Taking up the gauntlet ……

With interest I read Terry O'Neils article "Dig deeper to find the root of back problems", and with pleasure I take up the challenge to do just that. This article will explain why injuries happen, how peak loading and muscle adaptation can be managed to prevent injury, and six top tips for injury prevention.

But to call a spade a spade, his statement that the Rowperfect is based on the Concept II model B is incorrect and needs rectification; anyone with basic engineering training will easily see that the Rowperfect was designed from scratch and differs from C-II model B in every engineering detail.

Cause of injury

In general, injuries are caused by overloading parts of the body through activities in daily life, including sport training. Injuries can very often be traced back to the accumulation of repeated minor damage over a prolonged period. This is the main reason why, as Terry rightly indicated, the potential causes for injury are many, and why it is often difficult to single out one particular factor. It can be safely stated, however, that the higher the proportion of training-related activities in the total daily body load, the higher the chance that these either cause the injury or make an injury acute.

The overwhelming majority of the 8 million Concept II 'safe' training sessions claimed by Terry, were done in fitness centres to improve general fitness. They were done at training loads below the norm for the average club rower, let alone the national squad rower seeking to maximise his performance. The use of this non-relevant information to suggest that a well-designed and verified research project is flawed is unwarranted. Dr. Bernstein's research project was not aimed at finding whether he could provoke injuries in his test subjects but, being a skilled Musculoskeletal Physician, to investigate the mechanisms that can eventually lead to injuries. For this a sample of 6 people is more than adequate. To ignore the message of caution resulting from such research is rather superficial and can lead to inappropriate suggestions and false conclusions.

Training and peak loading

Training provides the body with stimuli to adapt. For optimal effect the training load should be kept within a narrow bandwidth of the maximum allowable load. Too low a load provides no training effect; too high can lead to injuries and over-training. Peak loads limit the scope for manoeuvre within this narrow band and avoiding them is of crucial importance for maximum training benefit.

The speed with which the various tissues adapt to a higher load varies widely. Almost 100% adaptation for muscle tissue to an increased load can be achieved in approx. 35 weeks, whereas for cartilage only a 75 % adaptation can be expected within two years. This is the main reason why it takes so many years of intensive preparation to be able to sustain the loads placed upon elite rowers. For many young athletes, especially for those without a previous sports career, the cartilage very soon becomes the weakest link, followed by tendons and ligaments.

To create the safest possible training environment for the athletes, equipment should be designed to avoid peak loads with the load magnitude and how the load is applied carefully monitored.

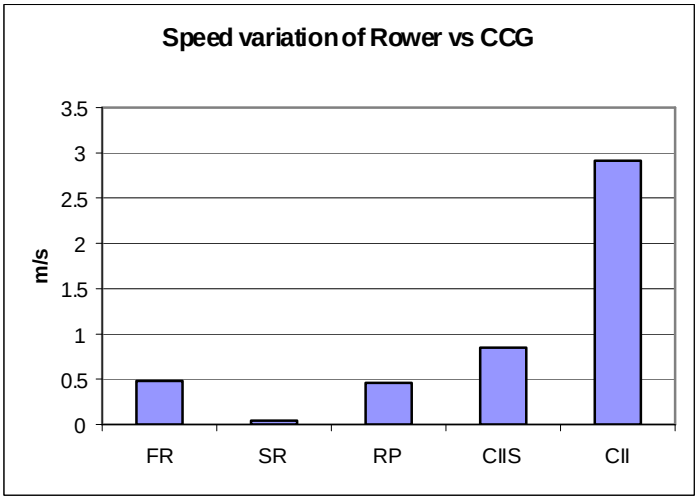
Rowing is a cyclic movement, based on a series of highly automated reflexes. One important effect of training is that an increase in the level of automation increases power generating efficiency. For this reason, cross-training should exercise muscles over the activity's full range of movement, load and speed of contraction. Therefore machines used for cross-training should simulate the dynamics of a light racing shell (e.g. a single scull) as precisely as possible. If they do not, a severe loss in power generating efficiency can be expected. That is clearly illustrated by the fact that the transfer of an oarsman from a stationary Concept II to the same machine on slides *decreases* the oarsman's power output to the flywheel instead of increasing it. The same occurs when transferring a rower from a stationary ergometer to a light racing shell, or vice versa. **This explains why many good boat movers do not score well on stationary ergometers, and why some "erg champions" are poor boat movers.**

