

Plyometrics for Soccer

Plyometrics is a type of exercise training designed to produce fast, powerful movements, and improve the functions of the nervous system, generally for the purpose of improving performance in a specific sport. Plyometric movements, in which a muscle is loaded and then contracted in rapid sequence, use the strength, elasticity and innervation of muscle and surrounding tissues to jump higher, run faster, throw farther, or hit harder, depending on the desired training goal.

Plyometric training involves practicing plyometric movements to toughen tissues and train nerve cells to stimulate a specific pattern of muscle contraction so the muscle generates as strong a contraction as possible in the shortest amount of time. A plyometric contraction involves first a rapid eccentric movement, followed by a short amortization phase, then an explosive concentric movement, which enables the synergistic muscles to engage the myotatic-stretch reflex during the stretch-shortening cycle. Plyometric exercises use explosive movements to develop muscular power, the ability to generate a large amount of force quickly. Plyometric training acts on both the musculotendinous and neurological levels to increase an athlete's power output without necessarily increasing their maximum strength. Plyometrics are used to increase the speed or force of muscular contractions, often with goals of increasing the height of a jump or speed of a punch or throw.

Physics of plyometrics

Muscular power is determined by how long it takes for strength to be converted into speed. The ability to convert strength to speed in a very short time allows for athletic movements beyond what raw strength will allow. Thus an athlete who has strong legs and can perform the free-weight squat with extremely heavy weights over a long duration may get less distance on a standing long jump or height on a vertical leap than a weaker athlete who is able to generate a smaller amount of force in a shorter amount of time. The plyometrically trained athlete may have a lower maximal force output and thus may not squat as much, training allows them to compress the time required to reach their maximum force output, allowing them to develop more power with each contraction.



Musculotendinous component

For a muscle to cause movement it must shorten; this is known as a concentric contraction. There is a maximum amount of force with which a certain muscle can concentrically contract. However, if the muscle is lengthened while loaded (eccentric contraction) just prior to the contraction, it will produce greater force through the storage of elastic energy. This effect requires that the transition time between eccentric contraction and concentric contraction (amortisation phase) be very short. This energy dissipates rapidly, so the following concentric contraction must rapidly follow the eccentric stretch. The process is frequently referred to as the "stretch shortening cycle", and is one of the underlying mechanisms of plyometric training.

Neurological component

In addition to the elastic-recoil of the musculotendinous system there is a neurological component. The stretch shortening cycle affects the sensory response of the muscle spindles and golgi tendon organs (GTO). It is believed that during plyometric exercise, the excitatory threshold of the GTO's is increased, meaning they become less likely to send signals to limit force production when the muscle has increased tension. This facilitates greater contraction force than normal strength or power exercise, and thus greater training ability.

The muscle spindles are involved in the stretch reflex and are triggered by rapid lengthening of the muscle as well as absolute length. At the end of the rapid eccentric contraction, the muscle has reached a great length at a high velocity. This may cause the muscle spindle to enact a powerful stretch reflex, further enhancing the power of the following concentric contraction. The muscle spindle's sensitivity to velocity is another reason why the amortisation phase must be brief for a plyometric effect.

A longer term neurological component involves training the muscles to contract more quickly and powerfully by altering the timing and firing rates of the motor units. During a normal contraction, motor units peak in a de-synchronized fashion until tetany is reached. Plyometric training conditions the neurons to contract with a single powerful surge rather than several disorganized contractions. The result is a stronger, faster contraction allowing a heavy load (such as the body) to be moved quickly and forcefully.

Therefore, a plyometric exercise involves:

- An eccentric contraction
- A brief amortisation phase (no change in muscle length)
- A short concentric contraction delivering maximum force in a short period of time

Safety considerations

Plyometric exercises carry increased risk of injury due to the powerful forces generated during training and performance, and should only be performed by well-conditioned individuals who are under supervision. Good levels of physical strength, flexibility and proprioception should be achieved before commencement of plyometric training.

