SOCCER FITNESS INC.

SOCCER FIT-FACTS

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ASSESSMENT OF LEG MUSCLE POWER, ELASTICITY, AND REACTIVE STRENGTH



Leg strength and power are key components to physical performance in soccer players. A challenge among soccer fitness coaches has been to define exactly what aspects of leg strength are specific to the sport of soccer, as well as to determine how best to assess athletes' leg power, and subsequently to train and improve it in order to improve performance.

A review of the literature regarding leg power in soccer has determined three separate factors which together contribute to optimal performance in the sport:

1. Leg Muscle Power
2. Leg Muscle Elasticity
3. Reactive Leg Muscle Strength

Leg muscle power is defined as the ability of the legs to produce a large amount of force in a short amount of time. Leg muscle elasticity is related to leg muscle power, but it also takes into account the ability of the leg muscles to stretch, and then contract, quickly to produce force (an action known as the "stretch-shortening cycle"). Finally, reactive leg muscle strength, has to do with the speed of stretching/contracting muscles, or stretch-shortening cycle, as it applies to a reactive force such as landing from a jump, or slowing down/decelerating from a run.

Before a training program can be implemented, soccer fitness coaches need to assess these specific abilities in their players. Conventional methods of vertical jump assessment, including the 'wall-and-chalk', and Vertec system, are effective only in measuring leg muscle power and elasticity, with no real means of measuring reactive leg muscle strength. Furthermore, the wall-and-chalk and Vertec are also limited by a specific technique – of jumping with the arm raised – as well as limb length, which can adversely affect the reliability of the tests.

The Optojump Next electronic timing system, used by professional clubs from around the world, including in Italy, Spain, Germany, and the Netherlands to name a few, is a tool which enable soccer fitness coaches to quickly and accurately assess leg muscle power, elasticity, and reactive strength. The system consists of two bars, each 1 metre in length, which face each other and transmit/receive 100 infra-red lasers – 1 laser every 1 centimetre – along the ground. The system measures both the time duration, as well as the exact placement, of interruptions in the lasers, with incredible accuracy of over 1/100th of a second. Based on the athlete's weight and time spent in the air while jumping, an accurate measurement of leg muscle power and leg muscle elasticity can be made which eliminates the aforementioned technique and limb length problems associated with conventional vertical jump assessments. In addition, because the time the athlete's feet are in contact with the ground is recorded, the Optojump Next system also provides an accurate and reliable assessment of leg muscle reactive strength.

Following is a detailed description of the lower body assessments conducted using the Optojump Next electronic timing system. These tests are part of Soccer Fitness' Soccer-Specific Fitness Assessment protocols, which take place every Saturday morning, 9:00am-12:00pm, at the Soccer Fitness Training Centre. For more information, visit **www.soccerfitness.ca.** SF

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LEARN ABOUT IN THIS ISSUE:

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- **Global Positioning Satellite Technology**
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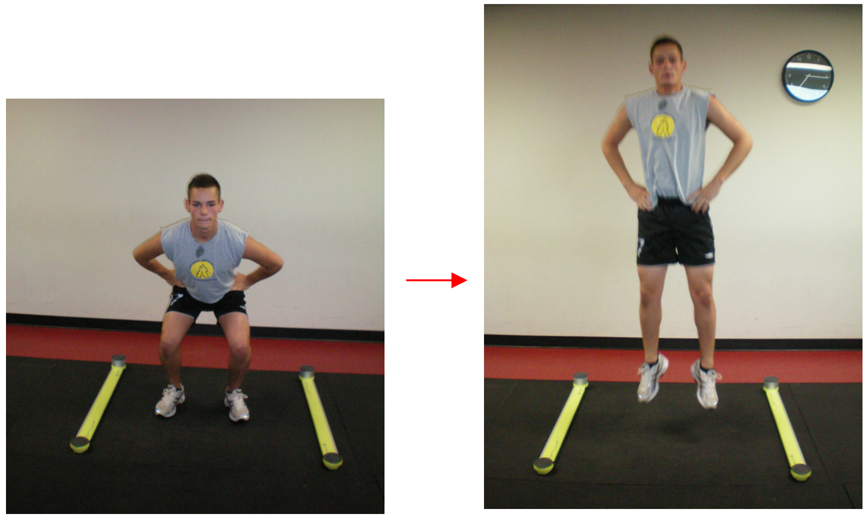
OPTOJUMP NEXT ASSESSMENT METHODS

