

# It's Snow Time!

## The Ergonomics of Skiing and Snowboarding

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There are several different types of skiing which all produce somewhat different strains and possibilities for injury, and snowboarding presents still different strains on the body. By far, the most prevalent recreational type of skiing is still Alpine or downhill skiing. Cross-country skiing has gained a lot in popularity, too, and provides the opportunity for a superb aerobic workout outside the usual ski resorts. Telemarking and ski mountaineering are fairly uncommon forms of skiing and since little data exists for these types of skiing injuries, we will not cover them in this article. Snowboarders, though they are on the slopes with the downhill skiers, do not share the same type of techniques nor injuries as skiers.

In contrast to most other sports, skiers and snowboarders appear to suffer many more trauma injuries than overuse injuries. Data may be misleading, however, since most studies include data from medical facilities at ski resorts that treat primarily traumatic injuries. In fact, one paper discarded data from any reported injuries that were not traumatic.<sup>1</sup> Overuse injuries are likely treated by a medical practitioner at some later time, even months or years after suffering mild discomforts of overuse.

Proper conditioning prior to the snow season is important for all of these sports. It will increase your endurance and control, and it will decrease your chances for injury. If you plan to head to the snow this winter, plan on tuning up your body ahead of time and be ready to enjoy yourself injury-free this winter.

### Traumatic Injuries

#### *Alpine skiing*

In Alpine skiing and snowboarding, trauma injuries are mainly due to falls and collisions, resulting in bruising, sprains, fractures and head injuries.<sup>1</sup> Ski injuries can encompass just about every joint in the body, but the most common joints which are injured are the knee, shoulder, and hand.<sup>2</sup> A disproportionate number of Alpine ski injuries were found among the "less than 16" age group by a factor of 2.2<sup>1</sup> This may be due to deficiencies in equipment for children or it may be due to the fact that most children have little fear of injury.<sup>1</sup> By a large margin, joint dislocations outnumbered other types of injuries.<sup>1</sup> Studies suggest that smaller, younger, lighter, and less experienced skiers are at the highest risk for injury.<sup>2</sup>

Knee injuries are very common in Alpine skiing due to the twisting of the upper leg one way, while the lower leg rotates the opposite way. This torque often causes tears to the anterior cruciate ligament (ACL) of the knee.<sup>3</sup> 32-48% of all Alpine ski injuries are related to the knee.<sup>2</sup> Females are two to five times more likely to injure their knees, with 33% more females injuring their ACL than males.<sup>2</sup> Males, however, are more likely to injure their head and shoulders than females.<sup>2</sup> 20-25% of knee injuries are to the Medial Collateral Ligament (MCL) and these commonly affect beginner and low-intermediate skiers in the "snowplow" position resulting from a fall, skis crossing, or the snowplough stance widening.<sup>1</sup>

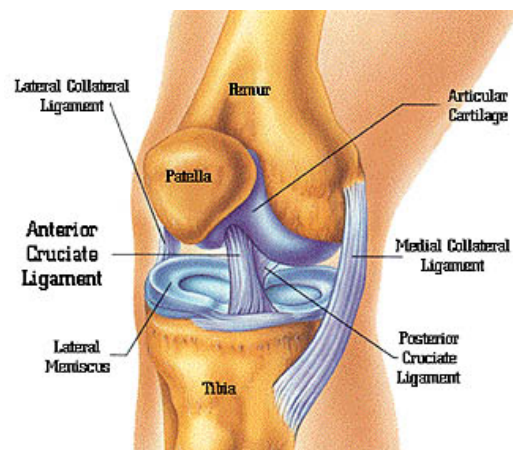


Illustration courtesy of <http://sportsmedicine.about.com>

Inexperienced skiers tend to have maladjusted equipment. Incidence of injury drops by one-half when beginners participate in supervised ski lessons.<sup>2</sup>

Improvements in ski equipment have reduced traumatic injuries steadily since the 1940's. In the 1950's and 1960's, there was an average of 6.6 injuries per 1000 hours. In the 1970's and 1980's, that decreased to 2.8 injuries per 1000 hours.<sup>2</sup> Ankle, tibial fractures and nonknee sprains have all shown a significant decline over the past 15 years, however ACL ruptures have increased 172% over the last 15 years and tripled over the past 22 years!<sup>1</sup>

### *Snowboarding*

When snowboarding, both feet are strapped onto the same board and always point the same direction. Because of this, the knee is not twisted as it is in skiing.<sup>3</sup> A skier has quick-release bindings during a wipeout, but with both boots bound to the board, a snowboarder can do little to shift leg balance during a fall.<sup>7</sup> The upper body takes the force of a fall.<sup>3,7</sup> Snowboarders fall landing on their hands, shoulders, rear-ends, or heads. The most common snowboarding injury is a wrist fracture. Other common injuries include wrist sprains, elbow strains and dislocations, shoulder and rotator cuff strains and injuries, broken collarbones, concussions, and other head and neck injuries.<sup>3</sup>

