Let's Talk Training #1:

Sets and repetitions

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This first of five articles covers terms used in strength training and an introduction to the rationale behind basic strength training programs.

Repetitions: the number of times an exercise is done without resting during one set. If the athlete does ten pushups, he or she has done ten repetitions. If this same athlete lifts 200 pounds in the bench twice, then he has done two repetitions with 200 pounds. For practical reasons repetitions are often abbreviated as reps.

Set: the completion of one exercise activity or the number of repetitions performed consecutively without resting. If the athlete lifts 200 pounds in the bench for six reps, takes a short rest, does another six reps and then does another six reps he has done three sets--to be exact, three sets of six reps. If he does four reps five times, always with a little rest between sets, he has done five sets of four reps.

Repetition Maximum: the maximal load that an athlete can lift over a given number of repetitions before fatiguing. For practical reasons it is abbreviated RM. This becomes very important when writing your workouts or reading another coach's workout. 1RM means the maximal load the athlete can lift for one repetition. 5RM means the heaviest load that can be lifted five times in succession. In other words, it is an all-out effort. More on this subject in the next issue when we will be dealing with intensity.

Volume: basically “how many.” It is related to sets and reps, not “how heavy.” A high volume workout means a lot of sets and reps, a low volume workout means a few sets and reps.

Specificity: physical conditioning for any sport should match the physiological demands of the activity. In other words, when training either on or off the field, train specifically how you are going to perform in the game or event. Strength development is known to be highly specific. Training exercises should duplicate the same mix of factors required in the desired final performance. For this reason isometric training would be wrong for basketball as would 1RM squat for cross country.

If the activity requires muscle endurance, the athlete should use sets and reps that will lead to improved muscle endurance. If muscle power is needed in the activity, muscular power should be trained. Research shows that if two training systems are emphasized simultaneously (e.g. muscle strength and endurance) the quality of the results expected of either or both may be inhibited. This does not mean that if the final result is muscular power, the athlete should not do some muscle endurance.

Editor's Note:

Much confusion lies in the development of strength and conditioning programs. A great deal of this is due to the wide variety of training variables and their diverse effects on athletes. This series of five articles will attempt to define these variables and explain their relationship to overall training programs.

Future issues will deal with intensity, choice and order of exercise, rest and recuperation, and peaking.

Program design is an art form with basis in scientific knowledge. It is important to realize that each athlete is an individual and responds to training in his/her own individual way.

As a strength and conditioning coach you should know the principles of program design, the specific type of conditioning best suited for the sport trained for, but most important, you should understand the training response of each of your individual athletes. In this way optimal performance can be realized.

We hope this series enlightens your awareness of the principles of program design as the author “talks training” to you.
Muscular Endurance: the ability of the muscle to perform work by continuing to raise and lower a submaximum load. For endurance training it is necessary to increase considerably the number of times the muscle will contract against a resistance. Most sports require muscular power-strength vs. muscular endurance. Muscular endurance training is very important for sports like wrestling, cross country, and swimming (long distance). When dealing with sports that require power-strength, muscular endurance is very important early in the cycle when a "base" needs to be built. When the athlete has developed a strong "base" then he can be more "specific" in his training.

The coach must remember that the progressive overload principle (more in next issue) is also a requisite for improvement of muscular endurance. Prolonged repetitions of "underloaded" muscle has little effect on muscular endurance. The weight must be heavy enough to give sufficient stimulation. As an example, it is better to do 100 pounds for 15 reps than 80 pounds for 25 reps. When training, the athlete should try to increase the load (weight) while maintaining the repetitions between 10 and 15.

The coach should remember that when training for muscular endurance, strength will also be gained to a certain extent. The stronger the athlete the better, even when training for muscular endurance.

Muscular Power: the ability to release muscular force in the shortest time. Power is the result of strength and speed and is the most obvious characteristic of a highly successful athlete. Power can be changed by alternating either the strength or speed components. If the athlete gets stronger he will be able to generate more power. If his limb speed improves (arms, legs, hips, etc.) his power output will be greater. The goal of all coaches should be to make workouts that will lead to maximum power output by the athlete.

Studies have shown that olympic-style lifts produce the highest power output of any human movement measured to date. In these lifts the athlete has to move the weight quickly to complete the lift. Because of the weight used and speed of the movement the athlete can generate great power. These type of lifts (power cleans, power pull, hang cleans, snatch, jerks or push presses) should be included in workouts along with the basic strength exercises like squats, benches, inclines, dumbbells, etc.

