THE INFLUENCE OF SLALOM GATE LENGTH ON PERFORMANCE, ACCELERATION, AND PERCEPTION IN YOUNG ALPINE SKI RACERS

Ronald W. Kipp[1], John G. Seifert[2], Jon Nolting[1], Lester L. Keller[1]

[1] United States Ski and Snowboard Association, Park City, UT USA
[2] Movement Science Laboratory, Montana State University, Bozeman, MT USA

KEY WORDS: ski racing, training, gate length, acceleration, skier perception

INTRODUCTION: Studies have shown that gate contact could result in considerable energy dissipation to the ski racer. A common belief is that young racers should begin with shorter gates and progress toward the FIS Type A 180cm length gate in order to optimize technique and performance. Theoretically, young skiers would suffer the most by training in longer gates. Yet, there is no data to support this belief. The purpose of this study was to determine how gate length affected performance, acceleration and perception of young ski racers.

METHODS: Eighty-seven ski racers with a mean age 12.0 ±1.0y (±SD), ht 153.4 ±8.9cm, wt 41.1 ±10.9kg, race experience 4.6 ±0.9y, and ski length 140.4 ±7.8cm. Twelve different slopes over 11 days were utilized with an identical 10 gate slalom course, randomized with 35cm Whiskers, 70cm Heroes, 137cm, 152cm, and 180cm length gates. Subjects completed a 10 pt. Likert scale at the end of each run rating their velocity, aggressiveness, confidence, and line. Acceleration was measured at 100 Hz with a 3-d accelerometer (Electronic Realization, Bozeman, MT, USA) which was attached to the crown of the helmet.

RESULTS: Reliability between runs of the same gate type (within athlete) was $r = 0.97$. Overall, racers were significantly faster for the shorter gates than longer gates (Table 1).

Table 1.

Gate	Avg.± SD (s)
35 cm Whisker	11.81±1.65*
70 cm Hero	11.77±1.98*
137 cm length	12.64±1.77**
152 cm length	12.50±1.60***
180 cm length	13.01±1.77****

*p<.01 from 137cm, 152cm, & 180cm
**p<.01 from 35cm, 70cm, & p<0.05 from 180cm
***p<.01 from 35cm, 70cm, & 180cm
****p.<01 from 35, 70, 152cm, p<0.5 from 137cm

Subjects felt slower, less aggressive, less confident, and less satisfied with their line (p<.01) skiing the 180cm gates compared to all other gates. Subjects felt less aggressive skiing the 70cm compared to the 35cm Whisker (p<.01). Less satisfaction with line and less confidence on the 152cm compared to the 137cm length (p<.01). No differences were observed between gate type for head peak acceleration. However, the more skilled skiers demonstrated greater mean head accelerations than the less skilled.

DISSCUSSION: In general, the shorter gates elicited faster times and greater satisfaction. Gate length impacts the performance and perception of young ski racers. Greater head acceleration found with the more skilled ski racers may be a result of aggressive skiing style.

CONCLUSION: Practitioners may ask "which gate is best?" This choice of gates is ultimately the coaches. With this responsibility, race coaches should pay attention not only to racer perception but toward time-per-turn. A World Cup slalom turn averages 0.84 s/turn. For young racers it may be advisable to train such that the time-per-turn reflects the slalom event along with a suitable gate type to improve technique and instill confidence.

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THE INFLUENCE OF SLOPE ANGLE AND GATE LENGTH DURING SLALOM TRAINING IN DEVELOPING ALPINE SKI RACERS

Erika L. Rauk[1], Becky Quigley[1], Ronald W. Kipp[2], John G. Seifert[1], Jon Nolting[2], Lester L. Keller[2]

[1] Movement Science Laboratory, Montana State University, Bozeman, MT USA
[2] United States Ski and Snowboard Association, Park City, UT USA

KEY WORDS: gate length, training, slope

INTRODUCTION: One common practice of ski coaches is to start alpine racers on low angle slopes, remain there until skills have been appropriately ingrained, and eventually advance to steeper angle slopes. Another method utilizes slope angle advancement to progress students. Both methods of training produce results. However, there have been no studies indicating if one method is superior. The purpose of this study was to compare finishing times with various gate sizes on two pitches in young, developing racers.

METHODS: Twenty-six ski racers participated (age: 12.2 ±0.6y, ht: 154.0 ±7.9cm, wt: 40.4 ±8.0kg). Subjects were selected by finishing times and observation by certified ski coaches. Two different slopes were utilized with an identical 10 gate SL course which was randomized with 35cm Whisker, 137cm, 152cm, and 180cm gates. The average high angle slope was 25° and the average low angle slope was 20°. Subjects were timed using a Brower Timing System (SLC, UT). A 10-pt Likert scale was used to assess racer perceptions of line, confidence, and aggressiveness on each course. An ANOVA with LSD post hoc test was used to separate means. Alpha was 0.05.

RESULTS: Times were faster with Whisker gates than the 137, 152, and 180cm gates on the low angle slope and faster than the 137 and 180cm gates on the high angle slope (Table 1). When comparing the influence of slope, each gate type was faster on the low angle slope compared to that gate on the high angle slope. Racers were less confident and less aggressive on the 180cm gate compared to Whiskers. No other differences were noted for perceived line, confidence, or aggressiveness between gates or between slopes.

Table 1. Finishing times for slope and gates.

	LOW ANGLE	HIGH ANGLE
Whisker	10.83 (0.83) *	12.91 (1.23) @ #
137 cm	11.90 (1.06)	13.99 (0.88) #
152 cm	11.87 (0.85)	13.53 (0.70) #
180 cm	12.27 (1.12)	14.24 (1.14) #

*: Significantly different from 137cm, 152cm, 180cm;
@: different from 137cm and 180 cm;
#: Gate times are significantly different from FLAT

DISCUSSION: Gate length and slope angle appear to be two variables that impeded racers' finishing time for this skill level of racer. Braking and technical development are the most likely causes as perceptions were not significant factors. Occasionally training racers on steeper pitches and shorter gates could be utilized to benefit development of the young racer.

CONCLUSION: Selecting a slope for racers is a case-by-case decision. However limiting training to low angle pitches is not necessarily dependent on skill level. Therefore, slope could be utilized as a teaching tool to allow natural skill progression as a result of terrain acting on the body to develop proper biomechanics.

ACKNOWLEDGEMENT: All gates were new SPM models provided by World Cup Supply, VT, USA.