THE ACCURACY OF 3D KINETIC AND KINEMATIC DATA USED FOR JOINT LOADING ANALYSIS IN SKIING AND SNOWBOARDING

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INTRODUCTION: Almost 50% of all skiing accidents in men and more then 70% of all skiing accidents in women concerned the lower extremities. In snowboarding about a third of all accidents concerned the lower extremities in both men and women (Burtscher et al., 2003). These high percentages afford systematic research to determine joint loading on the lower extremities in skiing and snowboarding. However, so far only rough estimations of joint loading are reported (van den Bogert et al., 1999; Quinn & Mote, 1992). More precise values would be possible by inverse dynamic analyses. These require representative 3D kinetic and kinematic data which serve as input for the inverse dynamic model to calculate the loading parameters. Therefore, the goal of this presentation is to give an overview and validation of the methodological procedures used in this study to collect and analyse 3D kinetic and kinematic data to determine the loading parameters.

METHOD: Kinetic data was collected with a mobile force plate (Kistler). The device was placed between the binding plate and the binding for skiing and between the board and binding for snowboarding. Kinematic data was collected with five synchronised analogue video cameras (50 Hz) of both legs, pelvis and trunk. The 3D marker positions were calculated with Simi Motion. Several tests have been performed to validate the methods used to collect kinetic data (Stricker et al., 2005) and kinematic data (Klous et al., 2004).

RESULTS: The methods presented in this study allowed to collect time synchronised kinetic and kinematic data for a measuring range of about 15 m. An accuracy of about 1-2% for measured 3D forces and an accuracy of about 1-5% for determined torques were reported for the kinetic measuring device (Stricker et al., 2005). Also a high accuracy was found in the 3D video analysis: error margins are in the range of 1-2 cm on a measurement range of 15 m. Fig. 1 shows the results of one of the validation tests in which the positions of the measured pass points are compared with the position of the calculated pass points.

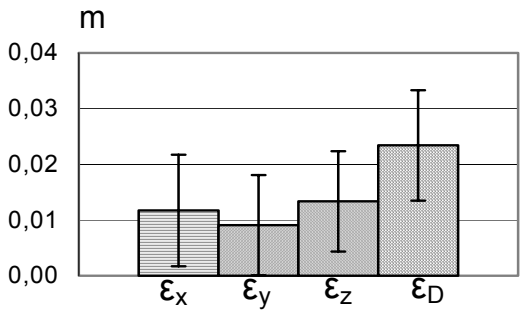

Fig 1: εx = Error in x-direction, εy = Error in y-direction, εz = Error in z-direction, εD = average error in the distance between measured and calculated values

CONCLUSION: The kinetic and kinematic methods used in this project are sufficient and acute enough to use the collected data as an input for the inverse dynamics calculation to determine joint loading.

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