CompassSport Series - Fitness for Orienteering

Warm-Ups: A Best Practice Review

Having outlined, through a series of articles over the past year, the essentials of designing and conducting an orienteering-specific fitness training programme, our attention turns now to covering a range of topics that will focus on further enhancing the development of the orienteer's physical conditioning. In this issue, we focus on warm-ups…

One of the most controversial topics in the field of strength and conditioning over the past twenty years has been that of warming-up prior to training and competition. Much of the discussion has focussed on, firstly, whether warm-ups actually provide many of the physiological and psychological benefits proposed by coaches and athletes, and secondly, what is the most effective method of warming-up. The traditional warm-up, consisting of a period of gentle cardiovascular exercise followed by several minutes of static stretching, has been the focus of much debate within the scientific community in recent times, with the use of static stretching, in particular, coming in for a good deal of criticism, and this has led to a number of new proposals for how to warm-up more effectively. This article will look at the research behind warm-ups and suggest an orienteering-specific routine, on the back of this work, which aims to prepare the individual for training and racing in an optimal fashion.

Traditional Warm-Up

For many years, coaches and sport scientists advocated a warm-up routine that began with general cardio-vascular exercise, usually of around 10-15 minutes in duration, and which, for orienteers, consisted mainly of jogging and building up gradually from around 50% to about 75% of maximum heart rate. This was then followed by a period of stretching, mainly static, and focussed primarily on the key areas around the lower body, such as the calf, hamstrings and quadriceps groups. Stretches would be held for a period of about 10-20 seconds and repeated two or three times on each muscle group.

The belief here was that the cv aspect would stimulate blood flow to the periphery, increase muscle temperature and enhance free, co-ordinated movement (Smith, 1994) and static stretches would result in a short term increase in the range of movement (ROM) at a joint or induce muscle relaxation and thus decrease the stiffness of the muscle-tendon system (Gleim & McHugh, 1997; Norris, 1999) but the scientific evidence supporting this approach was sketchy at best and, in many cases, based on supposition rather than proof.

In the last few years, the scientific community has begun to focus more attention on this area, something which has been long overdue, especially when considering the amount of time athletes have spent over the years warming-up and the fact that much of their practice was based on subjective opinion and trial and error rather than hard science.

Scientific Evidence

Summarising the key scientific research over the years is difficult, due to the many issues with the studies. Much of the early work was poorly conducted and controlled,

with few participants and a lack of statistical analysis. The protocols used were also extremely varied, with different types (active, passive and specific) and structures (intensity, duration and recovery) of warm up, making it difficult to draw effective conclusions (Fradkin et al., 2010). Later research has focussed on reducing these variables and taking a more rigorous approach to data collection and analysis and a clearer picture is now emerging. The general view is that there is little evidence to suggest that warming up is detrimental to performance and Fradkin et al (2010) have reported that warm ups have, in thirty two, high quality studies, improved performance in '79% of the criterions examined'.

The general view emerging now is that these positive effects of a warm up can generally be attributed to temperature related mechanisms, for example: decreased stiffness, increased nerve conduction rate, increased anaerobic energy provision and increased thermoregulatory strain. Other non-temperature related mechanisms, such as increased blood flow to the muscles and elevation of baseline oxygen consumption have also been proposed as being activated by a general warm up procedure (Bishop, 2003). Whilst most scientists are now agreed that a warm up is generally beneficial to performance, questions remain over the most effective method of preparing for competition.

Several investigations have cast doubt on the traditional use of static stretching during warm ups, due to its potential for reducing performance on vertical jumps (Church et al, 2001) short sprints (Fletcher & Jones, 2004), reaction time (Behm et al., 2004), tasks requiring maximal voluntary contractions (Kokkonen et al, 1998), and, most pertinent to the orienteer, muscle strength-endurance (Nelson et al., 2005), balance challenges (Behm et al., 2004) and energy cost and running endurance performance (Wilson et al., 2010). Reduction in performance has been attributed to a decrease in muscle-tendon stiffness and strength (Kokkonen et al., 1998) or a reduced neural drive to the muscles which results in a decrease in muscle activation (Knudson et al., 2001). Static stretching can also significantly increase muscle soreness and damage, as indicated by elevated creatine kinase in the blood (Smith et al., 1993), and thus tissue damage is another possible cause of reduced performance.

