STROKEARCS

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COACHING

From Experiences with Women Scullers

The most important thing for high performance in sport and for the length of any competitive career is success. Success clearly determines the length of training at the high performance level of every athlete.

Take Steven Redgrave for example. If he had come 4th, 5th or 6th at the World Championships or Olympic Games, he would surely not have continued in rowing for so long.

Additionally it is important to enure that one year is not exactly the same as the next. If that were the case, then I as a coach would have already lost the way.

If we compare oarswomen from the youth area and their motiation to compete at a high level, it is worthwhile to look at what are the substantial factors which have encouraged them to take up competitive rowing – their parents, teachers, school friends, other friends or through the club. All of these peer groups can have an ifluence on the individual athlete. Those who treat sport in a positive way and have encouraged training at a competitive level , contribute fundamental requirements for good development. A negative attitude will have the opposite effect, and lead to athletes giving up sport at a competitive level and following other interests.

The motives for a developing rower competing at a hogh level are different from those who are at a senior level. In the younger rower the motivating factors are such things as training in a squad, parents who drive the rower to training, the goo feeling of being in a team at the club, the enjoymet of a crew form your own club representing at important events, winning and losing together, spending time with rowing friends outside of training, e.g. going to the cinema, eating ice cream, and going to other sports and events.

The more experienced and the more successful the oarswoman becomes the more varied and all embracing, complex and complicated is the coaches work with the athlete. In senior women's rowing the external influencing factors – that is to say influences through partners or boy friends, managers, the federation, employers and media – are more intensive, broader and more multi faceted. This requires that the coach works much more individually with each rower, to determine what is important to achieve success. The awareness and interest of the rower in politics and business increases, and the personal obligations and commitments are greater. This demands of the coach that he or she provides clarity and precision, straightforwardness, good support and the power to persuade the rower, the ability to leave her alone at times, to trust her, to rein in her ambitions at times, to design and implement training sessions that are consistent, wel directed and convincing.

In this respect the media can complicate matters. They are capable of affecting the unity of the coach and the athlete. The way successes are valued in the media and in the eye of the public can lead the athlete to lose interest and confidence in and to drop out of the sport. For example Nils Schumann form Germany, the 800m Gold Medal winner in Sydney 2000, a young athlete with a relaxed attitude. The risk of not succeeding can lead to the career being abruptly terminated.

Nevertheless, the work and the experirnce with older athletes can be a great challenge for every coach.

For the athlete, their age, and the length of their competitive career are quite secondary, if they can still be successful! On the contrary, the athlete has a higher consciousness of her capacity and can better evaluate her own performance. On this basis she can achieve what she wants professionally, materially and existentially. The motivation ot measure herself in races against hard competition remains very much in the foreground.

TRAINING METHODOLOGY

The Role of Progressive Overload in Sports Conditioning

In order to make the most out any training program it is important to have a well designed plan that follows some basic principles of periodization. One major component in all training programs is the principle of progressive overload (2). Through the use of progressive overload, an athlete builds upon their work capacity, strength, and conditioning level in a systematic and logical way. This practice promotes maximized workout potential in a manner that is safe for the individual.

The Science Behind Progressive Overload

The principle of progressive overload suggests progressively placing greater than- normal demands on the exercising musculature (1). This is required for a training adaptation to take place. Without overload, there is no adaptation by the body. Neuromuscular adaptations occurs fi rst, followed by increases in muscle and connective tissue strength, and bone mass. Proper conditioning methods will lead to physiological advancements as well. Depending on the training goals, improvements in lactic acid tolerance, lactate threshold, maximal aerobic power, and a variety of cardiovascular functions could be appropriate responses (1).

Progressive overload involves applying stimulus. The human body's reaction to a training stimulus can be described as the General Adaptation Syndrome (GAS). Th e GAS concept further explains the need for progressive overload in a training environment. Three stages are involved in the response to stress; alarm, resistance, and exhaustion (1). The body undergoes the alarm phase when a new or intense stress is placed on the body. An athlete may experience extreme soreness or a temporary drop in performance during this time. The resistance phase follows, and results in the body adapting to the stimulus and returning to normal. Again, neurological adaptations are the fi rst to take place, while muscular adaptations appear later. The exhaustion phase results if the training stress persists for too long. Overtraining, mental fatigue, and other symptoms may accompany this phase as well (1). It is ideal to avoid the exhaustion phase, and is possible with proper periodization and adequate recovery. Through the use of periodization, an athlete can continuously challenge the body with progressive overload, while avoiding plateaus or detriments to training.

Needs Analysis
Before one can start to assess how to properly apply overload to our training, we must first consider the sporting needs. A needs analysis is the first step to a successful and effective training program. In terms of conditioning, there are some important factors to consider.

Energy System Usage
The body runs on three energy systems; phosphagen, glycolytic, and oxidative/aerobic. The energy system in use is primarily determined by the intensity of exercise and secondly by the exercise duration (1). The intensity and duration at which you train should closely match that of your sport.

The phosphagen system provides energy during short, high intensity activities, ranging from five to ten seconds and is active at the start of any exercise. The glycolytic system is the primary energy system for moderately intense exercise lasting from 15 seconds to three minutes. The oxidative or aerobic energy system is used at rest, during recovery, and for low-intensity activities longer than three minutes. Still, it is important to remember that no single energy system works alone; rather they overlap and alternate (1).

Work to Rest Ratio of the Sport
The sport's work to rest ratio is extremely important in conditioning as well. The proper metabolic system must be targeted to improve athletic performance. First, you must identify which energy system is mostly used in your sport. To do this, first consider what range of intensity best suits your activity. Secondly, decide the length of the activity bouts and recovery periods. Once you have an idea of your sport's intensity and work to rest ratio, you are on your way to a sound conditioning program.

