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THROWING POWER - Are we missing the obvious?

Citius, Altius, Fortius (or Swifter, Higher, Stronger). This is the Olympic motto. Three small words, but words with great impact and significance. It is especially the words, faster and stronger, which are of paramount importance to the thrower. We are well aware of the fact that genetic potential ultimately determines throwing distance, and this potential has to be developed optimally.

The modern thrower, apart from possessing an extremely high level of technical skills, also has to be very fast and strong, striving to reach greater release velocities at faster movement speed, which would lead to improved throwing distance. What is equally important is that technical skills, strength and power development, and speed must be developed in such a manner that no quality is developed at the expense of another. So often we see an athlete becoming stronger, but the thrower lacks in the technical skills department. This is a recipe for disaster, and must be avoided at all costs.

The modern coach wants to learn at a faster rate than his opposition, getting the edge on performance. The world has exploded with knowledge, and the coach must selectively choose what works and what doesn't, for his athletes. Coaches should not fall in the trap of paradigm paralysis, by thinking that he/she has the recipe for success, and this then becomes the norm. Or, coaches who believe that what they did 15 years ago, is all still applicable. They believe that their way is the only way, and that is how they will coach. The world however, is constantly changing. The world is designed to grow and change. Coaches have to stay on top of their game. Adopt new paradigms. Yes, paradigms are powerful. Widen your vision; be perceptive to all the new coaching possibilities. Learn to see with new eyes. Don't do the same things over and over and expect to see different results.

Right, let's get back to business.

Objectives of weight training for throwers

- To increase maximal or absolute strength
- To increase explosive strength

- To increase the rate at force production
- To increase muscle and connective tissue hypertrophy
- To increase muscle hypertrophy
- To increase connective tissue hypertrophy (tendons, ligaments, fasciae)
- To increase the quality of muscle and connective tissue
- To improve neuromuscular efficiency
- To improve biomechanical efficiency

(Adapted from Siff & Verkhoshansky 1996:9)

What is strength?

The late Dr. Mel Siff, one of the world's greatest sport scientists, defined strength as: "The ability of a given muscle or group of muscles to generate muscular force under specific conditions" (Siff & Verkhoshansky, 1996:1). Strength can also be defined as: "the ability of the neuromuscular system to produce force against an external resistance" (Stone, Stone & Sands, 2007:168). Zatsiorsky and Kraemer (2006:21) define strength as "the ability to overcome or counteract external resistance by muscular effort".

Maximum strength

Siff and Verkhoshansky (1996:1) define maximum strength as "[t]he ability of a particular group of muscles to produce a maximal voluntary contraction in response to optimal motivation against an external load". This differs from absolute strength, which refers to the greatest force a muscle or group of muscles are capable of producing with electrical stimulation (Siff & Verkhoshansky, 1996:1; Stone, Stone & Sands, 2007:168).

Within the context of the throws, it is quite clear that speed does not play a significant role in maximum strength. Yet it is important to have a very high level of maximum strength on which to build explosive strength ("power"), where speed of movement is of paramount importance. Within the same context it should be understood that javelin throwers need to generate power against a light resistance, while shot putters, hammer throwers and discus throwers to a lesser extent, need to generate power against a heavy resistance.

