

Training:

A Lens

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Purpose

The purpose of this book is plain and simple, and that is to give the reader the tools with which they can analyze, describe, and understand training in a much more accurate and concise way. A tool that will help them see training a bit more clearly. By no means is this text an attempt to cover all the possibilities training might take, for such a work would be infinite in scope, but it is an attempt at giving the reader a map, key, and compass with which they can more accurately observe and navigate their journey in sports training and hopefully keep themselves on the right path.

Rather than give some basic advice and then a number of cookie-cutter programs to follow, the goal of this piece is to teach the reader what to look for, how to recognize it, what it means, and how to improve upon or fix it, whereas “it” refers to each component of training. The text is basically taking a “teach a man to fish” approach rather than a “give a man a fish” approach. It may be harder and more time consuming to teach someone the skill set (in this case, a way of thinking), but in the end that person takes away something much more important than a one time gift of kindness (cookie-cutter approach) can provide.

Some words and concepts encountered here within may be completely new or wholly familiar, depending on the reader's past experiences, but I can guarantee the pieces (superfluous though some may seem) will add up to something very clear and useful in the end. It is imperative that each piece be paid attention to and considered carefully for an understanding of the whole is not possible without an understanding of its constituent parts.

The information contained herein is meant only to provide a frame of reference for training. How you use this frame is up to you. The application of the classifications and ideas will require mental effort to learn and apply, but the time and energy spent will be well worth it.

Training for Sport: The Basics

The point of this chapter is to introduce some of the very most basic concepts of training and alternative ways in which the mundane can be viewed and more fully understood. There won't be much of anything in the way of prescription, only instruction on what to look at and what it is.

The Nervous System

Throughout the ages, there have been as many ways to train for each sport as there have been sports in total. Needless to say, this is many. To this day, even with all of the knowledge at our fingertips, coaches still can't agree on how to train and their methods reflect such. Some coaches use bodybuilding-type training the weight room and expect the athletes' playing their sport will transfer the muscle gained into on court or field performance. Other coaches use highly specific methods in the weight room to try and simulate the sporting movement exactly and then go on to perform the sporting action. Which method is right? Without the correct tools to assess each approach no answer can be found.

However, the purpose of this text is to provide those tools and the first thing the reader must know is that if someone's training is not based around and targeting the nervous system then it is suboptimal. Instead of throwing out a boatload of complex and inapplicable terms the author will attempt to explain things in a simple and easily understood manner. Suffice to say, the nervous system controls the function of every organ in the body (the muscles and their components included) and through proper manipulation of the nervous system through training means the proper physical adaptations will arise.

Giving a quick example, it is the pattern of neural activation that determines what type of

muscle fibers a given motor unit is comprised of (fast twitch v. slow twitch). If the activation is one of fast twitch nature, the motor unit will take on a fast twitch profile. Likewise, if the activation is one of slow twitch nature, the motor unit will take on a slow twitch profile. (Roy et al, 1991). Seeing as fast twitch fibers contract up to 10 times faster than slow twitch fibers (Andersen et al, 2000), and have much more potential for hypertrophy through high load training (Andersen & Aagaard, 2000), it is obvious why such a switch would be desirable.

Moving on, as stated previously, the nervous system controls all forms of movement through different recruitment strategies of which there are 6 accepted variations (Roberts, 1976). They are as follows:

Set: A limb or joint moves freely without external resistance (moving an arm about freely).

Hold: A limb or joint maintains one position while under external forces (holding a grip on a barbell).

Drive: A limb or joint is moved against external resistance (arm wrestling).

Punch: A limb or joint gains momentum after forces much greater than necessary to move the limb are employed and the momentum is then transferred to another object (punching a heavy bag or an opponent).

Catch: A limb or joint absorbs external power (catching a medicine ball, landing from a leap).

Throw: An limb or joint moves against resistance to propel an object and then decelerates after it has been released (throwing a football, jumping from a squat.)

Many sporting actions are a mixture of these commands, such as jumping to dunk a basketball being primarily a combination of 'catch' and 'throw', and so one must be careful when assessing movements to make sure they have the right patterns. The importance of the above, and it is very important that the reader pay attention here, is that in order to train for jumping (a random example), which is a 'catch +throw' movement, many people use barbell squats or deadlifts, which are 'drive' movements. Yes, the

aforementioned lifts will make the trainee stronger, but the neural activation patterns behind each type of movement are entirely different, and that's why having a big squat does not mean being able to jump well. Instead of using a 'drive' movement, the trainee would've been better off using a combination of 'catch' and 'throw' movements for the appropriate musculature.