Specificity
The adaptations that occur with training are specific to the training performed. Your needs analysis must look at what are the attributes of the movements that encompass the sport (e.g. strength, power, speed, endurance, etc) and what muscles are involved in these movements. For example, if your sport involves multiple short duration sprints, then to benefit your performance you must train lower body power and perform interval training as well. Depending on where you are in your training cycle (e.g. in-season, off -season, etc), you should condition according to the mode of your sport. For example, a basketball player will condition mostly through a variety of running and jumping drills. A rower, on the other hand, will spend more time erging or rowing on the water. Cross-training is an exception, and involves training using a different mode of exercise than that of one's sport. Cross training can be used to maintain general fitness while aiding in recovery (1). For the most part, you will want to train close to the conditions of your sport.

Application of Progressive Overload
As an athlete, you may have tried, or have been tempted to adopt the training practices of highly successful or well known athletes. However, you would be better served by following a program based on your individual needs and physical limitations (1). This way, you are working at an optimal level, which you can build upon safely and effectively. To enhance athletic performance you must apply the principle of progressive overload to some extent in your training. The use of progressive overload in a periodized program involves implementing variations in training specificity, frequency, duration, intensity, and load. Applying progressive overload is appropriate after configuring a needs analysis. A periodization scheme will shift training priorities from non-sport specific activities of high volume and low intensity to sport-specific activities of low volume and high intensity (1). In other words, athletes beginning a conditioning program must develop a fitness base with longer, less intense workouts. Training will progress to more sport specific, shorter, intense activities. This overload will take place over the course of many weeks. The following are ways to add progressive overload to your conditioning by manipulating the variables of specificity, frequency, duration, intensity, and load.

Exercise Variation
Implementing different modes of exercises periodically will challenge your body in new ways, while taking stress off more frequently used muscles and joints (1).

Exercise Frequency
Frequency of training will depend on exercise intensity, duration, the athlete's training status, and time of season (1). The number of daily or weekly training sessions depends on all these factors, and can be manipulated accordingly.

Exercise Duration and Intensity
The length of time or duration of the training session can be varied as well. Exercise intensity will determine exercise duration. Generally, the more intense a

workout the shorter the length and vice versa. Exercise intensity should be closely monitored to ensure the proper amount of overload is applied.

Load
The load or intensity of the exercises will depend on the goals of the current training program. If the goal is strength, then the load assignment will be high. If the goal is endurance than the load will be lower. As the load increases, the number of repetitions performed decreases.

Summary
All athletes want to make the most gains from their training as possible. To do this, the principle of progressive overload must be used. Progressive overload involves systematically applying a training stimulus that forces the body to adapt and grow. Adapting conditioning workouts involves manipulating specificity, frequency, duration, and intensity variables. When we neglect proper progression during training, certain unwanted consequences may result. These consequences include overtraining symptoms along with decreased performance. The progressive overload principle is a way to safely make training gains. So, be aware of your training stimulus and how your body is recovering from training. Major performance gains take time and dedication, but are possible if you consistently progress your workouts.

Reference
1. Baechle TR, Earle RW. (Eds.). (2000). Essentials of Strength Training and Conditioning (2nd ed.). Champaign, IL: Human Kinetics.

2. Pearson D, Faigenbaum A, Conley M, Kraemer WJ. (2000). The National Strength and Conditioning Association's Basic Guidelines for the Resistance Training of Athletes. Strength and Conditioning Journal, 22(4): 14 – 27.

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PHYSIOLOGY

Blood Lactate

When Marc Rogers travelled to St. Louis back in July, 1984 to begin post-graduate research in exercise physiology at Washington University, he also commenced training for the St. Louis Marathon, which was scheduled for November. Before getting into his hard-core marathon preparations, Marc underwent an exercise test in the St. Louis lab and learned that his VO2max was 70 ml/kg/min, while his lactate-threshold (LT) velocity was reached at 78 per cent of VO2max, or at 54.6 ml/kg/min.

Marc proceeded to train very aggressively, combining high-intensity work with high mileage (about 80 miles per week) and was re-tested in early November. Despite the heavy-duty training, Marc's VO2max had moved upward by nary a millilitre of oxygen, clinging stubbornly to the same 70-ml mark of mid-summer. Fortunately, though, Marc's LT had gone through the roof, climbing from 78 to a lusty 90 per cent of VO2max (or 63 ml/kg/min). And yes - Marc won the St. Louis Marathon that autumn, primarily because of his huge advance in LT.

To understand what actually happened to Marc, and to discover how you, too, can make major gains in LT and performance, we need to tell a tale about something called lactate. The first chapter of this lactate parable will centre around a key physiological process called glycolysis.

Glycolysis is so important that if your muscles lost their ability to carry it out, you would not be able to compete in any athletic event lasting more than a few seconds. In glycolysis, glucose is broken down inside your muscle cells - via a series of 10 different chemical reactions - into something called pyruvic acid, releasing some of the energy needed for muscular contractions. The pyruvic acid can then be funnelled into a complex series of reactions called the Krebs cycle, which furnishes over 90 per cent of the energy you need to run, cycle, or swim. Since glycolysis provides your muscles with quick energy and also 'jump-starts' the Krebs cycle, it is a paramount player in muscular energy production. In fact, without gycolysis your muscles would grind to a halt after only 10 to 15 seconds of your workout or race - with your legs feeling as though they had bounced up against the mother of all 'walls'.

Fortunately, glycolysis usually proceeds normally, without your having to think about it, and it also tends to 'keep pace' with your exertions; the more intensely you exercise, the 'hotter' the glycolysis fires burn. One very important consequence of this is that if glucose is broken down to pyruvic acid at very high rates, pyruvic acid can begin to accumulate inside your muscle cells, and an enzyme called lactic dehydrogenase can promptly convert much of the pyruvic acid to lactic acid.

