

Lower-Body Resistance Training: Increasing Functional Performance with Lunges

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SQUATTING MOVEMENTS HAVE been used in the training programs of athletes for many years. Generally, squats are performed with the feet in line with each other about shoulder width apart. However, in most sports, the feet are not together but split apart so that 1 foot is in front of the other. This position of the feet is often referred to as the split position.

Recently, Hydock (5) outlined the sport-specific nature of the split position through exercises such as the split squat, clean, and snatch. For many athletes, these exercises can have significant advantages over traditional lower-body exercises such as the back and front squat and leg press and even several advantages over the power clean and power snatch (5). As previously mentioned, the feet are seldom, if at all, together in common human movements such as running, jumping, and throwing. Therefore, the performance of lower-body exercises in which the feet are together does not replicate this fundamental aspect of human movement. As such, the benefit gained from these traditional exercises is unlikely to be optimal.

Performing exercises with 1 limb at a time also has several benefits. These include the ability to detect muscular imbalances between each limb (9) and being able to focus on 1 limb at a time, thereby taking advantage of the bilateral deficit (see Sale (8) for more details) and the greater proprioceptive demand these split position exercises impose on the athlete (9). Due to this greater proprioceptive demand, these split position exercises may help athletes improve the dynamic stability throughout the lower body and torso. Therefore, athletes who utilize split position exercises in their training will tend to have a greater ability to maintain balance even when hit by external forces as in contact with other players in sports such as gridiron, rugby league or union, basketball, and hockey. Due to the large range of motion associated with some split exercises, these exercises can also help improve dynamic flexibility in the ankle, knee, and hip joints.

However, even the split position exercises outlined by Hydock (5) have some limitations, namely the direction of force/power appli-

cation. While the production of vertical force and power by the lower body is a vitally important skill in sports such as basketball, volleyball, gymnastics, and high jump, most sports also require the ability to produce force and power in anterior, posterior, and lateral directions.

To train the body to more effectively apply force in the anterior, posterior, and lateral directions, a number of lunge variations can be included in the training program. Some lunge variations will now be outlined, and sporting actions that may benefit from them will be described. However, creative strength and conditioning coaches should feel free to adapt these exercises to meet the specific demands of the athletes with whom they work.

■ Front Lunge

The front lunge is the standard style of lunge done in many gyms by a variety of people. In the front lunge, a forward step is taken followed by a powerful push backward. It serves well as an introduction to other forms of lunges and is a logical progression once

the split squat has been mastered. As with most lunges, the front lunge offers a good eccentric challenge to most of the extensor muscles in the lower body, especially the extensors of the hip and knee joints (7). This is due to the body initially moving forward until the foot contacts the ground, at which time the lead leg powerfully pushes the athlete back to the starting position. As such, the front lunge is a good exercise for athletes who need to rapidly decelerate their forward momentum and begin backpedaling, such as a tennis player who has moved toward the net to volley but then has to move backward to smash an opponent's lob shot or a rugby league player who has to backpedal 10 m to get back into the defensive line after performing a tackle.

Starting Position

Feet should be shoulder width apart with a light barbell resting comfortably on the shoulders or a light dumbbell in each hand, with the back straight or slightly arched.

The Exercise

The exercise is performed as follows:

- Take a moderately large step forward with the left leg so that the left thigh is parallel to the ground, the left knee is located directly above or slightly in front of the left toes so that the right knee is slightly behind the hips, slightly bent, and just above the level of the floor. (See Figure 1.)
- Using the power of the left leg, push backward so that both legs are again together. Repeat for the desired number of sets and repetitions.
- Throughout the entire exercise, focus on maintaining the back in a straight or slightly



Figure 1. Front lunge: position for exercise.

arched position and on keeping the upper body as vertical as possible.

Some beginners may show some lateral pelvic and/or torso flexion during this and other versions of the lunge due to a lack of muscular control or strength in the stabilizers of the hip and torso. Another relatively common problem in beginners is their upper body may lean too far forward at the bottom position of the lunge, which suggests a lack of flexibility in the hip flexors. Some beginners can also experience difficulty reaching a position in which the front thigh is parallel to the ground. This tends to indicate tightness in the hamstrings or calves. Beginners who exhibit any of these flexibility deficits will need to focus on stretching the tight muscle groups as well as striving to gradually increase the range of

motion during the performance of the lunges.

If the strength and conditioning coach offers immediate feedback to the athlete and applies the use of the correct stretches during the learning phase of this and other lunge exercises, these problems can be corrected.