Load, Tension, and Progression

Now that the nervous system is out of the way for the time being, the next thing that will be dealt with is load, tension, and progression. Basically, what needs to be gotten across is that of the 600+ muscles in the human body, their sole purpose is to contract. The better a muscle is able to contract, the better it will be able to do its job. Since this is the case, the prime goal of training should be to train your muscles and tendons to absorb and create higher levels of force. The more force one is able to create within the time constraints of their sporting action, the better they will be (provided technique is sufficient).

To allow the muscles, tendons, and ligaments to handle more tension and stress, most people turn to weight training. Over time, they increase the amount of weight lifted as per the Overload Principle (load, either volume or intensity, must be above the habitual level for positive changes to take place) and their muscles and connective tissues strengthen (Zatsiorsky, 1995). However, there are alternative strengthening methods.

When a lot of people think of load or intensity in their training, they often think of the weight that is on the bar, but that's not the only way to think about it. Another way to think of load is intramuscular tension (or the tension the muscles are under). Simply put, dropping from a high height and sticking the landing actually creates more force within the muscles and tendons than could ever be created in the weight room. In fact, muscles have been shown to be capable of creating up to 1.6 times their concentric maximum force in eccentric contractions (Dursenev & Raevsky, 1978).

By starting with a box height one can comfortably stick the landing from and increasing the height as ability allows the muscles and tendons will adapt to handle more force just as if one had used weight training. In addition, the strength gained from high speed eccentric methods would seem to have a much better transfer over to sports and weight training than straight weight training often would if the same results from isokinetic training were any indicator (Perrine & Edgerton, 1981). High speed explosive training also preferentially favors fast twitch muscle fibers (Hakkinen, 1985) and high speed concentric training conditions the nervous system (Siff, 2003).

In a similar vein, just about anything can be used for strengthening purposes, as long as there is a consistent way to add load available (either in the form of extra weight or kinetic energy gained from a drop). One's imagination is the only limit. For a few quick examples, one option is to do a vertical leap with 10 pounds (arbitrary number) and set a baseline of height, let's say 30". Then, one would use 11 pounds and try to jump 30" again. When they could, they would add another pound and so on and so forth. For another example, one could jump off of one box and rebound up onto another. As ability increased, so would the height of the boxes and therefore the intensity. As said before, the limit is one's imagination.

The basic thing to take away from all of this is that anything can be used as "strength" training as long as the difficulty can be continually increased. Also, one should always be aiming to progress from session to session, even if no progress is made. As long as there is a definite mental focus on getting better, an athlete's abilities will improve given time and training. Another thing that should probably be taken away is that strengthening methods that match the sport skill's form of recruitment strategy is probably best.

Efficiency in Movement

Beyond training the muscles and tendons to be able to withstand and produce more force, an

athlete must also focus on gaining proficiency in their sporting movement(s). Naturally, the best way to get good at a movement is to practice it with the best form your abilities allow. If an athlete has a hard time holding certain positions or activating certain muscles then flexibility or activation work needs to be done in conjunction with practicing the sport skill. In all cases, practice only makes permanent. It takes perfect practice to make perfection.

By training one's sport skills directly through practicing the skill itself numerous times over long periods, one can make their movement more efficient so they expend less energy to perform the same task. In fact, as sporting proficiency rises, there is usually a decrease in energy used (Vorobyev, 1978). This is because beginners often activate muscles unnecessary to their sporting goals or activate muscles with incorrect timing or in an incorrect pattern (Siff, 2003).

Because becoming good at one's sporting skill is so important, a good deal of training should come from performing the sport skills themselves. Not all time needs to be devoted to the skill, but an athlete should try not to go more than a week without practicing, even if it is at a decreased intensity. And this leads right up to the next point.

The best practice for one's sporting skill is to perform the sporting skill as intensely as possible. Using sprinting as an example, if one can run a 10.0 second 100M, then running 10.5 second 100M dashes will help with form some, but they won't provide the same learning experience for the body as running as fast as possible. The closer things are to competition speed or power in practice, the better off one is. However, as the intensity of practice increases, the volume will naturally have to be lowered to prevent either burnout or poor form being used. Depending on what an athlete needs, the sport skill can be practiced at varying intensities.