### *Cross-country skiing*

There are two types of cross-country skiing, each with somewhat different equipment and different stresses to muscles and joints.<sup>4</sup> Classical cross-country skiing is still very common, where both skis are pointed straight ahead and thrust forward by pushing off from the middle of one ski while the other glides forward. Ski-skating has become increasingly popular since the mid-1980's. The legs are alternately pushed outward to each side as in speed skating, rather than directly backward as in the classical stride. This technique has led to new equipment design such as shorter skis with different flexibility patterns, longer poles, and higher boots on a more stable binding. Traditional boots used in classical skiing are not fixed at the heel, which has thought to be responsible for fewer lower extremity injuries. Ski-skating boots and bindings offer more rigidity and stability, which may be found to contribute to different injury patterns with as more data is accumulated over time.<sup>4</sup> In 1983 and 1984, the Swedish national team, where ski-skating predominates, reported that 75% of its injuries were overuse, rather than trauma injuries.

The sport's true injury incidence is difficult to establish because recreational skiers ski wherever snow is available and not necessarily at ski areas that provide immediate medical assistance and recording of data. Recent estimates are that 0.49 to 5.63 injuries occur per 1,000 days.<sup>4</sup> This is a very wide range, but in any event, it's clear that the injury rate for cross-country skiing is much lower than for Alpine skiing or snowboarding. Just over half of the injuries in cross-country skiing are to the lower extremities, the knee being the most common of these. The most common knee injury is sprain of the medial collateral ligament, often occurring when a skier catches a ski tip or edge while the leg is in a fixed position. ACL and meniscus injuries are also common. Ankle injuries, especially sprains are quite common. About 1/3 of all cross-country injuries involve thumb or shoulder injuries. Falling while holding a pole will lever the thumb down causing stress on the ligament. Falling on the shoulder can cause shoulder dislocations, rotator cuff tears, and fractures of the collarbone. Only about 10% of cross-country injuries are to the head, neck and trunk.<sup>4</sup>

## **Traumatic Injury Prevention**

### *Alpine Skiing*

Proper warm-up and stretching can improve flexibility and reduce the chances for pulls and strains. Conditioning calves, gluteus muscles, hamstrings and quadriceps in preparation for the ski season is a good idea to improve muscle control. Also, strengthening the abdominal and core muscles will help you get up after a fall.<sup>7,8,9</sup>

Take lessons from a qualified instructor. Injuries are much more likely for novices who have not had any instruction in skiing. If you ski occasionally, it is best to brush up on your technique before hitting the slopes.<sup>8</sup>

Wearing a helmet can prevent head injuries, which can be fatal. Design of helmets for skiing and snowboarding is improving, making them more comfortable and popular for all ages.<sup>7</sup> Anticipate the maneuvers of other skiers and snowboarders around you. For instance, snowboarders make wider-arch turns than skiers.<sup>7</sup>

Be very careful late in the day when you are fatigued, even if you don't feel tired. Many people injure themselves during the last run of the day. Take your last run slowly and use it as a cool-down for your body.<sup>9</sup> Do not use alcohol or drugs. And avoid off-limits areas where there may be avalanches, drop-offs, cliffs, trees and unseen

rocks and underbrush.<sup>7</sup> Skiing off piste, (off the designated ski runs) can be hazardous. People may not know where you are and safety teams do often not patrol them. Weather patterns may be erratic and you may be caught in an unknown area during a whiteout. It's best to stay on runs and areas which are designated for skiing.<sup>7,8</sup>

### *Snowboarding*

Conditioning, warm-up, and stretching all help avoid muscle and ligament strains and tears. By the time you walk from your car to the hill with all of your equipment, you are probably adequately warmed up. Though the skiing and snowboarding are very different sports, they do use similar muscles. Strengthen the core muscles of the abdomen and back, calves, glutes, hamstrings, and quadriceps in preparation for the snowboarding season.<sup>7,8,9</sup>

Wrist guards, such as those used for in-line skating, may be helpful. Elbow guards can ease the force of falls on the elbows. Knee pads and tailbone pads can help protect the knees and tailbone during a fall, too.<sup>3,7</sup>

Learn to tuck and roll when you fall to distribute the force of the fall.<sup>7</sup> Falling with all of your force on one body part, such as your wrist, causing greater injury.

Design of snowboarding boots and bindings is evolving rapidly. There is a tradeoff in how loose the boots and bindings are secured. The looser your ankles are secured into the boots and bindings, the greater your risk of injuring a foot or ankle. However, with tighter boots and bindings, the greater your risk of injuring a knee, typically ligament damage or ruptures, especially the ACL. As a general rule, if you're a beginner, keep your bindings relatively loose to spare your knees. As you improve, gradually tighten the bindings to improve your control over the board.

