Skate Smart:
How to identify potential injuries both on and off the ice

2007 Sports Medicine Society
Kat Arbour
MS MPT CSCS PES

Athlete:
Strong, Flexible, Balanced, Powerful, Graceful

Skating is Risky!

- Injuries can not be prevented however, the risk of developing an injury can be reduced by knowing early warning signs.
Ways to Define “INJURY”

*Acute or Chronic/Overuse Injury that results in:*

- Time loss from skating
- Interruption in practice or competition schedule
- Need to seek medical attention

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Overuse Injuries

**Why do athletes get injured?**

- Exceed *individual’s* tolerance to activity

**Where do athletes get injured?**

- Skaters sustain mostly LE overuse injuries

1999 Bloch RM

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Acute Injuries

- Contusion
- Concussion
- Laceration
- Fracture

Marie-France Dubreuil and Patrice Lauzon from Canada
### Incidence of Injuries

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
<th>Acute</th>
<th>Overuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>Kjaer M., Larsson B</td>
<td>56%</td>
<td>44%</td>
</tr>
<tr>
<td>2003</td>
<td>Dubravcic-Simunjak, S</td>
<td>26%</td>
<td>44%</td>
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<tr>
<td></td>
<td>Junior World &amp; Croatia Cup (Singles)</td>
<td></td>
<td>30% uninjured</td>
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<tr>
<td>2003</td>
<td>Fortin, J., Roberts, D.</td>
<td>36%</td>
<td>64% exacerbations</td>
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<td></td>
<td>US Nationals</td>
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</tr>
<tr>
<td>2003</td>
<td>Dubravcic-Simunjak, S</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Synchro</td>
<td>42%</td>
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</tbody>
</table>

### Intrinsic Risk Factors

- Physiology and Biomechanics of the Skater
  - Ligament Laxity
    - Extreme flexibility
      - Beilmann, Donut, P-cake
    - Early Joint wear changes
  - Ligament Tightness
  - Knee alignment
  - Hip IR/ER

### Extrinsic Risk Factors

- Environmental Factors Affecting the Skater
  - Air Quality
  - Air Temperature
  - Ice Condition
  - Twisted Boots
    - Function of boot or foot in boot?
  - Poor Blade Placement
  - # Jumps, Spins & Lifts
Overuse Injuries
How Many is TOO MANY?

• Low Back Pain
• Shoulder
• Jump Volume / Stress Fractures
• Falls
• Alignment
• Boot / Foot Injuries

Overuse Injuries: Low Back

How many Biellmann or Donut positions in a day?
  – 20? 30? 40?
  – High compressive loads on spine that greatly exceed safe levels recommended by NIOSH.
  • 3450N = 764 lbs!!!

Overuse Injuries: Low Back

Forceful and Repetitive flexion/extension/rotation of lumbar spine
  increases risk of fracture
  – Landings, layback/sit, spirals/splits
  – spine hypo or hyper-flexibility

2003, Drey MA, Michael Li, Gettins PG; 1999, Block
Overuse Injuries: Low Back

2000, Omey ML, Micheli LJ, Gerbino PG; 1999, Block

- **Spondylolysis**
  - Stress fractures in pars interarticularis
  - Pain with back banding or hip extension

- **Restore Strength & Coordination**
  - Restoring L’ROM is **not** a Goal for Spondy
  - HIP ROM **is** Goal!!
  - Restore co-ordination and control
  - Restore strength and endurance in trunk m

Caroline Zhang & Sasha Cohen

*Extreme Flexibility is not taught!*

- SLUMP TEST
  - Test position for Disk/Nerve irritation!

How many Hyper-Flexion positions in a day?
- 20? 30? 40?

- How many Hyper-Flexion positions in a day?
- 20? 30? 40?

- SLUMP TEST
  - Test position for Disk/Nerve irritation!
Overuse Injuries: Low Back

It is NOT NORMAL for children to have LBP!

- Bulging Disk
- Pain with forward bending
  - repeated falls into flexed position
  - lifting partner
  - sit spins
  - lunging
  - twisting

Overuse Injuries: Low Back

The need for trunk strength to maintain body position is frequently under-emphasized in Jumps, Landings, Throws & Lifts.

Overuse Injuries: Shoulder

- Common in Pairs & Dance
- Increasing in Singles
  - Rotator Cuff Tendinitis
  - Impingement
  - Dislocation / Instability
Overuse Injuries: Shoulder
External Rotation

Alyssa Czisny  D Biellmann

Extreme Shoulder External Rotation / Abduction

Overuse Injuries: Shoulder
Internal Rotation / Elevation

• End position for male in
  – Over head lifts
  – Throws

• Neer: Test position for Impingement!

