Dear valued clients, partners, and training community,

The team at Performance Training Systems Inc. would like to extend a very gracious thank you to all of our newsletter recipients who responded via email and Facebook with their thoughts regarding our 1st issue, and for making their suggestions for future topics and the format of upcoming editions. We encourage and welcome this feedback.

The goal of this newsletter is to bring the ‘Sport and Exercise Science’ issues and concepts important to our clients and partners in a concise and educational format. Based on the responses that we’ve received, we did that in our 1st issue. You’ve told us you like the format, and the type of content. You’ve also told us that you would like to see more ‘reviews of the research’, and more ‘in-depth’ discussion. It is our hope that in this issue; ‘Power for Sport Performance’, we describe, discuss, and illustrate the methods, techniques, and applications supported in the research and by the strength coaches in the field, that develop, and maximize power output on the fields of play. Enjoy this issue, and please let us know what you think!

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What is Power for Sport Performance?

Sport specific Time Motion and Physiological Demand Analysis suggest that sport is characterized by either single or repetitive explosive and forceful or powerful movements. Whether it’s jack’in one over the fence, a bodycheck, powering out of the start blocks, or a wide receiver jumping for a catch, it is these explosive efforts that ‘powers’ sport movements. In this context then, ‘Power’ is competitive advantage, it is the physical expression of strength that allows you to jump higher, push harder, and run faster than your opponent. Mathematically, power is a function of the amount of force generated over a given distance in a quantified period of time; \[ P = \frac{F \times \text{Dist}}{\text{Time}} \].

Power is what successful sport performance is all about; there is no sporting activity where an athlete’s performance is not limited by their power output and power profile. So how is power achieved?

To answer this we must look at the above mathematical equation, understand some basic principles of muscle physiology and sport movement mechanics, and most importantly, we must forget the idea that the stronger athlete is, the higher their power output. The articles in this newsletter will explain each of these factors in greater detail.

Power for Sport Performance, as with all other physical expressions of strength, is measured primarily in relation to body weight (Pbw) and maximal values (Pm). When it comes to comparing athletes in sport, particularly weight class sports like wrestling, or positional sports like football, athlete evaluation and selection is position or weight class specific.

It is the athlete that has the best athletic profile for the specific demands of a position that are chosen at selection camps, not the biggest, or the strongest, or the most powerful, but the athlete with the best overall profile. It is for this reason that Pbw values are of greater importance to the training athlete. Continued on page 2.
The Physiology of Muscle Power

Pure muscle power; explosive force production, is the product of high neural activity (motor unit activation and synchronization of cocontracting muscles generating high rates of contractility and force development) and anaerobic metabolism; more specifically the result of Phospho-Creatine (PCr), and glycolytic energy pathway ATP synthesis. These energy systems, while independent of each other, work intermittently along with periods of oxidative recovery, to power the repeated maximal forceful outputs that occur during competition. The 1st 0-10 seconds of max effort is powered by the PCr system, the next 40seconds is powered by the glycolytic system. In non-oxidative environments, the ‘conditioning’ of the glycolytic energy system (aka Lactic Acid cycle) determines the athlete’s rate to exhaustion and fatigue. As an athlete, trainer, coach or parent concerned with appropriate sport-specific training, you must fuel your body, and train your energy systems to the work : rest demands of your sport. Time Motion and Physiological Demand analysis should be the foundation of your power training set : rep : recovery cycles. When specific to your sport, muscle deoxygenation and recovery kinetics are greatly improved. This style of training is referred to as Sport-Specific Interval Training, and ideally, should include exercises that mimic the movement demands of your sport. By using appropriate work : rest ratios, and sport based movement patterns, your energy pathways adapt to the physical demands of that sport, and make you more efficient, allowing you to exert more power, at higher frequencies for longer periods of time, providing you with that competitive advantage!

Power, Plyometrics and the Stretch Shortening Cycle

Power, more specifically the ability to generate repeated maximal power outputs is a critical factor influencing sport performance. The Stretch Shortening Cycle (SSC) and Plyometric Training (PT) are the reported mechanism and type of exercise that train the utilization and development of Power output in Athletic Movements. The SSC is an ‘afferent / efferent neuromuscular reflex activity’ and ‘series elastic component’ response that incorporates a rapid eccentric muscle action followed by an immediate and forceful concentric contraction. The concept of a muscle containing ‘series elastic components’ refers to the fact that a muscle and it’s connecting tendinous attachments can be stretched, and, if recoiled shortly after stretching, can exert a volume of stored potential energy created and held within the increased number of actin-myosin cross-bridge formations held throughout the eccentrically contracted muscle. It is this mechanical actin-myosin disruption during eccentric muscle contraction, and the subsequent reciprocal detachment that is responsible for the increased muscular force and power output, and favorable structural adaptations in muscle tissue when compared with a static, non-prestretched positions or contractions. Essentially, the SSC powers the ‘spring’ in an athlete’s step, jump, or throw.