If the athlete is a beginner or of poorer proficiency then exposure to the sporting movement should be increased. In a case like this, the athlete would be performing the sport skill at 90-95% intensity as this would allow for the use of more volume and at the beginning levels the specificity of

performing at or near 100% is not necessary. Now, once that athlete becomes more advanced, specificity becomes much more important and the amount of training at or near 100% must be increased, even if that means volume is reduced.

Breaking down the previous few paragraphs into a few easy points, one would want to understand that it is very important to practice one's sporting movement as frequently as possible while incorporating strengthening movements. Lower level athletes can practice at lower intensities with higher volume and higher level athletes need to practice at higher intensities with lower volume.

Evaluating Sporting Movements

The following chapter will cover how to evaluate sporting movements from a neural, muscular, and energetical perspective and how to structure 'strength' training for the best results. Since proficiency in a sporting task is dependent both upon the strength of the muscular and tendons systems as well as the skill of performing the sporting action itself, it is important to train the appropriate musculature through the correct ranges of motion with the correct recruitment strategy. Without in depth knowledge of the sporting action, it would be impossible to train for it optimally.

Recruitment Strategy

The first thing to cover when analyzing a sporting movement is to decide what kind of neural recruitment strategy it requires. This is usually straightforward enough, but some movements (and almost all sports) are a combination of strategies and this can make things slightly more confusing. To start, some examples will be covered.

For basketball, many players want to improve their leaping ability. As was briefly touched on in the last chapter, leaping is a combination of a 'catch' and a 'throw'. The athlete dips down to take a countermovement and their muscles must work to absorb the force created by their body in the descent. Then, once the dip has been brought to a halt the muscles work to accelerate the body upwards and propel it into the air. For this reason, the strengthening movements for jumping should be 'catch' movements, 'throw' movements, or a combination of the two.

For another example, rock climbers scale walls and use controlled and deliberate motions to pull themselves upwards. While there is no actual external loading, their bodies provide the resistance (which can be considerable if held only by the hands) and therefore they are using a 'drive' recruitment

pattern. So, the strengthening movements used for climbers should be of the 'drive' recruitment pattern.

Now, it is important to note that one can use training of any recruitment pattern for the sole purpose of strengthening their muscles and tendons and it will work especially if the strengthening exercises are used in conjunction with the sporting action itself. However, by using strengthening methods that are of the same recruitment pattern as the sporting action, the muscles and tendons will be strengthened and the nervous system will become more proficient at performing said recruitment pattern.

Muscles and Tendons

Once the recruitment pattern(s) of a sport skill has been determined, the next step is to figure out which muscles are involved. Naturally, in most sport skills a majority of the muscles within the body will be involved, but the trick is to find those that are the prime movers. The prime movers in the sport skill should also be the prime movers in the various strengthening exercises used to supplement skill practice.

Using the standing vertical jump as an example, the quads are the prime movers followed by the muscles of the hips (the glutes and hamstrings), followed by the plantar flexors (calves) (Hubley & Wells, 1983). Support muscles include the erector spinae, the abdominals (for pelvic alignment), and the shoulder extensors. From this evaluation, it becomes obvious that the strengthening movements need to emphasize the quads, hips, and calves with other work being done for the supplementary muscle groups.

Now that the prime movers have been recognized, the next step is to look at the range of motion (ROM) through which the sporting action occurs across all relevant joints. Going back to the standing vertical jump as an example, the ROM of each joint varies between individuals based upon a number of factors, but general measures can be set. The knees usually won't bend past 90 degrees, the hips to a

similar angle, and the calves around 10-20 degree dorsiflexed from neutral. While the range of motion might not seem important at first, it actually is.

When a muscle is trained, it gains the most strength in the range through which it is trained with lesser strength increases in nearby sections of the ROM (Zatsiorsky, 1995). Since the goal of the strengthening exercises are to better prepare the body to perform the sport skill, it is obvious that an athlete would want to develop the most strength through the ROM in which their skill is performed. However, performing strengthening exercises only through a limited range of motion can lead to inflexibility as well as muscle imbalances if full range of motion work is not included. To remedy this, at least half of the strengthening exercises used should move through a full ROM. The strength gained by training through a full ROM will still be useful too, as strength gained in the stretch range carries over very well to all other parts of the ROM (Kubo et al, 2006) as well as providing many other benefits.

