A KAYAK ERGOMETER FOR DRY-LAND TESTING AND CONDITIONING

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ABSTRACT

A dry-land ergometer suitable for testing and conditioning has been designed and constructed. The ergometer allows the kayaker to assume the same anatomical position on the ergometer while closely approximating the musculature involved during the kayak stroke. The ergometer can also be used for teaching young paddlers proper stroke technique and balance.

INTRODUCTION

To attain a high level of performance in any sport requires a well planned year-round training program (Bompa. 1983). The elite flatwater kayaker has been characterized as an athlete that exhibits great strength. anaerobic capacity and endurance as well as a high aerobic power in the muscles that are specific to the sport of kayaking (Tesch. 1983: Tesch et al.. 1976).

During the winter months in Canada approximately 80 - 90 percent of the paddler's conditioning is in the form of dry-land training. This training period involves an extensive strength training program and general aerobic conditioning (Garner. 1983). The strength program is centered around the muscles of the upper body which are specific to the sport. However, the aerobic conditioning has traditionally involved running, cross-country skiing and swimming (Edwards, 1982), activities which are not specific in utilization of the musculature involved in kayaking.

The sport scientist has attempted to overcome this disadvantage by utilizing arm cranking on a bicycle ergometer to assist in the assessment and conditioning of

the upper body (Cermak et al., 1975; Vrijens, 1975). Although arm cranking is specific to the upper body its validity for simulating the kayak stroke is questionable (Thoden et al., 1982). Therefore, the purpose of this study was to design a dry-land ergometer which allowed the paddler to assume the same anatomical position on the ergometer and closely approximates the muscular contractions during the stroke cycle as would occur in the kayak.

CONSTRUCTION

The ergometer is comprised of two main sections, the resistance unit and the paddling frame (figure 1). The resistance unit is provided by a modified Biokinetics Swim Bench (Biokinetics, Inc., Albany, CA.) The unit provides a semi-accommodating resistance allowing regulation of the speed to be preset. The amount of mechanical work performed during an exercise or testing session can be measured from the digital work integrator supplied with the bench.

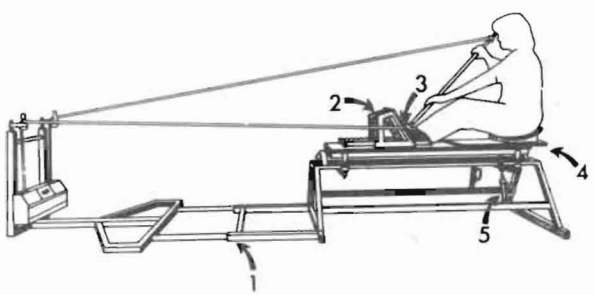

Figure 1.
Dryland kayak ergometer: 1) resistance unit-paddle frame adjustment, 2) foot support, 3) end of modified paddle, 4) adjustable stoppers, 5) shock absorbers

To insure that the "catch" position of the stroke was simulated as closely as possible with the on-water conditions it was necessary to provide a means of adjusting the distance between the resistance unit and the paddling

frame (figure 1-1). This accommodates the anthropometric differences among paddlers.

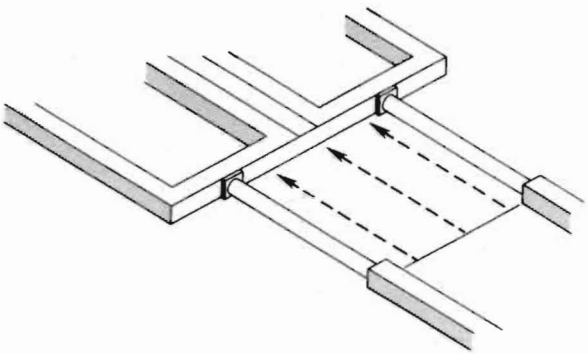

Figure 1-1
Adjustment for resistance unit and paddle frame

An adjustable foot support is designed to accommodate paddlers of 1.52 to 1.98 meters (m) in height (figure 1-2). The seat is fixed and is not adjustable.

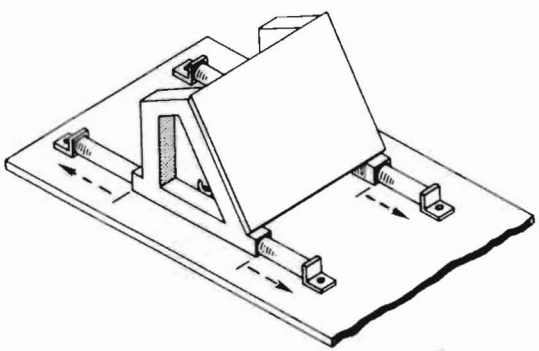

Figure 1-2
Adjustable foot support

A regulation paddle has been modified with only the handle and shaft portions being used. Figure 1-3 shows the end of the modified paddle with the rope connection and pulley attachment. This modification allows the shaft to rotate freely in the paddler's hands simulating the "feathering" action required when exiting the paddle from the water (Plagenhoff, 1979). The 2.44 m length of rope supplied with the swim bench from the manufacturer was replaced with a 4.27 m length to allow for the increased distance between the resistance unit and the paddling frame.