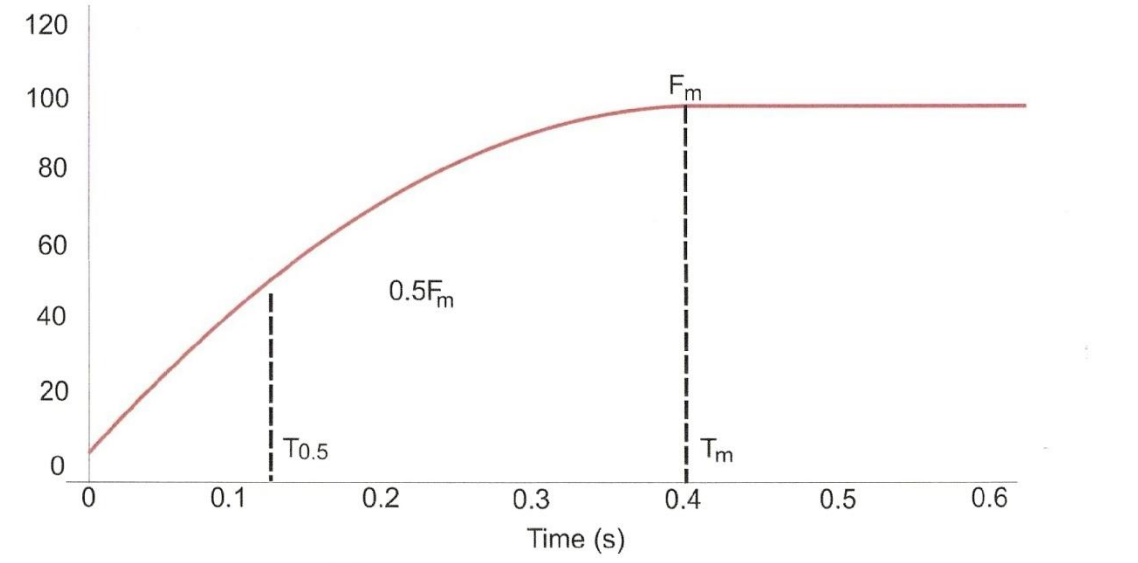
Power

Some athletes might be very strong, but lack in the power department. So what is power ("explosive strength")?

$$\text{Power} = \frac{\text{work}}{\text{time}} = \frac{\text{force x distance}}{\text{time}} = \text{force x velocity}$$

From the above equations it is evident that power refers to the rate at which work is performed (Newton, 2010:16). Speed of movement execution is crucial. Explosive strength refers to the muscle's ability to exert maximum force in minimal time (Zatsiorsky & Kraemer, 2006:28). The main determining factor for power is the distribution of muscle fibre type, which is hereditary. Typically athletes possessing a larger amount of fast-twitch muscle fibres, which can contract extremely powerfully and fast, but fatigue quickly, have a distinct advantage.

However, irrespective of the amount of fast-twitch or slow-twitch muscle fibres that you have been blessed with, you still have to train correctly, and also apply the *principle of specificity* (defined later in this paper). Typically the thrower wants to generate maximum muscular force in the quickest possible time, and the time in which to apply this force to the implement (e.g., javelin, discus, shot, hammer) is extremely short. This creates a problem in the sense that is not possible to generate maximum force, because of the very short time span available for force application. (javelin: 0.16 – 0.18s; shot put: 0.15 – 0.18s) (Zatsiorsky & Kraemer, 2006: 27). This means that throwers are not able to utilise their strength and explosive power to their full potential, which is illustrated in Figure 1.



Development of maximal muscular force over time. T_m is the time to peak force F_m; $T_{0.5}$ is the time to ½ of F_m.

Figure 1

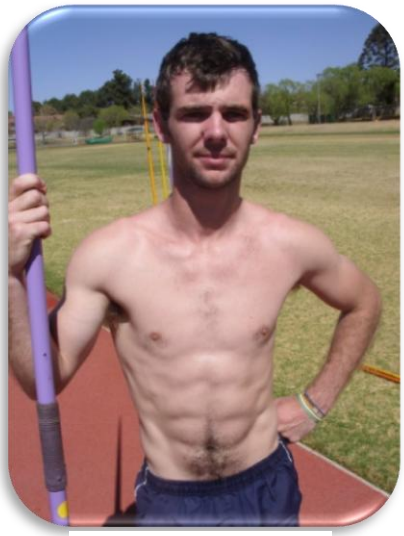
(Zatsiorsky and Kraemer 2006: 26)

It is therefore of paramount importance to be able to develop the ability to generate the maximum amount of force in the shortest possible time. Rate-of-force-development

training should form an integral part of all throwers' training, and is, sadly to say, the one often neglected.

The explosive strength deficit should thus be decreased in order to maximise power output.

Bernard Crous (South Africa) achieved a throwing distance of 77.80m at a bodyweight of only 68kg, displaying a superior level of relative as well as explosive strength. By employing sound training principles, he has become very powerful and explosive and able to generate huge forces very rapidly.



Bernard Crous

Throwers and their coaches should always remember that longer throwing distances can only achieved by attaining higher release velocities. Apart from superior throwing technique, both components (force and velocity) must be developed. An increase in power is quite specific to the resistance and the velocity of movement. This once again underlines the importance of rate-of-force-development, as well as velocity-specific exercises.

Sunette Viljoen (South Africa) is arguably one of the smallest, elite female javelin throwers in the world (1.68m; 70kg). Despite her size, she is deceptively strong and fast, and possesses a high level of intramuscular and intermuscular coordination. She has proved that she can generate the same amount of release velocity as the world's best

Sunette Viljoen

Core Stability

This has recently become quite a buzz phrase. So what actually is one's core? In layman's terms, it is the body's natural corset and comprises two deep abdominal muscles, the Transversus Abdominus and Internal Oblique muscles, and the Multifidi muscle. The main function of the first two abdominal muscles is to compress the abdomen, and to give support to the abdominal viscera against the pull of gravity (Jarmey, 2008:71 & 73).