Having rambled on about only the muscles at this point, it may seem as if the tendons had been forgotten about. This is not the case though, as any training which would condition the muscles will simultaneously condition the tendons as well. Some types of training are better for the tendons than others, but as long as one trains in a way beneficial to their sporting skill, the tendons will develop just as they need to. And while the tendons do not actually contract, they can be made stiffer to withstand higher forces with less deformation (a good thing for power production and absorption) as will happen as one gains proficiency in their strengthening exercises.

Energetical Means

In this section what is being determined is what energy system or pathway the sporting skill primarily utilizes. By figuring out which system is used, strength training can be further specialized to aid the sporting skill.

As far as this text is concerned, there are only two energy sources with which anaerobic power athletes need to concern themselves: the adenosine triphosphate/creatine phosphate energy system, and the anaerobic glycolytic pathway. Neither of these two energy sources require oxygen and therefore are termed anaerobic. For the speed and power athlete, the aerobic pathways are not as important and will likely not be trained outside of light recovery work.

The adenosine triphosphate/creatine phosphate (or ATP/CP) energy system is the first system activated and the first to expend all of its energy. This energy source lasts from the beginning of exercise up to around 3 seconds (Brooks et al, 1996). Due to its extremely short duration of energy supply, only sports requiring one violent movement typically rely heavily on this system. These sport skills would include the throwing of a shot, discus, or javelin, or performing a single leap for maximum height. Generally, sport skills reliant on this energy source are of the highest magnitude in relation to force generated. They are acyclic actions where the goal is to create as much energy at one time as possible.

After the ATP/CP system has been exhausted, the anaerobic glycolytic (AG) system kicks in to take its place. The AG energy source can provide power from 4-50 seconds after exercise has started after which the work becomes aerobic in nature (Brooks et al, 1996). Sporting skills that rely on the AG system are usually cyclical in nature and their goal is to produce a high level of power repeatedly for a duration of time. These skills would include such sports as sprinting, basketball, or martial arts. In sports such as these, it is important to be able to produce power over an extended period of time rather than just in one burst.

Now that one understands which pathway their sport skill is dependent upon, it is time to move on to what that means as far as application. Unlike dealing with the nervous system or the muscles, assigning work based on the energy systems used isn't quite as straightforward. No matter what the goal is, athletes of all events can benefit from strength training that relies on both systems. Meaning to

say, athletes who's sport skill depends on the ATP/CP system can benefit from AG work and athletes who's sport skill depends on the AG system can benefit from ATP/CP work.

To provide example for the above, a 200M sprinter, who's event relies almost entirely on the AG pathway, can benefit from 30M sprint starts, depth jumps, or low repetition reactive squats, all of which are dependent on the ATP/CP system. Similarly, a shot putter who's sport skill only takes a couple of seconds can benefit from higher repetition reactive work and even longer duration 'drive' movements if more musculature is needed. The text will not go into detail on why this is right now, but will cover it in the “Programming” chapter.

Summary

From this chapter one should have learned how to tell what type of neural recruitment strategy their movement utilized, what musculature is involved, and what energy system it is reliant upon. From this information, they will be better able to program their strength work. Further information on how to integrate this information into an actual training plan will follow in the next chapter.

Programming

The following chapter will touch on not only how to program training starting with individual sessions and working up to longer plans, but will also explain some interesting phenomena that can be used to further training results. The chapter may appear to go on tangents at points, but it is imperative that everything be paid attention to lest something important go unseen.

The Nanocycle

A nanocycle is the term used to describe a single training session. A single training session won't make or break an athlete, but many of them combined can and will. For this reason, nanocycle composition is of great importance, even if each individual one is not too significant. Within each nanocycle, there should be three parts. The warm up, the training session, and the cool down. The text will now cover them in order.

Warm Up

For the warm up, the goal is to raise the body's temperature while gradually moving the joints through a greater range of motion. To do this, an athlete would usually start with 5-10 minutes of light activity just to get some blood flowing. From there, the athlete would use any drills they could, with the exception of static stretching, to slowly make sure there were no restrictions around any joint. The reason no static stretching is used is that static stretching prior to exercise can lower one's explosive abilities (Young & Behm, 2003). In place of static stretching, ballistic stretches can be used or one can merely get into the stretch range of a joint and then gently bounce against it, aiming to go a little lower each time. Once the body has been warmed up and the joints loosened, one can then perform a small

number of sets of their training session exercises at a lower intensity before moving on to the training session itself.