Bad stuff?
As an athlete, you're probably no stranger to the idea that lactic acid forms rather readily in your muscle cells, especially when you are exerting yourself quite strenuously. In fact, you probably believe that the 'burn' you feel in your leg muscles when you're running, cycling, or swimming very fast is caused by lactic acid - and that the soreness you experience the day after an especially tough workout is produced by the same 'troublesome' compound. You may also cling to the idea

that lactic acid is a 'waste product' formed in your muscles during strenuous exercise, and that lactic acid appears in your muscles when you 'run out' of oxygen, or because you've gone into 'oxygen debt'. In short, you probably believe that lactic acid is really bad stuff!

Well, it isn't! All of the above statements are untrue: lactic acid doesn't produce burning sensations, it does not induce soreness, and it's not a form of metabolic 'rubbish' which must be eliminated from your cells as quickly as possible. In addition, oxygen shortfalls are not required in order to make lactic acid appear in your muscles and blood: The truth is that lactic acid is produced in your body all the time, around the clock, even when you're at rest, and its concentrations rise whenever you take in a carbohydrate-containing meal. Fortunately, we're not telling you all this to improve your chances of gaining a PhD in cell physiology: We're giving you the straight scoop because an understanding of how lactic acid actually functions in your body can improve your performances tremendously!

You see, instead of being a dangerous compound which wreaks havoc inside muscle cells, lactic acid (or more accurately, lactate) is actually the key chemical your body uses to 'dispose of' dietary carbohydrate; without it, it would be very difficult to maintain normal blood-sugar levels or keep your liver and muscles stockpiled with carbohydrate. About 50 per cent of the lactate you produce during a very tough workout is actually used by your muscles to form glycogen; far from damaging your tissues or inducing soreness, this glycogen provides you with the energy you need to carry out subsequent quality workouts ('Disposal of Lactate during and after Strenuous Exercise in Humans,' Journal of Applied Physiology, vol. 61(1), pp. 338-343, 1986). During exercise, lactate is an irreplaceable source of energy for muscles and other tissues, so much so that enhancing your ability to 'process' lactate can improve your race times rather dramatically. If you're a typical runner, the 'lactate training techniques' outlined in this article should hasten your 10-K clockings by at least a minute.

As if that weren't enough, lactate also helps keep you from getting fat. To understand how that happens, let's pretend that you have just finished a high-carbohydrate meal. Much of the carbohydrate in that repast enters your bloodstream as glucose - and heads straight for your liver. Paradoxically enough, your liver refrains from picking up this train-load of glucose, preferring instead to let it 'slip away' to the rest of the body. Once the glucose eludes your liver, it goes to many places, including your muscles, which can - via glycolysis - quickly break down the glucose to lactate, releasing usable energy in the process. Much of the lactate produced by glycolysis can return to the blood, head back to the liver, and finally be used to boost concentrations of glycogen (a key 'storage' form of carbohydrate) in the liver.

This somewhat circuitous process of glycogen formation means that blood levels of both glucose and lactate rise after you've had your high-carbo meal. However, lactate levels don't rise nearly as fast as glucose concentrations, primarily because lactate is rather rapidly removed from the blood once it appears, while glucose is taken away only sluggishly. By changing some of the absorbed glucose from your meal over to lactate, your body quickens the 'disposal' of blood carbohydrate, thus controlling the amount of insulin which pours into the blood from your pancreas (the higher the glucose level, the greater the insulin response). This limiting of insulin production helps to prevent wild upswings in fat formation (one of the 'bad' points about insulin is that it coaxes glucose into adipose cells, where it is converted into blubber).

The lactate shuttle

Lactate is also the primary player in an important process which occurs in your body - and which may be called the 'lactate shuttle.' Described by George Brooks and his colleagues at the University of California-Berkeley, the lactate shuttle involves the following chain of events:

1. Lactate is formed in ample amounts in tissues in which glycogen and glucose are being broken down at high rates (for example, in your leg muscles when you are running at a strenuous pace). As we indicated, pyruvate is actually formed first; as pyruvate 'piles up', it is readily converted to lactate.

2. After pyruvate is converted to lactate, the lactate can slip quickly and quietly out of cells and into surrounding tissues and the blood. This 'lactate escape' in effect prevents glycolysis (the conversion of glucose into pyruvate) from shutting down (if pyruvate built up to overly generous levels, glycolysis might 'back up', thwarting energy production). As lactate leaves hard-working muscle cells, it can be 'picked up' by other muscle cells and tissues. This departure of lactate from cells engaged in strenuous activity is sometimes called the 'spilling' of excess lactic acid into the blood.

3. The muscle cells and tissues receiving the lactate have the option of either breaking down lactate for fuel (lactate is a rich source of ATP, the key 'energy currency' within cells) - or else using lactate as a building block for the formation of glycogen. The glycogen created from lactate can simply hang around quietly in cells until energy is needed at a later time.

Knowledge of the lactate shuttle helps you understand how important lactate really is: its easy diffusibility prevents glycolysis from shutting down, and its 'high-octane' fuel status helps a variety of cells to satisfy their immediate energy requirements or else store energy for future use.

An understanding of the lactate shuttle also helps you make sense of those curious Scandinavian studies which have shown that vigorous training carried out with only the right leg can also upgrade the fitness of the left leg - and even that vigorous leg exercise can improve the fitness of the arms! Sure, there's a cardiovascular effect going on in such research (a heart strengthened by exercise will do a better job of getting blood and oxygen to the whole body), but the other part of the story is that the non-working tissues learn how to process the lactate 'spilled' in their direction by the hard-working cells (from one leg to the other or from the legs to the arms). As the non-exercising 'lactate-recipient cells' get better at using lactate, they have more energy available to sustain activity when they are actually called upon to exercise.

What is the lactate threshold?
The lactate shuttle also helps you comprehend that mysterious phenomenon called the lactate threshold, or LT. When you begin a fairly moderate workout, lactate levels in your blood initially rise, simply because glycolysis is working away to provide quite a bit of the energy you require. If there were plenty of oxygen around, the pyruvate formed from glycolysis could 'be broken down all the way' to carbon dioxide and water, releasing a lot of important energy in the process. However, because you've just started your workout and therefore the blood and oxygen flow to your muscles is still somewhat minimal (heart rate is just beginning to rise, and capillaries leading into the muscle are not yet in the full-open position), pyruvate will be converted to lactate, and lactate will pile up inside your leg-muscle cells and begin spilling out into the blood. If we measured your blood-lactate levels at this early stage of your workout, we might find surprisingly high concentrations of lactate, even though you were ambling along at a pretty modest pace.