The specified minimum strength requirement varies depending on where the information is sourced and the intensity of the plyometrics to be performed. Chu (1998) recommends that a participant be able to perform 5 repetitions of the squat exercise at 60% of their bodyweight before doing plyometrics. Core body (trunk) strength is also important. Flexibility is required both for injury prevention and to enhance the effect of the stretch shortening cycle.

Proprioception is an important component of balance, coordination and agility, which are also required for safe performance of plyometric exercises.

Further safety considerations include:

- Age - low-intensity and low-volume only for athletes under the age of 13 or for athletes who squat less than 1.5 times their bodyweight.
- Surface - some degree of softness is needed. Gymnastics mats are ideal, grass is suitable. Hard surfaces such as concrete should never be used.
- Footwear - must have adequate cushioning and be well fitting.
- Bodyweight - athletes who are over 240 pounds (109 kg) should be very careful and low-intensity plyometric exercises should be selected.
- Technique - most importantly, a participant must be instructed on proper technique before commencing any plyometric exercise. They should be well rested and free of injury in any of the limbs to be exercised.

Plyometrics is not dangerous, but the potential for high intensity and stress on joints and musculo-tendonous units makes safety a strong prerequisite to this particular method of exercise. Low-intensity variations of plyometrics are frequently performed in various stages of injury rehabilitation, indicating that correct performance is valuable and safe for increasing muscular power in all populations.

Reducing the risk of injury

The following list of rules should help prevent serious injury to soccer athletes who perform plyometrics:

1. Athletes must not ignore any aches or pains in the lower back, knees, ankles, or feet. A certified health professional should evaluate the pain before the athlete continues.
2. To help absorb landing forces, players should wear a sturdy training shoe with a solid mid-sole and forefoot construction.
3. Athletes should perform a thorough flexibility routine and warm-up before training
4. Make sure the landing surface is resilient. Portable mats or grassy areas are acceptable surfaces. Gymnasium floors are not.
5. Do not begin a plyometric workout schedule without the benefit of a comprehensive training program.
6. Preadolescent athletes should avoid plyometrics because of the stress on immature bones and connective tissues. Strength at this age will be sufficient for increasing speed and power without the use of plyometrics.

Using proper technique

Technique for any exercise is important, particularly when athletes are working on creating power. For speed of movement, proper positioning, and injury prevention, athletes must observe certain performance parameters.

- Players should land with as little flexion as possible at the ankles, knees, and waist. Too much flexion means too much

time on the ground, which translates into reduced reaction time and speed of movement.

- For explosion, balance, and reaction, athletes should use their arms aggressively.
- Players must rest between sets for proper recovery. Plyometrics is a high-quality exercise. Players should not be fatigued while performing the drills.
- Athletes should maintain a position of balance from the beginning of the movement to the end.
- Drills should be closely related to soccer movements, including speed and change of direction.



Improving Balance

Hurdling, hopping, and jumping over objects require balance for proper execution. Changing directions rapidly while dribbling or marking would be almost impossible without good balance. Plyometrics, whether performed with one or two legs, will force the body to learn balance and at the same time create strength in a balanced position. This training has a carryover effect to the most fundamental soccer actions—jumping, heading, tackling, striking, and positioning.

Training for explosiveness

Explosiveness here refers to rapid acceleration or a quick change of direction. The ability to attain speed from a dead stop is demonstrated when a back-to-the-goal attacker turns and sprints to the near post for a shot on goal. The player who jumps for a punted ball at midfield in a group of defenders must jump vertically as fast and high as possible. Changing direction at any speed with little delay occurs when a wing jogs slowly down the sideline and then breaks at full speed to the goal for a cross ball. Rapid acceleration from different running speeds is required when a defender moves slowly into position, and then marks an opponent without the ball, and then sprints as an attacker tries to reach a free ball in the corner.