Also of importance, though not noted previously, is that an athlete be in the correct mental state before beginning their actual training session. By using visualization and positive self talk exercises, an athlete can increase their ability to recruit more muscle fibers at a higher rate of fire (Siff, 2003). Visualization work can be done immediately prior to the 'training session' portion of a nanocycle as well as in between sets.

Training Session

After the warm up is the training session. This is where either the sport skill itself is trained or other methods meant to build the capabilities of the muscles, tendons, and nervous system are employed or both are used. If both strengthening exercises and the sport skill are used in the same session then one needs to be careful not to induce too much fatigue before practicing the sport skill or else technique will suffer and much of the benefit of practicing will be lost. For this reason, it is usually suggested that technical work take place first in a workout (Ozolin, 1971). However, a small amount of strength work can be used prior to training the sport skill to provide a potentiation effect and actually increase the performance of the session.

By including only a small amount of tonic strength work, performance in the sport skill can be increased. For instance, when training for the vertical leap, performing a small volume of other barbell squats or depth jumps lead to increased vertical leap heights only a few minutes later (the potentiation peaks at roughly 4 minutes for the squat, and 8 for the depth jumps) (Siff & Verkhoshansky, 1999).

After skill work has been finished, if one chooses to include skill work at all in an individual session, strengthening exercises can be applied. To get the reader started, the text will list a number of good strengthening exercises that would work for most sports by their neural recruitment pattern.

Drive	Catch	Throw	Catch+Throw
Barbell Squat	Altitude Landing	Paused Jump Squat	Reactive Jump Squat
Barbell Deadlift	Reactive Squat	Paused Jump Snatch Pull	Depth Jump
Bench Press	Snatch Balance	Paused Bench Throw	Bounding
Chin Up	Olympic Lifts	Squat Jump	Reactive Jump Snatch Pull

It is useful to pick several strengthening exercises that one has ready access to and can commit to in the long term, even if only 1-2 are used per session. An athlete interested in vertical leap might really focus on improving his strength through depth jumps and reactive jump snatch pulls as they both focus on a 'catch'+ 'throw' recruitment pattern. However, if either portion of their skill is relatively weaker than more work should be done to correct that. For instance, if an athlete has trouble absorbing force going into a running leap then 'catch' work should be present in greater quantity. If the athlete can stick the approach really well and absorb the energy but can't 'throw' themselves into the air afterwards then more 'throw' or 'catch'+ 'throw' work should be included. The basic premise is to cater to one's weaknesses.

Once exercises have been selected, more questions arise. How many exercises, how many reps, how many sets, how long to rest in between sets? All are good questions and vary depending on the goals of the session as well as one's sport. Since there are a list, they will be covered in order.

The number of exercises in one session should be anywhere from 2-5 including the sport skill itself. If fewer than two exercises are used then it is likely that something will be neglected. If more than 5 exercises are used it is likely that the training effect will be too diluted as each exercise will have to be done for less volume. Sport skill work can be done every session, but this is not necessary if the athlete's form is very good. Instead the excess skill work can be traded for more strengthening work. If the athlete's form is very poor then skill work should probably be implemented during every session. Once the primary exercises are finished, supplementary work can be included for the supporting

muscles, such as upper body training for a sprinter. The important thing to remember is that supplementary training is just that, supplementary. Excessive volume and intensity should not be used for fear of disrupting gains in the primary strengthening movements and the sport skill.

Moving on to how many reps should be done per set, this varies depending on a number of factors. Also, instead of reps, it would be wiser to think of things in terms of set duration rather than repetitions. The reason for this is that a set of 10 shrugs will take much less time than a set of 10 barbell full squats. To make them comparable, the wisest thing to do would be to use seconds taken per set rather than repetitions. In other words, 20 seconds of squats will yield the same adaptation as 20 seconds of shrugs, regardless of the number of reps done for each.

Depending on what one's goals are, the set duration will vary. Shorter duration sets are usually of higher intensity. Higher intensity sets will bring about better gains in absolute abilities, but are more costly regeneration-wise, allow for less overall volume, and do little to increase work capacity. Longer duration sets typically are less intense, less draining on the body and CNS, do less for gains in absolute ability, but do help to increase work capacity or the duration to which power can be produced. It is generally wise to perform mainly longer or shorter duration work in one session, however a couple of sets of short duration work can be used to potentiate longer duration work in the same session without incurring too much fatigue.

