

# Ergo design and safety: fixed head or floating?

For two and a half years, researchers have been developing a model to examine data obtained from athletes on ergos. Ian Bernstein of the ARA medical sub-committee looks at the relationship between fatigue, co-ordination and ergo design on the potential to cause injury

The starting point for the research team from the Institute of Human Performance in Stanmore (part of University College, London) was that ergo training has been shown to be the second most common cause of land training injuries in the national squad. Stationary ergos, like the Concept 2, are the most commonly used type in this country. Other types include wheeled ergos (where the whole ergo is mounted on wheels) and floating designs (where the flywheel is mounted on rollers so that it can move independently of the seat on the track), such as the RowPerfect. Floating ergo designs more closely simulate the mechanics of rowing on the water than other designs. The results of the initial study, examining two commonly-used ergo designs, were recently published in the British Journal of Sports Medicine.

Six elite male oarsmen performed two 20 minutes rows on a RowPerfect. The effects of fatigue and variation between athletes was studied. Sufficient break was given between the pieces for rest and rehydration.

By design, the RowPerfect has a floating flywheel. To simulate a fixed flywheel ergo, the floating flywheel was clamped at one end. The illustration (right) shows the movements of the body and flywheel with both designs.

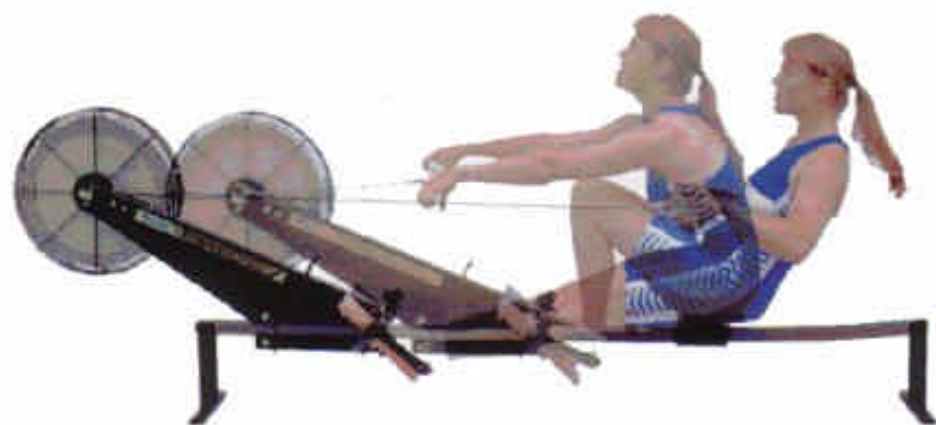
By using the RowPerfect to compare both fixed and floating flywheel designs, researchers were able to reduce the number of variables in the comparison. This was preferable to comparing two makes of ergos as there are many differences, including: the characteristics of the fans used and the seating arrangements.

A CODA MPX motion analysis system – which can track the movement of up to 42 body surface markers in 3D to within 0.3 mm – was used to collect data.

The stroke length was 5.3 cm longer with the fixed compared to the floating flywheel. As the pieces progressed and fatigue ensued, the stroke length in-



Movement of the body and flywheel with, above, fixed power head and, below, floating power head



creased at the catch by 2.0 cm and at the finish by 0.8 cm. However, the increase with fatigue was only seen with the fixed flywheel.

The average force per stroke was 12.1% higher with the flywheel fixed versus floating for the same total work done during the pieces.

When changing directions at each end of the stroke, the energy involved with moving (kinetic energy) has to reduce to zero. This energy is about six times higher with the flywheel fixed compared to floating, which means the distance required to reverse direction at each end of the stroke will be further. The analogy is that the braking distance for a heavier car will be further than that for a lighter car using the same braking force.

Researchers' review of relevant scientific literature leads them to believe that the longer stroke length with the flywheel fixed is a risk factor for injury to the body structures absorbing the kinetic energy. This would be exacerbated by the effect of fatigue causing further lengthening, which was only seen with the fixed flywheel.

Analysis of 3D movement using the CODA equipment provided a unique insight into co-ordination. 'Co-ordination signatures' were developed – numbers that describe the contribution of the legs, back and arm displacements to the total movement of the handle during the power phase. It was shown that co-ordination was different between the two flywheels and changed with fatigue.

The 'co-ordination signature' described above may prove a useful tool for describing an athlete's stroke profile. There were marked similarities in these signatures for the same athlete with both the flywheel fixed and floating. However, the signatures were quite different between different athletes and could be used as a training or selection aid. Rowers with similar 'co-ordination signatures' might be expected to row well together in crew boats.

The initial study does not explain how much the risk of injury could be reduced by using floating flywheel ergos instead of fixed flywheel ergos. However, researchers believe changing to floating flywheel ergos would reduce injuries caused by ergo training.

Whilst further research is awaited, the team believes it would be prudent to diversify ergo training and testing to include both fixed and floating flywheel ergos, minimising the theoretical risk of injury and allowing development of performance benchmarks on the floating flywheel ergos.

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