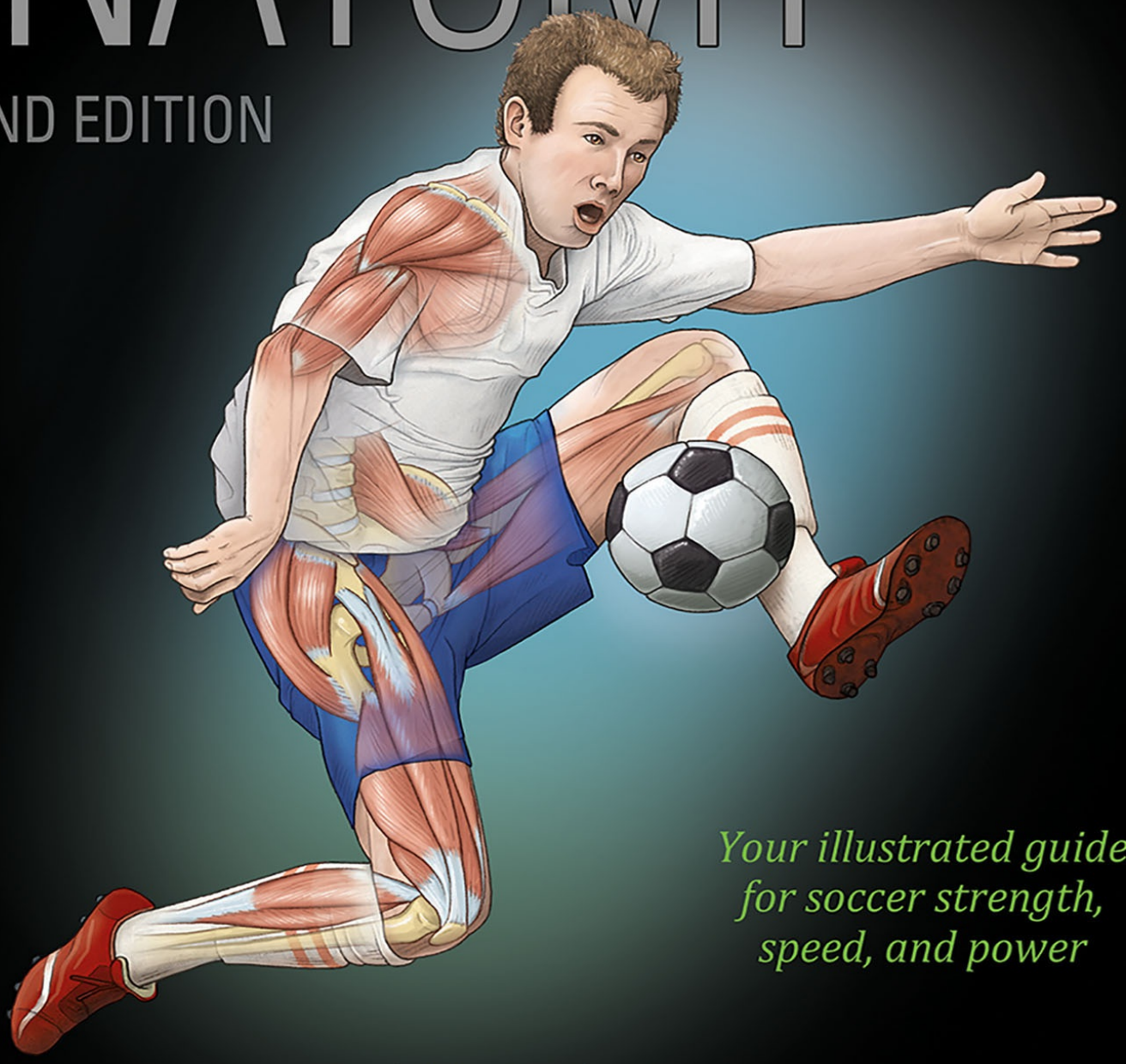
SOCCER ANATOMY

SECOND EDITION



Your illustrated guide for soccer strength, speed, and power

DONALD T. KIRKENDALL | ADAM L. SAYERS

SECOND EDITION

Soccer ANATOMY

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Adam L. Sayers, PhD

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For all those young players and coaches wanting to raise their game.

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PREFACE

Pelé called it "the beautiful game." The simplicity of his comment about soccer has resonated among fans of the game for decades. The beauty of soccer begins with skill. Beautiful soccer means controlling an impossible ball, such as Dennis Bergkamp's 89th-minute goal in the 1998 FIFA World Cup or Maxi Rodriguez's chest-to-volley strike from the upper corner of the penalty area at the 2006 FIFA World Cup. Soccer's beauty is in the perfectly paced seeing-eye pass threaded through the smallest opening in the defense, which you will see anytime Luka Modric (Croatia), Kevin De Bruyne (Belgium), or Paul Pogba (France) is playing. Soccer's beauty is also seen in a solo dribbling run through the defense, such as Diego Maradona's 1v7 run against England in the 1986 FIFA World Cup or in nearly any game featuring the incomparable Leo Messi. You can also find the beauty in the long-range "bombenschuss" strike by Paul Breitner at the 1974 FIFA World Cup or the audacious half-field score by Carli Lloyd in the 2015 FIFA Women's World Cup final.

Then there is tactical brilliance. How about the 25-pass sequence to a goal by Argentina against Serbia in the 2006 FIFA World Cup or the lightning-fast length-of-the-field counterattack for a goal by the United States against Brazil in the 2009 FIFA Confederations Cup final? Brazil's fourth goal against Italy in the 1970 FIFA World Cup is still considered a masterful display of teamwork, skill, and guile.

The objective of soccer is the same as in any other team sport: Score at least one more than the opponent to win the game. This simple philosophy is enormously complicated. To be successful, a team must be able to present a physical, technical, tactical, and psychological display that is superior to the opponent. When these elements work in concert, soccer is indeed a beautiful game; when one aspect is not in sync with the rest, however, a team can be masterful and still lose. The British say, "They played well and died in beauty."

Soccer, like baseball, has suffered under some historical inertia: "We've never done that before and won. Why change?" or "I never did that stuff when I played." That attitude is doomed to limit the development of teams and players as the physical and tactical demands of the game advance.

How the game has advanced! For example, the first reports on running distance

during a match noted English professionals of the mid 1970s (Everton FC) averaged about 8,500 meters (5.3 miles). Today, most distances average between 10,000 and 14,000 meters (6.2 and 8.7 miles). There are reports that many females, with their smaller hearts, lower hemoglobin levels, and smaller muscle mass, can cover the 6 miles attributed to men. The distance and number of runs at high speed have also increased as the pace of the game has become more ballistic and powerful. To those of us who have followed the game over the years, the professionals sure do seem to strike the ball a lot harder now.

The benefits of soccer extend beyond the competitive game. There is a continuing line of evidence showing that regular participation in recreational soccer by children, adults, and seniors (up to 70 years of age and beyond) is as effective as traditional aerobic exercise such as jogging for general health. In most cases, recreational soccer is better than more traditional exercises such as jogging or instructor-led classes. Regular recreational soccer play helps (1) stabilize or even reduce blood pressure, (2) improve cardiovascular structure and function, (3) improve the body's ability to handle fats and glucose, (4) strengthen bones, and (5) allow players to lose fat mass. These benefits have been shown to occur in people with type II diabetes, hypertension, weight issues, and selected cancers, and soccer can even help improve the health of the homeless. That's quite a host of benefits—all from playing an enjoyable game. An interesting side note is that when those studies were concluded, many non-soccer-playing participants just quit, but soccer players looked at each other and said, "Great. Can we go play now?"

The soccer community—and not just in the United States—has viewed supplemental strength training with skepticism. In addition, soccer players tend to view any running that is longer than the length of a field as unnecessary; players tend to avoid training that does not involve the ball. But give them a ball, and they will run all day. The problem is that many coaches apply the principle of training specificity too literally ("if you want to be a better soccer player, play soccer") and end up denying players training benefits that are proven to improve physical performance and prevent injury.

There are two major additions to this second edition. Foremost is the addition of a practicing coach who can offer insights about training as applied to the modern game. Adam Sayers brings a wealth of academic and coaching experience. He has a PhD in human performance, holds the A license from both the USSF and UEFA, is the all-time winningest coach of women's soccer at East Tennessee State University, and is part of the USSF sport science staff that works with the U18, U19, and U20 women. His insights are a welcome addition. The second major addition is a new chapter directed at comman injuries and their prevention, which should be an important feature of any type of soccer-specific and supplemental training. There are plenty of potential readers who

might not blindly accept that training can prevent injuries. Thus, the decision was made to add a new chapter specifically devoted to injury prevention. Results of research on the most common types of injuries and their prevention are presented in chapter 2.

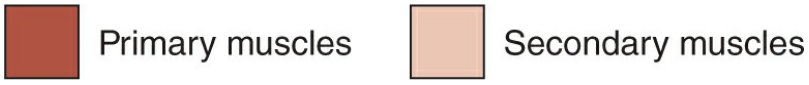
This book is about supplemental strength training for soccer. When developed properly, increased strength will allow players to run faster, resist challenges, be stronger in the tackle, jump higher, avoid fatigue, and prevent injury. Most soccer players have a negative attitude toward strength training because it is done in a weight room and does not involve the ball. These attitudes were taken into consideration when the exercises in this book were selected. Many can be done on the field during routine training, and some involve the ball.

When a player or coach does favor some strength training, the primary focus is usually the legs. But as any strength and conditioning specialist will tell you, a balance must be struck up and down the body because the body is a link of segments—chains, if you will—and the most prepared player will have addressed each link of the chain, not just an isolated link or two. Furthermore, those same specialists will say that while one group of muscles may be important within a sport, to address that group alone and neglect the opposite group of muscles will result in an imbalance around that movement or joint. Imbalances are known to raise the risk of injury. It has been known for years that strong quadriceps and weak hamstrings increase the risk of knee injuries, but it is also known that athletes with a history of hamstring injuries not only have weak hamstrings but also have poor function in the gluteal muscles. Weak hamstrings are also implicated in low back issues. The first edition of Soccer Anatomy presented 73 exercises. About 20 to 25 percent of the exercises in this second edition are new and reflect recent trends in supplemental training.

Many readers will review these exercises and select those that address specific weaknesses. The exercises in Soccer Anatomy are good choices to supplement traditional soccer training, but the concepts continue to evolve. These exercises are a good place to begin. With a regular program that uses systematic progression, players will improve aspects of fitness important for competitive play—aspects not addressed in traditional ball-oriented training. Players who want to keep playing and stay healthy with as few injuries as possible need to include some strength training. Players who neglect the strength element of training but want to move up to the next level of competition will be in for a shock. They will discover how far behind they are and realize just how much catching up is necessary. Should these exercises be considered the definitive list? Of course not. Will conditioning professionals offer alternatives? Of course they will. But this is a good starting point with options for the coach and player.

The unique aspect of Soccer Anatomy isn't the supplemental exercises; many other resources can provide suggestions. Soccer Anatomy takes you inside each exercise to

show you which muscles are involved and how they contribute to proper execution of the exercise and to success on the field. The anatomical illustrations that accompany the exercises are color coded to indicate the primary and secondary muscles featured in each exercise and movement. Non-muscle anatomical structures that also are involved are indicated in italics.



Use this information to improve your skill, build your strength and endurance, and stay on the pitch. Choose exercises that are appropriate for your age, gender, experience, and training goals. Even young athletes can benefit from resistance training. In preadolescent athletes, strength improvements come mostly from increasing training volume by adding repetitions and sets while using modest resistance (e.g., 2 or 3 sets of 12 to 15 repetitions on 2 or 3 nonconsecutive days per week). Excellent exercise choices for preadolescents are those that use body weight for resistance.

Resistance training, like any physical training, has inherent risks. As athletes mature, they are better able to process, follow, and adhere to directions that minimize injury risk. In general, when an external resistance is lifted, such as a barbell or dumbbell, the set is performed to muscle failure. Exercises that use body weight as resistance usually have a set number of repetitions as a goal, although sometimes muscle failure occurs before the goal is reached. Depending on the training goal, the load must be individualized and age appropriate. When the desired repetitions in a set is reached without muscle failure, increase the resistance by 5 to 10 percent.

Training goals will influence the workout program. Improving local muscle endurance requires high volume (sets of 20 to 25 repetitions) and low intensity. Hypertrophy training acts as the entry point to higher-quality training and requires 10 to 20 repetitions per set and low to moderate intensity. In basic strength training, the intensity is high (80 to 90 percent of capacity), but the volume is low (two to five repetitions per set). Power training, which usually includes explosive movements, requires a higher intensity (90 to 95 percent of capacity) and a low volume (two to five repetitions per set). In general, soccer players should focus on higher-volume exercises of low to moderate intensity, performed twice a week during the season with a focus on maintenance. Save strength and power gains for the off-season.

Safety is key when working out in a weight room. Always work with a spotter. Use safety collars on weights. When picking up weight plates, lift with your legs, not your back. Drink fluids regularly, and use correct posture and form. Dress properly, and be careful not to drop weights. Consider keeping a workout journal to track your progress. Listen to your body, and don’t work through joint pain or unusual muscle pain. See a

physician who specializes in sports medicine. If you want to recruit help in the weight room, consult a certified strength and conditioning specialist (CSCS certification) or certified personal trainer (CPT certification).

1
THE SOCCER PLAYER IN MOTION

Unlike individual sports such as golf, dance, swimming, cycling, and running, in which the individual athlete largely dictates her own performance, soccer is a team sport. A team sport adds the dimensions of direct opponents, teammates, a ball, and rules regarding fouls and conduct that are applied during a constantly changing environment of individual, small-group, and large-group offensive and defensive tactics. A team sport such as soccer requires a range of complexity, intensity, and physical and mental preparation beyond what is seen in many individual sports.

Preparation for competition in a team sport involves skill acquisition, tactical development, mental preparation, and physical training. Soccer players must prepare for nearly all aspects of physical fitness. As a result, a well-trained soccer player typically excels in all aspects of fitness if he is not especially outstanding in any one aspect (one notable exception is agility). A sprinter must have speed. A marathoner must have endurance. A weightlifter must have strength. Unlike these sports, soccer does not require a player to excel in any one area of fitness to be successful. This explains part

of soccer's appeal—anyone can play.

This chapter focuses on the physical demands of soccer, but inherent in any discussion of the physical work required is the inclusion of some basic tactics. Tactics and fitness are intimately related. To know the players, one must know the game. Is a team's tactical performance the result of the players' fitness levels? Or does a higher fitness level allow the team to execute a broader vision of the game? That's soccer's version of the chicken or the egg question.

THE SPORT OF SOCCER

At its most basic level, soccer appears to be a game of nonstop motion. The adult game consists of two 45-minute periods played with a running clock with the potential of up to 30 minutes of overtime if the scores are tied after the completion of the second half. (In leagues with younger players, the duration of each half is shorter.) There is no allowance in the rules for the clock to stop, but local leagues may allow stoppages. Although the clock runs continuously, the ball is not in play for the full 90 minutes. In general, the ball is in play for only 65 to 70 minutes. All those seconds when the ball is out of play—after a shot or a goal, over the touchline, before a corner, during an injury, when a player is singled out by the referee, and so on—add up. If the referee believes these circumstances are shortening the game, additional time, called stoppage time, may be added to the end of each half. One of the charms of the game is that the only person who knows the actual game time is the referee. Note: Some leagues, such as the National Collegiate Athletic Association (NCAA) and many high school leagues, control match time from the sideline.

Since the game is not continuous, neither is the running of each player. The game can generally be described as consisting of longer periods of low-intensity activity interspersed with shorter periods of high-intensity, maximal, and explosive activity. Specifically, people who study the movement of soccer describe several distinct actions: standing, walking, jogging, cruising, and sprinting. Cruising is defined as running with manifest purpose and effort, which is faster than a jog but slower than a sprint. The speeds above jogging are sometimes further defined as high-intensity running and very high-intensity running, which are further combined with jumping, sideways running, diagonal running, and backward running. A soccer player will execute nearly 1,000 to 1,200 distinct actions during a 90-minute match. For the player, action changes about every four to six seconds. When the running pattern is viewed like this, the game is no longer considered to be continuous activity simply because of a running clock. Instead, soccer is a hybrid of many actions, speeds, and changes of direction. Because the action changes frequently, it is not surprising that soccer players consistently score extremely high on agility tests. The bulk of the data on the physical demands of soccer,

however, is based on the smallest fraction of actual participants: adult male professionals. So while the absolute distances and speeds one might obtain on players who are younger, less experienced, and less skilled will be less, the basic pattern of running is fairly consistent.

Successful soccer is about how each team uses space. Soccer tactics can be summarized in a simple concept: When on offense, make the field as big as possible (attacking team shape); when on defense, make the field as small as possible (defending team shape). Taking this definition further, four phases can be identified:

1. When team A initially gains possession of the ball and team B is unset (team B transitions from attacking shape to defensive shape)
2. When team A has possession of the ball and team B is set (team B has attained defensive shape)
3. When team B initially gains possession of the ball and team A is unset
4. When team B has possession of the ball and team A is set

The style of play a team adopts can influence the decision of action in each case. For example, a team that plays a counter-attacking style of play typically will attempt to attack immediately upon winning possession, when the opposition is unset. Conversely, a team that plays a possession-based style may attempt to secure possession safely rather than attack immediately upon gaining possession, allowing the opposition to get set defensively.

In addition to the style of play a team adopts, the system of play selected by the coaching staff can also vary. Many systems exist, and the selected system is usually dictated by the strengths and characteristics of the players available. The role and responsibilities asked of any player within a system can differ greatly from the role and responsibilities of a player in a similar position in a different system of play, with a different style of play. The physical aspect of the game heavily influences the decision of system and style of play, and vice versa.

BALL MOVEMENT

The objective of soccer is the same as in any other team sport: Score more than the opponent. On average, 1.5 to 2 goals are scored per match. When counted over many matches, shooting success is relatively low. The overall shots-to-goals ratio is typically 10-to-1. At the 2014 FIFA World Cup Brazil, the average number of passes by a team was 390 per match, which is based on 32 teams over 63 matches. Individual teams have recently posted some impressive numbers. In October 2017, for example, Manchester City completed 844 passes in a league match against West Bromwich Albion. Because

of the nature of the sport, ball possession changes constantly. Over 90 minutes, a team will have about 240 or more separate ball possessions, which averages to 10 or 11 seconds per possession. (Remember, one team does not have possession for the full 90 minutes; the other team has possession, too.)

A ball possession can be brief, with no completed passes, or consist of a long string of completed passes before possession is lost because of poor skill, an intercepted pass, a tackle, a ball lost out of play, or a goal. When plotted over thousands of matches, about 40 percent of all possessions have no completed passes, and 80 percent of possessions involve four players and three passes or less (figure 1.1). This explains why so many small-sided training activities are 4v4; it is the essence of the game.

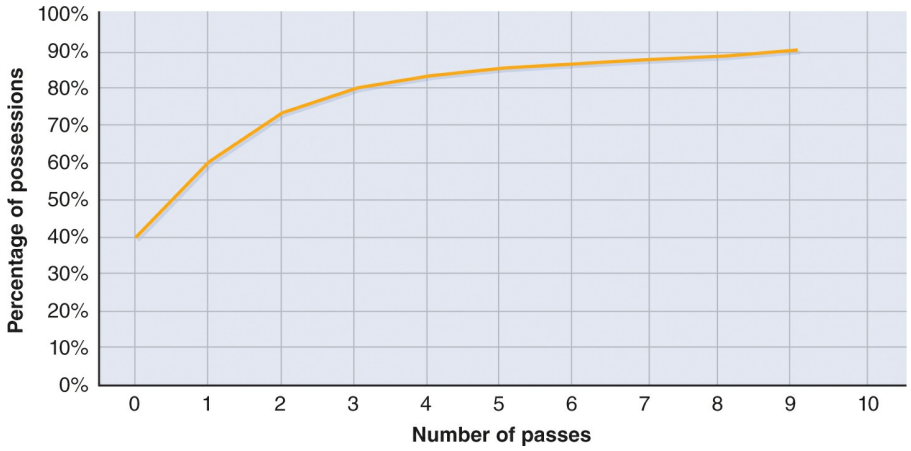


FIGURE 1.1 Number of passes per possession.

If your team gains possession close to your opponent's goal, the number of players and passes will be less. This is an important concept. Forcing your opponent to make a mistake near its own goal puts your team at a distinct advantage. In soccer, goals often are the result of an opponent's mistake instead of a long string of passes by the attacking team. Strange as it sounds, high-pressure defense in the opponent's defensive end is an important offensive tactic. Soccer is a hybrid of running speeds and directions, but it also is a hybrid of sustained possession and quick-strike strategies.

In the English Premier League, about 80 percent of any individual player's possessions are only one touch (a redirect) or two touches (control and pass) with no dribbling. Also in the English Premier League, about 70 percent of the goals come from one-touch shots, and about two-thirds come from open play. The remaining one-third come from restarts—free kicks, corners, and penalty kicks (PKs). Combine these statistics with the number of passes, and it becomes obvious that soccer is a passing game, not a dribbling game. The less dribbling and the faster passes are played, the faster the game is overall.

Rapid developments in technology have allowed analysts to accurately track and

record a plethora of statistics, particularly in the technical and physical aspects of the game. For example, during the 2018 FIFA World Cup Russia, the percentage of the match in possession of the ball ranged from 69 percent (Spain) to 33 percent (Iran). France, the eventual champions, averaged 48 percent of ball possession. The average number of passes completed per match during the tournament was 473, with 84 percent passing accuracy.

PHYSICAL DEMANDS ON THE SOCCER PLAYER

Many years ago, if you asked someone how far a player runs in a soccer match, he might have estimated 10 miles. If you do the math, 10 miles in 90 minutes results in 9 minutes per mile; this is doable. But a typical field is 110 yards (100 m) long, and 10 miles is 16,000 meters. That would mean a player would have to run the length of the field 145 times at a constant 9-minute-per-mile pace to accumulate 10 miles; this is not likely.

Tracking a player's running distance isn't easy. People have used a paper and pencil coding system (at matches or while watching video replays), step counters, GPS, and more. No matter what the method, gathering the data is labor intensive and time consuming, although recent and rapid developments in technology have made this process easier, more accurate, and more time efficient to the point of match data being captured in real-time. Those who study the physical demands of soccer generally agree that the average running distance in adult male professional soccer is between 6 and 8.5 miles (9,700 to 13,700 m). Adult female professional soccer players run about 5 miles (8,000 m), but there are reports of female midfielders covering the 6 miles (9,700 m) males run. The total distance is obviously less in younger players, who play a slower and shorter game.

Since soccer is played at many different paces, the distance is divided according to speed. The general observation is that one-half to two-thirds of the game is played at the slower, more aerobic paces of walking and jogging. The rest is at higher, more anaerobic paces plus sideways and backward running. In addition, distances vary by position. Central attacking and holding midfielders cover the most distance followed by wing midfielders and defenders, strikers, and finally central defenders. Some call the slower paces positional intensities (get to the right place on the field) and the faster paces strategic intensities (make something happen).

Matches may be won or lost by a strategically timed sprint, so many select teams look carefully for fast, skilled, and tactically savvy players, understanding that endurance can be improved by training. In general, sprints in soccer are 10 to 30 yards (9 to 27 m) long and happen every 45 to 90 seconds. The overall distance an adult male

professional player covers at a sprint is roughly 800 to 1,000 yards (730 to 910 m), although in 10- to 30-yard (9 to 27 m) chunks. Hard runs (cruising) happen every 30 to 60 seconds. The time between these hard runs is spent walking, jogging, or standing.

During the 2018 FIFA World Cup Russia, the average total distance covered, across all participating teams, was 104.6 kilometers per match for the 10 outfield players. This ranged from 113 kilometers per match (Serbia) to 97.1 kilometers per match (Panama). Divide that by 10 (the number of field players on a team)to find an estimate of each player's total distance covered.

Data can be further analyzed according to position. A positional analysis by the FIFA Technical Committee at the 2015 FIFA Women's World Cup Canada revealed that central midfield players covered the most total distance per match on average, averaging 11,230 meters. They were followed by wide midfield players (10,902 m) and forwards (10,781 m). Of the outfield positions, central defenders covered the least—10,020 meters. Goalkeepers covered 5,521 meters on average per match. Taking the wide midfield position as an example, the total distance covered of 10,902 meters consisted of 3,854 meters while their team had the ball, 3,635 meters while their team did not have the ball, and 3,413 meters while the ball was out of play.

Again taking the wide midfield position as an example, the total distance covered can be broken down to various speed thresholds:

0 to 6 kilometers/hour: 2,964 meters

6 to 12 kilometers/hour: 4,507 meters

12 to 16 kilometers/hour: 1,929 meters

16 to 18 kilometers/hour: 534 meters

18 to 20 kilometers/hours: 393 meters

20 to 23 kilometers/hour: 224 meters

> 23 kilometers/hour: 351 meters

Additionally, the number of bouts, average distance of each bout, and recovery time between each bout for each position at each threshold can be recorded. The wide midfield position is again used in the example shown in table 1.1.

TABLE 1.1 Frequency, Distance, and Recovery Times for Match Running Speeds

Speed	Bouts	Average distance of each bout	Recovery time between each bout
0-6 km/h	394	8 m	7 sec
6-12 km/h	498	9 m	8 sec
12-16 km/h	192	10 m	30 sec

16-18 km/h	54	10 m	130 sec
18-20 km/h	35	11 m	223 sec
20-23 km/h	11	17 m	461 sec
> 23 km/h	25	14 m	314 sec

Profiles such as the one shown here for 2015 Golden Ball winner Carli Lloyd can also be built to analyze individual player performance.

Player: Carli Lloyd

Main playing position: Central midfield/forward

Total distance (match avg.): 11,685 meters

Distance covered at 16 to 20 kilometers/hour: 1,214 meters

Distance covered at > 20 kilometers/hour: 429 meters

Average speed: 7.4 kilometers/hour

Average maximum speed: 30.1 kilometers/hour

Data obtained using GPS technology from an NCAA Division 1 women's team during the 2018 season shows an average total distance covered per match (among players who completed 90 minutes of play) of 9,520 meters. This included a match-average distance covered at more than 18 kilometers/hour of 428 meters (27 bouts), and a match-average distance covered at more than 15 kilometers/hour of 962 meters (76 bouts). Additionally, the average number of changes of direction per match was 271, ranging from 375 per match (central defender) to 143 (outside defender).

The physiological load on a player when running at any speed is increased by about 15 percent when the player is dribbling a ball. Therefore, one simple way to increase the intensity of any activity is for players to dribble. Small-sided games (4v4 or smaller) that increase the number of ball-contact opportunities are usually more intense than games played in larger groups (8v8 or more) during which ball contact is less frequent and players have more opportunities to stand and walk.

PHYSIOLOGICAL DEMANDS ON THE SOCCER PLAYER

Many attempts have been made to describe the physiological demands on the soccer player. A basic factor to observe is heart rate during a match. When a person goes for a jog, his heart rate increases rapidly and then settles to a plateau that stays fairly constant throughout the run. When this happens, oxygen demand is being met by oxygen supply.

When the jogger stops, the heart rate slows rapidly to a new low-recovery plateau that is still above resting heart rate until it finally returns to the resting level. The corresponding oxygen consumption is shown in figure 1.2.

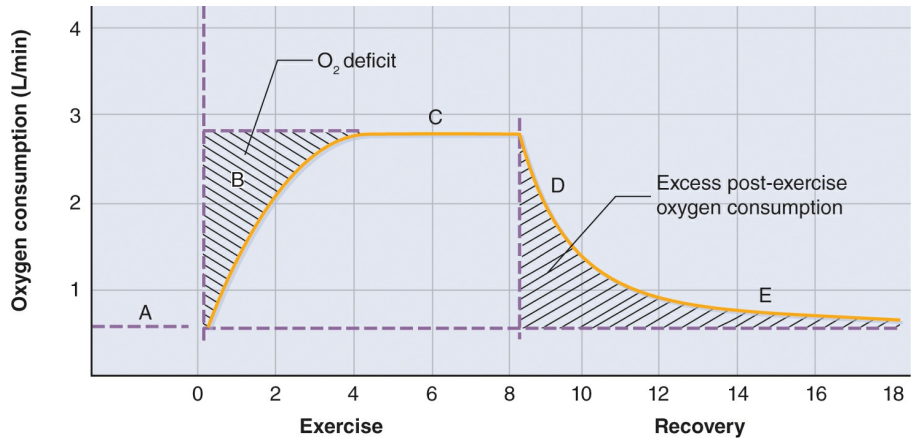


FIGURE 1.2 Oxygen consumption during exercise and recovery.

In a soccer player, a remarkably similar pattern emerges, and average heart rates are reported (figure 1.3). When the time scale is expanded, however, the pattern is quite different and reflects the intermittent nature of the game. The heart rate is rarely very steady during a match. Brief, rapid increases in response to faster runs are followed by rapid drops in heart rate during recovery periods (figure 1.4). Most reports show the typical heart rate range of a competitive adult soccer player is 150 to 170 beats per minute, with periods at or above 180 beats per minute. Most players work at 75 to 80 percent of their capacity. Based on common interpretations of exercise heart rate, soccer is considered an aerobic exercise.

When the body works intensely, lactic acid is produced. Lactic acid is a product of anaerobic metabolism. Its buildup is perceived as pain (burn) in the exercising muscles, but lactic acid is rapidly removed during recovery. The resting level of lactic acid is around one unit. High levels for most people are 6 to 10 units. Anaerobic athletes such as wrestlers and rowers can produce lactic acid levels well into the teens or even twenties. Soccer does not require that kind of anaerobic commitment. Most reports show an elevated level of lactic acid during a match (figure 1.5), but it is hardly overwhelming considering the spectrum seen in sports. Lactic acid values are based on the time between the last intense run and when the blood is drawn. Most researchers sample blood at a fixed time (as seen in figure 1.5). If it has been a while since the last hard run, the blood sample could show a low level of lactic acid. A key physiological feature of a well-trained soccer player is the ability to recover quickly after each hard run, so lactic acid values in soccer players often seem to be low. Soccer players are able to get rid of lactic acid quickly because soccer training has taught their bodies to

recover very quickly.

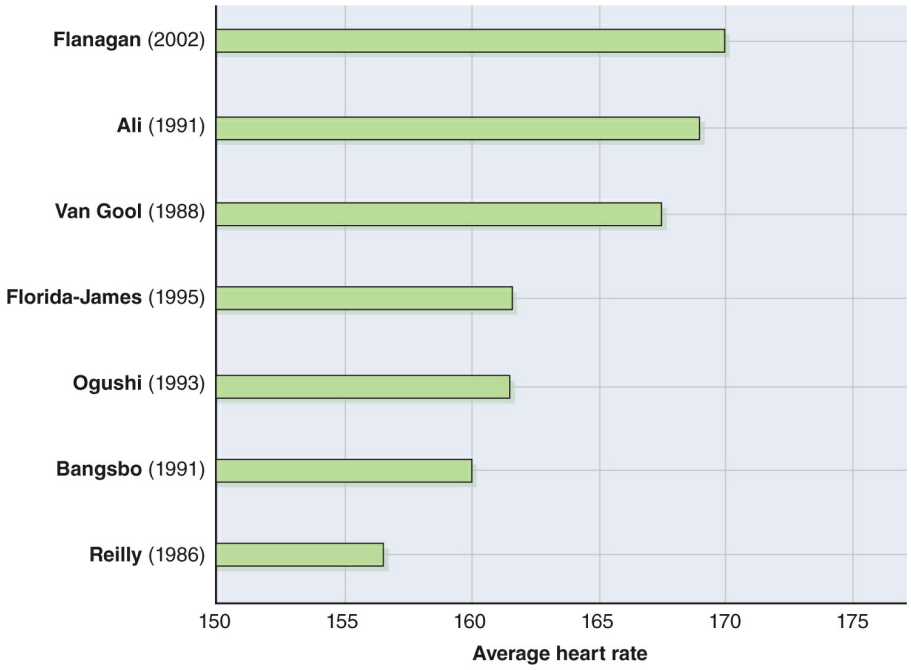


FIGURE 1.3 Average match heart rate reported by seven research studies.

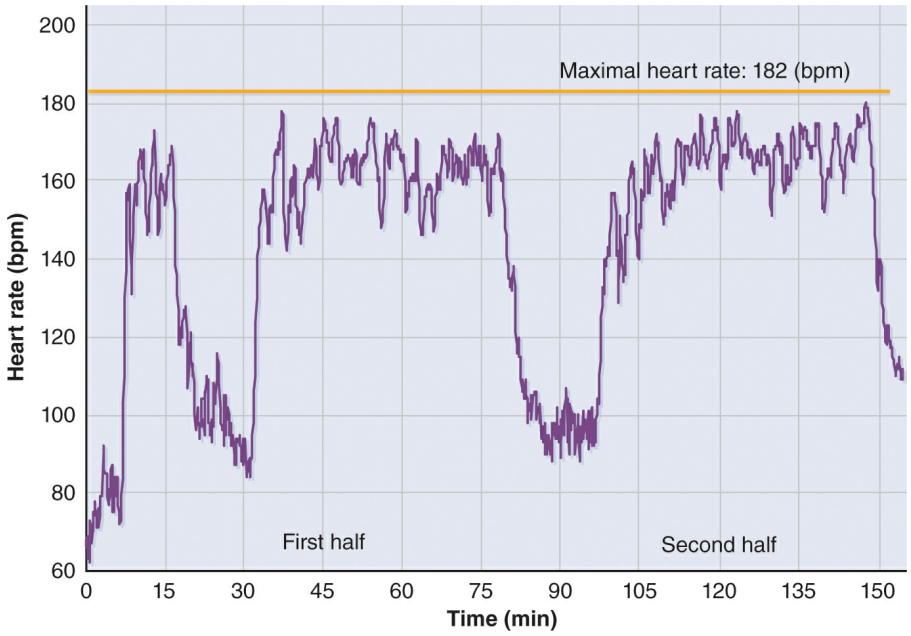


FIGURE 1.4 Heart rate fluctuations during a soccer match.

Courtesy of Dr. Peter Krustrup.

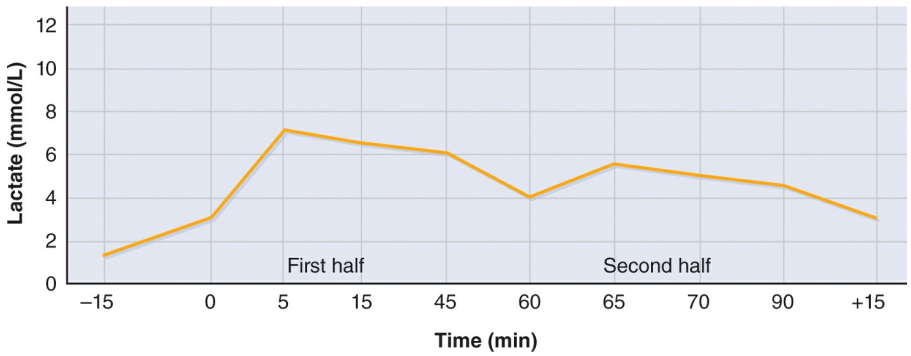


FIGURE 1.5 Lactic acid levels during a soccer match.

Courtesy of Dr. Peter Krustrup.

UNDERSTANDING BODY CHEMISTRY AND SOCCER

To understand the demands of soccer, you need to understand the basics of energy. To perform mechanical work, the body needs fuel, which goes through a chemical process to provide energy. A car has one tank that holds one type of fuel, but the body has a number of fuel options found in multiple tanks. Fuel preference depends on fuel availability and the intensity of exercise.

Our bodies need energy, which we obtain from the sun through the ingestion of food. Technically, we do not make energy; we transfer energy from the sun through food to the cells so the cells can perform their specific jobs. The currency of cellular work, exercise included, is adenosine triphosphate, or ATP. The adenosine backbone has three phosphates attached. Energy is stored in the chemical "glue" that holds the phosphates to the adenosine molecule. To get the energy, we must strip off a phosphate and release the energy, leaving a two-phosphate molecule called adenosine diphosphate, or ADP. Enzymes accelerate this process. Once the phosphate has been split and the energy released, we need to replenish our ATP warehouse by gathering enough energy to reattach a phosphate to that ADP. The body is constantly using and replenishing ATP. The estimate is that the total amount of ATP in the human body would probably fill something between a shot glass and a juice glass, which is why we have to keep refilling our stores. We are never completely at rest because the body always uses and replenishes ATP.

Released energy is used for many tasks. During exercise, energy is used primarily for muscle contraction, an enormously complex mechanism. The mechanical work of a muscle functions much like a ratchet. Each turn of the ratchet requires energy from a chemical source. Each turn uses energy, so the ratchet needs more energy to keep going.

Only about 40 percent of the energy available is actually used for cellular work, such

as muscle contraction. The remainder is released as heat. The rapid breakdown of ATP during exercise to power all those ratchets heats the body. This heat needs to be dissipated so we do not overheat.

Anaerobic Metabolism

The word anaerobic means "in the absence of oxygen." We have two ways to produce energy anaerobically. One is simply to break down ATP and release the energy. If more ATP is needed, the body can take two ADPs and slide a phosphate and its energy from one ADP to the other to make a new ATP, turning the donor ADP into adenosine monophosphate, or AMP. Both processes are incredibly fast, but they drain the supply of available ATP almost as quickly. If any activity ran this way exclusively, we would run out of fuel quickly, causing contraction to cease.

Once an ATP has been used, it must be replenished. The body does this by transferring a phosphate and its accompanying energy from another high-energy molecule called phosphocreatine (abbreviated as either PC or CP) to the ADP. This gives us a new ATP and a free creatine that must be resupplied with high energy for bonding a phosphate to be ready for the next transfer. If you were to sprint using only this as a fuel source (which never happens), the sprint might last 10 seconds at best. The simple ATP–PC cycle goes nonstop with each ratcheting of muscle contraction. There must be a continuous feeding of energy and phosphate to keep the cycle running, which is accomplished by the metabolic breakdown of carbohydrates (glucose) and fats (triglycerides) during exercise.

Another anaerobic way to produce ATP for the ATP–PC cycle and provide energy is the chemical breakdown of glycogen, the body's storage form of glucose. Glycogen is a long chain of glucose molecules stored in many places in the body. For our purposes, we will focus on muscle glycogen as the source. Glucose is a six-carbon molecule that is broken down into two three-carbon units. In the process, enough energy is generated to reattach a phosphate to an ADP molecule and make ATP. Actually, four ATP are produced, but the process needs two ATP to run, so the breakdown of a glucose molecule nets two ATP—not much. Because the process has a far greater source of fuel (muscle glycogen) than our juice glass of ATP, it can continue for a longer time—but not as fast and at the cost of lactic acid accumulation. When lactic acid, a product that causes a burning pain in the muscles, is produced faster than the body can get rid of it, the local tissue chemistry is altered. To prevent injury to the muscle cell, the metabolic process is slowed. This is one aspect of fatigue. If you were to sprint using only the anaerobic breakdown of glucose as fuel (again, this never happens), the estimate is that the sprint might last about 45 seconds before the chemical effects of lactic acid would cause the cells to shut down in an attempt to prevent cell damage.

Aerobic Metabolism

The aerobic breakdown of glucose proceeds through the process just described with one twist. In the presence of oxygen, lactic acid is not produced. Instead, the predecessor of lactic acid moves into a circular cycle that spins off carbon dioxide (those six carbons from the original glucose molecule need to go somewhere) and a number of compounds that carry hydrogen (those six carbons of the glucose molecule have hydrogen attached, and they, too, need to be dealt with). These hydrogen-containing compounds go through a process that transfers the hydrogen down a series of steps to the final acceptor, oxygen. Each oxygen molecule accepts two hydrogen molecules, producing water. During this transfer of hydrogen, enough energy is captured to transfer to an ADP, secure a phosphate, and replenish spent ATP. Depending on the details, the complete metabolism of a single glucose molecule produces 35 to 40 ATP.

Glucose, a carbohydrate, is not the only substance metabolized aerobically. Fat is a rich fuel source for energy. While glucose is a six-carbon molecule, a triglyceride has a glycerol head (with its three carbons and associated hydrogens) and three fatty acid chains, any of which can be less than 10 to more than 20 carbons in length. In fat metabolism, each fatty acid chain is cut up into two-carbon segments that each follow an aerobic path similar to the one taken by glucose to produce energy. Remember that a glucose molecule is split in half, and each half goes through the energy production process. A triglyceride, on the other hand, is far larger because of its three long fatty acid chains. The 3 chains may have 18 carbons, and the process proceeds in 2-carbon units (and do not forget the glycerol head); therefore, the aerobic breakdown of a triglyceride produces far more ATP than does glucose, perhaps by a factor of 10 or more, with the same easily eliminated products of carbon dioxide and water. The problem is that fat metabolism is the slowest process.

We also can produce energy from the aerobic metabolism of proteins, but the amount of energy we get from proteins during exercise is relatively small. Most people tend to ignore the energy contributions of proteins to exercise.

The end products of the aerobic metabolism of carbohydrates and fat are water and carbon dioxide, both easily eliminated, especially when compared to lactic acid. The aerobic breakdown of glucose and fat takes longer than the anaerobic metabolism of glucose and far longer than the ATP–PC cycle. Although speed of production is not its strong point, aerobic metabolism has the capability to produce energy for exercise for an indefinite period of time because everyone has an ample supply of fat.

Energy During Exercise

The interaction of all these metabolic processes can be complicated. At no time are any

of the metabolic processes or sources of fuel supplying 100 percent of the energy needed for exercise. The intensity and duration of the exercise dictate the predominant energy process and fuel. Intensity and duration of exercise are inversely related: The longer the exercise, the lower the intensity; shorter work is more intense. You could not run a marathon at your 100-meter pace, and you would not want to run a 100-meter race at your marathon pace.

Figure 1.6 helps explain this interaction. The X-axis is exercise time, and the Y-axis is the percentage of energy supplied by the various fuel sources. For exercise of very short duration, such as a 40-meter sprint, the primary fuel source is stored ATP and phosphocreatine, but a small portion of energy comes from anaerobic and aerobic metabolism of glucose. As the duration of exercise increases, up to around four minutes, the primary source of energy comes from anaerobic metabolism of glucose, but some energy comes from other pathways. Exercise that lasts four minutes or more is fueled primarily by aerobic metabolism of glucose and fat, with a progressively smaller fraction of energy coming from the other processes.

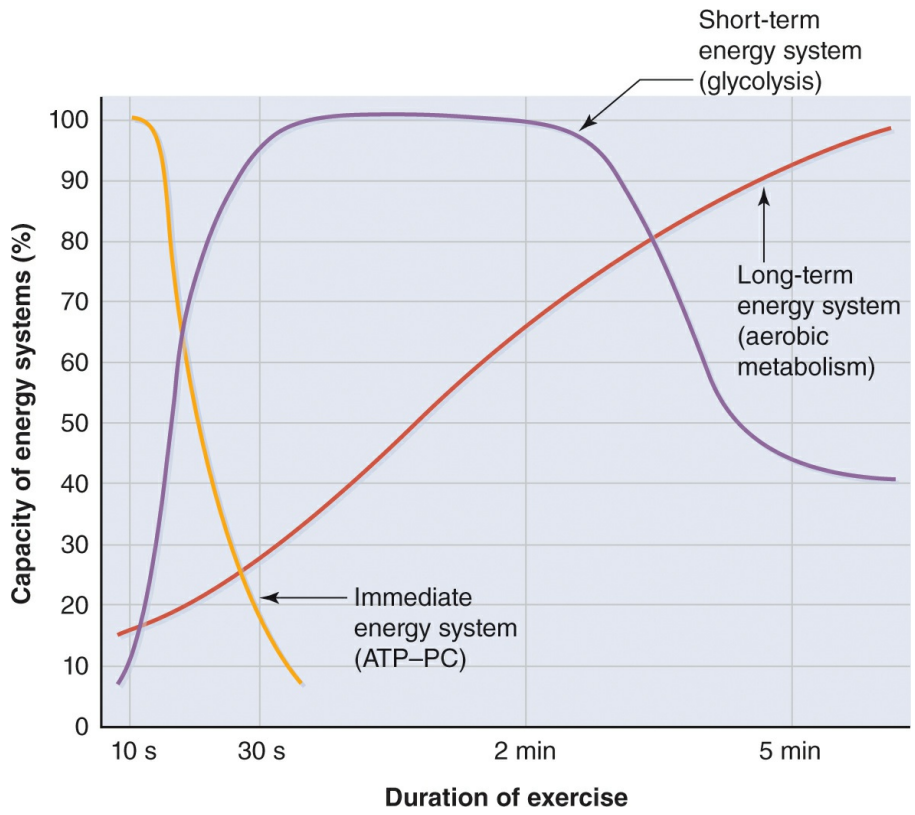


FIGURE 1.6 Relationship of exercise duration and energy systems.

The amount of energy available from stored ATP and phosphocreatine is very small. The amount of energy from stored carbohydrates is greater but still limited. The amount of available fuel from fat is essentially unlimited. The fat that is stored within the

muscle, surrounds the organs, and lies under the skin is far more than anyone would need for exercise. Remember, however, that it takes time to obtain fuel from fat. It is estimated that if fat were the sole source of fuel for running, you could run at only about 50 percent of capacity—a walk or slow jog at best. Muscle glycogen also is a limited fuel source. Someone who runs out of glycogen will slow down because the main source of fuel is now from fat. Most people run out of muscle glycogen in the fibers recruited for exercise in about 90 minutes, so soccer players can run out of glycogen during a match. To compensate, soccer players should follow dietary recommendations to increase muscle glycogen that individual-sport athletes have wisely adopted. A combination of training and high carbohydrate intake allows muscles to pack in more glycogen, allowing the player to go further into the match before running out.

Application to Soccer

Let's get back to the game. Soccer is a game of numerous short sprints and episodes of high-intensity anaerobic work separated by periods of low-intensity aerobic recovery in preparation for the next bout of high-intensity work. During a sprint, shot, jump, tackle, or cut, some ATP is spent, and some glucose is used to power the muscles for the hard work. The player then recovers during a lower-intensity phase of play (walking, jogging, standing) during which ATP is replenished and lactic acid is removed. (Lactic acid is metabolized aerobically, which is one reason you continue to breathe hard after slowing down or stopping.) This prepares the muscles for the next bout of hard work.

How soon the player is ready to work hard again depends on how quickly ATP is replenished, how much lactic acid is removed, and how a few other electrochemical processes connected with contraction are completed. The important parts of the game—the parts that define who wins and those high-intensity runs—are fueled primarily by anaerobic means, and the recovery periods are accomplished aerobically.

Recovery is an aerobic event. This is something most coaches and players either forget or ignore. The higher a player's aerobic capacity, the faster she will recover and the more frequently she can work hard, going deeper into the match before tiring. A player with poor aerobic fitness will take longer to recover from a sprint before again being able to use that blazing speed, and chances are that each successive sprint will be shorter and slower. Research shows that training-induced improvements in speed are not nearly as great as training-induced improvements in endurance. That is why speed is such a highly valued trait in a soccer player; the coach knows endurance can be improved more easily than speed. Coaches look for fast players who can improve their endurance instead of players who can run all day but need to improve speed. The modern game is not about raw speed; it is about how quickly a player can repeatedly recover to maximize the speed she has.

Some studies can nearly rank the final standings of a league's clubs according to each team's aerobic capacity. Aerobic capacity for rapid recovery is that important. Coaches are very adept at designing training sessions to improve endurance and the ability to recover. To raise intensity, they use short small-sided games on a small field, with restrictions to force play (for example, multiple two-minute games with limited recovery between each game; 4v4 or fewer for more ball contacts; or games in a penalty area or smaller marked area to force quick decisions, with restrictions such as overlapping every pass with a sprint). The smaller sides mean less downtime, so the body has to learn to adapt for fast recovery from the temporary fatigue induced by each sprint. For endurance, activities usually involve more players in a larger space, with restrictions that force a more constant pace of play for a longer period of time (for example, a 15- to 20-minute drill or games of 8v8 or more, in a three-quarter or full field, with restrictions such as all players in the attacking zone before a shot). A player with higher aerobic fitness can recover more quickly than an unfit player. The fit player gets to a new position faster and is ready for higher-intensity work well before the unfit player.

Jogging at a constant pace around a field or a park will improve jogging ability, but it won't train the body to do what is necessary to recover in a start–stop game. When jogging, you recover once—at the end. In soccer, recovery happens repeatedly. A well-trained soccer player will be able to keep the heads of each ratchet in the muscle well supplied with ATP to keep the ATP–PC process running and delay the influence of lactic acid on local muscle fatigue. Players who are unable to rapidly replenish ATP for that ATP–PC cycle will be standing around waiting while other players are running past.

Muscle Fiber Recruitment

We are all blessed with a mosaic of muscle fibers with unique characteristics that make us supremely adaptable to a multitude of activities. Basically, big fast-twitch fibers produce tension very quickly but can't keep producing this amount of tension for many contractions. Smaller slow-twitch fibers produce less tension at a slower rate but can keep contracting repeatedly. Think back to the description of energy, and apply that to the concept of fiber type. Fast-twitch fibers produce most of their energy anaerobically (for a rapid production of tension), while slow-twitch fibers produce most of their energy aerobically (for repeated contractions). The distribution of fast-twitch and slow-twitch fibers is, for the most part, fixed by genetics. Although some people might reason that a soccer player should have more of one type than the other, most studies show a soccer player has about a 50:50 ratio. Soccer is the game of the masses, so it makes sense that no genetically predetermined factor, such as a high percentage of slow-twitch

fibers in a marathoner or height in basketball, is a requirement to play the game.

FEMALE PLAYERS

Much of the worldwide growth in soccer is due to the increased participation of women. Although the rules are the same, there are subtle tactical differences between the men's and the women's games that may not be evident to casual fans. The general pattern of work is similar but at a lower running volume and pace, although some female midfielders cover the 6 miles (9,700 m) male players do. Women have a physiologically smaller engine capacity because they have less muscle mass, smaller hearts, less total blood volume, and less hemoglobin. A female playing a match of the same duration and field size as a male and running the same distance as a male will have to play the game at a higher intensity. It isn't unusual for adult female professional players to exhibit heart rates above those of their male counterparts. They work hard.

Interestingly, if you were to scale the demands of soccer according to anthropometric and physiological sex differences between men and women, as researchers in Norway did in a 2019 paper, the women's goal would need to be shrunk (from 2.44 meters high by 7.32 meters wide to 2.25 meters high by 6.76 meters wide), as would the field size (from 105 meters long by 68 meters wide to 84 meters long by 54 meters wide). Doing so would make the two games more equivalent, but don't expect that to happen. Just appreciate what is and isn't similar between the men's and women's game—no need to make them identical.

Female athletes have other issues that can cause health problems. The female athlete triad is the interaction of disordered eating, menstrual dysfunction, and reduced bone density. Some female athletes choose not to eat appropriately, which can lead to a disruption in the normal hormonal balance that becomes evident in menstrual problems. A disruption of the normal hormonal balance, especially of estrogen, can reduce bone density. The repeated impact of physical training can then lead to stress fractures, mostly in the lower extremities. Because the triad begins with reduced calorie intake and possibly disordered eating, ensuring females are consuming adequate calories is imperative for maintaining normal menstrual function and healthy bones.

Females also need to ingest appropriate amounts of iron and calcium. Even athletes on a vegetarian diet can eat plenty of these minerals with proper food selection. The Fédération Internationale de Football Association (FIFA) has produced an excellent booklet on the female player; see the bibliography on page 235.

NUTRITION AND HYDRATION

Our fuel for exercise comes from the food we eat. We all have plenty of fat, but

carbohydrate storage capacity is limited, meaning we have to refuel carbohydrates frequently. For you to be a player in motion, you need to be well fueled; that fuel comes from carbohydrates. FIFA has an excellent booklet on nutrition specifically written for the nonscientific audience. See the bibliography on page 235.

Dehydration is a problem in soccer. The length of the game, the intensity of the running, the elements, and the lack of planned stoppages all contribute to players not getting necessary fluid during a match. A fluid deficit of as little as 2 percent—only 3 pounds (1.4 kg) of fluid loss in a 150-pound (68 kg) player—can negatively affect performance.

Fluid Recommendations

Team sport athletes are notorious for not following fluid and nutritional suggestions. The ongoing UEFA Champions League Study has shown that nearly 40 percent of professional soccer players are still dehydrated 24 hours after training or a match. The American College of Sports Medicine has a number of suggestions regarding fluid ingestion before, during, and after exercise.

Before exercise

1. Prehydration should begin several hours prior to exercise.
2. Drinks with sodium or water in combination with a salted snack or meal can help stimulate thirst and retain some of the ingested fluid.

During exercise

1. The goal of fluid ingestion during exercise is not to replace all the water lost in sweat; the goal is to limit fluid loss to less than 2 percent of body mass. Weighing in before and after exercise gives a player a good idea of how much water was lost and needs to be replaced.
2. Drinks with some carbohydrates (less than 8 percent) and electrolytes (20-30 mEq/L sodium; 205 mEq/L potassium) can help maintain a balance of fluid and electrolytes as well as exercise performance. Players with extra salty sweat might find a drink with more sodium more palatable.
3. Overhydration during training or a match is not advised and (in marathoners) has been shown to be dangerous or deadly. You shouldn't weigh more after training than you did before training.

After exercise

1. Over the course of the next 24 hours, drink 1.5 pints of fluid for each pound of weight lost. Drinks with a little sodium will help retain water and stimulate thirst.
2. Drinks with caffeine or alcohol can slow this process.

Players should take advantage of normal stoppages to drink water, sports drinks, or both. To keep fluids available, players place water bottles in or around the goal and along the touchlines and drink during injury stoppages or other dead-ball situations. Because central midfielders are the farthest from the field boundaries, they have the most difficulty taking advantage of stoppages; they need to make a conscious effort to get to water wherever it is placed, and the coach needs to make sure that fluids get to them during such stoppages.

Players who produce very salty sweat might be inclined to choose a drink with salt and add extra salt to their meals. These players can be identified as those whose shirts show a crusty substance as the water in their sweat evaporates from their clothing. This is especially obvious when they wear dark shirts.

Drugs and Food Supplements

We cannot seem to separate sports from drugs, especially so-called performance-enhancing drugs, or PEDs. Although drugs seem to be endemic in sports such as cycling, soccer has little history of drug abuse. This is probably because soccer does not rely on one specific factor that could be enhanced by a PED to affect the outcome, as anabolic steroids do for weightlifters or erythropoietin (EPO) does for road cyclists. FIFA's own statistics show a trivial number of positive drug tests, and half of those positive tests were for recreational drugs, not PEDs.

A high percentage of athletes take over-the-counter, and largely unnecessary, supplements. Some reports show nearly 100 percent of Olympic athletes in some sports from certain countries take supplements. The most common supplement is a multivitamin, but that is not the point. The supplement industry does not follow the same purity rules that the U.S. Food and Drug Administration (FDA) requires for the food and drug industries. Therefore, what is on the label may not be a full account of what is actually in the bottle.

Recently, the International Olympic Committee (IOC) randomly

selected supplements known to be used by athletes. The IOC tested the products and found that nearly one-quarter of them would have produced a positive drug test. In sports, the athlete is always responsible for a positive drug test. Any player who thinks college, international, or professional play is in his future will face drug testing and must be very careful about what he ingests.

If you eat a well-rounded diet, choosing from a wide variety of fresh and colorful items from all food groups, supplements will only enrich your urine and empty your wallet. The renowned sports supplement researcher Dr. Ron Maughan from Loughborough University (UK) has an axiom: "If it works, it is probably banned. If it is not banned, it probably doesn't work." Why take the chance?

The other problem with soccer players is that they often do not drink enough between training sessions or matches. There are reports that as many as 40 percent of players on a team could be dehydrated even before they step onto the field.

The typical formula for fluid replacement is 1.5 pints (24 oz or 720 mL) of fluid per pound (.5 kg) of body weight lost, so know your weight, and check it often. Full replenishment cannot be done in one sitting. It can take a full day. Keep a close eye on your urine color. If it looks like diluted lemonade, you are probably OK. If it looks more like apple juice, you need to drink more fluids. See the nutrition booklet in the bibliography (page 235) for more information.

HEAT ILLNESSES

For many countries in the Northern Hemisphere, soccer is a fall-to-spring sport; summer is the off-season. In the United States, the professional game parallels the baseball season, making it a spring-to-fall sport. Depending on the time of year, soccer in the Southern states can be played in pretty oppressive conditions. All summer leagues and tournaments need to have a plan in place to handle players suffering from heat illnesses. Players who succumb to the heat may initially show minor symptoms such as heat cramps, but problems can rapidly progress to far more serious issues such as heat exhaustion and heatstroke, which is a potentially fatal collapse of the body's ability to control its temperature. You may have read about heat-related deaths in American football players.

The body loses heat in four ways: radiation through radiant loss of heat through heat waves; convection (like standing in front of a fan or air conditioner); conduction, which is direct contact with a cooler surface (like placing an ice-cold towel on the head); or

evaporation, which is the most important mechanism during exercise. Sweat production is not the loss of heat; the evaporation of the sweat results in heat loss. Any barrier to heat loss will slow the rate of evaporation. Two barriers frequently encountered in soccer include clothing, especially dark clothing that covers much of the body, and humidity. Today's sports clothing is designed to aid evaporation.

When matches are scheduled during hot and humid weather, put strategies in place to make fluids available. Many youth leagues, particularly in the South, have water breaks in each half as part of the rules. If water breaks are not part of the rules, the coaches can approach the referee and ask for a break if the conditions warrant it. The referee has this authority and would probably appreciate the break as well. During the men's gold medal match at the 2008 Beijing Olympics, a water break was included in each half because of the conditions. Since that match, international match officials are instructed to insert a water break midway in each half when the ambient temperature at kickoff is 90 degrees Fahrenheit (32.2 degrees Celsius) or higher.

FATIGUE

A good definition of fatigue is the failure to maintain an expected power output—you want to run fast but are unable to. Fatigue can be both general and temporary and can come from a number of mechanisms. For example, to run fast, you need fuel in the form of muscle glycogen. When muscle glycogen levels decline below set levels, you walk. Increasing muscle glycogen stores through training and proper food selection will delay fatigue and allow you to go deeper into the match before tiring. In addition, an ample store of glucose ensures that the brain has a ready supply of the only fuel it can use; the brain can become fatigued, too. Elevated body temperature and the accompanying loss of fluids by evaporation are also factors in general fatigue. Because body temperature affects performance, it is necessary to keep fluid levels up so the body can produce sweat for evaporation and heat loss. Pay attention to your thirst and drink often.

Temporary fatigue is a result of rapidly altered and remedied local muscle chemistry that affects the ability of the muscle fibers to contract. Lactic acid contributes to temporary fatigue. You tire after a few repeated fast runs, but in a few minutes, you can be back and ready to go again. Any improvement in aerobic capacity will let you perform more, or longer, hard runs before temporary fatigue sets in by improving your ability to recover more quickly. Training for rapid recovery minimizes the effects of temporary fatigue by speeding up the removal of lactic acid and quickly re-establishing the processes associated with the muscle's ability to contract.

Fatigue is an interesting topic. In a muscle physiology lab, fatigue is the failure of an isolated muscle preparation to contract. That never happens in intact muscles because we have multiple safety measures in place to protect muscles. But fatigue also has a

cognitive element. Sometimes you feel that further exercise can just be too much; your conscious brain is getting feedback from your body, and the sum of this information tells you whether to do more or less work. So, what is it about soccer that increases your perception of (temporary or overall) fatigue?

In most sports, soccer included, the combination of overall distance and the intensity of running interact to increase your perception of developing fatigue. Physiological intensity can be measured (at a cost), but it is also important to know how a player feels about the exercise intensity, which can be determined simply by using the rating of perceived exertion, or RPE. There are many such scales, but the simplest is the 0-10 scale. A player is asked to give the exercise load a numeric rating. It is a relatively simple system, and it is also quite accurate and useful.

When out for a jog, the runner will usually use breathing frequency and depth to arrive at an RPE. But what cues does a player in a team sport use to arrive at a rating? Recent information suggests that the primary cues soccer players (and other team-sport athletes) use to judge intensity are the frequency and rate of deceleration. How often do they have to quickly slow down? Think about it. Run 100 yards in about 15 seconds (a good hard-striding run for most high school aged players). How hard was that? Now run that 100 yards as a 4x25 yard shuttle, still in 15 seconds. Same work (100 yards), same time (15 seconds), but this last run will seem to be far harder. Why? When running a straight 100 yards, there is one period of acceleration and one period of deceleration. In the latter, there are four accelerations and four decelerations, each of which will be more demanding to cover 100 yards in 15 seconds. And the decelerations are the harder of the two. The more decelerations, the harder the perception of effort, which is something to be considered when selecting training activities and planning a training calendar.

2
INJURY PREVENTION

While it might not be a common sideline topic, everyone—players, coaches, and parents—must accept the possibility of injury. Simply making the decision to play means that everyone accepts some risk of an injury. Most injuries are unintentional; some involve contact, while others seem baffling when there is no contact. Regardless, an injury could mean lost time, require extended rehabilitation, or even contribute to decisions about continuing to play.

TARGETS FOR PREVENTION

Prevention programs can be generalized (e.g., FIFA's The 11+, designed to reduce overall injuries) or specific (e.g., programs to prevent primarily an ACL tear or an ankle or groin strain).

Although most soccer injuries are to the lower extremity, nothing happens in isolation. Players can have complaints (defined as physical issues that have little impact on play) about all parts of their bodies; some studies collect data on complaints as well as injuries. Injury epidemiology research is quite common and focuses mostly on acute match and training injuries. As such, the incidence of injury is fairly well established and reasonably consistent across ages, genders, and levels of play. Overuse injuries are a bit more complicated and are handled differently. Table 2.1 shows the ranking of the most common injury locations.

TABLE 2.1 Most Common Injuries by Body Part, Age, and Gender

	YOUTH	HIGH SCHOOL		COLLEGE		PROS	
Part of the body	**(boys and girls pooled)**	**M**	**F**	**M**	**F**	**M**	**F**
Head	—	4	3	3	3	—	—
Hip, groin, thigh	3	2	4	1	4	1	1
Knee	2	3	2	4	1	2	4
Lower leg	5	—	5	—	5	4	5
Ankle	1	1	1	2	2	3	2
Foot	4	5	—	5	—	5	3

For the most part, ankle injuries (overwhelmingly sprains) are the most common. Hip, groin, and thigh injuries are mostly strains (primarily "pulls" to the hamstrings and some to the groin and quadriceps), with hamstring strains being more frequent in older players and more common at higher levels of play. Knee injuries (ACL and meniscus injuries) are usually, but not always, more of a problem in females. Head injuries (contusions, lacerations, and concussions) are problems in high school and college players.

Two other critical elements relate to a player's injury history. First, a history of most any injury is the strongest predictor of suffering that same injury again. Second, a major injury is frequently preceded by an incompletely rehabilitated minor injury. For example, if an ankle is not fully stable, a player might botch a landing or a cut and end up injuring a knee. The importance of preventing the first injury should be obvious.

The general philosophy has been to prevent those injuries that are the most common. We'll look at how the most common injuries happen and ways the risk factors can be reduced. Don't forget this distinction: a sprain is damage to a ligament, and a strain is damage to a muscle.

RISK FACTORS OF INJURY

One of the purposes of a preparticipation physical examination is to identify factors that might predispose a player to an injury. Many issues need to be considered when acting on what is identified in this examination. In general, injury risks can be categorized as intrinsic (for example, age, prior injury, strength, neuromuscular skill, and more) or extrinsic (such as equipment, environment, playing surface, officiating, opponents, etc.); many injuries aren't an either/or consideration because, as you'll see, intrinsic and extrinsic risks interact with each other. Finally, some injuries are simply an accident that no one can predict.

A torn ACL is one of the most feared injuries and can happen with or without any direct contact to the knee. The noncontact tear of an ACL requires many little things to come together at just the right time, mostly during cutting or landing. During the numerous training hours and matches, players will cut and land thousands of times. In the presence or absence of identifiable risk factors, why did the ACL fail this specific time? A question without a good answer.

There are two simple ways to prevent injury: improve fitness and improve skill. The skilled, fit player is injured far less often than the unskilled, unfit player. And if poor fitness is related to injury, the onset of fatigue must also be a factor. Overall injury rates increase with time during a match. In most studies, around 25 percent of all injuries happen in the last third of the second half. Additionally, most injuries happen during preseason training when the players are less fit and working hard to improve their fitness. Once the competitive season begins, the days of hard training are less frequent, and the injury rate declines. Another fatigue-related factor is the training-to-match load ratio. The smaller this ratio (meaning a congested schedule of fewer training days in preparation for each match), the greater the injury rate. A final fatigue-related issue is one that applies to teams with longer seasons than typically seen in the United States. Ekstrand, Spreco, and Davison (2018) show that leagues without a winter (midseason) break have more injuries in the second half of the season than leagues with that break.

Age is a factor in certain injuries. For example, hamstring strains are more common in older players, while ACL tears are more frequent in younger (middle or high school) players. As with many injuries, however, the susceptible age for a hamstring strain seems to be dropping.

If age is an issue, so is gender. Females have a greater risk for ACL tears and head injuries than their male counterparts. Another age-related concern is the growth spurt of adolescence. Growth (especially in boys) is linear (up) first followed by circumferential (muscle mass). That tall gangly boy who has quickly grown tall but has not yet filled out is at a greater risk for injury than other same-age teammates who have

yet to hit their growth spurt (the late maturers) or those who have already gone through their growth spurt (the early maturers).

Strength, flexibility, and balance are issues in most every injury. Preseason evaluations usually test each leg separately for these factors, and test results are rarely symmetric; one leg is often "better" than the other. For example, most players will have a preferred leg (limb dominance) that will usually test better than the other leg. (How is the dominant leg determined? Is it the preferred kicking leg or the preferred leg to do a long jump? It's not always the same.) It is interesting that more injuries happen to the dominant leg. When imbalances are evident, corrective training can minimize limb differences and prevent some injuries.

One of the main aspects of the preparticipation exam is to identify each player's injury history. A prior injury is one of the strongest predictors of a future injury. If an athlete has previously suffered from a sprained ankle, chances are good that another ankle sprain will happen. The risk of a reinjury can be as low as 1.5 times for an ankle sprain or as much as 5 times for an ACL tear. When the next injury might happen is unknown.

With 11 field positions, injuries vary according to player position. Defenders have the most injuries followed by strikers. Midfielders and goalkeepers are the least injured. Previously injured players often enter back into the lineup by playing a position with a lower chance of injury.

Once a player is injured, a rehabilitation period begins. We will not be discussing how injuries are rehabilitated nor will we outline the criteria necessary to return to activity, training, or competition, although returning to activity, then to training, then to competing, then back to full preinjury level of competition is currently a very hot research topic.

Before most international matches will be a display of FIFA's Fair Play banner. Players and coaches make a pledge to play according to the Laws of the Game. This is not an idle slogan. At the professional and international level, roughly 40 percent of all injuries occur during foul play, so adherence to these laws prevents injury. Coaches need to continually instruct players to stay on their feet (despite what they see on TV). Tackles during which the defender leaves his feet (and generally has his studs up) puts both players at risk for an injury and the tackler at risk for a red card.

Most of the injury research (and chapters like this one) addresses acute injuries, injuries with a specific identifiable event. Another class of injury is the so-called overuse injury, injuries without a specific identifiable event. A minor tweak may become an annoyance that is not treated, and training continues. At some point, the pain becomes sufficient enough that the player seeks medical attention. These training-induced injuries slowly become more limiting; if the constant progression of the training

load makes things worse, the best treatment is reducing the training load through rest. Rapid progression of training loads increases the risk of an overuse injury, but this is a topic for another book!

For both preinjury prevention and postinjury rehabilitation, compliance to the prescribed programs is critical. Prevention activities are effective only when done regularly and should never be considered a novelty to break up the monotony of training. After an injury, every player wants to get back as soon as possible. We can't possibly detail the complete list of training exercises and regimens that have been tested and proven to be effective. Most certified athletic trainers and physical therapists can provide those details. Athletes return to play sooner when the therapist's instructions are followed exactly. Don't try to return too quickly; returning too early from a seemingly minor injury puts the player at a high risk for another, usually more severe, injury.

Finally, plenty of injuries are simply accidents—a purely random occurrence. A player may miskick the ball that then strikes the side of an unsuspecting player's head. The resulting angular acceleration can cause a concussion. A player may jump and land on another player's foot, resulting in a sprained ankle for the jumping player. Neither situation can be predicted.

ANKLE

Incidence

Across the age and level-of-play spectrums, the ankle is the weak point in soccer. At the high school level, ankle sprains account for 20 to 25 percent of all injuries. Females experience more ankle sprains than males. Youth players sustain the most ankle sprains and professionals the fewest (under 15 percent).

Mechanism of Injury and Risk Factors

Ankle sprains can be either contact or noncontact. Contact sprains typically happen during a poorly timed or executed tackle. Noncontact injuries happen when a player lands awkwardly from a jump, plants the foot awkwardly for a cut, or catches a foot on a poorly maintained field. The same result can happen: The sole of the foot rolls inward, spraining the lateral side of the ankle.

Two other ankle injuries are far less common. Think of a classic tackle in which both players contact the ball with the medial side of the foot. If one player can overwhelm the other, the sole of the other player's foot can roll out for a medial (inside of the) ankle sprain, a rare injury. A medial ankle sprain also can result from an opponent attempting a tackle from the outside.

Another rare ankle injury is the so-called high ankle sprain, more formally known as

a syndesmotic sprain. This is more of a basketball injury that occurs when the foot rolls under at the same time the foot is twisted. This motion to the top bone of the ankle (talus) effectively pries apart the two bones of the lower leg (tibia and fibula), damaging the ligament that runs the length of the two bones.

