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## **Strength training and soccer players: Methods and applications for a better athletic performance**

**Iason Vasileiadis**

Cardiff Metropolitan University (MSc), Dagli72Xanthi Greece, Department of Strength and Conditioning and Sport Science  
Xanthi Football Club Thrace, Greece

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### **Abstract**

Football is a sport where high intensity bouts, quick turns of the body and explosive movements are occurring frequently on the playing ground and in many occasions those abilities determine the result of the game. During a soccer game sprints can reach up to 10% of the total distance covered on the pitch by a soccer player and up to 3% of games effective time. (Bangsbo *et al* 1991, Bangsbo 1992, O'Donoghue 2001) <sup>[5, 6, 26]</sup>. Additionally during games a sprint is happening approximately every 90 seconds, with its duration being around 2-4 minutes. (Reilly *et al* 1976, Bangsbo *et al* 1991, O'Donoghue 2001) <sup>[28, 5]</sup>. So it is prevalent that sprint ability and explosiveness are parameters that are crucial regarding soccer player's performance and the at the same time the ability to maintain or even improve those abilities are really important. In addition the sport is characterized by many injuries happening during game days and training sessions. Strength training can be a really useful tool when we aim to improve our athlete explosiveness and performance but also when we want to decrease injury rates and keep our players healthy.

The aim of this presentation was to examine the way that strength training improves performance and reduces injuries in soccer players, to analyze four strength training methods that have been shown to prevent effectively improve performance and decrease injuries in soccer players. The aims of this presentation are to inform S & C coaches about strength training and its beneficial effects, to examine the underpinning principles and theory related to this kind of training and finally to convince S&C coaches, that working inside the gym is efficient and motivate them to imply strength training programs, regardless to the level of the athletes they work with (amateur, elite, youth).

**Keywords:** soccer, strength, training, injury prevention, performance

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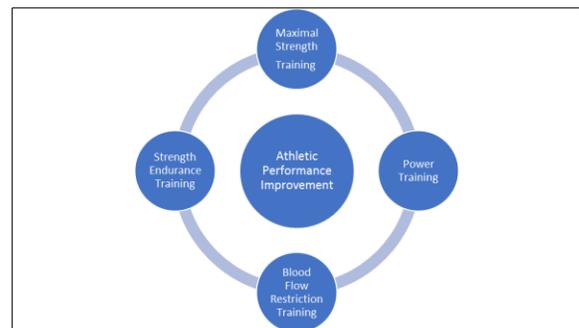
### **Introduction**

In the world of soccer players have to perform a great number of games in a short period of time. Those games involve high intensity efforts like sprints, change of Directions (COD) or high intensity runs. A player that wants to be quick and explosive on the pitch has to be strong, as strength is the foundation when it comes to explosive movements. (Bompa 2009, Jeffreys & Moody 2016) <sup>[10]</sup> A player that is not strong, will not be able to reach his potential on maximal speed or cut fast on the pitch. Thus it is prevalent that strength training plays a major role in soccer performance. Even today the opinion that strength training can make athletes slower has prevailed in many, coaches and athletes. This view is not only unreliable but also incomplete contrast with what scientific literature says, as it has been proved that strength training not only makes athletes quicker but also helps them remain healthy and fit. Thus it is of high importance to make clear the positive effects that strength training has respecting sprint performance and explosiveness, and also clarify which kind of strength training results in negative results on Athletes performance and makes them slower.

### **Strength training and Athletes performance**

It has been scientifically proved that strength training can assist athletes to reach their potential (Bompa and Carrera 2005; Zatsiorsky and Kraemer 2006) <sup>[9, 36]</sup>. The two main goals for every strength and conditioning (S&C) coach when we use strength training should be : a) to enhance performance and b) to prevent athletes from injuries and reduce injury rates. (Edge *et al.* 2006, Bompa and Haff 2009, Jeffreys- Moody 2016) <sup>[14, 10]</sup> Based on that it is really important to clarify the types of strength training

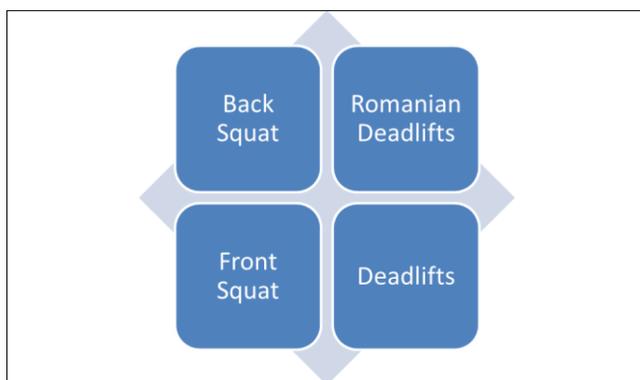
that affect positively athletic performance in soccer. Knowing those methods can help us design the proper training program for our players and achieve our goals. Maximal strength training, power, strength endurance and blood flow restriction training are some of the methods every S&C can use, when he wants to improve player's performance. (Figure 1) Knowing that there is a great contribution between the application of those methods and player's enhanced performance constitutes a really powerful weapon for every fitness coach. Nevertheless every training method is different regarding its principles. Thus is crucial to first clarify the differences between the four training methods we previously mentioned.