If you keep moving along at a temperate pace, your blood lactate will quickly simmer down, however. As heart rate increases and capillaries dilate, oxygen will pour into your muscle cells, lactate will be oxidized for energy, and the spill-over process will abate. Your blood-lactate levels will drop a bit and then hold steady, which simply means that the entry and exit rates of lactate into and out of the blood are equal.

And lactate levels may hold steady, even as you gradually increase your exercise intensity. As long as you're not going too fast, eg, as long as enough oxygen is moving into your muscle cells to take care of the pyruvate produced by glycolysis and thus control the lactate spillage, your blood lactate will appear to be as calm as a small Scottish pond on a windless day.

It's only when you get up to a point (actually to a speed or exercise intensity) at which glycolysis is tearing along so fast that your leg muscles can't convert all the lactate being formed to carbon dioxide and water that the spilling process may accelerate - so much so that lactate levels in the blood may really begin to lift off. This point may be reached because not enough oxygen is getting into the cells to 'handle' all the lactate (pyruvate) being produced, or because there are not enough enzymes available to guide along the pyruvate-oxidation process, or even because your tissues are not very good at 'clearing' large amounts of lactate from the blood. Whatever the reason, the lactate-appearance rate in the blood may suddenly exceed the lactate-disappearance rate, and so blood-lactate levels begin to climb. You have gone above your lactate threshold!

What a low LT speed really means
To put it another way, your lactate threshold (LT) is the running, cycling, or swimming speed above which lactate begins to accumulate in your blood. As mentioned, in one sense, that sudden lactate pile-up is normal: Every single endurance athlete in the world has an LT; everyone eventually reaches an intensity at which lactate begins to burgeon in the blood. However, if your LT is reached at a somewhat low exercise intensity, it often means that the 'oxidative energy systems' in your muscles are not working very well. If they were performing at a high level, they would use oxygen to break lactate down to carbon dioxide and water, preventing lactate from pouring into the blood. If your LT occurs at an inchmeal pace, it may mean that you're not getting enough oxygen inside your muscle cells where it really matters, or that you don't have adequate concentrations of the enzymes necessary to oxidize pyruvate at high rates - or enough mitochondria in your muscle cells (mitochondria are the small grain-like structures which are the actual sites for the oxidation of pyruvate; without mitochondria, pyruvate simply can't release its energy to the cell). As mentioned, since blood lactate depends not only on lactate formation but also on how well your tissues can utilize lactate once it appears, a low LT can also mean that your muscles, heart, and other tissues are not very good at extracting lactate from the blood.

In practical terms, you want to progressively move your LT to higher and higher running, cycling, or swimming speeds, because doing so will mean that your oxidative energy systems are improving and that your muscles are getting better at pulling lactate out of the blood and using it for energy. In effect, having a low LT is not bad in itself (the lactate won't hurt you) but is a symptom that all is not well with your muscles' 'machinery' for breaking down pyruvate, using oxygen, and/or processing lactate.

It's important to note that for many endurance athletes improving lactate threshold is the key to better performances. A variety of different scientific studies have shown that lactate threshold is the single best predictor of endurance performance - better even than that vaunted physiological variable - VO2max, aka maximal aerobic capacity ('Blood Lactate: Implications for Training and Sports Performance,' Sports Medicine, vol. 3, pp. 10-25, 1986, and also 'A Longitudinal Assessment of Anaerobic Threshold and Distance-Running Performance,' Medicine and Science in Sports and Exercise, vol. 16(3), pp. 278-282, 1984).

It responds well to training
There's also great news (and certainly great news should be very welcome now that you've waded through all this physiology): not only is LT the best predictor of performance, but it is also very responsive to training - much more responsive than VO2max. If you've been training for several years, VO2max may not move upward at all over the course of a single year of hard work, while LT might soar by up to 20 per cent!

Remember Marc Rogers - our St.-Louis-Marathon winner? You'll recall that he won the race not because of a big move in VO2max, which actually was static despite a very impressive training regime, but because of a huge lift-off in LT. Marc's 'machinery' for oxidizing pyruvate and processing lactate improved dramatically, lifting his LT from 78 to 90 per cent of VO2max in less than four months of training, so he was the one who took home the first-place trophy!

Why is LT so dynamic? 'The skeletal muscles can adapt rather suddenly and strikingly to training, producing major gains in LT,' says Marc, who is currently an exercise physiologist at the University of Maryland. 'In contrast, VO2max is a fairly stable cardiovascular variable in experienced endurance athletes. To understand that, bear in mind that VO2max is to a large degree dependent on the size of the left ventricle (the key heart chamber which pumps oxygenated blood out to the body), and the left ventricle just doesn't change very much in volume after you've been training for a number of years. That's why VO2max values may not rise at all - or may only increase by a couple of percent, even with a high volume and/or intensity of training. Meanwhile, LT can be expected to increase from 5 to 20 per cent - given the appropriate training stimulus.'

And research agrees

Marc's comments are well supported by scientific research. For example, when scientists at Georgia State University and the Emory University School of Medicine followed nine elite distance runners over a two and a-half year period during which the athletes prepared for the 1984 Summer Olympic Games in Los Angeles, they found that VO2max remained unchanged over the entire 30-month period, while LT advanced by an average of 6 per cent. The LT upswing corresponded with either improved PBs or higher competitive rankings for the runners involved in the study ('Physiological Changes in Elite Male Distance Runners,' The Physician and Sportsmedicine, vol. 14(1), pp. 152-171, 1986).