The questions remains however, how does an athlete train, or enhance their SSC and power output capabilities? The Answer; they practice PT. PT, or Plyo’s involve movement patterns where there is a rapid deceleration of the body, followed by a rapid acceleration of the body in the opposite direction. Visualize a countermovement jump (CMJ), where an athlete undergoes coordinated triple flexion of the ankles, knees and hips, dropping into a squat, whereby they eccentrically load the glutes and hamstrings, and then explosively concentrically co-contract the glutes/hamstrings, moving through triple extension of the ankles, knees and hips, powering the body upright and off the floor. Granted there are other muscles co-contracting synergistically here; providing postural support, and working in various eccentric-concentric co-contraction rates, but you get the picture.

Plyometrics can simply be viewed as ‘regular’ movement patterns performed explosively. It must be stated that before an athlete, coach, trainer or parent urges power or plyo training, the athlete’s movement mechanics and strength capabilities must be evaluated. Due to the high rates of force development, the contraction strength and tension generated between actin/myosin cross bridges and at the myosteninous junctions, and the resulting force vectors within the moving limb segments, the athlete must 1st demonstrate high levels of joint stability, sound technique, and a developed level of muscular strength.

Looking for Power exercises?

Check the PTS Conditioning Room at www.performancetrainingsystems.net/ConditioningRoom.php

CONTACT US

We want to hear from you! We want your suggestions. We want your feedback. Let us know what you think. Fill out our confidential email form at www.performancetrainingsystems.net

Continued from pg 1… So, how do you train Power for Sport Performance? You could fill a book trying to answer this question; we will answer it in the following articles, breaking down each of the contributing factors mentioned, into their individual parts, in efforts of providing you with simplified explanations, and applicable training suggestions and techniques. We hope you enjoy this edition of SPORT & EXERCISE SCIENCE
Power Training & Injury Prevention

Power training can help reduce sport related injury. One of the most common sports injuries is muscle or tendon strain and tearing. By regularly incorporating low-intensity plyometric movements (bounding, jumping, pushing etc.) you can increase your resistance to these types of injuries. The stretch-shortening responses of these movements train the muscles through longer lengths, and increase the length-tension relationship within the muscle, myotendinous junction and tendon. In addition, training programs that utilize plyometric based movements have shown to improve active joint stabilization through increasing muscle spindle fiber afferent neural feedback, increased rates of force development, increased motor unit size, the correction muscle imbalances within limb segments, improved recruitment and synchronization of muscle contraction patterns, and increase bone mineral density. Collectively, these morphological adaptations reduce varus and valgus loads within a joint, and lead to greater force absorption during landing and directional changes. Further, research indicates that repeated plyometric training can induce changes in muscle fibre composition, to favor greater Type IIX contractile properties, and increase the number of Type I and Type II fibres. All of these adaptations lead to a stronger more responsive muscle, which makes the competing athlete faster, stronger, more efficient, and more resistant to injury. Before beginning any type of Plyometric training program be sure to consult a strength and conditioning professional to check your movement mechanics and to develop a program appropriate for you.

From the Research

In a study involving 29 non-athlete college aged males researcher’s investigated the influence of either plyometric exercise, weight training, or weight lifting (Olympic lifts and variations) on Eccentric Utilization Ratio, measured as the ratio of a Counter-Movement Jump (CMJ) to a Squat Jump (SJ), and is considered to be an indicator of training status in athletes. Previous research from the same authors revealed that EUR is an indicator of SSC performance. Further, they have identified that athletes in sports requiring high power outputs such as rugby, hockey, and soccer, had higher EUR values when compared to other sports. An EUR above 1 is considered to be required for successful performance in power sports. The purpose of this current study was to identify if EUR was sensitive to different types of resistance training programs (weight training, plyometrics or weight lifting). A secondary purpose was to identify if the different training styles influenced Vertical Jump performance and lower body strength. Results indicated that EUR did not significantly change, suggesting that this indicator may not be useful in a recreationally active group. Results did indicate that high velocity and high force training programs consisting of Olympic lifts and Plyo’s improved jump height and power.