As with skiing, taking lessons from a qualified instructor is likely to decrease your chances of injury. And just because you may be an excellent skier, you may be a novice on a snowboard.<sup>3,7,8</sup> They are very different sports. Snowboarding has a steep learning curve, which means that, though beginners may feel frustrated at first, they soon find it gets easier. Novice snowboarders can advance much faster than inexperienced skiers.<sup>9</sup>

Wearing a helmet can prevent concussion, brain injury, or fatalities. No helmet can prevent other serious injuries due to recklessness, however. Stay in control and be aware of other snowboarders and skiers around you. The long-arch turns of snowboarders differ from the shorter-arch turns of skiers. Avoid collisions with others by anticipating their maneuvers. Check blind spots before turning, especially on backside turns. Don't sit down in traffic areas or anywhere you can't be easily seen.<sup>7</sup>

Attach a security strap to your front foot. Detach your right foot from its bindings while using lifts or tows.

As with skiing, be very careful late in the day when you have been snowboarding all day and are fatigued. Never use alcohol or drugs when snowboarding. Stay on designated slopes and areas.<sup>7,8</sup>

### *Cross-country Skiing*

Attention to equipment is very important in injury prevention. It is best to stay on marked trails and let someone know where you are going. There are miles of cross-country trails many of which are lightly patrolled by safety teams, especially in comparison to heavily populated downhill ski areas. If you become injured, it can take quite a while to get help to you. Weather conditions can change rapidly, so be aware of your location and trail branching. It is very wise to take a course in winter survival offered by ski patrol or forest service in some areas. Carry plenty of water, layers of clothing, sunscreen, and protective eyewear. Make up a small survival pack to carry that contains a space blanket, trash bag (for cover/tent), waterproof matches, compass, and mirror or reflector. Most importantly, if you get lost, stay where you are. It will be far easier for rescue teams to find you if you don't get farther off the track and deeper into the woods. Panic is very common and it is important to remain calm and conserve energy.

## **Overuse Injuries**

### *Alpine skiing and Snowboarding*

Very little information is available regarding overuse injuries during skiing and snowboarding. In all cases, these mostly appear to occur as a result of poor technique or training.

Wrist pain and tendinitis can result from repetitive flexing and rotating of the wrist as skiers withdraw their planted ski poles in deep snow. Advanced skiers may be more at risk because of their more aggressive style of pole planting.<sup>5</sup> This type of injury had an 11.9% incidence rate in one group of Alpine powder skiers.<sup>5</sup>

#### *Cross-country skiing and ski skating*

Swedish ski-skaters most commonly reported medial tibial stress syndrome, Achilles tendon problems, and low back pain.<sup>4</sup> Patellofemoral syndrome is also common. This is a strain between the kneecap and femur (lower leg bone) caused generally by quadriceps contraction, and resulting in pain behind the kneecap. In classical cross-country skiing, "skier's toe" and sesamoid inflammation are common.<sup>4</sup> Skier's toe is an arthritic change in the main joint of the big toe, typically including swelling and pain when the toe is flexed. Sesamoid bones of the big toe are small round bones in a tendon where it passes over the joint. These can also become painful, especially during the kick phase of classical cross-country skiing.<sup>4</sup>

Ski-skaters may experience problems with the iliotibial band (just above the kneecap on the outside of the leg) and resulting problems with kneecap tracking...and associated pain and swelling. This is caused by the swinging of the leg out to the side and back down again during the recovery phase of the kick.

Exposure to cold and wind can cause injury to the exposed skin of face and hands. Frostnip, is the numbness and blue-white discoloration of exposed skin. Frostbite involves deeper skin layers and can be a precursor of hypothermia.<sup>4</sup>

### **Overuse Injury Prevention**

#### *Alpine and snowboard*

Alpine skiers should be instructed in powder skiing pole technique, especially avoiding deep pole planting and pole dragging. Decreasing the pole length by 2 inches and downsizing the basket diameter to 2.5 inches may also help prevent injury.

#### *Cross-country*

Boots, poles, and skis should be properly fitted to the skier and skiing style. Properly waxed skis can prevent repeated backward slipping on icy, hard tracks, which can prevent over-stressing muscles and tendons.<sup>4</sup>

Proper warm-up and cool-down exercises, as well as endurance and strengthening exercises, are necessary to avoid overuse injuries. Ski-skating relies on the hip adductors and rotators, which are muscles not routinely involved in pre-season conditioning, such as running.<sup>4</sup> Roller skiing can be a good strategy in pre-season conditioning and training.

Layered clothing, adequate hydration, and protective eyewear help prevent cold and wind related injuries.

Use of an orthotic that incorporates a rigid shank (Morton's extension) that extends the length of the big toe is the most effective non-surgical treatment of skier's toe. If the problem persists, surgery may be considered.<sup>4</sup> For sesamoid problems, a shoe insert with a cut-away section beneath the sesamoids is usually helpful. For continued problems, a bone scan may be necessary to rule out a stress fracture or other injury.<sup>4</sup>

Following adequate warm-up stretching can help release tension in the outside muscles of the upper and lower leg and hip. The stretch shown is effective for ski-skaters because it stretches the entire length of the outer leg and hip.



Illustration courtesy of SilentSports.net

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