

The ACL Epidemic in Female Skiers

There are a LOT of knee injuries in skiing—nearly one out of three reported ski injuries involves the knee, making knee injuries the biggest single medical issue in the history of the sport. Further, women account for 60% of ACL injuries. Why is this the case? Here's an in-depth look at ACL injuries and their effect on women.

How do ACL injuries occur on skis?

Most ACL injuries in skiing (over 70%) occur when the skier is in the “back seat” and catches an inside edge. The actual mechanics of the injury are simple. When your hips and knees are bent, you can rotate your leg inward (i.e. while sitting, you can place your right foot on your left knee) but you cannot rotate it outwardly. To experience this – sit in a chair (hips and knees bent), and pull your foot directly sideways to the outside. Your leg simply can't bend that way.



Skiers routinely find themselves in such a “sitting” position - pounding through bumps, landing a jump on the tails, recovering from a skid, or simply being momentarily off-balance to the rear. Flexing your ankles, knees, and hips is the natural way for your body to manage these forces, and by itself, this does not cause injuries.

However, if a skier happens to be in this configuration at the moment some other

force pushes the foot directly sideways to the outside, an injury is likely.

It is usually the snow that pulls or pushes the ski. If the force acts on the ski tip OR the tail, the ski will rotate around the skier's boot heel, and the toe is likely to release from the twisting force. However, if the force is at both the tail AND the tip, or if the force enters the ski at or near the heel (pushing the ski directly sideways), the forces do not twist the ski around the boot heel and ordinary alpine ski bindings will not release. Skiers all know what it's like to “catch an inside edge.” If this happens when the knees and hips are bent and the lower leg is pulled too far, a knee injury is likely.

The most reliable method for reducing your chance of a knee injury is to use ski bindings that have been specifically designed to protect against knee injuries.

Why women are more at risk than men

On skis, women are believed to be at more than twice the risk that men are of an ACL injury. That is a LOT more. It is appropriate for women to be aware that they are more at risk, and many (most?) women already know it, and often seek ways to reduce that risk. There is no single “smoking gun” answer to this. Rather, a number of factors may contribute:

“Q-Angle” – Women’s hips are wider in relation to their ankles, with significant differences in the related bones and muscles. Men’s hips are narrower, forming a straighter connection at the knee (generally about a 15% angle), while women’s knees generally form wider angles (generally about 20%).

Muscle Differences – Women have proportionally less leg muscle mass – muscle that may help stabilize and protect the knee in some situations.

Muscle Response - There is evidence that women do not have the same neuromuscular control and speed as that men do. Studies have shown, for example, that a female quadriceps does not “fire” as quickly as a male’s.

Intercondylar Notch - The ACL passes through and over bone. In women, the bone is formed with a tighter, sharper opening than in a man’s. This is widely believed to be the reason female ACL injuries are more likely to be complete, rather than partial, tears. Some elite female athletes have had “preventative” surgery to “round off” this sharper bone to reduce the chance of injury.

Genetic Material – the actual ACL material in a woman is not genetically identical to the ACL material in a man. No one knows for sure why it evolved differently.

ACL Size – a female ACL is not as thick as a male ACL in proportion to muscle mass. Female athletes appear able to create muscle mass that is disproportionately larger than their ACLs compared with male athletes.

Menstruation/Hormones – Women generally have more flexibility than men, which may contribute to the risk. In addition, many believe that menstruation and other hormonal influences such as birth control pills can accentuate this by relaxing and expanding joints even further. One study – conducted some fifteen years ago – found that women are more likely to be injured just before or just after their cycle than during it. It has been theorized by some that menses causes physical changes that put women more at risk, but also that women may subconsciously change their behavior during the peak of their cycle, thereby reducing their risk.

It is almost certain that the increased risk for women is multi-factored – that the above reasons combine in various ways to create increased risk. None of these is a proven, single cause. However, they may contribute to the increased likelihood of an injury during a “phantom foot” event.

How can women reduce their risk?

It cannot hurt to get in shape. While there is no “hard” proof that physical conditioning reduces the risk of injury in skiing, it only makes sense to be as fit as possible. Pre-season conditioning can reduce various injuries. Proponents suggest a 4 to 6 week pre-season regimen of strength and flexibility training for the legs, under the theory that improving muscle tissue will help protect the knee. Getting in shape for ski season is always a great idea!

Ski Smarter! A program promoted by the Vermont Ski Safety organization conducted a study decades ago showing the risk of ACL injuries may be reduced by following specific on-snow practices. Under this program, a group of ski professionals lowered their injury rate by following some guidelines such as - “finish falling” before you try to get up. This seems to make sense, but despite significant adoption of this training program at resorts across the country, the overall injury rate has not been significantly affected. If you are in the prime position to increase the likelihood of a knee injury (hips and knees bent, rear-weighted), you are unlikely to be able to affect the outcome.



The most reliable method for reducing your chance of a knee injury is to use ski bindings that have been specifically designed to protect against knee injuries. Most bindings are NOT designed to release in situations that cause knee injuries, but a new kind of bindings is now readily available in North America that can release directly sideways at the heel, before the forces are great enough to otherwise damage the knee. Such bindings reduce the rate of knee injuries by at least as 75%.