On-Line Shop Coming Soon

PerformanceTrainingSystems.net is in the process of developing and launching an on-line shop to service your athletic training needs and wants. Click this link to take you to our on-line shop www.performancetrainingsystems.net/PerformanceShop.php

Power Training Guidelines

- Before beginning a power training program consult a training professional to screen your movement competencies.
- Train with proper technique.
- Begin all training with a neural / Dynamic warm-up.
- Limit metabolic interval training to 2-3x a week max.
- Power Training should be a component of a structured periodized training program.
- When training for peak power, give a 100% effort.
- Vary the load (sets x reps x wt) during your workout to develop a dynamic power profile.
- Avoid passive rest to keep neural activity high b/n sets.
Power Training: Dynamic Constant External Resistance
As discussed previously, power training exercises include jumping, bounding, and basically any exercise that is performed with controlled, explosive technique. However, there are other ways of changing the physical demands of your work-out so that you trigger higher power outputs. The most common way of doing this is through the application of Dynamic Constant External Resistance (DCER) to traditional lifts such as the Bench Press or Back Squat. An example of DCER would be attaching resistance bands to the ends of on Olympic bar, anchoring them to the floor, so that the direction of pull is constantly against the direction of the lift (see below right). The effect of the resistance bands creates greater eccentric load, and when powerfully controlled through the concentric phase of the lift, can mimic the dynamic neuromuscular and strength demands of sport movements, and better train the athlete for athletic performance.

Application of DCER should be limited to a select group of exercises, namely presses and pulls and bodyweight movement patterns (i.e; lunges and squats) in linear directions, and should be properly instructed and supervised by a Certified Strength & Conditioning Specialist (C.S.C.S.). Other methods of applying DCER include the addition of chains to the ends of bars, partner assisted manual resistance, weight vests, chutes, and other applications of resistance bands. If you would like to learn more about DCER and possible training applications, please contact a Performance Training Systems Inc Conditioning Coach at http://www.performancetrainingsystems.net/EmailForm.php

Power Training: The Olympic Lifts
The Olympic Lifts are multi-joint, whole body, exercises that require the synchronization and co-contraction of multiple muscle groups. When performed correctly these exercises improve an athlete’s ability to generate, and transfer high power outputs throughout the body in balanced and coordinated sport appropriate movement patterns. If you would like to learn more about the Olympic lifts, contact a Performance Training Systems Strength and Conditioning Coach.

Try this Resistance Band loaded squat to press power exercise
Pre-load the band by positioning yourself where the band applying resistance. Drop into an athletic position, and explode triple extending the ankles, knees, and hips while driving the body in an upward and forward direction. Feel the transfer of power going through the legs, hips and out the arms. Give max effort each rep!

FROM THE RESEARCH
Time Motion & Physiological Demands of Football
- Competition modeling involves evaluating sport competitions and designing specialized metabolic conditioning programmes.
- Avg football work : recovery ratios: HS 5.75:31.49s (1:5.5), college 5.60:33.98s (1:6.07), NFL 5.70:35.24s (1:6.2).
- The average HS game consists of 294 plays, college 242, NFL 267.
- 90% of the energy utilized in football comes from the PCr system.
- The avg recovery between plays where there is no stop in play is 31.59s (HS), 33.98s (college), 35.24s (NFL).


Periodized Power Training Program Design
Let PTS develop a sport-specific power training program for you and your team. Whether you’re in pre-season, in-season, post-, or off-season we can develop the program right for you!

Is there a link between Nutrition & Power Output?
Yes. Sport dietetic research indicates that a pre-, during, and post-power training nutrition strategy be based on whole foods containing a combination of high and low glycemic sugars, high concentrations of high biologically available proteins, electrolytes (Na, Ca, K, and Mg), and anti-oxidants are effective in satisfying the substrate demand, required to promote muscle protein synthesis, the regeneration of muscle glycogen stores, and neutralize the circulating free radicals associated with power training. Exact quantities or volumes required are individually specific, dependant on physiological demand. A power training fueling plan should be developed by a qualified sports nutritionist. Contact Arwen or Adele, PTS Performance Nutritionists to get your personal Power Training Nutrition plan.

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Ontario Human Performance Olympic Lifting Workshop
Learn the movements & related exercises in this 2-day workshop. 5-6 June 2010, Sheridan College Institute for Technology & Advanced Learning. $165 for both days. Contact PTS www.performance trainingsystems.net/Contact.php

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