The greatest risk factor for a lateral ankle sprain is a prior injury (sprained ankles are often sprained again). Other risks include reductions in the strength of the muscles in the lower leg, joint sense, flexibility, and balance. To many players, an ankle sprain is viewed as a nuisance injury, but that's naïve. Poorly healed ankle injuries are a common predecessor to more serious injuries farther up the legs. Most orthopedic surgeons suggest that players wear some form of external ankle support for up to six months after the injury. Ankle injuries rarely require surgery.

Intervention

Many prevention programs have been tested, and most are successful as long as they are properly and consistently complied with. (See Grimm et al. 2016.) The ones that work are all multifaceted, meaning each rendition uses exercises from different fitness categories. These programs involve various combinations of training to improve core stability, stretching and flexibility of the ankle, agility, proprioception (e.g., balance board), plyometrics and strengthening (both concentric and eccentric contractions of the lateral lower leg muscles), and balance. Ankle programs can be extensive and somewhat time consuming, requiring up to 30 minutes to complete the full spectrum of exercises. The best studies were typically tightly controlled, so compliance with the programs was usually very high.

Effectiveness

When the best ankle sprain prevention studies are considered, the reported reductions in sprains (versus no participation in a prevention program) range from 13 to 75 percent fewer sprains. Overall, the studies report on average a 60 percent reduction in ankle sprains.

KNEE

Incidence

The knee is perhaps the most vulnerable joint in the body; the distance from its neighbors—the hip and the ankle—exposes the knee, making it vulnerable to injury. More than a simple hinge joint, the knee is quite complex with two major external ligaments (medial and lateral collaterals), two internal ligaments (anterior and posterior cruciate), and two meniscus pads, as well as tendons and associated bursae that connect a number of muscles to the bones. The knee has many nerves and blood vessels, as well

as the ends of two main bones (femur and tibia) that have the body's largest surface area covered by cartilage. Damage to any of the knee anatomy can lead to a substantial loss of training and playing time. The general injury literature doesn't consistently break out injuries according to which of the tissues is damaged and instead lumps all knee injuries together—except for the ACL, which gets a lot of attention. There are also minor knee injuries, such as contusions and lacerations, that might hurt but not result in much loss of training or playing time.

Youth players are more prone to incur knee contusions and lacerations, making up around 20 percent of all bodily injuries. Players in middle school and high school, the level when players commit to the sport and the game starts to get serious, are vulnerable to more serious injuries. Although middle school and high school players are less likely to experience knee injuries (12 to 15 percent versus 20 percent in youth players), those they do experience tend to be more serious (ACL and meniscus tears, for example). In addition, girls have more knee injuries than boys (17 to 22 percent versus 12 to 15 percent), with much of the difference due to the dreaded ACL tear. The percentages of total injuries that occur to the knee in college-aged men (12 to 16 percent) and women (18 to 20 percent) and soccer professionals (13 to 18 percent) are somewhat similar. In general, the female rate of ACL tears is about 2.2 times that of men.

Collateral ligament injuries are rarely treated with surgery but can require a long recovery period, usually measured in months. Surgery for a torn ACL (or PCL) requires a long recovery and rehabilitation period, typically a year. Some athletes return to play within six months, but those instances are true outliers. In reality, most of the return-to-play data indicate that while the player with an ACL tear can return to play within a year, full return to preinjury level of play will probably be longer, closer to two years. Recovery from a meniscus tear can be quicker, depending on the nature of the damage. Damaged cartilage is not good. Surgery (sometimes two or more) and extensive rehab are necessary, and failure to fully recover from cartilage damage is often the main reason a player retires due to knee issues. Players should do everything possible to prevent knee injuries.

Mechanism of Injury and Risk Factors

Noncontact injuries get the most attention and are the focus of this section. If a player gets hit just right by the defensive equivalent of a runaway truck, no amount of prevention is going to help. Knee injuries can be contact or noncontact injuries that can damage the cruciate ligaments, the collateral ligaments, the menisci, or the cartilage. Knee injury mechanisms are under intense study, and research has revealed many issues that interact, resulting in damage (Pfeifer et al. 2018). A noncontact injury typically happens during either cutting or landing from a jump—things players have successfully done thousands of times. One common factor is that ground contact for changing

direction or landing happens when the knee is near extension, causing the impact to reverberate up. The trunk wobbles a bit, forcing the need for some whole-body adjustment. Then, perhaps due to adjustments to the awkward landing, the lower leg rotates outward while the thigh rotates inward. Normally, the hamstrings help protect the ACL but provide little help for the ACL when the knee is close to or at extension. Without the hamstrings' help, these slight rotations are enough to allow the tibia to slide forward and tear the ACL.

Recent data (Owusu-Akyaw et al. 2018) show that it's the forward slide of the tibia under the femur that tears the ACL. The inward collapse of the knee that is so obvious in a video replay is less the cause of the injury and more a consequence of the injury. Collateral ligaments are usually damaged by contact to the opposite side of the knee (like a clip in American football damages the medial collateral ligament). Injuries to the lateral collateral ligament happen most often during more catastrophic situations such as a knee dislocation. Meniscus injuries can happen when a player twists the knee while changing directions or can happen in conjunction with an ACL injury. Cartilage injuries usually happen in conjunction with other injuries but can happen in isolation.

Proposed risk factors for ACL tears (table 2.2) are numerous and are categorized as extrinsic (the environment) or intrinsic (the player). They can be sport specific (e.g., a risk in soccer may not be an issue in skiing). Numerous factors have been proposed because the factor might make sense (e.g., Q-angle, menstrual status, etc.) but fail to be useful after being subjected to rigorous study.

TABLE 2.2 Environment- and Player-Related Risk Factors of an ACL Injury

ENVIRONMENT-RELATED RISK FACTORS		PLAYER-RELATED RISK FACTORS	
Factor	**Details**	**Factor**	**Details**
Weather	Dry conditions Hotter weather	Bone and joint anatomy	Narrow intercondylar notch High posterior tibial slope Higher femoral head offset angle ACL anatomy Joint laxity
Playing surface	Bermuda grass or rye grass Turf versus grass (yes, no, maybe)	Neuromuscular	Absolute or relative strength of quadriceps, hamstrings, pelvic muscles implied but not proven conclusively
Footwear	Bladed edge boots	Biomechanical	Low hip range of motion Erect stance at the hip and knee during cutting, landing

Table 2.2 presents most of the factors that help predict who might be at risk of an ACL tear. The problem with risk factors is that they often can't be prevented. A coach might discourage the use of bladed boots, but is a game going to be canceled because the field is all Bermuda grass? Dry and hot conditions generally mean the traction will be good. The data tend to support the concept that ACL tears are very infrequent on wet fields on which traction is reduced. The better the traction (due to weather conditions, type of surface, footwear, playing surface, and player motor skills), the greater the risk. (However, it's unlikely players will choose to reduce traction. If asked, they'll accept that risk.) Bony anatomy is genetic and can't be altered. Strength can be improved, but the effectiveness of strength improvements is mostly unproven. Of the factors listed in table 2.2, an erect stance during cutting and landing has the greatest potential for modification to reduce the risk of an ACL injury. For unknown reasons, this is a particular problem for females. (A surgeon friend speaking to high school basketball coaches described the reasons girls have more ACL tears than boys, focusing on the erect stance girls use when cutting. Afterward, an older coach came up and said he knew why girls have more ACL tears. "You do? How's that?" To which this older coach replied, "Girls don't squeak their shoes. Can't squeak your shoes if you are playing while standing straight up." Old coaches are the smart ones.)

Finding Proven Knee Injury Prevention Programs on the Internet

To learn more, search the Internet for any of these specific knee injury prevention programs: Knee Injury Prevention Program (KIPP); Prevent Injury and Enhance Performance (PEP); HarmoKnee program; or Anterior Knee Pain Prevention Training Program (AKP PTP).

Intervention

There is no single widely accepted program proven to effectively reduce ACL injuries. (See Grimm et al. 2014.) Numerous ACL injury prevention programs have been proposed, tested, rejected, modified, redesigned, and tested again. The most successful programs are those that address multiple modifiable intrinsic issues and have been shown to be effective for both males and females. The best programs target strength and plyometrics, dynamic balance, and motor control of the whole body (with special emphasis on the trunk and whole leg) during dynamic actions (landing or cutting). A program that incorporates those target actions can be effective, but there is a catch: They must be done regularly. These activities are not occasional distractions in training.

Research shows that injury prevention programs need to be done during at least 75 percent of training sessions and matches. To date, failure of a prevention program can be traced directly to unacceptable compliance.

When reviewing an ACL program, look for the following activities:

Low-intensity running such as short-distance jogging and shuttle runs as well as forward, lateral, and backward running

Dynamic flexibility exercises that focus on the quadriceps, hamstrings, groin, hip flexors, and calves

Strength exercises that stress the quadriceps (such as lunges), hamstrings (Nordic hamstring curl), and calves (toe raise)

Plyometrics such as single and double leg hopping (forward, backward, lateral, and scissors)

Agility exercises such as shuttles, diagonals, and bounds

Effectiveness

The research is fairly consistent. Compliance (over 75 percent of all sessions) with a prevention program is effective at reducing any knee injury by about 25 percent and in reducing ACL injuries in particular by about 33 percent for males and females, middle school age and older. Some studies have even reported as much as a 75 percent reduction in ACL tears. Prevention is effective if you make the commitment to do it. Unfortunately, not all levels of play make the same commitment. Professional men's teams have notoriously lax compliance and instead try prevention tactics that are based on insufficient evidence. Also note that the second ACL tear (to the same or the opposite knee, which is a particularly harsh problem in females) is not addressed here. That's a different situation, currently with no verified answer.

HIP, GROIN, AND THIGH

Incidence

The most commonly strained muscles are the biceps femoris (part of the hamstrings, page 118), the adductor longus in the groin (page 118), and the rectus femoris (part of the quadriceps, page 118). The focus in this section will be on the biceps femoris, the most frequently injured muscle. Muscle strain injuries account for 18 to 35 percent of all injuries, with older professional males populating the high end of the range. When just looking at a strain injury, 38 percent are to the hamstrings (men are 65 percent more likely to suffer a hamstring strain than women), 31 percent to the adductors, 18 percent to the quadriceps, and 13 percent to the calves.

Mechanism of Injury and Risk Factors

The mechanism of a muscle strain injury (a pulled muscle) is predictable and well established. At its simplest, if a muscle is stretched and then stimulated to contract intensely, the tissue can fail at its weak point, the junction of the two soft tissues where muscle tissue connects to tendon tissue (the muscle–tendon junction). The muscles most often strained are also predictable; they are called two-joint muscles. They originate on a bone, cross over the first joint, then cross a second joint before inserting on another bone. For example, the most commonly injured hamstring muscle (the biceps femoris on the outside of the thigh) originates on the pelvis, passes across the hip joint (the femoral–acetabular joint), then passes across the knee joint before inserting on the fibula—thus, a two-joint muscle.

Injuries to the hip, groin, and thigh are combined because so many muscles attach to the pelvic bones. The mechanism of a muscle strain injury may be well defined, but there are small differences in how each muscle is injured.

A hamstring strain is a sprinting injury that can happen during a rapid transition to a sprint or in the attempt to sprint just a bit faster. For example, while running very fast, the player tries to get a bit more speed by overreaching (overstriding) with the lead leg. The player pushes off with the left leg, flexes the right hip, and extends the knee to reach forward with the right foot. This reach stretches the hamstrings. When the right leg contacts the ground, the overstretched hamstring contracts eccentrically, and the muscle fails.

An adductor longus strain is more of a defender's injury. Picture a defender reacting to a dribbler and reaching laterally for the ball. The reach stretches the muscle. Contact with either the ball or the ground stimulates the eccentric contraction and can strain the muscle. This differs from the chronic sports hernia that is thought to be more of an overuse issue.

Injury to the rectus femoris of the quadriceps muscle is unique because some indirect contact may be involved. Two players simultaneously try to kick or tackle the ball using their instep. One player makes stronger contact. The other player, while still in midcontraction, is overpowered, and the quad is stretched and damaged. This occurrence is pretty rare.

Risk factors are simple. As usual, a prior strain is the strongest predictor of a subsequent injury. Older age is also an issue, especially for the risk of hamstring injuries. Many other factors have been studied (strength, flexibility, etc.), but the results are not conclusive.

Intervention

Strains are common, but programs designed specifically to prevent any strain injury are lacking, and most guidelines are based on tasks that make sense. Three tactics are very common: improving strength (especially eccentric strength), improving flexibility, and

warming up. Many athletes believe that stronger and more flexible muscles are more resistant to strain. Although this makes sense, supporting data are lacking. A good warm-up prepares the muscle for activity and raises the muscle's temperature. However, strong players and weak players, flexible players and inflexible players, and those who perform warm-ups versus those who don't sustain strain injuries at about the same rate.

A hamstring strain is the number one injury in professional male players and can result in extended lost playing time. The Nordic hamstring curl (see page 50) has been studied extensively and shown to be effective. The number two strain injury is to the adductors, and the Danish are testing an adductor-specific exercise, the Copenhagen adduction exercise (figure 2.1) for possible inclusion to The 11+ (see chapter 3). This exercise is effective at improving adductor strength (over 36 percent), and a recent trial showed it can reduce groin injuries by 40 percent (Haroy et al. 2019). Other exercises that address the adductors are found in chapters 6, 10, and 11. Again, none have been tested yet.

Effectiveness

When used as a regular part of training, the Nordic hamstring curl has been shown to reduce hamstring injuries by 50 percent in professionals and up to 80 percent in amateurs. A hamstring strain is not just a player availability or tactical problem at the professional level. It is also a financial issue. How expensive can it be? In the 2017-2018 season, Messi strained a hamstring and was out for three weeks. His salary was estimated to be $667,000 per week, so that injury cost Barca over $2 million. For a professional club to have three or fewer hamstring injuries in a season would be a good year. Over 13 years of the UEFA Champions League, roughly one in every five players had a hamstring strain. For a team of 25 players, that works out to 5 players each season having a hamstring injury. Imagine that annual cost! In addition, studies have shown the Nordic hamstring curl to be superior to any form of hamstring-specific stretching. With those kinds of results, you'd expect professional clubs to be on board with this exercise, but surveys of the UEFA Champions League teams show otherwise.

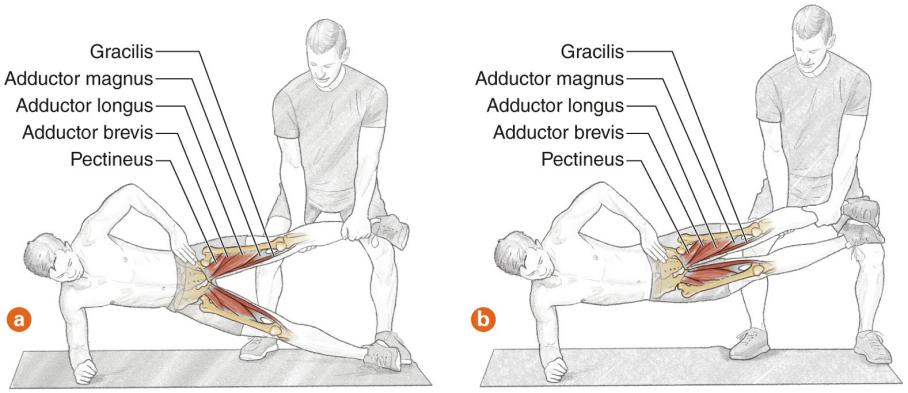


FIGURE 2.1 Copenhagen adduction exercise: (a) starting and ending position; (b) mid-position.

The lack of strain-specific prevention programs for the other strains makes it difficult to say if a program is effective. As a result, coaches focus on more generalized prevention programs such as The 11+ (chapter 3).

HEAD

Incidence

This is a tough one. With the increased awareness over the past 10 or more years, it's hard to determine any changes in the true incidence. Statistics say the rate of head injuries has risen. But is that an actual increase in the number of injuries, or are athletes simply being more forthcoming about their symptoms? Statistics also say women have more head injuries than men—perhaps because women are more honest about their symptoms than men, many of whom will deny symptoms (the gladiator effect). The definition of concussion has changed over time, and injuries that wouldn't have been counted 20 to 25 years ago now get counted.

One statistic that has been reasonably stable over time is that the incidence of any head or neck injury (contusions, lacerations, concussions, eye, etc.) remains at about 15 percent of all injuries, which seems reasonable given that the head and neck make up about that same percent of the body's total surface area. The clinical and investigative efforts, however, are focused on concussions, a very infrequent injury. At the 2014 FIFA World Cup Brazil, there were 3 documented concussions in 64 matches, for a rate of 0.14/1,000 match-hours. Said another way, that was 0.05 per match.

Mechanism of Injury and Risk Factors

Head injuries result from some type of collision, be it an accidental head–ball impact; impact with the head, elbow, hand, knee, or foot of another player; or impact with the ground or goalpost. The one head–ball impact that doesn't appear to be injurious is successful, purposeful heading—an unchallenged pass. The ball can cause a concussion—such as the miskicked ball that strikes an unprepared player, the player who happens to be in the path of the goalkeeper taking a punt, or the defender in a wall who can't get out of the way of a vicious shot—but those are mostly accidents.

The more common circumstances of concussive injury are pretty well understood. These injuries usually happen in the middle third of the field when two players approach from different directions, the attention of both is focused on the ball, and they jump to head the ball. Head–head (mostly females) or head–elbow (mostly males) contacts can lead to a concussion. In fact, there were so many head–elbow injuries in soccer that the rule makers granted the referee the authority to issue a red card for

intentional use of the elbow while heading.

Research into risk factors for a concussion hasn't yielded much. To date, the most common risks of a concussion are a history of a prior concussion and being female. However, that doesn't mean that other potential risks, such as neck strength or skill improvement, won't eventually become more important.

Intervention

Preventing what is commonly considered to be an infrequent accident has yet to be scientifically tested. A number of suggestions have been proposed. The most visible is the use of protective headgear. The thought is that an impact-absorbent material will cushion the head and reduce impact forces. For routine head–ball impacts, headgear offers little protection because when three surfaces collide during heading (ball, headgear, head), the softest material (the ball) absorbs the brunt of the impact. For the harsher impacts (e.g., elbow–head, head–head), protective headgear does reduce impact forces by around 25 to 35 percent. Whether that amount of force reduction will prevent a concussion is unknown.

Skill improvement has been mentioned elsewhere for other injuries. Heading is a very difficult skill to master, and the hardest part of heading doesn't even involve head–ball impact. Players have to be able to track a ball in flight before executing the necessary skills to successfully and accurately head a ball. Tracking a flighted ball is a skill most children under age 10 have little success with. The USSF has implemented age-based restrictions on heading. The simple version: for U10 and younger, no heading; for U11 and U12, training restrictions; and for U13 and older, no restrictions. Another rule restriction that has been proposed for young players (undefined age) is a ban on punting by the goalkeeper. The thought is to simply remove a temptation since the highest velocity balls most players will voluntarily head are punts, goal kicks, and driven corners.

One of the many things a player has to do when heading is to contract the neck muscles to control and stabilize the head. This means that the player's head, neck, and trunk act in unison and present a much larger mass than that of the ball. If a player doesn't fix the head to the trunk (as in an accidental head–ball impact), the ball can overwhelm the head, causing linear or rotational acceleration and a possible concussion. Some think that increasing neck strength should be protective, but there is currently no evidence to support strength training for the neck. This doesn't mean it's not protective; it just means that no study has been able to prove any effectiveness.

Remember the mechanism of injury—two players in the middle of the field, focused on the ball and approaching from opposite directions. If players know this is when concussions happen, they may be wary of what may be coming when facing the situation. This is called situational awareness and should be an educational emphasis (coaching

point) at all ages.

Effectiveness

The absence of any tested prevention program means that no data exist to say whether any specific prevention is effective.

GENERALIZED VERSUS SPECIFIC PREVENTION

The most basic level of prevention is improved fitness. While there are many studies about the effectiveness of a prevention program for a specific injury, combining each program into routine training would leave little time for anything else. The option is to use a generalized program designed to prevent overall injury instead of a specific injury.

Improving fitness reduces injury. Players need to assume the responsibility to arrive sufficiently fit to undertake team-based training, but many youth players simply rely on pickup play. Most coaches would say such play isn't sufficient preparation. Years ago, a study of preseason fitness training was done on high school girls in Cincinnati to see if injuries might be reduced (Heidt et al. 2000). The players were randomly placed into either a control group (their typical preseason training activities) or a preseason training group that performed a speed, agility, and quickness (SAQ) program for seven weeks (three days per week) prior to the team-based training camp. Injuries for both groups were recorded throughout the season. While the study has its flaws, the results were enlightening. In the trained group, 14 percent of the players had an injury, while 33 percent of the untrained group were injured. Those statistics included all injuries. This study proved that simply improving fitness prior to organized team-based training helped prevent in-season injuries. Additionally, only one of the SAQ-trained players sustained a season-ending injury (an ACL tear), while 11 in the untrained group had a season-ending injury, including 8 ACL tears. The trained group sustained a total of 3 knee injuries while the traditional group sustained 29 knee injuries. There were no specific knee injury prevention activities chosen, yet there were astonishingly few knee injuries in the trained group. In addition, studies in other sports have shown that simply increasing a player's aerobic capacity decreases serious knee injuries. When players put in the necessary fitness work on their own, prior to team-based training, good things happen that extend beyond just being ready to survive training camp.

3
THE FIFA WARM-UP

The Fédération Internationale de Football Association (FIFA) is the world governing body for soccer. At the 1994 FIFA World Cup, a high-level FIFA administrator casually asked the question, “Can’t we make the game safer?” Everyone has to accept that participation in sport, especially a contact sport, is risky. Players will get injured. But can’t steps be taken to lessen the rate of injury?

That simple question became the impetus for the development of the FIFA Medical Assessment and Research Centre (F-MARC). One of F-MARC’s primary goals was to reduce the incidence and severity of injuries in soccer. Their first task was to document the true incidence of injury at the world championship level. F-MARC needed to know what injuries to try to prevent. Should they attack the severest injuries, those that result in the greatest loss of playing time? Or the most common injuries, those that affect the most players? Many injury studies already existed, but the methods used were inconsistent, making comparisons and conclusions nearly impossible. F-MARC took the best methods available and started an injury surveillance program, beginning with the

1998 FIFA World Cup. This surveillance effort provided F-MARC a stable database on injuries at the world championship level and continues today at all FIFA-sponsored tournaments.

RESEARCHING INJURY PREVENTION

When F-MARC was organized, most prevention reports were based not on research evidence but on expert opinion. Before the mid-1990s, only one experimental research project designed to prevent injury in soccer—a study out of Sweden—had been published. But that program was so extensive that it was hard to zero in on the most effective aspects to relate to the local coach.

Injury prevention research is a four-step process. First, determine which injuries should be prevented through an injury surveillance program. Second, determine the mechanism of injury (how the injuries happen). Third, devise prevention protocols. Finally, implement the protocols on a large group of players and see if the injury rate decreases. In practice, a large group of players is recruited and randomly divided into two groups. One group receives the intervention, and one group does not. All injuries are recorded over a specific period of time, and the injury rates of the two groups are compared.

That first Swedish study reported a dramatic 75 percent reduction in all injuries, but in reality, no one could comply with the number of interventions or provide the personnel required to carry out their extremely rigid program. The first F-MARC injury prevention program, conducted on mostly high school-age European boys, showed a one-third reduction in overall injury rate, which is a level of reduction that is consistent with subsequent studies. That program was the pilot for F-MARC's initial prevention program called The 11, which consisted of 10 prevention exercises and the call for fair play. (At the world championship level, nearly half the injuries to men and about one-quarter to one-third of all injuries to women are due to foul play.)

An important aspect of injury prevention is establishing the risk factors of a particular injury. Risk factors are classified as player-related factors (lack of skill, poor fitness, or prior injury) or non-player-related factors (quality of refereeing, field conditions, or environment). Some risk factors, such as fitness level and lack of skill, are modifiable, while others, such as gender, age, environment, and field quality, are not. Research suggests that interventions are successful at preventing injury for some modifiable factors (e.g., hamstring strength), but the number one predictor of an injury is a history of that injury. A player who has had a strained hamstring has a dramatically higher risk of suffering from that same injury again; some reports suggest the risk is increased by a factor of eight times. The obvious conclusion, then, is to prevent the first injury.

Since the original Swedish project, a number of prevention trials have been conducted and published in medical literature. Some of the trials were general and designed to lower the overall injury rate. Other trials attempted to prevent specific injuries. For example, in team sports, programs were designed specifically to prevent ankle sprains, knee sprains, hamstring strains, and groin strains. Prevention programs may be classified as primary prevention (prevent the first injury occurrence) or secondary prevention (prevent a recurrent injury). Programs that prevent hamstring strains and knee sprains are considered primary prevention but are still effective in secondary prevention, while programs that prevent ankle sprains are considered secondary prevention. To date, no prevention program has been able to prevent an athlete's first ankle sprain.

GENERALIZED INJURY PREVENTION: THE 11+

As the evidence began to accumulate, F-MARC developed the second version of The 11. In the revision, the exercises were progressive, and the entire program was substituted for the typical generalized warm-up a team might do before training or a match. The result was The 11+.

The first serious clinical trial of The 11+ (on nearly 2,000 girls ages 13 to 17 years old) was published by Soligard et al. in 2008, and the results were quite good. Players who followed The 11+ had 31 percent fewer injuries overall (28 percent fewer match injuries), 53 percent fewer overuse injuries, 56 percent fewer contusions, 89 percent fewer complaints of low back pain, 52 percent fewer cases of tendon pain in the legs, and 45 percent fewer severe injuries (injuries with more than 28 days lost). The researchers showed an expected overall injury reduction of about one-third. They also had excellent compliance to the program because its revised design increased the interest of and participation by players and coaches.

Since then, The 11+ has been tested on other team sports and with players of various ages, both genders, and different levels of play. Since 2011 (when the first edition of Soccer Anatomy was published), there have been a number of systematic reviews of The 11+. (A systematic review is a rigorous, quantitative summary of many studies, providing a broader understanding of a topic than a single study.) When the data from multiple studies are combined, The 11+ reduces overall injuries in females by about 20 percent and in males by nearly 30 percent. Another important finding is that players who followed The 11+ had fewer days lost to the injury (injuries were mostly minor, so they returned to play sooner). Recent work has tested the utility of two new versions of The 11+: The 11+ for Kids (48 percent fewer overall injuries, 60 percent fewer recurrent

injuries, and 74 percent fewer severe injuries; ages 7 to 12) and the as yet untested The 11+ for Referees (details available at https://www.fifamedicinediploma.com/wp-content/uploads/2016/11/fifa_11_referee_manual.pdf). Finally, from the public health standpoint, the reductions in injury also show substantial savings in medical costs of sports injuries. One injury that doesn't seem to be impacted much by The 11+ is a groin strain. The next iteration of The 11+ will likely include the Copenhagen adduction exercise described in chapter 2.

Why does The 11+ work? A number of studies have asked just that question. We have learned that a wide range of neuromuscular adaptations occur in players who adhere to the program. Some of the main factors that have been shown to occur after complying with The 11+ include improvement in SAQ tasks (sprint speeds, agility, and quickness), jump test performance (static and countermovement), static and dynamic balance (faster time to stabilization, core stability, and dynamic control of balance), strength (quadriceps and hamstrings), and joint awareness (static and dynamic joint position sense). In short, regular use of The 11+ improves coordination and reactions to motor control disruptions that happen randomly during play.

The primary caveat is that the best results come when the program is a regular aspect of training that needs to be overseen by the coach. Left to themselves, players will not perform the activities with the same commitment. Research indicates that teams need to perform The 11+ (and probably any prevention program) as a part of 75 percent or more of all soccer activities (training and match). Any less and all bets are off. Training for prevention cannot be a novelty. It must be a regular aspect of training.

As a warm-up, The 11+ prepares players for training and competition. As a teaching tool, a number of the exercises teach players the proper techniques for landing, cutting, and pivoting. When the landing is done properly, the knee should flex over the planted foot (figure 3.1a) and not be allowed to collapse into what is called a valgus position (figure 3.1b). The coach needs to watch players do these exercises and correct players who display incorrect landing and cutting techniques.

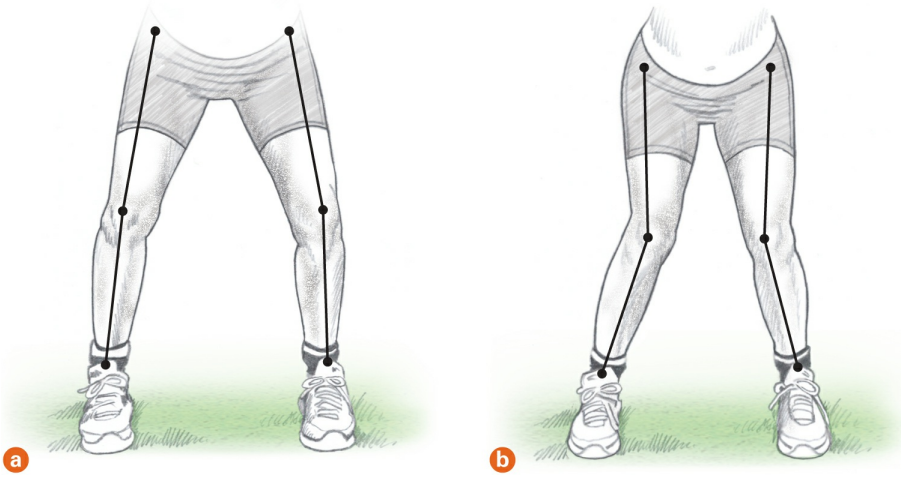


FIGURE 3.1 Landing knee position: (a) correct; (b) incorrect.

Although a number of prevention programs are available, The 11+ has gained wide acceptance, and its use continues to grow. Because of its success and specific focus on soccer, the exercises of The 11+ have been used as the foundation for the warm-up in this chapter. (See table 3.1.) Additional information about The 11+, including a chart that shows the entire routine, can be found at http://f-marc.com/11plus/index.html. Once a team has learned the exercise routine, the entire program can be completed in 15 to 20 minutes. Remember, The 11+ replaces a team's warm-up.

THREE PARTS OF THE FIFA WARM-UP

A warm-up gradually prepares the body for more intense exercise, which is important since the body operates more efficiently when warmer than when at resting temperature. For that reason, The 11+ begins with a short period of jogging.

After the jogging exercises, players move into strength, plyometric, and balance exercises. These exercises dynamically stretch the muscles and prepare them for more explosive maneuvers on the pitch.

One of the purposes of a generalized warm-up is to prepare the body for the upcoming activity. Many of the exercises in The 11+ are challenging but not very intense. Each running exercise is performed at a higher intensity, bringing the body closer to the intensity of more formal training. The pace of this running is not sprinting but a fairly hard stride. Increasing running speed means increasing stride rate and increasing stride length. Thus, the movement of the swing leg occurs faster, and the push-off by the ground leg is stronger. The actual muscles used at the various running speeds remain about the same, but the brain tells each active muscle to work harder by

recruiting a greater number of muscle cells as well as by asking each cell to contract harder.

TABLE 3.1 The 11+ Warm-Up Routine

JOGGING EXERCISES					
Exercise number	**Exercise title**			**Page number**	**Sets**
1	Jogging straight ahead			40	2
2	Jogging with hip out			41	2
3	Jogging with hip in			42	2
4	Jogging around partner			43	2
5	Jogging and jumping with shoulder contact			44	2
6	Jogging forward and backward			45	2
STRENGTH, PLYOMETRIC, AND BALANCE EXERCISES					
Exercise number	**Level 1**	**Level 2**	**Level 3**	**Page number**	**Sets**
7	Static plank	Plank with alternating legs	Plank with one-leg lift and hold	46	2; 2 each leg for plank with one-leg lift and hold
8	Static sideways plank	Sideways plank with hip lift	Sideways plank with leg lift	48	2 each side
9	Beginner Nordic hamstring curl	Intermediate Nordic hamstring curl	Advanced Nordic hamstring curl	50	1
10	Single-leg stance with ball hold	Single-leg stance with ball throw to partner	Single-leg stance with partner test	52	2 each leg
11	Squat with toe raise	Walking lunge	One-leg squat	54	2; 2 each leg for one-leg squat
12	Vertical jump	Lateral jump	Box jump	56	2
RUNNING EXERCISES					
Exercise number	**Exercise title**			**Page number**	**Sets**
13	Running across the pitch			58	2
14	Bounding			59	2
15	Plant and cut			60	2

Adapted from The 11+, developed by F-MARC.

JOGGING

JOGGING STRAIGHT AHEAD

Execution

Place 6 to 10 pairs of cones in parallel lines 5 to 10 yards (5 to 9 m) apart—closer for younger players, farther for older players. (This cone configuration will be used for all of the jogging exercises.) If many players are participating, consider setting up two or more sets of parallel cones. Start with a partner from the first pair of cones. Jog with your partner to the last pair of cones. On the way back to the start, progressively increase your speed. Perform this twice.

Muscles Involved

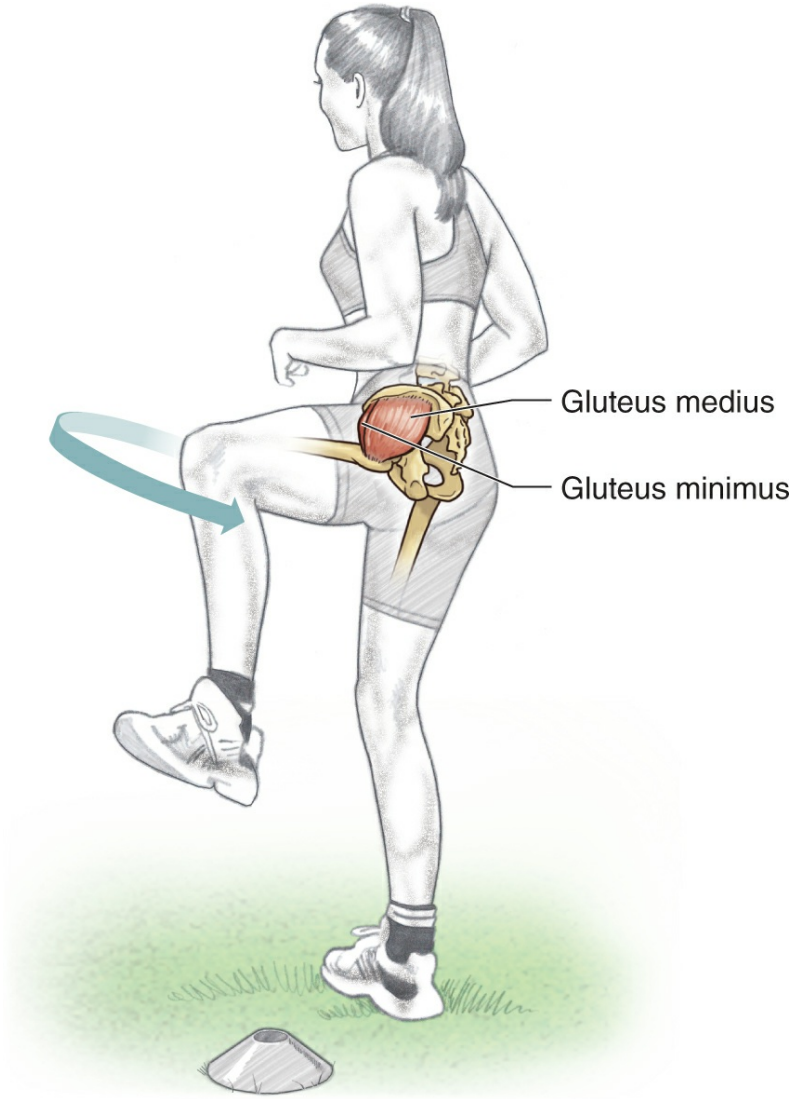
Primary: Hip flexors (psoas major and minor, iliacus), quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gastrocnemius, soleus

Secondary: Hamstrings (biceps femoris, semitendinosus, semimembranosus), peroneals (peroneus longus, brevis, and tertius), tibialis anterior

SOCCER FOCUS

One purpose of a warm-up is to increase your internal body temperature. This is important because the metabolic functions described in chapter 1 work most efficiently at temperatures above rest. Some general jogging is a simple way to start increasing your internal temperature. When you break into a sweat, your internal temperature is well on the way to a range where energy metabolism is most efficient. The 11+ will effectively increase your internal temperature.

JOGGING WITH HIP OUT



Execution

Set up cones in the same configuration as for the jogging straight ahead exercise. Walk or jog easily with a partner, stopping at each pair of cones to lift your knee and rotate your hip out. Alternate left and right legs at successive cones. Jog back to the start after the last cone. Perform two sets.

Muscles Involved

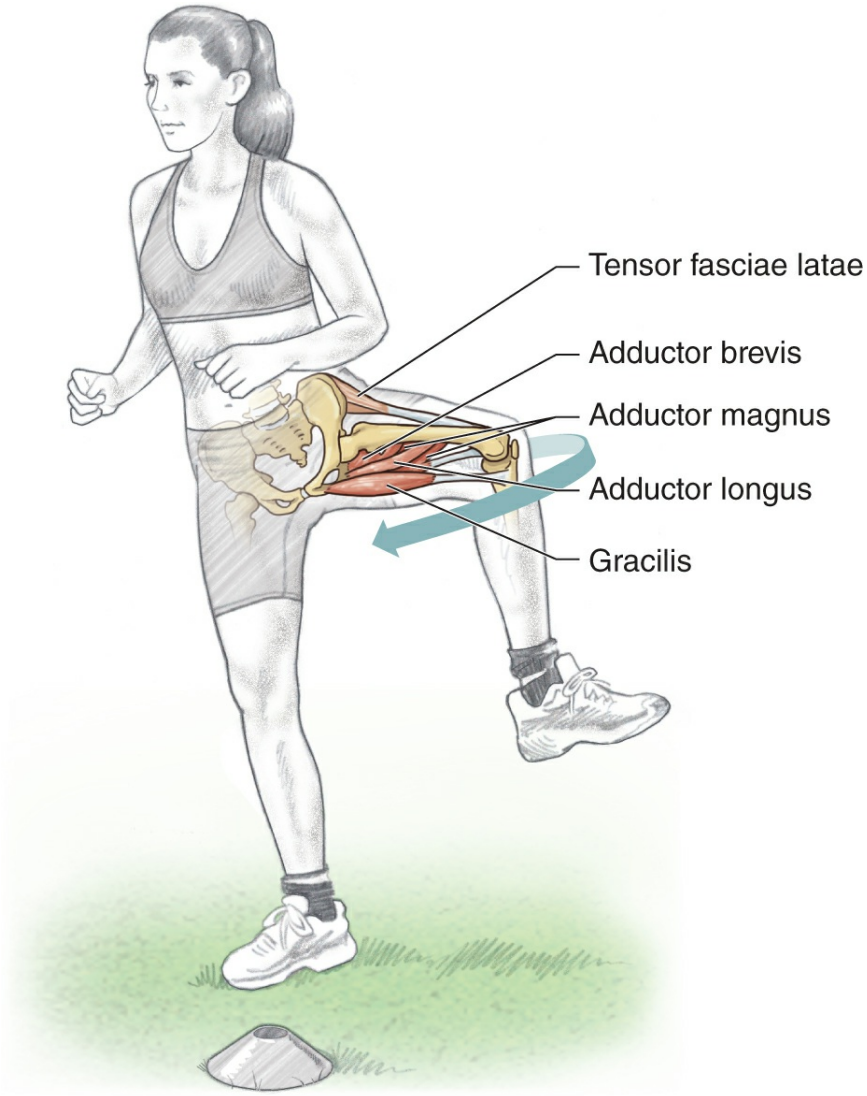
Primary: Hip flexors, gluteals (gluteus maximus, gluteus medius, and gluteus minimus), tensor fasciae latae

Secondary: Adductor longus, adductor magnus (posterior fibers), sartorius, piriformis

SOCCER FOCUS

Many coaches and athletes believe static stretching will improve performance and prevent injury, but the scientific evidence shows otherwise. Dynamic stretching, which involves taking the joint through a full range of motion, does not hamper performance and has been shown to reduce strain injuries. Soccer players are prone to groin injuries and may need to perform specific dynamic stretching of the groin as a part of every warm-up.

JOGGING WITH HIP IN



Execution

Set up cones in the same configuration as for the jogging straight ahead exercise (page 40). Walk or jog easily with a partner, stopping at each pair of cones to lift your knee up and out to the side before rotating your hip inward. Alternate between the left and right legs at successive cones. Jog back to the start after the last cone. Perform two sets.

Muscles Involved

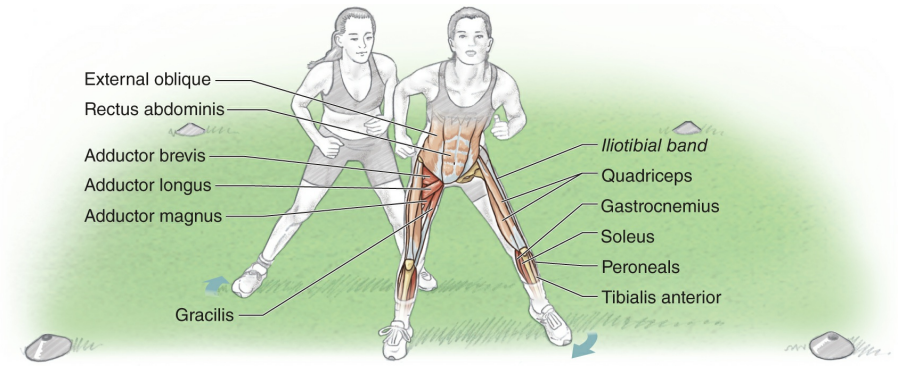
Primary: Adductors (adductor longus, adductor magnus, adductor brevis, gracilis), gluteus minimus, gluteus medius

Secondary: Pectineus, tensor fasciae latae

SOCCER FOCUS

Most flexibility programs emphasize opposing muscle groups. This dynamic internal rotation exercise balances out the previous dynamic external rotation exercise. With both of these dynamic flexibility exercises, be sure to move the thigh through the entire range of motion by either ending or beginning at the extremes of motion. These are effective exercises when each rotation attempts to go just a little bit farther.

JOGGING AROUND PARTNER



Execution

Set up cones in the same configuration as for the jogging straight ahead exercise (page 40). With a partner, jog together to the first set of cones. Shuffle sideways to meet in the middle. Shuffle an entire circle around your partner as she circles around you, and then return to the cones. Repeat for each pair of cones. Stay on your toes, and keep your center of gravity low by bending your hips and knees. Jog back to the start after the last cone. Perform two sets.

Muscles Involved

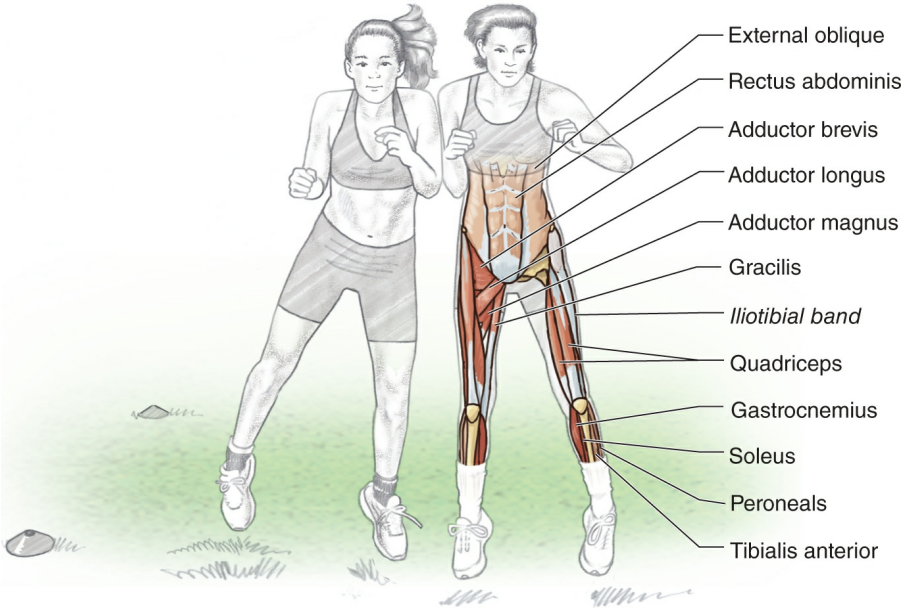
Primary: Gastrocnemius, soleus, gluteus maximus, iliotibial band (push-off leg), adductors (pulling leg)

Secondary: Hamstrings (biceps femoris, semitendinosus, semimembranosus), quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), peroneals, tibialis anterior, abdominal core (external oblique, internal oblique, transversus abdominis, rectus abdominis), and spinal extensors (erector spinae, multifidus) for postural control

SOCCER FOCUS

Soccer requires many lateral movements of varying distances, directions, and speeds. Lateral movement is one aspect of agility, which is a prized trait that soccer players are known for. This gentle exercise prepares players for the next exercise. Going both directions balances the load across the legs. As with all exercises that involve movement, be sure your knees do not collapse in.

JOGGING AND JUMPING WITH SHOULDER CONTACT



Execution

Set up cones in the same configuration as for the jogging straight ahead exercise (page 40). With a partner, jog together to the first pair of cones. Shuffle sideways to meet your partner in the middle, and then jump sideways toward your partner to make shoulder-to-shoulder contact. Land on both feet with your hips and knees bent. Do not let your knees buckle in. Synchronize the timing of your jump and landing with your partner. Repeat at each cone. Jog back to the start after the last cone. Perform two sets.

Muscles Involved

Primary: Gastrocnemius, soleus, gluteus maximus, iliotibial band (push-off leg), adductors (pulling leg), quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), hamstrings (biceps femoris, semitendinosus, semimembranosus)

Secondary: Abdominal core, peroneals, tibialis anterior

SOCCER FOCUS

A key factor in knee injuries, especially injuries to the ACL, is the knee collapsing in when the player lands erect. This awkward position adds strain on the ACL that may be sufficient to tear the ligament and damage the meniscus. Many of the exercises in The 11+ teach players to control landing and cutting. This is especially important for female

players from middle school age and up, the prime ages for an ACL tear. Land softly and quietly. Be sure your knees do not collapse in.

JOGGING FORWARD AND BACKWARD

Execution

Set up cones in the same configuration as for the jogging straight ahead exercise (page 40). With a partner, jog quickly to the second set of cones, and then backpedal quickly to the first set of cones, keeping your hips and knees slightly bent. Jog to the third set of cones, and then backpedal to the second set of cones. Repeat through all sets of cones. Jog back to the start after the last cone. Take small, quick steps. Perform two sets.

Muscles Involved

Primary: Hip flexors, quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), hamstrings (biceps femoris, semitendinosus, semimembranosus), gastrocnemius, soleus, gluteals

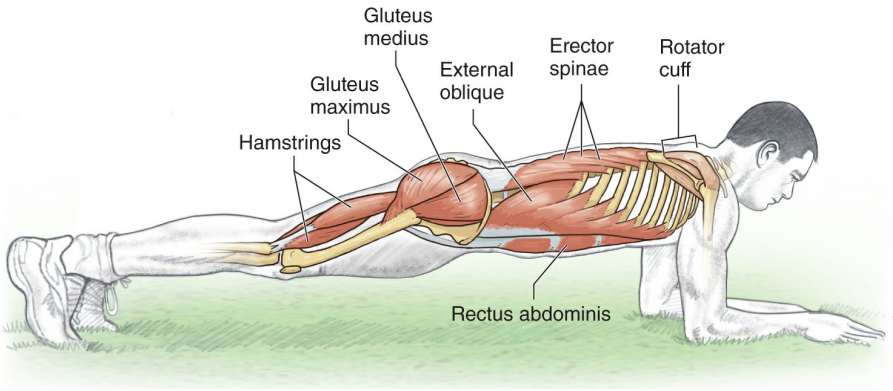
Secondary: Abdominal core, spinal extensors

SOCCER FOCUS

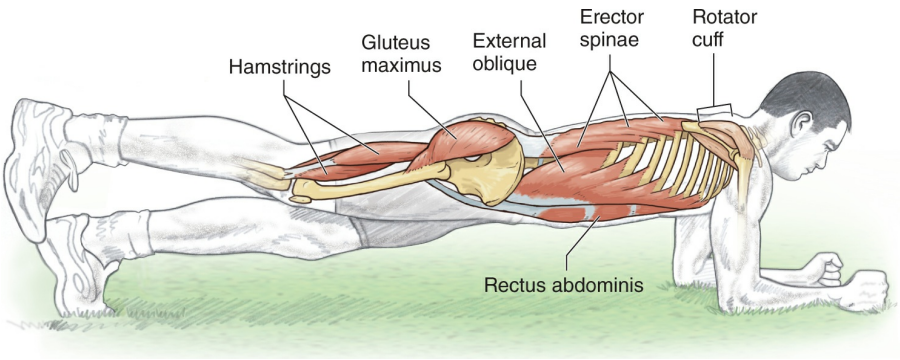
This exercise is done more quickly than the others in this group. Plant your front foot firmly, ensuring the knee stays over the foot and does not buckle in. Jog one cone forward and backward quickly, keeping good balance and posture. Plant the push-off leg firmly, and jog two cones forward quickly. Take small, quick steps, not loping strides. Maintain proper posture—flexed hips and knees—and an almost exaggerated arm action.

STRENGTH, PLYOMETRIC, BALANCE

PLANK



Level 1: static plank.



Level 2: plank with alternating legs.

Level 1: Static Plank

Lie on your front, supporting yourself on your forearms and feet. Your elbows should be directly under your shoulders. Lift your body, supporting your weight on your forearms. Pull in your abdomen, and hold the position for 20 to 30 seconds. When this static position is held long enough, you will feel it throughout the core muscles. Proper form is important, so make sure the elbows are directly under the shoulders and your body is in a straight line from the back of the head down to the trunk, hips, and heels. Try not to sway or arch your back. Lower your body to the ground, and repeat the exercise.

Level 2: Plank With Alternating Legs

Adding a hip extension is a simple way to make this basic core strengthening exercise more difficult. The challenge is to maintain a straight line all the way down the body. Good posture is critical. Lie on your front, supporting yourself on your forearms and feet. Your elbows should be directly under your shoulders. Lift your body, supporting your weight on your forearms. Pull in your abdomen. Lift your right leg, and hold for 2 seconds. Lower your right leg, and then lift your left leg, holding for 2 seconds. Continue by alternating legs for 40 to 60 seconds. For the best results, slowly raise and lower the leg. Keep your body in a straight line. Try not to sway or arch your back. Repeat this exercise for a second 40- to 60-second set.

Level 3: Plank With One-Leg Lift and Hold

This more difficult version of the plank combines isometrics (holding the leg in the up position) with dynamic movement (raising and lowering the leg). Holding the leg up for 20 to 30 seconds adds an additional challenge for the spine and hip extensors. Lie on your front, supporting yourself on your forearms and feet. Your elbows should be directly under your shoulders. Lift your body, supporting your weight on your forearms. Pull in your abdomen. Lift one leg about 6 inches (15 cm) off the ground, and hold the position for 20 to 30 seconds. Keep your body straight. Do not let your opposite hip dip down, and do not sway or arch your lower back. Lower the leg, take a short break, switch legs, and repeat. Do this twice for each leg.

Muscles Involved

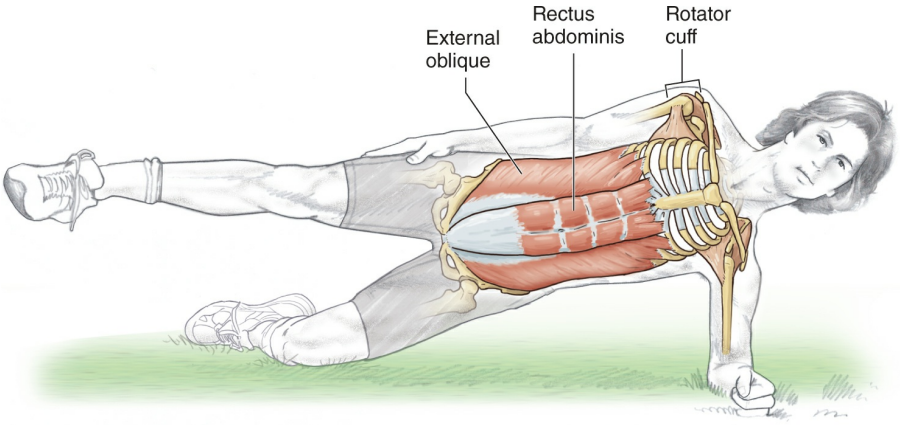
Primary: Abdominal core, spinal extensors, gluteals, hamstrings (biceps femoris, semitendinosus, semimembranosus)

Secondary: Shoulder stabilizers including rotator cuff (supraspinatus, infraspinatus, subscapularis, teres minor) and scapular stabilizers (rhomboid major and minor, trapezius, latissimus dorsi)

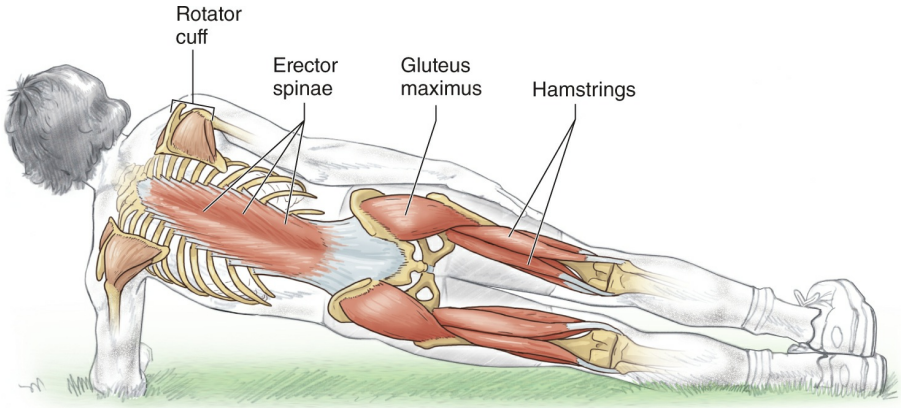
SOCCER FOCUS

The plank, sometimes known as the bench, is a basic core strengthening exercise. Do not skip levels 1 and 2 to get to the hardest version. When you can do a level easily, with minimal local fatigue and discomfort, progress to the next level. The advanced versions of the plank can be quite difficult if performed without some preparatory training.

SIDEWAYS PLANK



Level 1: static sideways plank.



Level 2: sideways plank with hip lift.

Level 1: Static Sideways Plank

Lie on your side with the knee of your lower leg bent to 90 degrees. Rest on your forearm and knee to support your upper body. The elbow of your supporting arm should be directly under your shoulder. Lift your upper leg and hip until your shoulder, hip, and knee are in a straight line. Hold the position for 20 to 30 seconds, and then lower your body to the ground. Take a short break, switch sides, and repeat. Do this twice on both sides.

Level 2: Sideways Plank With Hip Lift

The additional movement of this variation places an extra load on the core muscles. Lie on your side with both legs straight. Lean on your forearm and the side of your lower foot so that your body is in a straight line from shoulder to foot. The elbow of your supporting arm should be directly beneath your shoulder. Lower your hip to the ground,

and then raise it again. Repeat for 20 to 30 seconds. Take a short break, switch sides, and repeat. Do this twice on each side.

Level 3: Sideways Plank With Leg Lift

Level 3 is more challenging than level 2. Raising the leg laterally is relatively difficult. Lie on your side with both legs straight. Lean on your forearm and the side of your lower foot so that your body is in a straight line from shoulder to foot. The elbow of your supporting arm should be directly beneath your shoulder. Lift your upper leg, and then slowly lower it again. Repeat for 20 to 30 seconds. Lower your body to the ground, take a short break, switch sides, and repeat. Do this twice for each leg.

Muscles Involved

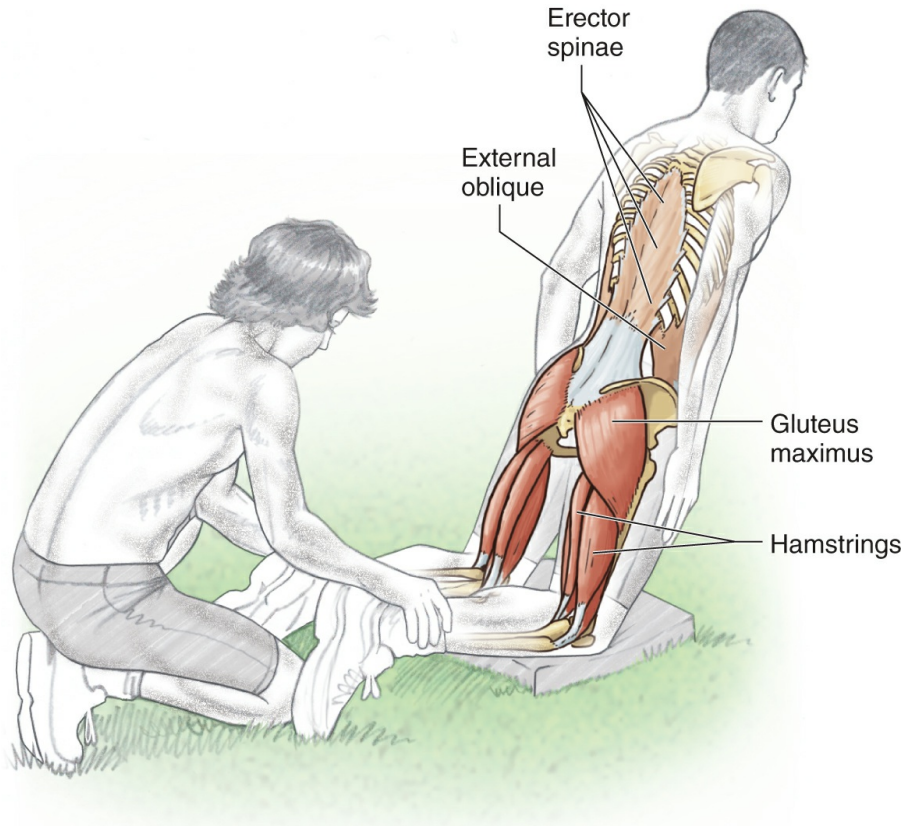
Primary: Abdominal core, spinal extensors, gluteals, hamstrings (biceps femoris, semitendinosus, semimembranosus)

Secondary: Shoulder stabilizers (rotator cuff, scapular stabilizers)

SOCCER FOCUS

The sideways plank directs the effort toward the muscles responsible for lateral control of the core. To neglect this group would neglect an important functional aspect of core control. As with the three levels of the plank exercise, do not bypass levels 1 and 2 to get to level 3. When you can do a level easily, with minimal local fatigue and discomfort, progress to the next level.

NORDIC HAMSTRING CURL



Level 1: Beginner Nordic Hamstring Curl

Kneel on a soft surface. Ask a partner to squat behind you and anchor your ankles to the ground. Your body should be completely straight from the shoulders to the knees throughout the exercise. You may cross your arms across your chest or simply keep your hands ready to catch your body in a push-up position. Lean forward as far as you can, controlling the movement with your hamstrings and your gluteal muscles. When you can no longer hold the position, gently absorb your weight using your hands, falling into a push-up position. Complete three to five repetitions.

Level 2: Intermediate Nordic Hamstring Curl

Perform the exercise as described for the beginner Nordic hamstring curl, but complete 7 to 10 repetitions.

Level 3: Advanced Nordic Hamstring Curl

Perform the exercise as described for the beginner Nordic hamstring curl, but complete 12 to 15 repetitions.

Muscles Involved

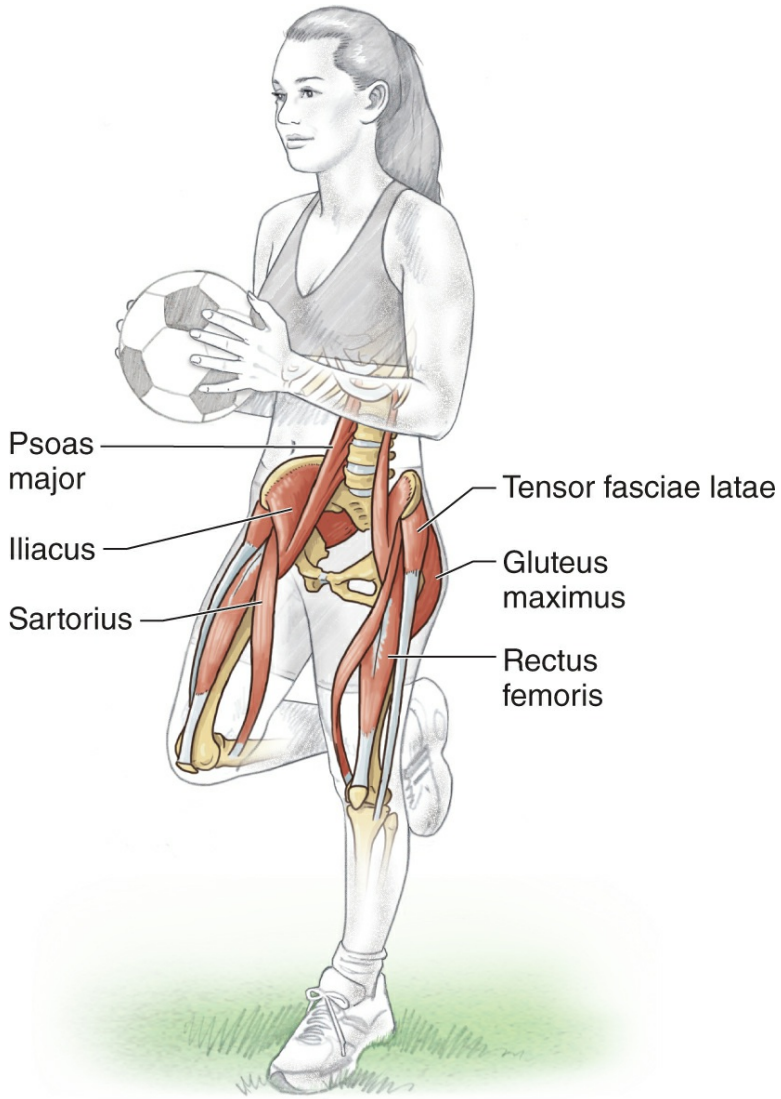
Primary: Hamstrings (biceps femoris, semitendinosus, semimembranosus), gluteus maximus

Secondary: Spinal extensors, abdominal core

SOCCER FOCUS

The pace of modern play has increased dramatically. Soccer has become a sport well suited to the high-power, ballistic sprinter. As skills and tactics evolve, so do injuries. In the 1970s, hamstring strains were rare. Today, hamstring strains are among the top four time-loss injuries in soccer. Some reports suggest a professional team can expect up to six hamstring strains or more per season. For a less severe strain, a player might be sidelined for a couple of weeks, but a more serious injury could sideline a player for four months or more. In the short, match-dense U.S. school and club-based seasons, a hamstring strain could be a season-ending injury. Thus, teams must do everything possible to prevent hamstring strains. This exercise, sometimes called Russian hamstrings, has been shown to effectively prevent hamstring strains, especially in players with a history of this injury, and should be a part of every training session. As strength improves, increase the number of repetitions you do, and control the descent, getting as close to the ground as possible. This exercise not only reduces the risk of hamstring strains but also strengthens the hamstrings, which helps stabilize the knee and hip when you cut or land, adding another level of protection against knee injuries.

SINGLE-LEG STANCE



Level 1: single-leg stance with ball hold.

Level 1: Single-Leg Stance With Ball Hold

Holding a ball provides a small distraction, taking your mind off the act of balancing and allowing the more subconscious regions of the brain and the spinal cord to regulate balance. Balance on one leg. Hold a soccer ball with both hands. Keep your body weight on the ball of your grounded foot. Do not let your knees buckle in. Hold for 30 seconds. Switch legs, and repeat the exercise. Do this twice on each leg. You can make the exercise more difficult by moving the ball around your waist or under your raised knee.

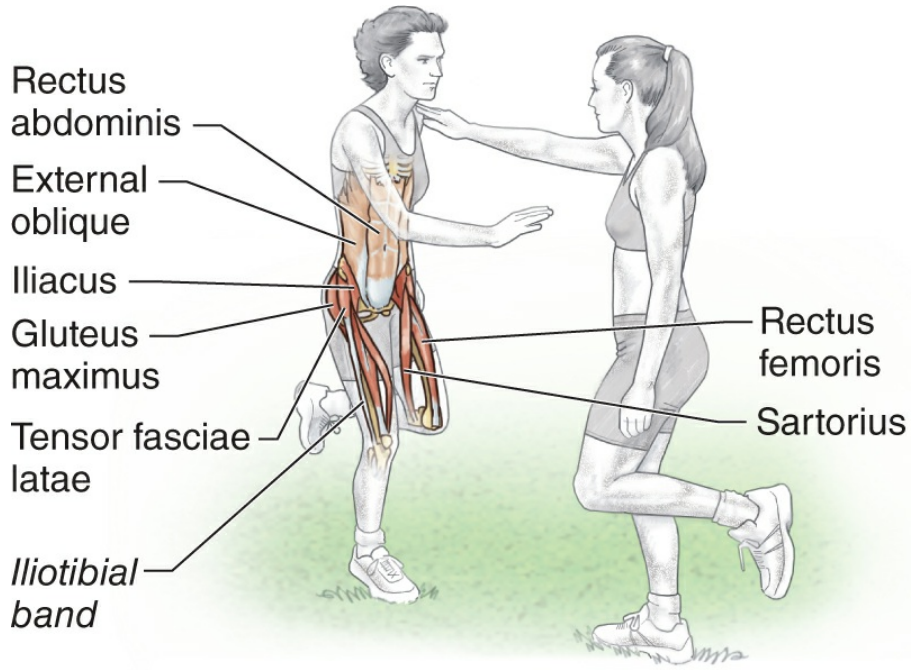
Level 2: Single-Leg Stance With Ball Throw to

Partner

Level 2 of this balance exercise adds the more demanding distraction of reacting to a ball tossed by a partner. The receiving player has to watch and track the thrown ball; predict and react to its flight; and adjust body position, balance, and posture before finally catching the ball. Stand 2 to 3 yards (2 to 3 m) away from your partner. Each of you should stand on one leg. Hold a soccer ball in both hands. While keeping your balance and contracting your abdomen, toss the ball to your partner. Keep your weight on the ball of your grounded foot. Keep your knee just slightly flexed, and do not let it buckle in. Control the supporting knee over the grounded foot to keep the knee from wobbling back and forth. Toss the ball back and forth for 30 seconds. Switch legs and repeat. Do two sets for each leg.

Level 3: Single-Leg Stance With Partner Test

Level 3 of this balance exercise is even more challenging. Stand an arm's length in front of your partner as both of you balance on one foot. As you both try to keep your balance, take turns trying to push the other off balance in different directions. Try to knock your partner off balance with a gentle touch by using one or both hands to attack from different directions. React quickly to the contact, and respond accordingly. Keep your weight on the ball of your foot, and do not let your knee buckle in. The goal is to maintain balance and keep the knee over the supporting foot. Keep this exercise under control; it's easy to get a bit out of hand. Continue for 30 seconds. Switch legs. Do two sets on each leg.



Level 3: single-leg stance with partner test.

Muscles Involved

Primary: Hip flexors (psoas major and minor, iliacus, rectus femoris), hip extensors (gluteus maximus, hamstrings), tensor fasciae latae, sartorius, iliotibial band

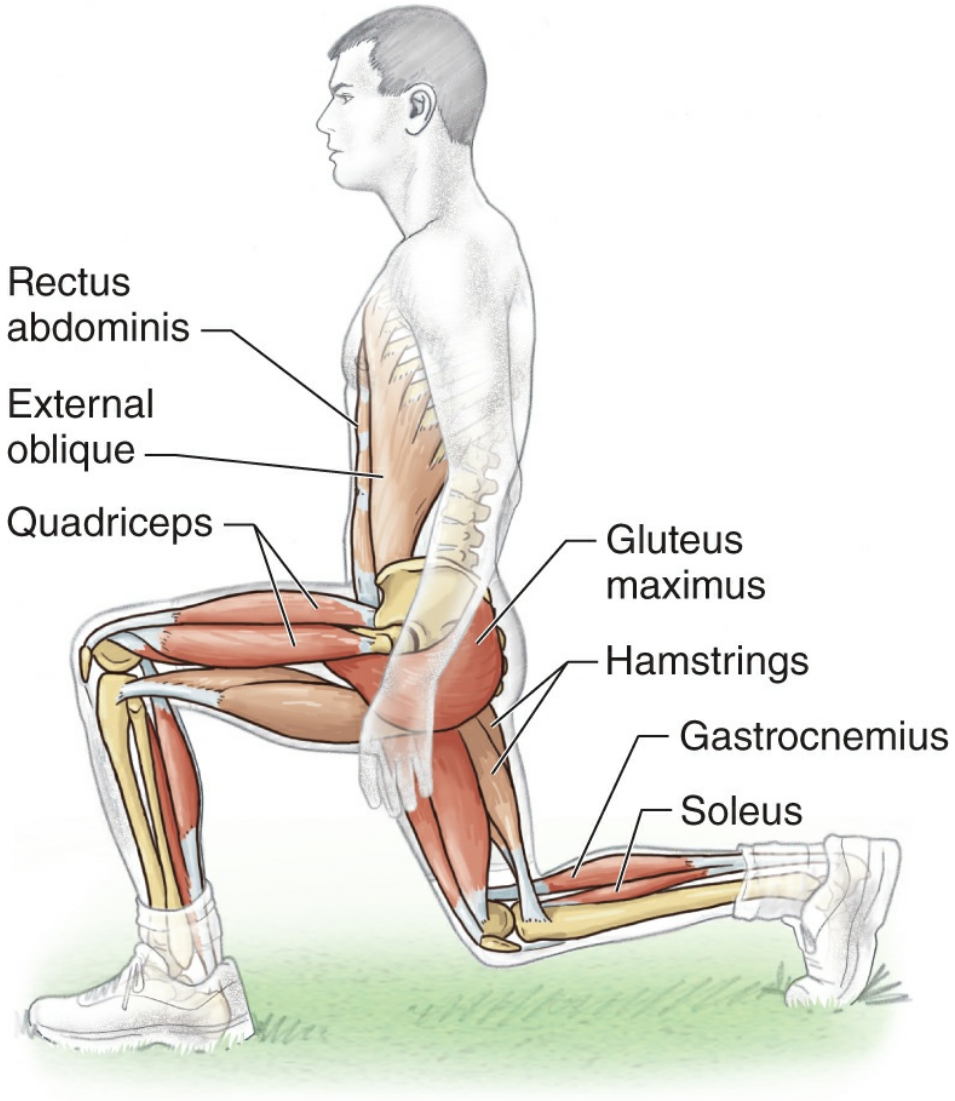
Secondary: Abdominal core, spinal extensors

SOCCER FOCUS

As upright beings, we are constantly maintaining our balance in an attempt to keep our center of mass over our base of support. When the center of gravity is outside a comfort radius around our base of support, we have to react and correct it, or we fall. Balance is a complex physiological process that integrates environmental sensations with movement and reaction patterns by the brain and spinal cord. Special areas in the brain compare planned and actual movement information before reacting, all in milliseconds. Many knee injuries occur because of an inadequate response to a loss of balance, causing the knee to collapse in. The single-leg stance, the squat (page 54), and jumping (page 56) are directed at improving balance and knee control during a variety of activities.