Reverse Lunge

The reverse lunge is similar to the front lunge except that the initial step is backward followed by a powerful push forward. The concentric phase of this exercise is quite similar to the sprint start from blocks and to that of a low, driving tackle as used in rugby league or rugby union, in which the tackler aims to make shoulder contact with the ballcarrier's hips and drive the ballcarrier backward.

The reverse lunge may also help the athlete change direction from backward to forward running. This may be applicable to a basketball player who is backpedaling while playing defense and steals the ball from the opponent, then attempts to quickly run toward the offensive end of the court. Rugby league players who have to run backward for 10 m after a tackle before running forward to make another tackle may also find this exercise beneficial.

Starting Position

The starting position for the reverse lunge is identical to the position for the front lunge.

The Exercise

The exercise is performed as follows:

- Step back with the right leg so the right knee is under or slightly in front of the hips and bent at around 90° and the left thigh is parallel to the floor with the left knee above the



Figure 2a. Reverse lunge: position for exercise.

left toes. (See Figure 2a.) While the position of the body segments is similar to that for the front lunge, the rear foot during the reverse lunge is not as far behind the body as in the front lunge, which will allow the rear leg to more readily assist the front leg during the concentric phase.

- If the reverse lunge is used in the in-season phase of training to improve transition from backward to forward movement, the knee of the front leg should only be allowed to flex by about 45° before the athlete initiates the concentric phase, as this angle will more closely replicate the position of the front knee in these activities.
- Using both legs, push forcefully back to the starting (finishing) position and repeat for the desired number of sets and reps.

- As with the front lunge, keep the back straight or slightly arched at all times during the exercise. As seen in Figure 2a, the upper body should have some degree of forward inclination, as this puts the body in a more favorable position to produce forward momentum.

Once technique has been mastered and the reverse lunge is used as a power exercise, the athlete should generate enough velocity through the concentric phase of the lift so that each repetition is finished with a jump into the air or so the athlete is at least on the toes of the lead foot. (See Figure 2b.) Therefore, when used as a power exercise, the reverse lunge shares some similarities to the frog leap from a block stance as described by Blazevich (2), although the reverse lunge allows greater levels of resistance to be used than does the frog leap.

■ Forward Walking Lunge

The forward walking lunge is the same as the front lunge except the trail leg comes through and past the lead leg so that, with each repetition, the athlete is 1 stride further away from the starting position. This sequence is repeated for the desired number of repetitions or distance. Therefore, the forward walking lunge is similar to the typical running gait with respect to the range of motion about the ankle, knee, and hip joints and direction of force application, although it is performed at a slower speed.

Starting Position

The starting position for the forward walking lunge is the same as for the front lunge.

The Exercise

The exercise is performed as follows:

- Step forward with the left leg in an identical manner as in the front lunge. (See Figure 1.)
- At the conclusion of the eccentric phase, i.e., in the bottom position of the lunge, push the body weight upward and forward and, in 1 complete motion, bring the right leg through until the right foot contacts the ground in front of the body. Push upward and forward off the right leg until the left foot contacts the ground in front of the body.
- Repeat this cycle for the desired number of sets and repetitions.
- Ensure that the upper body remains as vertical as possible during the ascent. This can be achieved by focusing on keeping the hips pushed forward.



Figure 2b. Reverse lunge: jump position.

■ Angled Forward Walking Lunge

This is identical to the forward walking lunge except that the athlete steps at an angle (approximately 30°) away from the forward direction while attempting to keep the body facing directly forward. Therefore, this exercise requires significant levels of vertical, anterior, and lateral force application and therefore is useful in conditioning the body for sidestepping maneuvers. Due to the lateral component of this exercise, the adductors and abductors of the hip are stressed to a greater extent than with the previous three lunge variations, which have focused on the hip, knee, and ankle extensors.

Starting Position

The starting position for the angled forward walking lunge is the same as for the front lunge except 1 foot is placed on each side of a line on the floor.

The Exercise

The exercise is performed as follows:

- While facing directly ahead, i.e., in the direction of the line on the floor, step with the left leg to the left at 30° to the line. (See Figure 3a.)
- Upon completing the eccentric phase, push through with the lower body so that a step is taken forward and to the right with the right leg at the same angle as used with the left leg. Hence, the right foot should land somewhere on, or very close to, the line with each step. (See Figure 3b.)
- Concentrate on keeping the orientation of the upper body and hips parallel to the line throughout the whole exercise, even when stepping laterally. If this is not done and the