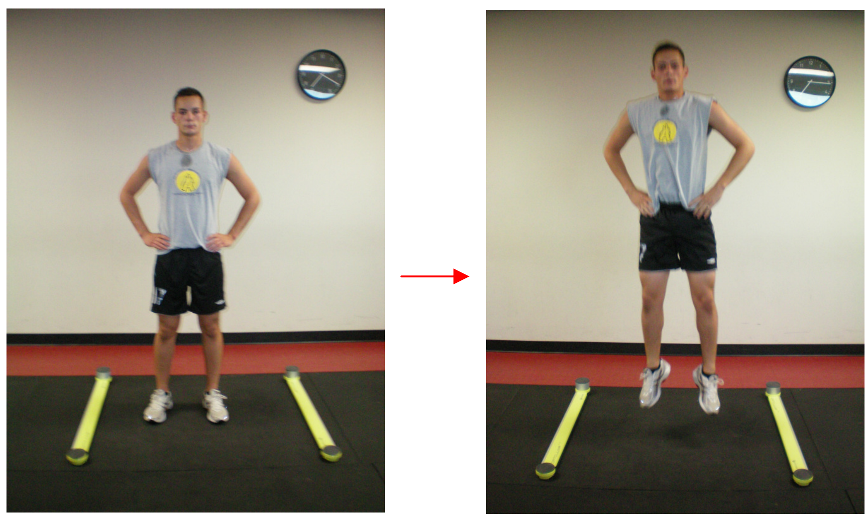
1. Squat Jump:

- athlete must stand inside the Optojump bars, with feet shoulder width apart, and place hand on hips
- athlete must squat to a 45-degree angle of knee flexion, and hold that position
- keeping the hands on the hips, and without lowering the body and/or bending at the hip or knee any further, athlete must jump as high as possible, finishing the jump with extended (straightened) hips, knees, and ankles
- The best score from three trials is recorded



2. Counter Movement Jump:

- athlete must stand inside the Optojump bars, with feet shoulder width apart, and place hand on hips
- keeping the hands on the hips, athlete must jump explosively by extending (straightening) the hips, knees, and ankles
- the best score from three trials is recorded



3. Drop Jump:

- athlete must stand on a 24cm box, placed directly behind the Optojump bars
- athlete lowers the body by dropping into the area inside the Optojump bars
- upon landing, athlete jumps explosively upwards by extending (straightening) the hips, knees, and ankles
- the best score from three trials is recorded

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GPS TECHNOLOGY AND SOCCER, BY PAOLO PACIONE

Among the many technological advances with in Sports Science, GPS — or Global Positioning Satellite — is becoming a familiar tool among high performance programs. Up until now we have had access to Heart Rate monitors for analysis of our training and competition. Unfortunately although a Heart Rate system can evaluate training load which is a crucial component to quantification of training, we are not currently getting the full picture.

Most sports use training loads as a function of measuring the stress the athlete undergoes during a training session in order to understand accumulative effects of training on an athlete. Heart Rate systems measure training loads internally through the monitoring of athletes' heart rates in beats per minute. When examining sports where power, speed, acceleration, and deceleration are main components, such as soccer, the physiological load and demands are much different than in sports such as cycling, running, and swimming. Therefore, training loads need to be measured externally as well.