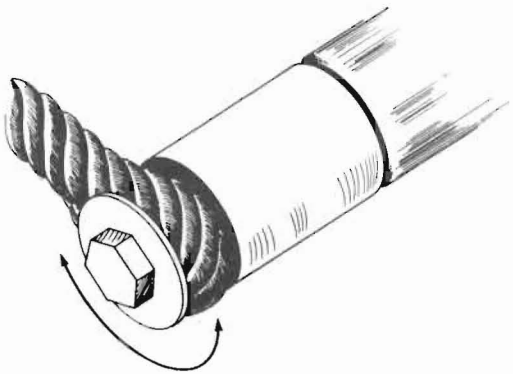

Figure 1-3
Modified paddle showing the rope connection and pulley attachment

The ergometer has been designed to allow for rotation around the center of axis (figure 1-4). This action simulates the kayak's motion on water forcing the paddler to maintain balance while attempting to generate sufficient power. Adjustable stoppers are placed at each corner of the bench (figure 1-4a) restricting the amount of listing of the bench. To reduce the abrupt movements hydraulic shock absorbers are fitted with an adjustable aperture (figure 1-5) which allows the speed of the list to be controlled. This arrangement has proven very helpful for teaching young paddlers the proper stroke technique while maintaining their balance.

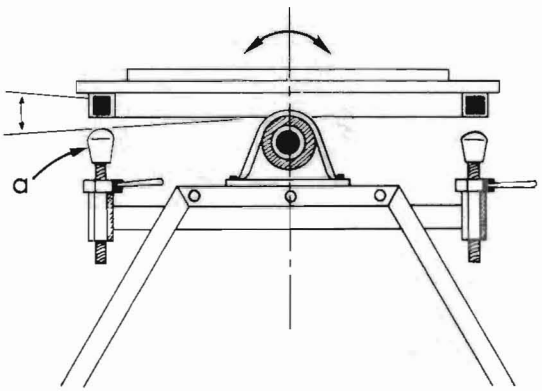

Figure 1-4
Rear view of ergometer with rotation around the center axis, a) adjustable stoppers

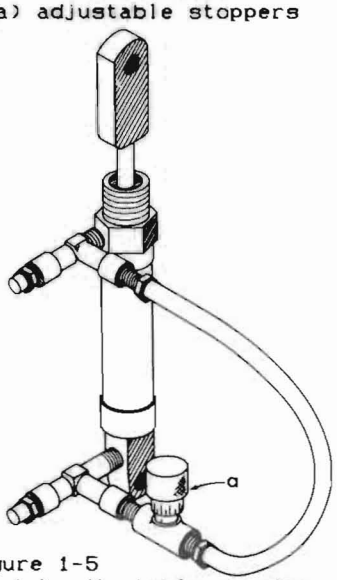

Figure 1-5
Shock absorber with (a) adjustable aperture

DISCUSSION

The kayak ergometer has been used for both assessment and conditioning of national, provincial and club paddlers during the past 3 years. The subjective assessment of paddlers and coaches suggest that the ergometer simulates on-water kayaking very closely. To validate this assumption a number of elite paddlers were filmed on both the water and ergometer using a Locam high speed camera. The path of the wrist elbow and shoulder were digitized from the lateral perspective films (figure 2) and showed a similar stroke pattern for both on-water kayaking and the kayak ergometer (Campagna et al., 1982).

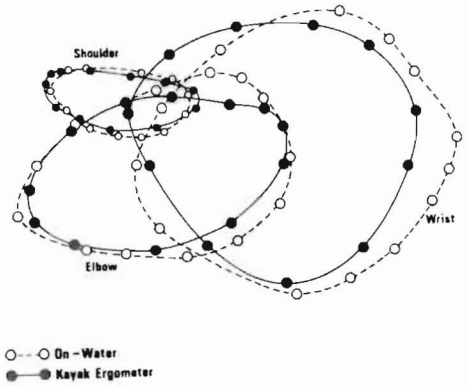

Figure 2
Comparison of movement patterns
on-water and ergometer for an elite paddler

Modifications of the original resistance unit was minimized to allow for easy conversion back to the swim bench. This enables the resistance unit to be switched quickly from swim bench to kayak ergometer.

The ergometer (figure 3) has proven helpful in the evaluation of training regimes, prescribing training programs and monitoring cardiovascular fitness throughout the yearly training cycles.

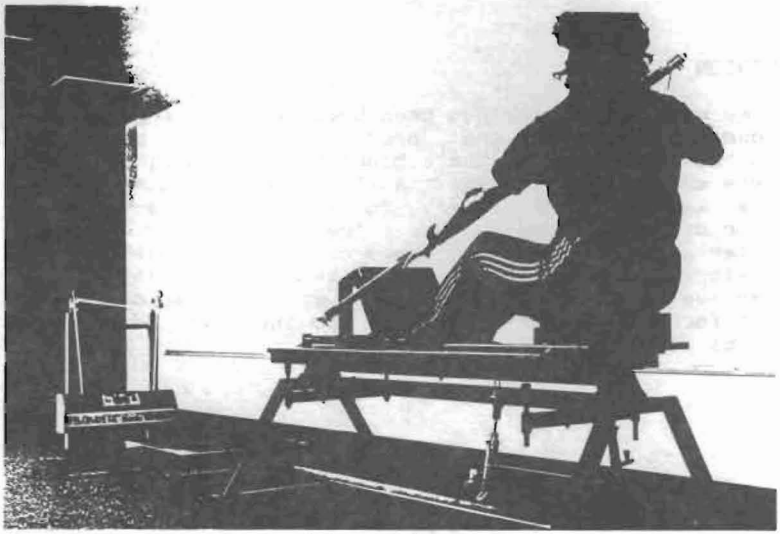

Figure 3
Dry-land kayak ergometer

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