SPORTS ENGINEERING AND BIOMECHANICAL ASPECTS OF CROSS-COUNTRY SIT-SKIERS

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INTRODUCTION: In cross-country (XC) sit-skiers adopt a pushing gesture very closed to the double poling technique. However while in standing athletes both upper and lower-body are involved, in sit-skiers the contribution of the lower-body is limited or absent due to the different impairment. The trunk control capacity is a key factor in the understanding the kinematics, kinetics, and the distribution of the workload in sit-skiers. In the frame of "IPC - Nordic sit-skiing classification" project, different tests had been conducted to assess how the impairment influences performances: perturbation test [1], ergometer vs natural skiing [2], uphill and flat skiing. From these tests consideration about the kinematics in sit-skiers can be gathered.

METHODS: test on sit-skiers can be divided in lab and in the field/on snow test. In the last group also evaluation during competition might also be taken into account. Tests and measurements were led over the last years on elite sit-skiers during Paralympics and World Championships. Different methodology had been adopted, involving the use of testing equipments which were both conventional (motion capture systems, electromyographs, force sensors, force platforms, etc) and specifically designed (adapted ergometer, perturbation sledges, instrumented poles, custom designed test-bench etc).

RESULTS and DISCUSSION: From both simulated and natural skiing it can be pointed out that different skiing strategies are adopted by athletes with different level of impairment. Considering that core stability is a key issue, then a difference can be observed in the trunk ROM between athletes (1) without any (2) partial and (3) complete functional abdominal and dorsal muscles. Moreover considering the mean flexion angle, this increases progressively passing from (1) to (3). The consequences of greater ROM and flexion angle are a more efficient poling, due to the contribution of the trunk muscles and trunk mass, and to a greater pole inclinations with respect to the horizontal. A forward flexion during the poling phase results also in a greater sledge stability and helps in keeping shoulder and elbow joints less extended during the poling phase; therefore to limit fatigue in skiing. When considering skiing in different condition with respect a straight and the flat one, then the biomechanics changes and differences among disabilities are even more evident. For example lateral trunk movement is essential when negotiating a curve. More studies in the field/on snow and/or during competition are desirable, especially when considering uphill sections and curves.