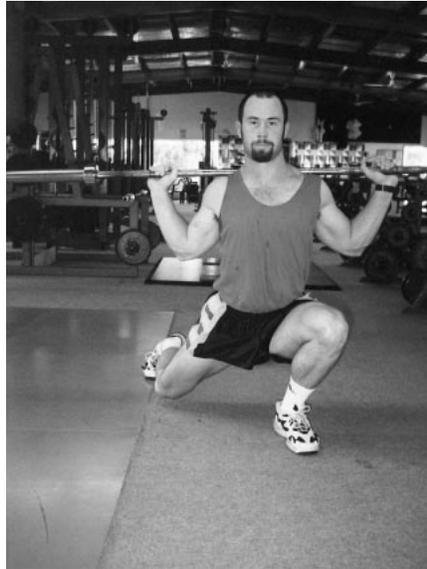


Figure 3a. Angled forward walking lunge: step with left leg.

upper body is allowed to follow the lower body along the 30° angle, the exercise may not fulfill its purpose of improving lateral motion because the resulting lateral motion would be caused by pivoting on the front foot and not by movement of the hips.

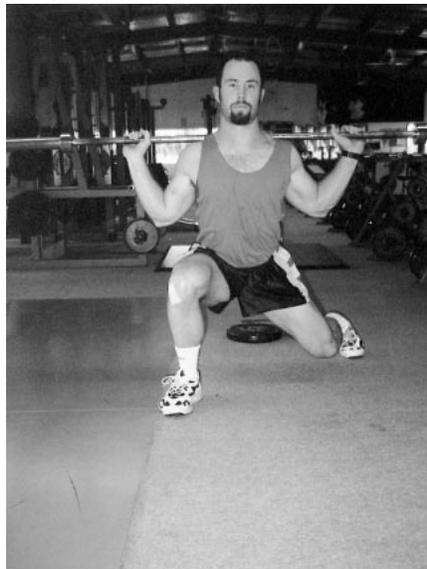


Figure 3b. Angled forward walking lunge: step with right leg.

■ Lateral Lunge

The lateral lunge is similar to the lateral squat described by Cross (3). However, the athlete should start with feet together and make a step with 1 leg directly to the side and, upon obtaining a position in which the thigh is parallel to the floor, push forcefully until both feet are back together again. Due to the fact that 1 foot is always moving on and off the ground, the lateral lunge would be thought to place greater proprioceptive demands on the athlete than the lateral squat (9). As a consequence of the lack of anterior or posterior movements, the lateral lunge places even greater stress on the hip adductors and abductors than does the angled forward walking lunge. Therefore, the lateral lunge should be beneficial for very tight sidestepping maneuvers seen in activities such as gridiron, rugby league and union, basketball, and downhill skiing.

Starting Position

The starting position for the lateral lunge is the same as for the front lunge.

While dumbbells can be used, they tend to get in the way of the legs during the lateral step. As such, a barbell is the preferred option, although collars should always be used due to the fact that the barbell may not always be parallel to the floor in this exercise, especially when performed by beginners.

The Exercise

The exercise is performed as follows:

- Step directly to the left with the left leg using a moderately long step and allow the left knee to bend until the left thigh is parallel to the floor (flexibility permitting).
- The length of the step is wide

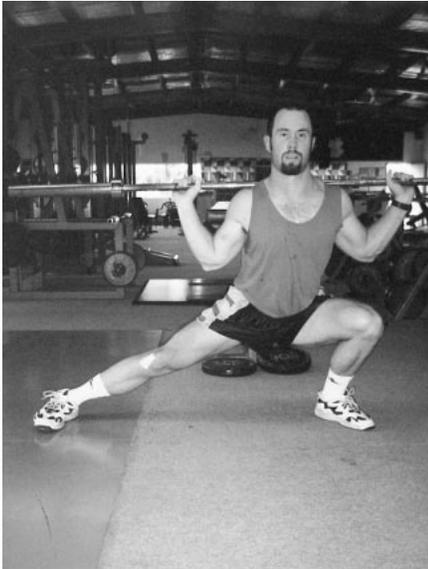


Figure 4. Lateral lunge: position for exercise.

enough so that the left thigh is approximately parallel to the floor and the right leg is straight (see Figure 4).

- Make sure that the feet are facing in the same direction as the knee (especially that of the moving leg), i.e., straight ahead or slightly to the outside, to minimize knee strain.
- Once the left thigh is parallel to the ground, forcefully push back to the right with the bent left thigh.
- Focus on keeping the back straight or slightly arched throughout the exercise and on keeping the torso as vertical as possible, especially as fatigue starts to set in.
- Complete the desired number of sets and repetitions.

■ Instructing, Programming, and Periodization

The order in which these lunges have been described is a general order in which most athletes can be taught these exercises, from the simplest (the front lunge) to the hardest (the angled forward walking lunge and the lateral

lunge). For athletes who have trouble with the front lunge, the split squat as described by Hydock (5) could be used as a preparatory exercise. Initially, these lunge exercises should be performed at a slow to moderate speed and only done explosively once technique at slower speeds is mastered (1, 9).

