of course just one of many benefits of membership. The long list includes:

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- Speaking opportunities at various school meetings
- Opportunity to print various sports medicine-related brochures for office distribution
- Access to sports medicine-related power point presentations

For questions on membership benefits or any other aspects of the AAPSM, please contact Executive Director Rita Yates at ritayates2@aol.com. •

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Snowboarding

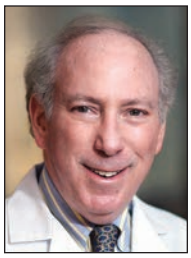
Snowboarding has become the mountain rave. A winter version of skateboarding, or surfing, snowboarding has its risks just as alpine skiing does. The incidence of injuries between the upper extremity (44%) compared to the lower extremity (43%) is nearly equal. The most common site of injury is the wrist, followed by the knee, and then the ankle (Ganong, et al., 1992). The difference between alpine skiing and snowboarding is that the "boarder" lacks the freedom of individual leg movement, thus decreasing the chance for recovery. Whereas alpine skiing incorporates the integration of the foot, knee, and hip motion, snowboarding focuses energy on the hips and knees, due to the nature of the short pivoting turns. An evolution has also taken place in boots (Figures 1, 4). Earlier designs produced a soft boot with more freedom of movement, whereas more recently a full hard shell and half shell are typically worn. The softer design, allowing for more foot motion, also resulted in more injuries than the harder designs. The most common injury site with the soft boot was the ankle, while the rigid, full-shell boots protect the ankle, but allow for more forces to be transmitted to the knees. As a result, more knee injuries have been reported due to this change in shell design. **PM**

Note: Excerpts taken from Ross, J.A.: Sports Medicine and Injuries in Neale's Foot Disorders Diagnosis and Management, Sixth Edition, Churchill Livingstone, London, Pages 329-331, 2002.

Ross, J.A., Subotnick S.I: Alpine Skiing In: Subotnick SI (ed.) Sports Medicine of the Lower Extremity, 2nd ed. Edinburgh: Churchill Livingstone, pp. 671-686, 1999.

Ross, J.A., Cohn S.;If the Boot Fits, You Probably Have a Custom Insole, Ski Magazine, October, 1984.

Ganong RB, Heneveld EH, Bernanek SR, Fry P; Snowboarding Injuries: A Report on 415 patients. The Physician and Sports Medicine 20:114, 1992.



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