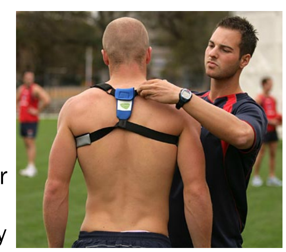
In soccer, the amount of high intensity running performed has been shown to be a strong correlate of high level performance. Increasing the capacity of soccer players to achieve greater running loads will allow our players to achieve greater success at every level. The majority of the top soccer clubs in the world, and their countries' international federations, currently monitor external loads through a camera based system or local positioning system. Popular camera systems include Amisco, and Pro Zone, and popular local positioning systems include Inmotio and ZXY. Both of these types of systems allow real time tracking of the movement patterns of players, and can provide information about where on the field the athletes move, using heat maps, charts, and graphs. The problem with these types of technologies is twofold. One, the cost of the system is quite expensive, often times being upwards of $300,00. Secondly, the system is not portable. As a result, the system cannot be carried to other stadia or training fields.

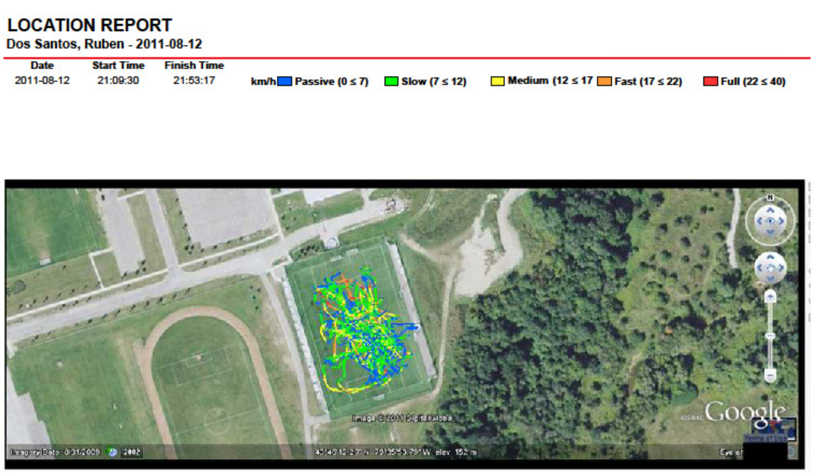
Using Global Positioning Satellite is an alternative option. Not only is it less expensive, but the greatest benefit is that the system is portable and can be used on the training ground and during exhibition games. GPS provides reliable information to help coaches and trainers monitor training loads during training, and aid in performance analysis. Information we gather from GPS systems includes peak speed, distances travelled at various levels of speed, number of sprints, distance of high intensity running as well as movement paths on the field.

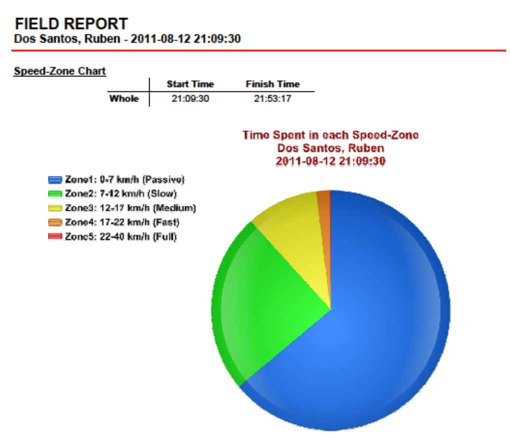
Several different GPS systems are presently used worldwide. Many of the Different Football Codes (Soccer, Rugby, Aussie Rules, and Gaelic) are using this technology quite extensively to monitor the athletes' training loads during training. While no published reports have been generated, this information has been used to reduce injury rates through understanding player's tolerance to high intensity training, and has also aided in improving tactical formations many clubs now employ. The aforementioned benefits are seen in addition to the performance factors that are clearly outlined by this system.

In my present role with our youth National Teams and Regional Training Centres, I am able to provide the information needed to assist coaches with not only their training prescription but also player selection. This method has been an invaluable tool and is quite easy to apply. SF

"The physiological load and demands are much different in soccer, where power, speed, acceleration, and deceleration are main components "







Figures 1 and 2: Examples of data obtained from a Global Positioning Satelltie (GPS) System used in a soccer game

HOW TO MEASURE PHYSICAL MATURATION IN SOCCER PLAYERS, BY ROBERT RUPF

The human body goes through many changes as an individual enters adolescence, which include rapid growth and muscular changes. For an aspiring young soccer player, physical attributes such as speed, coordination, and aerobic endurance can suddenly enhance during these ages. However, not everyone enters into these maturation years at the same age. This can lead to discrepancies in not only height and weight between competing athletes, but differences in their physical abilities, which may discourage young players from continuing in the sport if their development age is slightly behind their peers.