SQUAT

Level 1: squat with toe raise.



Level 2: walking lunge.

Level 1: Squat With Toe Raise

This is the first of three progressively more demanding exercises designed to increase leg strength. Stand with your feet hip-width apart. Place your hands on your hips if you like. Imagine you are about to sit on a chair. Squat by bending your hips and knees to 90 degrees. Do not let your knees buckle in. Descend slowly, and then straighten up more quickly. When your legs are completely straight, rise on your toes, and then slowly lower back to the starting position. Continue for 30 seconds. Complete two sets.

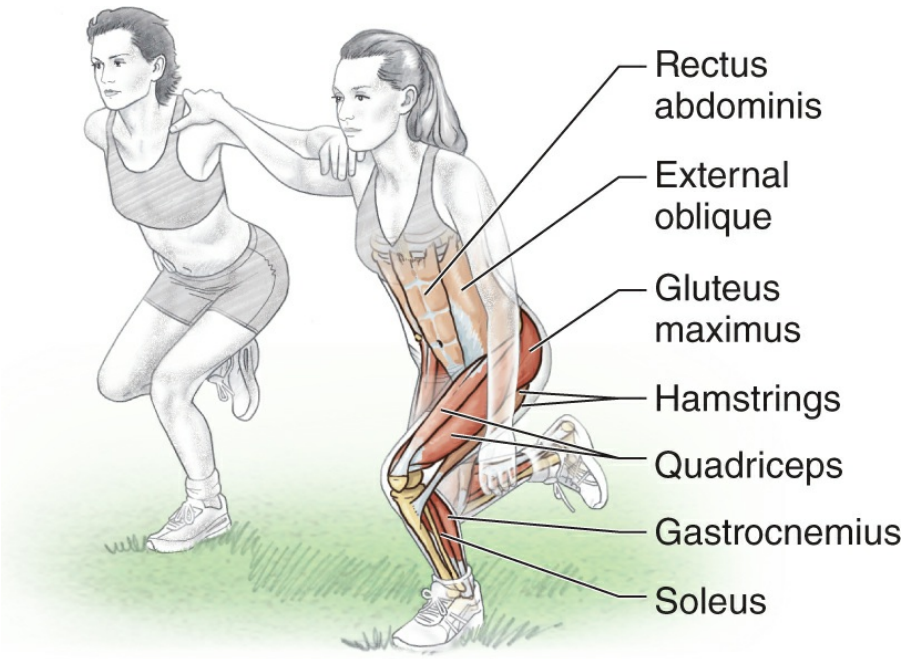
Level 2: Walking Lunge

This level 2 exercise narrows the focus to a single leg by using the walking lunge. It may help to have a coach watch your performance from the front to ensure proper technique. The walking lunge increases dynamic flexibility of the quadriceps, hip

flexors, and groin. Stand with your feet hip-width apart. Place your hands on your hips if you like. Slowly lunge forward. As you lunge, bend your leading leg until your hip and knee are flexed to 90 degrees and your trailing knee nearly touches the ground. Do not let your forward knee buckle in. Keep your upper body erect, with the head up and hips steady. Focus on keeping the forward knee over the foot but not beyond your toes. Do not let the knee wobble back and forth. Inhale and draw in the core during the lunge; exhale when you stand up. Many people pause briefly between each lunge. Alternate legs as you lunge your way across the pitch (approximately 10 times on each leg), and then jog back. Do two sets across the pitch.

Level 3: One-Leg Squat

The level 3 exercise is quite challenging. It is difficult to squat on one leg and keep the knee over the grounded foot. Of all the exercises, this is probably the most difficult one to successfully control the knee. Have a coach watch from the front and alert you if you fail to adequately control the knee. Position yourself beside your partner, each of you standing on one leg, loosely holding on to one another for balance. Keeping the trunk as erect as possible, slowly bend your knee as far as you can but no farther than a 90-degree angle. Concentrate on preventing the knee from buckling in. Bend your knee slowly, and then straighten it a little more quickly, keeping your hips and upper body in line. Repeat the exercise 10 times, and then switch legs. Do two sets on each leg.



Level 3: one-leg squat.

Muscles Involved

Primary: Hip flexors, gluteus maximus, quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gastrocnemius, soleus

Secondary: Abdominal core, spinal extensors, hamstrings (biceps femoris, semitendinosus, semimembranosus)

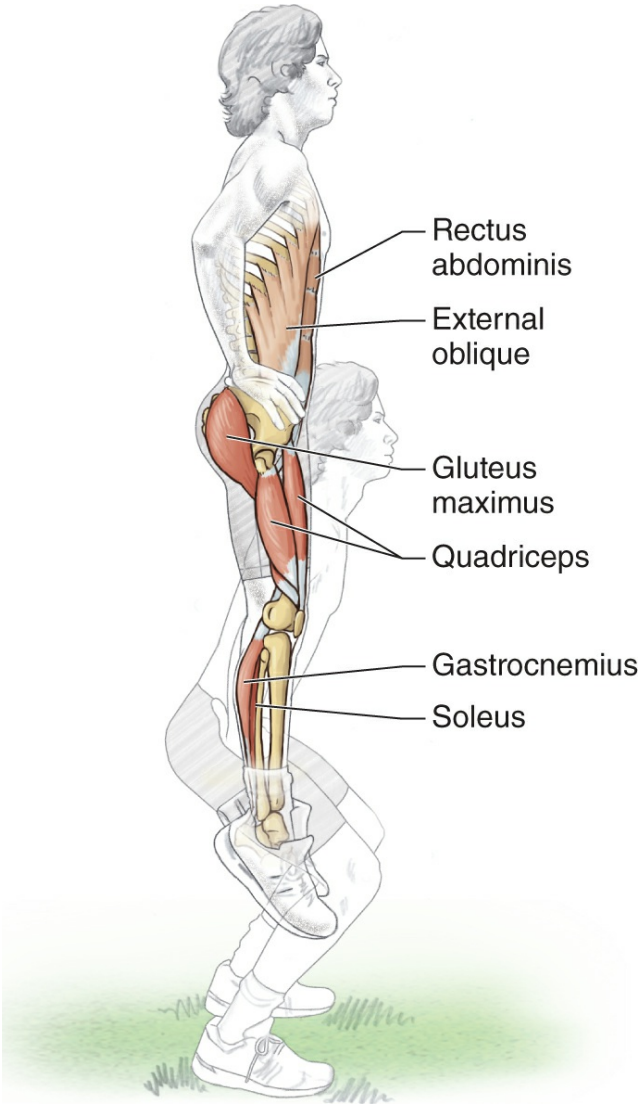
SOCCER FOCUS

Another part of this prevention program is controlling how players land, either during cutting or jumping. Players who are at risk for knee injuries when landing are those who land stiffly in an erect stance. To counter this, players must learn to land softly, absorbing the force of impact with their hips, knees, and ankles. Landing softly requires having good ankle mobility because it is hard for the knees and hips to make up for the ankles, another example of linkage as discussed in the preface. One thought is that players who land stiffly do not have the strength to absorb the force of impact.

JUMPING

Level 1: Vertical Jump

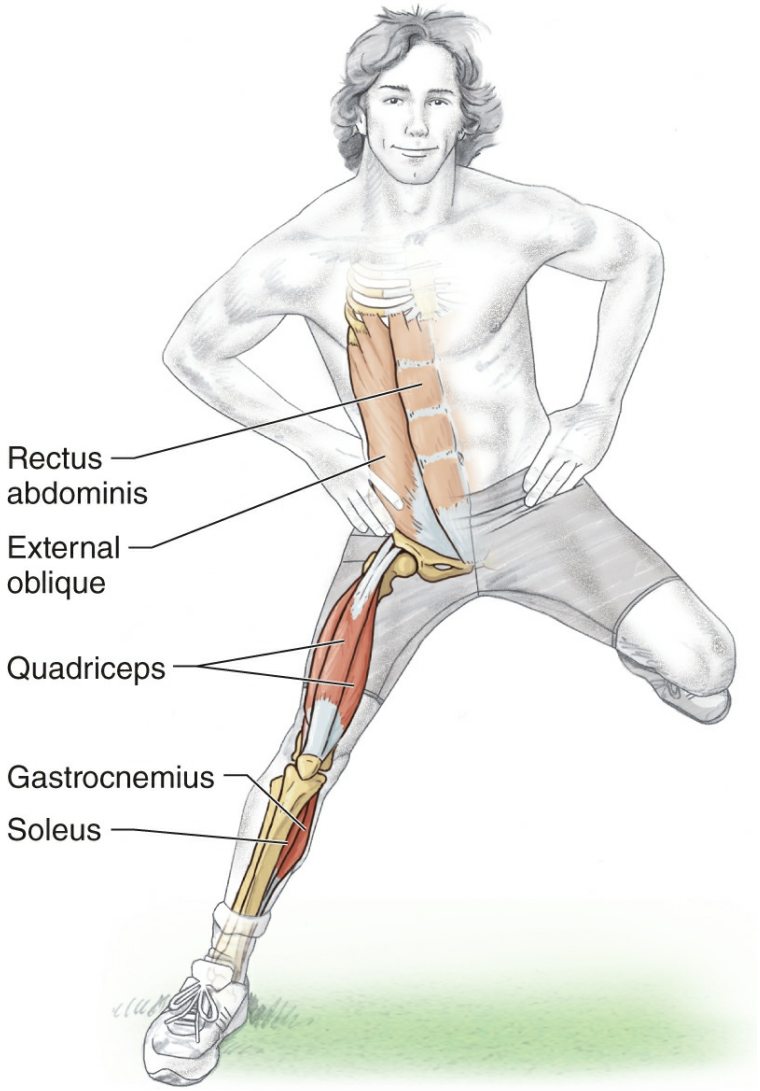
Stand with your feet hip-width apart. Place your hands on your hips if you like. Imagine you are about to sit down on a chair. Bend your legs slowly until your knees are flexed to approximately 90 degrees, and hold for 2 seconds. Do not let your knees buckle in. From this squat position, jump up as high as you can. Land softly on the balls of your feet, with your hips and knees slightly bent. Repeat the exercise for 30 seconds, rest, and then perform a second set.



Level 1: vertical jump.

Level 2: Lateral Jump

Landing on one leg is more difficult, and the level 2 exercise also adds lateral movement. Landing on one leg from a lateral jump is like a change of direction (cutting) performed in soccer. Although the exercise is markedly slower than cutting during a match, correct form, not speed, is what is important. Stand on one leg with your upper body bent slightly forward from the waist and your knee and hip slightly bent. Jump approximately 1 yard (1 m) sideways from the supporting leg to the free leg. Land gently on the ball of your foot. Bend your hip and knee slightly as you land, and do not let your knee buckle in. Also control the trunk so that it remains stable. Recent research has shown that poor trunk control precedes a wobbly knee on ground contact, yet those with good trunk control also have good control of the knee.



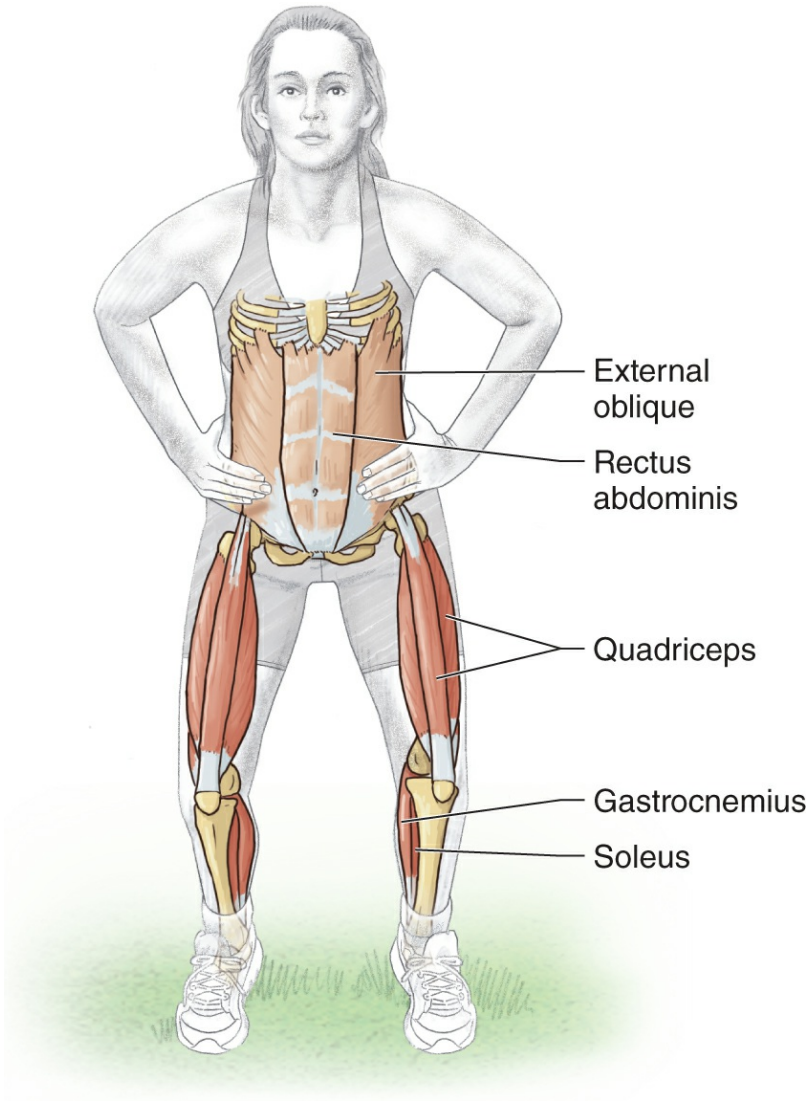
Level 2: lateral jump.

Maintain your balance with each jump. Watch out for errors such as slight trunk rotation, lateral flexion, or both. Also watch for counterreactions from the arms in an

attempt to maintain balance. If you are having trouble controlling your trunk, reduce the distance of the lateral jump until you develop adequate control. Only then should you increase the lateral distance of the jump. Repeat the exercise for 30 seconds, rest, and then perform a second set.

Level 3: Box Jump

Level 3 combines lateral, forward, and backward movement with two-foot landings. Stand with your feet hip-width apart. Imagine that a cross is marked on the ground and you are standing in the middle of it. Alternate jumping forward and backward, left and right, and diagonally across the cross. Jump as quickly and explosively as possible. Your knees and hips should be slightly bent. Land softly on the balls of your feet. Do not let your knees buckle in. Jump from point to point on the cross you have envisioned on the ground, executing the proper landing technique. Land quietly, absorbing the shock with the ankles, knees, and hips. Repeat the exercise for 30 seconds, rest, and then perform a second set.



Level 3: box jump.

Muscles Involved

Primary: Gluteus maximus, quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gastrocnemius, soleus

Secondary: Abdominal core, spinal extensors

SOCCER FOCUS

Knee control when landing is a key factor in injury prevention. These three simple plyometric exercises address landing. (Plyometric exercises stretch a muscle right before it contracts.) Land softly and quietly, absorbing the force of the landing with the ankles, knees, and hips. Keep the knees over the feet, and do not let the knees collapse in.

Do not land stiff-legged when you come down from a jump. This seems to be an especially common problem in middle and high school female players. The shock of

landing combined with weak hamstrings causes some players to land stiffly and erect. Landing on stiff, straight legs can cause the tibia to shift forward, putting stress on the ACL. When the knees are nearly straight, the hamstrings are at an anatomical disadvantage for resisting this forward shift of the tibia, setting up the ACL for injury. This tibial shift does not happen if you flex the knees during impact; the greater the knee flexion, the less strain on the ACL.

RUNNING

RUNNING ACROSS THE PITCH

Execution

Run from one side of the pitch to the other at 75 to 80 percent of your maximum pace. Jog back, and repeat a second time.

Muscles Involved

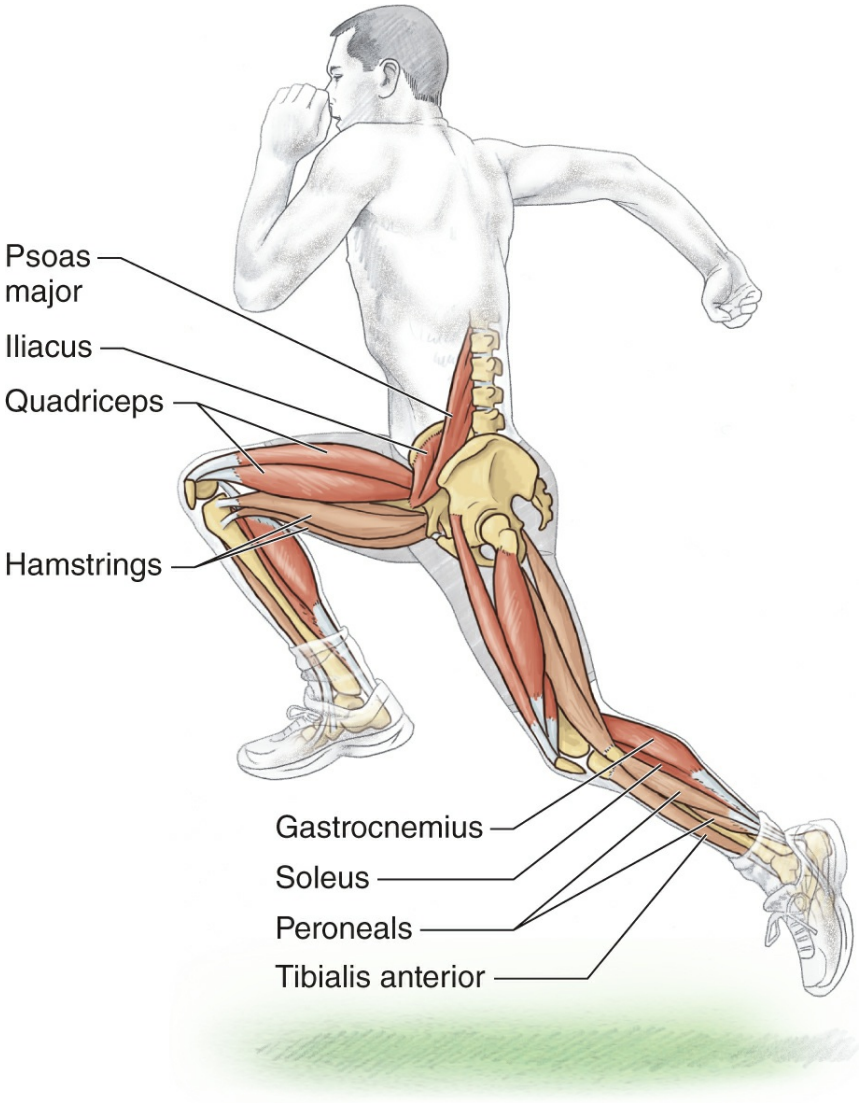
Primary: Hip flexors, quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gastrocnemius, soleus

Secondary: Hamstrings (biceps femoris, semitendinosus, semimembranosus), peroneals, tibialis anterior

SOCCER FOCUS

Chapter 1 summarizes the physical demands of soccer. About two-thirds of the game is played at a walk and a jog. Some have referred to these as positional intensities, when you are adjusting your position on the field in relation to ball and player movement. Faster speeds make up the other one-third of the game. These faster speeds—cruising and sprinting—have been termed tactical intensities, when you are making a concerted effort to attack or defend the goal. The warm-up prepares you for the upcoming training, which will include tactical training for attack or defense. Inclusion of some higher-intensity running is important to prepare your body for the harder work to come. To neglect higher-intensity running and move directly into high-intensity training would be too rapid a progression in training intensity, which increases the risk of injury.

BOUNDING



Execution

Run with high bounding steps, lifting the knees high and landing gently on the balls of your feet. Exaggerate the arm swing (opposite arm and leg) for each step. Do not let your leading leg cross the midline of your body, and do not let your knee buckle in. Repeat the exercise until you reach the other side of the pitch, and then jog back to recover and repeat a second time.

Muscles Involved

Primary: Hip flexors, quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gastrocnemius, soleus

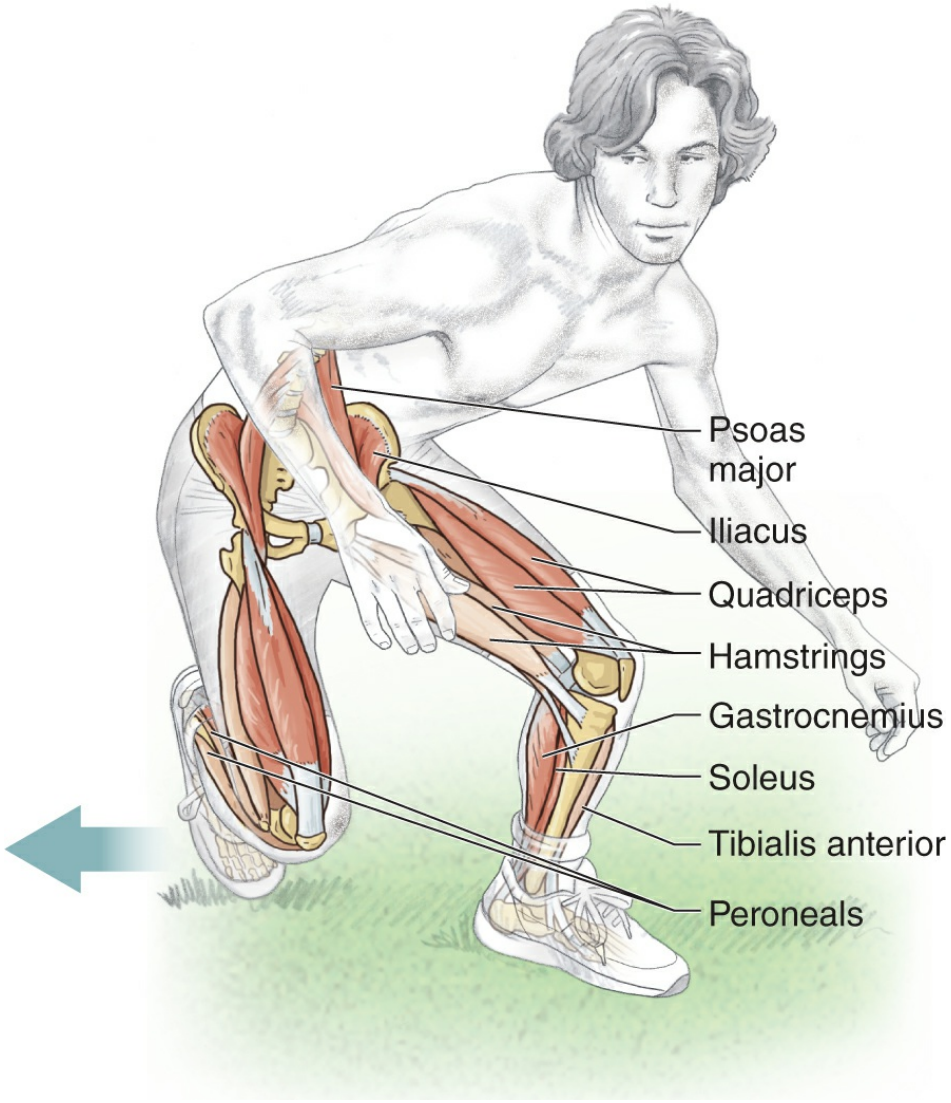
Secondary: Hamstrings (biceps femoris, semitendinosus, semimembranosus),

peroneals, tibialis anterior

SOCCER FOCUS

Anyone who has seen a track athlete train should be familiar with this exercise. Exaggerate each step with a forceful push-off by the grounded leg and a forceful upward knee drive by the swing leg. The leg drive is aided by an exaggerated arm swing. Keep the trunk stable and erect. Do not allow the leading leg to cross the midline of the body. Keep the knee over the foot of the front leg, and do not let it go into the valgus position (see page 38) when landing.

PLANT AND CUT



Execution

Jog four or five steps, and then plant on the outside leg and cut to change direction. Accelerate and sprint five to seven steps at 80 to 90 percent of your maximum pace before you decelerate, execute a new plant, and cut in the opposite direction. Do not let your knee buckle in during the plant. Repeat the exercise until you reach the other side of the pitch, and then jog back and repeat a second time.

Muscles Involved

Primary: Hip flexors, quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gastrocnemius, soleus

Secondary: Hamstrings (biceps femoris, semitendinosus, semimembranosus),

peroneals, tibialis anterior

SOCCER FOCUS

This exercise is about agility. Many people think agility exercises need to be done as fast as possible, but when speed is the focus, form and posture tend to falter. In this case, correct form, posture, and knee control are more important than speed. Perform this exercise quickly—but not so fast that form is sacrificed. Plant the outside foot firmly; absorb the force of impact using the ankle, knee, and hip; and then sprint off at an angle in the opposite direction.

4
CORE TRAINING

On many levels, the old guys were right about a great many things about soccer coaching. Drills that seem novel today often can be found in coaching books from decades ago. Just because someone coached in the 1950s or 1960s doesn't mean he didn't know the game. Although we have revised their recommendations for fluid replenishment and distance running for match fitness, their thoughts on individual ball training are being revisited as coaching methods go through inevitable cycles. Coaches of past generations would have players do sit-ups to strengthen their abdominals to withstand collisions. Today, most people, athletes included, will point to their abdominals when asked about their core, probably saying something about six-pack abs. In reality, the core is far more than just the abdominal muscles. The core refers to the body's midsection from the hips to the shoulders. Around this center, all movements occur.

A strong core is the platform around which your limbs perform. For the upper and lower extremities to move about the trunk in the most coordinated manner, the muscles

of the core, of which the abdominals are just one part, need to stabilize the hips, spine, and trunk. If the trunk is not stable during movement, the limbs will have to compensate for unexpected movements by the trunk. To demonstrate this, stand on one leg, close your eyes, and note what happens to the lifted leg and your arms as your trunk shifts away from being over the support leg. Reactions like this in the frantic, uncontrolled situations of a match might lead to something unfavorable, such as an injury. In fact, high-speed videos of people who experienced noncontact knee injuries show that just before the injury the trunk wavered slightly, the player reacted a little differently than planned, and the knee failed. This is why core training is part of almost every knee injury prevention program, such as The 11+ (see chapter 3).

Over time, the core has gone from being a training afterthought ("a few sit-ups") to being a key—some might say the key—element in a training program. Because of the dozens of books, hundreds of exercise options, and thousands of websites devoted to core training, choosing training options can be intimidating.

The lower abdomen, between the rib cage and the pelvis, is like a cylinder. At its sides are the abdominal muscles, the spinal muscles, and the lumbodorsal fascia. The diaphragm above and the pelvic floor below close the ends of the cylinder.

ABDOMINAL MUSCLES

The abdomen is unique in that the skeletal structure for muscle attachments is borrowed from other regions of the body. From above, some abdominal muscles originate on the ribs; from below, others originate from the pelvis. From the back, still other muscles originate from the vertebral column and a very strong layer of tendinous tissue in the lower back called the lumbodorsal fascia (sometimes called the thoracolumbar fascia). Because of the limited locations for bony insertion for the lower abdominal muscles, portions of the muscles that wrap around the front attach to a tendon called the linea alba that runs from the sternum to the pelvis. This gives certain muscles an attachment to pull on. There are few traditional joints or ligaments in the abdomen. The structure of the pelvis is outlined in chapter 5.

The most obvious muscles of the abdomen are the transversus abdominis, external oblique, and internal oblique (figure 4.1). Their arrangement and functions are complex. These three muscles are flat sheets that lie on top of one another. They are named for the direction of their fibers and their location in the layers. A fourth muscle, the rectus abdominis, is embedded within the midline tendons in what is called the rectus sheath.

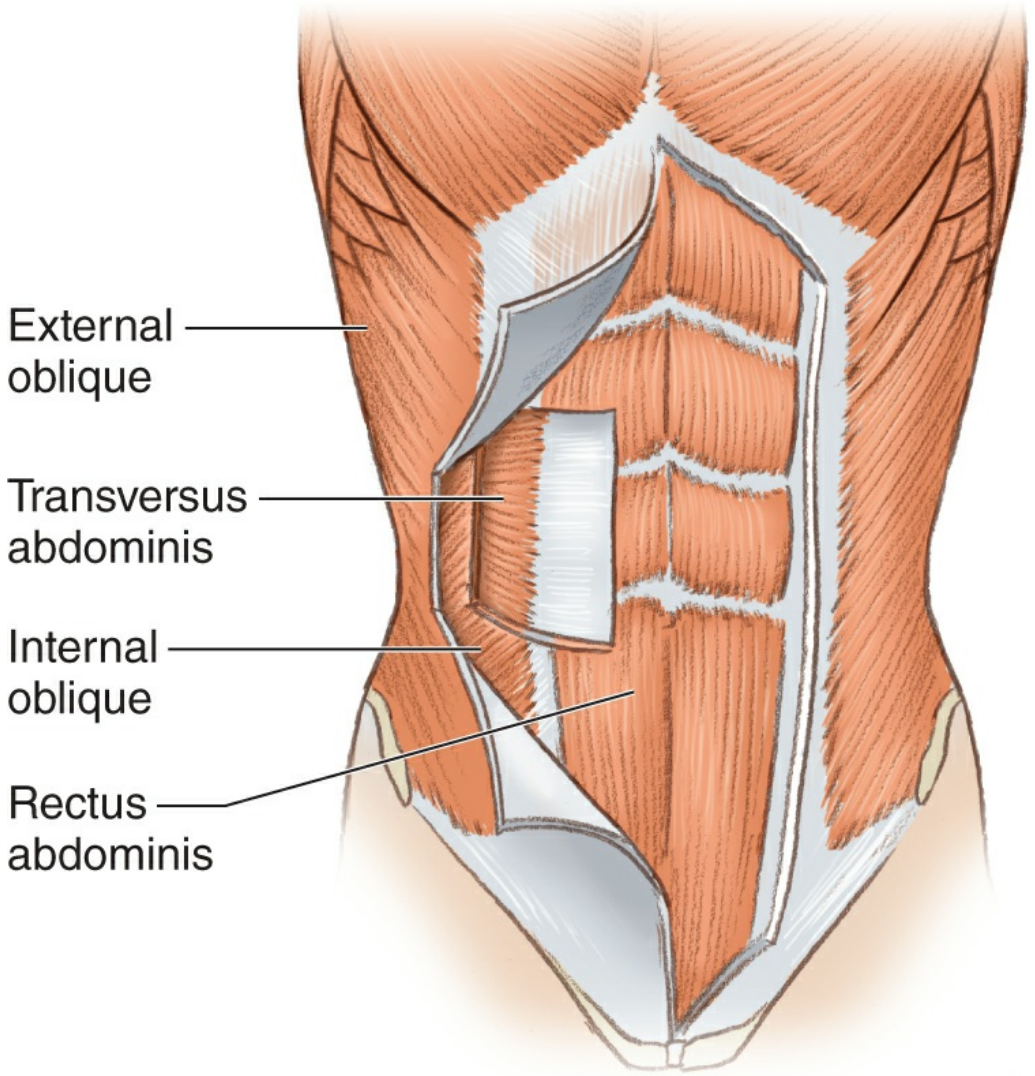


FIGURE 4.1 Transversus abdominis, external oblique, internal oblique, and rectus abdominis.

The paired rectus abdominis muscles run side by side and adjacent to the midline, between the sternum and pubic bones, the lowest part of the abdomen. The rectus abdominis originates where the two pubic bones join (the pubic symphysis). The fibers run up to the end of the sternum (the xiphoid process) and the nearby surfaces of the fifth through seventh ribs. This muscle is unique in that there are tendons within the muscle. In most cases, a tendon is the link between a muscle and a bone, but the rectus abdominis has three tendons that break the muscle into distinct sections. When this muscle is well trained and the layer of fat under the skin is thin, the result is the highly sought-after six-pack appearance associated with rock-hard abs.

The external oblique, as its name implies, is the outermost layer of the abdominal muscles that wrap around the lower abdomen. Its fibers run in a diagonal direction. It originates laterally on the outer surface of the lower eight ribs, and the fibers run diagonally down toward the pelvis to insert on the iliac crest (that bony ridge on your

side), the rectus sheath, and the linea alba.

The internal oblique lies just under the external oblique, and its fibers run perpendicular to each other. The internal oblique originates from the lumbodorsal fascia of the lower back and the adjacent iliac crest of the pelvis. Its fibers run diagonally up to the outer surfaces of the ninth through twelfth ribs, the rectus sheath, and the linea alba.

The deepest abdominal muscle is the transversus abdominis. This muscle has a broad area of origin from the outer, lateral surface of the lower six ribs, the lumbodorsal fascia, and the iliac crest. Its fibers run horizontally to insert on the linea alba and rectus sheath. Don't make the mistake of calling this the transversus abdominal oblique. The fibers are horizontal, not diagonal, so to add oblique would contradict the transversus in its name.

These three muscles connect to the linea alba by way of fairly long, flat tendons because the actual muscle tissue ends well lateral of the midline. The only muscles per se that are on either side of the navel are the paired rectus abdominis muscles.

Many people believe the abdominals collectively perform trunk flexion and trunk rotation. When considering the direction of the muscle fibers, however, it is as hard for the rectus abdominis to aid in rotation as it is for the transversus abdominis to perform trunk flexion.

We know the direction of the fibers, the attachments, and the rule about muscles pulling the insertion toward the origin, so the actions of the abdominal muscles are predictable, if complex. Also remember that these muscles can work with their partners on the opposite side or work alone. Let's look first at the external oblique. When both external oblique muscles contract, they flex the trunk. When the muscle on the right side contracts, the trunk flexes laterally to the right, but helps rotate the trunk to the left. When the muscle on the left side contracts, the trunk flexes laterally to the left, but helps rotate the trunk to the right.

The internal oblique is similar but has one main difference. Contract both sides to flex the trunk. Contract the muscle on the right side, and the trunk flexes laterally to the right. The difference is with rotation. Contract the muscle on the right side, and the trunk rotates to the right.

The transversus abdominis has different isolated actions. When activated, it increases intra-abdominal pressure and provides support for the abdominal organs.

The final abdominal muscle, the rectus abdominis, flexes the trunk and also helps perform lateral flexion and rotation.

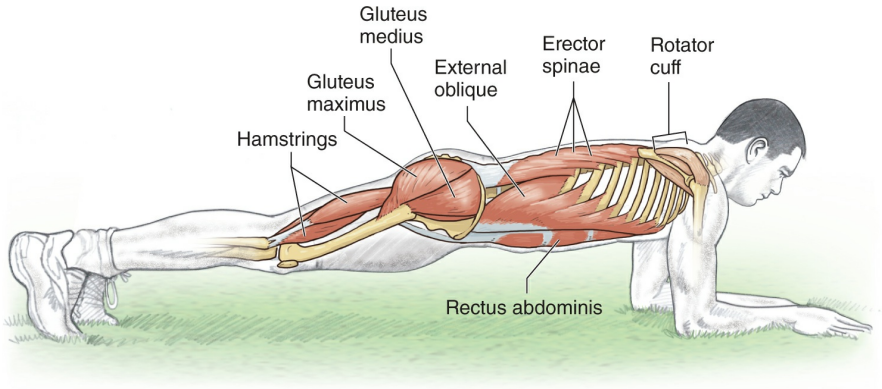
Collectively, all four of these abdominal muscles work with each other and the long spinal muscles (see chapter 5) to provide support and stabilization for what many fitness professionals refer to as the lumbo–pelvic–hip complex.

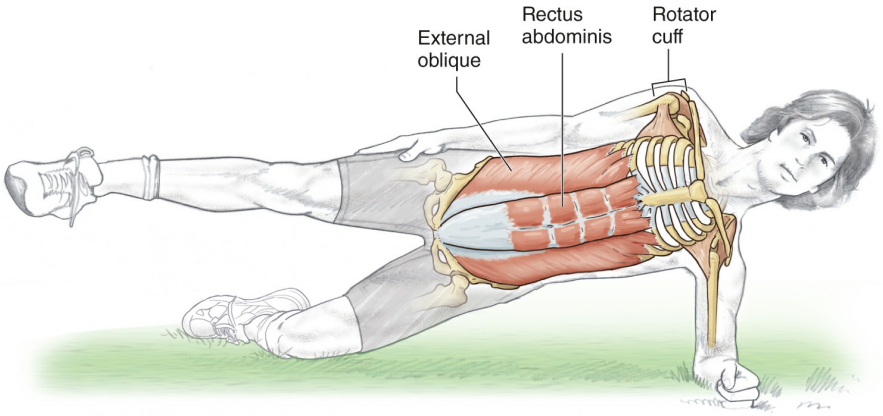
The abdominals also play other roles. They contribute to the integrity of the vertebral column. In fact, weak abdominal muscles are often responsible for low back pain caused by poor intervertebral disc alignment. The abdominals also can aid in exhalation. When they contract, they squeeze on the underlying organs that push up against the diaphragm to increase intrathoracic pressure and help push air out of the lungs. Additionally, most people can appreciate the contribution of the abdominals in evacuating the bowels from the last time they had a lower gastrointestinal flu.

Those who choose to look further into abdominal exercises and core fitness will find dozens of exercises designed to activate very specific areas of the core such as the upper, middle, or lower abdominals. Such specificity will ensure that every aspect of each muscle is activated. It is easy to get both overwhelmed with the exercise options and carried away with implementing more activities at the expense of technical and tactical training for the game. Athletes are encouraged to perform their core training at a time apart from formal team training, reserving a few core exercises for the warm-up.

Plank

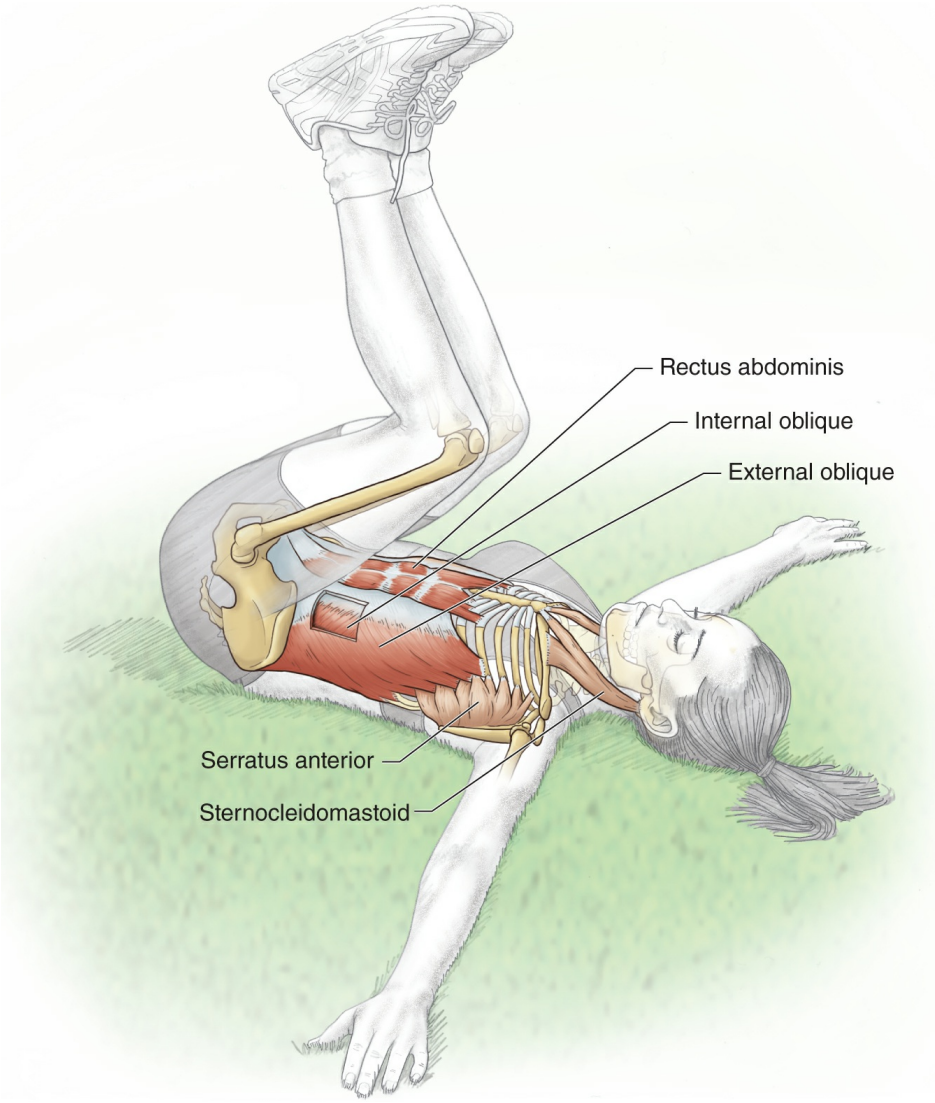
The plank is a foundation exercise for the core. The definition and explanation are listed in chapter 3 as part of the FIFA warm-up. In addition to the static plank and static sideways plank (pictured below), several variations exist, which can be included in strength programs that focus on the core. Examples include a plank push-up hold, plank oblique twist, plank with hip dip, plank with oblique knee tuck, and bird dog plank.





CORE

REVERSE CRUNCH



Execution

1. Lie on the ground on your back, and spread your arms to the sides for balance. Keep your head, neck, and shoulders on the ground.
2. Flex at the hips and knees, and raise the knees until they are over the hips.
3. Perform the crunch by pulling the knees in toward the head. Perform the exercise slowly. The primary movement is pulling the knees toward the head. Do not move the shoulders or head to the knees.
4. Pause, and then return to the starting position.

Muscles Involved

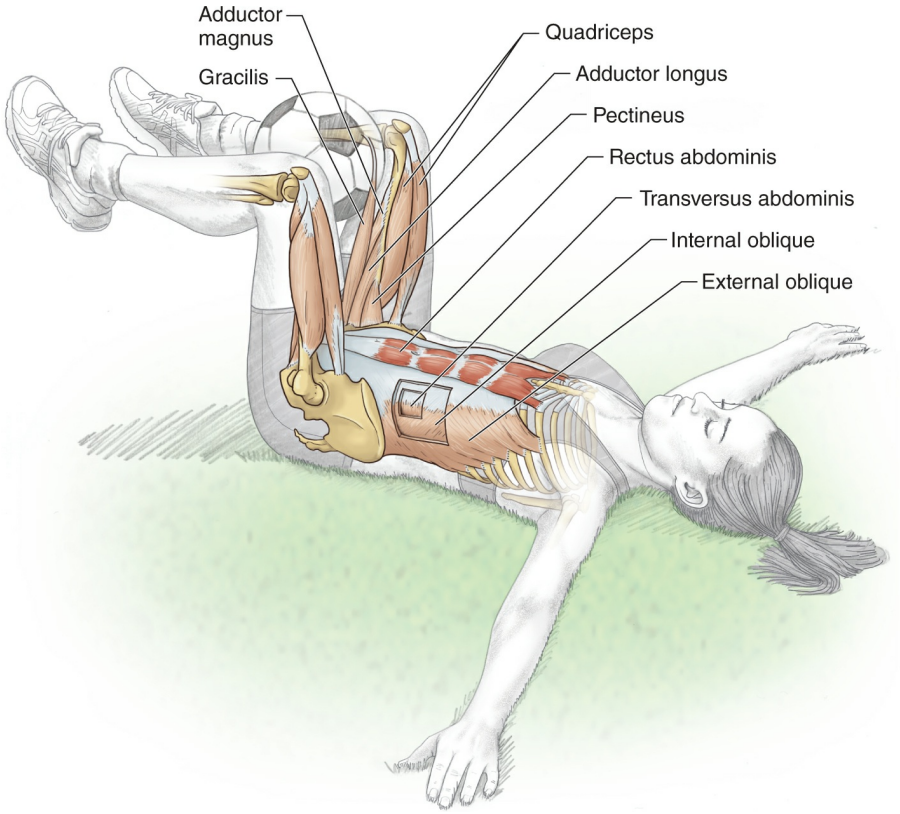
Primary: Rectus abdominis, external oblique, internal oblique

Secondary: Sternocleidomastoid, serratus anterior, rhomboid major and minor, lower trapezius, psoas major and minor

SOCCER FOCUS

A strong core is important in sport for posture and general fitness, for performance and skill enhancement, and for injury prevention. A strong core anchors the movements of the limbs and minimizes extraneous motions often seen in players with poor technique. Much of the skill needed to play soccer involves rotation around an axis, and a strong core is the foundation for efficient movement. A strong core is also a factor in good posture. Muscles work best when the skeleton is properly aligned. A slouched posture increases the effort of the movement. Performance is enhanced when the body does not have to use unnecessary muscles to execute a movement. A strong core is known to have effects beyond the muscles to prevent injury. Some leg injuries, especially ligament injuries of the knee, are linked to a weak core that allows slight movements that need to be compensated for at the knee.

SOCCER BALL CRUNCH



Execution

1. Lie on your back, arms stretched to the side and knees bent with thighs perpendicular to the ground. Squeeze a soccer ball between your knees.
2. Pull your knees toward your chest by lifting your pelvis off the ground until your lower legs are perpendicular to the ground.
3. Slowly return your hips and legs to the starting position.

Muscles Involved

Primary: Rectus abdominis

Secondary: External oblique, internal oblique, transversus abdominis, quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), hip flexors (psoas major and minor, iliacus), adductors (adductor magnus, adductor longus, adductor brevis, pectineus, gracilis)

SOCCER FOCUS

Core training has gone from being an afterthought to being a primary focus of training. More than just the abdominal muscles, the core includes every muscle that crosses the body's center—muscles that work together to accelerate and decelerate almost every activity in all sports. Power developed in the lower extremities can diminish as the energy passes up the movement chain, so developing the core helps transfer power to the extremities for performance. Because soccer has many abrupt changes in speed,

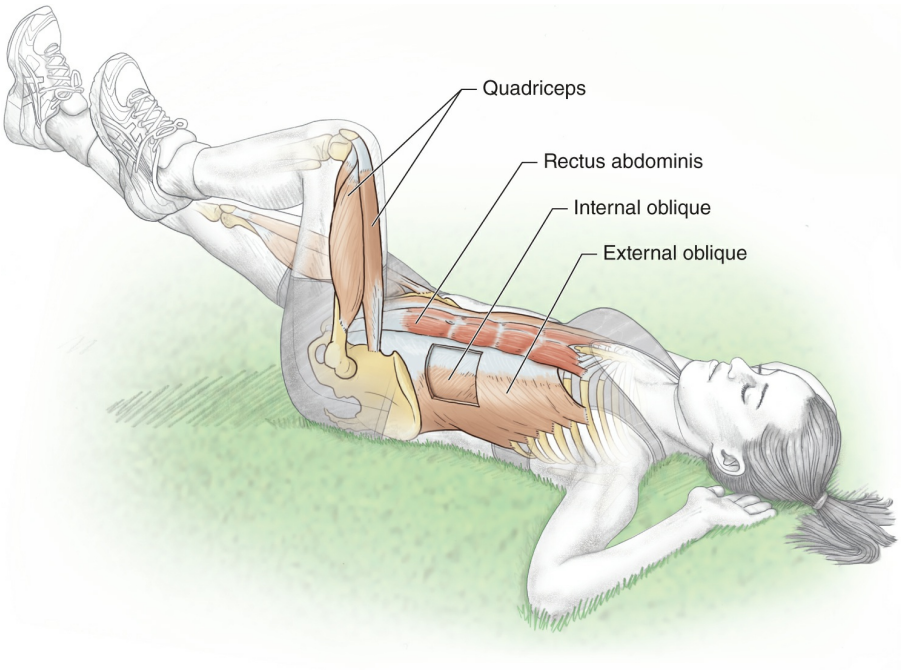
direction, or both, a weak core could mean the trunk and upper limbs might react to changes in an uncontrolled manner, placing the lower limbs in a precarious position that could lead to injury. Awkward movements of the trunk have been reported to precede ACL injuries.

VARIATION

Captain's Crunch

Dozens of exercises are designed to strengthen the core. The soccer ball crunch can be performed on the field. A variation of this crunch focuses on the rectus abdominis and can be done in the weight room using a captain's chair. Support yourself on your forearms in the captain's chair, flex your knees, and lift your knees toward your chest.

BICYCLE CRUNCH



Execution

1. Lie on your back with your hands behind your head, fingers barely touching. The shoulders should be on the ground.
2. Draw one leg toward the chest so that the thigh is at about a 90-degree angle to the trunk. Draw the other leg up so that the thigh is at about a 45-degree angle to the trunk.
3. Alternate the legs back and forth as if you were riding a bicycle.

Muscles Involved

Primary: Rectus abdominis

Secondary: Hip flexors, quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), adductors, external oblique, internal oblique

SOCCER FOCUS

A number of core training exercises are performed in a slow, controlled manner. This exercise can be performed slowly or rapidly, depending on your goals. When this exercise is performed rapidly, the core is exposed to higher-velocity limb movements similar to those experienced during competition. Many experts suggest doing core training at high speed for just that reason. Increasing the speed of movement makes the exercise more functional and dynamic, which prepares the core for those explosive and

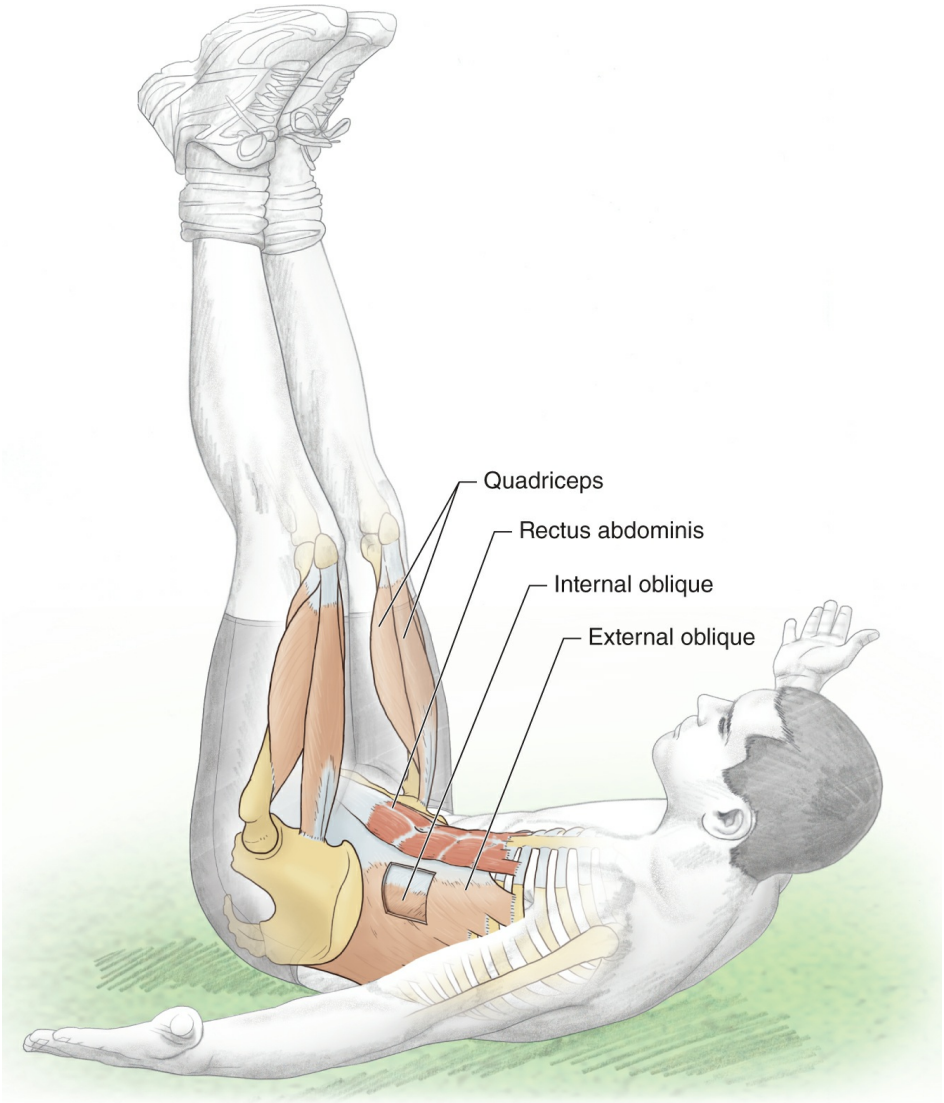
reactive balance situations that happen every four to six seconds. A strong core will help you transfer the power you've developed from performing the exercises in this book to the field of play.

VARIATION

Twisting Bicycle Crunch

To make the bicycle crunch more intense and increase the involvement of the external and internal obliques, bring the right elbow to the left knee and vice versa.

VERTICAL LEG CRUNCH



Execution

1. Lie on your back with your hands on the ground beside you.
2. Flex your hips to bring both legs vertical. You may prefer to cross your feet.
3. Slowly perform a crunch. Attempt to bring the sternum toward the thighs. Do not flex the neck.
4. Return to the starting position and repeat.

Muscles Involved

Primary: Rectus abdominis

Secondary: External oblique, internal oblique, hip flexors, quadriceps (vastus

medialis, vastus lateralis, vastus intermedius, rectus femoris)

SOCCER FOCUS

A great deal of work has been done to determine which portions of the abdominals are used most in specific exercises. The general thought is that a routine crunch focuses mostly on the upper portion of the abdominals. When you lie back and flex the hips to raise your legs, the focus shifts toward the lower abdominals. Doing both types of crunches allows you to train a greater portion of the total abdominal mass. This is important when thinking about the transfer of power during the execution of skills. The buildup of kinetic energy for kicking begins when the planting foot strikes the ground. Power builds and is transferred up the leg through the abdomen and hips and then down the kicking leg. You can lose a lot of that power if the core fails to fully control the trunk, wasting some energy in unwanted trunk rotation or other movement. Engaging all the abdominals with the entire core fixes the trunk to allow the transfer of kinetic power from one link in the chain to the next. Although this is an abdominal exercise, you will probably experience some hip flexion. Keep your neck neutral by not letting your chin tuck toward your chest. For more resistance, hold a small medicine ball in your outstretched arms, and move the ball toward or beyond the feet as you crunch.

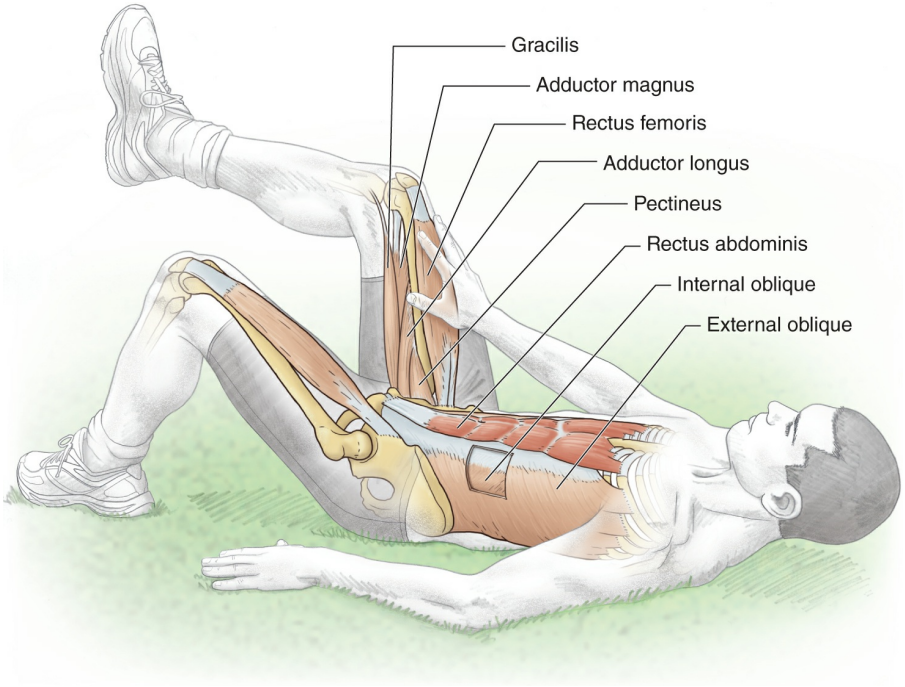
VARIATION

Full Vertical Crunch

This small variation changes the focus of the vertical leg crunch. Clasp the hands behind your head or to your sides for stability, and perform a routine crunch—only this time

push your feet toward the ceiling to give your body a U shape. This effectively shifts the focus from the rectus abdominis only and draws in more core muscles.

SINGLE-LEG ABDOMINAL PRESS



Execution

1. Lie on your back on the ground with your feet flat and your knees bent.
2. Raise your right leg so that both the knee and the hip are at a 90-degree angle.
3. Place your right hand on your thigh down near your knee.
4. Use your abdominals to further flex your trunk while resisting the movement with your hand.
5. Change to the left leg, and then repeat the exercise.

Muscles Involved

Primary: Rectus abdominis, psoas major and minor, iliacus

Secondary: Rectus femoris, adductors, external oblique, internal oblique

SOCCER FOCUS

Although this is listed as an abdominal exercise, it is also an example of a field-based strength training exercise for hip flexion. Hip flexor strain injuries are becoming more common in soccer and, like hamstring strains, appear to result from the increased speed of the modern game. Strain injuries happen when a muscle contracts strongly when it has been lengthened. In sprinting, just before the trailing leg leaves the ground, the hip flexors are stretched. Once that foot leaves the ground, the hip flexes powerfully. This

combination of stretch and contractile forces can tear the muscle. This can also happen when taking a hard kick, such as shooting or making a goal kick. There are six muscles linked together as hip flexors, half of which are classic groin muscles (adductors) that also assist with hip flexion. The other muscles, the rectus femoris (one of the four quadriceps), the iliopsoas, and the sartorius all perform hip flexion as a primary action. This exercise is designed to improve the strength of those main hip flexors. This should not, however, be the only method for preventing hip flexor strains. The walking lunge (page 55 in chapter 3) should also be performed at each training session to prevent this frustrating injury.

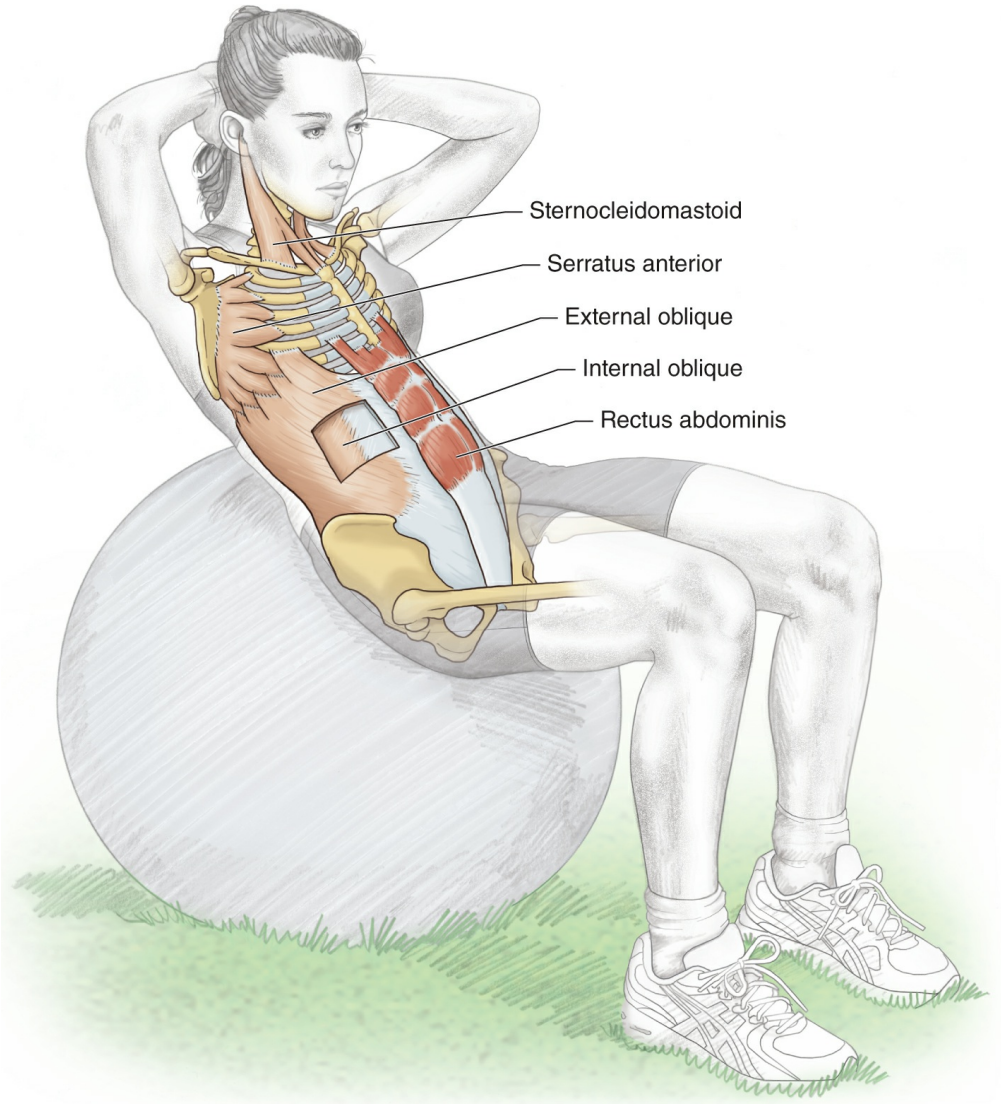
VARIATION

Opposite-Arm Abdominal Press

Using the opposite arm requires the trunk to twist, thereby increasing the use of the external and internal oblique muscles. In addition, this method also is thought to

increase the use of a group of the lesser known, but very important, pelvic floor muscles: the levator ani and the coccygeus.

STABILITY BALL TRUNK LIFT



Execution

1. Lie back across a large stability ball so that the ball is under your lower back. Your feet should be flat on the ground and spread to a comfortable distance that will help maintain stability. Your thighs should be parallel to the ground, and your knees should be at 90 degrees of flexion. Lightly hold your fingers behind your head.
2. Using your abdominals, slowly raise your shoulders off the ball as far as you can. Keep the neck as straight as possible to avoid tucking your chin.
3. Pause at the top of the motion before slowly returning to the starting position.

Muscles Involved

Primary: Rectus abdominis

Secondary: External oblique, internal oblique, serratus anterior, sternocleidomastoid

SOCCER FOCUS

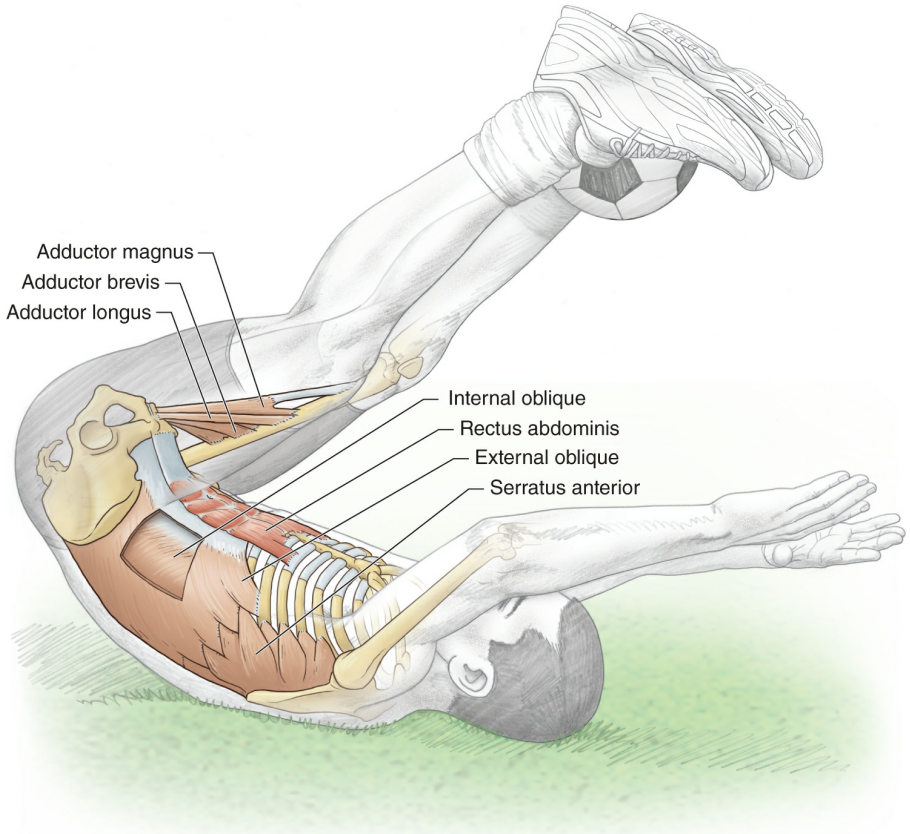
Years ago, the emphasis on the core was limited to some sit-ups and maybe some straight-leg raises. Today, the role of the core has risen from almost an afterthought to a primary focus of training. Why is the core so important? Many fitness professionals believe that nearly all movement extends from the core and most certainly passes through the core. Thus, it is difficult to coordinate the lower and upper body with each other for efficient movement through a weak core. Inefficient movements through a weak core increase the risk of injury and may lead to hip instability that must be compensated for. This reactive compensation alters normal movement patterns and can cause injuries, with the knee being the weak link in this chain of events. Practically every action in soccer—running, cutting, stopping, landing, kicking, and heading—can be performed more efficiently if you have a strong core.

VARIATION

Side-to-Side Trunk Lift

Hold a soccer ball in your hands, and add a twist to the movement to increase the emphasis on the external and internal obliques. This simple variation increases the muscle mass for this exercise. Want to make this a bit harder? Use a medicine ball instead of a soccer ball. Medicine balls come in different weights. Hold a light medicine ball with your arms extended perpendicular from your trunk. Move up to progressively heavier medicine balls to increase the intensity of the exercise.

V-SIT SOCCER BALL PASS



Execution

1. Lie on your back with your arms and legs extended. Clench a soccer ball between your ankles.
2. Keeping your legs straight, raise the ball over your head until the ball is over your hands, and then drop the ball into your hands. This is the first repetition.
3. Lower your feet to the starting position, leaving the ball in your hands.
4. Repeat the motion to retrieve the ball from the hands. This is the second repetition. At first, you may not be able to keep your legs straight throughout the exercise. As your strength improves, work on keeping the legs as straight as you can for as much of the exercise as possible.