Injury prevention research

Research at Rowperfect, aimed at injury prevention by improving the dynamics of the simulation of the rowing motion, started in 1989. Results were reported at the ARA Senior Rowing Conference in 1993 (Ref.1). This research demonstrates that **to prevent injuries it is necessary to accurately simulate the dynamics of the rowing stroke, particularly at catch and finish.** To achieve this an ergometer needs to have a "floating head" (moving flywheel) is essential. The balancing mass should closely match the mass of the part of the boat that moves relative to the rower.

The Rowperfect had a moving mass of around 17.5 kg and meets this criterion for most rowing shells; the Concept II "Slide" is roughly double the correct weight. It therefore behaves like a 280kg eight or a 35kg single scull. A fixed head (stationary flywheel) machine has dynamics similar to a super-tanker.

The effects are illustrated in the graph below, showing the speed differential between rower and the common centre of gravity (CCG) of the boat, or floating head, and rower. This differential is the dominant factor in accurate simulation of the rowing motion.



Key:
FR = Fixed Rigger
SR = Sliding Rigger
RP = Rowperfect
CIIS = Concept II on slides
CII = Concept II

[Data for the fixed rigger (FR) and the sliding rigger (SR) boats come from Ref.2 (tests 1.9 and 2.5), data for the Rowperfect (RP), the Concept II on Slides (CIIS) and the Concept II fixed (CII) have been calculated from there, using the same relative movement of Rower versus stretcher.]

From the graph it can be seen that the movement of the rower relative to CCG is nearly identical for the fixed rigger boat and the Rowperfect. It is much smaller for the sliding rigger boat, almost doubles for the Concept II on slides and is *six times* greater for a Concept II ergometer.

On a fixed head ergometer (such as Concept II) this forces the rower to adapt his co-ordination pattern (Ref 3) leading to a gradual increase in over-compression of the knees at the catch and use of the big hip flexors to induce the forward swing at the finish. Together this creates a higher strain on the lower back.

Injury prevention

From the above discussion the following recommendations can be made:

1. To prevent injuries, the maximum allowable load to the rower's weakest "link" should not repetitively be exceeded, and peak loads should be avoided.
2. To avoid peak loads it is essential that equipment for training and condition testing truly simulate the dynamics of a light racing shell. Certainly for younger athletes without a previous sporting career, condition tests, selection tests and races on "fixed head " ergometers have to be discouraged.
3. The elasticity of a suitable dynamic boat-simulator ergometer should resemble the overall elasticity of a real boat as closely as possible. The Rowperfect ergometer forces the rower to maintain technique at higher levels of fatigue, further helping to avoid overloading.
4. To control the loads on the various muscles and tissues of the athlete during training on dynamic boat simulators, it is recommended to have the athletes train on a prescribed Stroke Force and Stroke Length profile, which may not be exceeded.
5. Peak-loads in the boat can be avoided to a big extent, by synchronising the whole Crew's Stroke Profiles on land during winter training on a dynamic boat simulator. This prevents the individual rower from being forced to pull the boat all by himself for a split second.
6. Having part of the crew doing "power tens" with the others stabilising the boat should be forbidden.

A well-designed rowing-simulator reduces the risk of injury and enables the rower to hone his co-ordination to perfection.

This is exactly what Frans Göbel did, warming up on his Rowperfect before his title-winning lightweight single scull finals at the World Championships in 1989 and 1990, and what the late Harry Mahon did with two Rowperfects and the British Mens Eight until 15 minutes before the Sydney Olympic final.

References

Ref.1. C.J.N.Rekers. "Verification of the Rowperfect ergometer". A.R.A.Senior Rowing Conference (1993). Downloadable from www.rowperfect.com under Articles /Publications.
Ref.2. V.Nolte, "Die Effektivität des Ruderschlages". (The efficiency of the rowing stroke, Doctoral Thesis) Cologne (1984) Bartles & Wernitz
Ref.3. B.Hänyes, V.Lippens "Vom Messen im Boot und auf dem Ruderergometer"(About measurements in the boat and on the rowing ergometer) Rudersport 30/88 Page 11-14.