

## Five steps to increasing the effectiveness of your strength training program

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Overtraining and periodization seem to be the hottest topics today in the field of strength training. In the past, football has borrowed from the iron game most of its training methods. Not too long ago, and probably still today, the over-zealous coach wanting it all would design a program made up of the Bulgarian pulling cycle, Bill Kazmaier's bench press routine, and Arnold Schwarzenegger's "Blitz Your Biceps Training Secrets." Then came the concept of periodization with its percentages progression, the classic heavy, light, medium schedule, and so on, which reduces the probability of overtraining. However, the present field of strength training has progressed tremendously over the last few years and can offer a lot more to the design of a better strength training program.

The goal of this article is to present to the football strength coach five steps to increase the effectiveness of the training program he or she prescribes by solving the following problems:

- The "wanting it all" syndrome
- The "general strength vs specificity" debate
- Undertraining vs overtraining

### Alternate accumulation phases with intensification phases

In order to force the neuromuscular system to adapt to the training load, it is of the utmost importance to plan variations in both volume and intensity of the load (5). One must note that strength training programs lose their efficiency after *only two weeks* since the body adapts very rapidly to

the stress of training loads (22, 31).

Few people realize that in order to maintain increases in maximal neural activation the training intensities must be periodically varied and/or kept at progressively increasing levels if the neuro-muscular system is allowed to adapt to constant training loads. That is, if the stimulus is always presented to the body in exactly the same way, its efficiency will diminish. Unfortunately in North America, very few strength coaches are aware of this fact. This is why the programs they prescribe produce much less than optimal results. In order to obtain optimal progress, phases of high volume (a.k.a. accumulation, extensive loading), phases of high intensity (a.k.a. intensification, intensive loading), and unloading phases must be alternated.

A common mistake seen in strength training programs for football is linear intensification, that is, moving ever increasing intensities. For example, the athlete will go through a progression of monthly blocks, illustrated in **Table 1**. In this manner the intensity will move in a

linear fashion to respectively 75, 85, 90, 95 percent maximum. A few problems arise with this form of training:

- The intensity is continuously climbing up, creating ever increasing levels of stress, therefore allowing very little time for regeneration.
- The hypertrophy gained through the first month of training is hardly maintained in periods where sets of five repetitions and fewer are performed, since volume is a prerequisite for optimal muscle mass increases.

**Table 2** offers an alternative solution where both the volume and the intensity are changed in an undulatory fashion. In this manner the volume decreases at a much slower rate while intensity is building up in a more gradual fashion. The phases are much shorter allowing for a more frequent change of stimulus which is highly inductive to strength gains. Varying this system by alternating the stressors through volume and intensity is quite popular with weightlifting coaches of Eastern Europe, West

**Table 1. Standard linear intensification of training in strength development**

Weeks	1-4	5-8	9-12	13-16
Reps	10	5	3	2
Sets	5	3	3	3
Intensity	75%	85%	90%	95%
Volume (total reps)	50	15	9	6

**Table 2: Alternating accumulation and intensification phases for strength development**

Weeks	1-2	3-4	5-6	7-8	8-10	11-12
Reps	10-12	4-6	8-10	3-5	5-7	2-3
Sets	3	5	4	5	4	6
Intensity	70-75%	82-88%	75-78%	85-90%	80-85%	90-95%
Volume (total reps)	30-36	20-30	32-40	15-25	20-28	12-18

Germany and Canada. Ben Johnson, world record holder in the 100 meter sprint, is another proponent of this system.

Since linear overloading is hardly advisable to the athlete, the undulatory approach should offer a more rewarding alternative (2, 27). According to Schmidtbleicher (36), one reaches his strength potential faster if methods favoring the development of muscle mass are used first, followed afterwards by methods favoring motor-unit activation enhancement (increased recruiting and firing rate of motor units, i.e. nervous system training).