In regards to how many sets to do, this will also vary depending on one's goals, but a general rule is that the more volume one puts into a session, the longer it will take before they're recovered and they can train again. If an athlete wants to train more often then they'll have to do less work per session, and if they want to train less often then they'll be able to do more work per session. Actual volume is highly dependent upon the individual's work capacity, so there is no set rule to follow.

Getting to the final question of rest periods, these also depend on what type of work is being done. Elite weightlifters typically take 4-5 minutes between heavy sets to allow recovery (Zatsiorsky,

1995) so this seems like a good place to start. Since quality is always favored over quantity and proper form is a must, it is always good to err on the side of longer rest periods when in doubt. Rest periods can be as short as 2 minutes or as long as 40 (in between full speed 400M sprint reps), as long as two conditions are met: one, the body has not cooled down too much by the time the next set starts, and two, performance is not allowed to deteriorate because of inadequate rest. Again, this is a unique issue and depends on the individual, but most plyometric and weight lifting exercises need around 2-5 minutes of rest in between sets while sprints can use the rule of thumb of 1 minute rest for every 10 meters ran.

Cool Down

After the training session itself the body is usually returned to its initial condition to aid recovery (Siff, 2003). This is done through the use of a cool down. In essence, the cool down phase is the exact opposite of the warm up. The aim is to lower body temperature, relax the mind, and get the body away from the stressful state the training session created. To do this, restorative means must be employed.

A list of restorative techniques include stretching (ballistic, static, PNF, etc.), massage, hydrotherapy, epsom salt baths, contrast showers, ice rub downs, vibrational massage, deep breathing or progressive relaxation exercises, or easy physical activities such as Tai Chi or yoga. One does not need to use many methods after a session to aid recovery and the application of 2-3 is usually fine. There's no need to complicate the process as a short walk, some light stretching, and a relaxing bath or spurt of meditation will usually do the trick. All that matters is that the body and mind are returned to a comfortable and calm state.

Immediately after the body is cooled down, the next action should be to eat something consisting of protein and carbohydrates. Without fuel with which to repair the tissues damaged during

training, the body will not hesitate to catabolize muscle to ensure its survival.

The Macrocycle

A macrocycle is an arrangement of nanocycles in sequence. The length of a macrocycle can vary from a week to many months, but it is often not important for anything other than classification or monitoring purposes.

By keeping macrocycles to a certain length, let's pick an arbitrary duration such as two weeks, you can monitor results over time by keeping careful track of things. As time goes on, an athlete's work capacity should be slowly improving. One way to check if it is is by adding up the total volume (by poundage, sets, meters, etc.) within a number of macrocycles over a several month period and seeing how it varies. Another way a macrocycle can be of use is for timing progressions. For instance, a sprinter may gradually increase the length of his sprints as a macrocycle progresses and once the a new macrocycle starts he may start back over at the shorter distances and see how he's improved. Really, macrocycles can provide information about any number of things provided you keep detailed records and spend time looking.

Another use for macrocycles is volume manipulation to break through training plateaus. If an athlete's absolute abilities or work capacity have failed to increase as rapidly as would be liked, they could engage in a process like concentrated loading. Concentrated loading is where the volume of work is increased so that an athlete's abilities decline and stay below baseline for a number of weeks, then when the extra volume is removed, the athlete's abilities supercompensate and rebound to above their previous levels. This method works especially well for starting strength and explosive strength (Siff, 2003). To arrange a bout of concentrated loading, a good way to start is to calculate the volume for your last macrocycle and then increase the volume of the next macrocycle by 50% over that. During this overloaded cycle, one's strength and explosive abilities will diminish. If they do not, the volume

needs to be increased further. For the next macrocycle after that, reduce the original volume by roughly 50%. This reduction in work will allow the supercompensation process to take place.

Moving on, this would also appear to be the place to cover what to do in between macrocycles. Since progress is made not while training, but while recovering, it is important that one do all they can to ensure that recovery is as expedient and complete as possible. To do this, restorative measures like those listed in the “Cool Down” section above should be employed on off days. There's no need to go crazy, but a little recovery work will go a long ways in keeping one healthy and working hard.

Interesting and Useful Phenomena

This chapter will cover some things that didn't necessarily fit in to the previous chapters but are still easily applicable and of considerable use. Any number of these exercise-related phenomena can be included in one's training without much difficulty and probably already are. The purpose here is just to inform the reader about them so they can better structure their own sessions.

