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A new jig for validation of instrumented paddle shafts in sprint kayaking

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INTRODUCTION:
The interest to use new technologies to record paddle stroke forces and power in kayaking has increased over the last decade as a tool for performance development in elite athletes. However, a comprehensive validation of this new technology is needed. For this purpose, a jig is required to handle the physical inconsistencies and characteristics of the paddles, as well as differences in measurement principles. The aim was to further develop a previously described calibration jig (Aitken and Neal 1992) concerning calibration and evaluation of sensors attached to paddle shafts to record stroke forces.
METHODS:
A jig was developed by means of modifying a strength training weight stack and adding commercially available aluminum profiles (40x40mm) with open grooves that permit versatile fastening of various panel elements such as shaft and blade support and rotation devices. A force transducer was positioned beneath each support position to record the blade and top hand forces in the vertical plane. To record the bottom hand force a sling was placed around the shaft at the bottom hand position and connected to a force transducer attached to the weight stack. A linear motion path recorder enabled vertical and horizontal displacement was attached to the jig frame to calculate shaft stiffness and measure positions. Two strain gauge based counter-levered moveable sensors (MS) measuring force in one plane were mounted on a GUT-wing blade elite-paddle and sensor responses were recorded with stepwise vertical loading from 5 to 50kg and the paddle rotated stepwise from ±15 to ±45 from the initial vertical force direction. In addition, the response of embedded force sensors (EFS) in four paddle shafts (Gen 2.1, One Giant Leap, Port Nelson, NZ) with Jantex and Bracá blades were recorded at stepwise vertical loading (10, 20, 30 and 40kg) without rotation.
RESULTS:
The recorded responses of all force sensors showed correlation coefficients indicating a highly linear response in the vertical force direction. The r-values for MS were 0,9945 (left) and 0,9979 (right) while for EFS the range was from 0,9992 to 0,9998 (n=8). A lowered response of the MS sensors was significant in stepwise rotation of the paddles from the initial vertical force direction on both left (L) and right (R) sides. At +45 L 69%, R 63%; +30 L 83%, R 75%; +15 L 95%, R 85%; -15 L 94%, R 90%; -30 L 86%, R 81% and at -45 L 68%, R 67%.
CONCLUSION:
Performance of sensors based on different measuring methods to measure stroke forces during sprint kayaking can be feasibly evaluated during static conditions with the versatile jig. In addition, the present study shows decreased responses in one plane sensors with rotation out of force plane.

Aitken DA, Neal RJ. An on water analysis system for quantifying stroke force characteristics during kayak events. Int J Sport Biomech.1992;8:165–173.

Topic: **Sport Technology**

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