One must force adaptation of the neuromuscular system through volume (accumulation phase) and then stimulate it through intensity (intensification phase). This form of training variety eliminates the physiological and psychological causes of progress stagnation caused by an overemphasized specialization on volume or intensity. In this manner strength and muscle mass can be built at higher and faster rates.

#### Vary the form of muscular contraction

Variety in strength training is a critical factor in maximizing training response, but, unfortunately, it is likely to be the most overlooked of the training principles. Gains in strength come about faster if the athlete utilizes many types of contractions instead of only one (29, 42). Soviet National Weightlifting Coach A.K. Worobjow (41) recommends the following proportion between the different types of contractions for optimal strength development: 70 percent concentric, 20 percent eccentric, 10

percent isometric. Eccentric training allows one to reach the highest levels of muscular tension possible (19) which in return favors greatly the development of hypertrophy and strength (14, 20). It has been shown many times over that different combinations of concentric and eccentric training increased maximal strength faster than if concentric training is used alone (13, 29).

Eccentric training offers the following advantages:

- It can induce more strength and muscle mass gains than concentric or isometric methods alone, because of the highest levels of muscle tension associated with this method, thereby allowing athletes to break through strength gain plateaus.
- Fast eccentric work (e.g. plyometrics) make force-time curves shift to the left, resulting in higher rates of force development.
- Because of the very high loads involved in eccentric methods, like in maximal weights methods, there is an impact not only on the muscle but also on the nervous system.

Eccentric training can take various forms, including:

A typical eccentric workout for an *accumulation* phase could follow this loading pattern:

110 to 120% 4 to 6 sets,  
4 to 6 reps rest intervals 4 to 5  
minutes between sets.  
slow tempo of execution (8 to 10 seconds per lowering)

An intensification phase eccentric workout could take the following form:

125%, 132.5%, 140% 3 to 6 sets,  
3 3 2 to 3  
tempo of execution moderate (3 to 5 seconds per lowering)

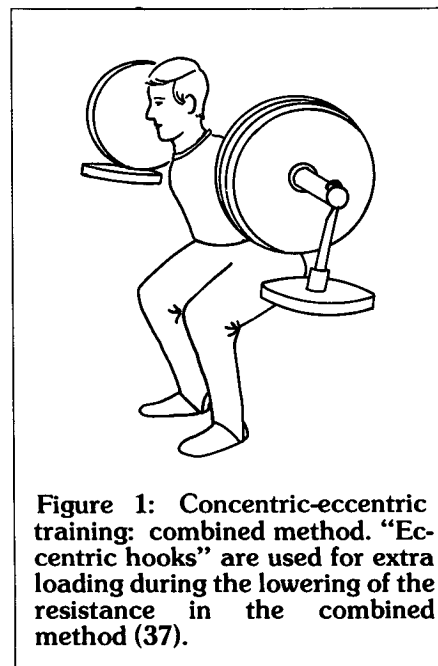
- Use specially designed equipment to increase the eccentric loading (see Figure 1).

- At the end of a conventional concentric 4 to 6 RM set at 80 to 82 percent, additional eccentric work can be performed by adding 25 to 30 percent extra weight to the concentric training poundage on the barbell and performing additional eccentric-only repetitions. As an alternative, a training partner can manually apply resistance (i.e. push down on the bar) for the eccentric portion instead of adding weight. These additional negative repetitions will exhaust eccentric strength levels after achieving concentric muscular failure. This method applies more to an accumulation phase where strength gains through hypertrophy are desired.

It is vital that the athlete can control the descent of the resistance selected, or injury can occur.

Even though eccentric training shows great potential for strength improvement, it has a few disadvantages:

- Athletes should begin eccentric work only after one to two years of a solid base in strength training.
- Due to the high levels of muscle soreness experienced with this type of training, training frequency with this method is limited to once every seven to 10 days. Eccentric can increase the probability of overtraining



**Figure 1: Concentric-eccentric training: combined method. "Eccentric hooks" are used for extra loading during the lowering of the resistance in the combined method (37).**

and should therefore be used sparingly. Use is not recommended during your competitive season since it severely hampers your recovery time.

