



Australian Mountain Running Association

Downhill running by John Harding

Most distance runners shy away from hard downhill running, both in training and racing, because of fear of soreness and injury. In the Lore of Running by Dr Tim Noakes, there is a lengthy discussion of the medical and physiological research literature about muscle soreness and its various causes. The bad news is that fear of soreness is well founded for the runner untrained for downhill running. The good news is that not only can the possibility of ill effects from hard downhill running in cross country, mountain running and road races be minimised by appropriate training, but such training can greatly improve performance.

In 1992 Anthony Scott and Nicki Taws, a husband and wife who are two of Australia's best orienteers, competed in the inaugural Australian mountain running championships on Mounts Ainslie and Majura in Canberra. They were well used to running up and down hills in orienteering events and tended to train over hilly terrain for their long runs in training. In the championships they finished well behind the leading runners but what surprised them most was how very sore they were during the week after the race, far worse than anything they had experienced in any other event.

Nevertheless they enjoyed the challenge and 12 months later found themselves in the ACT team for the Australian Championships on rugged up and down courses on Mt Wellington in Hobart. There were several favourites for the men's championship, but Anthony was not mentioned in despatches as a contender. In the women's race, Louise Fairfax was rated as unbeatable after finishing 4th in the 1992 world championship.

So it was considered a monumental boilder when the husband and wife duo of Scott and Taws secured individual gold medals in both championships. Later that year Anthony finished in the top half of the field in the men's world championship and Nicki was brilliant in finishing 13th, adding for good measure 11th in a World Orienteering Cup event.

Rob DeCastella has always said that you can learn more from a bad run than a good run, and that was the secret of the Scott-Taws amazing improvement in performance. Anthony and Nicki are two very intelligent people, an almost essential criterion for elite success in orienteering coupled with the fitness needed to run flat chat between controls through rugged country for 8 to 12 kilometres. Another advantage of an orienteering background is that it is par for the course to undertake an evaluation of the event afterwards, with friendly discussion of route choices, the difficult controls and the terrain. After experiencing such immense soreness from the 1992 Australian mountain running championships, Anthony and Nicki figured out for themselves that some specific downhill work would be an essential ingredient in their preparation for any future championships. So in the lead-up to the 1993 championship, they incorporated some hard downhill running into their weekly training program to condition their legs for downhill racing. The rest of the story is a fairy tale result, the stuff of dreams.

In the Lore of Running, Tim Noakes says that soreness after unaccustomed or particularly severe exercise is not due to an accumulation of lactic acid in the muscles, as many people have argued in the past, but is most likely due to damage of the muscle cells, 'in particular the connective (supporting) tissue as well as the contractile proteins'. The most muscle damage occurs with hard downhill running because of the eccentric contractions that occur during downhill running. Noakes explains that when an unloaded muscle contracts, it always shortens, and this is called a concentric contraction. In contrast, when a force applied to the muscle exceeds the force that the muscle can produce during contraction, then the muscle length increases, and is called an eccentric contraction. In downhill running, these contractions occur in the quadriceps muscles (upper front of the leg) when the forces through these muscles become very large, particularly as the foot lands on the ground, and can be as much as three times the body weight. Noakes says the initial contraction of the quadriceps is not quite strong enough to overcome this force, so that the muscle is stretched in an eccentric contraction for a brief instant every time each foot hits the ground. Muscles are not designed to repeatedly experience eccentric contractions, and so running long downhills hard makes the muscles susceptible to muscle fibre damage, creating severe soreness.

However the good news is that a study by Byrnes in 1985 found that a single session of downhill running offered protection from muscle damage from a similar downhill session for up to six weeks. In other words, as Anthony Scott and Nicki Taws found, there is an increase in the strength of the muscle fibres, or some other positive adaptation of the body, with downhill training specific to the race situation which protects the muscle from damage in the race situation, or at least minimises the level of damage.

Later work by two Australians from Monash University, David Morgan, research director of the Centre for Biomedical Engineering, and Uwe Proske, professor of physiology, supports these findings with more advanced physiological analysis, reported in New Scientist magazine on 16 August 1997. Muscle fibres are made up of two proteins, actin and myosin, which interlock with repeating units called sarcomeres. Morgan found that in eccentric muscle contractions in downhill running, the muscle fibres will be overstretched leading to sarcomeres 'popping'. If enough sarcomeres pop, the whole muscle fibre can die, leading to 'weakening of the whole muscle and pain as the body's immune cells secrete enzymes to clean up the mess'.