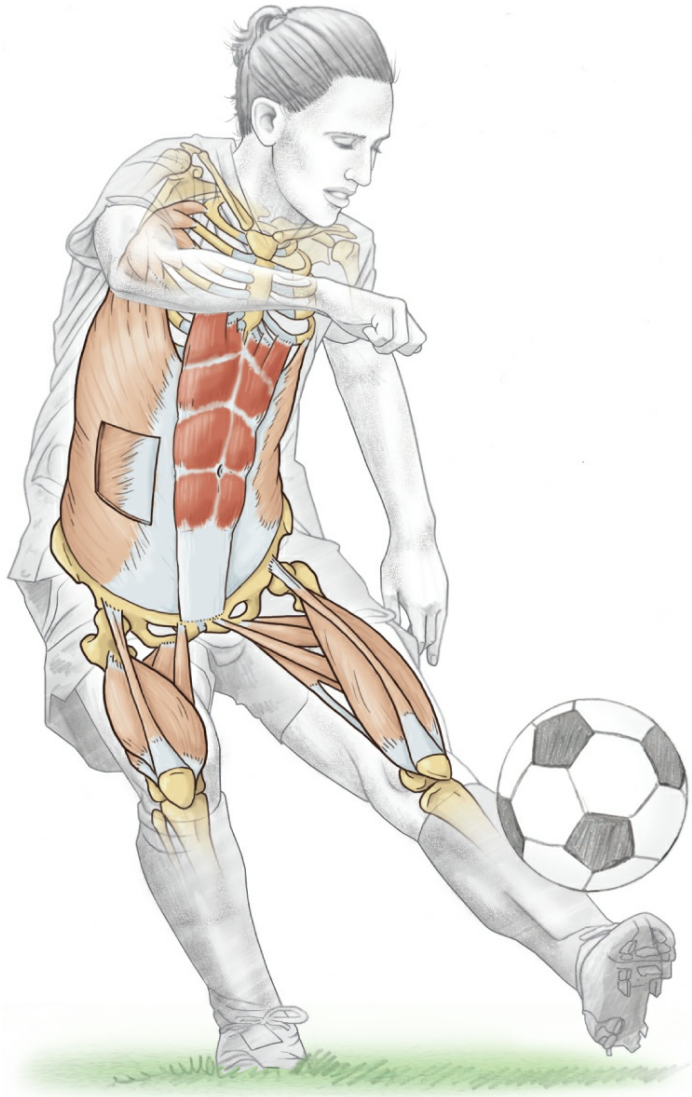
Muscles Involved

Primary: Rectus abdominis

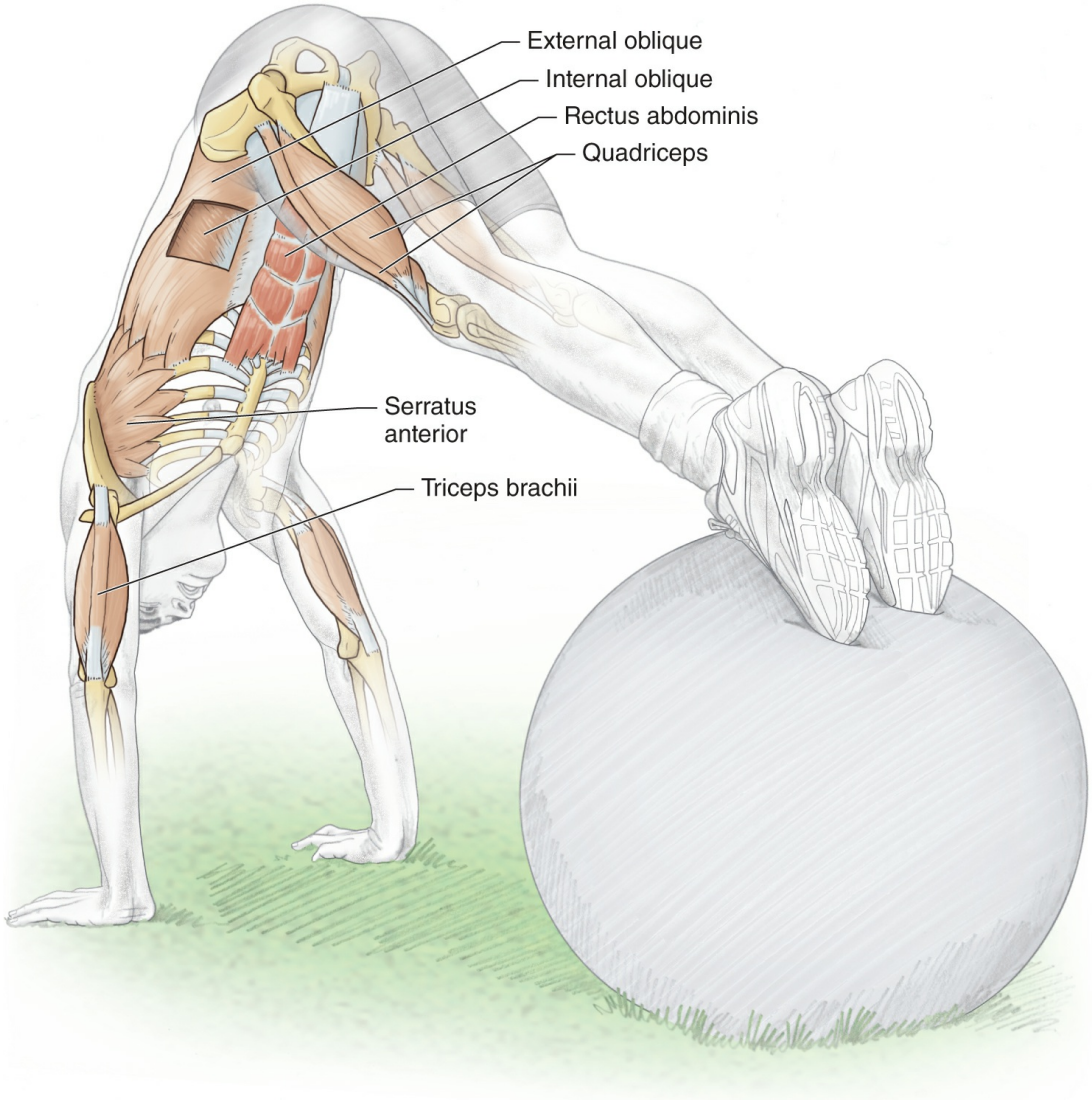
Secondary: External oblique, internal oblique, adductors, hip flexors, quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), serratus anterior

SOCCER FOCUS

This exercise has a long history in soccer and is described in many older coaching books. Back in the early 1970s, Pepsi partnered with the legendary Pelé to produce the so-called Pepsi Pelé movies that showed a number of his training methods. One of the movies featured a fitness circuit that had multiple stations for what might be considered early-generation core training. The exercises included basic sit-ups and what we eventually would call crunches. The films also showed Pelé on the ground with a partner holding his ankles about waist high for a sort of inclined sit-up. The exercise that got everyone's attention was Pelé lying on his back, his head between the feet of his partner as he held his partner's ankles. Pelé raised his feet over his head to his partner's hands, and the partner then shoved Pelé's feet toward the ground. Pelé never allowed his feet to touch the ground. The audience usually groaned. Although most people would prefer exercises with less strain on the low back, one has to wonder how much of Pelé's training contributed to his ability and longevity in the game. Most strength and conditioning coaches prefer to select a variety of core exercises rather than focus on just a few, as was done in the past. Doing too many repetitions of a few exercises can place unwanted stress on tissues, which can lead to overuse injury. Using the ball for some core work, such as this exercise, keeps players focused on the ball while doing the core a world of good.



STABILITY BALL PIKE



Execution

1. Get into an up push-up position with your shins on top of a large stability ball.
2. Flex to raise the hips while rolling the ball as far forward as possible from your shins to your toes. Make sure both your back and legs remain straight throughout the full movement.
3. Return to the starting position.

Muscles Involved

Primary: Rectus abdominis

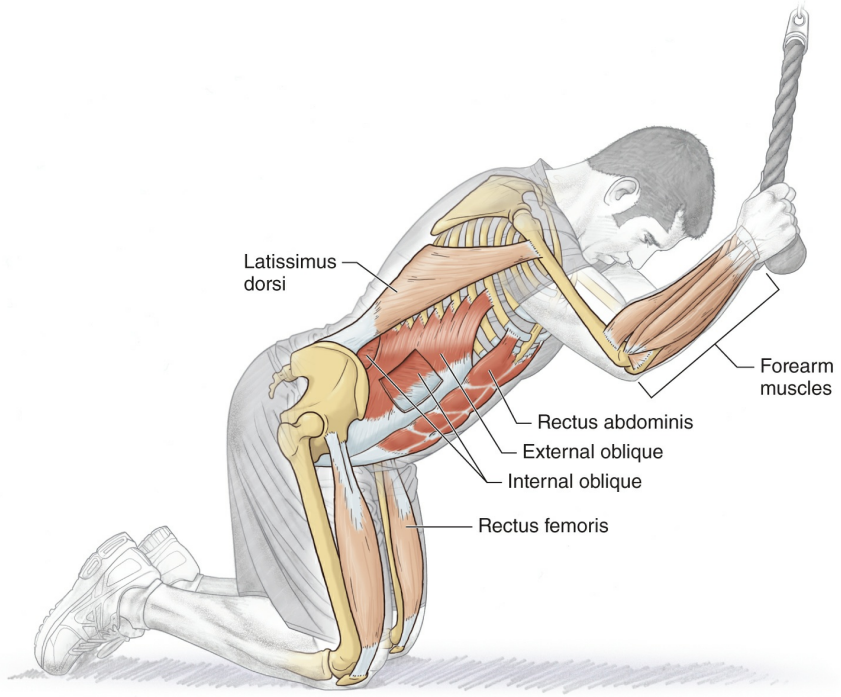
Secondary: External oblique, internal oblique, serratus anterior, hip flexors, triceps

brachii, quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris)

SOCCER FOCUS

A strong core is important for many reasons. Since your arms and legs extend from the trunk, it's only logical that a strong core will be an anchor for efficient movement of the limbs. In addition, forces for whole-body movements that are generated by the legs need to be transferred across the core to the arms for successful performance (e.g., using the arms to make your trunk bigger when in a crowd of players maneuvering to receive a goal kick or a corner kick). When forces pass through a weak core, some of the force generated will be lost to other nonfunctional movements, meaning less force gets to its destination. The core is the link between the upper and lower body. The stronger the core, the less energy will be lost and the more force can pass between the upper and lower body for the most efficient movements.

CABLE CRUNCH



Execution

1. Kneel in front of a cable machine, facing the weights.
2. Using an overhand grip, pull the rope attachment down to the shoulders, and flex the hips slightly. (Your machine may have a long bar, short bar, handles, or a ropelike attachment to the cable.)
3. Inhale, and then exhale while crunching by rolling the sternum toward the pubis. Your elbows should move toward the middle of your thighs.
4. Slowly return to the starting position.

Muscles Involved

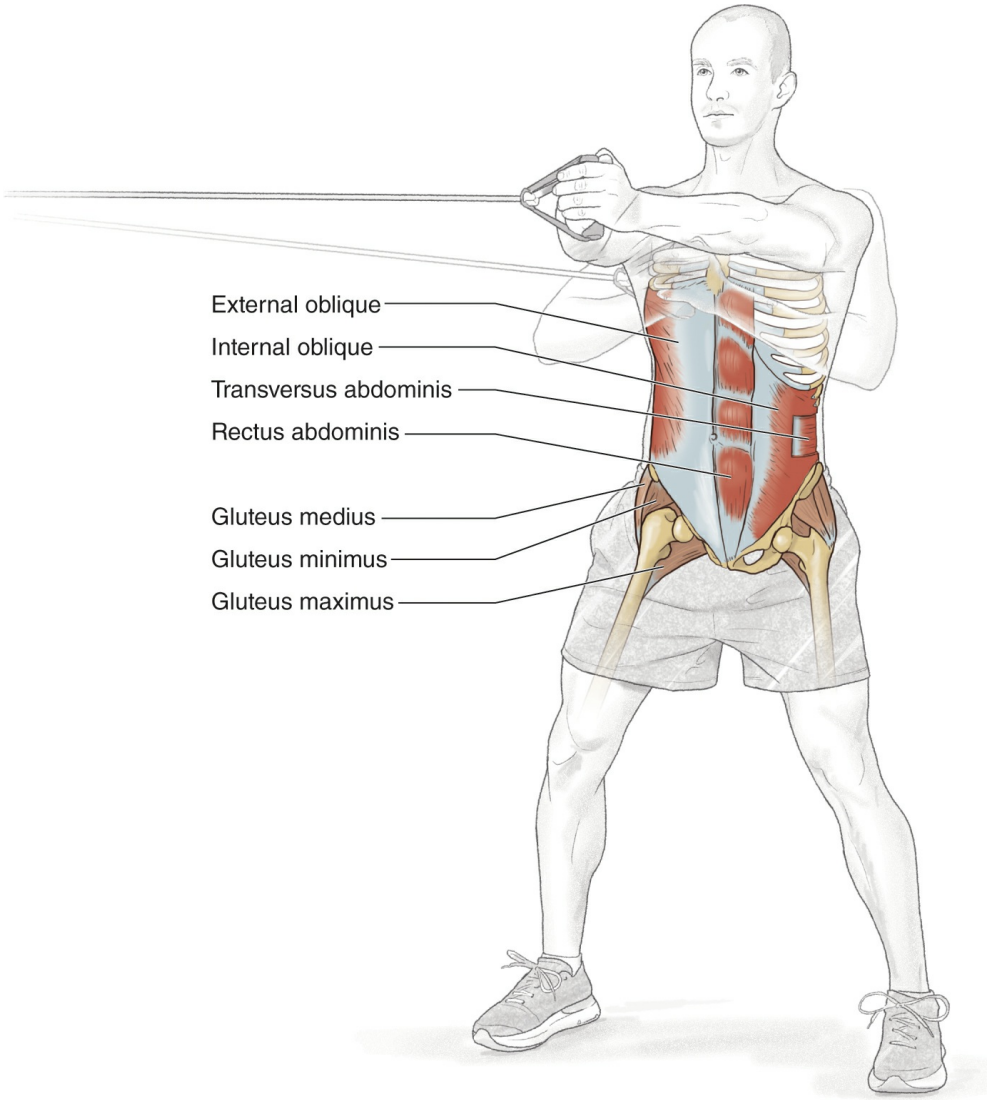
Primary: Rectus abdominis, external oblique, internal oblique

Secondary: Forearm muscles (mostly wrist and finger flexors, including flexor carpi radialis and ulnaris, palmaris longus, flexor digitorum superficialis and profundus, and flexor pollicis longus) to grasp rope, latissimus dorsi, rectus femoris, psoas major and minor

SOCCER FOCUS

Most crunches are performed on the floor. This variation of a traditional crunch is performed from a kneeling position, and it takes a little practice to do the movement properly. The plus for this exercise is that you can increase the resistance by adding weight without having to figure out a way to hold a plate. As in all core exercises, draw in the core by pulling your navel toward your spine. You can also work the obliques by adding a slight twist during the crunch. Resist the temptation to do this exercise quickly. You do not need to use heavy weights. Remember, this is an exercise for the abdominals, not for the hip flexors; use your abdominals.

PALLOF PRESS



Execution

1. Attach a D handle to a cable station, ensuring it is level with the shoulders. Stand side-on to the machine. Hold the handle at the chest with both hands. Begin with feet shoulder-width apart and a slight bend at the knees.
2. Extend the arms slowly, pushing the handle away at shoulder level, to full extension.
3. Ensure feet remain planted and hips remain square. Hold in an extended position for one to two seconds, and then return to the starting position.

Muscles Involved

Primary: Obliques, transversus abdominis, rectus abdominis

Secondary: Gluteals

SOCCER FOCUS

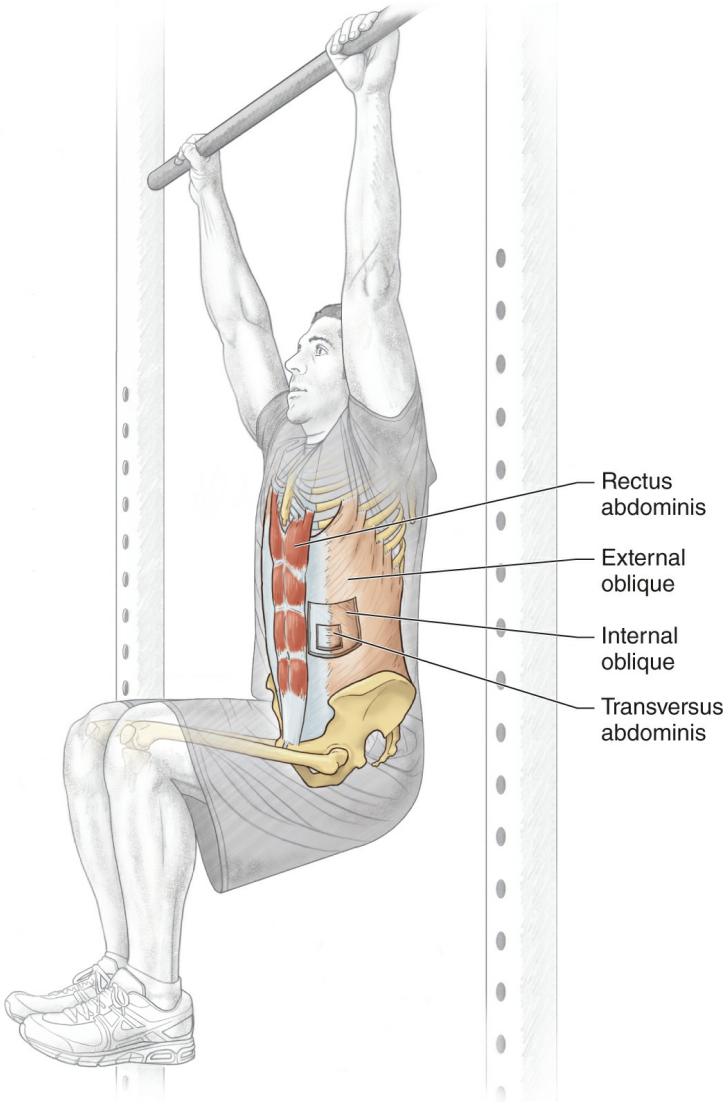
Core stability is used during many athletic activities, and a strong, stable core is particularly integral to soccer performance. The Pallof press improves strength and rigidity through the trunk and hips. When in possession of the ball and being pressured by an opponent, a player relies on core strength and stability, along with appropriate technique, to protect the ball while simultaneously identifying and executing the next move (i.e., accelerate into space, pass, shoot, etc.). When jumping to challenge for a header or to receive a ball on the chest, a player with a stable core will have more effective and safer landing mechanics. This also applies to goalkeepers as they jump to collect a cross in a crowded penalty area or dive to make a save and quickly get back up for a second save.

VARIATION

Pallof Press With Band

Using a band instead of a cable, loop the band through itself on a stationary pole or rack at shoulder height. Hold the other end with both hands at the chest. Perform the exercise in the same manner as when using a cable.

HANGING HIP FLEXION



Execution

1. With an overhand grip, grasp a fixed overhead bar.
2. Flex the hips and knees until your thighs are parallel to the floor or higher.
3. Pause, and then slowly return to the starting position.
4. Pause at the bottom before repeating to avoid generating any momentum. This exercise is about control, not about how fast you can do the exercise.

Muscles Involved

Primary: Rectus abdominis, hip flexors

Secondary: External oblique, internal oblique, transversus abdominis

SOCCER FOCUS

This hanging exercise, like many other core exercises, involves a number of muscles. How it is done depends on what muscles are most active. For example, if the movement is just hip flexion and doesn't involve much flexion about the waist, the primary muscles are the hip flexors, and the abdominals act mostly as static stabilizers of the pelvis and waist. Raising the knees as high as possible recruits the rectus abdominis and the obliques, adding their dynamic contribution to the movement. You can add more oblique involvement by adding a slight twist to each side as you approach the end of each repetition. Don't assume this exercise or any other abdominal exercise will reduce fat around the midsection; there is no proof that you can lose fat from one specific location (a process called spot reduction).

5
BACK AND HIPS

Undervaluing the importance of the back is very shortsighted when it comes to training. Nearly every functional movement in sports is anchored to the back. Some might say that because the back is not a location of many acute injuries in soccer, we don't need to worry about it. Although the back may not be injured very often, about one-third of all male soccer players have complaints about their backs. This can range from just under 20 percent of local adult-league players to more than 50 percent of top-level players. In middle and high school players, back complaints were highest among those with the poorest skill, suggesting that one way to minimize back complaints might be to improve skill. Better skill is always a plus. Players will not go far in soccer with poor skills.

Back complaints may not be serious enough to cause a player to miss training or matches, but they can be irritating enough to catch the player's attention. Considering the torques around the body during kicking and cutting and the fact that a player's speed, direction, or both change about every four to six seconds, it should not be surprising to

learn that these actions just might be culprits in the complaints expressed by players. There is a growing body of evidence that pain, even pain not severe enough to keep an athlete from playing, might be the first warning of an impending overuse injury that could sideline a player for an extended period.

Physical therapists use many effective exercises to help strengthen the backs of people with chronic back pain, but the best treatment for chronic back pain is to prevent the pain before it starts—to stop the potential pain in its tracks before it becomes a complaint. A little bit of work done each day will show great benefits in the future. You don't need to start with terribly challenging exercises; take your time, and you'll experience results fairly quickly. The more you have to gain, the more you will gain. Most athletes have ignored their backs, so they have a lot to gain. Vary your exercise choices, and don't overload this area, or any area, too frequently or intensely.

This chapter shows a number of exercises specifically for the back. A number of these options involve a ball or are a bit competitive, so they can be fun. Others involve a partner, while a few are done in a gym.

ANATOMY OF THE VERTEBRAL COLUMN

The back is made up of individual vertebrae and their cartilage, which make up the spinal column; ligaments for stability between each bone; the spinal cord, which carries information to and from your brain; and an almost dizzying array of muscles most players have never considered. In total, the back can be quite complicated. Consider the spinal cord. The spinal cord is more than just a series of highways carrying information to and from the brain. It is also capable of some decision making. As one spinal cord researcher recently said, "The brain gets things started, and the spinal cord sorts out the details."

The vertebral column is a series of similar bones. There are 7 cervical (neck), 12 thoracic (chest), and 5 lumbar vertebrae (figure 5.1). These are distinct and separate bones. Below this is the sacrum, which is made of 5 fused bones, and three to five coccygeal bones that may or may not be fused. The vertebral column is not arranged in a straight line. It has three curves within the sagittal plane that curve toward or away from the front of the body, not side to side. The cervical vertebrae curve anteriorly, the thoracic vertebrae curve posteriorly, and the lumbar vertebrae curve slightly anteriorly. The ribs articulate with the thoracic vertebrae.

Although the bones of each region have their own unique look, they all have the same common features. You see a large body, two lateral projections opposite each other (transverse processes), and a third projection by itself (spinous process) that all

surround an opening (vertebral foramen) (figure 5.2); the anatomical term for a projection is a process, and a hole is a foramen. The large body is anterior, and the process opposite the body that is all by itself is posterior and points down. When you run your hand up and down someone's back, those bumps are the spinous processes. There are a number of bony contacts that by themselves allow for limited movement but summed up allow the amazing movements of the entire column demonstrated by gymnasts, divers, acrobats, and dancers.

The vertebral foramen is for the spinal cord. When you put one vertebra on top of the other, another foramen (intervertebral foramen) is seen on each side, and this is where spinal nerves take information to and from the spinal cord. A large cartilaginous disc sits between the bodies of adjacent vertebrae. This disc has two distinct sections. The outer ring is called the annulus fibrosa and surrounds a gelatinous center, the nucleus pulposa (picture a jelly donut). A herniated disc is one that bulges out from between its vertebrae and can cause pain if the bulge pushes on the spinal cord or spinal nerves.

Each pair of vertebrae is connected by a series of short ligaments from the process above to the process below as well as other points of bony articulations. There are also long ligaments that run the length of the vertebral column. One ligament runs along the most anterior surface of each vertebral body, while an opposite ligament runs down the smooth posterior surface between the processes. A third ligament, the strongest of the three, the ligamentum flavum, runs the length of the posterior surfaces within the canal that houses the spinal cord. In total, these ligaments provide for impressive stability and mobility of the vertebral column.

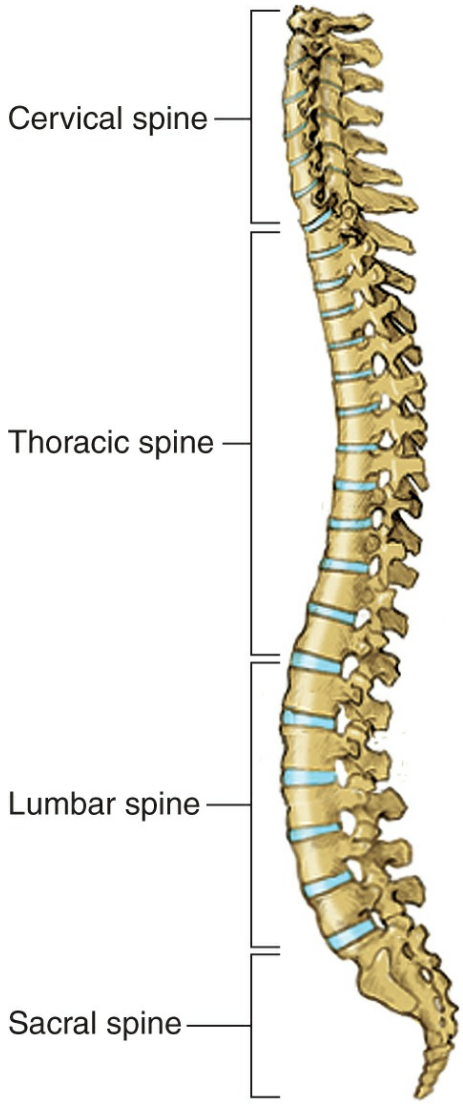


FIGURE 5.1 The cervical, thoracic, lumbar, and sacral regions of the spine.

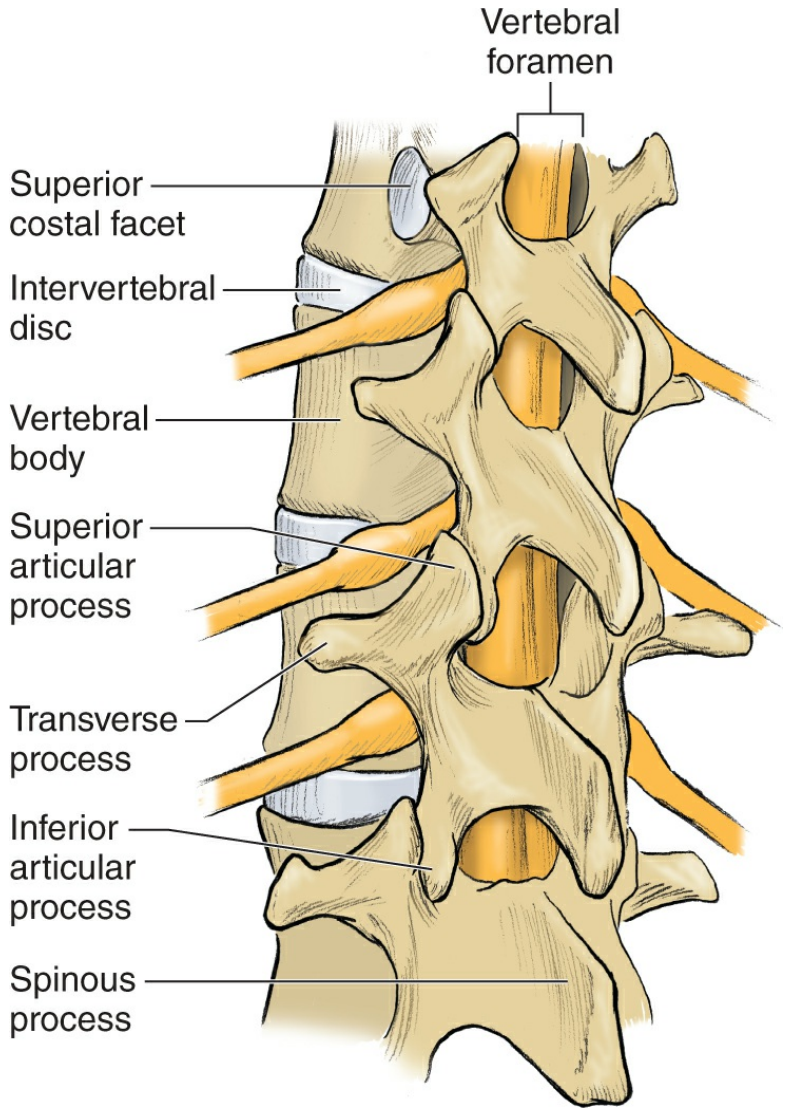


FIGURE 5.2 The vertebrae of the spine.

The joints between each vertebra are complex and vary according to region and function. These joints can be capable of minimal movement, such as between the vertebral bodies, or can be quite movable, such as between the first and second cervical vertebrae to aid movements of the skull.

BACK MUSCLES

The muscles of the spine are highly complex. There are long muscles that run the entire length of the vertebral column, and there are tiny muscles between each vertebra. Working individually or in groups, these muscles produce a wide range of movements. A number of back muscles with their origin on the vertebral column that attach to the scapula or arm are listed in chapter 7.

Spinal muscles differ from other muscles in that they don't really have a single origin

or insertion. Most begin on the pelvis and insert along each vertebra up the column. Others begin on the vertebra below and insert on the vertebra above. Some have the opposite orientation, while still others overlap muscles up the column. Some are region specific, while others have segments both within and between sections.

The most widely recognized muscle acting on the vertebral column is the erector spinae (figure 5.3). This name is applied to a collection of muscles called the longissimus, spinalis, and iliocostalis. Each of these may have region-specific portions, such as the semispinalis capitis, longissimus cervicis, and iliocostalis thoracis. As its name implies, the erector spinae extends the spine for an erect stance. Muscles pull the insertion toward the origin; therefore, to extend the spine, the origins are low, and the insertions are high on the back.

Other muscles of the back include the multifidus, quadratus lumborum, rotatores thoracis, and interspinalis. All told, there are about 30 pairs of named muscles that extend, rotate, compress, and perform lateral flexion of the various regions of the vertebral column.

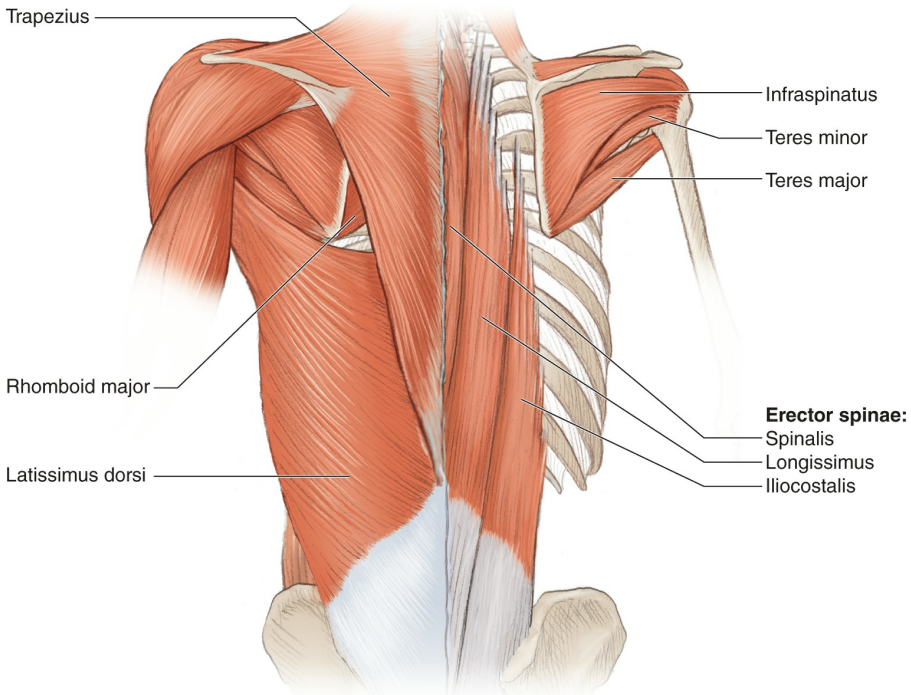


FIGURE 5.3 The muscles of the back.

ANATOMY OF THE HIP

The pelvis, which makes up the hips, is actually three fused bones on each side (figure 5.4). The three bones are the ilium, ischium, and pubis. The configuration of the three bones can be confusing. That ridge you feel under the skin on your side is the fan-shaped

crest of the ilium, or iliac bone. You sit on a specific landmark of your ischium. The two pubic bones connect with each other in the midline of the lower abdomen. These three bones are fused together, and each fused set of three bones connects with its counterpart on the other side through the pubic bones. Posteriorly, the two iliac bones articulate with each side of the sacrum to form the sacroiliac joint, a joint with surprisingly little motion.

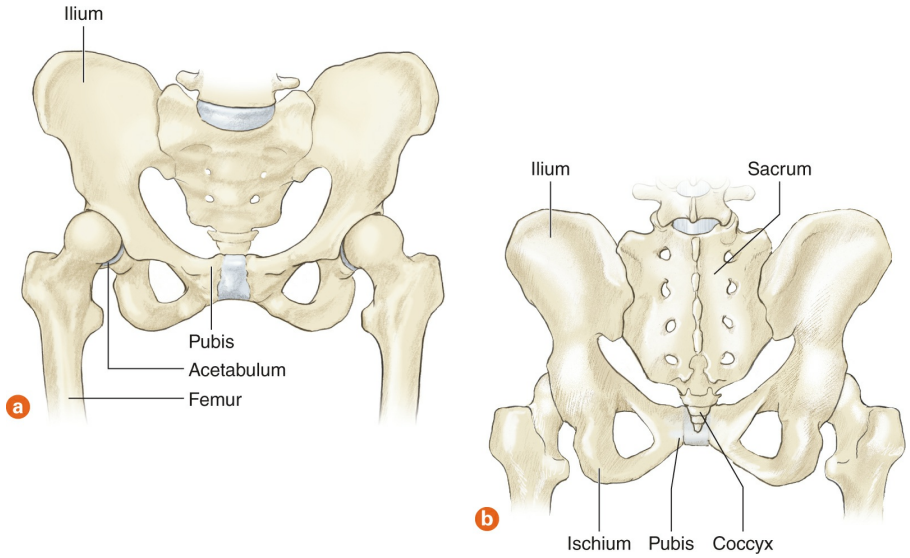


FIGURE 5.4 Bones of the pelvis: (a) front; (b) back.

Along with the pelvic floor muscles, the pelvis provides support from below for the abdominal organs, numerous locations for muscle attachment, passageways for nerves and blood vessels, and the site of bony articulation with the lower extremities. Injuries to this strong set of bones are not common, but there are a number of injuries to tissues that have some connection with the pelvic girdle.

HIP MUSCLES

The primary actions at the hip are flexion and extension. For hip flexion, bend your knee, and then raise your thigh up toward your trunk. Hip extension is the opposite motion; you move your leg behind your trunk.

Two sets of muscles create hip flexion. The primary muscles are part of a group called the iliopsoas. This group includes three muscles—the iliacus, psoas major, and psoas minor—that begin on the lower lumbar vertebrae and the deep cut of the pelvis. (Actually, 50 percent of people don't have the psoas minor muscle.) All insert through a common tendon on the femur to flex the hip and externally rotate the femur. Each psoas muscle also assists in lateral flexion of the trunk. Secondary muscles for hip flexion are the rectus femoris, one of the four quadriceps muscles of the thigh (see page 118), and

the sartorius. Although these muscles are secondary for hip flexion, they are no less important. The rectus femoris begins on the rim of the socket portion of the ball-and-socket hip joint and joins with the other three quadriceps muscles to eventually insert on the tibia just below the patella (kneecap). The rectus femoris is primarily a knee extensor, but because of its origin on the pelvis, it also is a hip flexor. The sartorius is a curious muscle that begins roughly in the area where one might suffer a hip pointer (anterior superior iliac spine) and then runs diagonally down the medial thigh and inserts behind the tibia below the knee, giving it numerous actions: hip flexion, knee flexion, hip abduction, and lateral rotation of the hip. If you were to check the sole of your shoe to see if you stepped on gum, you would involve all the actions of the sartorius.

Hip extension also requires two groups of muscles (see figure 5.5). The three hamstring muscles originate near the bony prominences on which you sit (ischial tuberosities) and insert below the knee on the back of the tibia and fibula. Their main function is knee flexion, but the pelvic attachment means they also perform hip extension. The other main muscle is the gluteus maximus, the large muscle of the buttocks. This very powerful muscle has a broad origin along the back of the pelvis and narrows to insert on the back of the proximal end of the femur. Because of the diagonal direction of its fibers, the gluteus maximus also can rotate the femur laterally as well as assist in trunk extension.

The other two gluteal muscles, the gluteus medius and the gluteus minimus, are named for their relative size and position. These originate underneath the gluteus maximus on the back of the pelvis but insert elsewhere on the femur to assist in thigh abduction (moving the thigh away from the midline of the body) and lateral thigh rotation. Depending on the position of the femur, the gluteus minimus also can help rotate the femur internally.

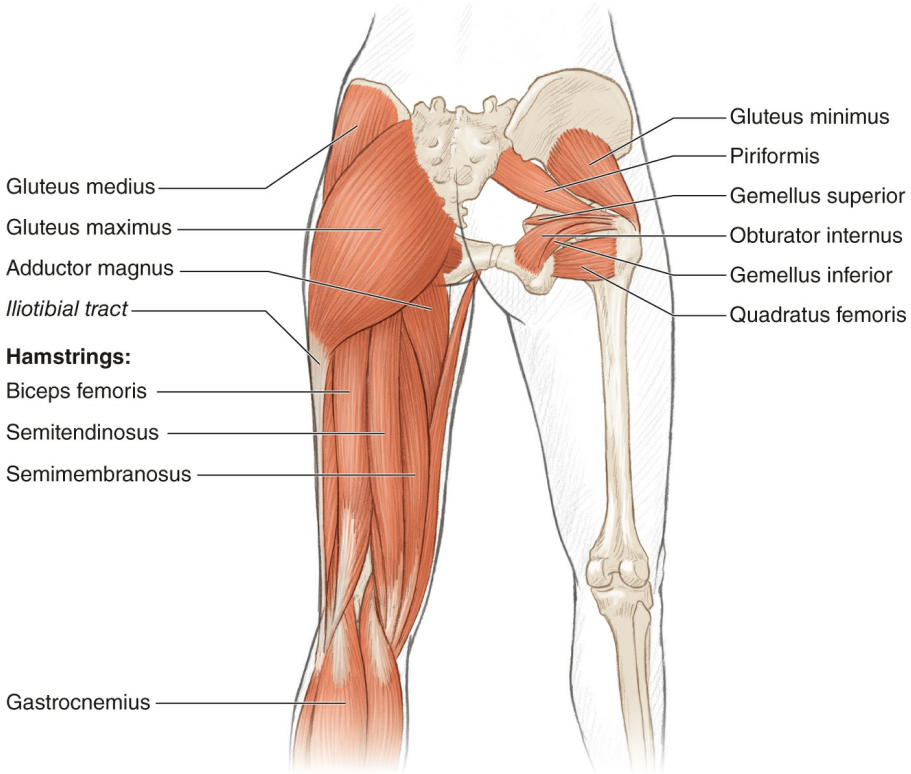
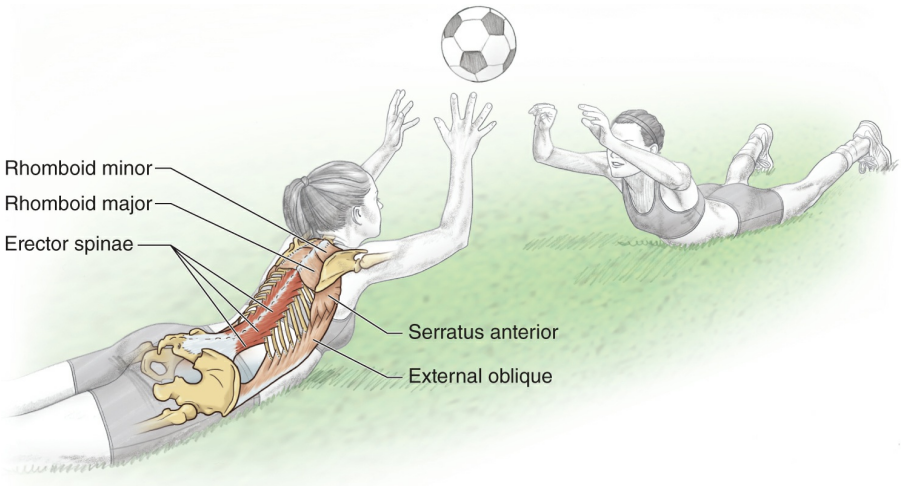


FIGURE 5.5 Muscles used during hip extensions include the hamstrings and the glutes.

BACK AND HIPS

PRONE PARTNER BALL TOSS



Execution

1. You will need a partner for this exercise. Lie on your abdomen on the ground a few yards or meters away from your partner, head to head.
2. Take a soccer ball, arch your back to lift your chest off the ground, and gently toss the ball to your partner using both arms equally. Think of a throw-in.
3. Your partner arches her back to catch the ball. She tosses the ball back to you.
4. Continue tossing the ball back and forth. Toss back and forth for about 15 seconds, and add time as strength improves.

Muscles Involved

Primary: Erector spinae

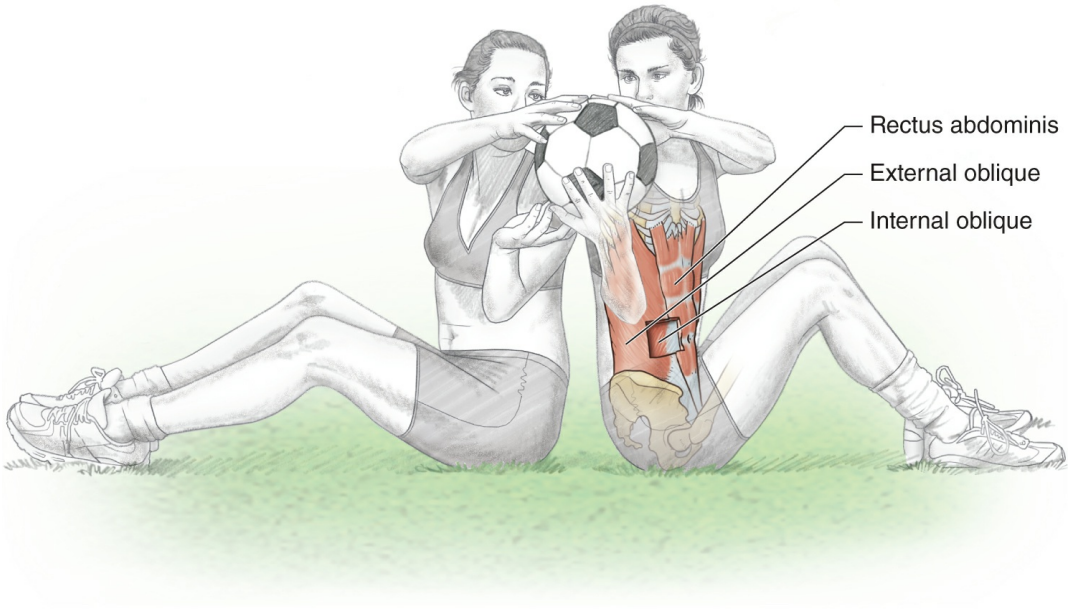
Secondary: Abdominal core (external oblique, internal oblique, transversus abdominis, rectus abdominis), scapular stabilizers (such as rhomboid major and minor and serratus anterior)

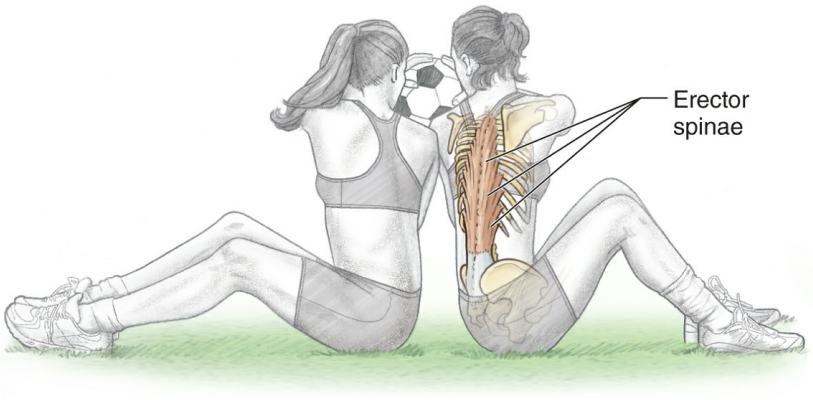
SOCCER FOCUS

We are learning more about the role of the spine in sport. Its role in the concept of the core should not be minimized, partly because we now know that some injuries to the lower extremity frequently are preceded by some minor wobble of the trunk. Add this to the fact that a substantial percentage of soccer players have back complaints. These complaints may be enough to mention to the medical staff but not enough to keep the

players off the field. The constant starting, stopping, and changing of direction in soccer twist the spine over and over again, which can lead to discomfort. Do not neglect supplemental training of the neck and spine just because you think such exercises are not soccer specific. Strengthening the muscles that attach to the spine will go a long way toward stabilizing the core, preventing injury, and minimizing back complaints. Although prone back extensions can be done individually, having the players toss a ball engages teammates with each other.

SEATED PARTNER BALL TWIST





Execution

1. You will need a partner for this exercise. Sit on the ground back to back with your partner. You may either extend or bend your legs for balance.
2. Hold a soccer ball in both hands.
3. At the same time, you and your partner twist to one side, and your partner reaches around to take the ball. Then you both twist to the opposite side, and your partner hands off the ball to you. Keep repeating the exercise for around 15 seconds, increasing the time as strength improves.

Muscles Involved

Primary: Abdominal core

Secondary: Spinal extensors (erector spinae, multifidus)

SOCCER FOCUS

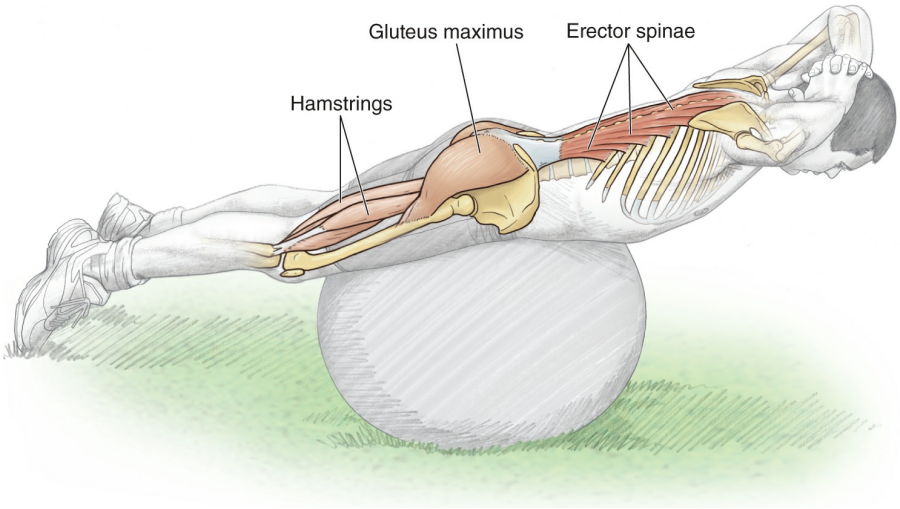
Soccer players are known for being among the most agile of all athletes. Agility is defined as being able to change speed, direction, and level quickly and accurately. The process of changing direction usually involves making a feint to get the opponent to move in one direction and then taking off in another direction yourself. This feint is most effective if a twisting trunk is used to help decoy the opponent. The opponent will assume the rest of the body will follow the direction of the trunk. (An old coaching adage is to watch the numbers on the jersey in the belief they will tell you where the opponent is going.) Highly skilled and devious players know this and will use the trunk to confuse the defender. This exercise is good not only as part of a core training program but also to help a player's movements become harder to read. As players get better at this exercise, they will (usually on their own) try to do this drill faster and faster. In the gym, some swap out a soccer ball for a medicine ball, effectively adding resistance to the movement.

VARIATION

Broomstick Twist

The broomstick twist is a solo version of the partner exercise just described. The broomstick twist, a fundamental exercise in golf, requires only a stick. Try not to generate too much momentum. Perform the twist under control with the goal of extending the limits of the trunk's range of motion, not to see how fast the movement can be performed.

STABILITY BALL TRUNK EXTENSION



Execution

1. Lean forward and place your hips on the stability ball, keeping your feet on the ground. Continue to lean forward, wrapping your trunk over the ball. Clasp your fingers behind your head.
2. Raise your chest off the ball, keeping the chin tucked in to stabilize the neck.
3. Slowly return to the starting position.

Muscles Involved

Primary: Erector spinae

Secondary: Trapezius, rhomboid major and minor, gluteus maximus, hamstrings (biceps femoris, semitendinosus, semimembranosus)

SOCCER FOCUS

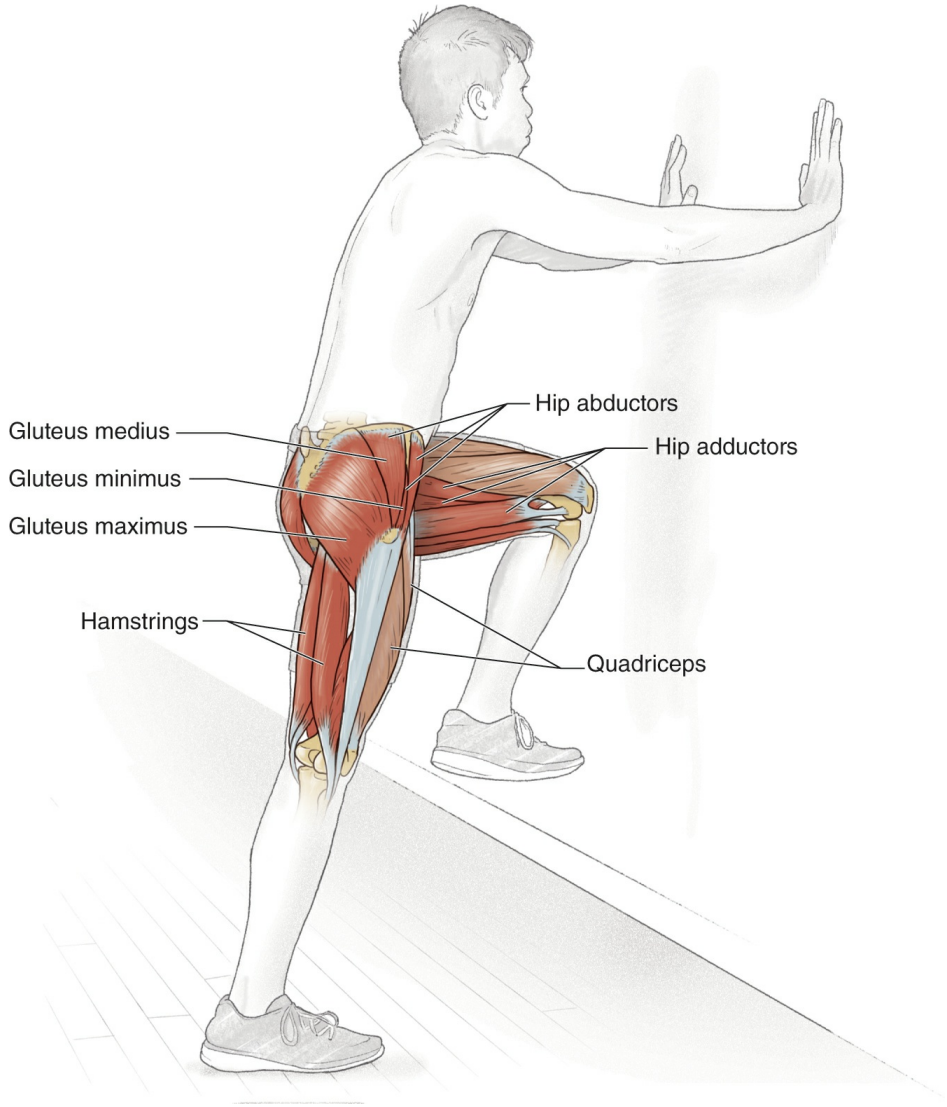
Acute, traumatic injury to the spine is, thankfully, rare in soccer, but that does not mean a soccer player's spine is immune to problems. When injury surveillance studies look beyond acute injury and ask players about any musculoskeletal complaints (things that bother them but do not prevent them from playing), back pain is cited by more than 50 percent of top-level adult players. Low back complaints are not just an issue for adult players—more than 40 percent of low-skilled youth players (14 to 16 years old) have low back complaints. Some researchers are investigating whether low-level pain without a specific incident may be the first warning of an overuse injury such as a stress fracture. A spinal stress fracture would lead to an extended time-loss period, so athletes should do what they can to lessen the stresses on the spine to keep playing.

VARIATION

Oblique Crunch

You can increase the load on the obliques by doing stability ball crunches on your side and performing lateral flexion to the side opposite the ball.

MOUNTAIN CLIMBER



Execution

1. Place both hands against a solid wall at shoulder height, keeping the arms straight.
2. With both feet flat on the ground, the body should form an upward incline toward the wall of approximately 45 degrees.
3. Propel the knee upward in an explosive, sprinting motion to a position with the thigh parallel to the ground, knee at hip height, and the ankle flexed. Use a rapid pace.
4. The standing leg should be at full extension, with the weight on the ball of the foot.

5. Maintain a neutral spine.
6. Slowly lower the leg, and repeat on the other side.

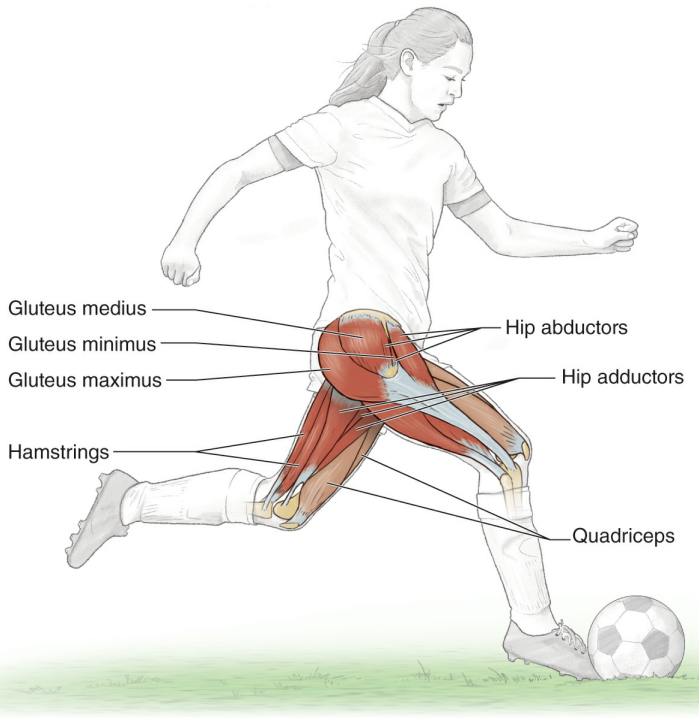
Muscles Involved

Primary: Gluteals, hamstrings (biceps femoris, semitendinosus, semimembranosus), hip adductors and abductors

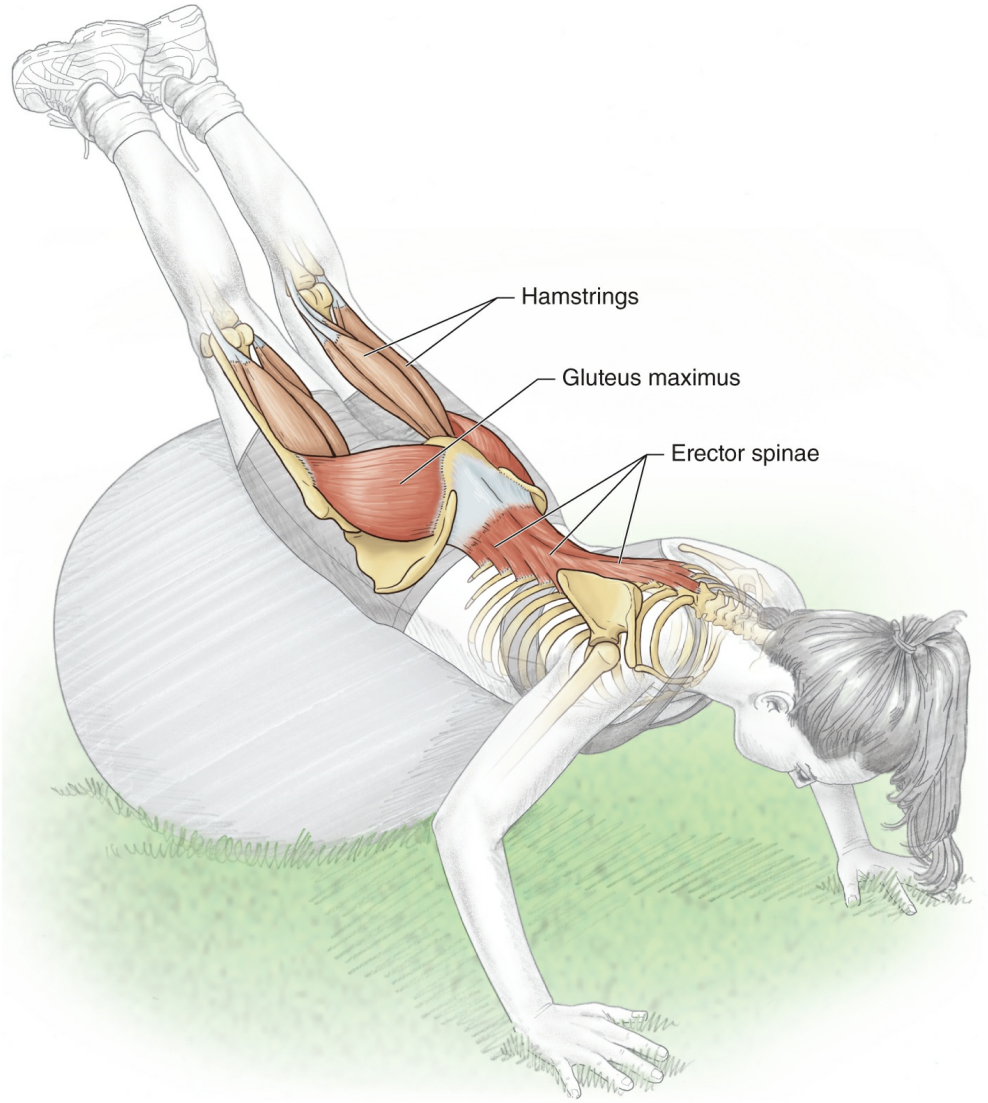
Secondary: Quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris)

SOCCER FOCUS

Soccer requires physical exertion of the body and many fitness components. Even so, arguably the explosive moments in games are the most decisive—a sprint onto a through ball, a defensive recovery run to deny a goal-scoring opportunity, a jump to head a cross at goal, a goalkeeper diving to make a save, or a striker generating power in a shot. The inclusion of exercises that train explosive movements are crucial to any training program. This exercise creates context for speed development by focusing on the lean and position of the body, angle of limb movement, and leg action and should be used in conjunction with other speed development activities.



REVERSE LEG EXTENSION



Execution

1. Select a stability ball appropriate for your size: too big and you may not be able to touch the ground with the hands and feet at the same time; too small and there is little challenge.
2. Lie across the ball with your lower abdomen on the ball. Extend your arms, placing your palms on the ground. Your legs should be extended so that your toes touch the ground.
3. By extending your hips, raise both legs in unison as high as you can, keeping the legs straight.
4. Slowly return to the starting position.

Muscles Involved

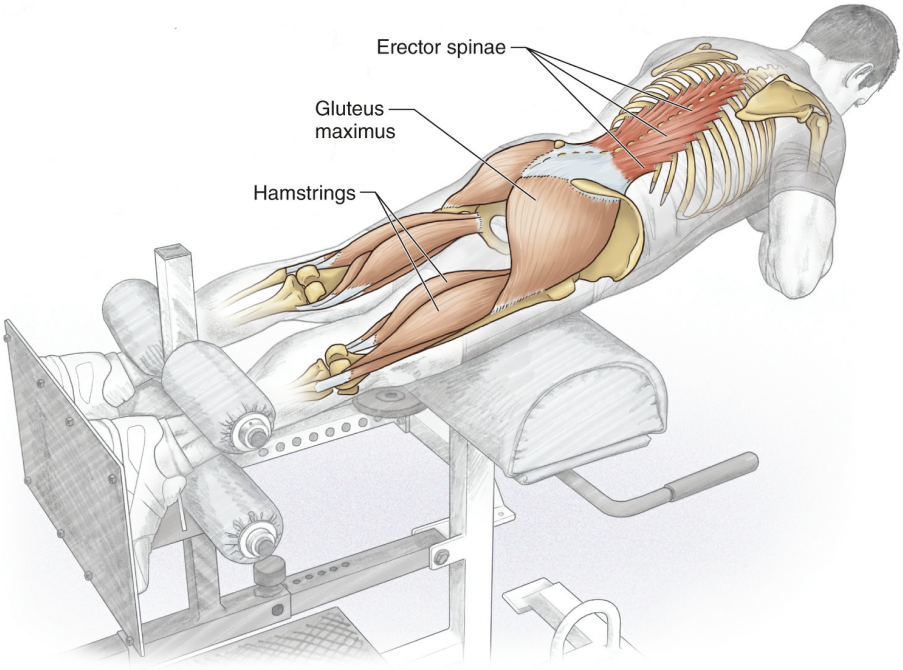
Primary: Gluteus maximus, erector spinae

Secondary: Hamstrings (biceps femoris, semitendinosus, semimembranosus)

SOCCER FOCUS

Heading is a hard skill to master. Those who are good at it are highly prized members of a team. When standing, it should be obvious that much of your heading power comes from pushing against the ground to provide the energy necessary for a successful heading opportunity. When jumping, you don't have the ground to push against, meaning you need to coordinate the hyperextension of your trunk with a rapid flexion of the trunk to apply power to the ball. In a match, this opportunity might happen only a couple of times, but heading practice (for appropriately aged players) can provide multiple opportunities for this hyperextension–flexion motion and the spinal muscles. Exercises that recruit the erector spinae muscles will help support the vertebrae during this demanding skill.

INCLINED LUMBAR EXTENSION



Execution

1. Lie in a prone position on a Roman chair by standing on the platform and hooking your ankles under the pads. Your thighs will be on the cushion and your arms folded across the chest. The hips need to be free to move.
2. Slowly lower the trunk to the floor.
3. Raise the trunk until it is in line with the legs.
4. Do not attempt too many repetitions. Start with a few, and gradually add more repetitions as you get stronger.

Muscles Involved

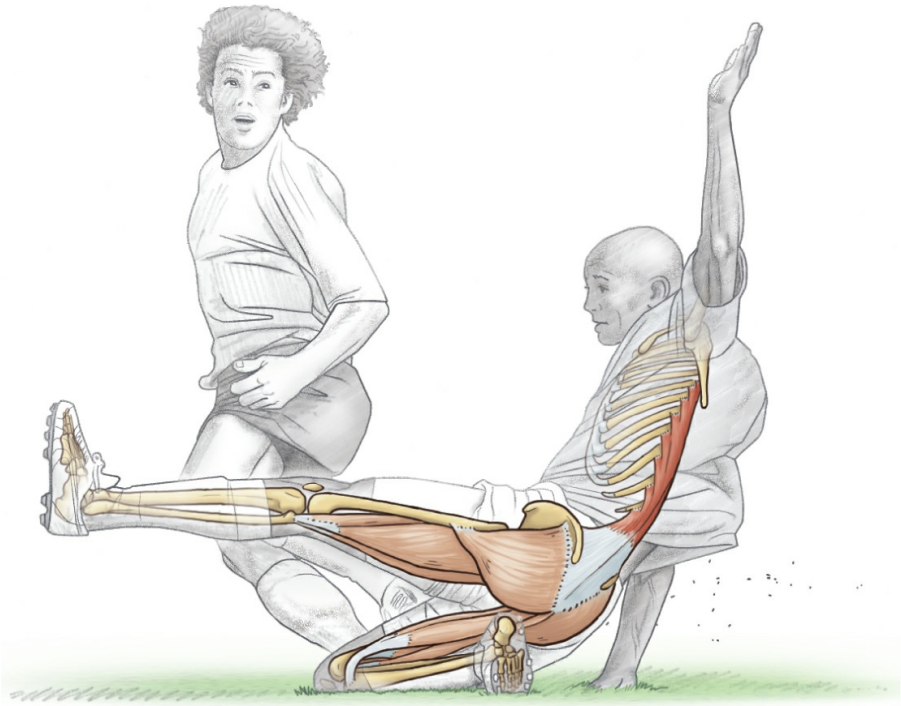
Primary: Erector spinae

Secondary: Gluteus maximus, hamstrings (biceps femoris, semitendinosus, semimembranosus)

SOCCER FOCUS

A recent study looked at stress fractures to a particular area of the lumbar spine in young players. The name of the injury is a mouthful: spondylolysis (pronounced spon-de-LOL-eh-sis). The exact cause is still under study to determine whether it begins with a specific event or if there is a genetic component. Axial loading (pushing down on top of the bones) or repetitive twisting motions have both been suggested as potential

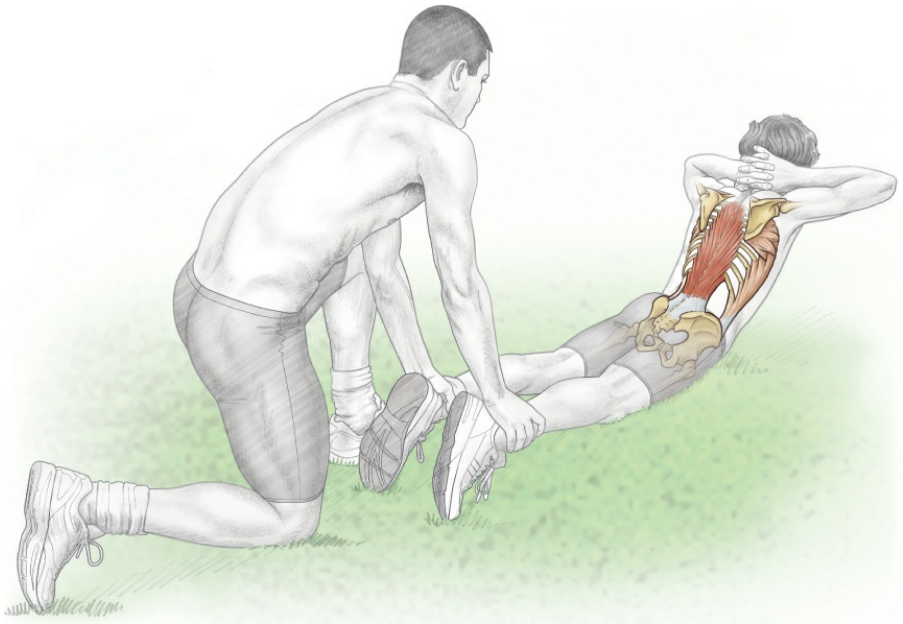
culprits. Axial loading is not all that common in soccer, but excessive twisting is quite common. Rest is the best treatment for this condition, and most physicians expect three months or more lost to sport for complete healing. Most sports medicine specialists believe that increasing the strength of the muscles around susceptible bones and joints will go a long way toward preventing problems. This is especially true for the back, an area with a reputation for being weak and poorly conditioned.



VARIATIONS

Partner Lumbar Extension

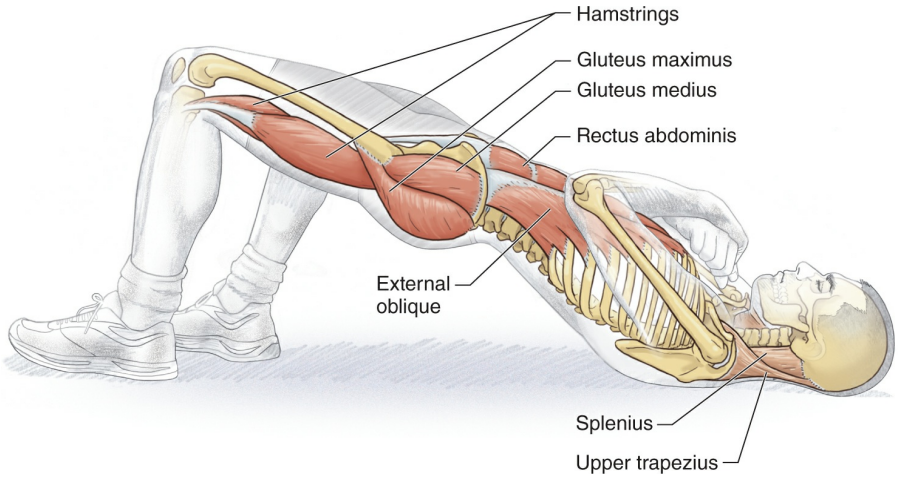
You will need a partner for this exercise. Lie supine on the ground, and clasp your hands behind your head. Your partner kneels at your feet and anchors your ankles to the ground. Slowly extend your spine, raising your trunk and shoulders off the ground. With control, lower the trunk to the ground, and then repeat the exercise. Do not go overboard at the beginning by attempting too many repetitions or trying to extend too far. Start with a few repetitions, and gradually add more.



Rotating Lateral Extension

This variation includes the obliques in the exercise. Simply perform the exercise as described, but alternate a twist to each side with each repetition. As you get stronger, twist in both directions on each repetition.

FLOOR BRIDGE



SAFETY TIP At the top of the bridge, the shoulders should be in contact with the floor. This should not put any strain on the head or neck.

Execution

1. Lie on your back with your knees bent, feet flat on the floor and spread about hip-width apart. You may need to spread your arms to your sides for balance.
2. Raise your hips and trunk until your body forms a straight line from your knees to your shoulders.
3. Pause at the top position for a couple of seconds, and draw in your core. Slowly lower your trunk nearly to the ground. Hold this position, and then repeat the exercise. Start with five repetitions, and progress as strength improves.