- Slow eccentric training has been associated with a reduction in the rate of force development (14), suggesting it should be used mainly in the preparatory period (off-season), while fast eccentric training (plyometrics) should be reserved for the competitive (pre- and in-season) period.

- It requires in most instances the help of one to two partners or special equipment to move the resistance in the concentric range. Eccentric training can therefore be hazardous during certain weight training exercises (e.g. squats, if the spotters are not properly trained).

Isometric contractions are more specific to sports like wrestling and gymnastics than football, but nonetheless can be used to break through strength gain plateaus in the key lifts you prescribe. Since 10 to 15 percent higher levels of force can be produced in isometric contractions, this form of work can be periodically used to favor growth of strength levels. You can implement isometric work in the following forms:

- By doing a functional isometric contraction after pre-fatiguing the muscle with four to six partial repetitions. A power rack is needed with this method. After a regular warm-up choose a weight that you can move from one set of pins to another, for example, from midpoint to six inches before lockout in bench press (see **Figure 2**). Perform 4 to 6 RM and at the end of the last concentric repetition, contract isometrically with maximal tension against the top pins for a count of six to eight seconds (see **Figure 2**). Lower the barbell, and attempt another repetition. If you can

perform another repetition, the resistance selected was too light.

- Isometric work can be used to prolong the intensity and duration of a conventional set carried to concentric muscular failure. For example, an athlete has just completed the last concentric portion of a 6 RM set of barbell curls. He lowers the barbell 30 degrees, stops for a count of eight seconds and repeats the process at two other angles. In this manner, he achieves greater fatigue than with a conventional set.

- Isometric stops can be incorporated in the dynamic range of a movement. For example, six second holds can be incorporated at various points in a clean pull: two inches off the floor, below knee, mid-thigh.

- Functional isometric contractions can be performed at various points in the range of motion to work on specific points of the force curve.

#### **Work all aspects of the force-velocity curve**

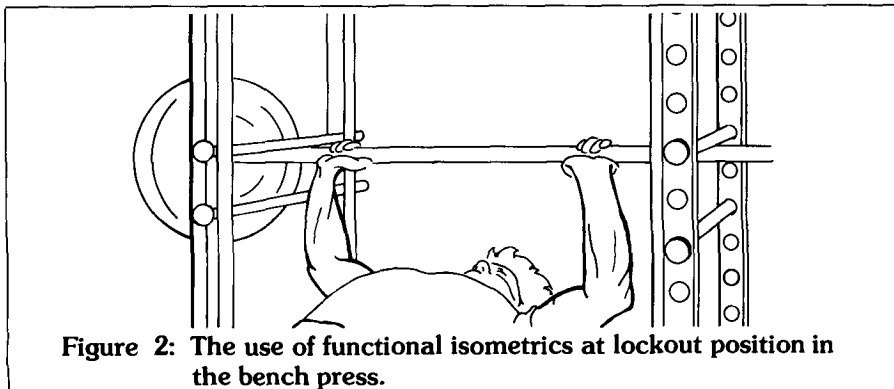
In North America there are conflicting schools of thought on the optimal speed at which strength work should be performed. One school advocates high velocity training, while another contends that strength gains can optimally be gained through only slowly performed repetitions. However, both schools are correct. Muscles gain faster in strength if trained at various speeds, than if always trained at the same speed (3, 41) (see **Figure 3**). Furthermore, one should realize that speed of contraction has a specific training effect on the neuromuscular system. Training at slow speeds has a definite advantage over high speed lifting for the development of maximal strength (1, 6). Moving high loads at slow speeds eliminates the use of momentum to lift the resist-