Another exciting aspect of LT improvement is that it seems to be much less limited by the ageing process, compared with upswings in VO2max, economy and power ('Effects of Physical Training on Skeletal Muscle Metabolism and Ultrastructure in 70- to 75-Year-Old Men,' Acta Physiologica Scandinavica, vol. 109, pp. 149-156, 1980, and also 'Maintenance of the Adaptation of Skeletal Muscle Mitochondria to Exercise in Old Rats,' Medicine and Science in Sports and Exercise, vol. 15, pp. 243-251, 1983). To put it another way, as you get older, your best opportunity for improving your performances may come from LT-type training.

That should not be a big shock. Remember that as you get older, maximal heart rate tends to decline by an average of one beat per year, and the strength and flexibility of the left ventricle also tend to diminish. These factors lower maximal cardiac output, a key component of VO2max. Meanwhile, those pesky little mitochondria which play a large role in boosting LT, and also the aerobic enzymes which give LT a kick-start, are not necessarily reduced by the ageing process ('The Ageing Muscle,' Clinical Physiology, vol. 3, pp. 209-218, 1983).

Keeping up with athletes with higher VO2maxes

This ability of older athletes to make big advances in LT no doubt explains a fascinating piece of research carried out several years ago by researchers at Washington University in St. Louis. In that investigation, eight veteran athletes (average age 56) were compared with eight young runners (average age 25) who trained the same number of miles per week (41) and happened to have the same 10-K performance ability (mean 10-K finishing time for both groups was around 41:30). As it turned out, VO2max in the older competitors was almost 10-per cent lower, compared to the youngsters, and running economy was identical in the two groups. So why were the gray-haired harriers able to keep up with the rosy-cheeked saplings?

If you're guessing LT, you're right! Both the old and young runners reached LT at a speed of about 230 metres per minute (about seven minutes per mile), so it was no surprise that both groups ran their 10Ks at a pace of around 6:42 per mile (LT and 10-K pace are predictably linked together). The higher VO2max values of the younger runners were irrelevant for predicting performances (those lofty VO2maxs should have foretold faster 10-K times for those young whippersnappers, but they didn't), because the LTs of the senior runners occurred at a higher percentage of VO2max! In fact, average LT for the vets settled in at 85 per cent of VO2max, while LT for the younger ones rested at only 79 per cent. As a result, the older runners were able to complete their 10Ks at about 90 per cent of VO2max, while the youngsters could only handle 81 per cent ('Lactate Threshold and Distance-Running Performance in Young and Older Endurance Athletes,' Journal of Applied Physiology, vol. 58(4), pp. 1281-1284, 1985).

However, it really doesn't matter if you're young or old: you can do the same thing. Giving your LT a hefty shove to a higher running, cycling, or swimming speed (eg, to a higher percentage of your VO2max) will allow you to keep pace with - or beat - individuals with higher maximal aerobic capacities and will also help you reach the PBs you have always dreamed about.

LT training recommendations

So how do you actually cure a sickly LT - or take a pretty good LT and make it sensational? Although athletes have traditionally believed that prolonged, moderate exercise represents the ultimate LT therapy, the truth is that fairly intense training is the best LT booster, because such workouts improve the heart's capacity to deliver oxygen and the muscles' ability to use oxygen once it's delivered, as well as the ability of the heart and muscles to 'clear' lactate from the blood. For example, in a study carried out at the University of North Carolina at Greensboro, runners who raised their average training intensity by completing two fartlek sessions and one interval workout per week boosted LT significantly in eight short weeks and shaved over a minute from average 10-K time. The fartlek work involved two- to five-minute bursts at 10-K pace; the intervals were completed at about 5-K speed ('Increased Training Intensity Effects on Plasma Lactate, Ventilatory Threshold, and Endurance,' Medicine and Science in Sports and Exercise, vol. 21(5), pp. 563-568, 1989).

The idea that intense workouts are best for boosting LT was even more strongly reinforced in research carried out at York University by Stephen Keith and Ira Jacobs ('Adaptations to Training at the Individual Anaerobic Threshold,' Medicine and Science in Sports and Exercise, vol. 23(4), Supplement, no. 197, 1991). In the York investigations, one group of athletes trained exactly at LT, a very popular way to attempt to heighten LT, for 30 minutes per workout. A second group divided their 30-minute workouts into four intervals, each of which lasted for seven and a-half minutes. Two of the intervals were completed at an intensity above LT, while the other two were carried out below LT. Each group of athletes worked out four times per week for a total of eight weeks.

In the second group, the 'below-LT' intensity (which was used for two of the four 7.5-minute intervals) corresponded to an intensity of about 60 to 73 per cent of VO2max, a very, very moderate intensity which is used by many runners during their long, slow runs and easy, shorter efforts - and which is unlikely to have much impact on LT. The 'above-LT' intensity (also used for two 7.5-minute intervals per workout) was set at about 30 per cent of the difference between lactate threshold and actual VO2max. 30 percent of the LT-VO2max difference would actually represent an intensity of up to 87 per cent of VO2max, or about 88 to 93 per cent of maximal heart rate. In terms of actual running velocity, it would correspond to a running speed which is almost exactly the same as 10-K pace (or perhaps a few ticks per mile slower). In contrast, actual LT intensity is more like 15-K to 10-mile race pace.

An amazing result

Which strategy was better for boosting LT - working at LT intensity or putting in the time above it? After eight weeks of workouts, both sets of athletes achieved similar increases in VO2max and LT. The actual gains in LT were absolutely tremendous, averaging 14 per cent in both groups! Advances in muscle-cell enzymes were also rather splendid - and nearly identical in the two groups. In an endurance test in which group members exercised for as long as possible at an intensity which corresponded to their pre-training LT, the above-LT trainees seemed to hold an edge, continuing for a total of 71 minutes, while the at-LT subjects could last for only 64 minutes. However, this difference was not statistically significant.