Muscles Involved

Primary: Hamstrings (biceps femoris, semitendinosus, semimembranosus), gluteus maximus, gluteus medius, abdominal core

Secondary: Upper trapezius, splenius, spinal extensors

SOCCER FOCUS

In years past, supplemental training for the neck was limited to neck bridges borrowed from wrestling. In wrestling, neck bridging is an important skill to keep from being pinned, but it is largely isometric and mostly involves neck extension and hyperextension. In soccer, a strong neck not only helps with heading but also is important for stabilizing the head during collisions with the ball, other players, the ground, the goalposts, and more. However, other options for improving support from the

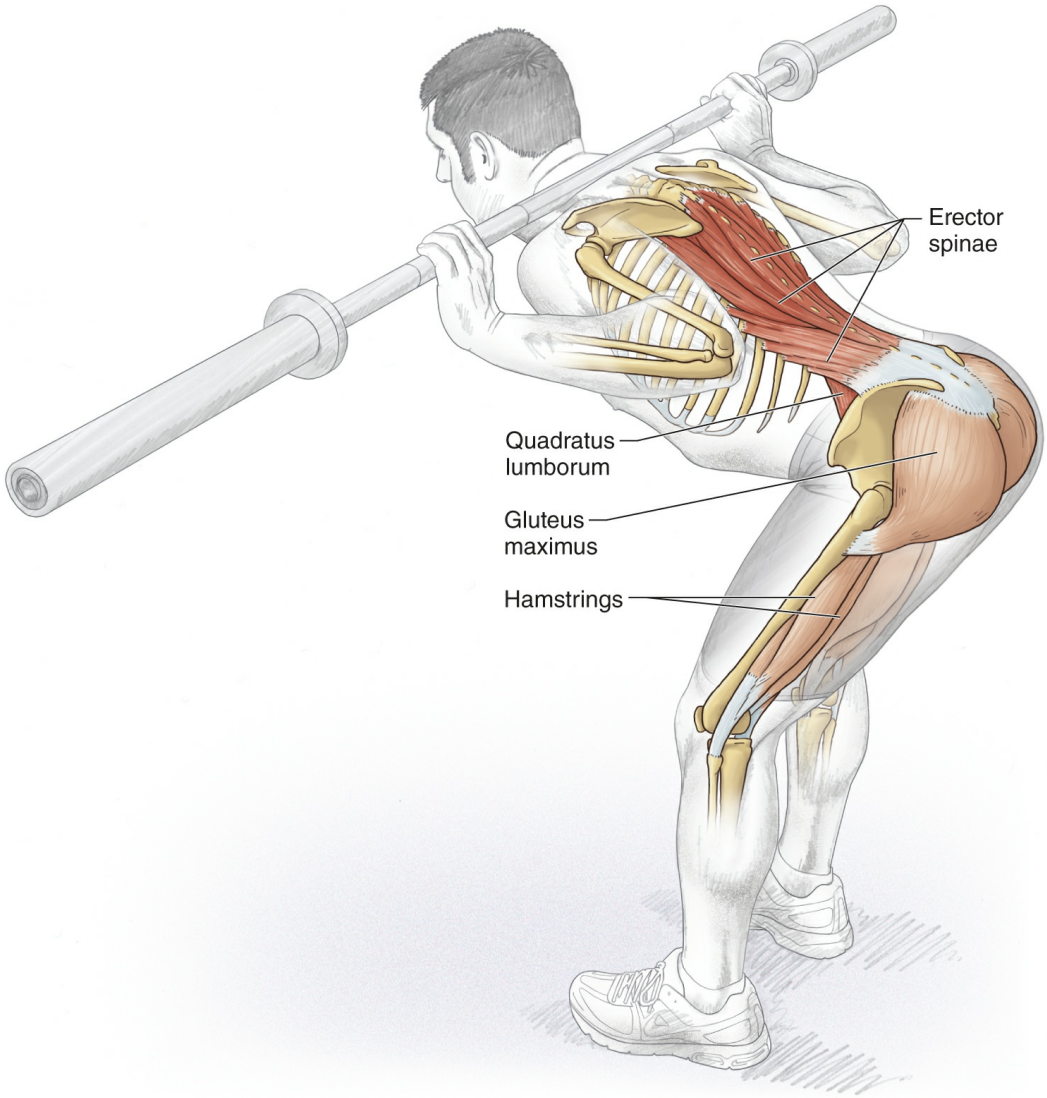
neck and shoulders are available. Although the floor bridge is most commonly thought of as a core exercise, the neck and shoulders are one of three points of ground contact and have to work against the push applied by the feet. The hamstrings and glutes are also activated when the trunk is elevated. Keep the glutes contracted and the abdominals drawn in throughout the exercise.

VARIATION

Barbell Hip Bridge

Start in a seated position on the ground. Using a pad under the bar, roll the bar directly over the hips, and lie flat on the floor. Initiate the movement by driving through the heels, and extend the hips up through the bar. The weight should be supported by the upper back and heels. Extend as far as possible, and then return to the starting position.

GOOD MORNING



SAFETY TIP There is no need to use heavy weights for the exercise. A slight bend at the knees can make this exercise a bit easier.

Execution

1. Stand with your feet apart, with a little knee flexion. Using an overhand grip, hold a barbell across your trapezius.
2. Slowly bend the trunk forward, while keeping the trunk straight and your head up, until the angle between the trunk and thigh is about 90 degrees.
3. Pause at the bottom, and then slowly raise the trunk.

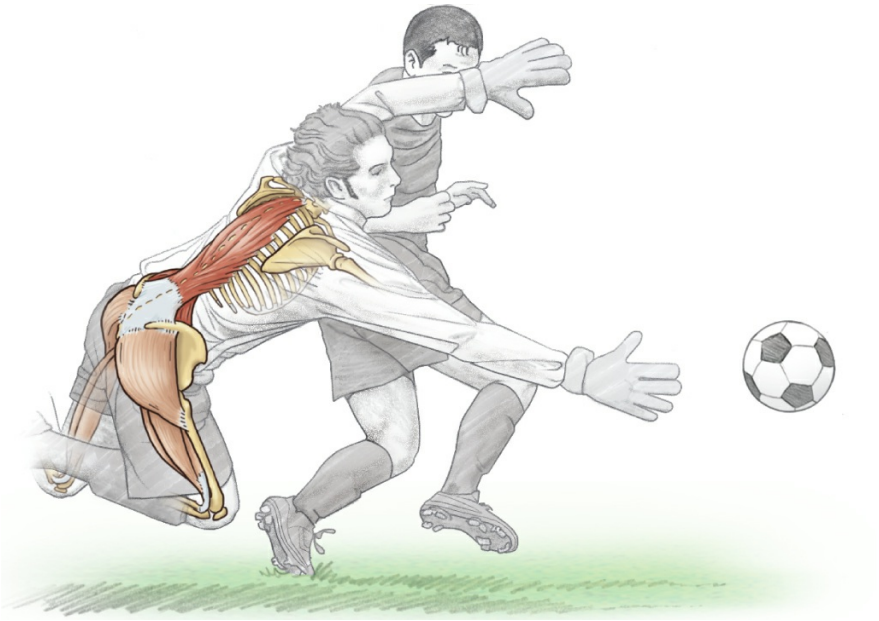
Muscles Involved

Primary: Erector spinae, quadratus lumborum

Secondary: Gluteus maximus, hamstrings (biceps femoris, semitendinosus, semimembranosus)

SOCCER FOCUS

Most of the examples so far have been directed toward field players. The goalkeeper has a unique position. The goalie spends a great deal of time apart from the action, talking to his defenders about positioning and opponent movements that might not be seen by all. More important, the goalie will usually need to make three or more saves to keep his team in the game. These actions are highly ballistic and frequently quite acrobatic and can bring gasps from spectators and players alike. Stretching across the goal mouth, arching his back, and reaching out to get his fingertips on the ball to redirect the shot away from danger requires every muscle to be prepared to act in an instant. Because the goalie also is allowed to use his hands, his upper trunk and upper body have a unique role in comparison with field players. Goalies are getting bigger, with players 6 feet 2 inches (188 cm) or taller routinely manning the posts. Just the length of a goalie this size changes the torque about his joints.

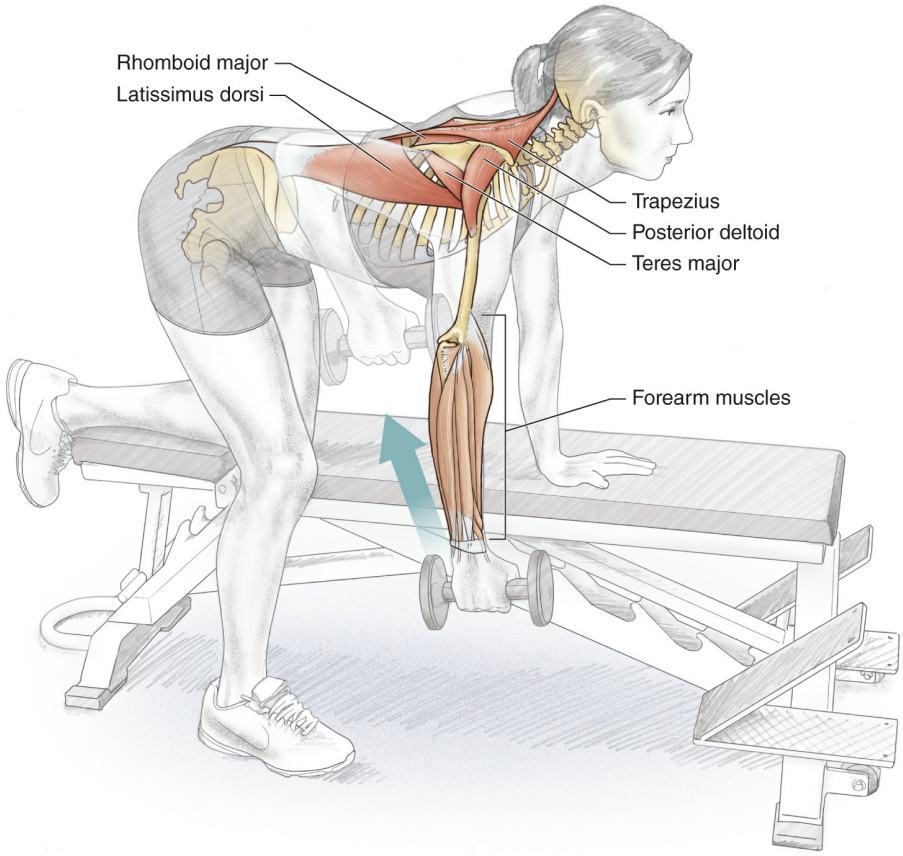


VARIATION

Machine Back Extension

Machines offer a safe and stable way to isolate a muscle group. Athletes with a history of back pain or back complaints as well as athletes returning from injury should use a back extension machine as their first choice.

ONE-ARM DUMBBELL ROW



Execution

1. Kneel on your left knee on a padded bench. Add support by placing your left hand on the bench. Your right foot is flat on the floor, as is a dumbbell.
2. Lean forward at the hip while keeping the spine straight, and grasp the dumbbell.
3. Inhale as you raise the arm, and flex the elbow as high as possible, lifting the weight to the trunk.
4. Pause at the top of the lift, and then exhale as you lower the weight until the arm is fully extended. The motion is similar to sawing wood.

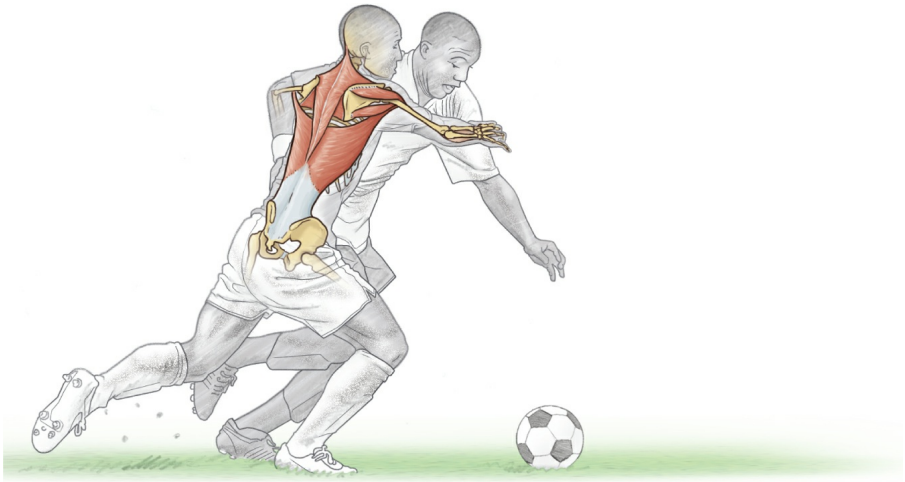
Muscles Involved

Primary: Latissimus dorsi, teres major, posterior deltoid, trapezius, rhomboid major and minor

Secondary: Forearm muscles, spinal extensors for posture

SOCCER FOCUS

Modern soccer tactics are twofold. On offense, the team tries to make the field as big as possible to give players room to maneuver and spread the defense thin. On defense, the team tries to make the field as small as possible so the team defense is very compact and each defender is close to the ball. Players inevitably find themselves in very close quarters while competing for the ball. One of the best ways players, especially strikers, can keep a defender away from the ball is to shield the defender from the ball. This requires back and shoulder strength to make the attacking player seem bigger than he really is and avoid the wrath of the referee for unfair use of the arms. A player who is adept at screening defenders and able to maintain possession of the ball will play many minutes. Possession is a big part of the game, so being able to screen defenders away from the ball is a critical and often overlooked skill.



VARIATIONS

Options for Rowing Exercises

Posture is important during rowing exercises. The standing row is a complex exercise, like many barbell lifts. You must raise the weighted bar off the floor to the thighs and then assume the specific posture before executing the row. T-bar rows, especially when performed while lying on a bench, provide support for the trunk and offer a measure of safety. Many cable machines are capable of a rowing motion that isolates the movement for safe execution of the lift.

6
LEGS: MUSCLE ISOLATION

At last, exercises for the legs. Maybe now you'll gain the strength for that killer shot, the 60-yard goal kick, or the accurate penetrating pass out of the back that shreds the defense. Soccer is primarily about the legs. All other exercises are for support. Let's get to the good stuff.

For most sports, the power behind the activity comes from the legs. Even sports that emphasize the arms build momentum from the ground up. Problems in the legs can affect the arms and shoulders. For example, the damaged shoulder of baseball pitching legend Jay Hanna Dean, better known as Dizzy Dean, began with a toe injury. A soccer player who does not have a good foundation may soon find a lack of balance, agility, and more affecting his soccer skills. Ill-timed or poorly executed actions above the legs can be seen as poor skill execution. Players who spend too much time working their legs while neglecting the rest of the body will never realize their full potential.

Players make the greatest gains in developing a stronger shot or a longer goal kick by kicking. Improvements in velocity and distance are due mostly to the coordinated timing

of all the complex mechanical actions of kicking with the recruitment of the optimal muscle fibers at the instant of ball contact. Improving strength improves general motor skill performance and prevents injury.

BONES, LIGAMENTS, AND JOINTS OF THE LEGS

The leg is made up of three main bones. The femur (thigh bone) is above the tibia (shin bone), which is parallel to the fibula. The patella (kneecap) has no direct bony connection to the femur or tibia because it is embedded in the back of the tendon of the large thigh muscle, the quadriceps femoris. The foot and ankle are a complex mix of seven tarsals, five metatarsals, and 14 phalanges. Although the actions and dexterity of the foot are less than in the hand, the foot is no less complex.

The hip, knee, and ankle are the three primary joints of the leg, but there are more. The hip is a classic ball-and-socket joint. It is a strong, sturdy joint whose integrity is supported by three strong ligaments that begin on the pelvis and wrap around the neck of the femur. The hip has good range of motion but not as good as the shoulder. The primary actions are flexion (swinging the thigh forward) and extension (swinging the thigh back), abduction (moving the leg sideways away from the body) and adduction (swinging the leg from the side back to the midline and beyond), internal rotation (rotating the thigh in toward the midline) and external rotation (rotating the thigh away from the midline), and circumduction (swinging the leg around in a circular motion).

The knee, where the femur sits on top of the flat surface of the tibia, is the definitive hinge joint. There is also the patellofemoral joint, where the patella glides along a smooth surface of the femur. The patella doesn't attach to the femur per se. Although the knee is a hinge joint like the fingers, it is a very complex joint. The real magic of the knee is in its ligaments. The medial collateral ligament, or MCL, connects the femur and tibia on the medial side of the knee, or between the knees. The lateral collateral ligament, or LCL, connects the femur and tibia on the lateral side of the knee, which is on the outside surface. These ligaments prevent the bones from becoming overly bow-legged or knock-kneed. The classic clip block in American football can damage the MCL.

Within the knee joint are the two cruciate ligaments. Both begin on the tibia and insert within the large notch at the end of the femur. The anterior cruciate ligament (ACL) begins in the front and runs diagonally toward the lateral wall of the notch, while the larger posterior cruciate ligament (PCL) begins in the back and crosses behind the ACL to insert on the medial wall of the notch. These two ligaments prevent the femur and tibia from twisting on each other. The ACL also prevents the tibia from sliding too

far forward underneath the femur, and the PCL prevents the tibia from shifting too far backward.

The knee also has a pair of crescent-shaped cups of cartilage called the medial meniscus and lateral meniscus. Another type of cartilage, called articular cartilage, covers the surfaces of the femur and tibia and the back of the patella. The two menisci and the articular cartilage support the free movement of the knee and are frequently damaged during sports such as soccer. An injury to the meniscus can create a sharp edge that can damage the articular cartilage; when this happens, you are on the fast track to osteoarthritis. A big problem with an ACL injury and the resulting instability is the risk of early-onset arthritis.

The main actions of a hinge joint are flexion (bending the knee) and extension (extending the knee). But the knee is more than a hinge joint because of smaller but no less important movements such as rotation of the femur and tibia with each other. Another frequently mentioned movement is a valgus (knock-kneed) or varus (bow-legged) motion that usually occurs in response to some force exerted from the opposite side. A physician can test the varus and valgus instability of a knee by prying open the medial or lateral side of the joint, which sounds worse than it is. It might be reported that someone tore an ACL when her knee went into an apparent valgus (the knee looks knock-kneed). The actual motion that tears the ACL is the interaction of seemingly minor actions that compromise the ligament. For example, landing or cutting on a nearly extended knee with some internal rotation of the femur at the hip within the presence of sufficient traction may allow the tibia to slide forward under the femur and tear the ACL. That knock-kneed appearance of the knee seems to be more a consequence of the failed ACL and less a contributing cause. Prevention programs are designed to teach safe cutting and landing techniques that do not place the ACL at risk. The knee is far more complex in its structure and function than we yet understand. Orthopedic surgeons who specialize in the knee learn something new nearly every day.

The fibula is a thin bone that runs parallel to the tibia. The bony connection between the tibia and fibula up near the knee is quite strong, but it is not as strong down at the ankle. Those large knots on the inside and outside of your ankle (each is called a malleolus) are actually the ends of each bone. They form a pincer-like grasp on the top tarsal, the talus. Ligaments connect the ends of each bone with nearby tarsals to add stability to the ankle. The primary actions of the ankle are inversion and eversion plus plantar flexion and dorsiflexion. Inversion is rolling the sole of your foot inward, and eversion is rolling the sole outward. Flexion and extension of the foot are more properly called dorsiflexion (pointing your toes up) and plantar flexion (pointing your toes down). The powerful kicking motion is done with a plantar-flexed ankle. The anatomy of the ankle makes it likely that you will sprain the outside of your ankle (an inversion

sprain) far more often than the inside of your ankle (an eversion sprain). With sufficient force, the talus can force the tibia and fibula out of parallel, resulting in what is often called a high ankle sprain.

Just like the hand and wrist, the ankle and foot have a dizzying array of ligaments for proper bony alignment. The same naming conventions for the bones of the hand and wrist apply, only with metatarsals instead of metacarpals.

MUSCLES OF THE LEGS

Some of the muscles that originate on the pelvis, insert on the femur, and act to move the leg are described in chapter 5. The muscles that act on the knee, foot, and ankle are the topic of this chapter.

The thigh muscles are in three primary groups. The quadriceps femoris (the four-headed muscle in the thigh, or femoral, region) has four distinct originations. The three vasti muscles—the vastus medialis, vastus lateralis, and vastus intermedius—all begin along the long shaft of the femur (figure 6.1). (Vastus is Latin for huge.) The fourth head is the rectus femoris, which begins on the pelvis around the socket where the femur articulates with the pelvis. You can easily see three of the quads, but the vastus intermedius is underneath the other three. These four muscles come together to form the common quadriceps tendon that passes over the patella and down to insert on the knot on the tibia just beyond the knee. In one of those anatomical naming quirks, once the quadriceps tendon goes past the patella, its name changes to the patellar ligament. A muscle pulls its insertion toward its origin, so when the quadriceps contracts, the knee extends. The rectus femoris begins on the pelvis and also assists in hip flexion.

The three muscles that make up the hamstrings (figure 6.2) are the opposite (antagonistic) muscles to the quadriceps. They all begin on the pelvis. The biceps femoris is the lateral and largest of the three; it inserts down near the top of the fibula. The semitendinosus and semimembranosus run down the medial side of the thigh and insert behind the medial side of the knee. Most people can find at least two if not all three of these tendons. The main action of the hamstrings is knee flexion, but because all the muscles originate on the hip, they perform hip extension, too. The hamstrings also play an important role in protecting the ACL from injury.

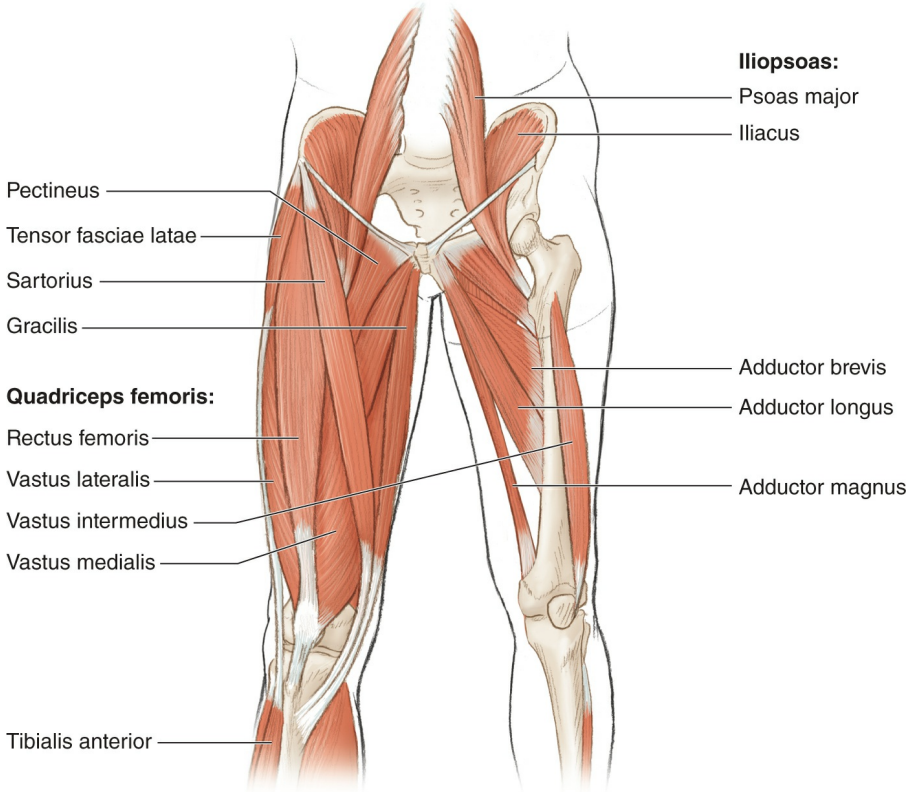


FIGURE 6.1 Muscles of the front of the leg.

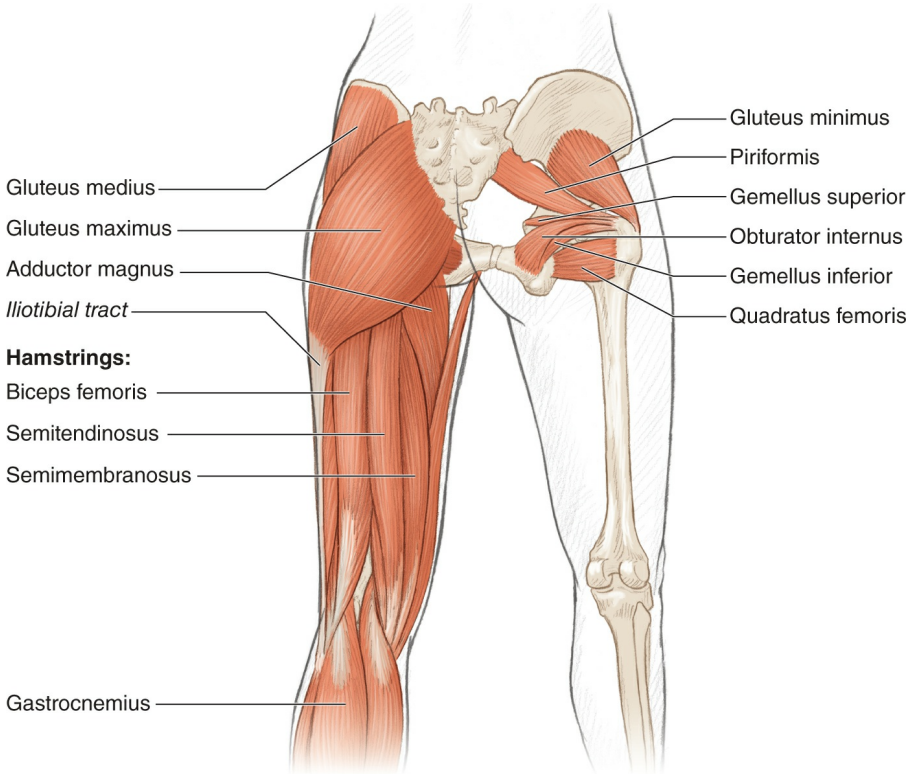


FIGURE 6.2 Muscles of the back of the leg.

The muscles commonly referred to as the groin muscles all begin on the pelvis near the midline and run diagonally down and laterally to insert on the femur. Most are referred to as adductors, muscles that move the thigh toward the midline of the body. They range from quite small (pectineus) to progressively bigger (adductor brevis, adductor longus) to very large (adductor magnus) or very long (gracilis). The adductor longus is particularly susceptible to a strain injury in soccer players. All these muscles assist in external rotation of the femur and more. You can't appreciate the importance of these muscles until you strain a groin and feel pain with nearly every step.

One final muscle of the thigh, sort of, is the tensor fasciae latae. The tensor fasciae latae is more tendon than muscle. This short, flat muscle originates on the crest of the hip, and the short fibers run down the outside of the thigh, ending roughly in the area of that knot felt on the side of your hip. Depending on your height, the fleshy portion might be 4 to 6 inches (10 to 15 cm) in length. From here, the tensor fasciae latae is mostly tendon all the way down the outside of the thigh, and it inserts on the mass of soft tissue that surrounds the knee. It abducts, medially (internally) rotates, and helps flex the hip.

Beyond the knee is a series of muscles that move the ankle, foot, and toes (figure 6.3). Originating along the front of the tibia are muscles that dorsiflex the ankle and others that go all the way to the toes for extension. On the lateral (outside) of the leg is a group of three peroneal muscles that originate on the fibula and mostly evert the foot but also assist in other actions. On the back of the leg are two major muscles. The gastrocnemius, which originates on the back of the femur and often is called the calf muscle, lies over the soleus, which originates on the tibia. The tendons of these two muscles join to become the Achilles tendon, which inserts on the heel (calcaneus). When these muscles contract, you rise up on your toes. They also contribute to your ability to jump and push off the ground during walking and running. These muscles are organized as distinct groups in the anterior, lateral, and posterior compartments of the leg. No muscles are considered medial.

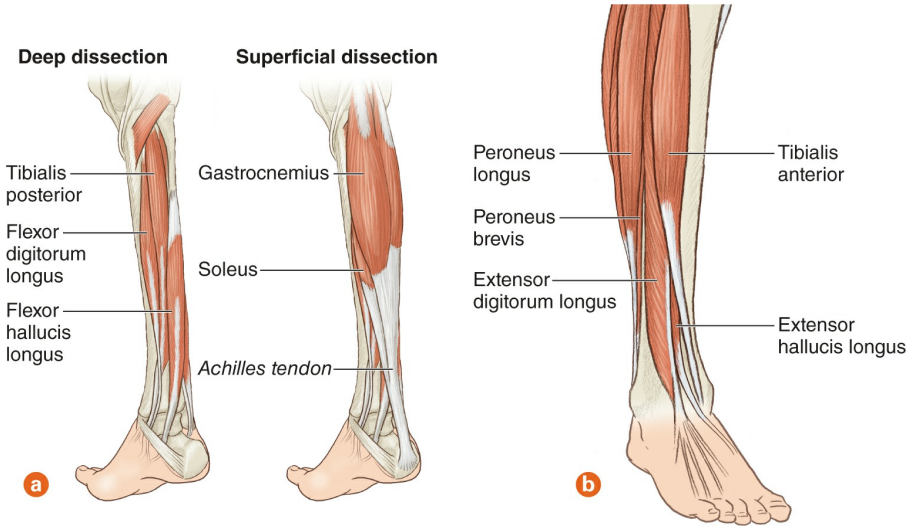
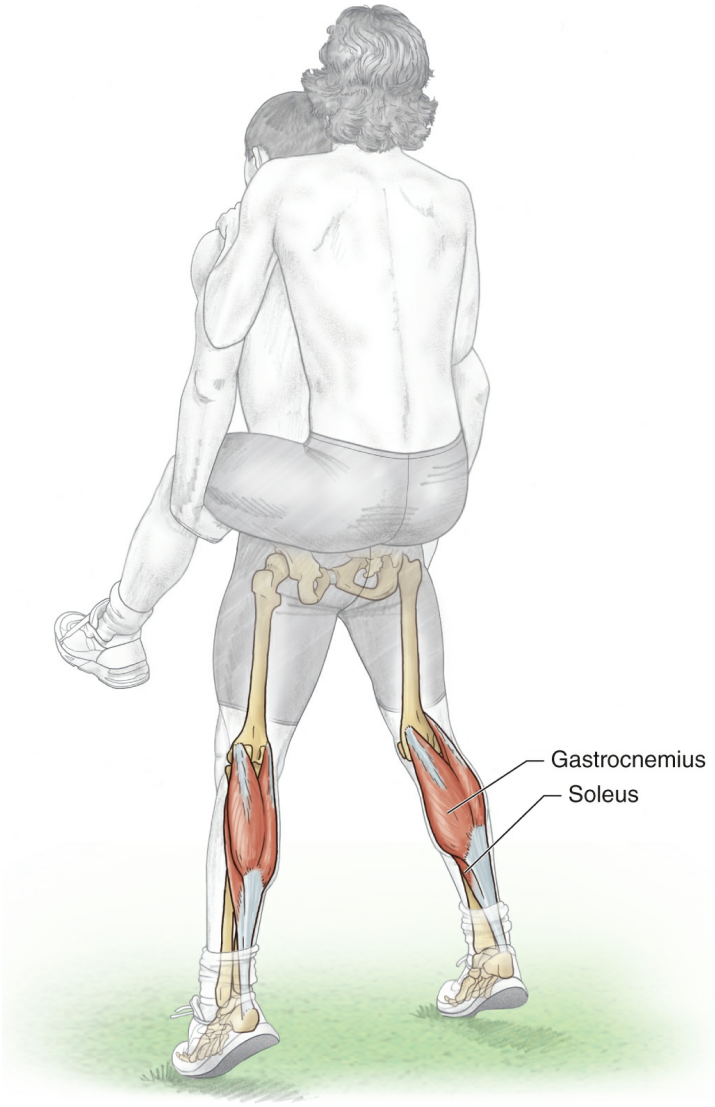


FIGURE 6.3 Muscles of the lower leg and foot: (a) back and (b) front.

LEGS: MUSCLE ISOLATION

TOE RAISE CARRYING PARTNER



Execution

1. Find a partner who is about the same height and weight as you.
2. Have your partner climb onto your back in a piggyback fashion.
3. Perform slow, controlled toe raises by rising as high as possible with each attempt. Swap positions, and then repeat the exercise.

Muscles Involved

Primary: Gastrocnemius, soleus

Secondary: Erector spinae and other accessory back muscles (such as latissimus dorsi and external oblique)

SOCCER FOCUS

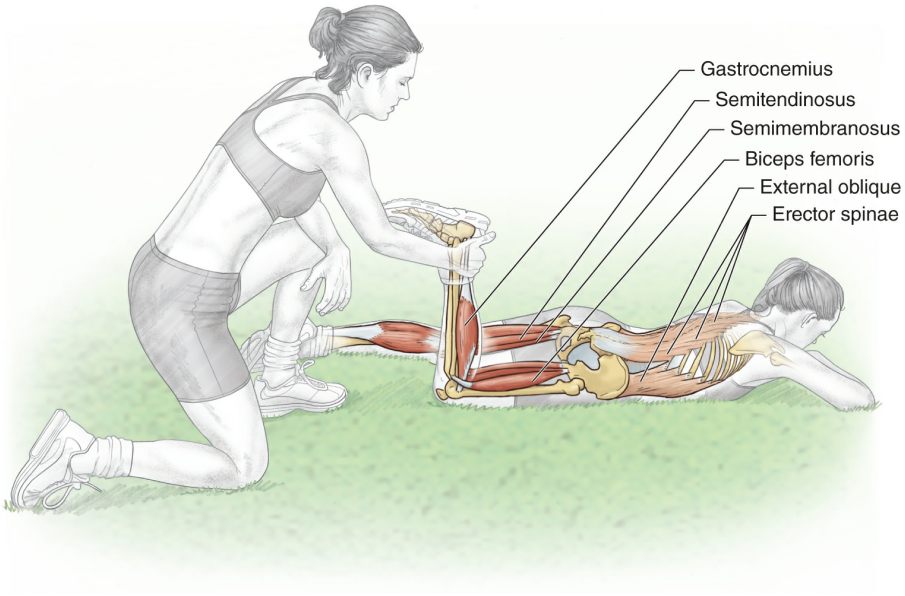
Jumping power comes from the coordinated contribution of hip extension, knee extension, and plantar flexion (rising up on the toes). All these muscle groups need to be trained so that each can contribute appropriately during a jump. The calf muscles are also involved in running because much of the power in the push-off portion of the gait cycle comes from the gastrocnemius and soleus. This is especially true during the initial takeoff and acceleration in sprinting. The increase in stride length with faster speeds is largely due to a stronger push-off from the gastrocnemius and the soleus. In addition, the calf muscles are strong contributors to the rigid locking of the ankle when striking the ball. Much of the power built up in the leg during the swing phase of kicking can be lost if the foot and ankle are not rigid at ball contact.

VARIATION

Single-Leg RDL

Balance on the left leg while holding a dumbbell in the right hand in front of the thigh. Sit the hips back, and bend the left knee slightly. The right leg should be straight and in line with the body throughout the exercise. Bend at the waist until the dumbbell is approximately in the middle of the shin, keeping the back flat. Drive through the heel, and push the hips forward to return to the starting position. Note: The full Romanian deadlift (RDL) is described in chapter 11.

PARTNER PRONE LEG CURL



Execution

1. Lie prone on the ground, with one knee extended and the other knee flexed.
2. Your partner kneels at your feet and holds the ankle of your flexed leg.
3. Perform knee flexion, curling the leg, while your partner resists the motion, allowing the flexion through the range of motion.
4. Switch legs, and then repeat with the other leg. After exercising both legs, switch places with your partner.

Muscles Involved

Primary: Hamstrings (biceps femoris, semitendinosus, semimembranosus), gastrocnemius

Secondary: Abdominal core (external oblique, internal oblique, transversus abdominis, rectus abdominis), erector spinae for core stabilization and posture

SOCCER FOCUS

For earlier generations of soccer players, a hamstring strain was a rare injury. The pace and ballistic nature of the modern game have made this previously rare injury the number one soccer injury; some studies show that professional teams see six or more hamstring strains a year. And these take awhile to heal, which means a team could be without a number of core players for an extended period of time. There are three risk factors for a hamstring strain. The strongest predictor of a strain, or almost any injury, is

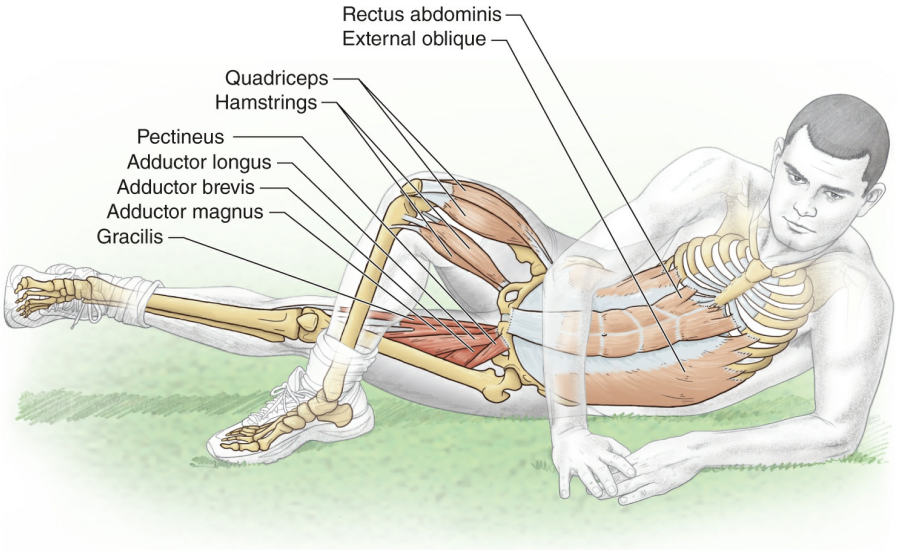
a history of a previous strain injury. Next, the older the player, the more likely he is to suffer a strain. Finally, poor hamstring strength increases the risk of a strain. Notice that of these three factors, the only one that can be modified is strength; thus, it is wise to improve hamstring strength to prevent this serious strain injury.

VARIATION

Machine Knee Flexion

Hamstring strength can be improved by using a machine designed for standing, prone, or seated leg curls. Regardless of the positioning, the knee flexion isolates the motion to the hamstrings and will effectively increase strength. The greatest strength gain and reduction in strain injury come from performing the Nordic hamstring curl in the FIFA warm-up (page 50).

LYING ADDUCTION



Execution

1. Lie on the ground on your side.
2. Flex your upper leg, and place the foot flat on the ground in front of the thigh of the lower leg. The lower leg is fully extended.
3. Slowly raise the lower leg off the ground. Hold briefly at the highest position, and then return to the starting position.
4. Switch sides, and then repeat on the other leg.

NOTE
This exercise is a good companion to the Copenhagen adduction exercise (page 31), which is more demanding.

Muscles Involved

Primary: Adductors (adductor longus, adductor brevis, adductor magnus, pectineus, gracilis)

Secondary: Abdominal core for posture, quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris) and hamstrings (biceps femoris, semitendinosus, semimembranosus) to maintain an extended knee

SOCCER FOCUS

A sport's pattern of activity can lead to some particular deficiencies. Soccer players are famous for poor flexibility about the knee, groin, and ankle. Are these weaknesses due to the nature of the sport or the lack of attention to improving flexibility? Poor flexibility

is considered a risk factor for a variety of injuries including groin strains, which can happen while defending or blocking a pass or shot, while taking a very hard shot, or during a rapid reactive change of direction. The most commonly injured groin muscle is the adductor longus. Most people don't realize how much the groin muscles are used during normal daily activities until one is injured. The leg is attached to the pelvis through a ball-and-socket joint (the hip) that allows the leg to pivot around the joint. During flexion and extension, the leg can move through a rather large cone-shaped range of motion, but the action of the adductors helps minimize the sideways motion of the leg as it moves through hip flexion and extension. Those who have suffered groin strains usually are receptive to supplemental exercises that help strengthen the adductors to prevent or delay the next strain. Another pesky groin injury is a sports hernia, sometimes called athletic pubalgia. Although the pain is situated in the groin, the actual problem can lie elsewhere, and the player may not be able to recall exactly when the injury occurred. See a sports medicine physician for an accurate diagnosis because the treatments for a groin strain and a sports hernia are quite different.

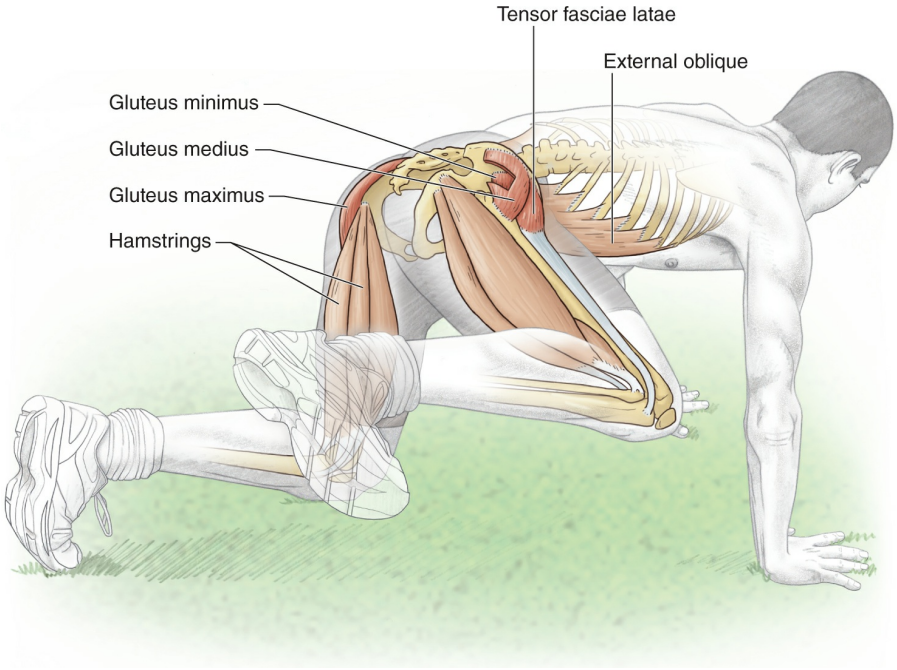
VARIATION

Cable Hip Adduction

The lying adduction exercise can be performed on the field. The only way to continue to train the adductors on the field is to do more repetitions, increasing local muscle

endurance more than pure strength of the adductors. (We have even seen teams bring ankle weights to the field.) To greatly increase adductor strength, go to the weight room and use the cable machine to add resistance.

FIRE HYDRANT



Execution

1. Kneel on all fours on the ground.
2. Raise one flexed leg to the side until the leg is parallel to the ground. Pause briefly, and then lower the leg back to the starting position.
3. Switch legs, raising the other leg to the side until it is parallel to the ground. Alternate legs.

Muscles Involved

Primary: Gluteals (gluteus maximus, medius, and minimus), tensor fasciae latae

Secondary: Vastus lateralis, hamstrings (biceps femoris, semitendinosus, semimembranosus), abdominal core for posture and balance

SOCCER FOCUS

The hip is a curious joint when it comes to sports injuries. Not many players remember a specific inciting event, one they can pinpoint as causing the hip injury. But a substantial number of retired players have undergone total hip replacements at an age most would consider too young for new hips. It seems the lack of control of the femur within the pelvis causes minor defects in the socket portion of the joint that, over time, will wear down and eventually need to be replaced. Because strength is important in joint stability, look for exercises such as this one that can be used to improve the

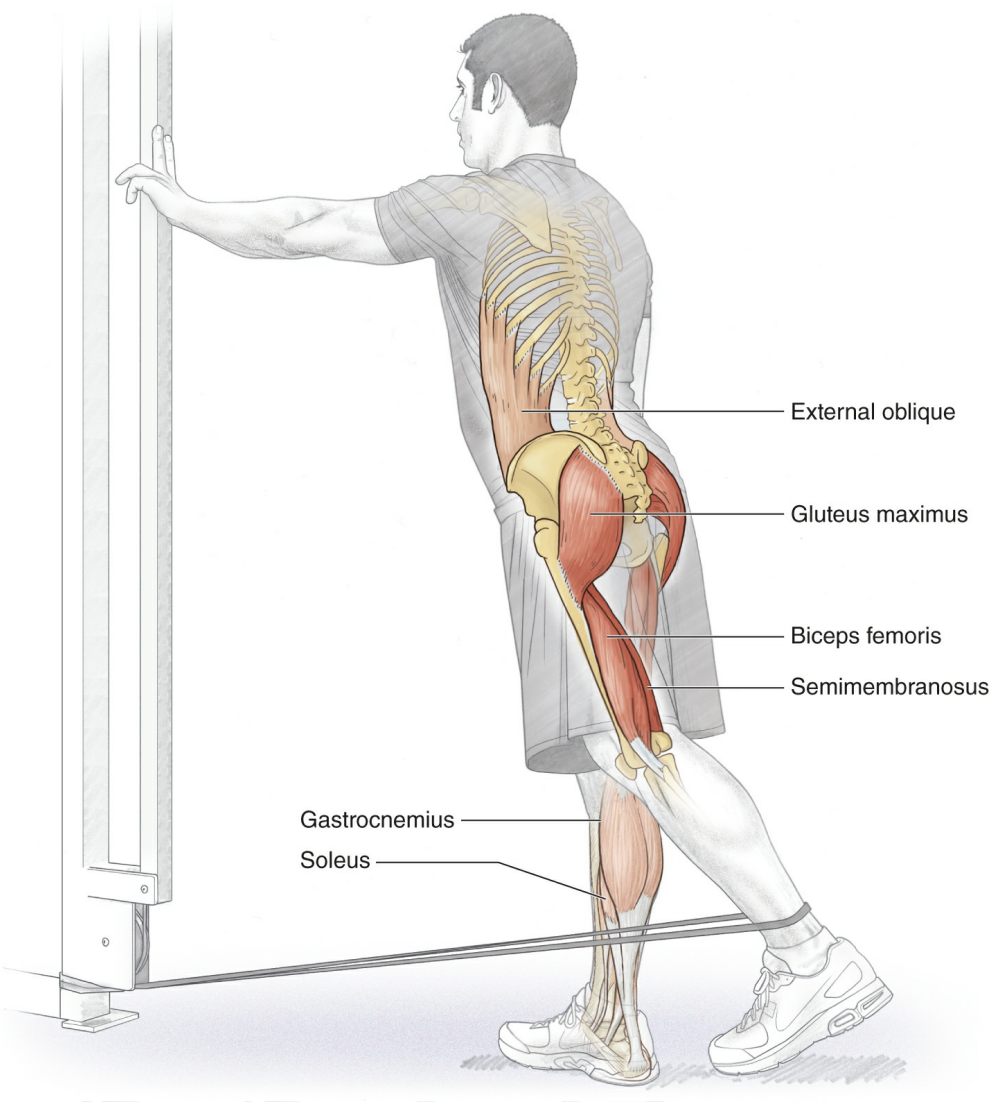
muscles around the hip joint. This exercise works the various muscles involved in hip abduction. At the same time, when done properly by taking the thigh through a wide range of motion, the fire hydrant is also a great dynamic stretch of the adductors. It should be easy to see where this exercise gets its name.

VARIATION

Side-Lying Abduction

Lie on your side, preferably on a mat, with the legs extended. Hold the feet together, with the lower arm under the head for support. Rest the upper arm on the hip. Hips and shoulders should be vertically aligned to the floor; the head should be aligned with the spine. Gently lift the upper leg off the lower leg, keeping the knee extended and the foot in a neutral position. Keep the hips vertical to the floor, with the knee of the raised leg pointing forward. Raise to the point at which the hips begin to tilt up or you feel tension in your lower back or obliques. Slowly return the raised leg to the starting position in a controlled manner. Roll over, and then repeat with the opposite leg.

CABLE KICKBACK



Execution

1. Stand and face a cable machine or other stable object. Loop a rope, strap, or resistance band around one ankle.
2. Keeping the leg as straight as possible, extend the leg at the hip (move it backward) as far as possible. Pause briefly, and then return to the starting position. If necessary, hold on to the machine for balance.
3. Switch legs, and then repeat with the other leg.

Muscles Involved

Primary: Gluteus maximus, hamstrings (biceps femoris, semitendinosus,

semimembranosus)

Secondary: Abdominal core for posture, muscles of the balancing leg (such as quadriceps, gastrocnemius, soleus, peroneus longus, peroneus brevis, and peroneus tertius)

SOCCER FOCUS

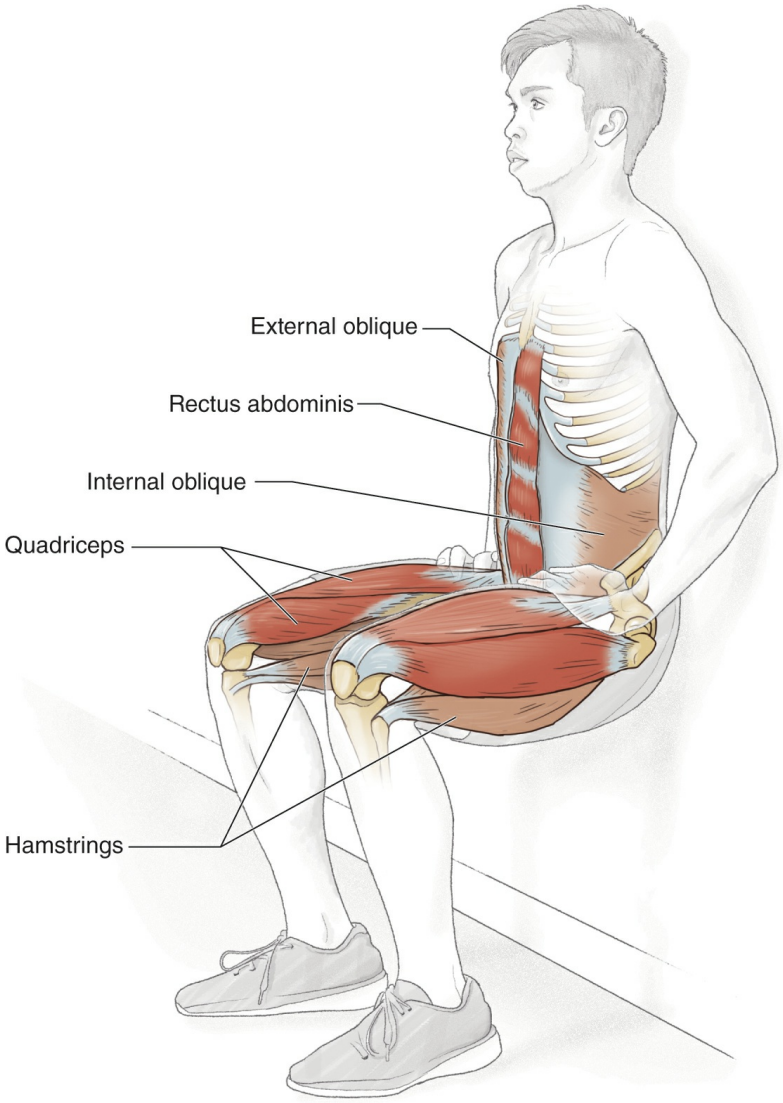
Any movement that results in a ball being thrown or kicked requires some sort of a windup. The longer the windup, the farther or faster the ball will go. The anatomy of the hip joint as well as a specific ligament of the hip (the iliofemoral, or Y ligament) limits the backswing of a kick. Kicking is not just about the forward swing of the kicking leg. You can increase your power by increasing the strength of the hip extensors, using as much of the motion available for the windup as possible.

VARIATION

Stability Ball Hip Extension

A hip extension variation can be performed with a stability ball. Lie on the floor with one foot high up on the ball. Cross the other leg over the leg on the ball. Push against the floor and ball to extend the hip. The stability ball increases the difficulty by adding a balance component to the task.

ISOMETRIC WALL SIT



Execution

1. Begin with the back against a wall, feet shoulder-width apart and approximately two feet from the wall.
2. Engage the abdominal muscles and slowly slide the back down the wall until the thighs are parallel to the ground.
3. Adjust the feet so the knees are directly above the ankles.
4. Keep the back flat against the wall.
5. Hold the position for 20 to 60 seconds.
6. Slide slowly back up the wall to a standing position.

Muscles Involved

Primary: Quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), abdominals

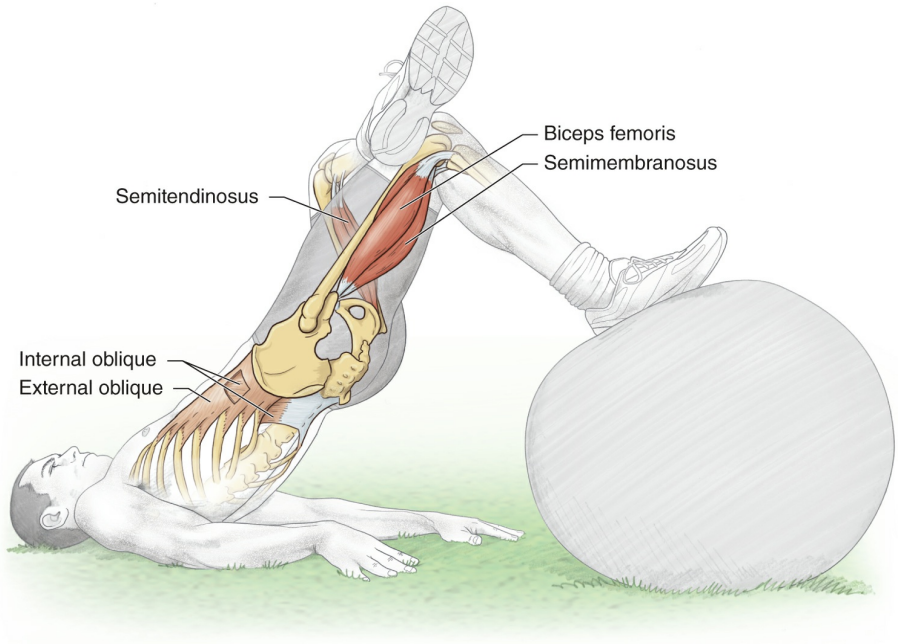
Secondary: Obliques, hamstrings (biceps femoris, semitendinosus, semimembranosus)

SOCCER FOCUS

The quadriceps femoris muscles (made up of the vastus lateralis, vastus medialis, vastus intermedius, and the rectus femoris) are responsible for flexing the hip and extending the knee, therefore being used to strike the ball. From a technical standpoint, "striking" the ball can take many different forms—passing with the inside of the foot, driving the ball with the laces, chipping, lofting, bending the ball, shooting with power, shooting primarily for placement or accuracy, backheeling, and volleying (not an all-inclusive list). Several of these techniques require the generation of power and

ultimately the ability to reproduce that power frequently over the course of a game. All involve knee extension and hip flexion. This exercise strengthens the quadriceps, reducing the risk of injury and improving the ability of the muscle to generate power. As it is a static exercise, it should be combined with quadriceps strengthening exercises that combine strength and speed, ultimately improving the ability of the muscles to produce power (speed times strength).

STABILITY BALL LEG CURL



Execution

1. Lie on the ground, and place the heel of one foot high up on the stability ball. Cross the other leg over the knee. Raise your trunk off the ground, and put the weight on your shoulders.
2. Flex the knee, and roll the ball from under the heel to the sole of the foot as far as possible. Pause, and then slowly return to the starting position. Switch legs, and then repeat the exercise.

Muscles Involved

Primary: Hamstrings (biceps femoris, semitendinosus, semimembranosus)

Secondary: Abdominal core for balance

SOCCER FOCUS

The Soccer Focus section for the partner prone leg curl (page 123) covers the importance of strengthening the hamstrings to protect them from a muscle strain injury. The hamstrings also figure into anterior cruciate ligament tears. Remember, the ACL begins on the front portion of the flat surface of the tibia (leg bone) and crosses back to the lateral surface within a big notch at the end of the femur (thigh bone), so it goes in sort of a diagonal direction. Think about its configuration. If you twist your right tibia in a clockwise direction, the ligament gets looser, but if you twist the right tibia in a

counterclockwise direction, the ligament tightens. That's not all. If the tibia slides backward under the femur, the ligament loosens, but if the tibia slides forward, the ligament tightens. The tibia slides forward every time you land from a jump or plant a foot to make a cut. Imagine if the hamstrings contracted just as the tibia started to slide forward. What would happen? The tibia wouldn't slide forward as far, and you would have protected the ACL from being stretched through the contraction of the strong hamstrings and by calling on the hamstrings at the right time after learning how to land and cut. Strong hamstrings are very important in team sports such as soccer.

7
SHOULDERS AND NECK

In a sport such as soccer, the attention is on the lower extremities, the legs. Soccer players move and perform the bulk of their skills with the ball using the lower extremities. Players who decide to add resistance training to their programs often focus on the legs alone, but this is shortsighted. Every section of the body above the legs is recruited during play to prevent injuries, maintain balance, increase speed, generate and transfer power, maintain space, perform throw-ins, and much more.

When choosing to supplement your ball training, realize that the entire body, not just the legs, needs to be addressed. Imbalances within and between the various regions of the body can derail performance and may even increase the risk of injury. An overall fitter player will be able to delay fatigue and go deeper into a match, increasing his chances of affecting the outcome of the match. The fitter player also is more resistant to injury; on teams that have minimal substitutes, keeping players healthy is a prime reason for supplemental training.

ANATOMY OF THE SHOULDER JOINT

A joint, or articulation, is where bones come together. The three main types of joints are immovable, slightly movable, and freely movable. Examples of immovable joints are the bones of the adult skull and the joints between the three bones that make up each side of the pelvis. Examples of slightly movable joints are seen where the ribs connect to the sternum. Freely movable joints are what most people think of when envisioning a joint —shoulder, elbow, knee, ankle, and others—and there are different types of freely movable joints. Two of the most common injuries sustained by soccer players damage the joint integrity of the ankle or the knee.

The typical freely movable joint is encased inside a sleeve of connective tissue called the synovial capsule. Thickenings of this capsule at specific locations form the ligaments. Ligaments connect bone to bone, and tendons connect muscle to bone. Most ligaments are extra-articular; that is, they are outside of the capsule that surrounds the two bones. The notable exceptions are the anterior and posterior cruciate ligaments, which are intra-articular and are found within the joint capsule of the knee. (Learn more about the knee in chapter 6.)

The upper arm and its connection to the central portion of the skeleton is called the axial skeleton, through what appears to be a very simple arrangement that has a complex overall function. The humerus, the upper arm bone, articulates with the glenoid, the mostly flat surface of the scapula that is made deeper by a cartilage cup called the glenoid labrum. The scapula rides on some deep muscles of the back and can slide and rotate a bit around the curved surface of the ribs. But its only connection to the axial skeleton is by way of the clavicle (collarbone) to the sternum (breastbone). There are three distinct joints: the sternoclavicular joint (clavicle to sternum), the acromioclavicular joint (clavicle to a specific location on the scapula, the point on the top of your shoulder), and the glenohumeral joint (the flat glenoid on the scapula to the rounded head of the humerus). You may hear of a scapulothoracic joint between the scapula and the ribs, although there is no direct bony articulation between the scapula and the ribs.

The ligaments of the sternoclavicular joint are quite strong, and this joint is not frequently injured in soccer. The acromioclavicular joint has a number of ligaments for both stability and mobility that can be injured during soccer play, mostly from a direct blow to the top of the shoulder (e.g., falling and landing on the tip of the shoulder). The glenohumeral joint is the most mobile joint in the body and is an amazing feat of biomechanical engineering. The joint capsule thickens into a number of distinct glenohumeral ligaments. This joint dislocates most often when the arm is outstretched and forced into another direction, usually backward, leading to the humerus dislocating

forward or anteriorly.

The body is divided into three planes. The frontal plane divides the body into front and back sections, the sagittal plane divides the body into right and left sections, and the transverse plane divides the body into upper and lower sections. All movements of the shoulder are described according to the plane in which the movement occurs. As the most mobile joint in the body, the shoulder moves in all three planes and has a number of distinct movements (see table 7.1).

TABLE 7.1 Shoulder Movements

Plane	Movement	Description
Frontal	Flexion	Arm raised in front of body
	Extension	Arm lowered in front of body, continuing beyond trunk
Sagittal	Abduction	Arm raised out to the side
	Adduction	Arm lowered back to the side
Transverse	Internal rotation	Humerus rotated toward the midline of the body; best visualized by flexing the elbow first
	External rotation	Humerus rotated away from the midline of the body; best visualized by flexing the elbow first
	Horizontal adduction	First the arm is abducted out to the side and then moved horizontally toward the midline
	Horizontal abduction	Arm is raised in front of body and then moved horizontally away from the midline
Multiplanar	Circumduction	Arm is held parallel to the floor and swung in a wide circle (incorporates all shoulder motions)

A shoulder dislocation occurs at the glenohumeral joint. A shoulder separation occurs at the acromioclavicular joint.

Mobility is a good thing, but it also increases the potential for injury. In soccer, collisions and falls cause most of the injuries to the upper extremity and shoulder girdle. A player with strong shoulder muscles will be able to react to and withstand impact to protect the shoulder.

SHOULDER MUSCLES

Most shoulder muscles attach to the scapula. A muscle has two attachments. In general, the origin is at the immobile end, while the insertion is at the movable end. In the

majority of situations, when a muscle is stimulated and contracts, it pulls the insertion toward the origin. Most muscles cross one joint, so the action is on that one joint; when a muscle crosses two joints, however, it can have an effect on both joints. When you can picture a muscle's origin and insertion, you can reason out its action.

Deltoid

The deltoid muscle group (figure 7.1) forms the cap over the shoulder joint. There are three distinct muscles: the anterior deltoid toward the front, the lateral deltoid in the middle, and the posterior deltoid toward the back. The anterior deltoid originates on the clavicle; the lateral deltoid originates on the acromion process of the scapula (that point on the top of your shoulder); and the posterior deltoid originates on the spine of the scapula, which is on the posterior surface of the scapula. These three muscles attach to a common tendon that inserts laterally (away from the midline) on the humerus.

Together, the deltoid muscle group abducts the arm. Individually, the anterior deltoid helps with shoulder flexion, and the posterior deltoid assists with shoulder extension. Put one hand over the deltoid, and perform each action. When you raise your arm as if you were answering a question (shoulder flexion), you should feel the anterior deltoid, but not the posterior deltoid, contract.

Rotator Cuff

The rotator cuff muscles are necessary for rotating the humerus in the glenoid, but they also are critical for shoulder stability. Unlike the hip, the shoulder does not have much in the way of structural constraints, so muscles need to provide the support. The rotator cuff (figure 7.2) is made up of four muscles. The subscapularis originates from the underside of the scapula, courses under the arm, and inserts anteriorly on the humerus. This is the main muscle for internal rotation of the humerus in the glenoid and is the muscle usually injured when a baseball pitcher tears his rotator cuff. The other three muscles of the rotator cuff are found mostly on the backside of the scapula: the supraspinatus (supra means it is above the spine of the scapula), infraspinatus (infra means it is below the spine of the scapula), and teres minor (teres means ropelike, and minor means it is the smaller of two ropelike muscles). Together, these three muscles perform external rotation of the humerus in the glenoid and assist in a number of other actions.

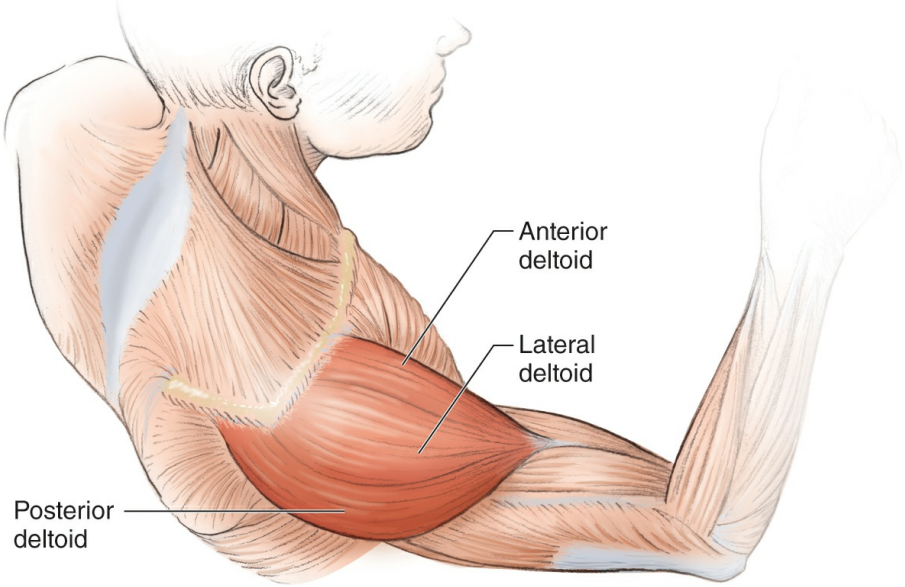


FIGURE 7.1 Deltoid muscle group.

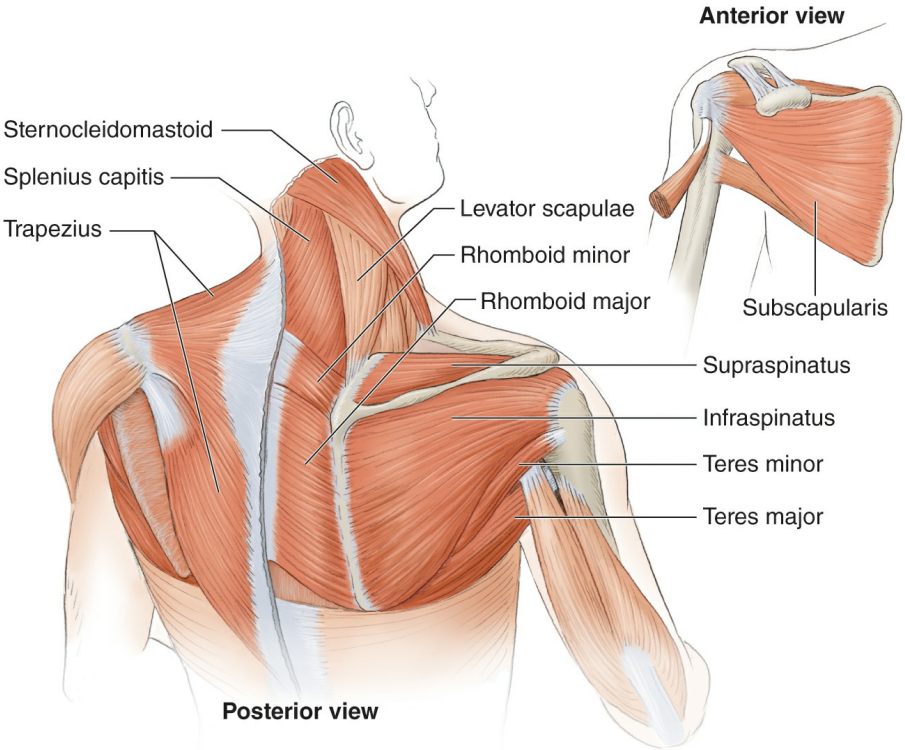


FIGURE 7.2 Muscles of the rotator cuff and neck.

Other Shoulder Muscles

Many other shoulder muscles help with shoulder mobility and stability:

• Rhomboid major and minor. These muscles originate mostly on the upper thoracic vertebrae (the vertebrae where the ribs attach) and run diagonally down, inserting on the

nearby border of the scapula. The rhomboids help adduct the scapula (pull the scapula to the vertebral column), elevate the scapula (shrug the shoulders), and rotate the glenoid inferiorly (down, away from the head) because of the diagonal direction of the muscle's fibers.

• Levator scapulae. This muscle originates on the upper cervical vertebrae (the neck) and inserts at the upper corner of the scapula. By its name, it elevates the scapula, but it also assists in rotating the glenoid inferiorly as well as in scapular adduction.

• Serratus anterior. This muscle can be difficult to visualize. It originates on the lateral surface (away from the midline) of a number of ribs and follows the ribs back toward the vertical border where the rhomboids insert. When activated, the serratus anterior pulls the scapula around the surface of the ribs, away from the vertebral column. Picture the movement of the scapula when someone performs a boxing jab. This muscle is addressed again in chapter 8.

• Trapezius. This broad, flat muscle of the upper back is just under the skin. It originates all along the cervical and thoracic vertebral column and inserts at the lateral end of the spine of the scapula to adduct the scapula. Functionally, the trapezius is three muscles: upper, middle, and lower. The upper trapezius elevates and rotates the glenoid down, while the lower trapezius rotates the glenoid up and stabilizes the scapula to prevent rotation.

NECK MUSCLES

The neck is very mobile, but it is also a fragile area of the body. Because of heading, the neck muscles figure prominently in soccer. The motions of the neck include flexion (moving the chin down) and extension (moving the chin up), lateral flexion (tilting the head toward either shoulder), and rotation (turning the head). These actions can be combined for circular motions.

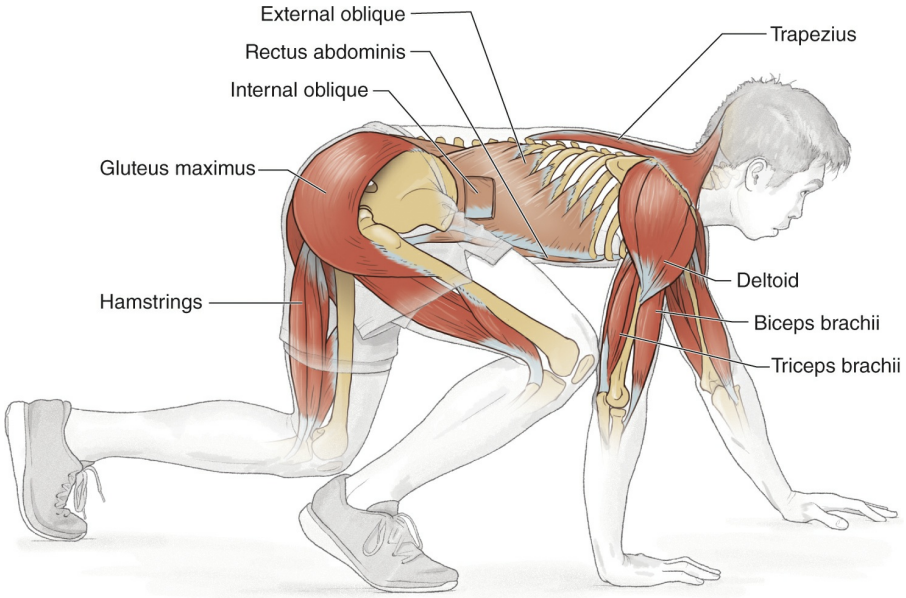
The primary neck flexor is the sternocleidomastoid, which originates on the clavicle and sternum, inserting on the mastoid of the skull (that knot behind your ear). The sternocleidomastoid also turns the head right or left; contracting the muscle on the right side turns the face to the left, and vice versa. The main neck extensor is the splenius capitis, which originates on a number of vertebrae and inserts at the base of the skull. The levator scapulae and upper trapezius assist in neck extension. Lateral flexion is accomplished by contracting these muscles on the right or left side to move the head in the appropriate direction.

In the skill of purposeful heading, the neck muscles have two functions. One function is to control the head movements needed to accurately redirect the path of the ball, the basic skill of heading. The other, more important function is to stabilize the head to the

trunk while heading. By doing so, the combined mass (head plus trunk and, in some instances, add in the rest of the body) meeting the ball far exceeds the mass of the arriving ball. This protects the head against the two prime culprits of concussive injury: linear and angular acceleration. If the neck muscles do not contract (like in an accidental head–ball impact when an unsuspecting player is struck), the impact from the velocity and mass of the ball can result in significant accelerations of the head and possible concussion. While it is known that neck muscles can be strengthened, a randomized trial of neck strengthening to prevent concussions has yet to be conducted.

SHOULDERS AND NECK

BEAR CRAWL



Execution

1. Crouch down with the arms extended and hands in front, shoulder-width apart. The feet should be behind, with the hips up in the air and the eyes looking forward.
2. Crawl forward, beginning with the left hand and right foot, following with the right hand and the left foot. Take four steps or more depending on space, and then turn around and bear crawl back.