ance. Slowing down the movement (three to 10 seconds for each eccentric phase) augments both the duration of the stimulus and the levels of tension imposed on the muscle, thus favoring a faster development of strength and muscle mass. When training at slow speeds, no more than 60 seconds of work should be done per set. For example, if one has slowed down the speed of the movement to the point where it takes six seconds for each concentric and each eccentric portion of the lifting, no more than five repetitions per set should be performed (5 X (6 seconds concentric + 6 seconds eccentric) = 60 seconds). Training at slow speeds raises the force time curve, while training at high speeds shifts it to the left (see **Figure 4**) (35, 13, 15, 38). Therefore, training explosively with lighter loads does not produce high increases in strength but, on the other hand, is highly beneficial to train the nervous system, resulting in a positive adaptation of the rate of force development (see **Figure 4**). Emphasizing the early part of force development is done for the following reasons: (a) it is advantageous in terms of synchronization; and (b) it is also relevant for practical purposes, because the actual time available for muscles to contract in normal movements and in athletic activities is very short (21).

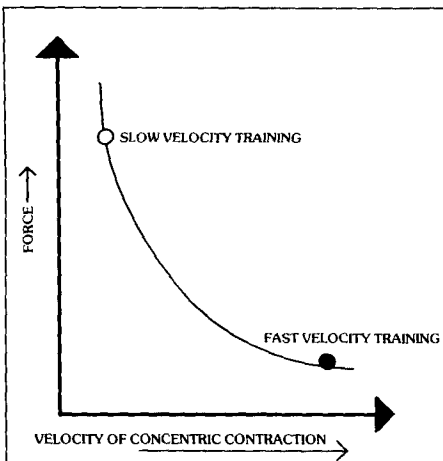
As shown in **Figure 3**, a slow velocity of execution is associated with the production of high forces. In contrast, high velocity movements favor high levels of neuromuscular output. It is therefore apparent that the resistance which is light enough for power training is not heavy enough for strength training (24).

For the first year of an athlete's strength training, European weightlifting coaches recommend the use of slow (30° per second) to moderate (60° per second) tempos of execution.

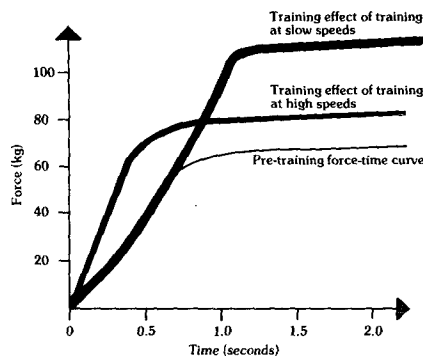
While strength training at high speeds is specific to movements done in football, it must be done only after obtaining a solid base of maximal strength. The latter can best be obtained through slow movements, hence, the utility of varying the speed of contraction to improve the athlete's performance. Movements in the general preparatory phase should



**Figure 2: The use of functional isometrics at lockout position in the bench press.**



**Figure 3: Low velocity training for high velocity performance. Schematic force-velocity relation for concentric contraction is shown.**



**Figure 4: The training effects of high speed training and low speed training on the force-time curve (36).**

therefore be of moderate to slow tempo and with a variety of types of contraction. A gradual speeding up of the movements as the competitive season approaches should also occur. Movements in the competitive season are to be of high velocities to train the nervous system specifically. **Table 3** illustrates how the use of various training speeds and contraction types can be implemented in your training program.

**Use a wide selection of exercises.**

Changing the nature and form of the exercise is another way to gain strength faster while eliminating boredom. Varying only the volume and the intensity in your strength training program is not enough to achieve optimal results. The order of recruitment of motor units is fixed for a muscle while performing a given movement even if the rate of force development and speed of contraction change (8). However in the case of a change in position (28) or in the case of a multi-functional muscle accomplishing different movements (8, 11, 34) the order of recruitment is changed. Certain motor units within a muscle have a low recruitment threshold for exercise X and a high recruitment threshold for exercise Y. This variation in recruitment order according to movement pattern may be partially responsible for the specificity of training that has been observed (33) and may support the notion long held by strength training practitioners that full development of a muscle is possible only when all its possible movements are trained (32). There is a wide variety of strength training exercises available to the strength coach. Exercises that strengthen the hip and knee extensors, which are greatly involved in football, can be done with various training implements (olympic bars, dumbbells, trap bar, iron circle, or machines). Furthermore, starting positions for certain exercises can be changed. In the case of the lineman doing clean pulls to improve his hip and knee extension power, they can be done on a podium, from the floor, from the blocks, from the hang, from mid-thigh, etc. **Table 3** illustrates how exercises can be varied to train the hip and knee extensors. Partial range of movement work is an excellent form of training which is, without a doubt,