At first glance, these results seem to suggest that there's not much advantage to be gained by sweating through above-LT workouts, but wait! If you've been following carefully, you probably noticed that the above-LT athletes really logged only 60 minutes of quality work per week (4 x 15 minutes), while the at-LT subjects put in 120 weekly minutes of quality exertion (4 x 30 minutes). To put it another way, the above-LT athletes achieved the same gains in LT and VO2max as the at-LT folks (and perhaps enjoyed a slight advantage in endurance) - with only HALF the total training time. It's reasonable to assume that had the above-LT athletes stepped up their volume of above-LT work a little bit, they would have outdistanced the mundane at-LT trainees.

What happens above LT?

Why does roaming above LT during training seem to be so effective at lifting lactate threshold? Research carried out with animals provides part of the answer. In investigations at the University of Missouri, several groups of rats hustled along on laboratory treadmills at a variety of different paces, which ranged from 15 to 37 metres per minute (43 to 100 minutes per mile). The faster (by rat standards) velocities produced a flood-tide of lactate in the rodents' bloodstreams, as expected, but the Missouri researchers also noticed something very interesting: high lactate levels were linked with glycogen depletion of the rats' 'fast-twitch' muscle fibres, not their 'slow-twitch' cells. In other words, fast-twitch fibres were primarily responsible for the huge upswing in blood lactate.

Of course, fast-twitch fibres aren't heavily utilized during moderately paced running but play a larger and larger role as running speeds increase beyond LT pace. Compared to their slow-twitch brethren, these fast-twitch cells are ordinarily somewhat low on mitochondria and aerobic enzymes, so it makes sense that they would begin belching out lactate as they are called into play. If they are very, very poor at oxidizing pyruvate, massive amounts of lactic acid will be produced, and LT will be reached at a very mediocre pace. As they get better at breaking down pyruvate, less lactate will be produced and LT speed will of course increase, but there's only one way to stimulate the fast-twitchers to get better: it's to use them during training, specifically at fairly sustained, fast paces. To put it another way, fast-twitch muscle cells can be the 'culprits' behind a low LT, and the only way to upgrade their oxygen-processing machinery is to hammer away at them during training. You'll get more 'bang from your buck' with faster-paced training, compared to slower efforts; after all, your slow-twitch cells are usually pretty good at the oxygen game; it's your fast-twitchers which need to do their homework.

The advantages of faster training were also illustrated in research completed at the State University of New York at Syracuse. In this study, which was carried out over an eight-week period, the concentration of a mitochondrial enzyme called cytochrome c increased by about 1 per cent per minute of daily LT training, as long as training intensity was set at 85 to 100% of VO2max (eg, for 10 minutes of daily training within this intensity zone, subjects boosted cytochrome c by 10 per cent after eight weeks; with 27 minutes of daily training, cytochrome c advanced by 27 per cent). In contrast, working at only 70 to 75% of VO2max increased cytochrome c by only 2/3 per cent per minute of daily training (upswings in cytochrome c should be correlated with improvements in LT).

In the Syracuse study, if one looked at fast-twitch muscle fibres only, the gains associated with faster training were even more impressive: 10 minutes of daily running at 100% VO2max roughly tripled cytochromec concentrations, while running 27 minutes per day at 85% VO2max expanded cytochrome c by 80 per cent, and 90 daily minutes at 70% VO2max boosted cytochrome c by just 74 per cent ('Influence of Exercise Intensity and Duration on Biochemical Adaptations in Skeletal Muscle,' Journal of Applied Physiology, vol. 53(4), pp. 844-850, 1982).

A range of optimal intensities

Overall, the scientific research suggests that the range of intensities from about 5-K pace down to about 10-mile race pace is great for improving LT, with the faster paces within this zone being 'better' for raising LT when the improvement is plotted as a gain per minute of training. However, the advantage of the 'slower' paces within this zone is that they can be used for many more minutes of weekly training, sometimes overcoming their per minute disadvantage (for example, it is much easier to complete 40 minutes of training at one's 10-mile race pace during a week of training than it is to charge through 40 minutes at 5-K pace, and the risk of overtraining and injury is also lower). The 'slower' paces may also be used for very long intervals and for up to 30 minutes of continuous running, which helps athletes develop the ability to sustain quality speeds for longer periods of time. In contrast, shorter intervals may have a more productive intensity but they don't simulate race situations as well (few races feature recovery intervals).

For cyclists and swimmers, the range of heart rates between 85 and 95 per cent of maximal appears to be optimal for heightening LT. As with runners, the higher end of this heart-rate zone is more productive for boosting LT when the improvement is plotted as a gain per minute of training. However, the lower heart rates can be used for many more minutes of weekly training.

Supporting the idea that the moderate end of the LT-raising zone can be great for spurring performance, research carried out at Charles University in Prague, Czechoslovakia, determined that runners improved their LTs and performances most dramatically when they augmented the amount of weekly running carried out at velocities which fell between 10-K and 10-mile race speeds (10-K velocity is about 2 to 3 per cent above LT pace, while 10-mile velocity is very close to actual LT speed, as mentioned). In this Czech research, a group of seven experienced runners reduced the amount of aerobic training they carried out (aerobic workouts were defined as those conducted at a pace slower than 10-mile race speed) from 80 to 72 per cent of all miles over a four-month period. Meanwhile, the quantity of LT training (defined as runs of five miles or less at a pace somewhere between 10-K and 10-mile race speeds) advanced from just 6 to 16 per cent of all miles (the remaining, basically unchanging volume of 12 to 14 per cent was always reserved for short, speedy intervals on the track at faster than 10-K pace). As a result of the increase in LT training, LT velocity improved by a full 10 per cent in four months, and 10-K race times sharpened by almost a half-minute - from 28:45 to 28:20 ('Ventilatory Threshold and Mechanical Efficiency in Endurance Runners,' European Journal of Applied Physiology, vol. 58, pp. 693-698, 1989).