The good news is that 'the body responds to this damage by building a new muscle fibre that is packed with more sarcomeres than before'. Morgan and Proske found in testing on rats that those which ran downhill developed 15 per cent more sarcomeres in their thigh muscles than rats that ran uphill or did no exercise. Down slope testing with humans on a treadmill led them to the conclusion that a single session sufficient to induce soreness was enough to condition the body, and 'a single bout of eccentric exercise every week kept the muscles permanently adapted'.

There are other significant benefits of downhill training:

Firstly, sprinters and middle distance runners have found that downhill running on a grass slope of 150 to 300 metres enables them to turn their legs over more quickly, an excellent form of exercising the fast twitch muscle fibres. A month or so of one or two downhill workouts a week on grass can produce a significant pick-up in leg speed and an improvement in running efficiency.

Secondly, training offers the opportunity to develop and improve technique. Running action is all important in achieving both downhill running efficiency and minimisation of the potential muscle fibre damage. There is a natural tendency by many runners to lean backwards and put on the breaks on a steeper slope. This is the worst thing to do as it increases the impact, jarring the body from the heels right through to the torso, creating stiffness and soreness in the quads, buttocks, hip flexors and lower back. Good technique involves leaning forward to get the body vertical to the ground, relaxing instead of tensing the legs and the arms, using the arms actively for balance, and using gravity to assist. To check up on your technique, the ideal is to get someone to take some video footage of you running fast downhill in a few different race situations, from the moderate downhill to the steep, from grass to fire trail. From seeing yourself in action, you should be able to work out for yourself areas you can work on to improve your technique, from arm movement to leaning of the torso to foot-plant, to stride length. If your technique is really terrible and you fall over, the good thing will be that this might be your big chance to win a motza on Australia's Funniest Home Videos.

Thirdly, training allows testing to occur of footwear options for race day. In cross country, road and mountain running, footwear that grips the ground firmly on the downhill, whether running spikes, or studded soles, or just good tread, enables a number of things to occur:

- Minimisation of the eccentric contractions of the legs. A stronger eccentric contraction develops if there is slippage or other loss of traction;
- Better running technique and thence faster running speed;
- The opportunity to relax and recover from the fatigue of an uphill, while running very quickly;
- The opportunity to put on a spurt and clear away from a fellow competitor who has not made a good choice of footwear or whose downhill running technique is poor.

Fourthly, psychological preparation for downhill racing is very important. The best form of preparation is to actually practise downhill surges over the course to be used for the race, as this allows refinement of technique over different slopes and surfaces, testing of maximum speed at critical sections, and positive self-imagery to be built up.

Fifthly, the great American runner Bill Rodgers once said that in a hilly race the best place to attack is coming off the top of a hill. Psychologically the other runners are probably looking for a breather when they reach the top of a hill. If you relax on the uphill and then accelerate coming over the top, you have a splendid opportunity to catch other competitors by surprise, particularly if your running armoury includes good downhill technique.

Finally, there is what I call 'the little kids' benefit of downhill training. A favourite past time of my three children when they go to a park or a forest is to go the top of a small grass or other hill, yell, 'Yippee (or something similar)', and run to the bottom. There is something exhilarating in just letting yourself go, and running fast downhill with the wind in your hair and the terrain rushing by.

How best then to do downhill training? My personal preference for technique training is soft dirt trails or short, firm grass, with the length of the repetitions dependent on the timing of the training cycle. I will explain this further. The research by Morgan and Proske suggests that year round weekly practice of downhill running is desirable, and some downhill striding out as part of a weekly long run on a hilly course would achieve this. However the best time to work on maximising downhill speed is the last six weeks before the major race being targeted. Start much earlier than that and you risk peaking too soon.

Initial workouts should desirably be downhill bursts over short distances of the order of 50 to 80 metres and not at full speed in order to provide transitional adaptation to eccentric contractions over three or four workouts. If the target race involves long downhills then the distance of the downhill burst can be extended up to 200 to 400 metres to practise technique, particularly if the training surface is soft and impact-absorbing. If the race course is over a harder surface such as fire trails, judgement has to be used about the length of the repetition. The goal is training and adaptation, not destruction and injury, particularly during the last month or so before a major race.

A series of short surges over downhill sections of training courses can pay big dividends on race day.