Phase Exercises	Sets/Reps	Speed of Contraction	Comments
G.C.S. Dumbbell deadlifts	3/15-20	Moderate	Stop and go
Hack squats	3/15-20	Moderate	
Acc 1 Trap bar deadlifts	4/8-10	Moderate	Stand on a 4' block Raise heels 3"
Heels elevated back squats	4/8-10	Moderate	
Int 1 Snatch deadlift on podium	4/5-6	Super slow	5-6 seconds to raise and lower the weight
Front squats	4/5-6	Super slow	
Acc 2 Stiff-legged deadlift	3/10-12	Moderate	Stand on a bench Two second pause at sticking point
Power squats	3/8-10	Moderate	
Int 2 Sequence deadlifts	9*/3-5	Moderate	* 3 sets each at these starting positions: floor below knee, mid-thigh. 8 seconds to lower the bar, up explosively.
Front squats	6/2-3	Varied	
Acc 3 Hang clean pulls	5/5-6	Fast	Explode from hang position. Alternate sets of normal work with sets of pure eccentric work
Back squats	6/5-6	Varied	
Int 3 Snatch pulls	9*/1-3	Explosive	Perform the sets in a wave form of loading. (3, 2, 1, 3, 2, 1, 3, 2, 1). Set bar at sticking point, and squat up
Front squats in power rack	5/2-3	Moderate	
Acc 4 Power cleans	5/3-5	Explosive	Use 5,3,5,3,5 loading pattern
Speed squats	3/8-10	Explosive	
Int 4 Speed cleans	6/2-3	Explosive	Explosive
Speed halfsquats	4/5-7	Explosive	

**Legend:**  
G.C.S.: General conditioning stage  
Acc: Accumulation phase  
Int: Intensification phase

**Comments:**  
Both intensity and volume move in an undulatory fashion.  
Speed of contraction is slow in the beginning of the cycle to favor the growth of maximal strength, the speed of contraction gradually picks up to train speed-strength.  
The range of motion is gradually reduced to the specific angles used in football.

**Table 3: An eighteen-week program to develop the strength and power of hip and knee extensors in the general preparatory phase. Every phase has a duration of only two weeks.**

not used enough. For example, strength and conditioning coaches are well aware of the fact that tremendous amounts of weight can be handled in the lockout position of pressing and squatting exercises. The resistance needed to perform full range exercises is not sufficient to overload these strong points in the strength curve, hence, the usefulness of power rack training. With the power rack, one can select specific parts of the range of motion and use optimal loads for those specific ranges of motion. Blocks of various heights can be used for performing the many varieties of the olympic lifts.

Changing the diameter of the grip can be a challenging training stimulus. Try doing chins or curls with over-size bars for a new kind of training effect for the elbow flexors. Tape, foam, plastic pipe or a combination of these can be used to thicken your bars.

Varying the exercises using the above methods will also have another positive effect on athletic performance—insuring that the athlete is strong in all planes of movement. Often the athlete is overconcerned about having a “Big Bench.” So what? Instead, why not be good in all forms of presses and have a shoulder structure that can apply force at any angle? In this manner he will probably attain the “Big Bench” faster. The benefits of such training to injury prevention is obvious.

