Ski Technique and Biomechanics

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Class 2
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Web Site: www.skitechtoday.com

• Has PSIA info
• Most questions should go through web site
• You can subscribe through RSS
Review

• Gravity gives you momentum
• The snow push on you through your skis
  – Slows you down
  – Makes you turn
• By controlling 3 angles of the ski
  – Platform angle
  – Steering angle
  – Edge angle
Review

• Ski are designed to turn
  – Oversteer
  – Carve
• Note that virtually all skis’ sidecuts are circular arcs
Frame of Reference
Frame of Reference
The Fundamental Skiing Skill

• Balancing on something that’s moving, while that movement changes
• Sensing the resultant
• Anticipating changes in the resultant
  – Magnitude
  – Direction
A Bit of Physiology
Muscles

• Pull in a straight line
• Cross one or more joints
• Work in pairs
  – “Antagonistic”
Names for Muscles

• General name
  – thigh muscles
• Group name
  – quadraceps
• Specific names
  – rectus femoris
  – vastus lateralis
  – vastus medialis
  – vastus intermedius
• Name by function
  – Knee extensor
More Nomenclature

- Extension / flexion
- Abduction / adduction
- Anterior / posterior
- Medial / lateral
Analyzing Movements

• Make the movement yourself
• Figure out what bones are moving, in what directions
• Look at charts of muscles and bones
  – Available in bookstores and online
Technique
Why Study World Cup Skiers?

- Virtually all the movements are there
- No subjective judgment
- Extremely challenging conditions
What is Technique?

• The movements we make with our bodies to manipulate the skis so that the snow pushes on us to produce our desired speed and direction
Fundamental Movements

• Movements that control some basic category of interaction between the snow, our skis, and ourselves
Categories

- The distribution of pressure along the length of the skis
  - Fore-aft movements
- The total force of interaction between the snow and the skier
  - Up and down movements
Categories

• The steering angle of the ski in the transverse plane
  – Rotary movements
• The platform and edge angles
  – Edging movements
• Lateral balance against centrifugal force
  – Lateral movements
Great Skiing: Tactics Drive Technique

• You choose the line you want to ski at the speed you want to go
• This dictates the needed interaction between the snow, the skis, and your body
• You make the movements necessary to achieve that interaction
Technique: Good vs Great

• All skiers have a collection of movements they can make to produce different effects
• Good skiers have well-practiced combinations of movements
• Great skiers can mix and match movements on the fly
5 Buckets

- Fore & aft
- Up & down
- Turning the skis about the balance axis
- Controlling platform angle and edge angle
- Lateral balance
Fore-Aft Movements
Most Basic Technique

• Fore–aft balance
• Relative position of CM and feet in the sagittal plane
• Controls
  – Stability through fore-aft balance
  – Self-steering characteristics of the skis
Balancing on a Slippery Platform
Moving Fore-aft in Shoes
Moving Fore-aft on Skis
Movements

• Forward
  – Flexion at the ankle and knee
  – Soleus, tibialis anterior, and hamstring

• Back
  – Extension at the ankle and knee
  – Calf (gastrocnemius) and quads
Fore-aft Balance
Controlling Skis’ Self-Steering

• Forward pressure makes ski turn more sharply
  – Increases oversteer when platform angle is > 90 deg
  – Deepens reverse camber on carving ski

• Mid to aft pressure makes ski turn less
  – Decreases oversteer (up to a point)
  – Reduces reverse camber on carving ski
Fore-Aft Through the Turn

- Forward pressure in start of control phase
- Mid- to aft-pressure at completion
Exercises

• See chapter 5
Up and Down Movements
What are “Up” and “Down”?
What are “Up” and “Down”? 

• What you sense as up and down when you’re skiing
• The vertical axis of your body
• The line of the resultant

The balance axis
Second Most Important Technique

• Moving straight up and down
  – In ski boots
• Relative distance between CM and skis along the balance axis
• Controls
  – Stability by moderating influence of terrain
  – Magnitude of interaction between snow, skis and skier
Problems with Up and Down Movement

- Amplitude
  - Hardly anyone has enough

- Moving straight up and down
  - Coupled with fore-aft for most skiers
Moving Straight Up and Down
Separation of CM Movements
Effects of Movements about Individual Joints
Coordinated Movements of Joints
Movements

• Up
  – Extension at knee and hip
  – Quads and lower back muscles

• Down
  – Flexion at knee and hip
  – Relaxation of quads and lower back
  – Contraction of hip flexors (iliopsoas and abdominals/rectus abdominus)
Moderating Influence of Terrain
Deliberate Changes in Force

• “Unweighting”
• Increasing force
Up Unweighting

- Begins with upward acceleration of the CM
- Apparent weight actually increases
- “Unweighting” occurs when upward force is reduced
Down Unweighting

- Begins with a downward acceleration of the CM
- “Unweighting” is instantaneous
Increasing Force

- Edge sets
- Stopping
Exercises

• See chapter 6
Virtual Bump