It has also traditionally been believed that static stretching reduces the risk of soft tissue injury, but there is a growing body of evidence to the contrary (Shrier, 1999). Increasing muscle temperature through ten minutes of running has been shown to be as effective in reducing muscle stiffness and, potentially, increase the resistance to muscle tears (Young & Behm, 2002).

Before we consign static stretching to history, however, we should be mindful about some of the issues around the research in this area. Criticism has been aimed at previous studies that have utilised methods that do not reflect normal pre-competition practice. Some protocols had stretches over a thirty second duration, designed to elicit increase in muscle length rather than joint specific ROM, and used multiple sets for one muscle group, which is generally in excess of normal practice. The disproportionate time used for the stretch routines may have seen a significant reduction in core temperature of the muscles and result in the participant effectively 'warming down'. However, even allowing for some of these issues, it appears that static stretching has little use beyond aiding in an orienteer's psychological preparation and general routine.

The focus of the latest research has been on the more recently adopted approach to warming up, which involves dynamic activities and stretching methods. These could include active stretch techniques, involving movements performed in a controlled fashion through a large range of motion, or partner assisted stretching, as seen in PNF techniques. Evidence from a variety of sources (Fletcher & Jones, 2004; Fletcher & Anness, 2007; Little & Williams, 2006; McMillan et al., 2006 & Taylor et al., 2009) points towards significant improvements in performance measures following dynamic warm up methods. The reasons for this are primarily linked by the researchers to temperature related mechanisms and preparing the body for competition by increasing the specific ranges of motion required in the sport. Dynamic warm ups involving running drills, incorporating forward, lateral and change-of-direction movements, paired with dynamic stretches, have also been shown to increase oxygen uptake, lower lactate levels, raise blood pH and improve efficiency of thermoregulation (Church et al., 2001; Chwalbinska-Moneta & Hanninen, 1989; Gray et al., 2007; Knudson et al., 2001 & Young & Behm, 2003). Although limited, there is also some evidence to suggest that dynamic warm-ups may help to reduce injury rates in sports performers (Knapik et al, 2003).

This research would indicate, therefore, that an active and dynamic approach to warming-up is the optimal approach to take for orienteers prior to exercise. However, the specifics of duration, intensity and recovery interval have yet to be scientifically established and there remains much more to be discovered in this field before definitive recommendations can be made. With this rider attached, we will now look at the current 'best practice' model for orienteers to adopt prior to training and competition.

Best Practice Approach

The warm-up should be divided into three phases, in order to cover both general and specific components, and these phases can be labelled: a) active warming; b) active flexibility and c) neurological preparation (Cone, 2007).

Phase 1: Active Warming

Here the main aim of this phase is to achieve an elevation of muscle temperature, heart rate and oxygen uptake and consists mainly of low level, introductory activities. Walking to jogging, through to running and low level shuffling actions (eg. side to side running and crossover steps), enables a gradual and progressive increase in temperature of the core and mobilization of oxygen to the working muscles. This should last around 10-15 minutes in duration and be up to about 60% $\dot{V}O_2$ max in order to maximise the metabolic benefits of active warming (Gray et al., 2002).

Phase 2: Active Flexibility

Here the orienteer should look to maintain the effects of the active warming phase and also develop a state of musculoskeletal and neurological preparedness for the training or competition to follow. The focus should be on dynamic stretch activities that target muscles and actions specific to the exercise to follow.

