Trends in Modern Alpine Ski Racing

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Theme

- Alpine racing technique and tactics are evolving quickly
- The evolution is driven by the evolution in equipment
Equipment Evolution

• Snow
  – Better prepared
  – More durable
  – More consistent
• Skis and Boots
  – Hold better
  – Carve tighter arcs
• Skiers
  – Stronger
  – Better trained

Technical Ramifications

• More inclination
• More retraction
• Wider stance
• Inside ski used more in certain places
• Less angulation
• Less countering
• Fewer pole plants
**Tactical Ramifications**

- Smaller, tighter arcs in all events
- Slalom turns are getting rounder
- Apex of turn is shifting, especially in GS
- Downhills set tighter to control speed and air time

**The Snow**

- The snow is holding up much better
- Most slalom and many GS hills are injected
- Later racers have better chance
Skis

- Narrow under the foot
- Deep sidecuts
- Quiet
- Longitudinally soft, but torsionally stiff
- Lifters

Some Implications

- A shorter ski is stable enough
- Encourages “park and ride” skiing
- Edge release is a harder skill to learn
- Can’t turn ski and wait for the right spot to engage it
Current Trends (Men)

• GS
  – 190 cm to 198 cm
  – Some experimentation with skis < 190 cm
  – 3 deg. side bevel, 0 – 0.5 deg. bottom

• Slalom
  – 155 cm to 165 cm
  – Length is not related to size of skier
  – Bindings mounted farther forward
  – 5 deg. side bevel, 0 – 0.5 deg. bottom

Boots

• Softer in the front
• Sole thickness is being regulated
• Experimentation with softening
• Forward lean – everyone can get very low
• Lots of lateral canting
Technique

- Inclination
- Retraction
- Width of stance
- Pressure on inside ski
- Focus on transition

Men’s WC Tech Team

- Decided to focus more on technique and less on tactics about four years ago
- Found that at least a third of the tactical issues went away
Basics

Popular Myths

- Lots of weight on the inside ski
- No pole plants
- Parallel shins
- No lead change
- No counter
- Level shoulders
Inclination

- Better holding + “bendier” skis
  - Tighter arcs
  - Greater centrifugal force
  - Greater inclination

Inclination

- Demands more strength
- Results in more boot-out
Transition

- Greater inclination
  - Skier’s body and feet take more divergent lines between turns
  - More attention to transition
Transition

• “Changing edges with your knees”
• Facilitated by wide stance
• Facilitated by retraction

Retraction

• Greater inclination
  ➔ Bigger “virtual bump” between turns
  ➔ Bigger upward forces between turns
  ➔ More retraction
Learning Retraction

- Hop back and forth across a pole as fast as you can
- Do it on a trampoline
Width of Stance

• Greater inclination
  ➤ Skier standing on steeper “virtual slope”
  ➤ More difference between flexion of inside and outside legs
  ➤ Wider stance
Stance

- Tips and toes *do not* line up with hips and shoulders anymore

Inside Ski
Use of the Inside Ski

- The more difficult it is to hold, the more weight is on the outside ski
- Some weight is often put on the inside ski
  - Not more than 30% intentionally, by my estimate

Why Put Weight on Inside Ski?

- Provides support in first half of turn until outside ski hooks up fully
- It’s the safety valve for overestimating grip
- Facilitates manipulation of outside ski
- Assists fore-aft pressure control
- Avoids brutalizing softer snow
Inside Ski

Popular Myths

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Thanks for Coming!

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Technical and Tactical Comparisons

Apex Placement

- Arcs are the same radius in both cases
- Skier on the left travels shorter distance
- Skier on the right has a safer, cleaner line
Bode’s Line

• “Straighter on ???”

Line Choice

• The green line is theoretically optimal, but risky
• The maroon line must tighten at the pole
• The purple line is more consistent
The Costs of Mis-Estimating

- The price paid for turning too soon or going too straight is greater than that for going too round
- Save the risky line for the turns where it will pay off the most

Line Depends on Pitch
Current Trends (Men)

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Edging the Ski

Shorter Radius Skis

- Using the same initial steering angle gives a longer, steeper transition
- This is the approach taken by Buraas, Amiez, Bourgeat.
Shorter Radius Skis

- Using the same transition angle gives a smaller initial steering angle and slightly shorter transition
- This is the approach taken by Kostelic, Miller

Equipment and Angulation
What Makes a Ski Hold?

- As long as the ski cuts a step in the snow that is perpendicular to the force from the snow, it will hold
- The force from the snow does not pass through the ankle
- This results in a torque, which the ankle cannot resist well without the boot

Torque on the Ankle

- A narrower ski places the center of the ankle closer to the line of action of the snow’s force
- This results in a smaller torque on the ankle
Angulation

• Angulation brings the ankle closer to the force from the snow, reducing the torque
• Hip angulation provides a coarse control
• Knee angulation is the fine adjustment

Raising the Ankle

• Increases the effect of angulation
• Binding lifts
• Plates
• Boot soles
Counter

- Aligns body so force of turn is carried by quadraceps and gluteus
- More hip angulation requires more counter

Effect of Equipment Evolution

- Lifts and narrower skis result in less angulation.
- Less angulation results in less counter
Inclination and Stance

Inclination
Inclination

- The amount of inclination needed in a given turn is dictated by the skier’s speed and the radius of the turn

- Because the new equipment holds better, the skier must balance against larger forces, requiring
  - More inclination
  - Wider stance to keep the legs out of each others’ way
  - Better physical conditioning
Stance Implications

• The greater the inclination, the wider the stance, laterally and fore-aft
• Inside hand must stay up
• Outside hand must stay forward
Stance Implications

Balance and Transition
Balance

- There are two types of balance
  - Static
  - Dynamic
  - The terms are commonly misused by coaches
- A skier is rarely in static balance, and never in dynamic balance when skiing
- Skiing is like a broom balanced on your hand
Transition Mechanics

- Feet and skis slow down, e.g. via an edge-set, and CM topples across the feet
- Skis tighten their arc, so CM “falls to the outside”
- Remove support of downhill foot
- By relaxing key muscles and flexing, upper body disengages from feet and its momentum carries it across

Edgeset
Skis Tighten the Arc

Flexion
Flexion

Flexion
Transition and Pole Plant

Pole Plant Mechanics
**Pole Plant Mechanics**

- When the turn needs to start with significant redirection, pole plant is essential.
- For the snow to exert a significant torque, the pole must be planted at an angle.

**Modern Pole Plants**
Effect of Equipment Evolution

- Skis hold tighter arcs
- Turns require less pivoting at the start (smaller initial steering angles)
- Rounder, cleaner and fewer violent edge sets
- Result is fewer pole plants

Inside Ski

- Used in first half of turn
- Weight goes predominantly to the outside ski as the turn progresses
- The more challenging the turn, the more weight is on the outside ski
Inside Ski

How Things Come Together

• Clearing poles
  – Better equipment = more inclination
  – Narrower skis & lifts = less angulation
  – More inclination + less angulation = clearing with outside hand
  – But not in flushes!
Summary

• Balance is a sometimes thing
  – Skier is seeking balance when the ski is engaged
  – Skier is deliberately out of balance in the transition

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Line
The State of Technical Evolution

• Skis
  – Hold better
  – Scribe tighter arcs
  – Turn themselves better (the self-steering effect)

• Tactical and technical ramifications
  – Smaller initial steering angles
  – More inclination
  – Wider stance
  – Phasing of vertical motion has shifted