Relaxation & Cyclical Sports

In sports of a cyclical nature such as sprinting learning to relax the muscles as quickly as possible is of great importance. The quicker and more completely an athlete is able to relax their muscles in between actions the more time they will have to resynthesize ATP and therefore the longer they will be able to maintain performance at a certain level. The ability to relax effectively has been shown to increase markedly as skill increases (Verkhoshansky, 1996).

To increase the ability to relax the best method to use is any one where a strong muscular contraction is followed by sudden unloading (Siff, 2003). Such methods include depth jumps, sprinting, bounds, RFI footwork drills, jump squats, reactive squats, or any number of similar exercises. If an athlete's sport is one of cyclical nature, then any of the above methods (especially sprinting) should be the main focus of the program.

The Stretch

Training in the stretch range (towards the end of a joints ROM where the working muscles are the longest) and with high-force stretching methods has some very interesting benefits that one might expect. One such benefit of training in deep angles is that any strength gained in the stretch will

transfer over uniformly to other joint angles (Siff, 2003). Another benefit of stretching work is that stretch overload (through plyometrics or other such training methods) has been shown to lead to increases in the number of muscle fibers present. Similarly, stretch overload can trigger the activity of satellite cells which may explain the hyperplasia above (Siff, 2003). And incorporating both ways of training, high-force stretching activities applied while the muscles are in the stretch would appear to alter sarcomere number and length and therefore lead to a muscle which is able to contract more quickly. Similarly, during high-force rapid stretching movements, fast twitch fibers are preferentially recruited while slow twitch fibers may be inhibited (Siff, 2003).

The Anaerobic Glycolytic Pathway & Stiffness

In many sports, sprinting especially, stiffness is king. Stiffness can be thought of as eccentric rate of force development, or how long it takes a muscle to build force eccentrically. The higher one's stiffness, the quicker they will be able to finish their transitions and they less time they'll need to spend on the ground when going up for a jump or when running. Stiffness is dependent upon a number of variables most of which are built up through various forms of strength training, but one is often overlooked. By studying high level sprint athletes, a correlation between their distance (60, 100, 200M, etc.), ability to produce lactate through anaerobic glycolysis, and their stiffness was found. The longer the race, and the higher levels of lactate found thereafter, the higher levels of stiffness (as assessed through a contact time test on a jump mat) they exhibited (Locatelli, 1996).

To benefit from this in one's own training an athlete should use sets of longer duration (20-50 seconds) in hopes of training the AG pathway. Due to the length of the set, the intensity will be lower and therefore neural and muscular adaptations will not be as great, but the energetic adaptations will make up for it. In order to do this, any intense activity lasting for more than 20 seconds but less than 50 in which the activity does not cease. Examples of which would include: sprinting, multiple response

hops, bounding, lifting weights, or anything else.

Potential Methods

Potential methods are methods which are meant to increase the performance of the work that follows them. These methods can be easily applied in one's own training with very little work. The text will break them up into two categories, active and passive. In truth, both methods require active participation, but active methods will require actual work sets to see the benefits whereas passive methods can be done during rest periods in between or before sets.

Active methods of potential are numerous but should be applied in limited volume lest the fatigue they generate detract from the primary workload. One example would be that applying preliminary isometric tension can increase the effectiveness of following dynamic work by up to 20% (Siff, 2003). Isometric tension can come in many forms and would include altitude landings or heavy weighted isometrics. One can also apply a small volume of heavy weights prior to exercise to achieve a toning effect of the motor apparatus which will yield an increase in both speed and strength (Siff, 2003) while reducing the amount of time necessary to achieve peak force (Verkhoshansky 1977). And for one final example, a moderate volume of barbell work can even help potential work done within the 24-28 hours as it will have a toning effect on the motor apparatus (Ozolin, 1971). The important thing to remember with any of the active potential methods is that too much volume will ruin the effect as it will generate fatigue. Also, it is equally important that enough rest be between the potential exercise and the work it is meant to potential in order to see the full effect.

Passive potential methods are different from active methods in that they are mostly mental in nature or focus on recovery in between bouts of work. For use immediately prior to a work set, self talk or visualization can increase motor unit recruitment and have them fire at an increased rate (Siff, 2003). Mental state plays a large role in force production and strong positive emotions can greatly enhance

muscular contractions (Siff, 2003). On a different note, laying a cold compress on the abdomen in between sets has been shown to improve performance (Vorobyev, 1978).