The stretches used by the orienteer should consist of single to multi-joint movements performed at slow to moderate speeds, with the muscle and joint ROM controlled effectively by the individual to ensure that the increase in joint mobility is not undermined by the risk of injury. It is recommended that each stretch is followed by a

short period of jogging to ensure that muscle temperature is maintained effectively. Below are examples of orienteering specific, dynamic stretch activities, with key technique points highlighted. There are many other dynamic stretch techniques available and the orienteer should choose those they feel most comfortable in performing with the correct technique. All of the stretches should be conducted as continuous movements, until the stretch is felt in the targeted muscle, and then released. The aim is not to hold the position for longer than a second or two, as this would take this into a static stretch. This phase should last around 5-15 minutes, with each stretch repeated a minimum of 5 times on each side of the lower body.


Fig 1. Ankle eversion


Fig 2. Ankle inversion


Fig 3. Ankle dorsiflexion


Fig 4. Hip extension


Fig 5. Hip flexion

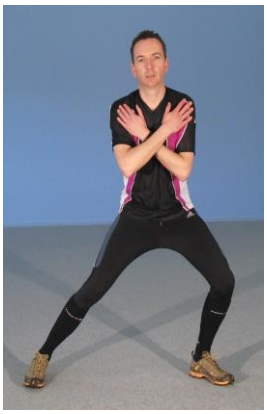
Fig 6. Hip abduction

Stretch 1&2 (Ankle eversion/inversion)
Aim – To stretch outer and inner calf and mobilise ankle joint
Technique – Bring lead leg forwards and off ground. Turn foot outwards/inwards. Release and repeat on opposite leg. Keep upright and balanced throughout.

Stretch 3 (Ankle dorsiflexion)
Aim – To stretch lower calf
Technique – Take a half stride and sink hips downwards by flexing knees. Rear leg should flex to around 60 degrees and stretch felt in achilles area. Release and repeat on opposite leg. Do not bend forwards.

Stretch 4 (Hip extension)
Aim – To stretch upper thigh and hip flexors
Technique – Front leg should have 90 degree bend at the knee and the thigh in a horizontal position. Back leg should have the thigh in a vertical position, with knee

close to 90 degree bend. Release and repeat on opposite leg. Keep upright in upper body.

Stretch 5 (Hip flexion)
Aim – To stretch upper calf and hamstrings
Technique – Extend the lead leg first and then sink the hips, keeping the spine straight and head up. Release and repeat on opposite leg. Do not bend over.

Stretch 6 (Hip abduction)
Aim – To stretch inner thigh and gluteals
Technique – Take a wide lateral step and lower gluteals towards the ground. Return to the start and repeat on alternate side. Do not bend at waist or lean forwards.

Phase 3: Neural Preparation
Whilst the neural impulse is naturally increased via activities in the first two phases, this final step for the orienteer is to target a further increase in specific neural preparation, particularly prior to a competition, so that the individual is fully prepared both physically and mentally for the race ahead.

The orienteer should return to jogging, in order to raise the pulse and oxygen uptake levels again following the dynamic flex phase, and begin to gradually increase the intensity of their efforts. A mixture of movements, specific to those in the training or competition, should be covered. As well as forwards running, there should be a mix of lateral movement (eg. side-to-side, cross-over steps) and these should become more explosive to replicate race conditions, where the orienteer will be moving quickly across varied and broken terrain. A 5-10 minute maximum period of activity at this 70-80% $\dot{V}O_2$ max level should mean that the individual is now primed for the event and arrive at pre-start ready to perform to their maximum ability from the outset of the race.

Usually there will be a period of recovery whilst the orienteer moves through the pre-start area, which will vary in length, and it is important that the competitor keeps as active as possible during this time, especially if conditions are cold, in order not to lose the benefits of the warm up.

Conclusion
Hopefully this article has given orienteers much food for thought in the way that they warm-up prior to training and competition and that there are some ideas that you will look to build into your regular practice. Of course, the science here continues to evolve and there is still much within this field of study that remains to be proven beyond all reasonable doubt. Static stretching before exercise will continue to have its advocates and, for some, there may still be physical and psychological benefits of pursuing this practice. However, I do hope that many individuals will, at the very least, begin to build in dynamic stretches to supplement their routines.

Next issue we will take a look at the practice of tapering prior to competition.

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