Muscles Involved

Primary: Biceps, triceps, shoulders, trapezius, glutes, hamstrings (biceps femoris, semitendinosus, semimembranosus)

Secondary: Abdominals, obliques

SOCCER FOCUS

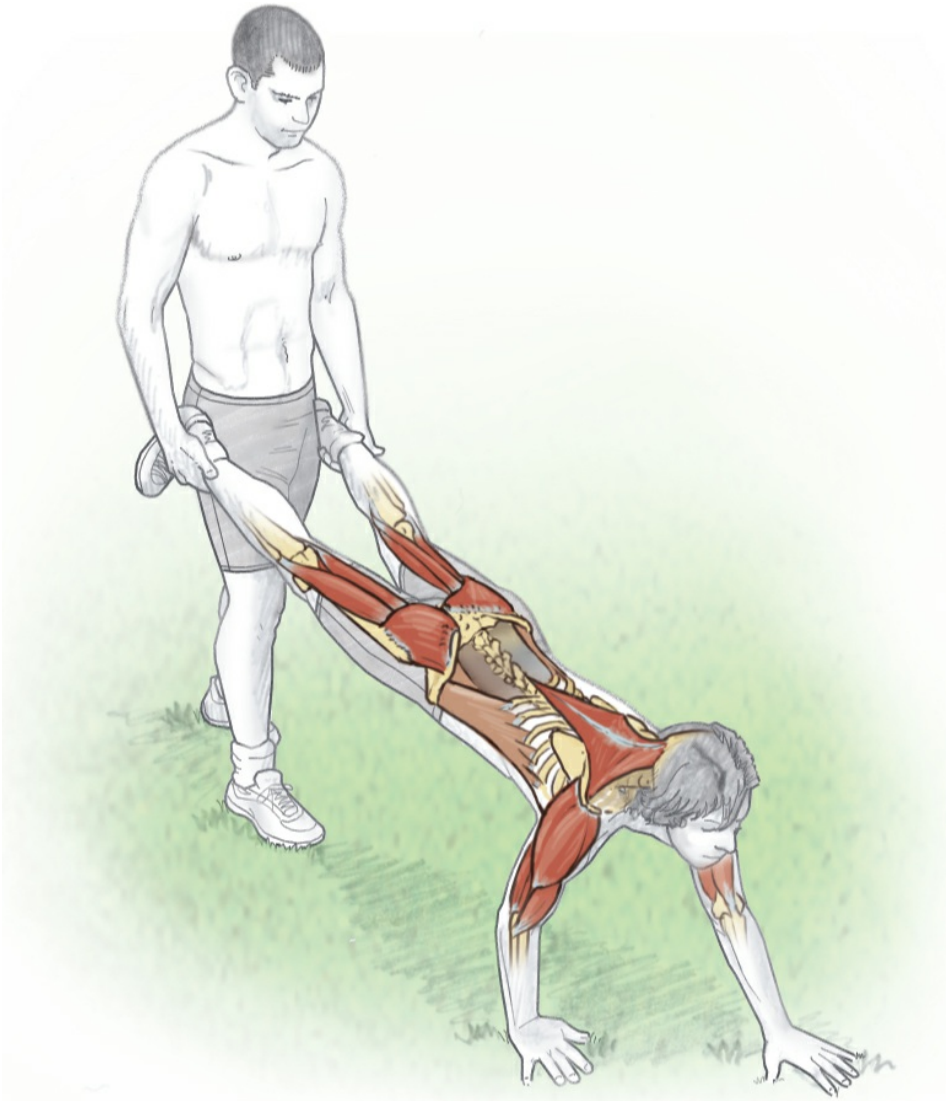
The bear crawl improves core strength and stability. However, given the nature of the exercise and the mobility involved, it requires an emphasis on stabilization of the core muscles during complex activity, which conceptually occurs in soccer. The body must be stabilized efficiently while receiving, passing, striking, dribbling the ball, holding off an opponent, and changing direction with or without contact and pressure from an

opponent and with or without the ball.

VARIATION

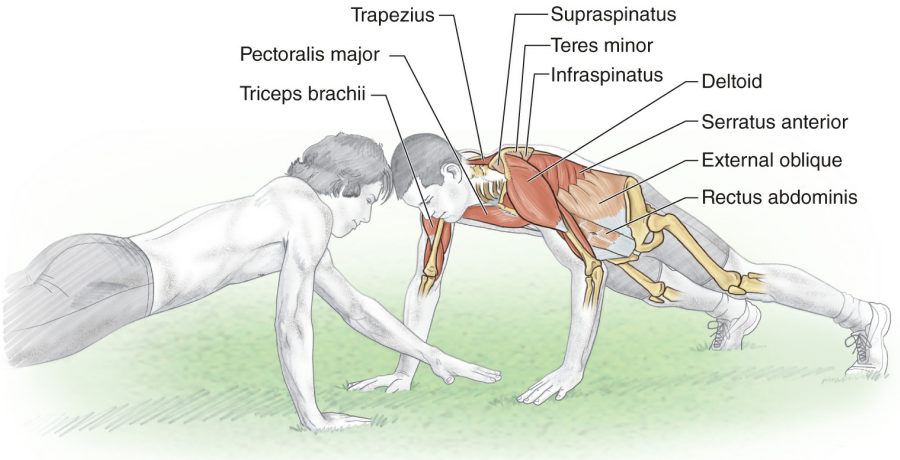
Wheelbarrow

The wheelbarrow exercise requires a partner. While performing the action, you provide the pace of movement, not your partner. You pull; your partner does not push. Keep your back straight. If you have trouble keeping your back straight, have your partner hold your legs farther up toward your thighs.



SAFETY TIP Try to keep your back straight when performing the wheelbarrow. It is best to perform both the bear crawl and wheelbarrow exercises on a safe surface such as grass or the floor. Avoid surfaces littered with debris that might cut or injure the hands.

ARM WRESTLING



Execution

1. You will need a partner for this exercise. You and your partner lie facedown on the ground with your heads nearly touching. Get in the up position for a traditional push-up.
2. On your coach's command, touch or gently slap your partner's hands while trying to avoid being touched or slapped by your partner. Although some movement may occur, try to stay in the same place.
3. The duration of this exercise will vary according to arm and abdominal strength. First perform the exercise for 15 seconds, and increase the time as fitness improves.

Muscles Involved

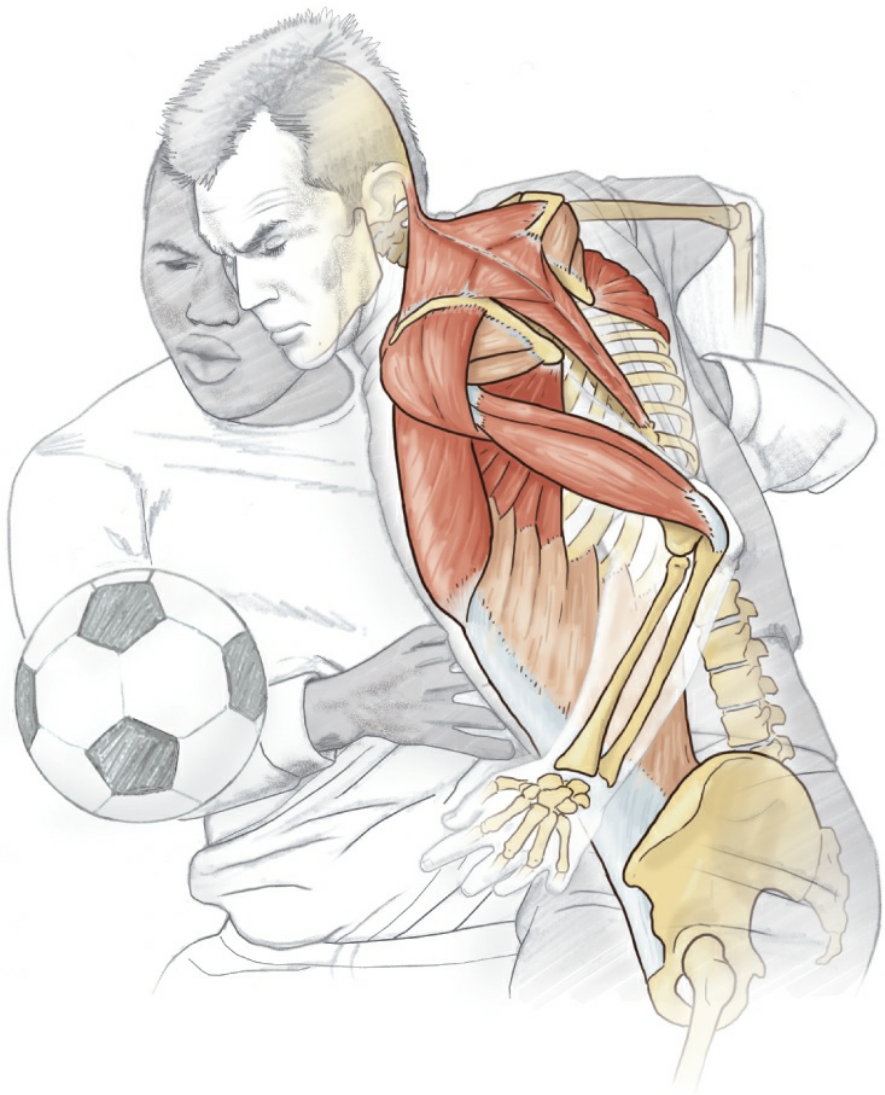
Primary: Triceps brachii, pectoralis major, deltoid, serratus anterior, trapezius

Secondary: Rotator cuff, spinal extensors, abdominal core

SOCCER FOCUS

This is a good exercise for working a wide range of muscles—the abdominals and back muscles for posture, the muscles that attach to the humerus to maintain the desired position and balance when one hand is off the ground, and the muscles that attach to the scapula to control the shoulders as you challenge each other. This exercise improves strength, balance, and local muscle endurance of the shoulders, arms, trunk, and back. Improvements in these aspects of muscle function will help you play deeper into the match and resist fatigue. Training is not just about the legs and the heart. Training for a whole-body activity such as soccer means addressing the whole body. Focusing only on

the legs is a common error when training.

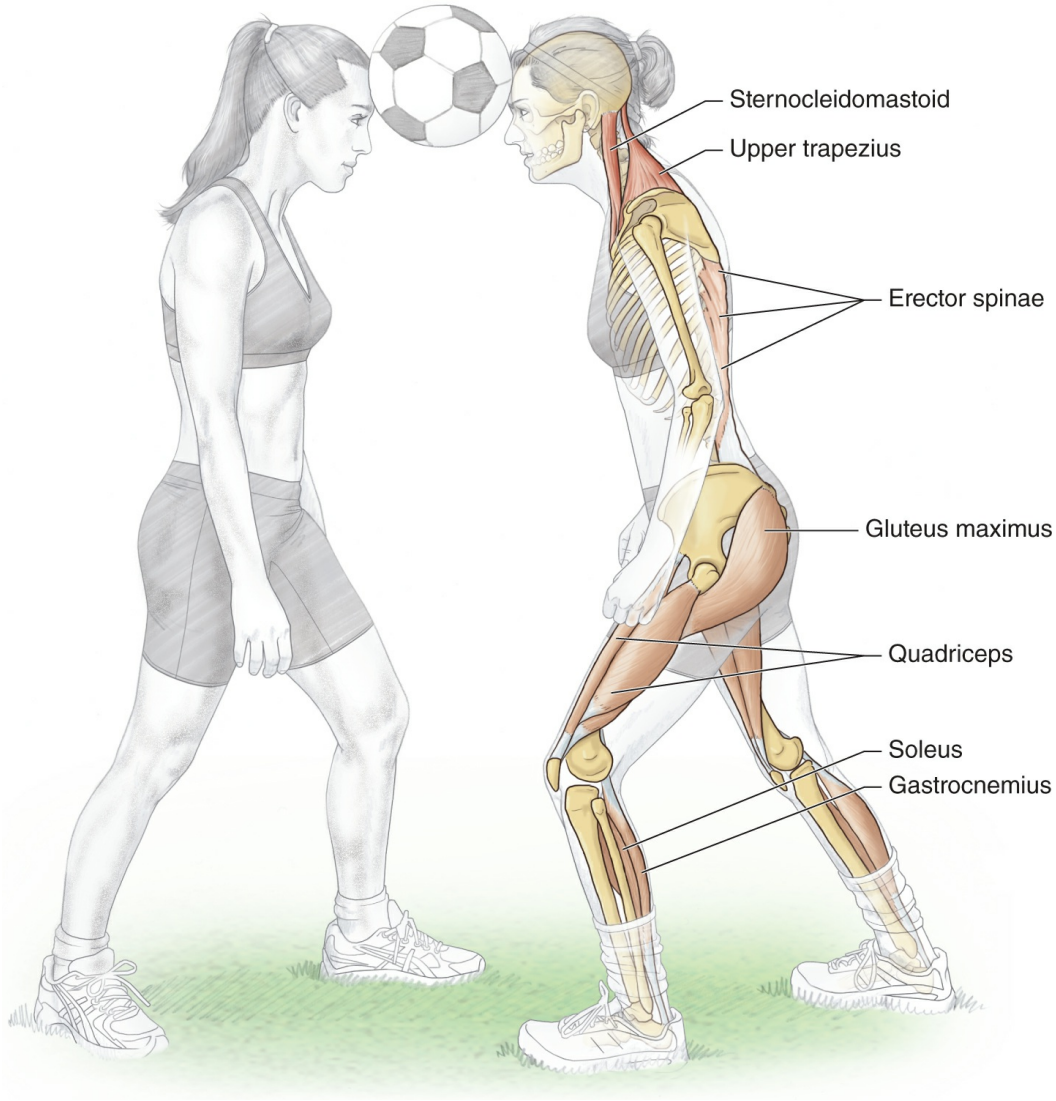


VARIATION

Arm Wrestling With Nondominant Arm

Grasp right hands with your partner while balancing on your left arms (or grasp left hands, if you both are left-handed). Your goal is to put your partner off balance while maintaining your own balance. Begin by simply grasping hands and holding this position. Once you both can maintain balance, add the combative element. It may take some practice to advance to using the nondominant arm, but that is a goal. Don't focus only on the dominant arm.

HEAD–BALL–HEAD ISOMETRICS



SAFETY TIP Trying to best your partner could make the ball pop out and cause you to bump heads. Be careful. This isn't about winning.

Execution

1. Find a partner of similar height and weight. Stand in a staggered stance facing each other. Pin the ball between your foreheads. You may find it helpful to hold each other's upper arms.
2. Push with your legs through the trunk, neck, and ball in an attempt to push your partner back as your partner attempts to push you back. Keep the ball pinned between your heads. This is not a competitive exercise. You are not trying to beat your partner. The idea is to squeeze the ball.

3. At first, perform a few repetitions of 10 seconds each. As you get stronger, increase the number and duration of repetitions.

Muscles Involved

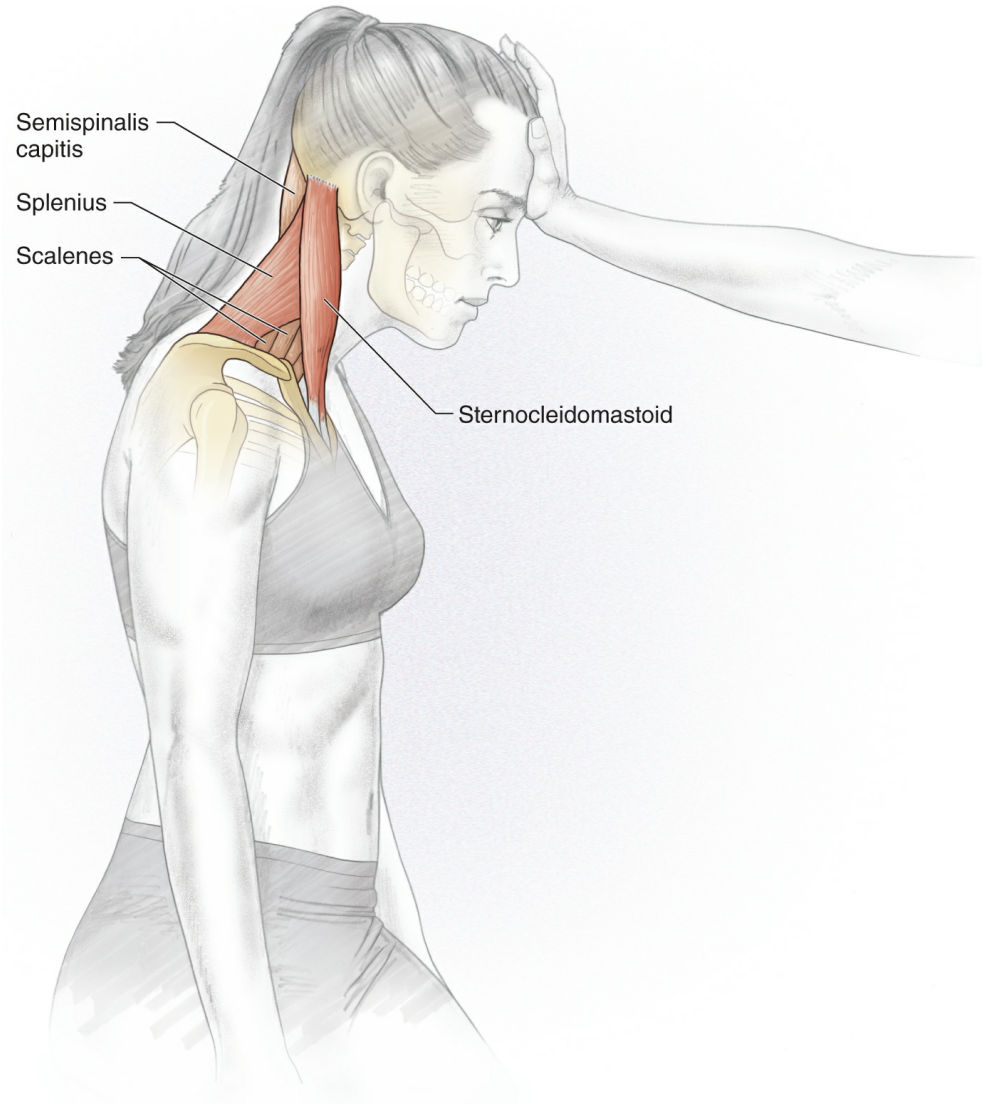
Primary: Sternocleidomastoid, upper trapezius

Secondary: Gastrocnemius, soleus, quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gluteus maximus, spinal extensors

SOCCER FOCUS

For very young players, heading the ball is more of a novelty that usually happens from a bounced or thrown ball. Most very young players are unable to consistently get the ball airborne or master the movements necessary to properly head the ball, making heading a relatively rare skill. As players age and grow, heading takes on an integral role in the game, making it necessary to devise ways to increase neck strength. Neck strength is important not only for heading but also to protect the head during collisions. The head is protected when the neck muscles contract to anchor the head to the much heavier torso. When the neck muscles are not strong enough, the head can jerk, causing whiplash or concussion even in the absence of a direct blow to the head.

PARTNER-ASSISTED NECK RESISTANCE



Execution

1. Find a partner of similar height and weight. Your partner will provide resistance to you as you perform the exercise. Have your partner stand in front of you with her arm extended and the palm of her hand on your forehead.
2. Flex your neck forward against the resistance provided by your partner. Your partner should provide resistance but still allow you to move through the full range of motion. The strength of this movement comes from the neck, not the trunk.
3. Repeat the exercise for all directions of movement. This can be repeated for neck

extension (partner's hand on the back of your head) as well as to both sides for lateral flexion (partner's hand on one side of the head and then the other).

Muscles Involved

Primary: Sternocleidomastoid (forward flexion, lateral flexion), splenius (extension), upper trapezius (backward extension, lateral flexion)

Secondary: Neck stabilizers (such as splenius, semispinalis capitis, and scalenes)

SOCCER FOCUS

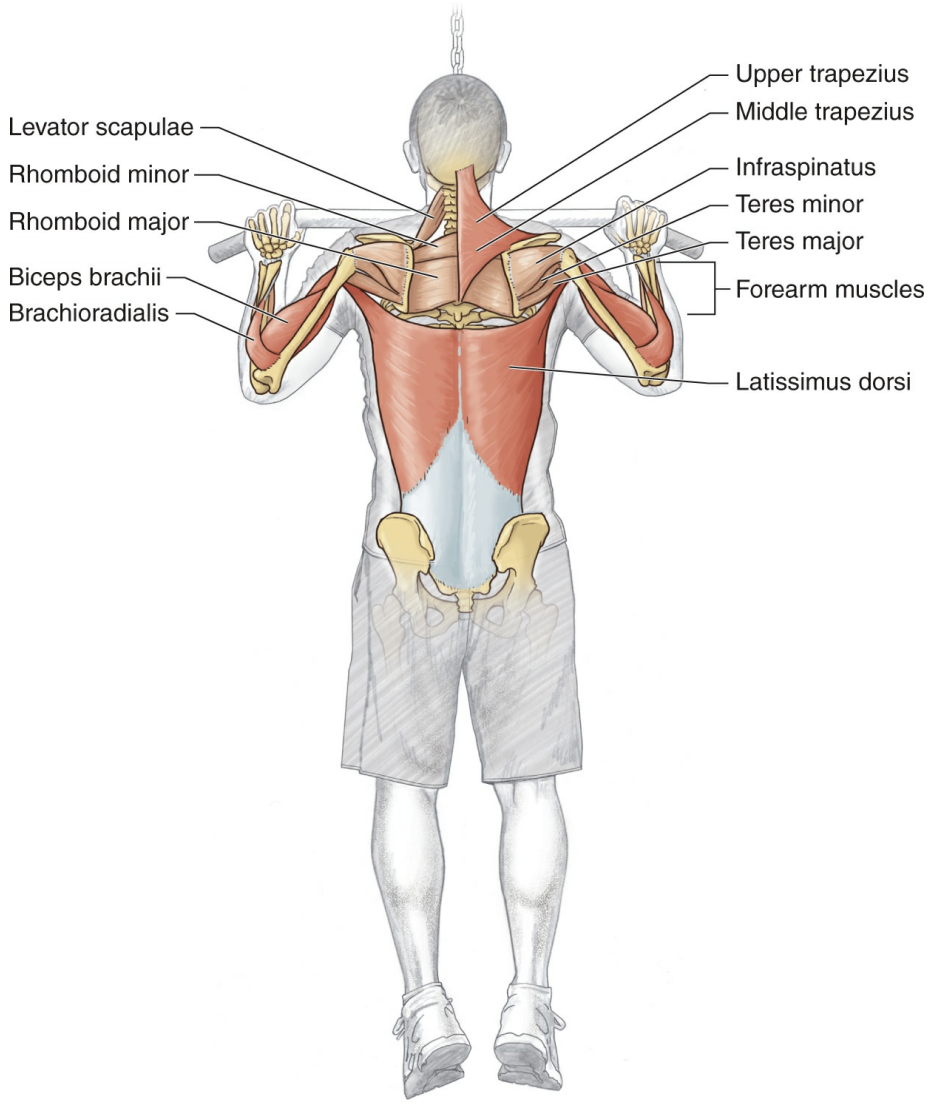
Heading is a complex skill that does not come naturally. Why would anyone voluntarily put his head in the path of a fast-moving object? Most teams have players who will do anything to get their heads on the ball and players who will go out of their way to avoid heading the ball. Consider the difficulty of heading. When the ball is in the air, the player must decide where on the field he needs to be to head the ball and what speed and direction are necessary to get there. When he heads the ball, will he be standing or running and, if running, in what direction? Will he have to jump? How high? Off one leg or two? Where will he redirect the ball? In the air, to the ground, to a teammate? If to a teammate, should he direct the ball to his teammate's feet, in the path he is running, or somewhere else? If the header is a shot on goal, the goalkeeper must be avoided, so where is the goalkeeper? Few of these decisions involve an opponent, and all decisions must be made well ahead of impact with the ball or the opponent. When done well, heading is an electrifying skill that can thrill player and spectator alike.

VARIATIONS

Options for the Partner-Assisted Neck Resistance

There are a number of variations to this exercise. One involves a towel. Your partner stands in front of you and drapes a towel around the back of your head, holding both ends. You perform neck extensions against the resistance of the towel. Your partner stands opposite the movement you perform instead of in the direction of your movement as in the main exercise. If you don't have a partner, another variation is to perform isometrics by squeezing the ball against a wall using the various neck motions.

PULL-UP



SAFETY TIP Avoid straining your shoulders by lowering your body slowly and by not hanging too long in the lower position.

Execution

1. With your hands a bit more than shoulder-width apart, grasp an overhead horizontal bar or handles on a pull-up rack, palms turned away from you.
2. Inhale, and draw the navel in. Pull the body weight up until the chin is over the bar. Exhale at the point of greatest difficulty.
3. Slowly return to the starting position, and then repeat the exercise. Do as many as you can.

Muscles Involved

Primary: Latissimus dorsi, upper and middle trapezius, biceps brachii, brachioradialis

Secondary: Levator scapulae, rhomboid major and minor, teres major and minor, infraspinatus, forearm muscles (mostly wrist and finger flexors including flexor carpi radialis and ulnaris, palmaris longus, flexor digitorum superficialis and profundus, and flexor pollicis longus) to grasp bar

SOCCER FOCUS

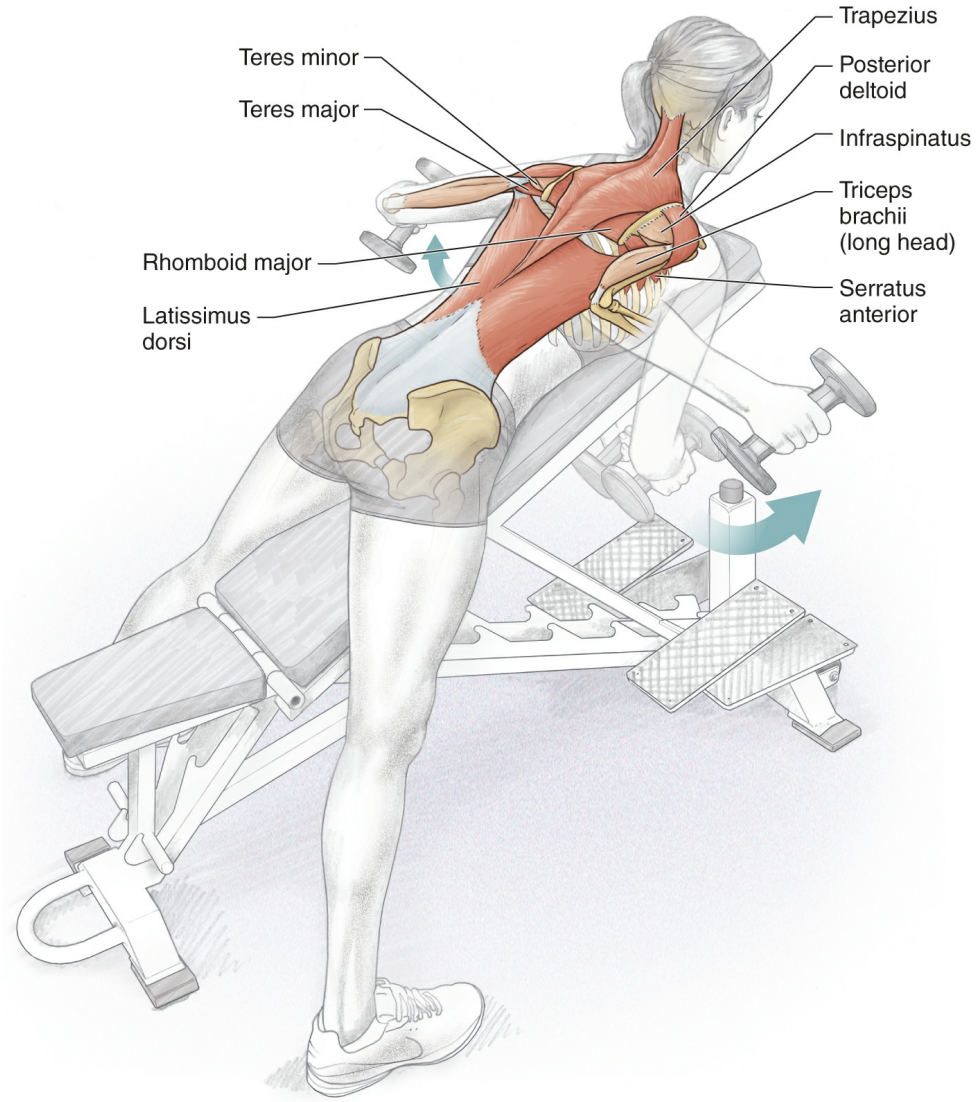
Many of the exercises in this book use body mass as the resistance. The classic pull-up is a multijoint exercise that uses body mass as resistance and is still hard to beat. For general, all-around work on the shoulders, you could do push-ups, pull-ups, and dips and expect to work almost every muscle with an attachment to the scapula and humerus. Although the pull-up increases strength, it also improves local muscle endurance because improvements are generally seen as increased repetitions. For greater strength, some athletes add resistance and intensity by hanging a free weight to a belt and wearing it around the waist.

VARIATION

Lat Pull-Down

Sit at a lat pull-down machine with the seat set for your body size. Adjust the seat so that the pad secures your thighs to keep you seated throughout the exercise. Grab the ends of the bar in an overhand grip. Leading with the elbows, perform elbow flexion to start pulling the bar below the level of your chin as you squeeze your shoulder blades together. Continue to pull the bar down. Slowly return the weight to the starting position.

PRONE DUMBBELL FLY



SAFETY TIP This exercise can be very difficult, so don't use too much resistance.

Execution

1. Lie prone on a padded bench. Your head or neck may hang over the end of the bench. Be sure the bench is well grounded and stable. Two dumbbells are on the floor on either side of the bench.
2. Grasp the weights. With elbows slightly flexed, inhale, and raise your arms to lift the weights, attempting to make the arms horizontal to the floor.
3. Slowly lower the weights as you exhale.

Muscles Involved

Primary: Trapezius, rhomboid major and minor, serratus anterior, posterior deltoid, teres major, latissimus dorsi

Secondary: Triceps brachii (long head), erector spinae, rotator cuff

SOCCER FOCUS

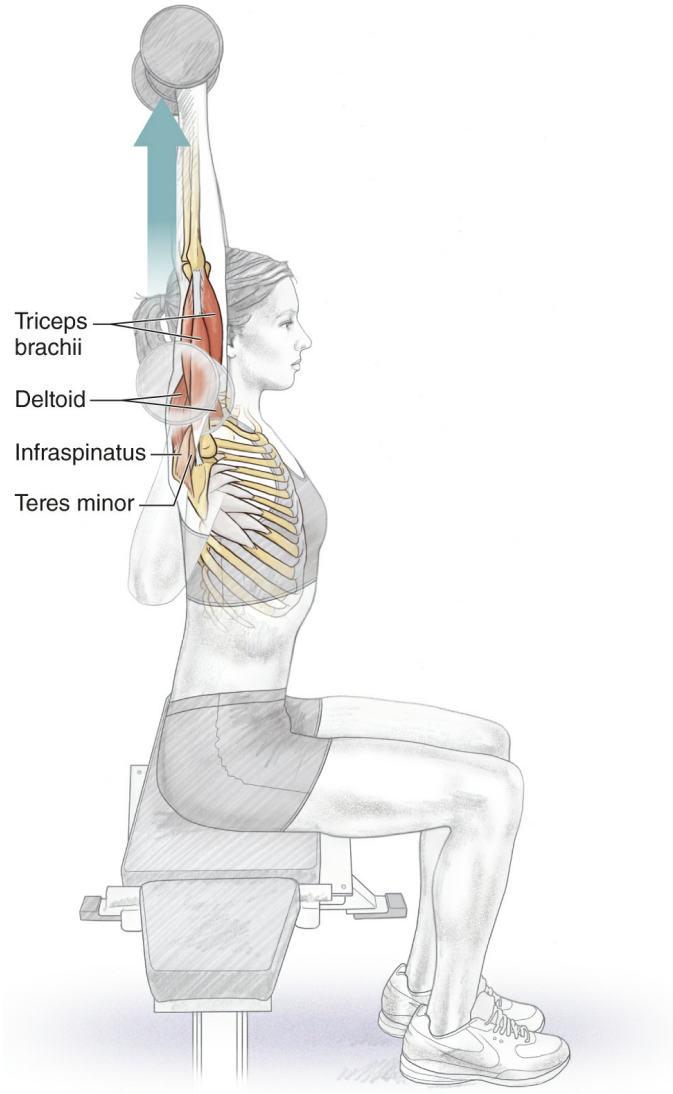
Watch what goes on in the penalty area of a professional match as players prepare to receive a corner kick. The pushing, shoving, grabbing, holding off, and fighting for position in the seconds just before the actual kick might surprise you. A corner kick is a scoring opportunity with enough probability for success that players will be very aggressive when establishing their positions to either deflect or defend the approaching ball. (Interestingly, the scoring probability for a corner kick is not as high as you might expect. Only about 2 percent of corner kicks result in goals. One coach told me his team went 1 for more than 100 in a single season.) A striker who is being counted on to gain an advantageous position for these opportunities will not be very effective if he isn't able to use his arms within the laws of the game to maintain his position in the crowded penalty area.

VARIATION

Bent-Over Row

A bent-over row is a good alternative to the prone dumbbell fly. Maintain good spinal posture when performing the bent-over row; don't round the back. This exercise mainly works the muscles that attach to the scapula—the muscles that help maintain good scapular motion, shoulder flexibility, and range of motion.

DUMBBELL SHOULDER PRESS



SAFETY TIP Begin with a low weight. You need some initial strength to be able to control the weight when it is overhead.

Execution

1. Sit on a weight bench with your back straight and your feet flat on the floor.
2. Hold a dumbbell in each hand using an overhand grip. Hold the weights at shoulder level.
3. Extend one arm vertically. Briefly hold at the top, and then slowly lower the weight to the shoulder. Exhale when raising the weight, and inhale when lowering the weight.
4. Repeat with the other arm, and do an equal number of repetitions for each arm.

Muscles Involved

Primary: Triceps brachii, deltoid

Secondary: Shoulder stabilizers (rhomboid major and minor, trapezius, levator scapulae, rotator cuff)

SOCCER FOCUS

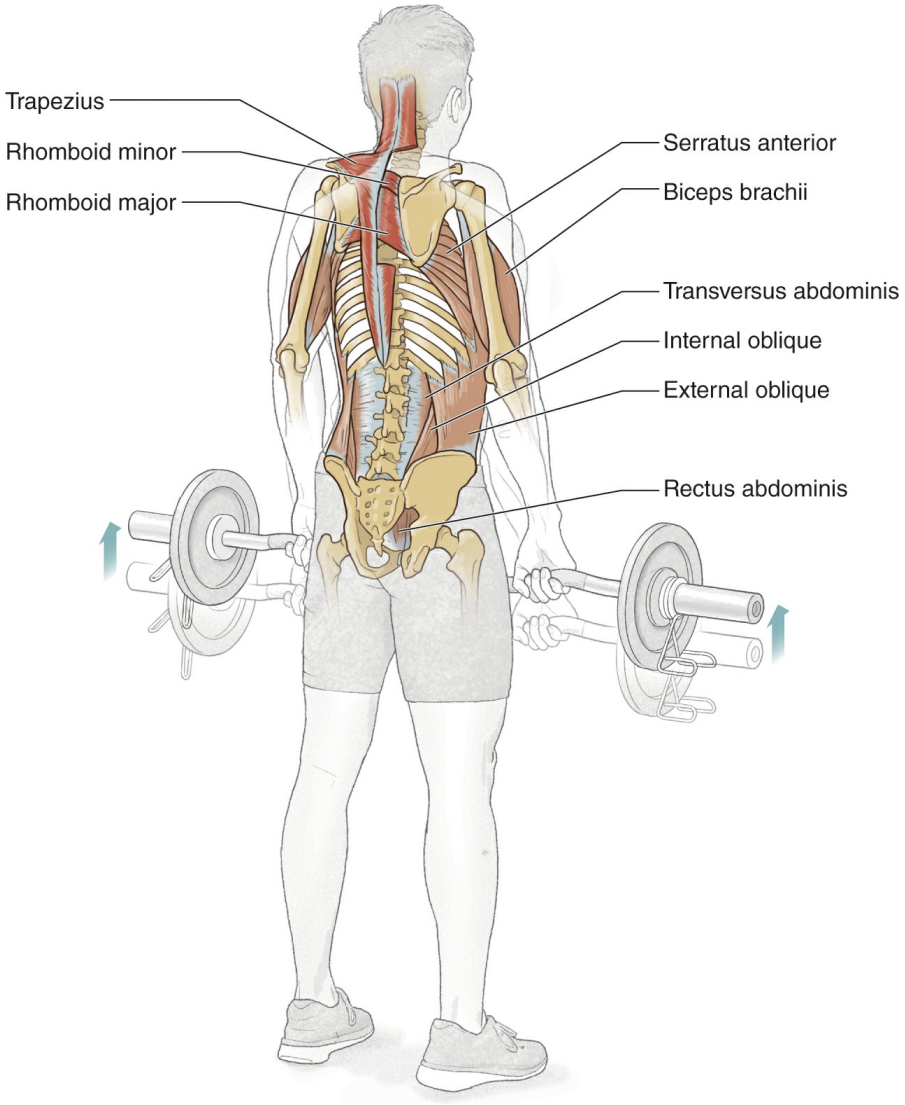
It is difficult to envision this movement as a primary action during soccer. A team picture might suggest that the goalkeeper likely has the most developed shoulders because the arms are integral to his game. That should not mean players other than goalkeepers should neglect this and similar exercises. A well-rounded supplemental strength training program will address all motions, including the shoulders, despite the minor role some motions might appear to play in any particular sport. Because of the speed of play and the amount of contact in the game, all players must be prepared for contact. As described, the dumbbell shoulder press is a unilateral exercise (one side at a time), but it can be made a bilateral exercise if you extend both arms in unison.

VARIATION

Machine Shoulder Press

As with all free weight exercises, the dumbbell shoulder press requires a certain degree of skill to perform correctly. One of the benefits of commercial machines is that you are fixed into a specific motion and the weights are supported. This provides a measure of safety for the exercise.

BARBELL SHRUG



Execution

1. Stand up straight behind the barbell, feet shoulder-width apart. Hold the barbell with both hands using a pronated grip. The hands can be slightly wider than shoulder-width.
2. Raise the shoulders as far as possible while exhaling, and hold the contraction for one second.
3. Slowly return to the starting position as you inhale.

Muscles Involved

Primary: Trapezius, rhomboids

Secondary: Biceps, flexors, serratus anterior, rectus abdominis, transversus abdominis, obliques

SOCCER FOCUS

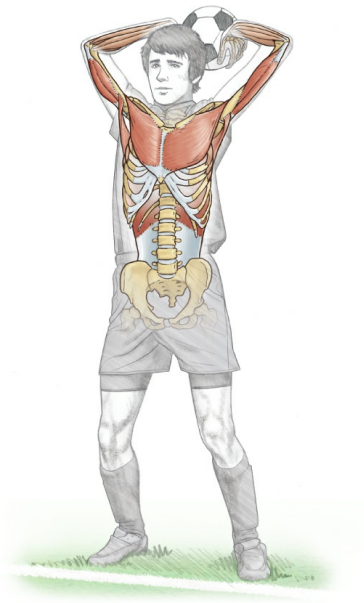
The barbell shrug is an effective exercise for strengthening the trapezius, the muscles running along the spine. The trapezius is largely responsible for controlling the movement of the head, neck, and shoulders and also the twisting movements of the arms. From a technical standpoint, heading can take many forms. For example, defensive headers to clear require power, height, and distance. Attacking headers require accuracy and direction, along with power, to beat the goalkeeper. Cushioned headers require the absorption of power, while flicked headers require changing the direction of the ball to assist a teammate. The arms are used frequently during the game. Aside from the obvious taking of throw-ins, arms are used for balance, protection, strength, acceleration, and change of direction. All these soccer-specific techniques and actions can be improved through the strengthening and increased flexibility of the trapezius.

VARIATION

Dumbbell Shrug

Instead of a barbell, hold two appropriately weighted dumbbells, one in each hand, with fingers parallel to the outer thigh. The same technique is then used.

8
CHEST



Soccer players might be hesitant to enter a strength training program for any number of reasons—lack of understanding, tradition, concern that bulking up might have a negative impact on play, and so on. One reason might be simply not having access to the equipment. Part of the purpose of this book is to show exercises that can be done either on the field or in the weight room. A player who does attempt some strength training might focus only on the legs, which could lead to imbalances throughout the body, increasing the risk of injury. Players and coaches must realize that a strength training program is for the entire body, not just the legs. All regions of the body, including the chest, must be addressed.

Many athletes think of the bench press when they think about developing the chest. Although the pectoralis major is the largest and most obvious chest muscle, others also play a role in how the shoulder girdle and upper extremities operate.

BONES, LIGAMENTS, AND JOINTS OF

THE CHEST

In the torso, there are 10 pairs of ribs that attach in the back to the vertebral column and in the front to the sternum, with 2 pairs of ribs that attach in the back but not to the sternum. Ribs 1, 11, and 12 have a 1:1 attachment with their corresponding vertebrae, while ribs 2 through 10 attach between two vertebrae. The bone of each rib ends at roughly nipple level and is then connected to the sternum by the costal cartilage (the Latin costa means rib) to form a cartilaginous joint that has only slight mobility. Ribs 1 through 7 are called true ribs because each attaches directly to the sternum through the costal cartilage. Ribs 8 through 10 are called false ribs because their cartilage attaches to the cartilage of the rib above before eventually attaching to the sternum. The small ribs 11 and 12 are called floating ribs because they have no sternal attachment. Between each pair of ribs is a pair of small muscles called the intercostals that aid in breathing. The floor of the rib cage is made up of the diaphragm. Movements of the ribs play a role in inhalation and exhalation, and their cage-like arrangement protects the heart, lungs, large blood vessels, nerves, and passages that conduct air to and from the lungs. The most common chest injury is a rib fracture from some form of ballistic impact, usually to the middle ribs.

The sternum, or breastbone, is made up of three bones that fuse during growth. If you slide a finger down your sternum you will feel a horizontal ridge one-quarter to one-third of the way down the bone. This is one of the fusion points. The third bone is a fragile extension called the xiphoid process off the bottom end of the sternum. It comes off the underside of the sternum, and the amount of covering tissue makes it difficult to feel.

The sternum is important because it is the only point of bony attachment connecting the central (axial) skeleton and the upper extremities. This sternoclavicular joint is quite strong because of the ligaments and cartilage from the clavicle to the sternum, a ligament connecting the two clavicles, and ligaments that connect the clavicle to the first rib. These all work together to maintain the integrity of this joint. Despite all these stabilizing tissues, there is some movement, so it has many of the features of the typical freely movable joint. This joint is rarely injured. The clavicle usually fractures before this joint dislocates, but injuries can happen. Think of the rodeo rider who falls from a height, cartwheels in the air, and lands on an outstretched arm.

The scapula attaches to the clavicle. Although the scapula glides over the curvature of the ribs, there are no bony articulations between the scapula and the ribs. Muscles that originate from the sternum and ribs, however, can also have their insertion on the scapula and exercise some control over the scapula's movements.

CHEST MUSCLES

For most everyone, chest muscles and the pectoralis major muscle are synonymous (the Latin pectus means chest). The pectoralis major muscle (figure 8.1) is the largest but not the only muscle of the chest. Because of its broad origination from the sternum and costal cartilages of ribs 2 through 6 (sternal head, or lower pectoralis) as well as the clavicle (clavicular head, or upper pectoralis), it is sometimes referred to as having two distinct origins. The muscle angles toward the shoulder, inserting on the chest side of the upper humerus. Remember that a muscle pulls the insertion toward the origin. The pectoralis major inserts on a highly mobile bone, so it has a number of primary and secondary actions on the humerus. Primary functions include horizontal adduction (arm parallel to the ground and out to the side moves across the chest), shoulder adduction, internal rotation of the humerus, and shoulder extension. You can feel the pectoralis major contract by placing a hand on the muscle and doing any of those actions. Through the connection of the humerus with the glenoid of the scapula, the pectoralis major also assists in some movements of the scapula.

Completely covered by the pectoralis major is the smaller pectoralis minor. (In anatomy, if there is a major, there probably is a minor.) The pectoralis minor originates on the outer surface of ribs 3 through 5 and, with the short head of the biceps, attaches on the scapula to abduct the scapula (move the scapula along the curve of the ribs, away from the midline), depress the scapula, and help rotate the glenoid down.

The final major muscle of the chest is the serratus anterior, so called because of its serrated appearance. (Think of the serrated edge of a steak knife.) The serratus anterior originates laterally on the surface of the upper eight or nine ribs and courses posteriorly, following the curve of the ribs to insert on the lower half of the border of the scapula that is adjacent to the vertebral column. The muscle's primary action is to abduct the scapula (move it away from the vertebral column), but it also assists in upward rotation of the glenoid (raising your arm as if in response to a question). The serratus anterior could be considered either a chest muscle because of its origin on the ribs or a scapular muscle because of its insertion on the scapula.

Think of all the muscles of the upper back and shoulder that are fully balanced by just these three muscles. Almost any exercise that addresses the humerus and scapula will require these muscles, while the opposing (antagonistic) muscles can often be singled out by specific exercises. Although most of the motions of the arms and shoulders in soccer are meant to widen your presence and make it harder for the opponent to get to the ball, it is wise to train the opposing chest muscles to maintain neuromuscular balance.

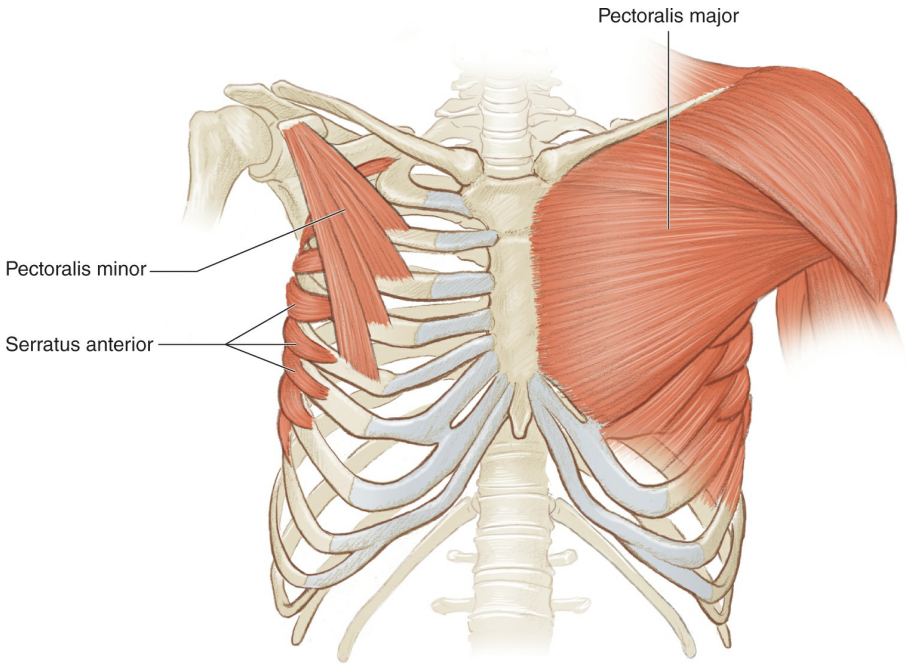
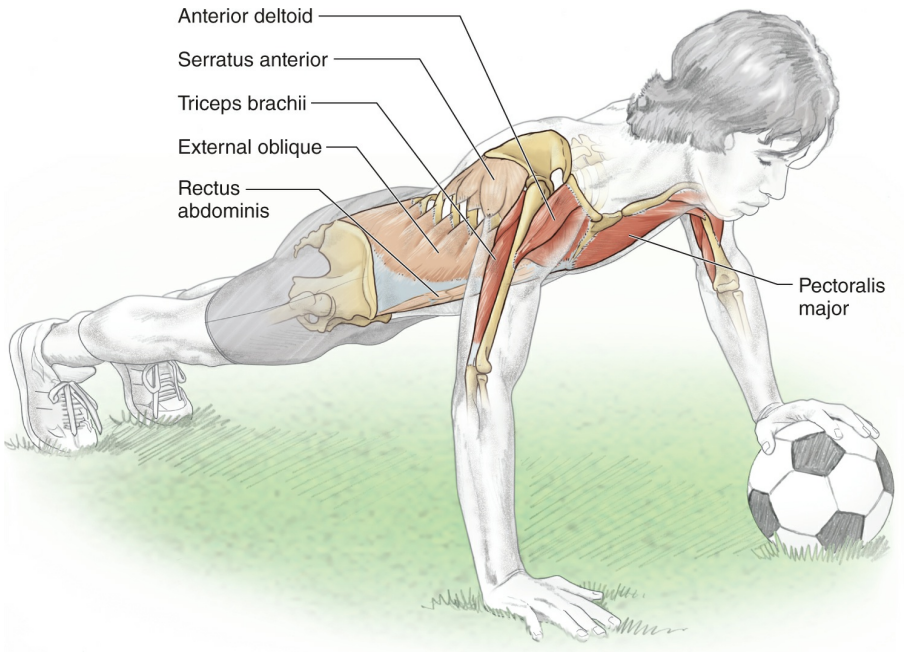


FIGURE 8.1 Muscles of the chest.

CHEST

SOCCER BALL PUSH-UP



Execution

1. Lie on the ground. Get into the up position of a traditional push-up, with your hands a bit wider than shoulder-width apart. Stay up on your toes with your feet together.
2. Carefully transfer one hand to the top of a soccer ball.
3. Perform a routine push-up.
4. After doing a few push-ups with one hand on the ball, stop, switch hands, and continue. Perform push-ups with the ball under the other hand.

Muscles Involved

Primary: Pectoralis major, triceps brachii, anterior deltoid

Secondary: Serratus anterior, abdominal core (external oblique, internal oblique, transversus abdominis, rectus abdominis) and spinal extensors (erector spinae, multifidus) for proper posture

SOCCER FOCUS

The modern game is far more physical than the game played by earlier generations. The speed and athleticism of the modern player means a defender can close down a striker

in the wink of an eye, and this means contact. The amount of pushing and shoving in a crowded penalty area during a corner kick would probably surprise most nonplayers. It should be intuitive that the stronger player will be better suited to handle the contact of the game. Although much of the strength necessary is initiated from the legs, the chain of actions continues up the trunk to the rest of the body. In this exercise, the height added by the ball means the body can be lowered farther than when both hands are on the ground. In addition, some reactive balance is needed because the ball can move.

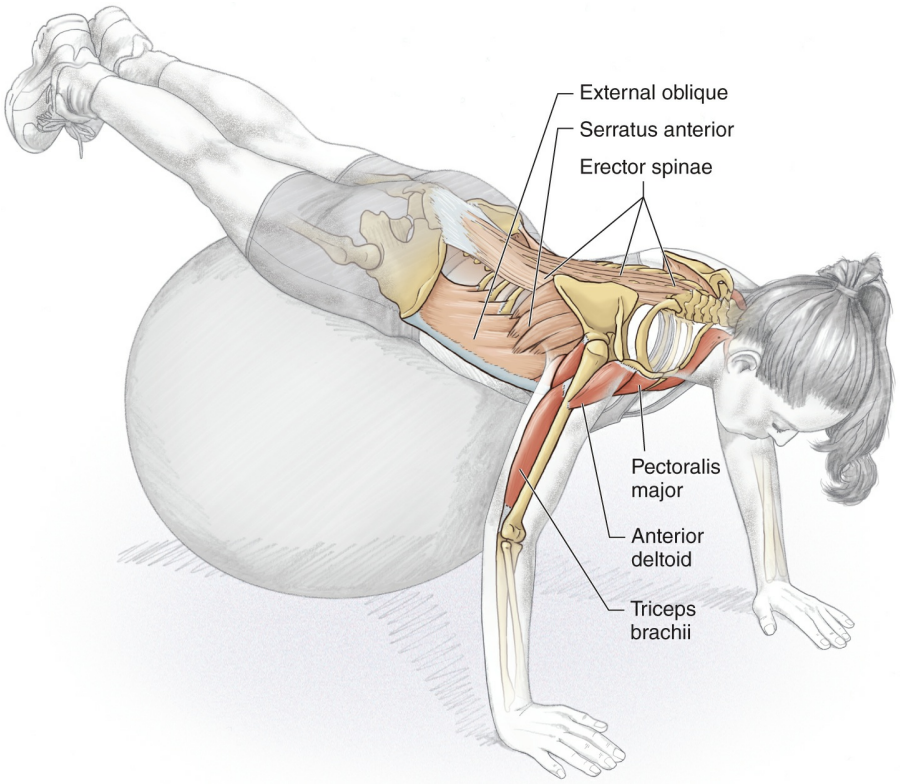
VARIATION

Soccer Ball Push-Up With Two Balls

You can improve your skill with push-ups by doing more repetitions. Some players even devise a safe way to add weight on their backs for more resistance. Make the exercise more difficult by going lower. Place soccer balls under both hands to be able to lower the body farther to improve strength. The balance required when using two balls is considerable.

SAFETY TIP Begin with regular push-ups, and improve your strength before attempting these. Raising one or both hands during a push-up means you can go lower. The lower you go into the push-up, the greater the stress on the shoulders. Be sure to listen to your body. Because of the balance required, you may want to keep your knees on the ground until you have more strength and confidence.

STABILITY BALL PUSH-UP



Execution

1. Lie facedown on a stability ball. Lean forward, placing your hands on the floor.
2. Walk your hands forward until the ball is under your trunk, thighs, or feet. The exercise is more challenging the farther the ball is from your hands.
3. Get into the up push-up position with your hands on the floor, and perform routine push-ups.

Muscles Involved

Primary: Pectoralis major (especially clavicular portion), triceps brachii, anterior deltoid

Secondary: Serratus anterior, abdominal core and spinal extensors for proper posture

SOCCER FOCUS

Strength and conditioning coaches have an arsenal of schemes to ensure that virtually every portion of any muscle can be exercised. A standard method is to change the alignment of the body in relation to the direction the resistance is being moved. In this

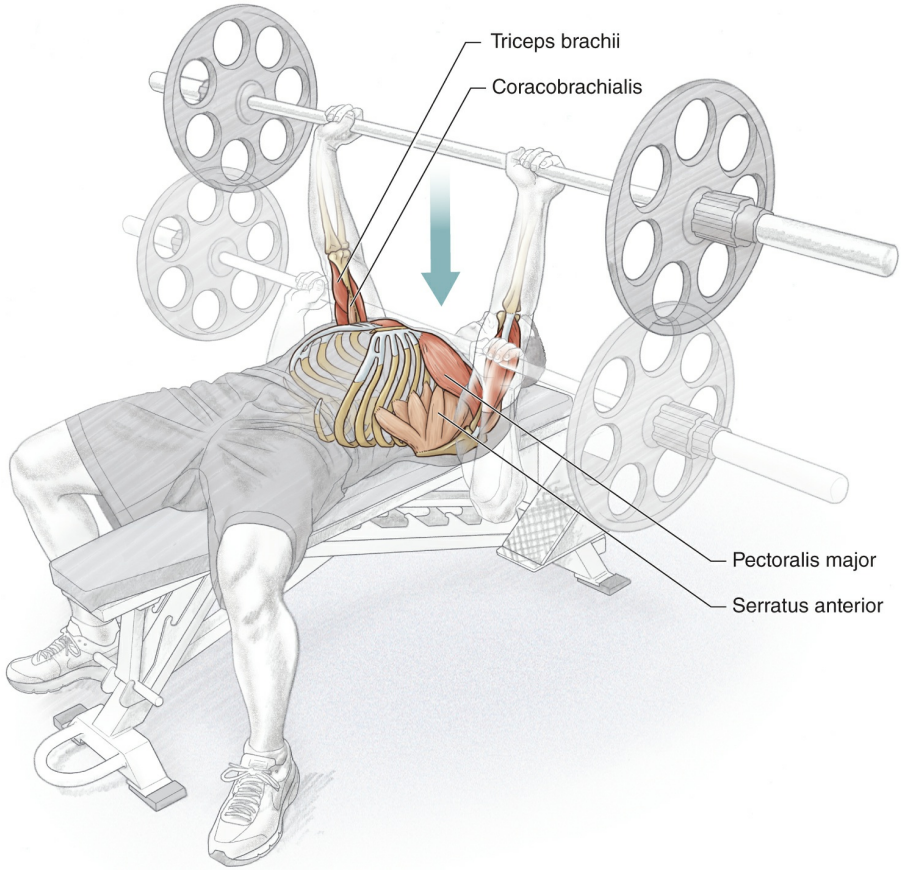
case, the athlete tilts the body in a different way. Raising the legs effectively changes the way the pectoralis major muscle is used. In a routine push-up, the lower two-thirds to three-quarters of the muscle is addressed. Raising the legs brings the remaining upper portion of the pectoralis major muscle into the exercise.

VARIATIONS

Multiple Options

This simple exercise has numerous variations. Using the stability ball, you can do a routine push-up with the feet on the floor and the hands squeezing the top and side of the ball. Or keep the hands on the ball, and prop your feet on a bench of the same height as the stability ball. Or leave the feet on the floor, and do push-ups with a stability ball for each hand. Also try this with the ball-height bench. Want a real challenge? Do push-ups with your feet on one ball and your hands on another. Or forget the balls altogether; keep the bench and do push-ups, placing the feet on the bench and the hands on the floor.

BENCH PRESS



SAFETY TIP Use an attentive spotter during this exercise for safety. Lock your thumbs around the bar. If you don't and lose control of the bar, the weight could slip out of your hand.

Execution

1. Lie on your back on a weight bench of sufficient length to support the body from the buttocks to the shoulders, with your feet flat on the floor. The barbell is on a rack at about nipple level.
2. Grasp the bar using an overhand grip, with the arms about shoulder-width apart.
3. With the arms extended but not locked at the elbows, lift the bar off the rack, and stabilize the weight. There may be a little arching of the back at this point.
4. Lower the weight to the chest, pause briefly, and then extend the arms to lift the weight again. Keep the arms steady to support the weight, but do not lock the elbows. Inhale as you lower the bar, and exhale as you the press the bar up (blow the weight up).

Muscles Involved

Primary: Pectoralis major, triceps brachii, anterior deltoid

Secondary: Serratus anterior, coracobrachialis

SOCCER FOCUS

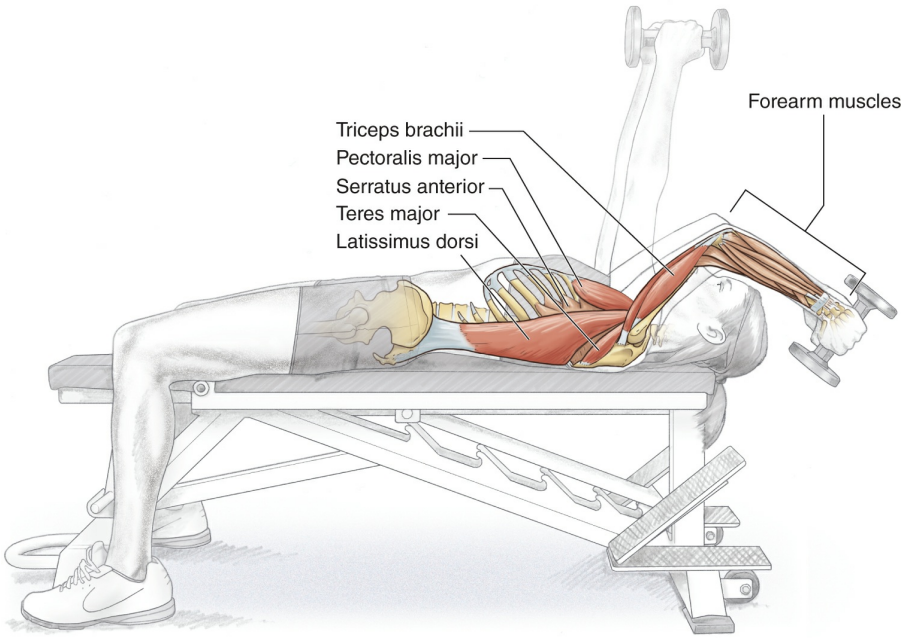
In a crowded penalty area, positioning for a corner is less about pulling the opponent toward you than it is pushing the opponent away to increase the space around you. Exercises such as push-ups and bench presses are very helpful. In essence, a bench press is an upside-down push-up and recruits many of the same muscles. The major difference is that the barbell bench press is overloaded because of the added weight on the bar. This type of incremental increase in resistance for a push-up is not as simple.

VARIATION

Incline Bench Press

Sit on the inclined bench with your feet flat on the floor. Arch the back, and retract the shoulder blades. Take a pronated grip covering the rings on the bar. Remove the bar from the rack, holding the weight above the chest with arms extended. Lower the bar to the sternum by flexing the elbows. The latissimus dorsi should stay tight, and elbows should be slightly drawn in. Touch the torso with the bar, and extend the elbows to return the bar to the starting position.

DUMBBELL PULLOVER



SAFETY TIP Have a partner put the dumbbell in your hands once you are lying on the bench.

Execution

1. Lie on your back on a weight bench of sufficient length to support your body from the buttocks to the shoulders, with your feet flat on the floor.
2. Wrap both hands around the inside weight of a dumbbell. Hold your arms extended and perpendicular to the floor.
3. Lower the dumbbell over your head and down, slightly bending the elbows.
4. After a slight pause, reverse the action, and return to the starting position.

Muscles Involved

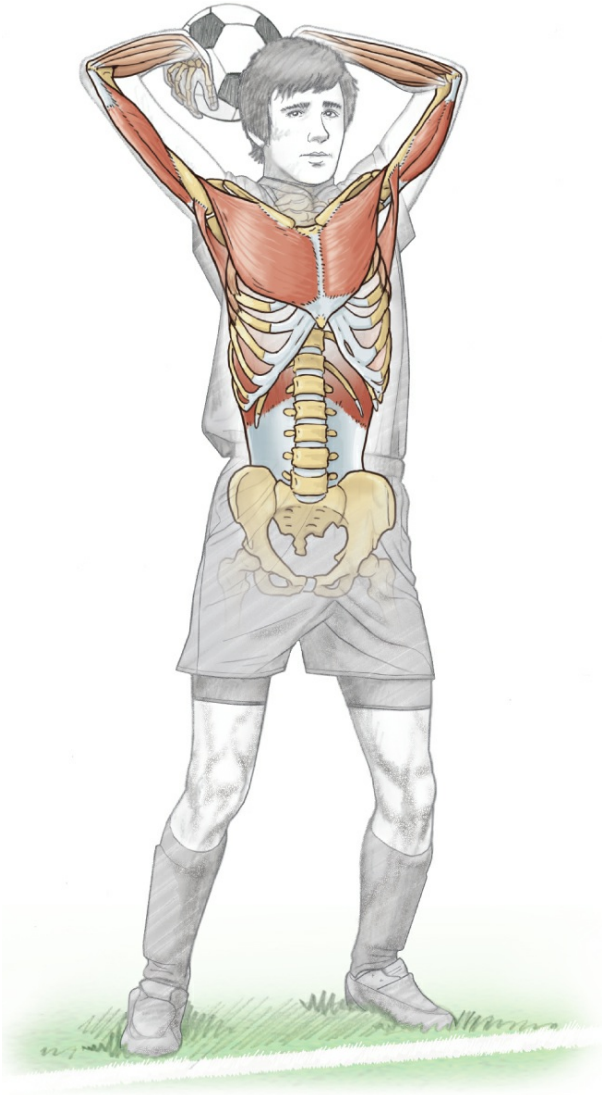
Primary: Latissimus dorsi, pectoralis major, triceps brachii, teres major

Secondary: Scapular stabilizers (rhomboid major and minor, trapezius, serratus anterior), forearm muscles (mostly wrist and finger flexors including flexor carpi radialis and ulnaris, palmaris longus, flexor digitorum superficialis and profundus, and flexor pollicis longus) to grasp dumbbell

SOCCER FOCUS

Over the years, soccer players have become bigger and more athletic. This increase in size has changed the game on a number of fronts. For example, the modern goalkeeper

can routinely punt a ball to the other goalkeeper on one bounce, and a 70-yard (64 m) goal kick by a professional male player is common. Another aspect that has changed is the throw-in. In earlier generations, a defender would try to send the ball over the touchline (sideline) rather than give up a corner because a throw-in to the face of the goal was very unusual, while a corner was much more dangerous. Today, most teams have one or two designated throw-in specialists just for restarts near the end line. These specialists can deliver a throw that is more like a corner kick, giving the team another offensive weapon. The movement of the dumbbell pullover is very similar to a throw-in, and you can bet a team's throw-in specialist does this exercise. The poor defender now doesn't know where to send the ball (but most everyone would still rather face a throw than a corner).

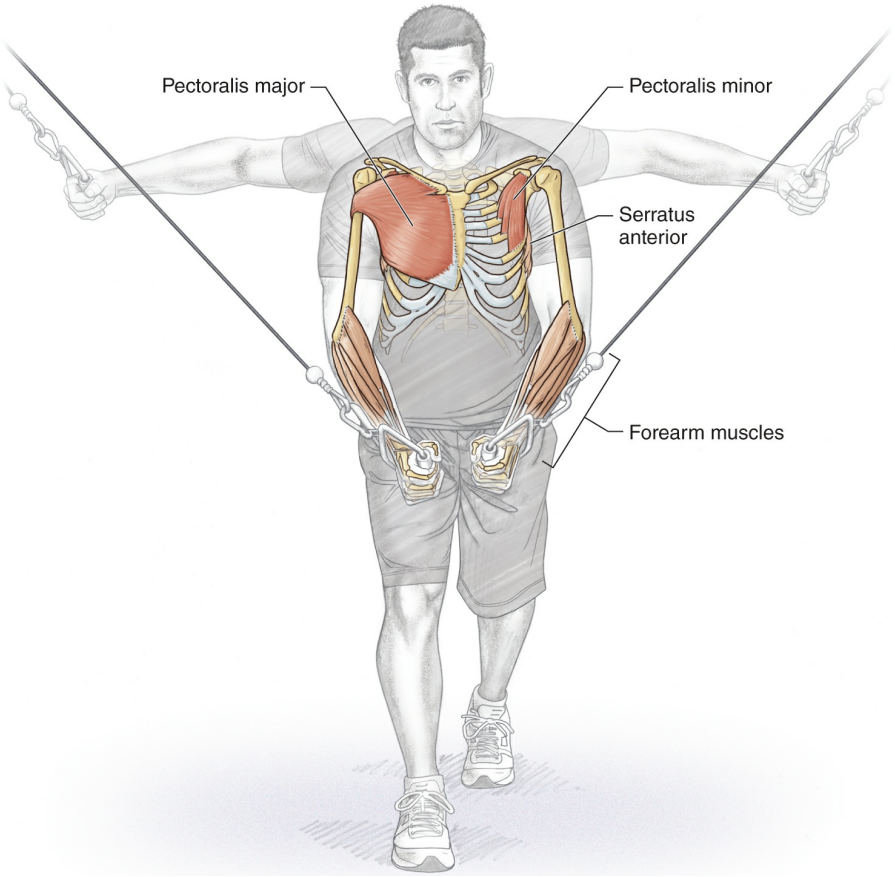


VARIATION

Machine Pullover

As with most free weight exercises, there are machine options that place the user in a fixed and safe position. Many of these machines are simple, isolating a single action such as the pullover motion, instead of compound, which allow actions across multiple joints.

CABLE CROSSOVER FLY



Execution

1. This exercise usually requires a setup dedicated to this specific lift. Stand with your back to the weights and your feet staggered, with the trunk leaning a little bit forward.
2. Reach up behind you, and grasp the handles of the cable machine in an overhand grip. The arms will be extended behind you, with a little flexion at the elbows. Picture a bird opening its wings.
3. Inhale, and squeeze the arms together in unison until the hands touch. Exhale when the hands touch. Try not to change the angle of elbow flexion during the movement.
4. Slowly allow the arms to return to the starting position. Be sure to keep control during the lift. It is easy to let gravity take over.

Muscles Involved

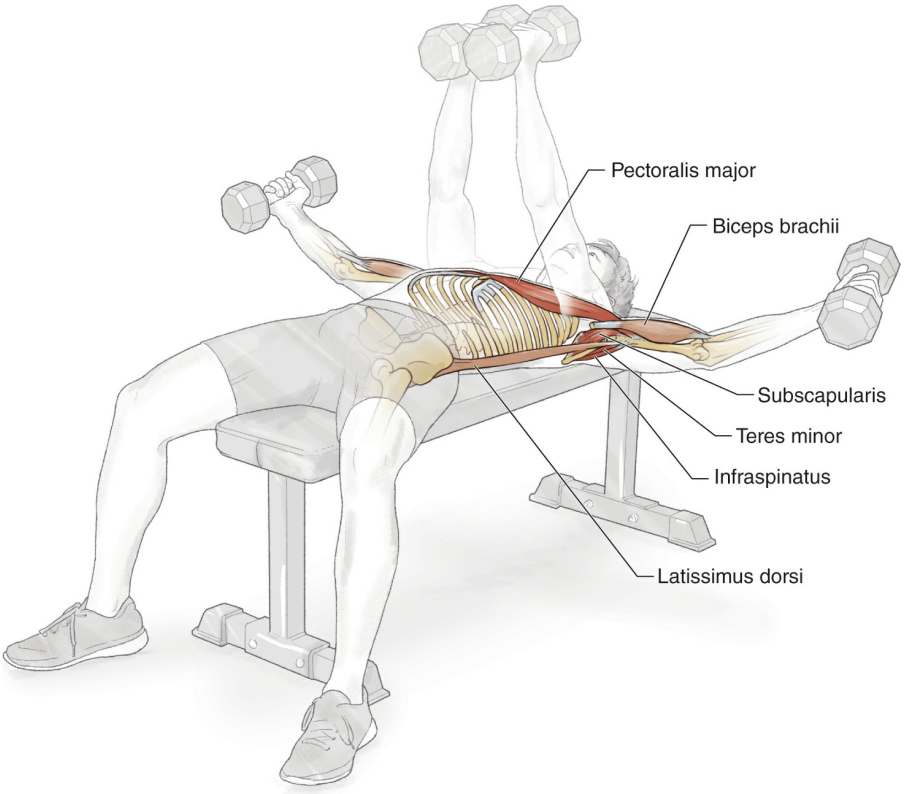
Primary: Pectoralis major, pectoralis minor

Secondary: Forearm muscles to grasp handles, scapular stabilizers (serratus anterior, rhomboid major and minor, middle trapezius)

SOCCER FOCUS

One could argue soccer players use strength training strictly to supplement their soccer-specific training. In this case, a player could get by with a few compound exercises that train most muscles of the shoulders and arms. However, just because a muscle performs a certain action doesn't mean the entirety of the muscle is being exercised. For example, the common bench press doesn't exercise a significant portion of the upper pectoralis major. Thus, a complete supplemental strength training program will include a variety of exercises to affect as many muscle fibers as possible. While the cable crossover fly is a great option that recruits most of the pectoralis major, it is also a great option to activate the pectoralis minor. The pectoralis minor lies under the pectoralis major and inserts on the scapula under the general area of origin of the deltoid. It stabilizes the scapula during movement. A stable scapula is important not only for optimal shoulder function but also to protect the shoulder when landing after a fall. This lift moves the scapula around the curvature of the ribs, which is a specific action of the pectoralis minor.

