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Randall L. Jensen
Northern Michigan University

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PEAK VELOCITY OF NORDIC SKI DOUBLE POLE TECHNIQUE:
STAND-UP VS. ADAPTIVE SIT-SKIING.

Jodi L. Tervo and Randall L. Jensen
Dept. HPER, Northern Michigan University, Marquette, Michigan, U.S.A.

KEY WORDS: cross country skiing, disabled sports, biomechanics.

INTRODUCTION: One of the event styles in cross-country skiing is the classic technique in
which the skis move in groomed tracks. Double poling is a technique used under the classic
skiing style, and is defined as when the upper body provides most of the propulsion via
bilateral pole pushes. Double poling during classic cross-country skiing has become more
popular in the past twenty years. It has also been shown to have strong correlations with
increased race speed (Smith, Fewster, & Braudt, 1996).
Maximal velocity considers an overall velocity of the movements, but does not specify at
which point during the poling phase that peak velocity occurs. By breaking a movement down
into its components one may be able to critique technique more specifically. This study
examined the point at which peak linear velocity occurred during the double poling cycle time
in Nordic stand-up and sit-down skiing.

METHODS: Four female and two male collegiate athletes participated in stand-up and sit-
skiing, and one experienced male sit-skier participated as a subject to reference for the
analysis portion of this study. All subjects arrived at an outdoor cross-country ski venue with
skis, boots, and poles. Ethical approval (#HS09-242) was received prior to conduction of the
study, and signed an informed consent and PAR-Q questionnaire were completed prior to
participating. A Canon Digital Video Camcorder NTSC Optura 20 (Canon Inc., Japan) was
placed perpendicular to the ski line approximately 4.5 meters away. A 1/1000 shutter speed
was used, with a 60 Hz camera. Each subject had markers placed on their ski binding to
allow digitization of movement. They were asked to mimic a race start using the double pole
technique. The video captured a recording of at least one complete cycle of double poling.
One cycle is defined from pole plant to pole plant. The Peak Motus System version 8.5
(Vicon Motion Systems Inc., Centennial, CO) was used to analyze the data. One poling cycle
lasted approximately one second. Using MATLAB each subject’s trial was standardized to
one second. This allowed the researchers to calculate the percentage of poling cycle (%PC)
for comparisons.

RESULTS & DISCUSSION: Paired T-Test indicated that the point at which peak velocity
occurs in Nordic sit-skiing (mean ± SD: 0.350 ± 0.066 %PC) and stand-up skiing is (0.231 ±
0.031 %PC) (p = 0.017). A One-sample T-Test comparing the experienced male sit-skier
(0.350%PC) to the subjects found no difference (p = 0.995). Results of the study indicate that
there is a difference in the point at which peak velocity occurs between Nordic sit-skiing and
stand-up skiing. Furthermore, it may be possible to use experienced stand-up skiers as
subjects in sit-skiing research. A larger subject base in the future may allow more extensive
conclusions to be made.

REFERENCES:
cross-country skiing. Journal of Applied Biomechanics, 12, 88 – 103.