As a coach, dealing with these changes can be difficult as athletes might lose their normal coordination patterns and experience changes in behavior. However, by understanding a bit more on how the body develops through these years, you can look to start to optimize the training of the athlete at various stages of their maturation process. Figure 1, from the Long Term Athlete Development (LTAD) Model, provides a general overview of training focuses a coach can introduce to look to optimize their training program. Each of these phases of training are based around physiological implications of puberty. For more background reading on the LTAD approach, please look at the OSA LTAD program.

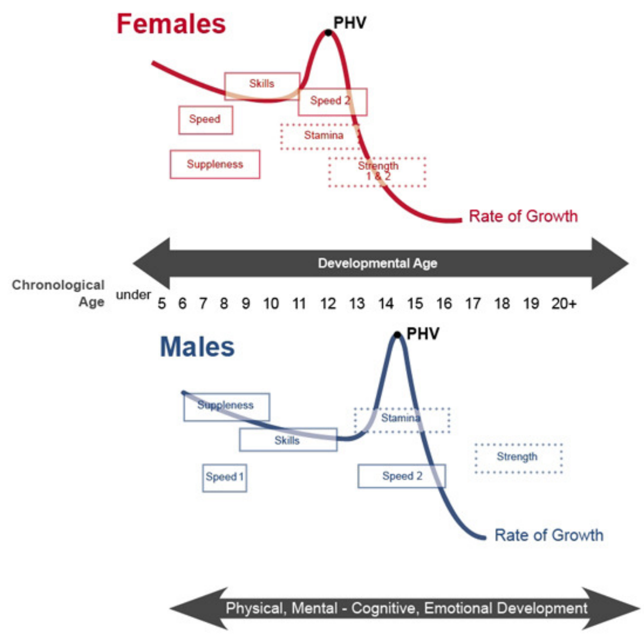


Figure 1: Training focuses according to developmental age

The key point in creating training programs around maturation is identifying the point at which the rate of skeleton growth is at its maximum. This point, known as peak height velocity (PHV), generally occurs for females around the age of 12, and for males around the age of 14.

So why is PHV important? Research that Soccer Fitness has partnered in has shown that female soccer players within 2 years after the onset of PHV achieve their fastest speeds over 20m. This means that after an athlete reaches PHV, training programs need to be tailored on establishing proper form, as athlete's attempt to re-organize their coordination through their growth spirt. Two years after PHV, speed characteristics are maintained until around 4-5 years post PHV, where the female soccer player may actually become slower. This might indicate that strength training should become important for female soccer players about 2-4 years after reaching PHV, to not only maintain speed, but also maintain lean muscle mass. If we think of this in terms of age groups, female athletes usually reach PHV around the age of 12. While muscle mass continues to grow in, female soccer players should focus on running biomechanics from the ages of 12-14 to generate this peak speed. After they reach the age of 14, strength training programs should be considered a necessity to help the athletes increase power produced from greater muscle mass, and maintain body composition to optimize power to weight ratio.

While the above recommendations are an interpretation on exciting new research in soccer, it is important to understand that every athlete enters the PHV at different ages. Therefore, identifying PHV for each athlete is important. One way in doing this is to measure the mass, the height, and the sitting height of each athlete. To do this you will need a scale, a tape measure that is at least 2.2m in length, and a box of known height. Weigh each athlete on the scale. To measure height and sitting height, put a tape measure on the wall placing the 0cm on the ground. Measure the height of the athlete with their back and feet against the wall. Look to use a straight edge like a book or cell phone to help identify the height of the athlete against the tape measure (Figure 2). After taking the height of the individual, put the box of known height against the wall. Have the athlete sit on the box, with their back against the tape measure. Measure the height of the athlete sitting on the box. Subtract the height of box from your measured height to determine the sitting height. The last step to determine PHV is to plug these values into the calculator on the Soccer Fitness website. Measurements can be taken once a year after the age of 10 to help identify PHV. The estimate generated from PHV calculator's will help you identify important periods of training for your athlete and for only three measurements it is worth the time. **SF**