BENCH FLY



Execution

1. Lie flat on a bench, with your feet flat on the floor.
2. Take a dumbbell in each hand. Begin with the dumbbells together, directly above the chest. The elbows should be slightly bent, with palms facing each other.
3. In a controlled manner, lower the weight down to the sides of the body. Keep the palms facing inward, and maintain a slight bend in the elbows. Pause when the dumbbells are parallel to the bench.
4. Hold the position, and contract for one or two seconds. Raise the arms back to the top following the same arc.

Muscles Involved

Primary: Pectoralis major, supraspinatus, infraspinatus, teres minor, subscapularis

Secondary: Latissimus dorsi, biceps

SOCCER FOCUS

Upper body strength is crucial to various "dueling" aspects of soccer performance. For example, upper body strength is required to control the ball under pressure, hold the

ball up to bring others into play, or shield the ball in tight areas until support arrives. Also, when running or sprinting alongside an opponent, legally holding her off to gain an advantage by reaching the ball first, upper body strength can be decisive. The action may then lead to shielding or holding the ball.

9
ARMS

Most fitness professionals have heard it before: Soccer is a leg game. Why should a soccer player, except perhaps the goalkeeper, pay much attention to the arms? People with these opinions should look carefully at match photos from soccer magazines or websites and note how the trunk, shoulders, and arms are used in soccer. Although the arms do not have much of a primary role in the game beyond the obvious throw-in, the speed of play and athleticism of players today put players in such close proximity that they must be able to navigate during close-quarter play. Physical contact requires adept balance, and the arms are heavily involved in maintaining balance.

Modern tactics are a combination of direct play and possession. Maintaining possession requires a player to be able to shield an opponent from the ball. Using the arms within the laws of the game helps make the player seem bigger and more difficult to displace from the ball, thereby helping him maintain possession. A system of play that

is gaining popularity is the 4-5-1, in which an important trait of the single striker is the ability to maintain possession of the ball to play it to oncoming midfield teammates. The player who can reliably hold possession when under defensive pressure will play many minutes.

If that isn't enough to convince you, look at the muscular development of some of the players on TV when they take their shirts off after a match. (If they do this in celebration after scoring, they risk getting a yellow card.) If that level of play is what you aspire to, upper-body resistance training is in your future.

ANATOMY OF THE UPPER EXTREMITY

The upper extremity is divided into three segments. The main bone of the upper arm is the humerus, which runs from the shoulder joint to the elbow joint. The forearm runs from the elbow to the wrist. The forearm includes two parallel bones, the radius and ulna. The hand and wrist make up the third segment. The wrist has 8 bones, and the hand has 19 bones (5 metacarpals numbered I through V beginning with the thumb; 14 finger bones or phalanges).

Bones, Ligaments, and Joints

The humerus is the one bone of the upper arm. The proximal end, the end toward the trunk of the body—in this case, the shoulder end of the bone—has a rounded head that articulates with the glenoid of the scapula. This is the ball portion of the ball-and-socket shoulder joint. Around this head are areas for the attachment of muscles from the chest and upper back. As you proceed down the upper arm toward the elbow, the bone is mostly smooth, with sites for muscle attachment for the common tendon of the three deltoid muscles and other muscles before it widens and forms the upper portion of the elbow.

The two forearm bones are the ulna and the radius. The ulna is on the side of the little finger, and the radius is on the thumb side. A unique feature of the forearm is its ability to rotate the palm down, or pronate, and rotate the palm up, or supinate. (This is easy to remember: You would hold a bowl of soup with the palm up.) When the forearm is supinated, these two bones are parallel; when the forearm is pronated, the radius crosses over the ulna. The elbow, or proximal, end of the ulna is, for lack of a better word, a hook that wraps around the spool-shaped surface of the humerus. (When you point to your elbow, you touch the knot on the back of the joint. That knot is the ulna.) The proximal end of the radius has a flat concave disc that articulates with the rounded

convex end of the humerus. Together, these two bones move around the humerus to flex (decrease the joint angle of) and extend (increase the joint angle of) the elbow. Pronation occurs when the disc-like end of the radius rotates over the ulna into a palm-down position. Technically, pronation and supination occur along the forearm, not the elbow. A number of ligaments maintain the integrity of the joint and are implicated in injuries such as tennis elbow and Little League elbow. A tough ligament that lies between the radius and ulna helps keep the bones parallel and broadens the area for muscle attachment along the forearm.

The wrist and hand are very complex and are best visualized in anatomical position: palms turned forward, with the radius and ulna parallel. The wrist is made up of two parallel rows of bones (carpals), each with four small bones and small ligaments that connect both sides of adjacent bones. The proximal row of bones articulates with the distal ends of the radius and ulna, with the larger radius having the most contact. The wrist actions are flexion and extension plus the unique motions of ulnar deviation, in which the hand bends toward the ulna (decreasing the angle between the little finger and the ulna), and radial deviation, in which the hand bends toward the radius (decreasing the angle between the thumb and the radius). The distal row of carpals articulates with the five metacarpals that make up the palm of the hand. Each of these metacarpals, numbered I to V beginning on the thumb side, has a digit (finger or thumb) attached. The four fingers are made up of three phalanges (proximal, middle, and distal), while the thumb has only two (proximal and distal).

Muscles

All muscles have two attachments. The origin is the immobile end; the insertion is the movable end. In the overwhelming majority of situations, activating a muscle causes contraction that pulls the insertion toward the origin. Knowing the anatomy of the skeleton and a muscle's origin and insertion tells you the muscle's action, or how the bones move around specific joints. The muscles of the upper extremity have their primary effect on the elbow, forearm, wrist, and fingers, but in a couple of cases, they also have some effect at the shoulder.

Muscles Acting on the Elbow

The elbow flexes and extends. The triceps brachii muscle (figure 9.1) of the upper arm performs extension. The word triceps refers to the three heads of the muscle, and brachii refers to the upper arm region. (Most muscle names are descriptive if you can navigate a little Latin.) The long head is the middle muscle that courses down the back of your upper arm. It originates just under the glenoid of the scapula. The medial and lateral heads originate along the long shaft of the humerus. They join together through a

common tendon attaching to that knot you think of as your elbow. As the triceps pulls its insertion toward its origin, the muscle pulls on the ulna, and the result is forearm extension. The long head of the triceps also crosses the shoulder and assists in shoulder extension.

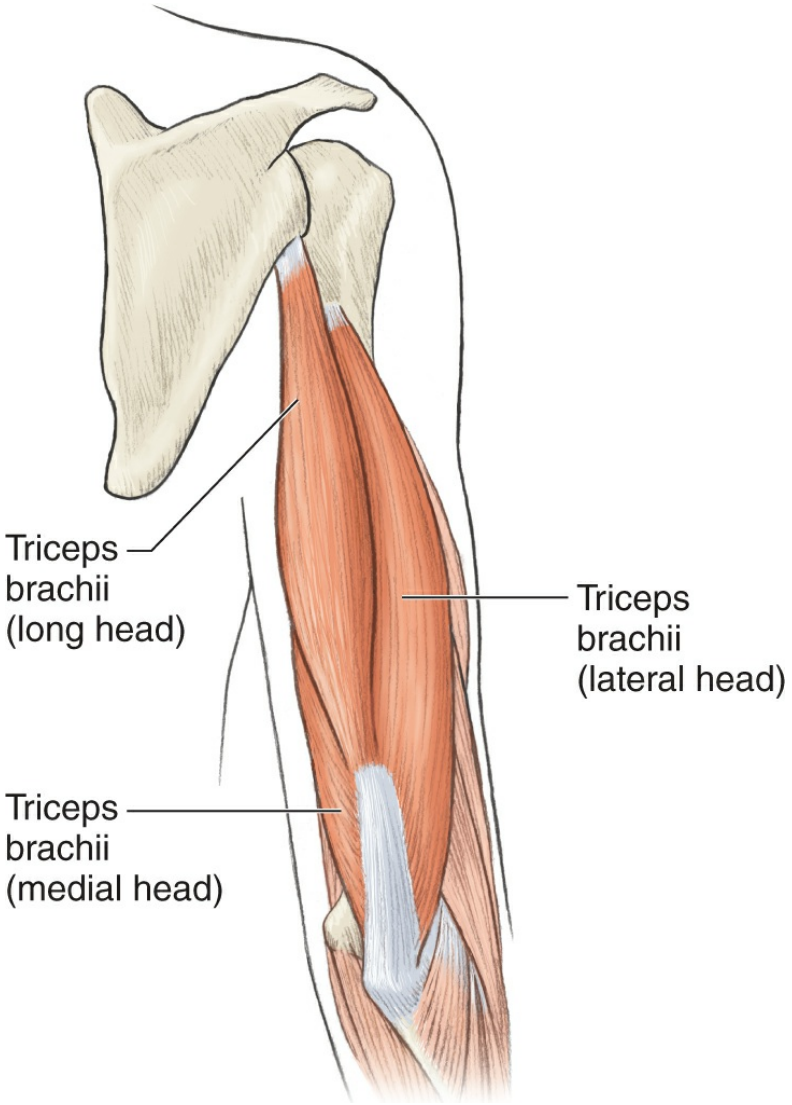


FIGURE 9.1 Triceps brachii muscle.

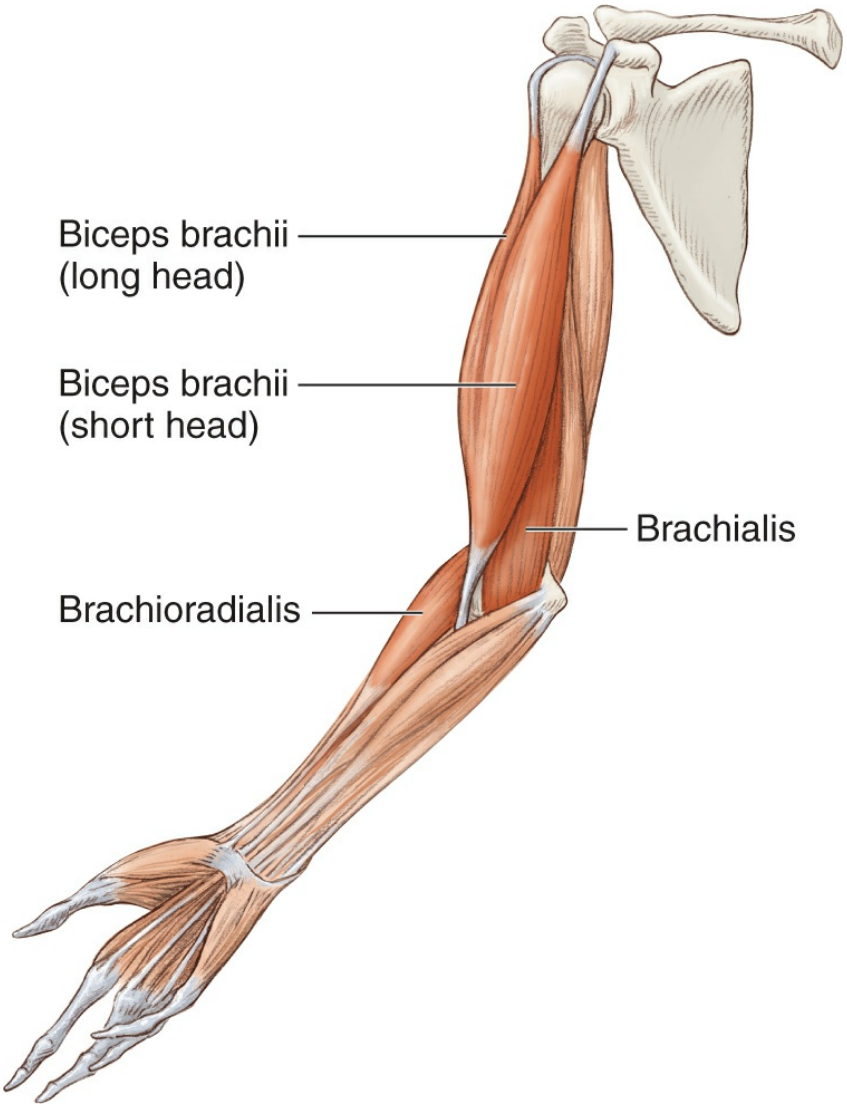


FIGURE 9.2 Biceps brachii, brachialis, and brachioradialis muscles.

The action opposite forearm extension is forearm flexion. The biceps brachii (figure 9.2) of the upper arm performs forearm flexion. The word biceps refers to the two heads of the muscle. Both heads originate on the scapula. One head begins above the glenoid, opposite the long head of the triceps brachii, while the other begins on another location on the scapula underneath the deltoid. These two heads come together to form the belly of the biceps brachii, which inserts on the radius through a single tendon that is easy to see and feel.

A second forearm flexor underneath the biceps brachii is the brachialis. It begins along the anterior (front) shaft of the humerus and inserts on the anterior side of the ulna, just beyond the ulna's hook. The third flexor, the brachioradialis, begins well down the shaft of the humerus and inserts on the radius down toward the base of the thumb. These three muscles work together to flex the forearm.

The biceps brachii inserts proximally on the radius. When this muscle contracts, its

first order of business is to supinate the forearm. Forearm flexion is its secondary action. When the forearm is supinated, the biceps can put all its efforts into flexion. But when the forearm is pronated, the biceps tendon is wrapped around the radius, so its first action is to perform supination. Pronate your right hand, and place your left hand on the biceps; feel the biceps brachii contract when you supinate your forearm.

Notice that the muscles are neatly arranged to work in opposition to each other—one group flexes, and one group extends. Muscles that work in opposition to each other are said to be antagonists. Muscles that work together to perform the same action are called agonists.

Muscles Acting on the Wrist and Hand

The dexterity of the hand is a marvel of engineering. To achieve this degree of fine motor control, a large number of muscles in the forearm insert all over the wrist, hand, and fingers. The bulk of the forearm muscles (figure 9.3) originate from a common tendon coming off either the medial or lateral side of the distal humerus. These are those little bumps on either side of your elbow; you might refer to the one on the inside of your elbow as your funny bone. The tendons of the forearm pass under a tough tendinous tissue, called a retinaculum, that wraps around your wrist where you would wear a wristband.

The muscles that perform flexion mostly originate from the medial bump and are found on the anterior side of the forearm. The extensors originate from the lateral bump and course down the posterior side of the forearm. There are a number of deeper muscles. Most forearm muscles are named for their action (flexor or extensor), location (ulnar or radial side), and insertion (carpal [wrist], digitorum [fingers], pollicis [thumb], indicis [index finger], or digiti minimi [little finger]). If you contract the muscles with radialis in their name, you get radial deviation. Muscles with ulnaris in their name perform ulnar deviation. A plethora of small intrinsic muscles in the hand assist all these muscles and also perform other actions such as spreading the fingers apart and moving the thumb.

The muscles that perform wrist flexion are the flexor carpi radialis, palmaris longus, and flexor carpi ulnaris. The muscles that perform wrist extension are the extensor carpi radialis longus, extensor carpi radialis brevis, and extensor carpi ulnaris. The muscles that perform finger flexion are the flexor digitorum superficialis, flexor digitorum profundus, and flexor pollicis longus. The muscles that perform finger extension are the extensor digitorum, extensor digiti minimi, extensor indicis, extensor pollicis longus, and extensor pollicis brevis.

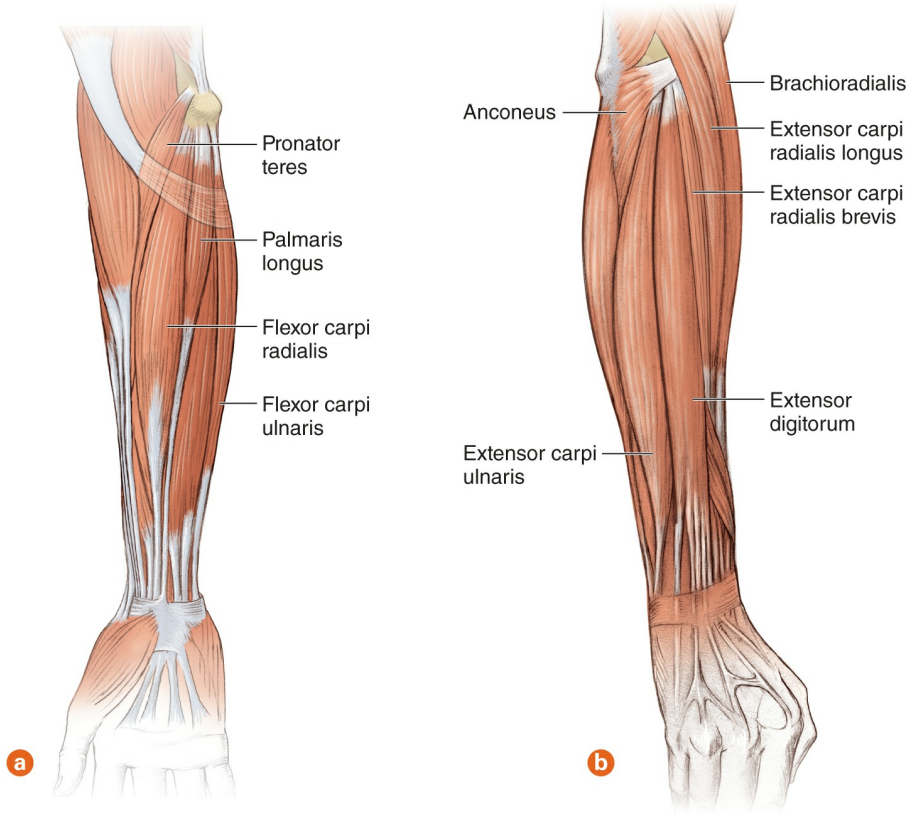
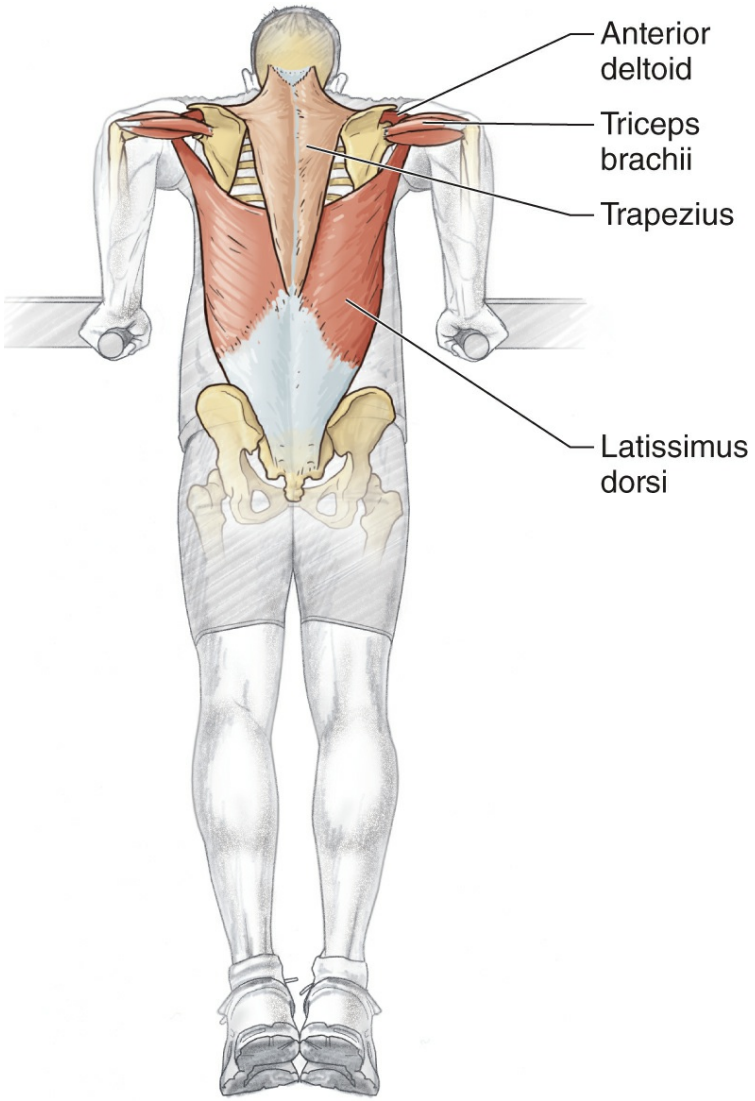


FIGURE 9.3 Forearm muscles: (a) flexors; (b) extensors.

ARMS

DIP



SAFETY TIP Lower your body only until your upper arms are parallel to the floor. Be sure your elbows are not above your shoulders at the lowest point of this exercise. If you do the exercise properly, you should feel a little stretch across the front of your shoulders.

Execution

1. Most weight racks include supports for doing dips. Adjust the height of the supports so that your feet do not touch the ground at the bottom of the descent.
2. Grasp the grips. Jump up, and extend your elbows so your arms are straight.
3. Slowly lower your body until your upper arms are parallel to the floor. Maintain

correct posture, and move the spine in a straight, vertical path.

4. Pause at the lowest level, and then reverse the movement, pushing yourself back up until the elbows are fully extended. Raise the body using the arms; do not push up with the feet. Your feet are for support and balance only.

Muscles Involved

Primary: Anterior deltoid, latissimus dorsi, triceps brachii

Secondary: Pectoralis major, pectoralis minor, trapezius, brachioradialis

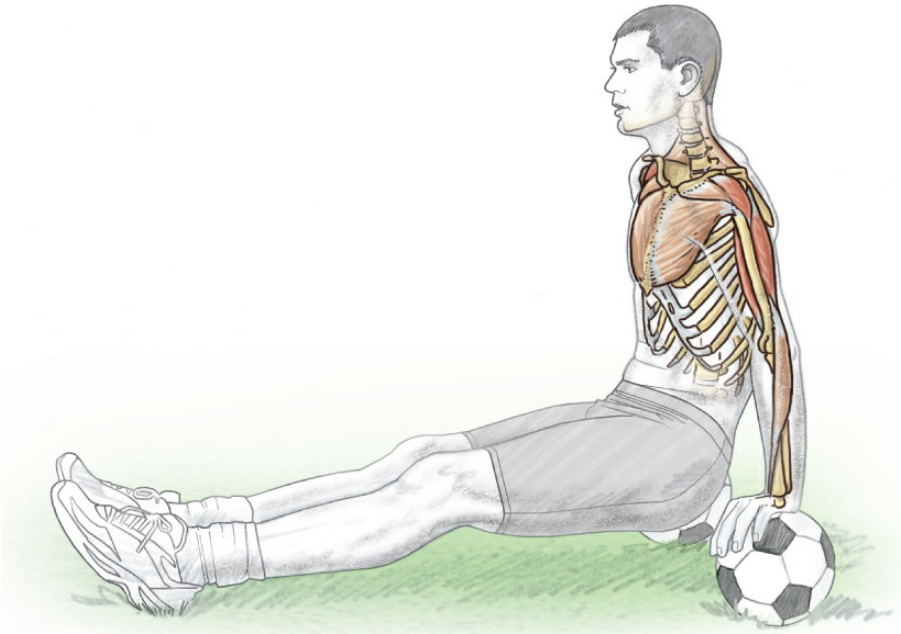
SOCCER FOCUS

The dip works the triceps and shoulders. Although soccer focuses on the lower extremity, nearly every challenge from an opponent must be met with resistance using the arms and shoulders. The player who neglects the arms when training will be at a disadvantage during physical contact. Players with the ball often use an arm to keep the opponent at bay. Be cautious when using the arms during such contact. A referee may call a foul if the arm moves toward or above horizontal.

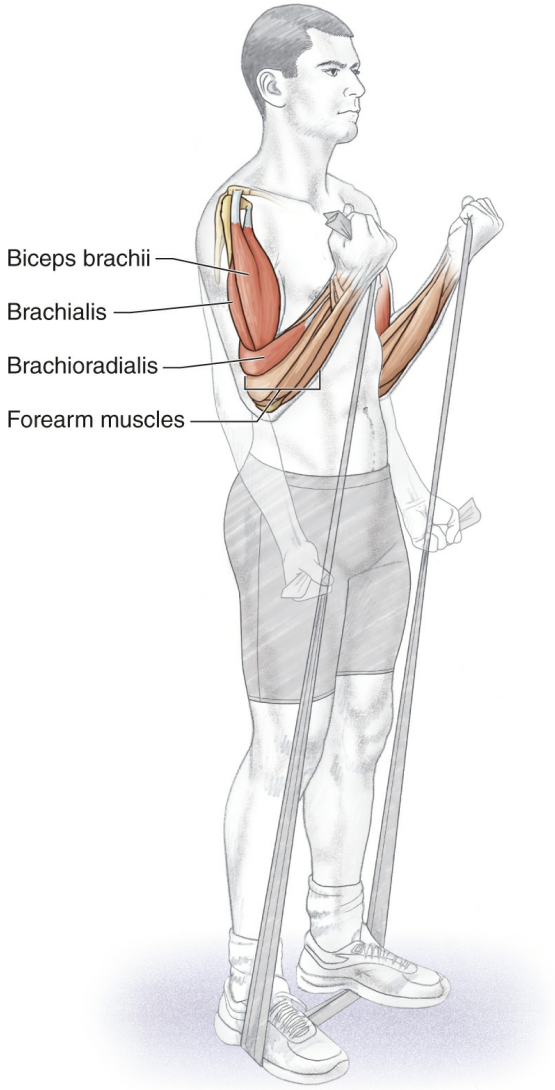
VARIATIONS

On-the-Field Dip Options

On the field, you can perform a modification of the classic dip. Use two stable benches, one for your hands and the other for your feet. Lower yourself toward the ground, moving your spine in a straight line, until your upper arms are parallel with the ground. Pause briefly, and then push back up. You can also do a dip by putting your hands on two soccer balls. The depth of the dip is reduced because the balls are not as tall as the bench. Maintaining stability on the round balls adds a dimension of reactive balance as the balls move.



ELASTIC BAND CURL



SAFETY TIP If you arch your back, develop a swinging motion in both directions, or use your back to help with the curl, you are probably using too much resistance. Reduce the amount of resistance.

Execution

1. This exercise can be done from a standing or seated position. Choose an elastic band with the proper level of resistance for you.
2. Stand in an erect posture, with your feet about shoulder-width apart.
3. Hold an end of the elastic band in each hand, and stand on the band with both feet.
4. Perform a traditional curl motion by flexing the elbows. Return to the starting position by slowly extending the forearms. You may use both arms in unison or

one arm at a time. Maintain an erect posture. Do not flex the trunk, hips, or knees during the exercise.

5. As your strength increases, perform more repetitions with the same band, shorten the band to increase the resistance, or switch to a band that supplies more resistance.

Muscles Involved

Primary: Biceps brachii, brachialis, brachioradialis

Secondary: Forearm muscles (mostly wrist and finger flexors including flexor carpi radialis and ulnaris, palmaris longus, flexor digitorum superficialis and profundus, and flexor pollicis longus) to grasp band

SOCCER FOCUS

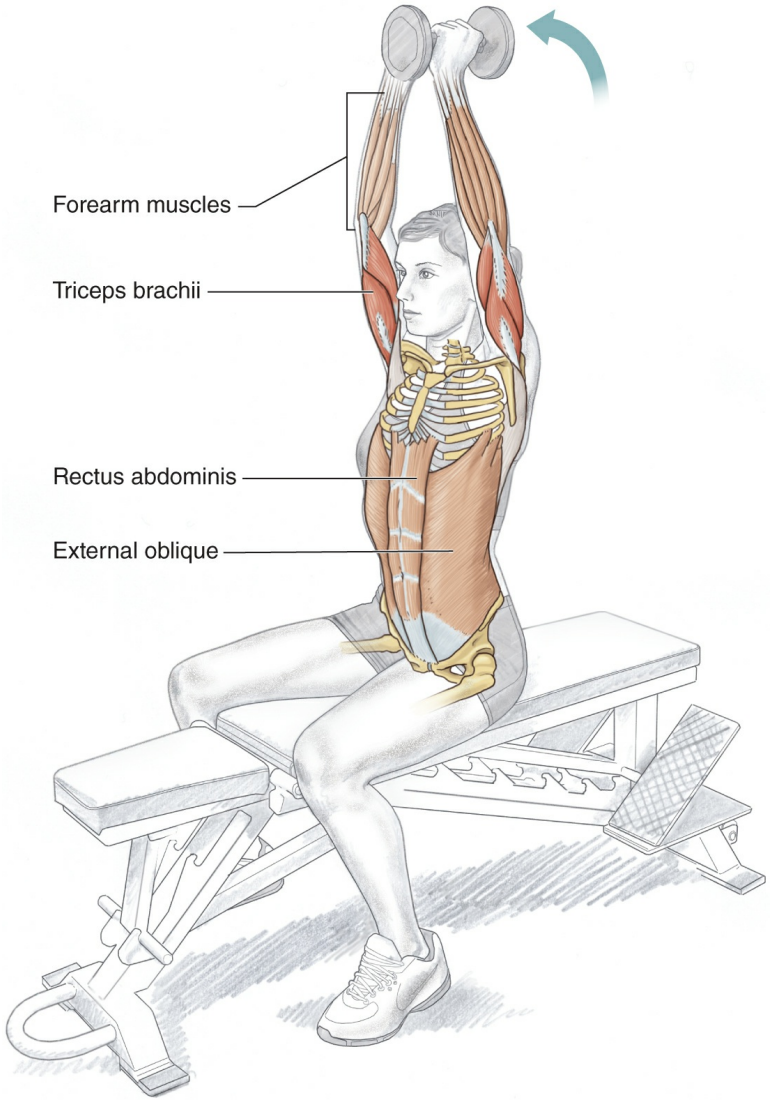
Improving strength during training can be a challenge. Push-ups are great for strengthening the forearm extensors and shoulders. Training the forearm flexors is more difficult but still needs to be done to achieve muscular balance in the upper arm. In the absence of a pull-up bar, a little creativity is needed. Elastic bands are very versatile and affordable and can be used to train most major muscle groups. Elastic bands have different degrees of resistance, usually indicated by the band's color. Using a shorter band that must be stretched from hand to hand can further increase resistance. A creative coach might use this exercise as one station in a circuit of various activities.

VARIATION

Dumbbell Curl

A dumbbell curl works the same primary muscles but allows the additional actions of pronation and supination. You can raise the dumbbell in a supinated (palm up) position and lower it in a pronated (palm down) position. When the entire curl motion is performed with the forearm in pronation (palm down), the biceps is less involved, forcing more work from the brachialis and brachioradialis. Sitting on a ball adds a balance dimension not encountered when using a stable bench.

SEATED TRICEPS EXTENSION



SAFETY TIP Posture is important. Keep the head aligned with the spine. Keep the elbows in a fixed position, and don't drop the shoulders to help lift the weight.

Execution

1. Sit in a chair with a low back or on a bench with no back support. Spread your legs, with your knees flexed and feet flat on the floor.
2. Hold a dumbbell vertical with both hands.
3. Raise your elbows toward the ceiling. Flex your elbows so the weight is behind your head. Keep your elbows close to your ears.
4. Extend your forearms until they are in full extension.

5. Slowly lower the weight back to the starting position. Maintain good posture with an erect back during the exercise.

Muscles Involved

Primary: Triceps brachii

Secondary: Abdominal core (external oblique, internal oblique, transversus abdominis, rectus abdominis), spinal extensors (erector spinae, multifidus), forearm muscles to grasp dumbbell

SOCCER FOCUS

Despite the large size of a soccer field (usually 110 yards by 70 yards [100 m by 64 m]), opponents may find themselves in close quarters anywhere on the field. Although raising an arm toward vertical during a confrontation may be whistled by the referee, angling the arms toward the ground and holding them in an almost isometric contraction can make it more difficult for an opponent to make a fair attempt at obtaining control of the ball. The focus of soccer may be on the lower extremity, but the arms play a repeated role in who obtains or maintains control of the ball.

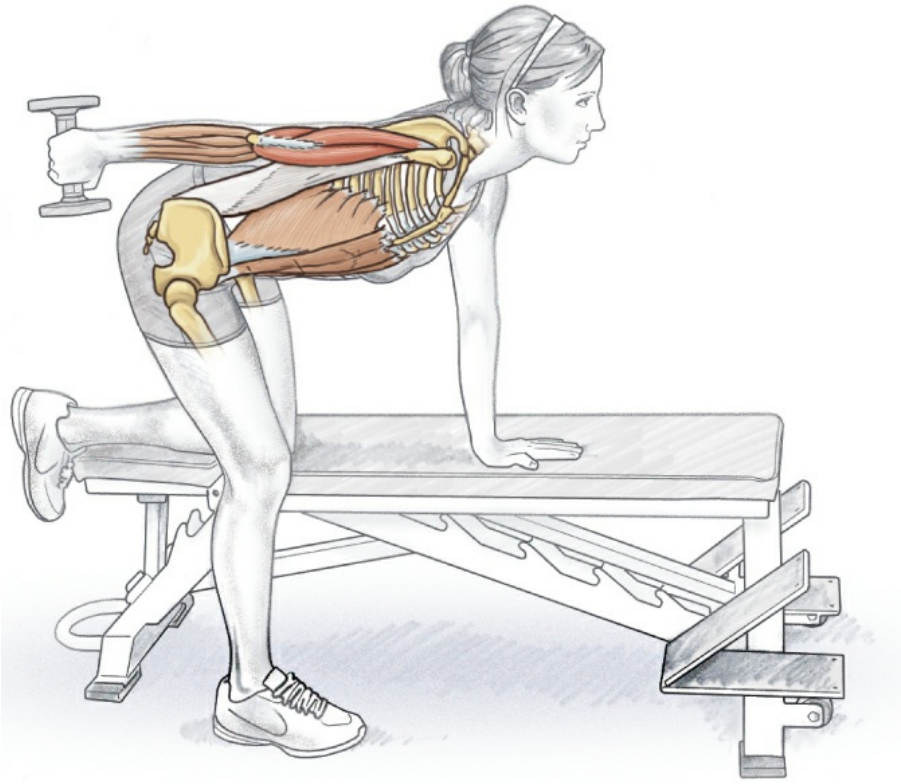
VARIATION

Triceps Kickback

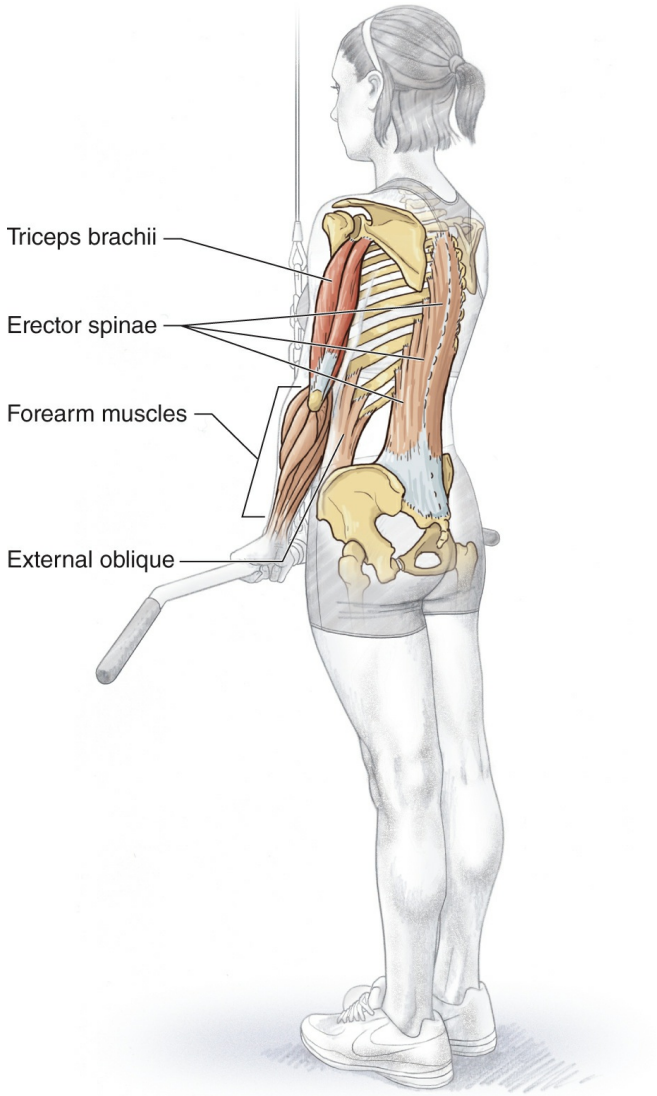
A variation is the popular triceps kickback with a dumbbell. Kneel on a weight bench, and lean forward until the trunk is about parallel with the floor. Hold the dumbbell in the arm opposite the kneeling leg so the upper arm is parallel to the trunk, and then extend the forearm to full extension. Or stand in a staggered stance with the weight in the

hand opposite the leg in front. Add stability by placing the inactive hand on the forward knee.

Seated triceps extensions can be made more challenging if you sit on a large stability ball. This will require you to react to the movements of the ball as you perform the exercise. Another alternative is to perform triceps extensions with a cable machine. Face away from the cable machine, and use both hands to grab the handle over your head. Extend your elbows.



STANDING PUSH-DOWN



Execution

1. Stand and face a cable machine. Grasp the bar using an overhand grip, with your hands about shoulder-width apart.
2. Keep your elbows close to your body as you bring your forearms to full extension.
3. Hold the bar briefly at full extension before slowly returning the bar to the starting position.

Muscles Involved

Primary: Triceps brachii

Secondary: Abdominal core, spinal extensors, forearm muscles to grasp bar

SOCCER FOCUS

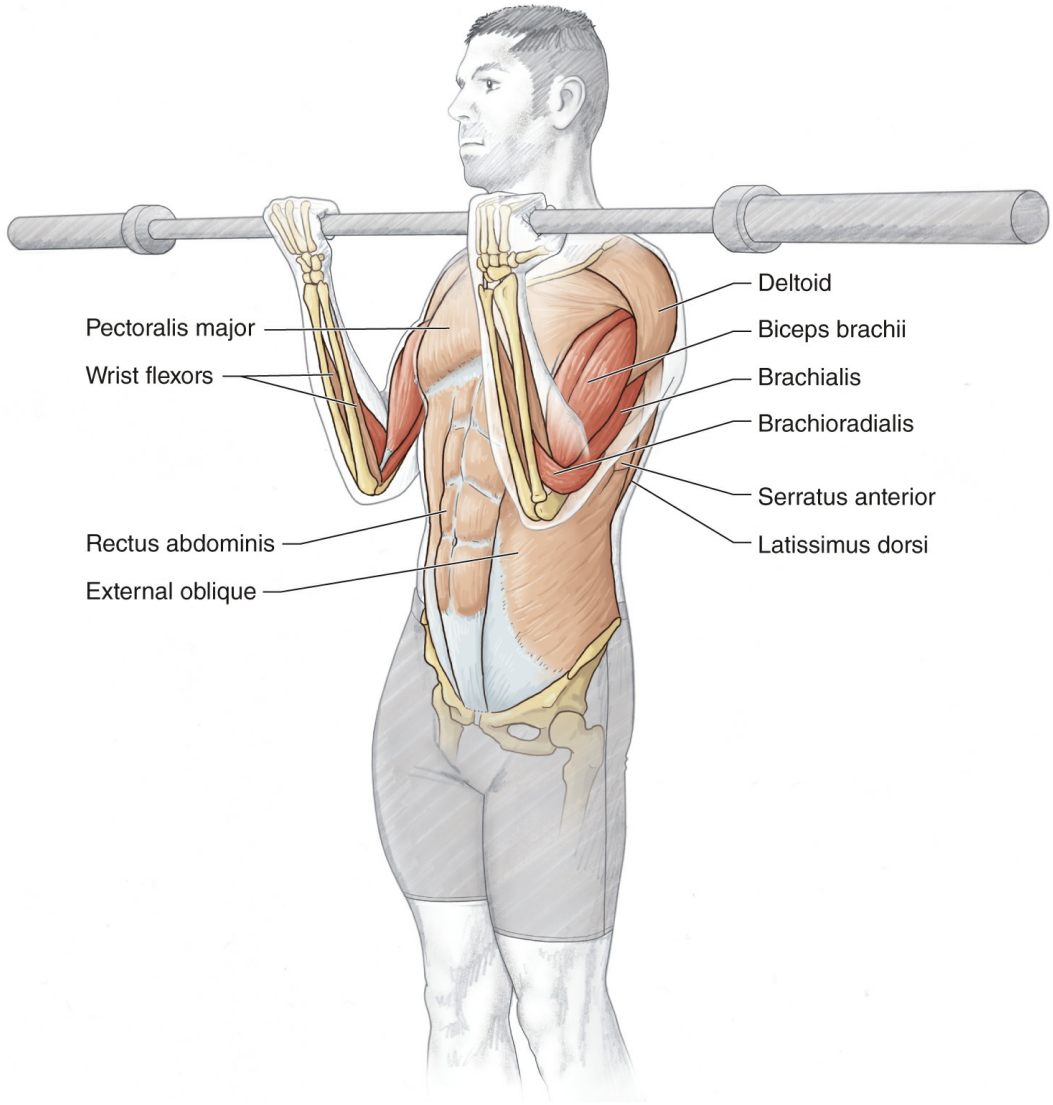
Some sports, such as American football, favor mass, and some, such as basketball and volleyball, favor height. Soccer is a game for the masses since it does not require any particular body dimensions for those who play and enjoy the game. The typical soccer player is closer to the average height and weight for his age and gender. It is uncommon to see heavily developed players, especially in the upper body, but neglecting the upper body would mean placing oneself at a disadvantage during physical challenges.

VARIATION

Reverse Push-Down

While standing, face the cable machine. Grasp the bar in a reverse grip with the palms up. Execute the same movement. This variation works the same muscles but recruits them differently.

BARBELL CURL



SAFETY TIP Keep the body aligned and the spine in neutral position. Keep the movement under control—do not let momentum play a role.

Execution

1. Stand in an erect posture, with your feet about shoulder-width apart and a barbell in front of you.
2. Grasp the bar in a supinated (palm up) grip.
3. Raise the bar by performing forearm flexion and moving the weight toward the shoulders. Lift the bar through the full range of motion. Pause briefly, and then slowly lower the bar to the starting position.

Muscles Involved

Primary: Biceps brachii, brachialis, brachioradialis

Secondary: Wrist flexors (flexor carpi radialis and ulnaris, palmaris longus), stabilizers of the trunk (abdominal core, erector spinae) and shoulders (deltoid, supraspinatus, infraspinatus, subscapularis, teres minor, latissimus dorsi, pectoralis major), scapular stabilizers (serratus anterior, rhomboid major and minor, middle trapezius)

SOCCER FOCUS

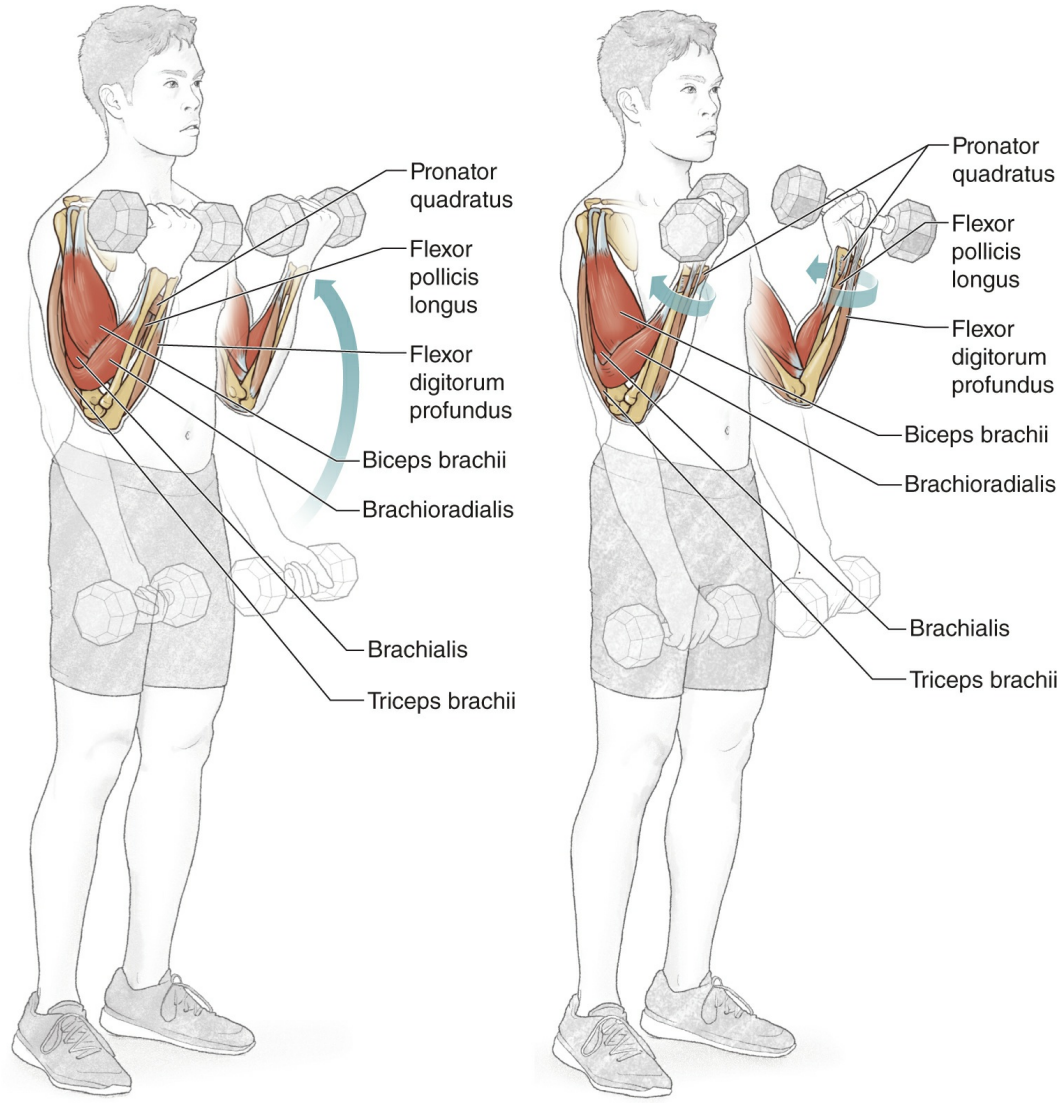
During free play on the field, the arms are used mostly to keep an opponent away from the ball or to gain a bit of an advantage when running with an opponent—within the laws of the game, of course. These actions generally do not require forearm flexion. It would be unwise, however, to focus strength training solely on actions specific to the game and neglect antagonist muscles. To do so would lead to muscle imbalances, which are not advisable for optimal muscle and joint function.

VARIATION

Machine Curl

A machine curl works the same primary muscles. Sit in a curl machine. Adjust the seat to allow access to the bar when you are in an erect posture and your feet are flat on the machine's platform. With the weight lowered, grasp the bar or handles in a supinated (palm up) grip. Raise the weight by performing forearm flexion and moving the weight toward the shoulder. Lift the weight through the full range of motion. Pause briefly, and then slowly lower the weight to the starting position.

ZOTTMAN CURL



Execution

1. Stand holding a dumbbell in each hand at arm's length by the sides, palms facing forward (underhand grip).
2. Ensure the elbows are tucked and locked. Curl the weights toward the shoulders.
3. Turn the grip 180 degrees to an overhand grip, lower the weights, and then turn the grip again (back to underhand) to return to the starting position.

Muscles Involved

Primary: Biceps brachii, brachialis, brachioradialis

Secondary: Triceps brachii, flexor digitorum profundus, flexor pollicis longus,

pronator quadratus

SOCCER FOCUS

The Zottman curl strengthens more of the arm's multiple muscles than a regular curl. It incorporates the forearm muscles in the second phase of the exercise. These muscles are also utilized in shielding the ball, holding off an opponent, and using the upper body to legally gain an advantage when running alongside an opponent. Additionally, distance from throw-ins could be positively impacted with increased upper and forearm strength. For goalkeepers, grip strength when holding the ball, minimizing the ground impact of a fall or dive, and distance when distributing a variety of throws could all be enhanced. The Zottman curl is a single-joint exercise, isolating the elbow flexors. As with all single-joint exercises, it is important to include other single-joint exercises to ensure a complete, balanced workout.

VARIATION

Forearm Curl

A forearm curl can be used in conjunction with a dumbbell row to provide balance.

10
LEGS: COMPLETE POWER

Many of the exercises in this book are isolation exercises. They are designed to isolate movement to specific muscles or muscle groups. These exercises are very effective at ensuring those specific muscles and their actions get the full benefit of training.

In sports, however, actions are rarely isolated. In a game, dynamic planned and reactive movements involve multiple joints and muscles in a coordinated pattern to achieve something as simple as bending over to place the ball to take a corner kick or as highly complex as a plant, cut, and turn with one touch of the ball. It is quite impossible to mimic every action of a sport with a supplemental exercise or even with what some call functional exercises. You would spend more time on those than on the actual sport itself.

The exercises in this chapter provide a glimpse into what is possible for more complex multijoint activities. Although few of these exercises mimic any particular sport, each requires components common to most sports, including soccer. Because the power output of soccer is driven by the lower extremities, these exercises are all about

improving leg power for running, cutting, stopping, jumping, maintaining static and reactive balance, and more.

It is important to include complex supplemental actions in physical training. You plan to plant your right foot and cut to the left, but your studs don't dig in as expected, or dig in too much, and you react with a slight skip or hop and adjust your posture to keep your balance during this seemingly minor adjustment. Most of the actions and reactions are handled by the cerebellum and spinal cord. If all your supplemental training activities were simple single-joint, single-muscle-group actions, your body would miss a valuable opportunity to train adaptations to support skilled performance. This is why you hear a lot about functional training.

Recent developments in technology, as referenced elsewhere in the text, have allowed practitioners and coaches to further and more specifically identify the physical demands placed on the body by various aspects of the game. For example, data collected by wearable GPS units can tell coaches the amount of times a player changes direction during a match, and the intensity of that direction change. Similarly, in addition to identifying how much distance a player covers at various speeds and levels of intensity, this technology also reveals the amount of times a player accelerates and decelerates. Coaches can also see how much distance a player covers laterally and backwards, not just forwards. These movements are instinctive and reactionary. The well-trained player who can perform these movements as frequently and as efficiently in the last 15 minutes as in the first 15 minutes will have a greater impact on the outcome because, as we all know, the final result is often decided late in the match. Improvements can be gained by preparing the body to meet these demands through the design and implementation of a training program that incorporates the lower-body, multijoint, complex exercises shown in this chapter.

Data can also be collected from training sessions in which the environment can be more controlled. From these training-based observations, coaches can identify improved or diminished performance in any of these measurable variables. Knowing which specific physical traits need to be improved helps coaches select training activities that should improve specific measurable performance deficits and enhance each player's opportunity for success. Coaches also need to know which players already have exceptional fitness so that specific training can be designed to ensure that these well-fit players are able to maintain (or even improve) their fitness.

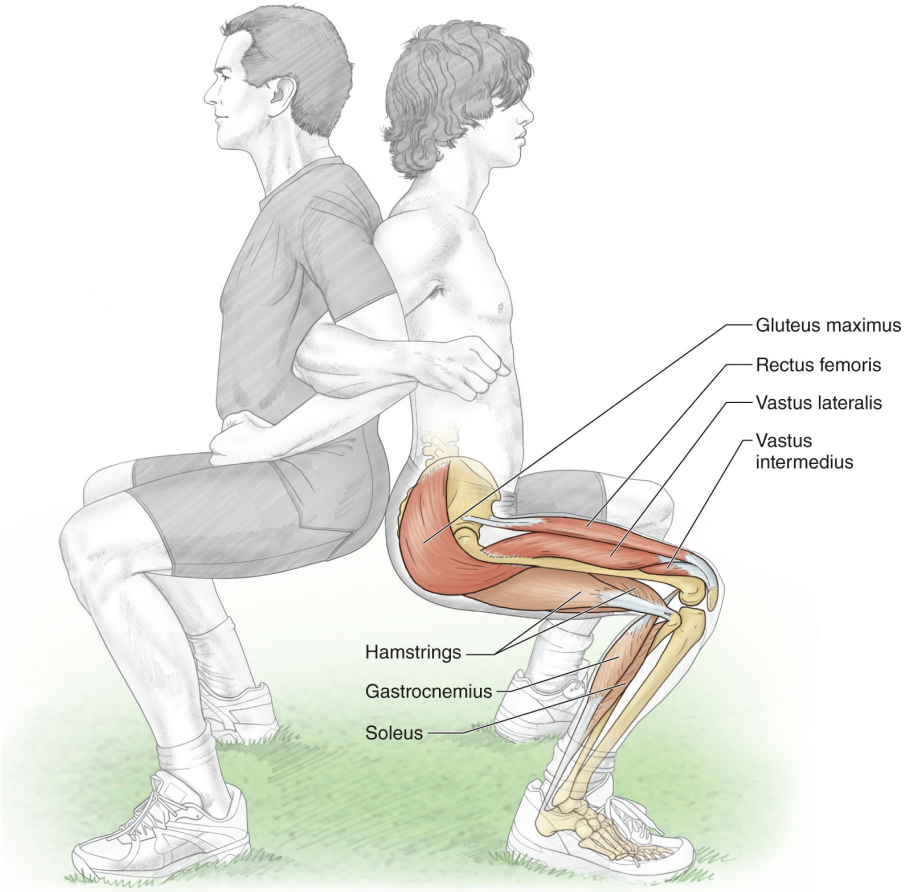
While this technology is not available at all levels of the game, there are methods, although perhaps less accurate and more time consuming, that could be used to collate such data. Using a pen and paper during training sessions or matches, for example, to tally changes of direction. Or reviewing video footage and collating the same way. The publication of such data from various levels (professional, semi-professional, youth

national teams, youth academy clubs, male, female, etc.) can provide a framework that can be used to assist in the design of training programs to prepare athletes for the demands of the game.

A common adage, if a little simplistic, is the so-called 10-year and 10,000-hour rule, which says that the truly elite achieved that elite status after putting in about 10 years and 10,000 hours of deliberate practice in their chosen fields. Although a great deal of the learning involved over the years is tactical, much of neuromuscular learning is the ability to use only those muscle cells necessary to perform a skill. Think of children learning to bounce a ball. They use their entire bodies—trunk, hips, legs, shoulders, and arms. Everything parallels the up-and-down movement of the ball. As they improve, they learn to rule out unnecessary muscle cells, eventually using the bare minimum. Watch professionals play, and you will see a midfielder on the run place a pass right in the stride of a running teammate. The passer had to gauge her own speed and the speed of her teammate, decide how to pass the ball (with or without spin, on the ground, in the air, with what part of the foot), and determine how hard to hit the ball (not so hard that it outpaces the receiver and not so soft that the receiver runs past the ball). We guarantee that not one of those decisions was made consciously. All had been pushed to the subconscious, and the player used only the muscle cells necessary to make a difficult pass look simple. One part of that 10-year, 10,000-hour rule is that motor skills become mostly rote and unconscious so the conscious brain can focus on planning, predicting, reacting, adjusting, and anything else that might fall under the executive function heading of tactics. All our midfielder did consciously was choose to whom to pass, a tactical decision. The rest was automatic.

LEGS: COMPLETE POWER

BACK-TO-BACK SQUAT



Execution

1. You will need a partner of similar height and weight for this exercise. Stand back to back with your partner, feet about shoulder-width apart.
2. Hook elbows with your partner, and lean back into each other as if leaning against a wall. There should be about 2 feet (.6 m) between your heels and your partner's heels.
3. In unison, squat down until your knees form 90-degree angles. Return to a standing position.

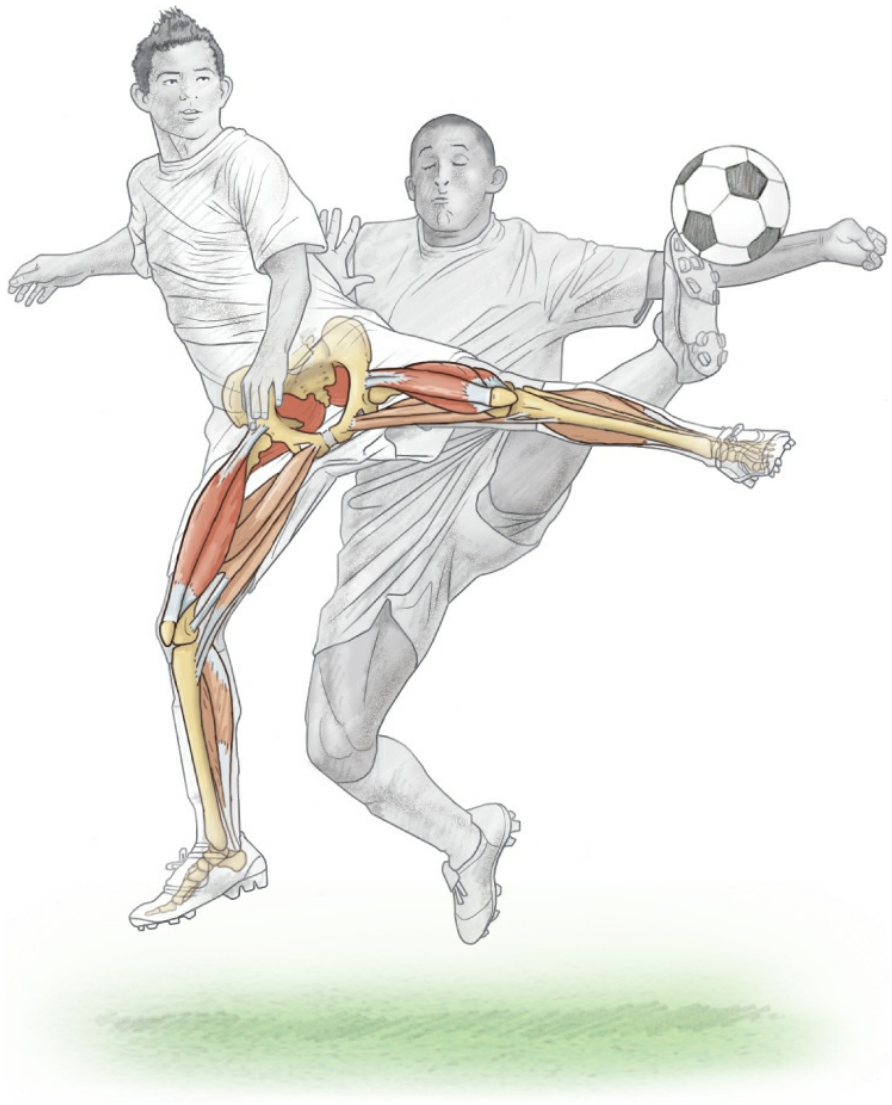
Muscles Involved

Primary: Quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gluteus maximus

Secondary: Hamstrings (biceps femoris, semitendinosus, semimembranosus), adductors (adductor longus, adductor brevis, adductor magnus, pectineus, gracilis), erector spinae, gastrocnemius, soleus

SOCCER FOCUS

Soccer requires explosive movements at a moment's notice: the goalkeeper pushing hard against the ground to dive across the face of the goal and make a save, the defender jumping high to clear a cross, or the striker leaping to head a shot. All of these require high power output from the hip extensors, knee extensors, and ankle plantar flexors. A coordinated pattern of movement from strong muscles is needed for maximum jump height and distance. All players would be wise to perform squats like these because the increased strength and power will be used frequently in a match. Although each muscle group can be trained separately, a compound movement such as a squat better simulates conditions faced in competition.

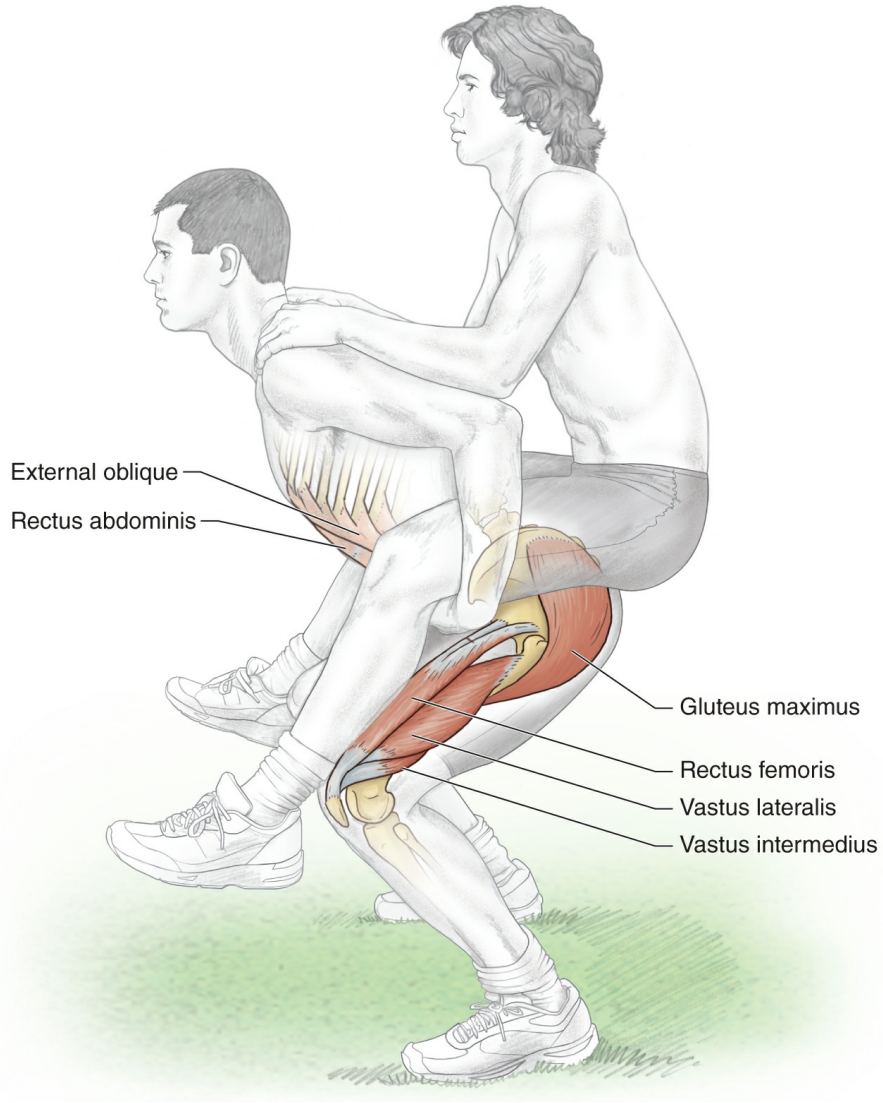


VARIATION

Racked Squat

Using a barbell, perform traditional squats within a safety rack. The rack supports the bar. Step under the bar, position it appropriately in the correct posture, and then stand up. The safety supports are removed, and the exercise begins. Safety stops are positioned a little below the level of the shoulders when the knees are bent to about 90 degrees.

PARTNER CARRY SQUAT



Execution

1. As in toe raise carrying partner (chapter 6), choose a partner of equal height and weight. Be careful when choosing a partner because this exercise can be demanding on the knees. This exercise isn't just about up-and-down strength; it is also about balance. Have your partner climb on your back in a traditional piggyback position.
2. With your legs comfortably apart and your partner centered on your back (you'll probably be leaning forward a little), perform a partial squat to about a 45-degree angle at the knees. Do not squat beyond 90 degrees of knee flexion.
3. Squat slowly. Pause briefly at the bottom of the squat before returning to the starting position and repeating. After finishing your repetitions, switch places

with your partner.

Muscles Involved

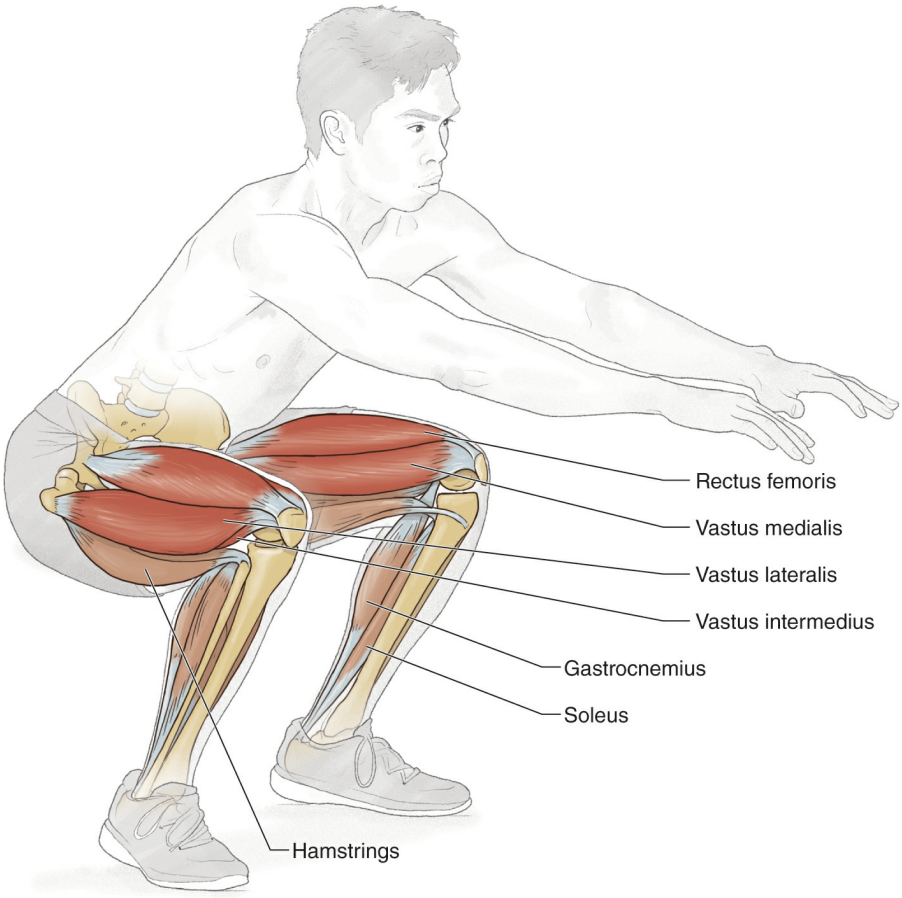
Primary: Quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gluteus maximus

Secondary: Adductors, erector spinae and abdominal core (external oblique, internal oblique, transversus abdominis, rectus abdominis) for posture

SOCCER FOCUS

The traditional squat exercise has numerous variations. One reason squat exercises are often included in any supplemental training program for sport is that they activate multiple muscles and several joints to perform the movement and maintain balance. The primary muscle groups for the movement are the quadriceps femoris for knee extension and the gluteus maximus for hip extension. One of the most important aspects of performing any squat is posture. Correct posture activates the abdominal core and erector spinae muscles during the squat. Widening the stance increases the involvement of the adductors. Never discount the importance of the force produced by these muscles during close physical contact during play. The player with the stronger hips, back, core, and quads will be at a distinct advantage during tackling and other player-to-player challenges.

BODYWEIGHT SQUAT



Execution

1. Begin with feet shoulder-width apart and toes slightly turned out. Contract the abdominal muscles. Keep the head up with eyes forward.
2. Bend at the knees. Sink the hips to lower the body, keeping the heels flat on the floor.
3. Briefly remain at the bottom position of the squat, and then push back up through the heels to the starting position.
4. Keep the back as straight as possible throughout the exercise.
5. Repeat for the desired number of repetitions.