As demonstrated, there is a wide choice of methods by which variety can be introduced into strength training workouts. Since training response is the result of the disruption created by the training stress, it seems only logical to prescribe, with as much variety as possible, disruption in order to stimulate supercompensation processes. In addition to eliminating boredom from your strength training workouts, the implementation of variety in your workouts maximizes progress.

### **Forget about percentages**

Often strength training programs are built using a system where various percentages of maximum are used. This method has serious drawbacks:

- Strength varies 10 to 20 percent over the course of a single day (39).

Therefore if you tested the 1 RM at 5:00 P.M., the percentage for training at 11:00 A.M. might be totally inappropriate.

- Even though the relationship between the 1 RM and submaximal loads has been established with a fair degree of precision, individual differences due to neural factors and fiber typing can deviate greatly. For instance, while most individuals usually perform 11 to 12 repetitions at 70 percent of 1 RM, one individual on the Canadian National Judo Team could perform 24 repetitions at this percentage.

- The percentage relationship between the maximum and submaximal repetitions is different from one muscle to another (17). For example, at 60 percent of maximum, 40 repetitions can be performed on the leg press, while only 11 can be done on the leg curls (30).

- Percentages don't allow for individual training responses. Some gifted individuals respond quickly to strength training programs and might be undertrained with fixed percentages, while other individuals can be overstressed with these percentages. This latter type of individual might be tempted into cheating to complete the prescribed number of repetitions at a given percentage to keep up with his peers. Furthermore, if he doesn't cheat, he might be discouraged since he cannot keep up with his teammates. Different recovery abilities between athletes are also an important factor. What then is the alternative? Actual repetitions performed should dictate the load, not vice versa. Use an intensity zone spread that is controlled by a fixed amount of repetitions.

Let's say your athletes are in a phase where they are working in a four to six repetitions range. If your athlete can perform seven or more reps, the weight is obviously too light and should be upgraded. Remember, there is nothing wrong with getting strong. If your athlete can do three repetitions or less during the same phase, the weight is obviously too heavy and should be reduced for the following set. In this manner you will at least control the duration of the stimulus imposed upon the muscle, and, since the intensity of the contraction is inversely proportionate to the

duration of the stimulus, you will have a good idea of the intensity at which your athletes are working. Furthermore, providing that multiple sets per exercise are performed, you will be able to individualize the optimal resistance for every athlete for that particular day. In this fashion, factors such as time of day, affecting the expression of maximal strength, will be taken into account in your training program.

Another point: in addition to having your athletes fill out an individual training diary, have them fill a training station diary; that is, a log at each individual station. This will allow you, at a glance, to assess the effectiveness of your program, since you will be able to compare the athlete not only against himself but against others.

The proponents of the percentage method will argue that it prevents overtraining. On the other hand, why perform five sets of five reps at 70 percent if you can in fact perform 12 reps at this percentage? If you are concerned with overtraining, cut back on the amount of sets and/or exercises. Your body is well equipped to protect itself against intensity of work, but not against volume of work. If the set is not a warm-up set, why waste it?

### **Conclusion**

As you can see there are many ways one can vary workouts in a logical and progressive manner which will allow the athlete to develop the physical qualities required in football. The only person who can train it all at the same time happens to be a journalist during the day time, at night he can fly over stadiums wearing a blue suit and a red cape and the only way he can overtrain is if he lifts with barbells made of Kryptonite. Remember that the program outlined is only an example. It is up to you to design a program for your athletes while considering all the factors which affect program design: training age, equipment, recovery time, etc. Progress in strength training, being regulated by various loading norms expressed in numbers is fairly easy to quantify, as opposed to progress in gymnastics or other sports. A program is only a map to tell you where to go; if roads are blocked because of a flood you would use an alternative route. Variety can do wonders for your program

if your athletes would agree to swim in a shark infested sea with an open wound than face another boring workout.

As the saying goes, variety is the spice of life! There is no reason not to add a little spice to your training program. Don't be afraid of being an innovator. Don't train to train, train to win. ●

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