Plyometric drills combine speed and strength, enabling the athlete to move quickly from a dead stop or accelerate in any direction at any speed.

How to make Plyometrics Effective

Randomly performing plyometrics without any attention to progression, technique, or conditioning will result only in injury and frustration. If you want your plyometric program to work, you must consider three major points.

Strength training

We hope by now you see that becoming stronger is essential to success in soccer. Earlier we discussed how important strength is to becoming more explosive. Strength is equally important in reducing injury while performing plyometrics. Leg strength is critical to avoiding injury to the knees, ankles, and lower back. Because plyometric movements are ballistic, a certain strength base is essential to prevent injuries as well as gain optimum benefits. Some data have indicated that an athlete should be able to squat between 1.5 to 2.0 times her body weight before engaging in a plyometrics program. But we feel that if a lower-body strength program is in place, the training should bring about positive changes in speed and explosiveness. Do not consider a plyometric program without a solid lower-body strength program and a comprehensive conditioning schedule. All three components must be present.



Some Sample Plyometric Exercises for Soccer

Here are some sample plyometrics for soccer exercises. A session might contain between 10 and 15 sets of 8 to repetitions in total. For example, you could choose 4 exercises and perform 3 sets of 8 reps for each exercise.

Exercise 1: Jump Running

This is one of the easiest plyometric exercises. Simply run in 'slow motion' landing on alternate feet. Try to achieve as much height and distance with each stride as possible. For every right and left foot strike, count one repetition.

Exercise 2: Bounding

1. Mark out a series of small cones or obstacles about 3 feet apart in a straight line. The number of obstacles depends on the number of repetitions you are performing.
2. Start behind the first obstacle in a semi squat position.
3. Jump as high and far as possible over each obstacle. It's a good idea to practise first to gauge how far apart you should set the markers. Again try to minimise ground contact time.
4. You can use anything to jump over, a training top or even just a line on a track.

Program

A conditioning program consisting of both plyometric training and resistance training can improve power performance. It appears that concurrent resistance and plyometrics training can actually improve power to a greater extent than either one alone. However, the overall program should be carefully planned as heavy weight training and plyometric training are not recommended on the same day. One way around this is to alternate upper body and lower body exercises as follows:

Table 1: Integrating Plyometrics with Concurrent Strength Training

Day	Strength Session	Plyometric Session
Monday	Upper body (high intensity)	Lower body (low intensity)
Tuesday	Lower body (low intensity)	Upper body (high intensity)
Wednesday	Rest Rest	
Thursday	Upper body (low intensity)	Lower body (high intensity)
Friday	Upper body (high intensity)	Lower body (low intensity)

Exercise 3: Ricochets

1. Mark out a small box shape on the floor (about 2 feet square) with paint or chalk.
2. Keeping your feet together, start at one corner of the box and perform small jumps from corner to corner in a random manner.
3. For this exercise the emphasis should be on speed and rate of leg movement rather than height.
4. Each ground contact is 1 repetition.

Exercise 4: Lateral Jumps

This is an advanced plyometric exercise. Build up to it over several weeks. Keep the total number of sets for advanced exercise down to 3-6.

1. Stand alongside a bench, box or cone approximately 30cm high.
2. Keeping your feet hip distance apart jump sideways as high over the obstacle as possible.
3. Immediately jump back to the start position minimising ground contact time. This counts as one repetition.
4. You can use anything to jump over, a training top or even just a line on a track. Just make sure you discipline yourself to jump as high as possible.

Exercise 5: Depth Jumps

This is an advanced plyometric exercise. Build up to it over several weeks. Keep the total number of sets for advanced exercise down to 3-6.

1. Stand on a box, bench or sturdy chair approximately 30-40cm high.
2. Step off the bench (don't jump off) and as soon as you land explode vertically as high as you can.
3. Try to minimise ground contact time i.e. don't sink down into a deep squat before jumping up.