A power-strength program involves fewer exercises, heavier weight loads, fewer sets, fewer repetitions and longer recovery intervals than does a size oriented program (e.g. body building). I was not able to find scientific proof, but it seems as the athlete trains for physical power on and off the field, he loses inhibition against exerting power. In other words, if the athlete does explosive, quick, maximum effort exercises or drills in training, he will be able to be more "powerful" in the playing field.

Hypertrophy: the enlargement of muscle that results from weight training. For years this was attributed solely to an increase in the diameter of the muscle fiber (hypertrophy). Now there is some conflicting evidence that shows that increases in strength can be also due to an increase in the number of fibers (hyperplasia).

When training for power-strength related sports, muscle hypertrophy should be a by-product. It will happen anyway, therefore, the coach should not make specific workouts just to increase muscle size. There is a big difference between power-strength training and the "bodybuilder" (size-oriented) type training. Just having "big muscles" does not necessarily
mean power-strength. Significant increases in strength are not always accompanied by significant increases in muscle size. In the early stages of training, significant increases in muscle size occur. After a certain amount of strength has been developed, further strength increases can yield much smaller gains in muscular size.

In certain situations when an athlete has to gain weight (muscle mass only, not fat) he will have to do some hypertrophy training just to gain that extra muscle mass needed. This can best be done by first doing his "regular" power-strength workouts and then doing extra work using more sets and reps. Auxiliary exercises like triceps, chest, leg extension, leg curls, etc. should be done for three to four sets of eight to ten reps.

In other situations, a coach may want gains in strength with limited increases in muscle size. (This is especially true with receivers, sprinters, wrestlers, etc.) You do not want a "bulky" 200 pound receiver, you want a strong powerful receiver who is not carrying too much weight even if it is muscle. There is a fine line here, and it is up to the coach to monitor the situation.

**Periodization:** the scheduled organization of the structure of the entire training process over a prolonged period. For our situation, the prolonged period is one year, from the end of one season to the end of the next. When making workouts, the coach should have a "plan of attack" with specific goals and the proper method to attain these goals. The year should be divided into three parts: off-season, pre-season and in-season.

**Off-Season:** this time of the year should be an "active rest" where the athlete does non-specific training, just enough to stay in shape. It is a great time to take care of injuries or strengthen any weakness or muscle imbalance. For the athlete who has to gain muscle mass, he can do a lot of "pump" work. A lot of muscle endurance should be done using sets and reps like 3x10, 3x12, 4x8, etc. Most of the work should be "physical" with little time spent in the actual technique of the sport (e.g. a linebacker doing tackling drills). This is the time to stay away from the sport and just work on strength, flexibility, speed, etc.

**Pre-Season:** this period is very important because what is done here carries over into the season. The athlete will spend a lot of time in the weight room. Be specific as to what you need: power-strength or endurance. If power is what you want then make sure you train properly by doing the right lifts, proper sets, reps and intensity. By the end of the pre-season the athlete should be at his best.

**In-Season:** at this time, the athlete should not spend as much time in the weight room as he did in the pre-season. Because of lack of time he will try to "maintain" his strength. The program should be similar to what was done in the pre-season as far as sets and reps goes. If power-strength is needed then 3x3, 3x4, 4x2 or any similar combination can be used. It is very important to continue lifting because studies show that most training benefits are lost within a relatively short period of time after training has stopped.

**Routine Variety:** one of the chief problems of strength training is simply to maintain the enthusiasm of the trainee so that he or she does not drop out of the program. A poorly designed strength program can be boring. If the athlete has to do the same exercises, same number of sets and reps over and over again, he will lose interest. Variety is very important. This does not mean doing sets and reps to train strength one day and endurance the next. No, you should stay specific to what you need, but put some variation in it.

For example, if the pre-season is twelve weeks long and the athlete is training for power, the workout should not be 5x5 in each lift for the whole twelve weeks. You might want to go 5x5 for four weeks, then do 3x3 for the next four weeks and the last four weeks do some doubles and singles.

If the same sets and reps are carried for too long a period, it will no longer show a good training effect. When this occurs it means that the body is no longer stimulated by the workout (e.g. plateau--more on this subject in the next issues):