BIOMECHANICAL ANALYSES AND PREDICTORS OF DIAGONAL STRIDE PERFORMANCE IN ELITE CROSS-COUNTRY SKIERS

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In cross-country (XC) skiing classical style (diagonal stride [DIAG]; double poling [DP] etc.) was the only racing style until the mid 1980s and the main focus of studies was on DIAG. With the introduction of free style biomechanical XC skiing research went in more for skating up to date compared to DIAG and DP although both went through further developments. Re-cently modernized DP technique has been thoroughly analyzed regarding basic biomechanical characteristics and performance factors (Holmberg et al., 2005) and the specific role of leg work (Holmberg et al., 2006). But there is still a lack of biomechanical data describing an ideal DIAG model. The aims of the present study were 1) to perform a complex biome-chanical description of modern DIAG, and 2) to analyze factors related to DIAG performance. Twelve elite XC skiers (Swedish National Team (VO2max-DIAG: 72.3 ± 3.8 ml kg-1 min-1) performed DIAG roller skiing at treadmill inclinations of 3°, 6° and 9° at 11 km/h for biomechanical analyses. DIAG performance was defined by time to exhaustion (TTE-DIAG) during a DIAG incremental test (4°-11° [1°/min]; 11 km/h). Leg and arm joint angles (goniometers), pole forces (strain gauge transducers) (2000 Hz) and plantar forces (Pedar Mobile; 100 Hz) were recorded. Correlations between TTE-DIAG and biomechanical vari-ables at 3°, 6° and 9° was examined by Pearson product moment correlation coefficient tests (statistical level of significance-P<0.05). TTE-DIAG (5:55 – 8:55 min) was more related to DIAG patterns at 9° and less to patterns at 3° and 6°. Among others, correlations (9° analyses) were found to cycle time and cycle length (r=0.62; P<0.01), cycle rate (r=-0.68; P<0.01), impulse of leg force (r=0.63; P<0.01), relative foot ground contact time (r=0.66; P<0.01), relative leg swing time (r=0.66; P<0.01), hip angle at ski plant (r=0.65; P<0.01), relative hip extension time (gliding phase) (r=0.57; P<0.01), angular hip flexion velocity before push-off (r=-0.56; P<0.01), rear foot force at minimal hip angle before push-off (r=-0.70; P<0.01), relative (%BW) peak pole force (r=-0.70; P<0.01), relative time of peak pole force (r=0.59; P<0.05) and pole force at start of hip extension (gliding) (r=0.74; P<0.01). It can be concluded that leg work of better DIAG skiers shows 1) a longer and more distinct leg swing forward, 2) a more explosive leg push-off with faster hip flexion and higher leg forces during shorter foot contact (higher impulse) preceded by a longer hip extension (preparation) and 3) lower and later peak pole forces (late accentuation).


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