Functional isometric lifting--Part I: theory

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Biomechanically speaking, strength is the effective force output of the muscular system. In terms of athletic conditioning, strength can objectively be categorized as dynamic base strength, power and muscular endurance. Dynamic base strength may be viewed as the application of muscular force in the execution of the bench press, squat or deadlift using 85 percent of the 1RM or greater for a given number of repetitions and sets. This type of strength is the foundation upon which power is eventually developed. Power is the combination of strength and speed through a full range of multiple body joint movement (e.g. power snatch and clean), and is the best expression of athletic type strength. Strength endurance is the ability of muscles to exert tension for a length of time or a number of repetitions.

Frequently, the terms of strength and power are thought of as synonymous, but they are not. Power is the amount of work that can be accomplished in a unit of time and is expressed as:

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\text{Power} = \text{Force} \times \text{Velocity}
\]

In throwing the shot for example, one can view power as the muscular strength generated by the body's so-called "power zone" (i.e. the strength generated by the thighs, hips, buttocks, abdominals, and lower back), plus the upper torso multiplied by the speed of the limbs as they move through the full range of the throwing movement.

The athlete who wants to develop high velocity power needs to emphasize both strength and speed development in training. To accomplish this, athletic strength training programs are generally based upon the periodization concept in which the training emphasis is divided into five phases. These are the 1) conditioning phase, 2) base strength phase, 3) strength and power phase, 4) competitive phase, and 5) active rest. Considered to be the most scientific approach to athletic training and conditioning, periodization assures continuous long-term progress while avoiding the pitfalls of a hit-and-miss program.

There are no doubts that through periodization, athletic type weight training produces superior strength and power gains. However, two critical questions may be asked. First, are these strength gains maximal? And, second, can strength development be accelerated without the danger of overtraining? As shall be seen, the answer to the first question is "no," and to the last one a definite "yes."

In order to maximize strength gains, the athlete's psychological and physiological systems must be periodically subjected to the shock of extreme training overload. The neuromuscular, sensory, and endocrine systems act together in producing performance. All three respond and adapt to the quality of the training stress. Optimal strength gains seem to occur when these systems are exposed to short-term, high-intensity workouts.

One method of strength training that can provide the necessary shock of extreme overload and greatly contribute to accelerating strength gains is functional isometric (FI) weight lifting. Recent research relating to FI seems to indicate that this type of training can have a significant influence on increasing dynamic strength (7, 10). In the past, athletes utilizing FI in their training programs have experienced substantial strength gains, but for unknown reasons little has been written about this in recent times.
Functional Isometric (FI) Concept

To accelerate the development of strength and power in olympic lifters, the concept of FI weight training was first suggested by Hoffman in 1962 (6). O'Shea in 1969 (11), described FI as a highly advanced method of strength training which could thrust the athlete toward his upper physiological and psychological strength limits.

Functional isometric lifting is a hybrid of dynamic and static muscle contraction. Utilizing an explosive-reactive-ballistic movement, FI places extreme demands on the neuropsychological system. It also stresses utilization of stored kinetic energy required in generating a powerful ballistic movement in the large muscle groups of the body's power zone. A ballistic impulse is what initiates the drive for the press, snatch, clean, squat, and all throwing and jumping movements.

Functional Isometric Lifting Technique

A FI lift is a two-phase movement consisting of both dynamic and static muscle contraction. FI training requires the use of a power rack with pins placed two inches above the support on which the barbell is resting. This distance allows for a limited range of movement. In executing a FI lift (press, pull, squat), the lifter carefully assumes a starting position that provides for the most effective line of force for pushing or pulling (Figure 6). Once in proper lifting position, the lifter generates an explosive ballistic impulse and drives the bar upward to the pins (the dynamic or isotonic phase), then presses it tightly against them for three seconds (the static or isometric phase - Figure 7). Close attention must be given to having the bar pressing solid against the pins and not cornered between the pins and the upright supports of the power rack.

Functional isometric lifting involves much more than brute strength. When utilizing mechanically correct FI lifting technique, there is a delicate balance involved in driving and holding the bar in a free, tight position against the pins that challenges and trains the muscle sensory system. This can have significant transfer value to dynamic free lifting, where the application of correctly directed forces is crucial as in squatting, power snatch ing and cleaning, and also, to all throwing movements.

Dangers of Functional Isometrics

As an advanced method of strength training, FI is not suitable for the untrained athlete. It must always be approached with caution to avoid injury to joints and the lower back. When FI lifting, it is extremely important to utilize good technique to avoid back strains. In pressing, pulling or squatting, strive to maintain a tight body throughout the lift. During the static phase of the press, avoid excessive hyperextension of the lower back. Otherwise, the lifter is in danger of compressing the lumbar vertebrae. Throughout the FI pull or squat, do not round the back at any time. A rounded back during the static phase generates a tremendous stress in the lower lumbar region at L4 and L5. Potentially this can be dangerous. Then training with heavy FI loads, take the precaution of wearing a belt and knee wraps.

