Skiing Injuries: Lower Extremity

Background
Upper Extremity
Nordic Skiing
Snowboarding

Epidemiology

1. Decline in tibial fractures, foot, ankle injuries by 87%
    - Due to new bindings/boots
2. Children more susceptible to tibial fractures

Prevention

1. Self test bindings each day
    - Step into binding
        - Twist to the side to release toe-piece
        - Lean forward to release heel-piece
    - If bindings do not release, professional adjustment necessary
2. Good ski instruction
    - Advance from novice level early

Knee Injuries

1. Epidemiology
    - 20-36% of all injuries
    - ACL injury
        - Most common
    - Women more often than men but less severe
        - Due to lighter weight
        - More susceptible to equipment related injuries
            - Strong springs or release capabilities not set for female skill, weight, and age
        - Extrinsic factors
            - Conditioning
        - Intrinsic factors
            - Joint laxity
    - Increase in Grade III tears from equipment causing force to be taken by knees instead of lower legs
        - Bindings are adjusted to prevent tibial fractures not knee sprains
        - Release too slow to protect the knee
2. Mechanism of injury
    - Valgus-external rotation
        - Catching inside edge and falling forward between skis
    - Boot induced
        - Land on back of ski with extended knee causing boot to force tibia forward as ski hits ground
    - Phantom foot phenomenon
        - Catching inside edge while falling backward between skis driving lower leg into internal rotation

- Usually no compression component like direct blow, deceleration, or change of direction
  - Leads to less secondary trauma-meniscal tears, MCL injuries, bony contusions

3. Symptoms
   - Immediate pain and/or instability
   - Pain increases over next 24 hours
   - Joint effusion
   - Movement improves with resolution of swelling
4. Physical findings
   - Positive Lachman's test
5. Imaging[5]
   - AP/lateral/tunnel views of knee
6. Treatment
   - RICE and crutches until swelling subsides
   - Surgery depends on desired activity level
     - Need for rotation, hyperextension movements
7. Prevention
   - Teaching programs that help people avoid high risk behavior
   - ID positions and maneuvers that may result in injury
   - Responding appropriately in high risk situation may be beneficial for ski instructors
   - No change in equipment seems to prevent injury

Tibial Plateau Fractures

1. Epidemiology[6]
   - Schatzker I
     - Llateral plateau split fracture
   - Schatzker II
     - Lateral split/depression fracture
   - Schatzker III
     - Lateral plateau depression
   - Schatzker IV
     - Medial plateau split fracture
   - Schatzker V
     - Bicondylar plateau fracture
   - Schatzker VI
     - Fracture with metaphyseal – diaphyseal separation
   - Schatzker I, II, III common
     - IV, V less common but increasing
2. Mechanism of injury
   - Increased forces transmitted to knee from equipment injuries
   - Anterior half of joint with or without disruption of MC most common site
   - Mechanism of injury
     - Valgus load leading to compression on lateral compartment
3. Symptoms
   - Immediate pain and swelling
   - May be intra-articular swelling from intra-articular fracture and subsequent hemorrhage into joint

4. Physical exam findings
    - Do thorough neurovascular exam
        - Superficial Peroneal
            - Sensation over dorsal foot, foot eversion
        - Deep Peroneal
            - Sensation at dorsal web of digits 1,2, big toe dorsiflexion
        - Posterior tibial
            - Sensation over back of leg, bottom of foot, foot plantar flexion, big toe plantar flexion
    - Imaging
        - AP and lateral of knee
5. Treatment
    - May perform arthrocentesis for joint effusion if necessary
        - Sterile technique to avoid infection
    - Schatzker I-III
        - Arthroscopic surgery
        - If non-displaced:
            - Cast with ROM at 6 weeks
            - Weight bearing at 3 months
    - Schatzker IV
        - Hybrid external fixator or ORIF
    - Schatzker V, VI
        - ORIF

Head and Spine Injuries

1. Epidemiology:
    - 7% of all injuries
    - Incidence increasing due to increased acrobatics and high speed activities
    - No change with equipment changes
    - Head injuries
        - Most common cause of death in ski injuries is traumatic brain injury
            - 50-88% of all deaths in skiing/snowboarding
        - Males
            - 2.2 times more than females and those under 35
            - 3 times more common than older people
        - Concussions most common head injury
            - 11% of all ski injuries and 83% of head injuries
    - Spine injuries
        - 2-4% of all ski and snowboard injuries
        - Permanent neurologic sequelae or death 1 in 995,322
2. Mechanism of injury
    - Simple fall-most common
    - Fall with blow by ski or ski pole
    - Collision
        - Immovable objects (most fatalities)
        - Other people
        - Blunt trauma from chair lifts and T-bars
    - Head injuries-increased risk with
        - Fatigue

        - Ungroomed snow
        - No lessons
        - Skiing recreationally rather than competitively
    3. Physical findings and treatment
        - See trauma: Head, Neck, Back
    4. Prevention
        - Helmets associated with 22-60% decrease in head injury (SOR C) [2]
            - Benefits of helmet use outweigh any possible risk of neck trauma in children due to lack of neck strength
        - Development of terrain parks
        - Focus on proper technique during acrobatic and snowboarding type moves
        - Strategies proposed
            - Limiting uphill lift capacities
            - Grooming snow to avoid high speed cruising
            - Careful marking of all obstacles
            - Heightened safety measures for children on ski slope and chair lift
            - Minimize angle of approach for merging trails and runs

Pediatric Injuries

1. Epidemiology
    - 23% of all ski injuries but only 12% of all skiers
    - Risk factors
        - Deficient binding adjustment
        - Low skill level
        - Use of rented equipment
        - Excessive fatigue
        - 15% associated with musculoskeletal immaturity
2. Mechanism of injury
    - Falls and collisions responsible for most trauma
        - Excessive speed
        - Adverse slope conditions
        - Overconfidence
        - Behavioral patterns within and among gender
3. Injuries
    - Head and neck
        - 11-20% of all injuries
        - Cranial trauma 67% of all fatalities
    - Upper extremity injury
        - 22-79% of all injuries
        - AC dislocation, clavicle, humeral fractures
    - Lower extremity
        - 47.7% of all injuries
            - Knee sprains and ACL tears
            - Tibial fractures higher in this age group
4. Prevention
    - Formal instruction focusing on collision avoidance
    - Helmet use
    - Fall training
    - Avoid behaviors that lead to excessive risk

- Binding adjustments
- Slope management
  - Overcrowding, trail and obstacle maker upkeep
- Minimize opportunity for excessive speed

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