Figure 2: Height Measurement

We are on the Web!
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MEET CONTRIBUTING AUTHORS

PAOLO PACIONE AND ROBERT RUPF

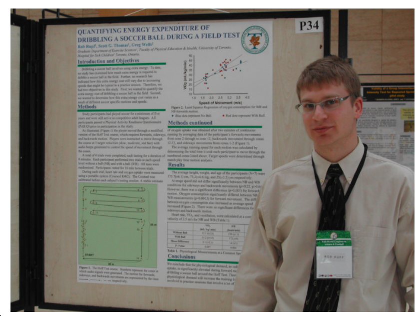
Soccer Fit-Facts is pleased and excited to feature two prominent sports scientists in this Issue of our newsletter. Paolo Pacione, Soccer Fitness Coach with the Ontario Soccer Association, and Robert Rupf, Exercise Physiologist with the Canadian Sport Centre Ontario, have both contributed articles relating to specific methods of physical and physiological assessment of soccer players. A brief biography of Paolo and Robert can be seen below.

Soccer Fitness extends its thanks to Mr. Pacione and Mr. Rupf for their help with our Fitness Assessment Issue!

CONTRIBUTING AUTHOR PAOLO PACIONE

Paolo Pacione, BSc., CSEP-CEP, FA FTA, is a Soccer Fitness Coach with the Ontario Soccer Association, and several Canadian National Soccer Teams. A graduate of the school of Kinesiology and Health Sciences at York University and former High Performance Trainer at the Canadian Sport Centre Ontario, Paolo holds the distinction of being the only Fitness Coach in Canada to have completed the prestigious English FA Fitness Trainer's Award, a course regarded as the standard for Fitness Coaches working with professional clubs in the English Premier League and the Football League. Paolo has more recently been the Director of High Performance at the Sports Injury and Rehabilitation Centre, a clinic located incised the Ontario Soccer Centre, where he also runs testing and training combines for the Ontario Provincial Teams and Canadian National Training Centre (NTC) programs. Paolo has extensive background in both theoretical and applied sports science specific to soccer. He has worked as a Fitness Coach with professional teams in the Italian Serie C and D (3rd and 4th divisions), and has also co-authored abstracts that were presented at the 2nd World Conference on Science and Soccer (Port Elizabeth, South Africa, 2010) and the 7th World Congress on Science and Football (Nagoya, Japan, 2011). He is also presently working with the Canadian Women's U-17, Men's U-17, and Men's U-20 National Soccer Teams. Away from the pitch, Paolo is an avid distance runner, and former CIS all-star in both Track and Field and Cross Country running.

CONTRIBUTING AUTHOR ROBERT RUPF



Robert Rupf, MSc., BEng., is an exercise physiologist with extensive experience in soccer-specific scientific research, as well in the practical coaching and training of soccer players. After completing his undergraduate degree in engineering, Robert began his graduate studies at the Human Physiology Performance Lab at the University of Toronto in 2005. There, he conducted research studies on amateur and professional soccer players, with his particular area of interest being the body's anaerobic contribution to the total energy expenditure in soccer.

Currently Robert works as an Exercise Physiologist at the Canadian Sport Centre Ontario (CSOC), a facility dedicated to testing and training elite level Canadian athletes. Robert has authored numerous articles and published papers in various sport-science related journals, many of which have been focused on soccer-specific testing and training. Most recently, along with others at the CSOC, Robert has helped to develop a soccer-specific fitness testing protocol that has been used to test over 1000 female soccer players at various levels in Canada, ranging from amateur club and university Varsity athletes, to elite Provincial and National team players.

In addition to his full-time work as a sports-scientist, Robert is also an accomplished soccer coach, holding an Ontario Provincial "B" License and having coached at the Rep. level for over 5 years. Away from soccer, Robert participates in a number of recreational endurance sports, and has been involved in competitive cycling for the past 2 years.