It is important to note that the more temperate end of the 'LT training zone' (eg, paces which are closer to 10-mile than 5-K velocity or heart rates which are nearer 85 per cent of max rather than 95 per cent) seems to work best when these 'cooler' paces are sustained in a continuous manner for periods of 20 minutes or more. An example of this is the classic study carried out at the famed Karolinska Institute in Stockholm, Sweden, many years ago. In this research, Swedish runners added just one thing to their usual training - a weekly 20-minute run completed at a pace which was about 10 to 12 seconds slower per mile than 10-K race speeds, which happens to be just about 10-mile race speed, or the bottom end of the LT zone. After a total of 14 weeks, the Swedes' LTs improved by 4 per cent, and 10-K times were trimmed by over a minute ('Changes in Onset of Blood Lactate Accumulation (OBLA) and Muscle Enzymes after Training at OBLA,' European Journal of Applied Physiology, vol. 49, pp. 45-57, 1982).

In addition to being a good duration for a long, LT-boosting interval, 20 minutes may just be a threshold for the amount of weekly LT-type work needed to heighten LT significantly. Research at the University of Ulm in Germany determined that investing 20 minutes or more per week in LT training can lead to large LT lift-offs, while completing less than 20 minutes of weekly LT work is linked with mediocre thresholds.

STRENGTH TRAINING

MISTRESSING THE PULL UP

Pullups are a cool exercise. They look tuff, they feel butch, they're low-tech, and they are one of the best exercises for all-round upper body strength. Not only are your back, biceps, forearms, and shoulders involved, but you may also feel them in your abs. (Gawd, my abs were sore for a week after my first attempt at pullups... felt like I'd pulled my ribcage out through my nostrils)

Pullups are also darn hard for the average woman to do. Most untrained females who are older than 10 and heavier than 50 lbs can't do them. The good news, though, is that most trained women CAN do them. It just takes practice, patience, and time. So, if you've always wanted to do a pullup, or you have to do a few to pass a military or police fitness test, this article is for you!

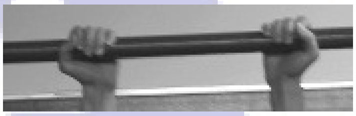
The first thing to mention is the role of strength relative to mass. The heavier you are, the more weight you're going to be pulling up. If you need to do pullups for something like a job-related fitness test and you have excess body fat to lose, then consider dumping some of that body fat overboard (of course, using a sensible nutrition plan of moderate caloric restriction and perhaps some interval training, as recommended elsewhere on this site). The lighter you are, the better your chances. That being said, the heaviest woman I've ever seen do a pullup was nearly 200 lbs., so it can be done even if you're bigger. It's just that this is one of those areas of physical unfairness where it's better to be smaller.

Here is the progression that will take you from ultra-beginner to your first pullup. Feel free to skip steps if you're already advanced, and/or if you're curious enough to see how you'll do on the harder levels. You don't need anything fancy like an assisted pullup machine, but the machine does come in handy if you've got one available.

Holding the bar

But first, a word about pullup grips. There are many ways to hold the bar. While in general, the movement remains more or less the same regardless of grip, there are slight differences depending on the grip. There are no rules about which grip to use, so use the one that you prefer.

An underhand grip is probably the easiest along with the parallel grip (see below). This grip is approximately shoulder width or narrower — even as narrow as your hands touching one another — and palms face you. This grip involves the biceps the most. Pullups done with an underhand grip are often referred to as chinups

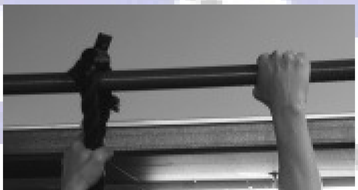


A parallel grip, with palms facing one another, is my personal favourite and in my opinion, frequently the easiest and most comfortable for the shoulders. Some pullup bars have a parallel grip built in. If your gym doesn't, steal the parallel handle from the cable row station and hook it over the bar as shown in the pic to the right. When using this modification with the handle, you'll need to orient yourself so that the bar is pointing front and back, rather than side to side, as in a regular pullup.

An overhand grip tends to involve the rear shoulders (deltoids) much more as primary movers, especially if the grip is wide. The more the grip causes your elbows to flare out from your body (as in the wide grip, bottom pic), the more involved the rear deltoids will be. The biceps involvement is somewhat less compared to the underhand grip. Also, the wider the grip, the more stress on the shoulders, so if you have rotator cuff problems, avoid the wider overhand grip as it may trigger shoulder pain. A wide overhand grip is generally the hardest grip to use aside from modified one-hand grips

As you get more advanced, experiment with other grips. A mixed grip uses one hand over and one hand under. You won't pull straight facing the bar; rather, your body will twist a little as you come up. This is good for a little extra challenge, particularly to the midsection that will have to work to stabilize you. Alternate hands with each set.

A modified one-hand grip is great for climbers, grip strength, and for working on the ultimate goal: a one-hand pullup (no, I haven't done it yet. I may never... but a girl can dream). One hand grasps the bar, while the other sits lower down, grasping the rope. You can use a towel looped over the bar, or in this case, the rope handle stolen from the cable station. This provides an asymmetrical load: the side holding the bar will have to do much more pulling work than the side holding the rope, but the side holding the rope will experience much more of a demand on forearm and hand strength. Again, remember to switch sides for each set.



OK, on to the progression!

Step 1: modifying the lat pulldown

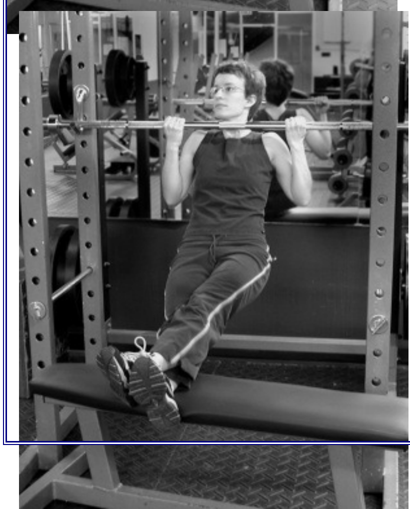
This movement modification more closely mimics the type of demand on the midsection that pullups involve. You can use a cable station or the lat pulldown machine. Stand behind the machine's seat if you're using the lat pulldown station, as shown in the pic on the right, facing the stack. Reach up and grab the handle. Squat down slightly, bending at knees and hips. Pull the handle or bar to your chest as you normally would. You don't even need to use the lat pulldown station; you could use any cable station that allows a handle to be attached at the top. It's fun to experiment with other handles, such as the parallel handle, or to do these one-handed for a little extra zing.