The Multifidis muscle runs almost the entire length of the vertebral column, and forms part of the transversopinalis group. It's main function is to protect the vertebral joints from movements generated by stronger superficial agonists (prime movers). It also aids in maintaining posture and stabilising the spine during all movements (Jarmey, 2008:64).

Powerful throwing movements are linked through the core. If this link is weak, the whole movement will be weak. The higher the level of throwing proficiency, the higher will the demands be on the core, and the stronger the core and surrounding musculature has to be. It is therefore imperative that the whole kinetic chain is strong, and core strength is maintained, not only during the athlete's throwing career, but indeed for the full duration of his/her life.

A strong core, in conjunction with overall body strength, good throwing technique and efficient neural pathways will ensure that forces are correctly and efficiently transferred from the legs, through the core and trunk to the throwing shoulder. If the core muscles are weak, this will not be possible.

Is core training new? No, it has existed for many years. Joseph Pilates (1883 – 1976), founder of the now famous and popular Pilates exercises, used it with great effect as early as the 1920's. My opinion is that people nowadays do not move and do natural exercises as people used to. Modern technology also created sedentary individuals. People have indeed become movement-poor. Young kids in general have poor posture; they do not sit properly; they cannot walk or run properly and they lack movement skills. They cannot effectively perform simple skills such as running, jumping, throwing, catching and kicking, and they lack coordination, general as well as specific.

Who is to blame for this situation? I guess there are a number of factors contributing to this dilemma, such as modern technology (children sit for most of the day; alarge part of the day is spent in front of the television set or computer), and of course lack of properly structured physical education programmes. But we also have to accept

responsibility for this situation. We have superior knowledge to bridge the problem. There are several ways to build a strong core, and also to prevent muscle imbalances. Many activities such as Pilates, physio-ball, kettlebells and TRX-suspension exercises, throws with medicine balls from a variety of body positions, Olympic weightlifting movements and many others can be incorporated in the training programme to build a core that is able to effectively utilise the power generated by the prime movers.

Specificity of training

The human body has the ability to adapt to training loads. This ability to adapt is referred to as the SAID-principle ("specific adaptation to imposed demands"). Siff and Verkhoshansky (1996:19) note: "It is not only the exercise which modifies the body, or, more specifically, the neuromuscular system, but the way in which the exercise is performed". If the demands are not specific to the performance demands of the throws, functional (transferable) adaptation will not take place (O'Shea, 1996:11). That is why the manner in which you perform exercises is so important. Siff and Verkhoshansky (1996:20) denote that the *principle of specificity*, which can be applied in many ways should take into account the following:

- Type of muscle contraction
- Movement pattern
- Region of movement
- Velocity of movement
- Force of contraction
- Muscle fibre recruitment
- Metabolism
- Biochemical adaptation
- Flexibility
- Fatigue

The late Dr. Mel Siff played a huge part in my coaching career. He was always willing to share with me his immense knowledge. It was also through his intervention in my athletes' training programmes that several throwers could compete with the world's best. By applying his sound and scientific based training principles, Marius Corbett won South Africa's first ever track and field gold medal at a World Championship meeting in 1997. Today I still apply his strength and power training principles. Sunette Viljoen, who won the bronze medal in the javelin at the 2011 IAAF World Championship, is proof of this.

Let's have a brief look at some examples how the *principle of specificity* can be applied:

- *Movement pattern and velocity of movement*
  Just by simulating exercises does not make them specific. Within the same context it can be said that by executing throwing movements correctly at low velocity, will not necessarily mean that the athlete will be able to execute throwing movements correctly at high velocity. One cannot always execute throws at high velocity, therefore careful planning must be done to accommodate this form of training. Too much high-velocity training might also have a detrimental effect on strength gains.

- *Muscle fibre recruitment*
  The thrower wants to activate as much as possible, and as fast as possible, fast-twitch muscle fibre. Although the amount of fast-twitch fibre or slow-twitch muscle fibres that an individual possesses is hereditary, they are typically equally distributed. Therefore, the neuromuscular system must be trained to maximally increase the potential of fast-twitch fibre usage.

