CompassSport Series - Fitness for Orienteering

Post-exercise recovery – part 2

This series of articles is covering a range of topics within the field of strength and conditioning, with the aim of helping to develop the orienteer's physical performance, irrespective of age or ability. In this issue, we finish outlining the post-exercise recovery process in the second of a two-part piece…..

Picking up from where we left off in the previous article, our summary of immediate post-exercise actions, to assist the recovery process, was highlighted previously in table 1 (below):

Table 1: Post-exercise Routine (Immediate)
0-15 mins • Exercise gently (around 50-60% max), gradually decreasing the intensity from run to jog to walk • Intersperse exercise with stretching (use of static and/or dynamic techniques) • Begin rehydration
15-30 mins • Continue hydration • Begin eating carbohydrate and protein mix • Self-massage of legs • Use of hydrotherapy (contrast shower, ice bath) if possible
30-60 mins • Continue hydration • Take in more food • Begin analysis of race • Start to unwind and relax

Adapted from Jeffreys (2005)

Much of the discussion in the previous article was around possible active and passive recovery strategies, including gentle exercise, stretching, hydrotherapy and massage, and these techniques were incorporated into a suggested routine shown in table 1. As stated before, the first half an hour after exercise is the most important time to begin the recovery process and the actions used to bring about recovery should not be delayed, wherever possible. The mix of gentle exercise and static/dynamic stretching, bringing the various physiological variables down to resting level, is the primary focus initially and it is recommended to intersperse the aerobic exercise with the key stretches. Hydration and refueling techniques are also of high importance during this time and the focus of this article is around optimizing this particular aspect of recovery, along with other longer term strategies.

Methods for Potentially Enhancing Recovery

A reminder that, according to Viru (1995) the main functions of any recovery strategy should be:

- Normalisation of functions
- Normalization of homeostatic equilibrium

- Replenishment and temporary supercompensation of energy resources
- Reconstructive functions, especially cellular processes and enzymatic functions.

The first two areas were discussed in depth in the last article and it is now the focus here to debate techniques for replacing energy used during the exercise bout and methods for helping to rebuild damaged tissue.

Physiological Factors for Consideration

The time taken to refuel adequately after exercise depends primarily upon four factors:

- The amount of glycogen depletion
- The extent of muscle damage
- The quantity and timing of carbohydrate consumed
- The training status and experience of the individual

The determining factors that contribute to glycogen depletion are, unsurprisingly, the duration and intensity of the exercise session. A long distance orienteering race will lead to far more significant glycogen usage than a sprint event and a half hour, intense circuit session will burn more carbohydrate than an easy jog of the same duration. The minimum time for complete restoration of glycogen stores is around 20 hours, but prolonged, exhaustive exercise, such as an ultra-long O event, may require up to 5-7 days for full replenishment (Costill, 1991).

Muscle damage will be determined by the intensity of the workout, with eccentric exercise, such as downhill running, plyometrics and heavy weight training, causing significant fibre impairment. Here the exercise causes forced lengthening of the tissue and this can lead to structural damage requiring up to 7-10 days of glycogen replenishment in extreme cases (Bean, 2006).

Logically, the higher the carbohydrate intake post-exercise, the faster will be the refueling of glycogen stores in the body. Figure 2 demonstrates this aspect and is a particularly important factor to consider if the orienteer is looking to either compete or train on a daily basis. Multi-day events and chasing sprints are two types of orienteering where the speed of glycogen replenishment is absolutely pivotal to an athlete's recovery and deficiencies here will inevitably result in compromised levels of performance. Figure 3 illustrates how impaired carbohydrate intake results in decreased glycogen storage (Costill, 1971) and a follow-up study (Costill, 1985) demonstrated that when participants ingested a high carbohydrate diet (550-600g/day), glycogen stores were fully replaced in the 22 hours between training sessions.

Finally, studies have shown that training experience and status improves refueling efficiency (Bean, 2006). Training adaptations include the increased ability of the body to store more glycogen, by as much as up to 20%, and it takes an untrained individual significantly longer to replace their carbohydrate stores following exercise.

Optimal Recovery Strategy

In terms of timing, research has shown that glycogen storage following exercise follows three distinct phases (Ivy et al., 1988). Immediately after exercise, and for up to 2 hours, the replenishment rate is at its most rapid, being up to 150% the normal rate, as the enzymes associated with glycogen synthesis are most active during this period. There is also evidence of increased glucose sensitivity and muscle cell membranes being more permeable to glucose during this time (Dohm, 2002). After this 'window of opportunity', the process begins to slow and, by 4 hours post-exercise, glycogen manufacture returns to its normal rate.

In terms of how much carbohydrate should be consumed in this period, research indicates that 1-1.5 g/kg of body mass over the first thirty minutes is optimal (Ivy et al., 1988). The rate of glycogen synthesis is limited (Coyle, 1991), so that an intake exceeding this rate has been shown to provide no extra benefit to glycogen restoration. For efficient glycogen refueling, athletes should continue to eat at least 50g of carbohydrate every 2 hours until the next main meal (Bean, 2006).