Qing Pang & Jian Tong

Overuse Injuries: Shoulder
Internal Rotation / Elevation

• Develop STRENGTH in both small stabilizing and large movement muscle groups

• Keep GH joint in excellent position during overhead skills.

Totmianina and Maximin
Overuse Injuries: Jumps

• How many jumps/day do skaters attempt?
  – 50? 60? 70? 80?

• How many throw’s/day are pair skaters attempting?
  – Landing from greater ht
  – Falling from greater ht

Overuse Injuries: Jumps
Hip Flexors & Groin

• Hip Flexion is useful for Jump LIFT
  – Maybe 50 double axels is too many!
• Can take MONTHS to heal!
  – AT first onset of pain:
    • limit repetitive motion
      – too many axels (FS)
      – lunge-movements (Dance)

Overuse Injuries: Jumps

1997, Lockwood K, Gervais P.
Insole measuring device collected pressure distribution & force inside the skate.

• Jump Ht = btw 1,2,3 rev jumps
  • Increased time required for rotation places the skater closer to the ice at time of impact.

• Toe-Heel foot-fall time: least in 3-rev J
  • Less time to distribute the forces
  • Higher impact in LE
  • Triples land w/ greatest forces

• Greater potential for injury?
Overuse Injuries: Stress Fx

2002 Oleson CV, Busconi BD, Baran DT.

• Compared BMD of 36 skaters to 22 a/m controls.
  – (10 w/ fx, 26 w/o fx hx)
• Skaters with fracture history
  – had BMD values comparable to controls.
• Skaters without fracture history
  – had calcaneal BMD values 15% to 24% greater than
    either the controls or skaters with fractures.
• Skaters w/o fx & could executed triple jumps
  – had 14% to 19% > BMD than double jumping skaters.
  – 7% to 11% greater BMD in the landing foot.

Overuse Injuries: Stress Fx

2002 Oleson CV, Busconi BD, Baran DT.

• Greater potential for injury in some; improves
  bone mass in others!
  – Stress fx in young sk NOT caused by low bone mass.
  – From excessive forces placed on normal skeleton.
  – Higher peak forces applied to landing ft.
• WHY?
  – Bone Density, Strength & Size?
  – Lean Body Mass?
  – Diet? Hormones?
  – Skeletal Alignment?
  – Training Routine?
  – Eccentric loading?

Overuse Injuries: FALLS

Bursitis, hematoma, bone bruise, Stress Fx

• What percentage of
  jumps end in FALLS?
  – 25%? 50%? 100%?
• Body position during
  fall
  – Hip IR/ER
  – Lumbar flexion
Overuse Injuries: Falls
PADDING for Protection!
(www.skatingsafe.com)

Decreased risk of
- Bursitis
- Hematomas
- Bone Bruising

Overuse Injuries: Falls
PAD for Protection
- Coccyx
- Ischial Tuberosity
- Greater Trochanter

Overuse Injuries: Alignment
- Ankle, Knee or LB Pain
  - Do skaters with better eccentric control and alignment suffer from fewer LE injuries?
    - Flexibility or Strength issue?
    - Neuromuscular issue?
- Biomechanics
  - High arches (rigid feet)
  - Low arches (floppy foot)
    - Do not optimally transmit/absorb ground forces
  - Hip Rotation / Femur Rotation / Knee Alignment
  - Spine mobility
Overuse Injuries: Foot & Ankle

2000, Smith AD

- Boots should be as flexible as skater can control, not as stiff as the skater can bear.

Overuse Injuries: Foot & Ankle

1999 Bloch RM

- Foot and ankle problems may be related to the rigidity of the leather skating boot.

Overuse Injuries: Foot & Ankle

2004 Anderson SE, Weber M.

- Persistent/disabling pain in ice skaters and snow boarders may correspond to a focal soft-tissue abnormality:
  - Subcutaneous fat impingement between the fibula and the shoe.
  - Bursitis
Boot Fit and the Poor Foot:
A Day at the Office

Bursitis, Tendinosis, Pump Bump, Lace Bite, Corns, Calluses, Bruising, Blistering, Bleeding...

Nobody thought it was strange!
In fact, they were proud to model their battle scars!