Step 2: assisted pullups
These can be done in two ways. One way is to use an assisted pullup machine (sometimes known as a Gravitron) that uses a counterweight so that you are only pulling up a fraction of your body weight. The assisted pullup machine has the advantage of providing progressively declining resistance. For example, you can begin with pulling up only 40% of your body weight and progressing in 5 or 10% intervals gradually towards your goal.

The second way, if you don't have an assisted pullup machine, or if you feel like going low-tech, is to do the assisted chinup as shown in the photos to the right. This is perhaps the one good use of a Smith machine, as it should never be used for squatting unless you enjoy having your spinal vertebrae slide and crunch over one another like amorous tectonic plates. You could also use a barbell placed in a squat cage or rack, as I have done in the pictures.

Set the bar up at approximately chest height. Push a bench in front of the cage or Smith machine. Sit down in the cage and reach up to grab the bar, then put your feet on the bench. The bench will support some of your lower body weight so that you aren't pulling up quite so much. The more of your legs that are supported by the bench, the more assistance you'll get.
The first photo shows the starting position for the assisted pullup. You can use whatever grip you like, although a shoulder-width or slightly wider overhand or underhand grip will work best. Dorky facial expression, as demonstrated, is optional (although judging from how often it appears in my lifting photos, perhaps it is the secret to strength).

The second photo shows the top position of this pullup. Why am I looking to the side? I have no idea. Perhaps there is a shiny object over there. I have the attention span of a goldfish. Anyhoo, notice that I keep my legs straight throughout the movement.



Step 3: negative pullups
This involves the same use of the Smith machine as in Step 2. Or you can use a regular bar; it's just easier to do when the bar is a little lower. A negative pullup eliminates the pulling up part of the rep, which is the hardest part, and just focuses on the lowering down part, which is easier. The "negative" refers to the negative part of the rep, also known as the eccentric portion. Thus, instead of focusing on pulling up (known as the "positive" or "concentric" portion of the rep), you focus on slowly resisting gravity on the way down.
Start by grabbing the bar with your desired grip. Jump up to the top position of a pullup, with arms fully bent and chin over the bar.
That's the starting position. Then, lower yourself down as slowly as possible. Try for a slow 3 or 4 count per negative.

Step 4: partner assistance
Once you can do 4 to 5 good slow negative chins, try a partner assist. Grab the bar, bend your knees 90 degrees, and have a partner place their hands under your shins in order to apply gentle upward assistance. Often, just a little boost from a partner at the bottom is all you need, and you should be well on your way!

Step 5: the pullup
Hell yeah! You did your first big-girl pullup!
Pause to celebrate the completion of your first pullup. It is a special moment in every woman's life, ranking just below giving birth and above your wedding day. Or something like that. Force everyone in the gym to kiss your biceps. Scream "YEAH!!" and pump your fist in the air. Do a victory lap around the gym while singing, "Weeeee are the chaaampyuuuns my freeeeeeend..."

Ok, i can haul myself up, now what?
You'll find that it's often easier to add weight than reps to chinups. Try for sets of singles rather than multiple reps, and try them more frequently than once weekly, say 2 to 3 times weekly. As long as you don't max out and you stay well under your capacity (e.g. do 1 pullup if you can normally do 3), you can even do them every day if you're used to them, but I don't suggest that beginners do this, as their wrists and elbows are not sufficiently conditioned and will likely complain.

Another option is to do a regular chinup 1 to 2 x weekly, then assisted lighter chins another 2 x weekly. This will also help with your grip. Ideally, go for shorter sets with pullups, and do them a couple of times a week. You'll fatigue easily with these, so the first set is where the magic happens.

The easiest way to add weight to pullups is with a dip belt. This is a nylon belt with a chain. The chain is threaded through a weight plate, and the plate hangs between the knees, as shown in the pic to the right. The belts are pretty cheap; maybe $20 or so at your local fitness emporium. They come in leather versions too, but I'm not crazy about those, as the leather tends to cut into your hips.

You can also try holding lighter plates (such as the 2.5, 5, and 10 lbs) between your knees. This isn't a bad method but I do not recommend just dropping the plate by opening your knees when you're done the set. It has a surprisingly high probability of smashing your ankle on the way down. Must be a funny gravity thing, I guess.

Make the extra effort to remove the plate by hand. As you get into larger plates, such as the one shown in the pic (which I think is a 35 lb one but can't tell definitively), you'll want to use a dip belt unless you have Knees O' Steel.

And of course, feel free to pursue the pot of gold dream of a one-handed pullup by using the mixed-grip methods shown above, and placing your rope hand further down the rope over time. If you manage it, take a picture and send it to me. I shall proclaim you Pullup Mistress.

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ARC
SOUTH AFRICA

Association of Rowing Coaches

Membership Application Form

First Name: ____________________________________

Surname: ____________________________________

Gender: ____________________________________

Nationality: ____________________________________

ID Number (RSA): ____________________________________

DoB: ____________________________________

Postal Address: ____________________________________

____

Cell Phone: ____________________________________

Email: ____________________________________

Club/Institution: ____________________________________

Volunteer/Half paid/Full Paid: ______________________________

Coaching Qualification Level: ______________________________

Representation: International/National/Provincial:_________________

This form must be completed and returned by fax to Jamie Croly (National Secretary) at 011 781 2987 or by Email at jcroly@stithian.com. You will be notified by email of the receipt and acceptance of the membership application.

Membership fee of R100.00 per year will be invoiced after membership has been accepted and processed.