**Fig 1:** The four strength training methods that can assist an athlete to improve his performance, by reaching his athletic potential and by avoiding injuries.

## Maximal Strength Training

Maximal strength improvement is considered to be probably the most important goal when it comes to football player's performance, due to its great contribution with rate of force development (RFD) and power levels maintenance and improvement. A considerable number of sport scientists claim that when we aim to enhance athlete's physical performance in the majority of team sports and Specially in soccer, training on the weight room should first focus on maximal strength. (Baker and Nance 1999, Baker *et al* 2001) <sup>[3, 4]</sup> It has been proved that any improvement in maximal power will be reflected in a change in RFD levels and power output. This is happening probably because of the adaptations of the peripheral system. (Buhrlé *et al* 1977, Hakkinen *et al* 1985, Weir & Brown 2012) <sup>[33]</sup> From an muscle-architecture standpoint, maximal strength training enhances the ability recruit fast-twitch muscle fibers, that will be activated during explosive movements on the pitch, and as a result of that players will be quicker and more alert during games. (Bompa and Haff 2009, Jeffreys- Moody 2016) <sup>[10]</sup> In addition a training session with peak efforts and long rest periods will result in greater testosterone levels, something that will result in great cross sectional area (CSA) and thus a bigger and stronger muscle, which produces more force during contractions. (Willardson, 2008) <sup>[34]</sup> It is really important to understand how maximal strength training effects positively RFD levels and as a result of that how the players become faster and more explosive on the pitch by using this kind of training. When we try to improve athlete's ability to change direction or jump, we aim to increase the displacement. The greater the displacement is the higher the movement or take of velocity is resulting in an improvement in impulse.. An increase in impulse means that the athlete will have the ability to apply either more force at the same time or the same force in less time and thus improve RFD levels. Athlete's ability to apply higher forces on the ground -and as a result of that to improve his RFD capacity- is being improved by heavy resistance training. (Haff *et al* 1997, Stone *et al* 2003, Carlock *et al* 2004, Sheppard *et al* 2009) Scientific literature highlight some exercises as the most reliable and efficient we our athletes are doing maximal strength training. (Figure 2)



**Fig 2:** Exercise selection during heavy resistance training. This parameters is really important when designing a strength training program, as exercises should be safe and effective at the same time. Many authors have characterized those exercises as the most proper when it comes to maximal strength training. (Bobbert *et al* 1994, Stone *et al* 2003, Sands *et al* 2005)

## Power Training

As we already know from literature, power is the result of force multiplied by velocity, and that means that working only on maximal strength (force parameter) will not result in better performance for our players, as we have to keep in mind that we want to enhance our athletes explosiveness levels and not only his strength. (Zatsiorsky 1995, Bompa 2009, Swinnen 2016, Jeffreys and Moody 2016) <sup>[35, 10]</sup> Power training results in great and high-frequency motor unit activation. In addition there is a specific recruitment and synchronisation of fast twitch muscle fibers and motor units. (Desmedt and Godaux 1978; Hannerz and Grimby 1979, Swinnen 2016) Power training could be a synonym of plyometric and Olympic weightlifting training. Plyometric training is described by Jeffreys and Moody as “a group of high intensity, shock-based methods who aim at enhancing high rates of force production, eccentric, control, and power. This kind of training involves activities that receive and return loads in high rates like high-impact landings and jumps and throws. During the receiving-load and the force application phase, acute increases in capabilities are seen as a result of the characteristic function of the stretch-shorten cycle (SSC)”. (Jeffreys and Moody 2016). So plyometric training, which is also can also be found at literature as “stretch and shortening cycle training” forces muscle to reach their maximum amount of force as quick as possible and that's why athletes are using it in order to improve their power performance. (Baechle and Earle 2000). It has been proved that plyometrics can be a really useful weapon for every S&C who wants to decrease the number of injuries in his squad. Increased joint stability, better muscle pre activation in every exercise or movement involves landing and more symmetric activation of agonists and antagonists are some of the adaptations that happen after plyometric training sessions and help players avoid serious incidents like ACL injuries or muscle strains. (Swinnen 2016, Chimera *et al.* 2004; Cuoco and Tyler 2012) When it comes to Olympic weightlifting this kind of training has been proved to be the most efficient regarding power output levels, as exercises that are used push players to express their power potential and achieve high levels of power performance.(Garhammer 1993; Haff *et al.* 2001; Häkkinen 1989; MacKenzie *et al.*2014).As athletes are able to lift explosively they gain the ability to move explosively on the pitch, something that results in great benefits during games. This is happening because of the biomechanical similarities between Olympic exercises-like clean and clean and Jerk- and player's movement on the pitch. Joint and muscle movements are the same, as there is a triple extension from the lower body and the same motor-unit activation with specific sport movements. (Hoffman *et al.* 2004; Tricoli *et al.* 2005) Sport scientists have proved that Olympic weightlifting training will result in great gains in regards with sprinting and jumping performance of the player. (Hoffman *et al.* 2004; Tricoli *et al.* 2005, Clayton *et al* 2015) Nevertheless this kind of training is unpopular in the world of soccer training, as most soccer players do not own the Olympic weightlifting, probably due to the high technique, mobility, and stability levels that those exercises require. Having considered all the above, it is quite prevalent that power training is always a useful tool when it comes to injury prevention and performance improvement. Both plyometrics and Olympic weightlifting can assist Player's become Better.