Resources

The following is a list of useful books and websites that will help to get a better grasp on all things sports training related. They are in no particular order, though books will be posted first.

Books

“Supertraining” by Mel Siff

Perhaps the single greatest book ever written on the topic of sport and training.

“Exercise Physiology: Human Bioenergetics and Its Applications” by George Brooks

A great and very thorough work on exercise physiology.

“Science and Practice of Strength Training” by Vladimir Zatsiorsky

A must-have for coaches and athletes alike. Lots of information on programming.

“The Sports Book: Best Training Ever” by Dietrich Buchenholz (aka Brad Nuttall)

An E-book that redefined the way I and many other people view training and its components.

“Running: Biomechanics and Exercise Physiology in Practice” by Frans Bosch and Ronal Klomp

A great piece of work that really breaks down sprinting form, even if the programming info is suspect.

Websites

higher-faster-sports.com

Kelly Baggett does a great job simplifying all things training related through his articles.

charliefrancis.com

Home of sprint coach Charlie Francis. The forums have some extremely smart people who are

willing to help.

wannagetfast.com

A wealth of free information provided by all around great coaches Chris Korfist and Dan Fichter.

elitetrack.com

Another T&F site. Ran by Mike Young, this site has a number of good articles along with discussion.

<http://www.iaaf.org/development/studies/archive/index.html>

The archives of the IAAF's NSA journal. Enough articles to keep one reading for years.

inno-sport.net

Home of the Inno-Sport system. Though the site is dead, there are a lot of good articles.

References

- Anderson JL, Aagaard P (2000) Myosin heavy chain IIX overshoot in human skeletal muscle *Muscle Nerve* July, 23(7): 1095-104
- Anderson JL, Schjerling P, Saltin B (2000) Muscle, Genes and Athletic Performance *Scientific American* September, 283(3): 48-55
- Brooks GA, Fahey TD, White TP (1996) *Exercise Physiology: Human Bioenergetics and Its Applications* Mayfield
- Dursenev L, Raevsky L (1978) Strength training of jumpers *Teoriya I praktika Fizescheskoi Kultury* 4: 56-57
- Hakkinen K (1985) Factors influencing trainability of muscular strength during short term and prolonged training *National Strength and Conditioning Journal* 7(2): 32-36
- Hubley CL, Wells RP (1983) A work-energy approach to determine individual joint contributions to vertical jump performance *Eur J Appl Physiol Occup Physiol* 50(2): 247-254
- Kubo K, Ohgo K, Takeishi R, Yoshinaga K, Tsunoda N, Kanehisa H, Fukunaga T (2006) Effects of isometric training at different knee angles on the muscle-tendon complex in vivo *Scand J Med Sci Sports* June;16(3): 159-167
- Locatelli E (1996) The importance of anaerobic glycolysis and stiffness in the sprints (60, 100 and 200 meters) *IAAF Quarterly: New Studies in Athletics* 11(2-3): 121-125
- Ozolin N, (1971) *Athletes training system for competition* Fizkultura I Sport Publ, Moscow
- Perrine J, Edgerton V (1978) Muscule force-velocity and power-velocity relationships under isokinetic loading *Med & Sci in Sports* 10: 159-166
- Roberts TDM (1976) The role of vestibular and neck receptors in locomotion *Neural control of locomotion*)pp. 539-560)
- Roy RR, Baldwin KM, Edgerton VR (1991) The plasticity of Skeletal Muscle: Effects of Neuromuscular Activity *Exercise Sport Science Reviews* 19: 269-312
- Siff MC (2003) *Supertraining* Supertraining Institute
- Siff MC, Verkhoshansky YV (1999) *Supertraining 4th Ed.* Supertraining International, Denver
- Verkhoshansky YV, (1977) *Fundamentals of Special Strength Training in Sport* Fizkultura I Sport Publ, Moscow
- Verkhoshansky YV, (1996) Quickness and velocity in sports movements *IAAF Quarterly: New Studies in Athletics* 11(2-3): 29-37

Vorobyev A (1978) *A Textbook on Weightlifting* International Weightlifting Federation, Budapest

Young WB, Behm DB (2003) Effects of running, static stretching and practice jumps on explosive force production and jumping performance *J Sports Med Phys Fitness* March;43(1): 21-27

Zatsiorsky YM (1995) *Science and Practice of Strength Training* Human Kinetics