Neuropsychological Aspects of FI Training

The neuropsychological aspects of training embrace both physiological and psychological factors which together set our strength limits. Although it is futile to attempt to make a clear distinction between the two, since both operate in the same nervous system, it is nonetheless helpful to attempt to separate them in our thinking. Physiological factors set the relatively fixed and outermost limits of strength; psychological factors the more proximate ones. In this context, it is appropriate to speak of the psychological limits of strength. While the physiological limits of strength are fairly well understood, the psychological limits are mostly unknown and difficult to measure.

In studying the effects of 1RM (one repetition maximum) on the quadriceps, Rose (12) concluded that “the persistence of strength as a learned act certainly does not appear to be an impossible concept.” Based upon Rose's observation, one may reason that the psychological factors--motivation, body image, and consciousness--are a crucial consideration in neuropsychology function and, ultimately, in the expression of optimal strength performance.

Functional isometrics challenges the higher brain centers involved in the voluntary recruitment of Alpha motor units innervating fast twitch muscle fibers. These motor units are recognized for their high activation threshold and ability to generate peak muscle tension. A strong impulse must be generated to recruit them. In the performance of a maximum strength task like FI, which demands a strong ballistic impulse and peak muscle tension, optimal arousal is required (1, 8, 9, 13); arousal being the act of “psyching up.”

A good example of arousal technique in action is seen when an athlete is preparing to execute a 1RM FI squat. He is told to “think strength”—“explode”—“drive hard,”
Guidelines
Functional Isometric Training

1. Warm-up
   a. Stationary bike riding (5 min.) to increase circulation and body core temperature.
   b. Stretching (5-7 min.)

2. Pressing
   a. Light dynamic press - 8 x 2
   b. Fl press
      1. Overhead position - Figure 1.
      2. Start position - Figure 2.

3. Pulling
   a. Light power cleans - 8 x 2
   b. Fl pulls
      1. High snatch grip pull - Figure 3.
      2. Middle clean or snatch grip pull - Figure 4.
   c. Low clean pull - Figure 5.
      (in the middle and low pull, the alternating deadlift grip may be used with heavy loads.)

4. Squatting
   a. Light dynamic squats - 10 x 2
   b. Fl squats
      1. Low position - leg angle 90 degrees
         - Figure 6 start position
         - Figure 7 finish static position
      2. High position - leg angle 110 degrees
         - Figure 8

5. Cool down
   a. Light dynamic squats - 10 x 2
   b. Stationary bike riding - 7 min.
   c. Light stretching - lower back
etc. The act of thinking strength involves mental imagery in which the athlete visualizes and feels the tremendous ballistic impulse (explosiveness) he must generate at the moment of execution, followed immediately by the all-out static strength effort required in holding the bar solid against the pins for a three-second count. Mental imagery stimulates the cerebral cortex into activating the arousal system (which includes the hypothalamus and adrenal medulla), bringing about greater motor unit recruitment through facilitation and spatial summation (1, 13). Spatial summation, or multiple fiber summation, is the means by which signals of increasing strength are transmitted in the nervous system by utilization of progressively greater numbers of fibers (3, 5). The stimulus becomes more intense as the number of nerve fibers stimulated increases. Spatial summation is the primary means of increasing the strength of muscle contraction.

Arousal can also cause more intense stimulation of the motor neuron, which increases its firing capacity, leading to great muscle tension. When a high frequency of nerve impulses is sent to the muscle fibers, the muscle tension from one stimulation is unable to relax before the next stimulation causes the contraction. The net effect is higher muscle tension produced by the motor unit, and greater force generated by a given muscle.

To conclude this discussion of the neuropsychological factors of strength performance, it may be stated that the intrinsic value of FI lifting is that it provides for optimal levels of self-generating, stimulus-specific arousal. In achieving this state, FI challenges and facilitates voluntary cortical function. Long-term FI training leads to enhanced cortical transmission, enabling the neuromuscular system to respond selectively to one set of stimuli, thus maximizing the motor response (generation of a strong ballistic impulse) required to execute a specific dynamic strength task. So in the process of having an athlete "think strength" and "think speed," there exists a neuropsychological factor that FI can effectively train and develop.

FI training enhances the interrelationship between the neuro-
muscular system and endocrine system assisting the athlete in transcending to a higher level of dynamic strength performance previously thought unobtainable. In essence, this is what scientific strength theory and application is concerned with.

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References