  Siff and Verkhoshansky also note: "since the force-velocity curve for muscle contraction reveals that force decreases with velocity of concentric contraction, high-velocity training may not produce a large enough force to stimulate maximal adaptation in the muscle. The special advantage of high-velocity concentric training is that it conditions the nervous system, whereas lower velocity training is better suited to development of muscle hypertrophy and slow speed strength". For eccentric training, the force-velocity curve shows that eccentric force increases with an increase in velocity (Siff & Verkhoshansky, 1996:22; Zatsiorsky & Kraemer, 2006:34). Figure 2 reveals that a further increase in velocity will cause eccentric force to remain constant. This type of training enhances muscle and neural adaptation, but carries with it the potential risk of injury.

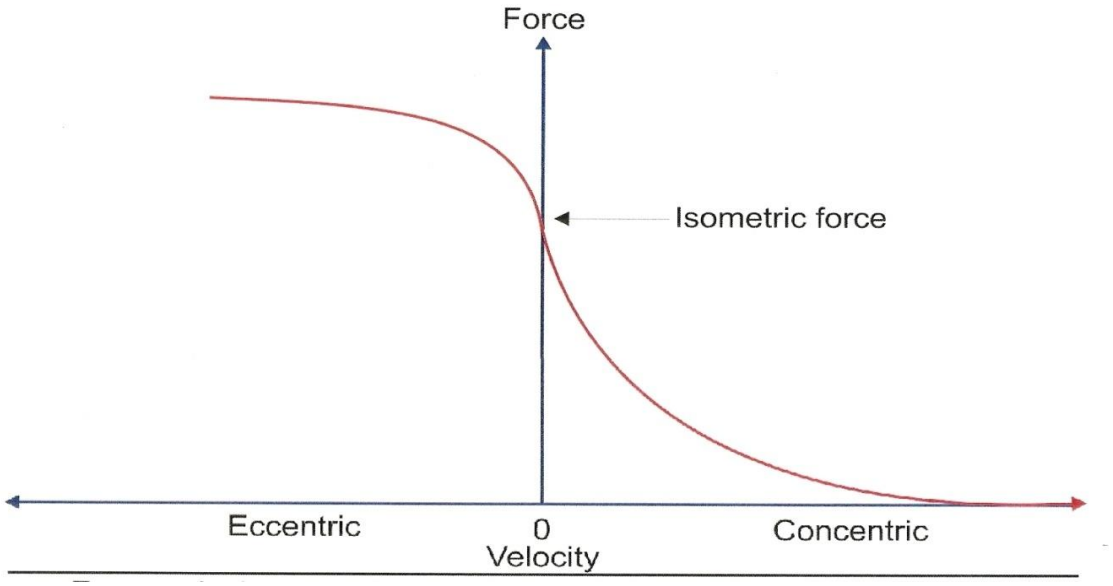


Figure 2 (Zatsiorsky & Kraemer 2006: 34)

Conclusion

The higher the athlete's level of proficiency, the more event-specific or functional exercises should be included in the training programme. Often coaches increase the volume of training by increasing the number of general exercises. What they should be doing is to increase the number of specific or functional exercises.

Case Study: Sunette Viljoen (Javelin)

Bronze Medallist: IAAF World Championship – 68.38m

Sunette Viljoen has improved in leaps and bounds over the past two years. In the process, she has also become extremely powerful and explosive. She is arguable one of the smallest, if not the smallest thrower on the international circuit. Some of the most important aspects regarding her training regimen which made a significant difference and brought about a vast improvement were:

- Strength-to-power development and throwing technique development were harmoniously blended.
- Adhering to the principle of specificity, the volume of high velocity training was increased. This applied to Olympic weightlifting movements, and to throwing and jumping exercises.

- Throws with overweight implements were closely monitored to ensure that correct throwing technique and correct movement pattern is maintained. Only heaver javelins of up to 700g were used, enabling the thrower to maintain throwing speed. This type of training, in conjunction with standard weight implements proved to have a positive effect on neuromuscular programmes.
- Special eccentric exercises were added in the weight room, as well as with throwing and jumping ("bounding"), enhancing her explosive-reactive power capabilities, and ensuring that the neuromuscular system is trained to generate large forces very quickly, and to ensure that fast-twitch muscle fibres are rapidly activated. Therefore, I would like to restate the importance of rate-of-force-development training. By carefully blending and periodising all the components made Sunette a more complete athlete, being able to display superior intramuscular and intermuscular coordination.
- Strength gains and power output were effectively transferred to the actual throw.
- Contrast-loading exercises where carefully implemented in the training programme.
- By carefully managing and striking an optimal balance between loading and recovery, adaptation has been optimal and believe it or not, Sunette has been injury-free for the past two years.
- And last, and perhaps one of the most important things, Sunette enjoyed her training sessions and competitions, and will continue to do so, also constantly learning more about the event, in search of an Olympic medal.

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