### Strength Endurance and Blood Flow Restriction Training

Strength endurance training is a form of training where athletes use their own bodyweight or light loads and perform many repetitions of one or more exercises, with small rest periods usually on a circuit form. (Willardson, 2008, Schoenfeld, 2010) Many sport scientists around the world have supported the beneficial effects of this kind of training regarding football performance, something that most strength and conditioning coaches don't now.

Injury prevention role of this kind of training is probably the most important one. Due to this specific type of training with many repetitions and light or no extra load, ligaments and tendons of the body are prepared for more intensive training, and as a result of this preparation injury rates are lower during more intensive training sessions. Thus this kind of training can be used for some weeks as a mesocycle that sets strength foundations for every soccer player or it can be even used as a warm up before every high intense training session. In addition strength improvement of the connective tissue results in better recovery ability and less injuries for every player (Bompa & Haff 2009, Jeffreys & Moody 2016)<sup>[10]</sup> Another advantage of this training is the improvement of opposite movement patterns balance. This is happening due to the low intensity which allows the athlete to perform exercises on various movement patterns. (Murphy and Schwarzkopf 1992; Swinnen 2016)<sup>[25]</sup> Finally there are authors who claim that this form of training results in great improvements in repeated sprint ability (Edge *et al.* 2006)<sup>[14]</sup> Blood Flow Restriction (BFR) training is a form of training where low intensity (20-25% of 1RM) is used, in combination with a restriction of blood flow in the muscle area that is trained. A pneumatic cuff is applied approximately to the muscle area we want to train and then the cuff is inflated to a specific pressure with the aim of obtaining partial arterial and complete venous occlusion. (Loenneke *et al.* 2012; Pope *et al.* 2013)<sup>[24, 27]</sup>

It has been strongly supported that this kind of training is beneficial for every athlete, as it results in strength and hypertrophy gains similar to high intensive training, as the hypoxic environment recruits fast-twitch (FT) muscle fibres. In addition the duration for full recovery is not long, as the muscle damage is not big and it needs 24 hours for an athlete to return to his baseline energy levels. (Laurentino *et al.* 2012; Loenneke *et al.* 2013, 2014; Wilson *et al.* 2013) A considerable number of sport scientists claim that this form of training can be used during periods where the training volume of the week is high, like weeks where two games are played. (Hortobágyi *et al.* 1993; Izquierdo *et al.* 2007; Koutedakis; 1995 Swinnen 2016) Hence it is clear that BFR can be used as a really useful tool to improve or maintain football player's performance, Specially on periods where training or game volume is high.

### Practical Applications and Periodization

Knowing that strength training does not result only in superior gains regarding performance but also can help athletes reduce injury rates, is really important. Nevertheless those information are useless if we don't take into consideration the time that this training is applied. Periodization of strength training is crucial, Specially from a microcycle standpoint. It is the authors opinion that when an S&C coach is programming strength training sessions for an upcoming week, he should take into consideration the phase of the season, the number of games that the team will

play and the levels of fatigue for every player. In the past S&C coaches use to design their periodization on a yearly manner. As football evolves and becomes more competitive we can see that there are many unpredictable parameters who can affect our programming procedure, Specially during in season. Thus an S&C coach can design his strength training sessions for the whole preseason period, but maybe it would be more reasonable and practical to evaluate first each in-season microcycle and then form his periodization for every week. Finally strength training during transition period is always based on every athlete's needs, and that's why mesocycles and microcycles-and strength training sessions- are not the same for every player.

### Conclusion

The opinion that strength training can have negative effects in football Players performance, is an point that is opposing what the majority of authors and sports scientist support. It has been proved scientifically that strength training can result in great advantages in player's performance, when this is applied on a proper and scientifically-based manner. There are four strength training strategies that can be applied when we want to achieve those advantages: Maximal strength, Power, Strength Endurance and BFR training. Nevertheless apparent from knowing those methods and their contents is not enough, as we should always consider the time the circumstances under which those training sessions will be applied.

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