Overuse Injuries:
Ankle Sprains and Strains

• On Ice
  – Poor technique on tap or land
  – Poor boot support
  – Stiff boots- laced loosely at top

• Off-Ice
  – Wear cross trainers for off-ice
  – Wear brace if hx of sprains

Extrinsic Risk Factors
A Real-life Scenario

Skater develops knee pain 2 wks before Natl’s
– Then Skater develops back pain
– Is it NERVES or OVER TRAINING?
– Skater seeks Medical Attention
– Skater continues getting worse
– Blame the know-nothing Doc/PT

• THEN.... SOMEBODY LOOK AT THE SKATE!!!
  – ‘Twisted’ Boot / Broken Down Boot
  – New boots seem to substantially help the problems
Periodization
Cycled Seasonal Training to REDUCE overuse injuries

### Training Season Guide Lines

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<tr>
<th></th>
<th>Dec</th>
<th>Jan-Mar</th>
<th>Apr-Jun</th>
<th>Jul-Sep</th>
<th>Oct-Nov</th>
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<td>Flexibility</td>
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</table>

Off-Ice Training

- Well-designed off-ice training program
  - Periodized Schedule
  - Fewer injuries & enhanced performance
- Excellent Aerobic/Aerobic Conditioning
- Knee overuse symptoms decrease w/:
  - Normal flexibility in LE muscles
  - Especially in the growing athlete
- Core body strength
  - Controls j landings & protects spine/ pelvis
- Adequate shoulder strength: pair/dance

Off-Ice Training

- Conditioning through Periodization
  - Strength
  - Flexibility
  - Power
  - Timing
  - Agility
  - Balance
Physiologic Profile of Competitive Skater

**GOAL:** VO2max > 60 ml/kg/m and LT > 85% of VO2

1992, Kjaer M., Larsson B.
- VO2 max: 54.7 to 68.8 ml/kg/m

1996, Mannix ET, Healy A, Farber M.
- On-ice training ALONE
  - pre = 44.2, post = 41.4 ml/kg/m
- On-ice PLUS cycle erg
  - pre = 50.7, post = 55.9 ml/kg/m

2000-2005
- US Figure Skating: Novice Training Camps
  - VO2 peak (on-ice) 50-55 ml/kg/min

Flexibility

- Splits
- Backward Bend
- Hip ER & Ext

Strength & Balance
Quickness & Power

Plyometric Training

• Floor Jumps
  – Focus on technique
    • Alignment
    • Explosive take offs
    • Quite landings

• Ability to DECELERATE

Quickness & Power

Plyometric Training

• Box Jumps
  – Gradually increase ht
  – 2 & 1 Ft
  – Up & Down

• Concentric Explosiveness

Not your typical figure skater
Quickness & Power
Plyometric Training

- Vertimax®
  - Resisted Jumps
  - No studies on young athletes
  - Safe & Appropriate?
    - More jumps at higher intensity?
  - Increased GRF!

Not your typical figure skater, either!

Athlete:
Strong, Flexible, Balanced, Powerful, Graceful

THANK YOU!
Questions?
Injuries and special concerns of female figure skaters.

- Figure skaters are often young athletes involved in an extremely stressful, structured environment that is focused solely on skating.
- Psychological concerns
  - poor communication skills, performance anxiety, stress, and family issues
- Sports Counseling can help athletes develop
  - self-awareness, techniques to control stress and anxiety, motivational strategies, ability to maintain concentration, and emotional balance

Injury Risk Reduction (Review)

- Know Pre-disposing Factors
  - Jumps / Day
  - Spin and Lift Positions
  - Number of Falls / Day
  - Padding
  - Jump Harness
  - Jump Drills
  - Skate Condition

Point of Comparison
Lance Armstrong

- Aerobic Sport
- A gifted elite cyclist
  - Maximum HR - 207
  - VO2max – 83.4 ml/kg/min
  - LT >85%
    - (that's 70 ml/kg/min!!)
Incidence of Injuries

1992, Kjaer M., Larsson B.
- 1.4 injuries/1000 h of training
  - 56% acute, 44% chronic injuries (n=8)

2003, Dubravcic-Simunjak, S.
- Junior World & Croatia Cup (Singles)
  - 44% Overuse Injuries
  - ≈ 26% Acute Injuries

2003, Joseph D. Fortin, DO, and Diana Roberts, ATC, PT
- US Nationals
  - 36% Acute
  - 64% exacerbations of a pre-existing injury

2006, Dubravcic-Simunjak, S.
- 42% Synchro injuries are Acute