Skiing and Snowboarding: Injury, Prevention and Rehabilitation

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Ski Injuries

Alpine ski injuries rate is approximately 2-3 per 1000 skiers each day (Koehle et al, 2002).

- Lower extremity: ~50%
  - Hip/thigh: ~4.9%
  - Knee: ~34.9%
    - MCL is most common
  - Calf/ankle/foot: ~17.4%
- Upper extremity: ~35%
  - Shoulder: ~17%
  - Elbow: ~3.2%
  - Hand/wrist: ~2.4%
    - Falls and pole planting
- Back/Trunk: ~7.6%
- Head injury: ~12.5%
Knee sprains: 3 common mechanisms

1. Valgus-external rotation
   - MCL
2. Boot-induced anterior drawer
   - ACL
3. “Phantom foot”
   - MCL/ACL
   - Most frequent
   - Skier falls backwards between the skis with knees flexed.
   - Upper body faces the downhill ski and the uphill ski is unweighted.
   - Inside edge of downhill ski digs into snow causing outward levering and IR force on the downhill hyperflexed knee.
Ski Injuries (con’t)

- Newer bindings allow for “multi-release” in different planes
  - No apparent change in ACL injuries (Koehle et al, 2002).

- St. Onge et al. (2004)
  - Examined the effect of the position of the binding pivot point and binding release characteristics on ACL strain in “phantom foot” falls
  - A binding with 2 pivot points (one in front, one in back) could sense twist loads applied to the ski both at the front and at the back.
Snowboard Injuries

- 2-3x greater risk for upper extremity injuries (Bladin et al, 2004).
  - 33% LE
  - 66% UE
    - Wrist injury is most common 10x that of skiers
      - FOOSH (fall onto out stretched hand)
    - Boarders who wear protective wrist guards are significantly less likely to sustain wrist injuries (Ronning et al, 2001).
      - Others suggest this may just transmit load to shoulder (Chow et al, 1996).

- 3x more likely to be injured jumping versus skiers (Bladin et al, 2004).

- Burst fractures of the spine most common spinal injury (Richards et al, 2001).
Snowboard injuries (con’t)

- Most common ankle injury position: dorsiflexion and inversion combined with ER (Bladin et al, 2004).
- Style of boot does not affect the ankle injury rate (Kirkpatrick et al, 1998).
- Jumps are most common cause for LE injuries in snowboarders
  - “Big air, flat landing”
Skiing versus Snowboarding

- Why the difference in injury type?
  - Snowboarders are fixed to the board and when falling the board is unable to act independently as a lever exerting torque on one knee or the other.
Four fundamental skills of Alpine skiing

- Balance, Edge, Pressure and Rotary.
  - Edge control involves a tipping action of the feet. As the skiers center of mass passes over the skis, pressure is increased. Then, to control the direction of the turn, rotary movements are used.
Steering Phase

- Done by transferring one’s weight to the inside edge of the outside ski.
- The force exerted on the snow by the skier during this phase can be as high as 160-175% of his body weight. Typically, and in good conditions, this force is split between the uphill and downhill ski by 25% and 75% respectively (Muller, 1994)
This EMG shows the upstemming process, where the center of gravity is moved to change the edge pressure from one ski to the other.

The tibialis anterior and the peroneus longus are the muscles that would be involved in the up-initiation, or extension. Any turn requiring the upstemming motion would require such activity from these muscles.

Little effort required from the thigh muscles.

The hip and knee extensors contributed little during the actual steering phase.

The only muscle that was worked continually was the tibialis anterior (Muller, 1994).
Skiing is a sport that demands physical effort.

The more ready you or your patient is in terms of being in shape, the less taxing it is on the body.
Injury Prevention (Pre-season)

1. Cardio
2. Stretch (UE, LE and neck/back)
   - Quads, HS, groin, psoas, gastroc/soleus, trunk rotation, cervical rotation.
3. Weight training
4. Core strengthening
   - Abdominals and trunk
5. Balance and flexibility
6. Plyometrics
   - Skier Jumps
   - Fitter
Balance and Core Strengthening
1. **General warm-up**
   - Can be as simple as the walk from your car.
   - A two degree increase of muscle temperature can give an increase in elastic properties of the muscle by as much as 15-20% helping to improve performance and prevent muscle strains.

2. **Stretching**
   - Quads, HS, groin, psoas, gastroc/soleus, trunk rotation, cervical rotation.

3. **Specific warm up**
   a) **Torso and shoulders**
      - Shrugs, arm swings, dynamic push-ups, trunk twists
   b) **Legs**
      - Figure 8’s, high knee marching, side-to-side shuffle steps, calf raises, stretching
Injury Prevention (On the slopes, con’t)

4. Speed and power warm up
   - Marching with arms and legs, alternating power lunges, plyometric jumps

5. Warm up runs
   - On colder or windy days it is vital that you take the extra time to perform a good warm-up because a warm muscle is not only stronger but the elastic properties of it are increased allowing for better shock absorption.
Other Examples

Lunges

Marching
Rehabilitation

- Rehabilitation should focus on the impairments you find.
- Typical ACL injury return to ski time depends on the patient.
  - Steadman-Hawkins Institute recommends conservative early rehab, progressing towards the end.
    - 6 mo. to 1 year
- Focus on functional exercises
  - LE strength, stretching, balance and coordination, explosion, core strength.
Rehabilitation Examples

- Sport-Cord
  - Works on lateral agility, landing on the inside leg
- Balance and Coordination Exercises
- Single leg squats
  - Against wall, attached to sport-cord. Pull patient off-balance and force them to react.
- Absorption exercises
  - Tuck squats, plyometric hopping, lateral explosive lunges.
Balance and Coordination

Examples

Skier Jumps

Balance Board
Helmet Study (Gorman et. al)

- Examined 75,395 skiers over 5 year period.
- Also examined trauma patients (head injuries from skiing/boarding) at St. Anthony’s in Denver

Conclusions:
- Greater percentage of snowboarders wear helmets....generation gap?
- Helmet use has increased every year since 1998
- Of 354 head injuries, 74.9% were un-helmeted.
- Helmets reduce the chance of brain injury among skiers and snowboarders by ~40%.
Most experts recommend not beginning to ski until the age of 4

Children are more susceptible to heat and water loss.

Stress fractures

Safety (American Academy of Orthopedic Surgeons)
  - Each year over 41,600 youths under the age of 15 are treated in emergency rooms for ski related injuries.
  - Cost of these injuries was more than $709.6 million in 1999.


Questions?