The from in which the post-exercise refueling takes is often down to preference, as it makes no significant difference to the glycogen storage rate whether liquid or solid forms of carbohydrate are ingested (Keizer et al., 1986). Often appetite is suppressed, particularly after strenuous exercise, and it may be difficult to contemplate taking on board solids at this stage, thus concentrated carbohydrate beverages may be preferred in this instance. Research has also shown that moderate and high GI carbohydrate intake in the first 6 hours after exercise results in faster glycogen replenishment than low GI (Burke et al., 1993), so this fact is of particular interest to those involved in multi-day events or who are competing more than once in a day. Longer term, orienteers should then switch to low GI, as this has been shown to improve endurance and performance in subsequent daily workouts (Stevenson et al., 2005)

The use of commercial recovery drinks, such as SiS REGO or For Goodness Shakes, has gained in popularity in recent years and there is mounting research evidence indicating that mixing protein with carbohydrate is more effective in promoting recovery than the use of carbohydrate alone (Zawadski et al., 1992; Ready et al., 1999; Tarnopolsky et al., 1997). Not only does this combination result in increased glycogen storage of around 30-40% by promoting the release of insulin, but it helps to promote more efficient tissue growth, through increasing higher levels of anabolic hormones (eg. testosterone), and helps reduce perceived muscle soreness the day after intense exercise (Bloomer at al., 2000; Gibala, 2000; Millard-Stafford et al., 2006). The optimal post-exercise meal or drink should therefore include around 20-40g protein and 60-120g carbohydrate, whether from solid food or commercial sports drinks or bars (Bean, 2006).

Alongside the replacement of energy stores, the orienteer should also be considering their rehydration strategy. Inevitably the use of carbohydrate beverages or protein-carbohydrate recovery drinks will assist in replacing fluid losses from the exercise workout and, whilst imbibing water itself will lower plasma concentration and replace water lost through sweating, research has indicated that the inclusion of electrolytes, particularly sodium, in the fluid is important in facilitating the rate of absorption of water into the body and in replacing those electrolytes lost through sweat (Reilly & Ekblom, 2005). Orienteers should always be encouraged to drink more than they feel they need, as the thirst response is a poor

indicator of restoration of water levels and any deficit is likely to be carried over into the following day and potentially affect future training or race performance. Simple measures to gauge hydration status can include monitoring body mass in the morning or assessing urine colour, which ideally should be clear or straw-coloured.

Finally, mention should be made of the use of easy runs in the twenty four hours post-exercise. The use of such 'recovery runs' has been advocated by athletes and coaches for many years, as a technique in assisting recovery from heavy workouts, such as high-intensity interval sessions or racing. The belief here is that this gentle exercise, performed at around 60% of maximum for between 20-40 minutes, helps in reducing DOMS, repairs damaged muscle tissue, maintains enzyme activity and gets the athlete prepared more quickly for the next heavy training session and is superior to advocating pure rest. At present, there is no empirical research to either support or refute such a viewpoint and we are reliant on anecdotal findings and subjective interpretation as to whether this approach is beneficial or not. Certainly the psychological benefits should not be discounted and, until such time as the scientific community proves otherwise, athletes should continue to follow this practice if they feel, through personal experience, that this is of benefit to them.

Recommendations

Let us finally revisit the initial routine in table 1 and build in this additional information to come up with a full post-exercise strategy, shown below in table 2. Table 3 shows examples of post-race recovery snacks, with a mix of low through to high GI carbohydrates and protein.

Table 2: Post-exercise Routine
0-15 mins • Exercise gently (around 50-60% max), gradually decreasing the intensity from run to jog to walk • Intersperse exercise with stretching (use of static and/or dynamic techniques) • High-GI carbohydrate and protein drink/food (4:1 ratio, using 1-1.5g/kg body mass of carbohydrate) • Hydrate with electrolyte solution
15-30 mins • Continue hydration with electrolyte solution • Continue with high-GI carbohydrate and protein mix • Self-massage of legs • Use of hydrotherapy (contrast shower, ice bath) if possible
30-60 mins • Continue hydration, principally with water now • Take in more food and switch to low to medium GI carbohydrates • Begin analysis of race • Start to unwind and relax
60 mins + • Use relaxation skills to switch off • Take in usual meals with low GI carbohydrate, low fat and protein balance • Ensure good quality rest/sleep

Adapted from Jeffreys (2005)

Table 3. Recovery Snack Examples

Smoothie: 1 cup fruit juice, 1 cup plain yogurt (*low GI*), and 1 large banana = *74g carb, 16g protein*
Recovery drink: 2 cups of chocolate milk and 1 large banana = *84g carbs, 18g protein*
Commercial Drink: 500ml of For Goodness Shake (from powder sachet) and 1 large banana = *78g carbs, 18g protein*
Sandwich: 2 slices of white/wholemeal bread, 1 tbsp of peanut butter (*low GI*), 1 tbsp jam *= 51g carbs, 10g protein*
Trail Mix: ½ cup raisins, ¼ cup dry-roasted soy nuts (*low GI*), 1 cup Cheerios = *65g carbs, 13g protein*
Other Medium to High GI snacks include: bagels; jelly beans; rice cakes; watermelon; crumpets; rye bread; honey and pineapple

Conclusion

Hopefully these two articles have given the orienteer much to consider in the design of their post-exercise routine and I would always advocate the adoption of a structured approach to warming down and refueling, which will ultimately aid in maximizing the ability of the athlete to recover quickly and efficiently for their next exercise workout, whether it be part of their training or racing schedule.

References

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