

Skiing Mechanics

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Downhill and Super-G are referred to as the speed events of ski racing. Slalom and Giant Slalom are referred to as the tech(nical) events. For speed events a lot of time is spent down in an aerodynamic tuck position and paraspinals and glutes become strong and dominant. These individuals are often very stiff as they ski and are frequently PEC's. The trunk spends much time parallel to the ground (lots of forward flexion), the hips are flexed and abducted so knees are directly under shoulders. In this position tibias remain vertical so that the skis can be flat on the snow (not on the edges) which is how they go fastest. The speeds can be up to 80-90mph and turning at this speed, especially as terrain changes, can lead to G-forces of 2-2.5x. When not skiing these individuals will often have deep lumbar spines and often some FA ER w/ TF IR B in order to line tibias up over flat skis with feet/skis pointing straight ahead.

At the youth level most kids are not doing a lot of downhill, but rather ski more slalom and giant slalom with occasional Super-G. The biggest differences are the turn frequency, duration and force. In these events there is less time in the static aerodynamic tuck and more shifting from turn to turn in a more upright position. They are more likely to be L AIC's. This shows itself while skiing as:

R footed turn (turning to the L) is more balanced than L footed turn (turning to the R). This is because of R thoracic abduction (trunk side bending to the R) holding the COG (center of gravity) over the R lower extremity. Pelvic orientation to the R (in ski terms this is referred to as "counter-rotation") further balances the skier over their R ski as their body is moving in the direction that the centripetal forces are pulling them. They tend to hang out too long on the R ski with late loading moving further and further to the heel/tail of the ski and have a hard time getting off it. They need to have more R AF ER (pelvic depression while bringing the R hemipelvis slightly forward in transverse plane) in order to get earlier snow contact and encourage a quicker/shorter loading period on the R side

The prolonged loading on the R foot means the start of the turn on the L is rushed. On the L footed turn with less L thoracic abduction (trunk side bending) the R abdominal wall is pulling the trunk/COG too far to the inside of the turn so that they lean in and are more likely to fall on this side due to having too much weight on the inside ski - the trunk moves in the opposite direction to where the centripetal forces are pulling them. The R orientation of the pelvis is further exaggerated because the start of the L footed turn is rushed so they tend to throw themselves into the turn rotating their skis, pelvis and even upper trunk. This rotation helps to bring the L shin against the tongue of the boot which helps to steer the front of the ski at the beginning of the turn however the tail of the ski CAN lose grip and slide (almost like fishtailing) slowing them down. This rotation forces them to get off the L foot too early and sends them back onto the R foot.

At the knees all skiers want to pressure the front of the boot when they ski and need their knees to line up fairly straight in line with their feet. This is necessary to be able to put pressure onto

the front of the ski at the start of the turn which is what allows you to start steering. In order to accomplish this as a L AIC, the L femur must ER and the R femur must IR. Often see patho AIC's with negative L EDT. Speaking to the head of the US ski team years ago, they have a tendency to see boot canting (lining up boot shell with tibia so that foot and ski are flat in natural stance) with the L tibia in varus and the R tibia in valgus.

At the feet the racers are looking for pressure through the arch in order to drive the medial border of the lateral ski/foot into the snow. Because the R foot tends to be more supinated there is greater need for R hip adduction and FA IR. This add/IR position is how you steer a ski so if you start in this position you have nowhere to go to create greater angles to ski with.

Ski research has shown that there are more L ACL tears than R (the only other injury with a side to side difference is spiral fx's of the lower leg). The ACL injuries occur due to limited L AF and FA IR as the ski catches and turns, aggressively internally rotating the tibia and femur to the point where FA IR hits is max earlier on the L than the R.

In ski racing the most common acute injuries are knee injuries (especially ACL) and concussions. Back injuries are the other common injury, but more chronic in nature, especially in GS where the rapid direction changes under high load overload the paraspinals - in males it is felt more in the lumbar spine and in females it is slightly higher in the lower thoracic spine. Another interesting note is that the vibrations in skiing are at the resonant frequency of the spine.