Once a specific lunge exercise has been mastered with an athlete's bodyweight, dumbbells can be used to increase the loading on the athlete as well to offer a greater proprioceptive challenge. On obtaining proficiency with the dumbbell lunge, the next progression for all athletes is to use the Olympic bar. Due to the length of the Olympic bar and the fact that it is positioned on the shoulders, its use results in a greater proportion of the mass being outside the athlete's base of support and an increase in the height of the athlete's center of gravity (4). Due to these factors, stability would be harder to maintain while performing barbell than dumbbell lunges (4). Once lunges can be performed satisfactorily with the Olympic barbell, a cable can also be attached around the waist of the athlete to add more resistance in specific directions for these lunge exercises. The front, reverse, and lateral lunge are most easily adapted to the use of cables, as the athlete does not move very far from the pin-loaded cable machine. Experienced lifters can utilize cable resistance along with that provided by either a barbell or dumbbells. When any lunge is done in this fashion, a very high level of proprioceptive demand is placed on the athlete due to the different line of pull of the cable in comparison to the dumbbells or barbell, especially when the lunge is performed rapidly (9).

The use of cables has several benefits over the use of dumbbells

or barbells. First, the athlete has to exert even greater levels of force in the anterior, posterior, or lateral directions due to the line of pull of the cable. Second, the stabilizers of the trunk have to work harder to maintain the natural curvature of the spine due to the different line of pull of the cable relative to the effect of gravity on the lifter's upper body. To help athletes maintain balance during the performance of any type of lunge, the strength and conditioning coach should emphasize a few key points. These are

- The athlete should maintain the upper body in the same position as recommended for squats, with the head and chest up, shoulders back, and stomach in.
- The athlete should try to keep the upper body as vertical as possible and push the hips through with each repetition (except for the reverse lunge, where some forward inclination is required).
- When stepping forward or backward, the feet should not be in a straight line with each other but rather about 20-30 cm apart to ensure sufficient lateral stability.

The strength and conditioning coach should also closely monitor the athlete's foot position relative to the knee, the foot's orientation to the knee, as well as the degree, if any, of lateral flexion of the pelvis or torso and correct where necessary.

While it could be argued that most of these lunge exercises are usually performed at slow to moderate velocities, some variations (front, reverse, and lateral lunges) can be performed at relatively high speeds and are therefore likely to improve power performance. When performed to enhance power, the athlete should

take a quick step in the intended direction to cause a rapid eccentric contraction in the involved leg. Aiming to minimize ground contact time, the athlete then rapidly performs the concentric contraction. Due to the intention of minimizing ground contact time, the range of motion may decrease while performing these lunges when the emphasis is on enhancing muscular power. However, this is generally not a problem, as this shortened range of motion is common in various actions such as sidestepping and jumping when performed at maximal speed.

To improve strength or muscular hypertrophy, Baker (1) suggests a full range of motion in conjunction with a more moderate speed of execution than that used for power training. As a consequence of the greater range of motion, the athlete will lose some leverage, which will in turn increase the difficulty of driving out of "the hole" and result in a more moderate speed of execution.

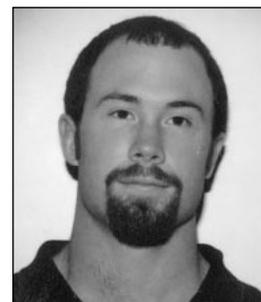
To increase strength and muscular hypertrophy, it might also be useful for the athlete to perform 1 set of lunges with the left leg followed by 1 set with the right leg or vice versa. This will increase the fatigue experienced by the working muscles and may contribute to greater gains in strength and hypertrophy as high-intensity fatigue is thought to act as a stimulus for these aspects of muscular function (6).

However, for the enhancement of muscular power, the alternating of legs, i.e., 1 rep with the left leg followed by 1 rep with the right leg, should be used in most cases. This will allow each leg some recovery between repetitions, and hence each repetition can be performed at greater speed.

Since these lunge exercises can be used to target muscles that are not overloaded through a full range of motion in most traditional leg exercises; require application of force in anterior, posterior, and lateral as well as vertical directions; and demand high levels of stability and balance, these exercises can serve many purposes. In addition to assisting in the development of muscular hypertrophy and strength, they can be used for injury prevention and as specific preparatory exercises for a wide range of plyometric and agility drills. This approach ensures that the athlete has adequate strength, flexibility, and stability in the lower body and torso so that the plyometric drills can be performed effectively and safely (9).

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