Muscles Involved

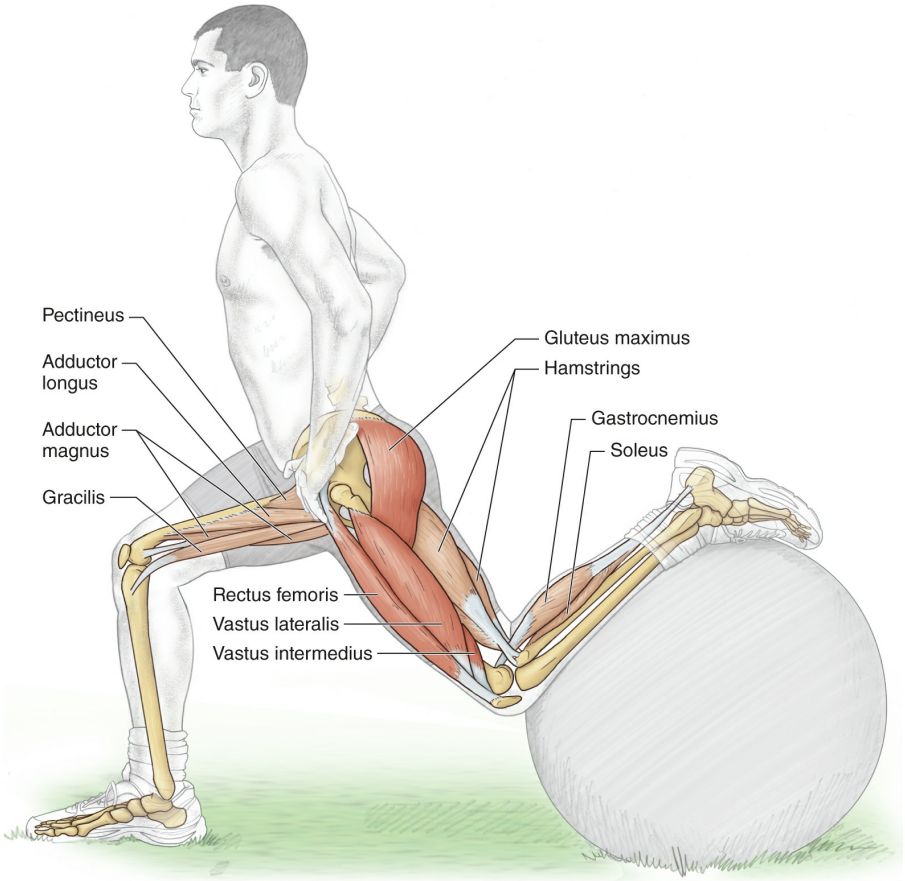
Primary: Quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris)

Secondary: Calves, hamstrings (biceps femoris, semitendinosus, semimembranosus)

SOCCER FOCUS

Bodyweight squats have several benefits. They are simple to execute and safe for young players, and they provide technical refinement for adding weight as the player progresses. Bodyweight exercises are useful in the absence of equipment. Strength can be increased by adding more repetitions. Increasing lower-limb strength and core stability are crucial to increased, sustained performance and injury prevention. Physically, acceleration, deceleration, jumping, landing, and changing direction can all be performed more efficiently and more frequently. Technically, shooting, range of passing, volleying, and protecting the ball can also be improved.

SPLIT-LEG SQUAT



Execution

1. Stand on one leg in front of a stability ball. Reach back with the other leg, placing the ankle or shin on top of the ball.
2. Flex the forward knee to about a 90-degree angle while rolling the ball back a bit with the trailing leg to prevent your forward knee from going beyond your foot.
3. Return to the starting position.

Muscles Involved

Primary: Quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gluteus maximus

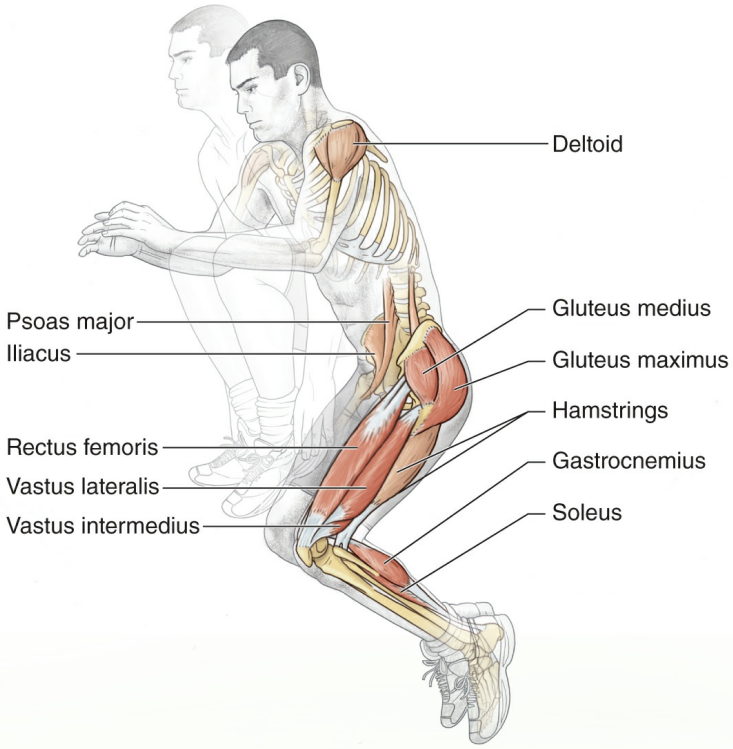
Secondary: Hamstrings (biceps femoris, semitendinosus, semimembranosus), adductors, erector spinae, gastrocnemius, soleus

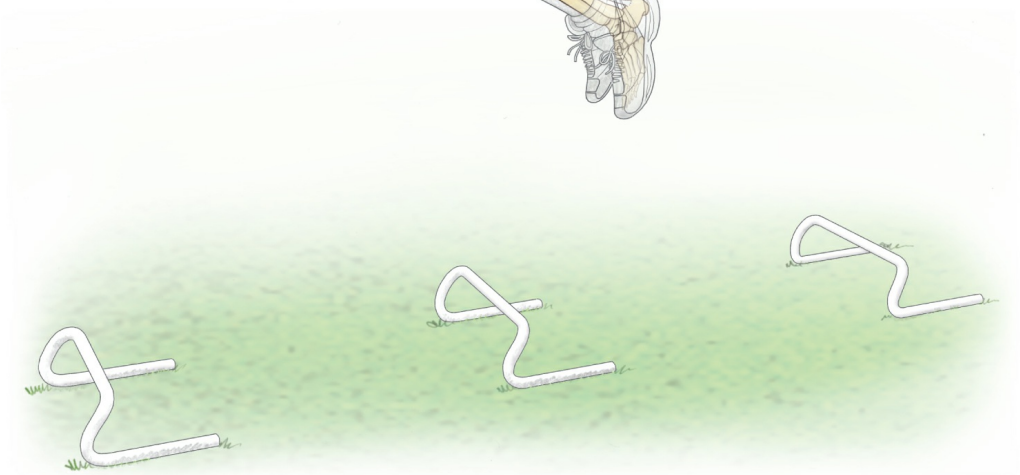
SOCCER FOCUS

Motor control of the knee is emphasized repeatedly in soccer, and this exercise is a

good test of your ability to control your knee during a functional movement. The knee should not waver to the right or left nor should it completely cover the foot. The strength and balance required by an exercise such as this should help control the lower body during the ballistic and reactive actions of cutting and landing from jumps, adding even more protection to the knee. Use a spotter or support if needed when assuming the starting position. Good balance and quad strength are needed for this exercise, so if either is lacking, this might not be the best initial option until you have improved both. Carrying dumbbells in each hand or an unloaded barbell on the shoulders, adding weight as strength improves, can make this exercise even more difficult.

LOW HURDLE





Execution

1. Set up a series of hurdles in a straight line, 3 to 5 feet (about 1 to 1.5 m) apart.
2. Approach the first hurdle with a step or two, and jump over the hurdle. Use a two-foot takeoff and landing. You will need to tuck your legs up to your chest to clear each hurdle.
3. Jump the subsequent hurdles with as little time on the ground as possible between hurdles. Think of this more as a series of rebounds than separate jumps.

Muscles Involved

Primary: Gluteus maximus, gluteus medius, quadriceps (vastus medialis, vastus

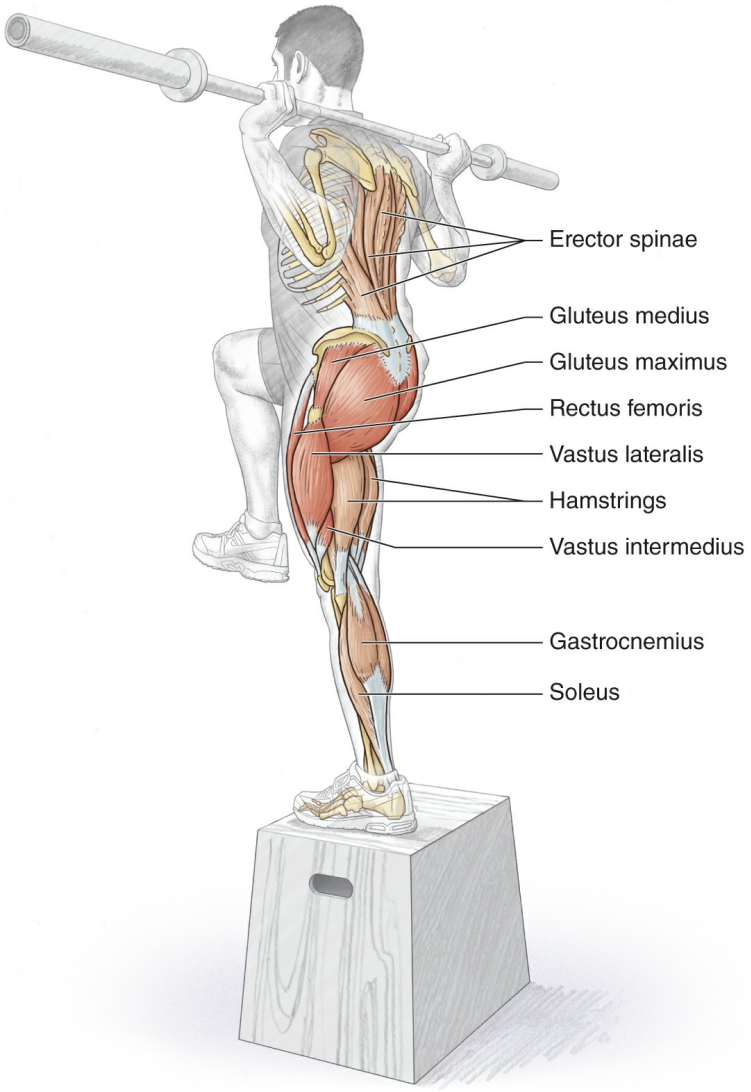
lateralis, vastus intermedius, rectus femoris), gastrocnemius, soleus

Secondary: Hip flexors (rectus femoris, psoas major and minor, iliacus, sartorius), erector spinae, deltoid, hamstrings (biceps femoris, semitendinosus, semimembranosus)

SOCCER FOCUS

Repeated jumping is a common training task across generations of soccer players, and it benefits players in many ways. For example, each takeoff helps improve leg strength for jumping. Each landing teaches the player how to land safely if the coach is watching and offering advice on landing form. Functional and reactive balance is required throughout the task. An understanding of the length of the legs and the force needed to clear each hurdle keeps the player from falling or working too hard. The plyometric aspect makes this task one of the best functional exercises for improving jumping ability. (Plyometric exercises apply a stretch right before the muscle contracts. This makes the subsequent jump higher. If you squat and hold the position and then jump, you will not jump as high as if you squatted and immediately jumped with no pause. The pause negates the effect of the stretch during the squat.) This exercise features reciprocal jumps over hurdles, but the same concept can be used with a speed ladder or back-and-forth or side-to-side movements across a line. Some coaches still ask players to jump over a ball, but this is not advised because landing on the ball can cause any number of injuries.

STEP-UP



Execution

1. Stand in front of a bench or box that is between shin and knee height. Using an overhand grip, hold an unweighted bar on your shoulders.
2. With the lead leg, step up onto the bench or box. Continue the step-up until the lead leg is straight, but keep raising the trail leg, knee flexed, until the thigh is parallel to the ground. The trail leg does not touch the bench or box.
3. Step back down, leading with the trail leg.
4. Switch legs, and then repeat, leading with the opposite leg.

Muscles Involved

Primary: Quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gluteus maximus, gluteus medius

Secondary: Erector spinae, hamstrings (biceps femoris, semitendinosus, semimembranosus), gastrocnemius, soleus, adductors

SOCCER FOCUS

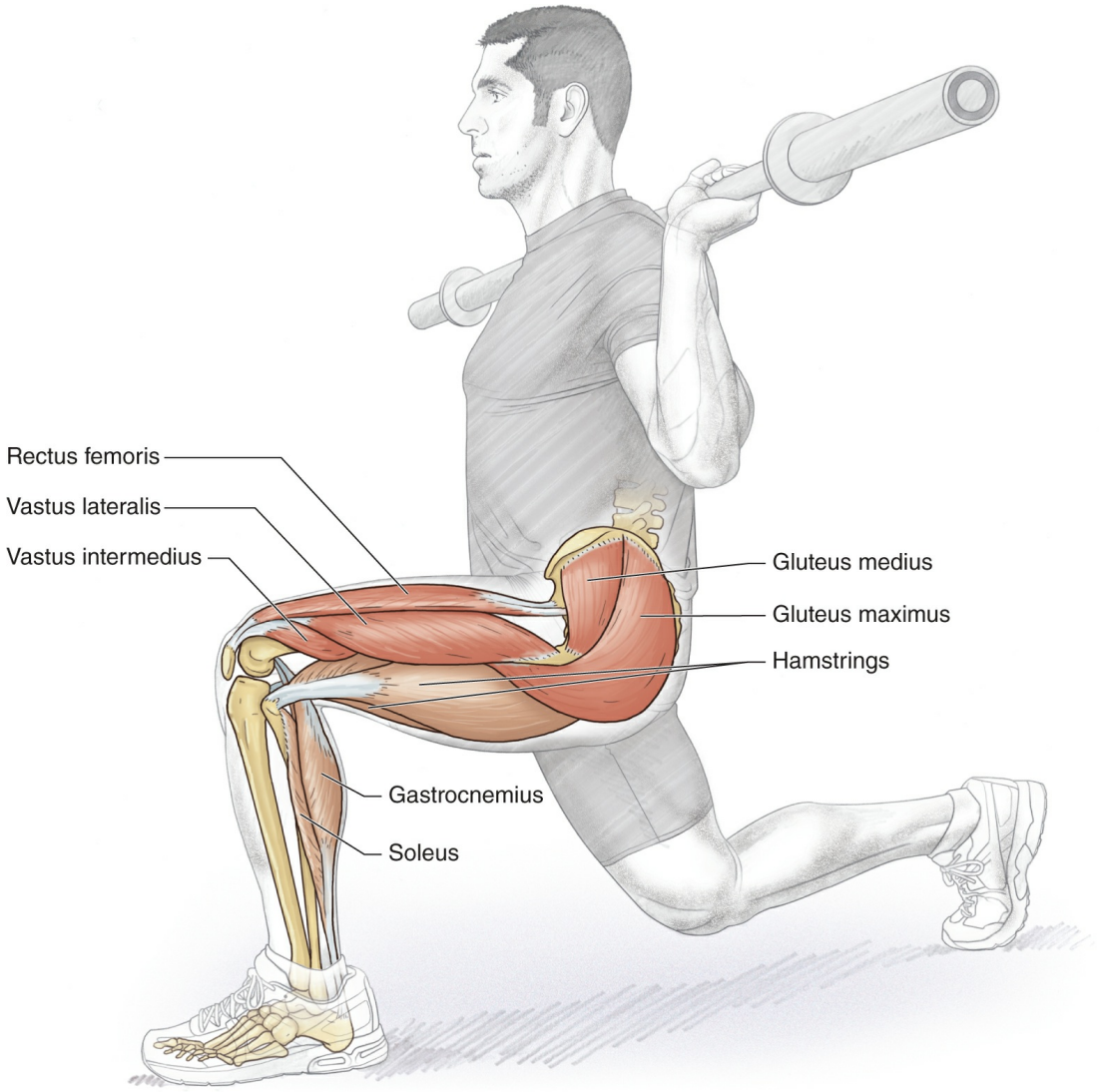
We all know that the dominant hand is the one we write with, but which is your dominant leg? Is it the leg you use for your hardest goal kick or the leg you use to take off for a long jump? Most of us have a dominant leg that works more than the nondominant leg when both legs are active at the same time. Single-leg exercises have some advantages over exercises that work both legs simultaneously. When the legs work one at a time to provide all the force, each leg gets worked equally without one picking up the slack for the other, although the entire exercise does take a little longer. And the benefits are not just for strength. Each leg is required to apply motor control of the knee and whole-body balance, two important factors for preventing injury, especially to the knee. Pay close attention to posture for safety as well as core stability.

VARIATION

Lateral Step-Up

Beginning with a box or bench of appropriate/variable height to the left, balance on the right leg. Step sideways onto the box with the left foot. Shift your weight onto the left leg, pushing through the left heel. Ensure the left knee remains centered over the left ankle while the right knee is lifted to hip height. Return the right foot to the floor, shifting the weight and the body back to the starting position. The lateral step-up can also be progressed by adding dumbbells.

FORWARD LUNGE



Execution

1. Hold a barbell in an overhand grip. Stand and place the barbell on your shoulders.
2. Step forward far enough so that when the lunge is complete, your leading knee is at a 90-degree angle and that thigh is parallel to the floor. The trailing knee will likely be just above the floor.
3. Step back to return to the starting position. Repeat with the opposite leg. Alternate legs on each lunge.

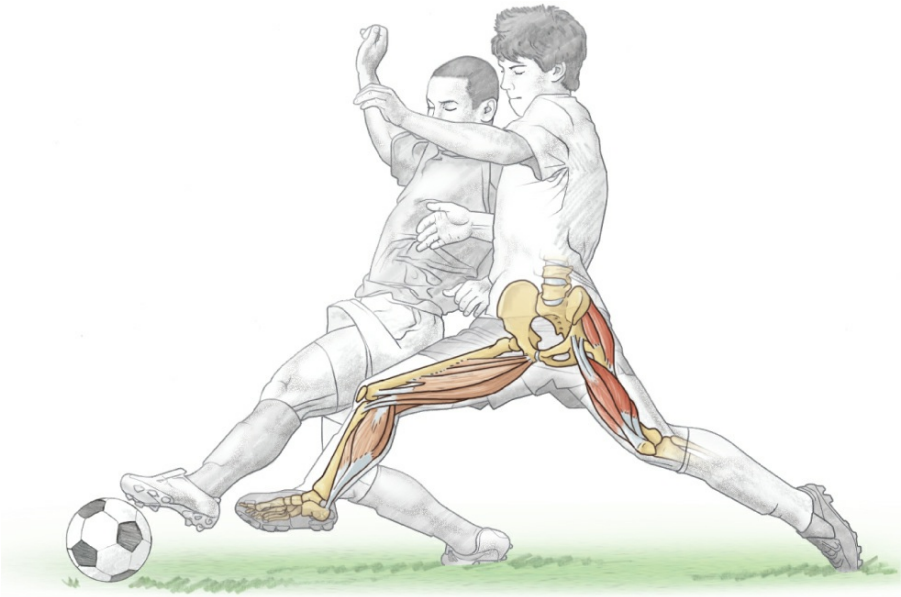
Muscles Involved

Primary: Gluteus maximus, gluteus medius, quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris)

Secondary: Erector spinae, hamstrings (biceps femoris, semitendinosus, semimembranosus), gastrocnemius, soleus, adductors

SOCCER FOCUS

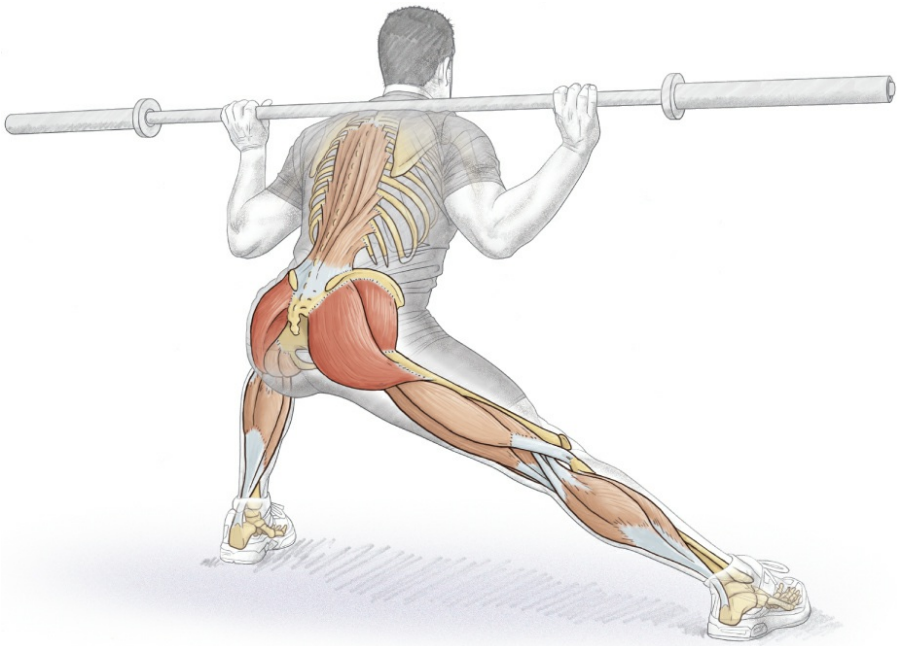
This exercise differs slightly from the lunge in chapter 3, which is used for dynamic flexibility of the hip and groin. In this version, you stay in one place and use a bar. This variation is more of a strength exercise and is highly valued by conditioning experts who create programs for the eccentric, concentric, and balance requirements of a number of different sports. Keep the back straight, and keep the head up and looking forward. At the end of the lunge, do not allow the leading knee to go beyond the toes or wobble across the long axis of the foot. Poor strength or fatigue can affect proper execution. If you struggle to perform the lunge correctly, reduce the load being carried, shorten the length of the lunge, or allow more recovery time between lunges to prevent fatigue.



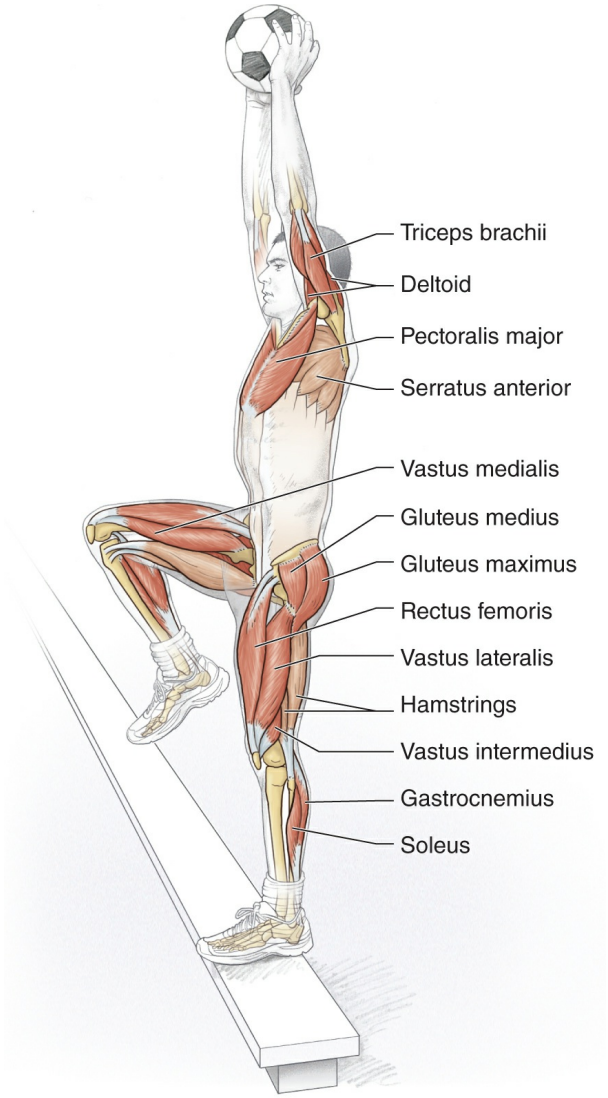
VARIATION

Side Lunge

Being able to control the knee during a change of direction is an important feature of knee injury prevention. When doing a side lunge, the knee of the leading leg must be over the supporting foot and not wobbling back and forth.



GOALIES



Execution

1. Stand in front of a low bench. Hold a soccer ball in both hands.
2. In a smooth motion, step up onto the bench with your lead leg, continuing the step-up until the knee of the lead leg is fully extended. Swing the trailing flexed knee as high as possible as you fully extend both arms overhead.
3. Reverse this smooth movement to return to the starting position.
4. Switch legs, and then repeat, leading with the opposite leg. Alternate legs with each repetition.

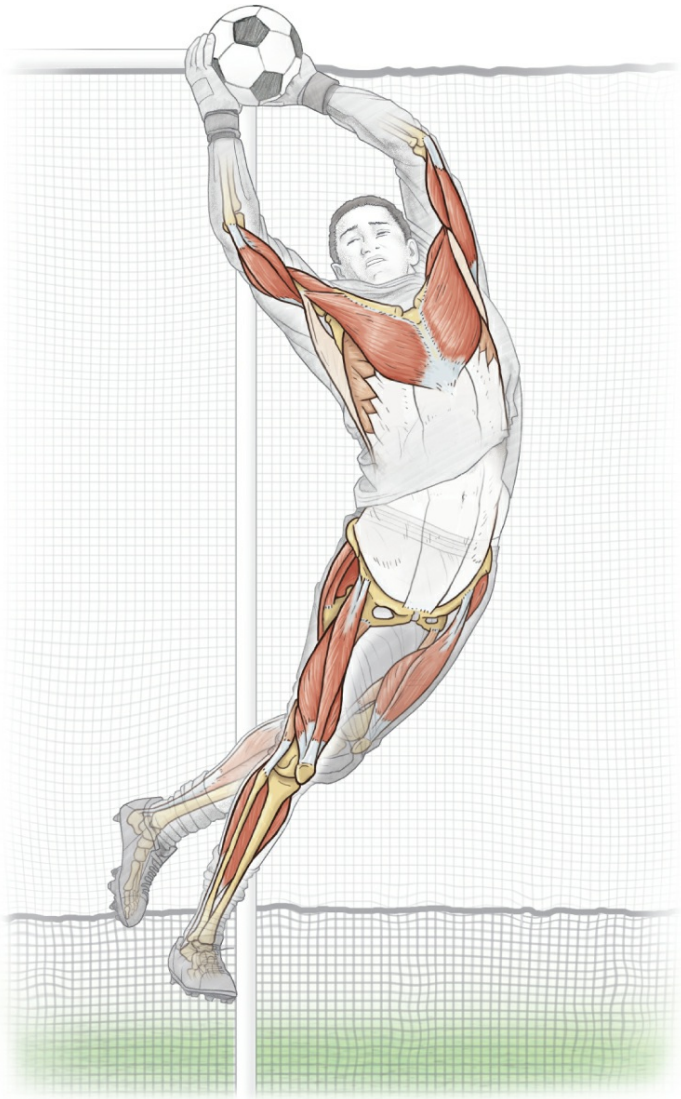
Muscles Involved

Primary: Quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gluteals (gluteus maximus, medius, and minimus), gastrocnemius, soleus, deltoid, triceps brachii, pectoralis major

Secondary: Hamstrings (biceps femoris, semitendinosus, semimembranosus), erector spinae, trapezius, serratus anterior

SOCCER FOCUS

As the name suggests, this exercise is great for goalkeepers, but it is useful for all players. Think about all the key movements needed to run and jump for a ball in the air. The main difference between a field player and a goalkeeper is that the goalie gets to reach up with the arms and hands. Both the field player and the goalkeeper must approach the area, plan the timing, decide which is the best takeoff leg, gather for the jump, extend and push off to leave the ground to contact the ball at the top of the jump, and then safely land. The emphasis of this exercise includes everything up to the takeoff and is an efficient way to incorporate the various individual lower-extremity exercises into one functional task.

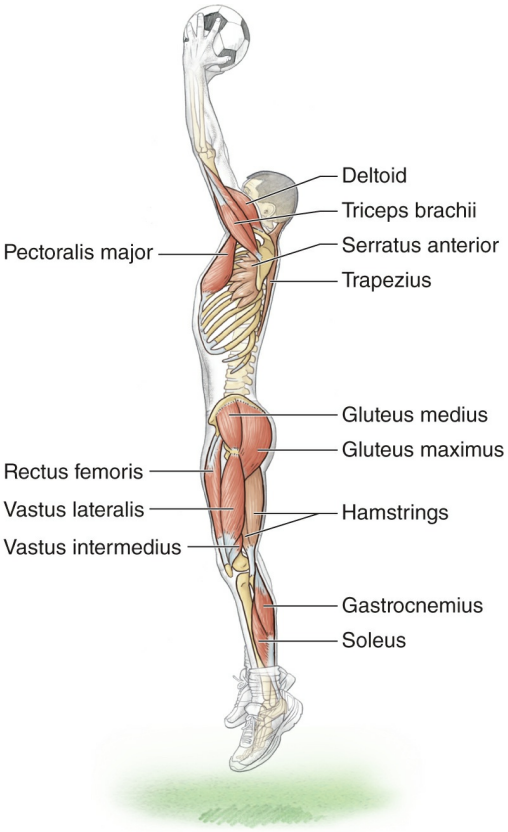


VARIATION

Stadium Stair Goalies

A reasonable alternative uses stadium or bleacher steps, and you carry dumbbells instead of a ball. Take every other step, pressing the dumbbell in the hand opposite the stepping leg. You may choose to raise both arms on each step.

REBOUND JUMP



Execution

1. You will need a partner for this exercise. Face your partner, who is holding a soccer ball.
2. Your partner forcefully bounces the ball on the ground. Using a two-leg takeoff, jump and catch the ball at the top of your jump.
3. Make sure you stick the landing. Do not let your knees wobble back and forth over your feet when you contact the ground.
4. To avoid fatigue from frequent maximal jumps, it is best for you and your partner to alternate jumps.

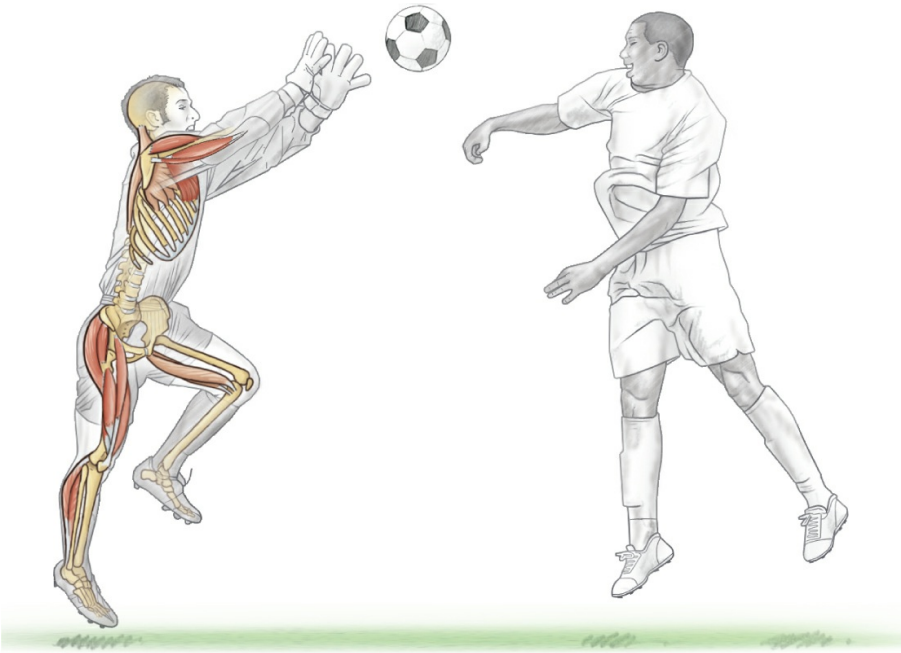
Muscles Involved

Primary: Quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gluteals, gastrocnemius, soleus, deltoid, triceps brachii, pectoralis major

Secondary: Hamstrings (biceps femoris, semitendinosus, semimembranosus), erector spinae, trapezius, serratus anterior

SOCCER FOCUS

The rebound jump exercise might be considered a functional extension of the goalies exercise (page 208), which did not require you to actually leave the ground. The rebound jump exercise requires significant timing because so much has to happen for you to get to the takeoff point, jump, and catch the ball at the peak of your jump, as a goalie might do during a match. This usually requires some movement on the jumper's part (the bounce rarely goes straight up) and correct timing to coordinate the ball's descent and your takeoff so you can catch the ball as high as possible. But it doesn't end there—you have to land safely. Many of the exercises in this book require that the knees flex and be over the feet when landing so that the knees do not wobble back and forth. Although all your attention is on the jump and catch, you can't forget about the landing. Try to land quietly, absorbing the shock of impact. Most players like the challenges—the bounce, the jump, and the landing—of this exercise.

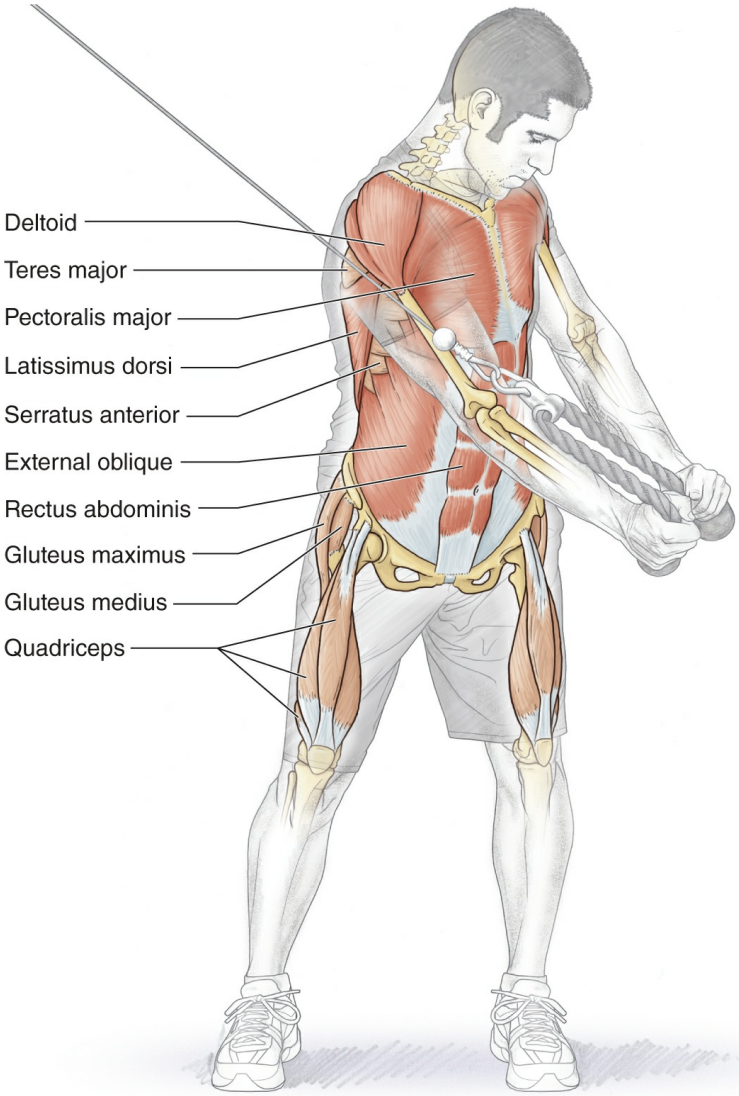


VARIATION

Single-Leg Rebound Jump

A simple variation is to use a single-leg takeoff. In most instances, the two-leg rebound jump is done when the ball is bounced nearly straight up. For this variation, the ball should be thrown to the ground in such a way that you have to run a little and jump for the ball from a single-leg takeoff, landing on both feet.

WOODCHOPPER



Execution

1. Stand sideways to and a slight distance from a high pulley. Lift your arms to grasp the rope, strap, or handle with both hands.
2. Start by pulling the rope down and across your body. As your hands pass your shoulders, twist the trunk and crunch your abdominals. Flex your knees slightly as you continue this diagonal pull toward the opposite knee.
3. Slowly and under control, reverse the movement to return to the starting position. After completing the desired number of repetitions, turn around, and then repeat the exercise in the opposite direction.

Muscles Involved

Primary: Rectus abdominis, external oblique, internal oblique, deltoid, latissimus dorsi, pectoralis major

Secondary: Quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gluteals, teres major, serratus anterior

SOCCER FOCUS

This whole-body exercise has many benefits. The action recruits the arms, trunk, gluteals, and quads in a stepwise, coordinated movement. There are no shortcuts, as one action must precede the next. On the surface, the arms and abdominals seem to be the focus, but the legs also play an important role as the base around which the actions occur. Pay attention to the position of the knees over the feet, and don't let the knees wobble back and forth. This functional exercise involves multiple muscles and actions. Multijoint activities such as this are very useful supplemental exercises for the whole-body demands of team sports such as soccer. Some instructions do not include trunk flexion and the squat, making it an arm extension and trunk rotation exercise.

VARIATIONS

Reverse Direction and Seated Options

On most machines, the pulley system can be reversed so the action is low to high. This exercise can also be performed while seated, using a medicine ball instead of a pulley system.

11
TOTAL BODY TRAINING FOR SOCCER

Throughout this book, the strength training focus has been on isolating a movement and the muscles involved in that movement. The strength training shelf of any commercial bookstore or library will display dozens of books that show how to train muscles in isolation. This concept ensures that every muscle is fully activated and will adapt to the new imposed demand.

The next step is to incorporate the muscles to function as part of a whole system, sort of the athlete's version of the whole being greater than the sum of its parts. Athletic performance is not done in isolation. Rather, the whole of performance is greater than the sum of the neuromuscular parts. Performance in sport is a combination of the technique required for that sport, the specific fitness (physical and psychological) for that sport, and the unique tactics for success. Some of these are planned, and some are reactions to the opposition, but all evolve over time as advances force the sport to

change. Any opportunity to involve multiple parts of the whole system will move the player closer to being able to execute the coach's vision of the sport. This is especially crucial in team sports since the outcome is influenced by so many things—each individual player, the interactions of small and large group play, the style of play, the style of the opposition, the referee, the environment, the crowd, and more.

The options presented in this chapter have one common thread: They all require multiple joints, muscles, and muscle actions. No exercise is done in isolation. Coaches who have experience with or exposure to earlier training methods might recognize that similar field-based exercises formed the core of fitness circuits found in coaching books dating back to the 1960s and earlier.

Although players from the old country might remember similar exercises in their training programs, those programs were deficient in the basic training fundamentals: frequency, intensity, duration, and progression. They might have done comparable exercises but can't recall doing things as frequently, as intensely, or for as long as what is currently in vogue. And their training certainly was not periodized over a long competitive calendar. What is seen today is a reincorporation of earlier modes of training into modern training principles.

The goal of these and other whole-body activities is to prepare players for the strategic actions that will lead to success either in scoring or preventing goals. Those actions frequently require high-power output for jumping or sprinting. Repetitive jumping is a plyometric activity, and various versions are used to take advantage of the stretch–shortening cycle that is known to improve power output not just in jumping but also in sprinting. If improvement in sprinting is a goal (and it should be), look at what track sprinters are doing, and you will see plenty of exercises directed toward repetitive jumping.

Incorporating whole-body training tools helps in coordinating the body during the random actions that occur every few seconds in a soccer game. Players will jump, hop, skip, leap, and cut at a moment's notice, often without any conscious thought at the time to the action or reaction. Although it is difficult to plan training to mimic what actually happens when facing a real opponent (as opposed to a teammate in training), it is not difficult to prepare each player's neuromuscular system to be ready to make sudden reactions to unforeseen circumstances during a match. It's the coach's responsibility to make sure each player is as prepared as possible. This is why it's more the norm today to see players doing guided activities that on the surface appear unrelated to the game. These might involve benches, hoops, hurdles, speed ladders, and other tools of the trade that will teach players to use their bodies efficiently with as few unnecessary movements as possible. Although the running form of a soccer player will rarely be mistaken for the smooth and efficient form of a sprinter, a comparison of soccer video

clips from a few decades ago to today's game should be proof enough that the training, coordination, and athleticism have advanced considerably.

Despite all the training advances of the past 25 years, none of them will produce the desired benefit if coaches and players fail to heed the lessons of experts in other supplementary aspects of performance. Consider the following:

• Research has shown that as little as 2 percent dehydration can impair performance. Don't use the running clock in soccer as an excuse not to drink during a match. There are plenty of dead-ball opportunities to take a drink. On really hot days, the referee has the authority to stop play for a fluid break. A water break is part of the rules in many youth leagues during hot and humid conditions, and FIFA began taking water breaks during especially sweltering World Cup games in 2014.

• It has been reported that between 25 and 40 percent of soccer players are dehydrated before they even step on the field for training or competition because they have failed to adequately rehydrate after the previous day's training or competition.

• Muscle requires fuel, and the primary fuel for a sport such as soccer is carbohydrates. Restricting carbohydrates will only hinder performance. Players who enter the game with a less than optimal tank of fuel will walk more and run less, especially late in the match when most goals are scored. For some reason, team sport athletes are not as conscientious about their food selections as individual sport athletes are.

• Injuries increase with time in each half, suggesting a fitness component to injury prevention. One aspect of injury prevention is to improve each player's fitness. Players should arrive at camp with a reasonable fitness level so that the coach can safely increase the fitness of the players even further through directed preseason training. Many teams have a very dense competition schedule, making it hard to increase fitness further during the season. Those who try to improve fitness each week with too much high-intensity work during a match-dense season risk acute and overuse injury, poor performance, slow recovery, and the possibility of overtraining.

• Some reports suggest that less skilled players suffer more injuries than more highly skilled players. Thus, another way to prevent injuries is to improve skill.

• Take the time to do a sound warm-up such as The 11+ outlined in chapter 3 (page 36). Tangible rewards should be realized when a warm-up is included as a regular component of training; there are no guarantees when it is done infrequently. Most coaches are good at planning a training session but neglect guiding the team through a good warm-up. And don't forget to warm up again for the second half. Teams that do not warm up again tend to play a little ragged in the opening 5 to 15 minutes. If your team takes about five minutes to warm up prior to the second half, your team will be more ready to play than an opponent. Teams that don't warm up again spend the first 10

minutes or more of the second half warming up for the rest of the match, which presents an opportunity for your team.

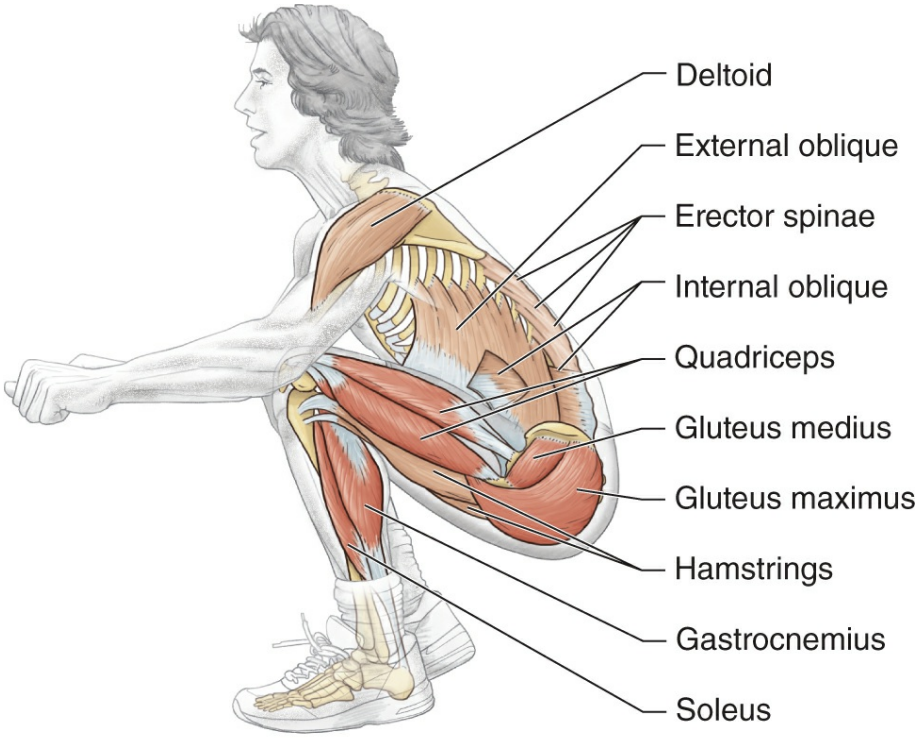
• The most dangerous part of soccer is tackling. Research has shown that the most dangerous tackles involve jumping, leading with one or both feet with the studs exposed, and coming from the front or the side. (Head-to-head contact is also dangerous. See the next item.) A simple axiom to remember is bad things happen when you leave your feet. Players should stay on their feet and not imitate what they see in professional games.

• Don't take head injuries lightly. Head-to-head, elbow-to-head, ground-to-head, goalpost-to-head, or accidental ball-to-head impacts are dangerous. You cannot see a concussion like you can see a sprained ankle. A player who experiences one of these head contacts should be removed from the game immediately and not be allowed to resume play until everyone is sure about his safety. The best advice is: When in doubt, keep them out. In the United States, many states are following the lead of the state of Washington, passing laws requiring written medical clearance before a player is allowed to return from a concussion. Don't mess around with head injuries. No game is that important. And make sure you follow the U.S. Soccer age-based restrictions on heading.

• Exercise some common sense when it comes to training. For example, use age-appropriate balls. Older players shouldn't train with younger players. The younger players will get run over or hit with high-velocity passes and shots. Next, the best predictor of an injury is a history of an injury, so an injured player should be fully recovered before returning. An incompletely healed minor injury often precedes a far more serious injury. Be smart; stand on a chair or ladder to put up or take down nets. The combination of jumping, gravity, rings, and net hooks is an invitation to a pretty severe laceration. Finally, never allow anyone to climb on goals. There have been serious injuries and even deaths because kids were playing on unanchored goalposts.

TOTAL BODY TRAINING

KNEE TUCK JUMP



Execution

1. Choose shoes with good cushioning, and jump on a forgiving surface.
2. Using a two-foot takeoff, jump as high you can. Bring your knees as close to your trunk as possible. Use the arms for balance during flight.
3. Land softly to absorb the impact, and then quickly take off again. Spend as little time on the ground as possible. This exercise is simply reciprocal vertical jumps.

Muscles Involved

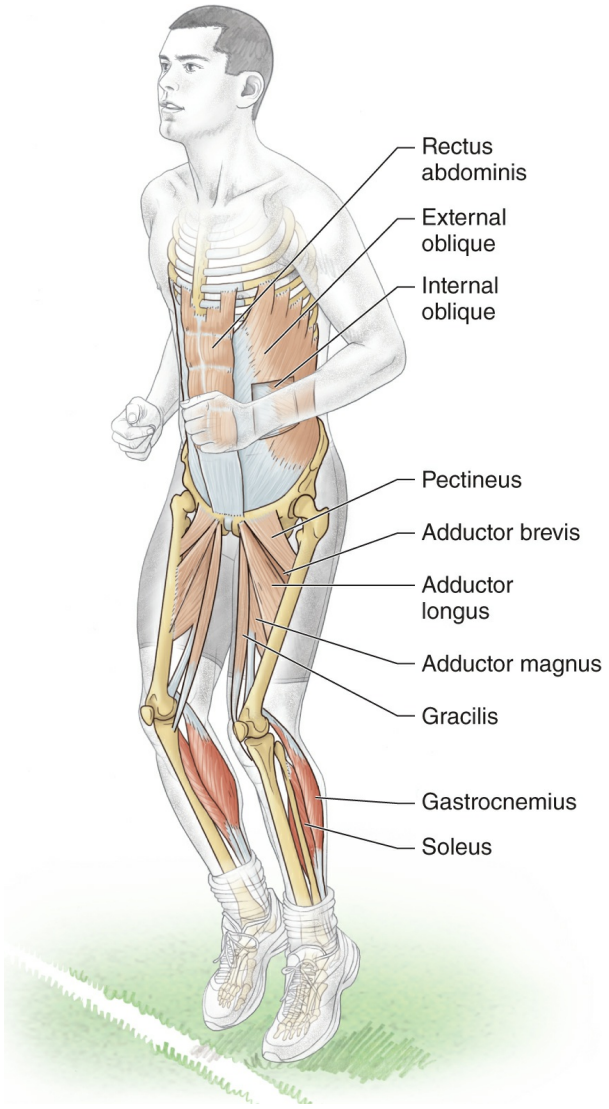
Primary: Quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gastrocnemius, soleus, gluteus maximus, gluteus medius, hip flexors (psoas major and minor, iliacus, rectus femoris, sartorius)

Secondary: Abdominal core (external oblique, internal oblique, transversus abdominis, rectus abdominis), erector spinae, hamstrings (biceps femoris, semitendinosus, semimembranosus), deltoid

SOCCER FOCUS

Most books state that soccer is an endurance activity. With a 90-minute running clock (even though the ball is in play for only 70 minutes at most) and no stoppages, the game does have a significant endurance component. But games are won and lost by high-power bursts of activity—executing a short 10- to 20-yard (10 to 20 m) dash to the ball or outjumping an opponent for a corner, for example. Although these opportunities do not occur very frequently, players need to be ready when the time comes to execute high-power output multiple times during a match. Many exercises train for high-power output. Some involve an apparatus, and others are deceptively simple but very effective. Other exercises in this book involve jumping. Performing this exercise effectively requires you to jump as high as you can, pull your thighs up to your trunk, and then land softly and quietly. One jump is tough enough, but multiple jumps are very challenging. As you develop more power, you will find yourself jumping higher with each jump. As your legs develop local endurance, you will find yourself able to do more repetitions. Perform this exercise sparingly, when you have two or more days to recover before the coming match.

REPETITIVE JUMP



Execution

1. Stand facing or right beside the touchline or end line on the pitch.
2. Using a two-foot takeoff, jump back and forth or laterally just barely across the line.
3. Upon ground contact, jump back across the line as quickly as possible. This movement is very rapid, with little flight time and minimal ground-contact time.
4. Rather than count the number of ground contacts, do these jumps as rapidly as possible for a defined number of seconds, adding time as fitness improves.

Muscles Involved

Primary: Gastrocnemius, soleus

Secondary: Abdominal core, erector spinae, adductors (adductor longus, adductor magnus, adductor brevis, pectineus, gracilis)

SOCCER FOCUS

Endurance, power, speed, agility—soccer requires virtually every aspect along the spectrum of fitness. Fast footwork is quickly becoming a part of skill training programs. You are asked to do a wide range of activities with as many ball contacts as possible in a short period of time. The player who has done these exercises knows that the physical demands of fast footwork training can be very tiring. Short, rapid touches in a very short time tax the ability of the body to produce energy rapidly. Exercises performed as fast as possible in a confined space prepare you for this kind of work.

VARIATIONS

Traveling Options

This exercise simply takes you back and forth across a line on the ground. You can think up any number of variations such as traveling up and down the line; performing two touches on each side of the line; or imagining a shape on the ground and touching each corner, forward and back, adding a half spin. Use your imagination; just remember the keys—minimal flight and ground time. Increase the duration as fitness improves. You will be surprised at how quickly you see improvements.

DEPTH JUMP

Execution

1. Choose a low box, about 12 inches (30 cm) tall.
2. Stand on the box with your legs about shoulder-width apart, hands and arms at your sides.
3. Step straight off the box. Land on both feet at the same time, bringing your hands up in front of you.
4. Absorb the impact of the landing by bending at the ankles, knees, and hips, sticking the landing so there are no adjustments to the impact.
5. Return to the box, and then repeat the exercise.

Muscles Involved

Primary: Hip flexors, quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gastrocnemius, soleus, adductors

Secondary: Erector spinae, abdominal core

SOCCER FOCUS

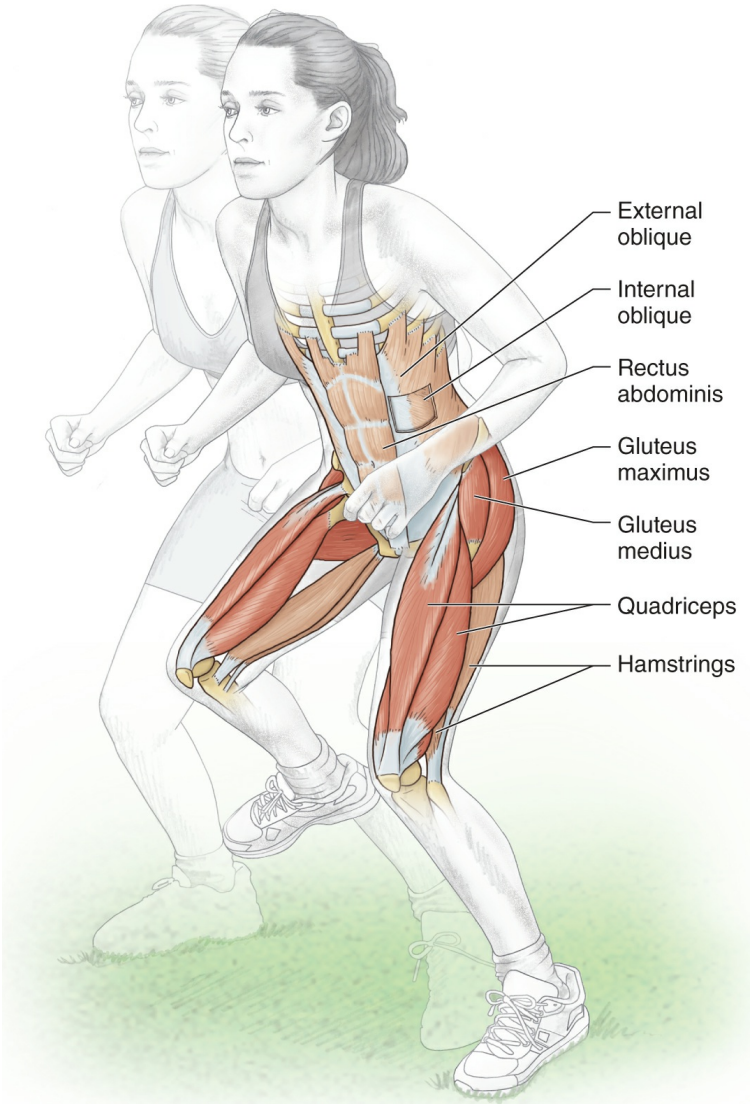
Injury prevention is a theme of this book. Prevent injuries to keep playing and improve your game. At the core of injury prevention is neuromuscular control of the knees and the surrounding joints such as the ankles, hips, and trunk during demanding activities such as landing from a jump or cutting to change direction. Your goal for this exercise is to control the impact and not allow the knees to wobble right or left when landing. In addition, it is important to begin absorbing impact at the ankle and to not let the trunk waver during landing. If either of these surrounding joints shifts inappropriately, the knee must adjust, and this adjustment could put the knee in a poor position that could cause damage. Your coach should watch you when you perform this exercise to make sure your form is correct. Remember, these are single landings.

VARIATION

Rebound Depth Jump

This is more of an extension of the depth jump than it is a variation. After landing, immediately jump up to another bench of similar height. This changes the depth jump from a shock-absorbing eccentric exercise to a plyometric task.

SPEED SKATER LUNGE



Execution

1. Stand with your legs about shoulder-width apart, with your hands on your hips or out to the sides for balance.
2. Keeping your trunk erect and straight, jump slightly, and lunge to your right, landing on your right foot. Your left foot is off the ground, and you are balanced entirely on your right foot.
3. Pause briefly, and then repeat the exercise, jumping and lunging to your left.

Muscles Involved

Primary: Gluteus maximus, gluteus medius, quadriceps (vastus medialis, vastus

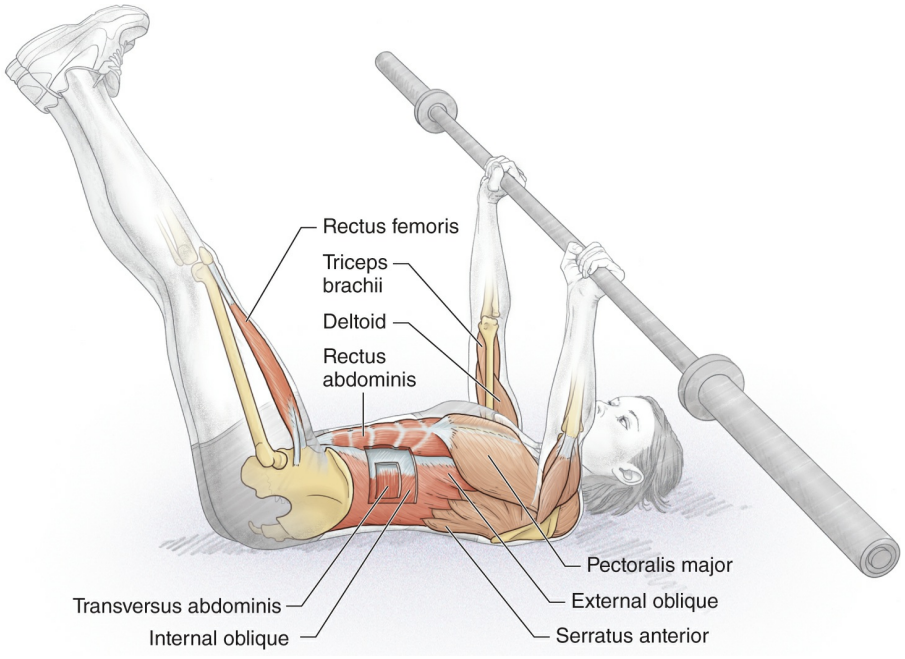
lateralis, vastus intermedius, rectus femoris)

Secondary: Erector spinae, hamstrings (biceps femoris, semitendinosus, semimembranosus), abdominal core

SOCCER FOCUS

This really is a whole-body exercise because it requires the legs to propel the sideways lunge; the core to stabilize the trunk during takeoff, flight, and landing; and the arms and shoulders for balance. With time, you will begin to notice improvements in lateral quickness and agility. During a match, you don't do much conscious thinking about your movements. You may find yourself dribbling at speed when a defender you didn't notice pops up to challenge you. In an instant, you plant a foot and lunge far in the opposite direction while redirecting the ball into your path. You never actually think about the movement; it just happens. The pace of your play and the ability to veer quickly and decisively away from your opponent can be drastically improved with simple exercises such as this. You will soon see an increase in the distance of the lateral lunge and the stability of landing as your strength and neuromuscular control improve.

FLOOR WIPER



Execution

1. Lie on your back, holding an unweighted barbell above your chest. Arms are straight.
2. Without moving the barbell, raise your straight legs up toward one end of the barbell.
3. Keeping your legs straight, lower them back to the floor.
4. Repeat, raising your legs to the opposite end of the barbell. Moving the legs right and left counts as one repetition.

Muscles Involved

Primary: Abdominal core, rectus femoris, psoas major and minor, iliacus

Secondary: Sartorius, pectoralis major, triceps brachii, deltoid, serratus anterior

SOCCER FOCUS

In the Soccer Focus section for the V-sit soccer ball pass (page 79), we mention a series of movies from the 1970s referred to as the Pepsi Pelé movies. Within this excellent series of training films was a group of abdominal exercises that were part of a Brazilian circuit training protocol. This exercise is very similar, only instead of holding the ankles of a standing partner as the Brazilians did, you hold a barbell overhead and perform hip and trunk flexion combined with a little trunk rotation. Most of the

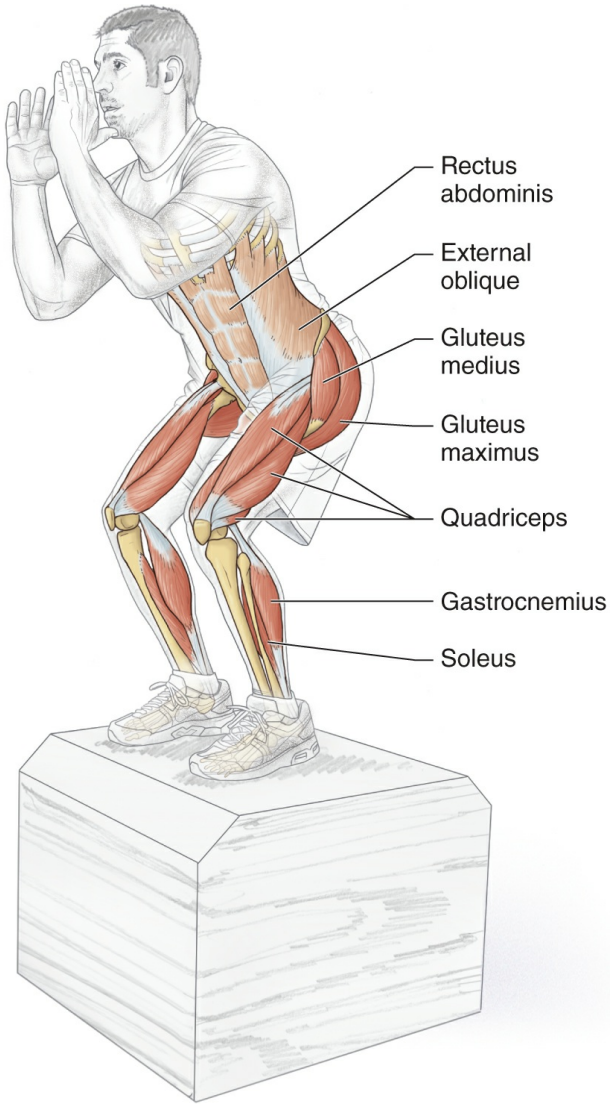
abdominal exercises in the Pepsi Pelé movies isolated the abdominals, but this exercise recruits multiple muscles of the core, making it a good bang for your exercise buck. Don't take this exercise lightly. It is quite challenging, especially when you realize the hard part of the action restricts your breathing. Don't forget that the bar stays overhead the entire time.

VARIATION

Floor Wiper With Dumbbells

This is the same exercise but with dumbbells. Holding a weight in each hand requires the arms and shoulders to balance each arm individually. Keep the arms overhead and the elbows extended as you perform the exercise as you would with a barbell.

BOX JUMP



Execution

1. Stand in front of a sturdy box—one that will not tip over—that is midshin to knee height.
2. Using a two-foot takeoff, jump high onto the box, landing on both feet. Don't jump just high enough to land on the box. Jump higher so you are coming down on the box.
3. Jump back to your starting point, landing softly and quietly to absorb the force of the landing.
4. Repeat in a continuous, nonstop motion. Start with 5 to 10 seconds, and add time as fitness improves.

Muscles Involved

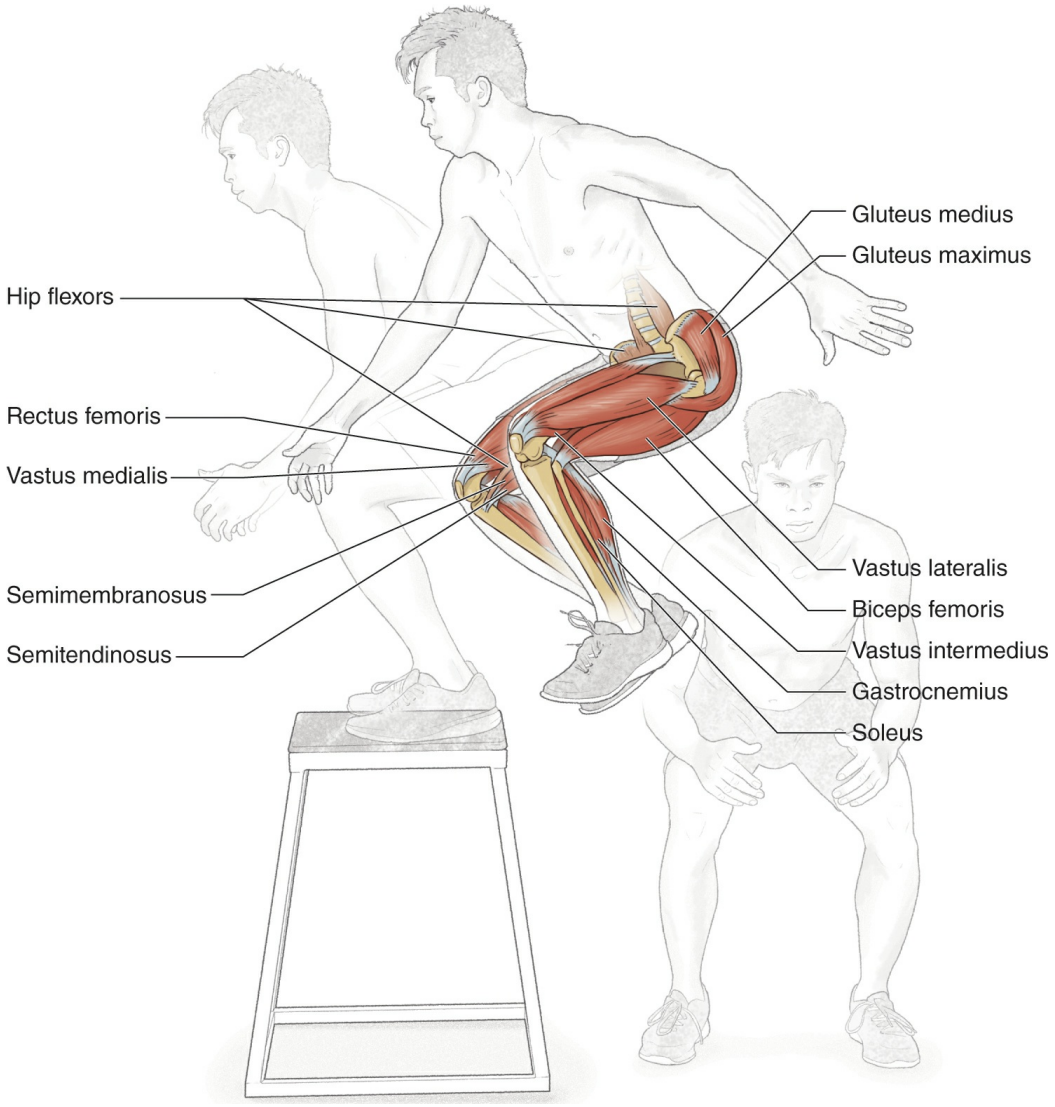
Primary: Quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gluteus maximus, gluteus medius, gastrocnemius, soleus

Secondary: Abdominal core, erector spinae, hip flexors

SOCCER FOCUS

Modern soccer is a mix of high-power-output activities surrounded by more endurance-oriented running. A sought-after trait is the desire and ability of each player to press everywhere on the field. Upon losing possession, the player, often with one or two teammates, will press the opponent on any number of levels (e.g., to immediately regain possession; to close down to occupy the opponent and keep the ball in front; to rapidly close down to force an errant pass; or to close down a player and delay forward movement, allowing teammates to recover). In each case, pressing the opponent requires a fast, controlled approach featuring a short-term period of very high-power output. This kind of work is very intense, but it can have important and nearly immediate outcomes when the opponent makes a mistake and a teammate collects the ball. The challenge is to develop sufficient fitness to press, and press appropriately, when the need arises. Nearly every coach will say how hard it is to get a player to press when that player has lost possession of the ball. Part of this is frustration or disappointment at having lost possession, but it also may stem from a lack of fitness. Jumping exercises such as this require a very high-power output that when used in combination with similar work on and off the ball should help put a team into the position of being very effective at pressing.

ROTATIONAL BOX JUMP



Execution

1. Stand sideways to the right of a box.
2. Jump up off both feet.
3. While in the air, rotate to the right, and land with both feet on the box.
4. Jump off the box, and rotate back to the starting position.
5. Repeat, facing the opposite direction.

Muscles Involved

Primary: Quadriceps (vastus medialis, vastus lateralis, vastus intermedius, rectus femoris), gluteals, calves, hamstrings (biceps femoris, semitendinosus,

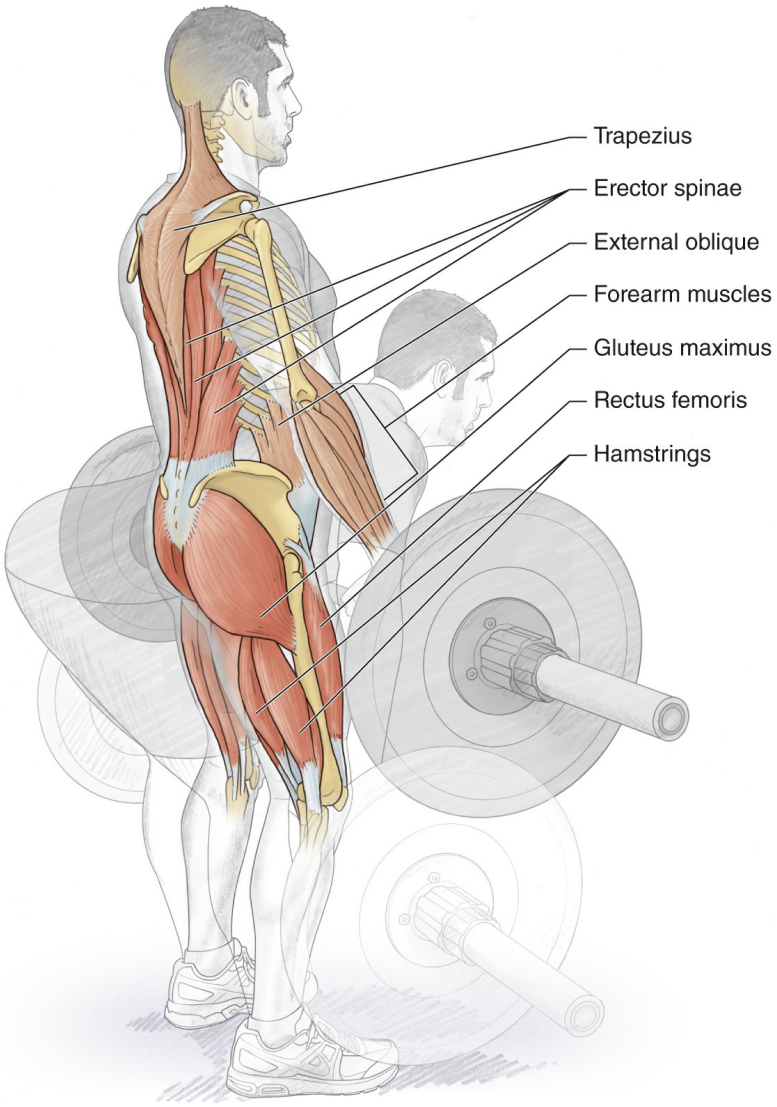
semimembranosus)

Secondary: Hip flexors

SOCCER FOCUS

Box jumps directly replicate soccer-specific movements; for example, jumping to head the ball and landing or jumping to avoid a tackle or onrushing goalkeeper. Box jumps are a bilateral exercise, meaning it is unlikely one leg is favored over the other. Adding rotation to the box jump further increases the scope of soccer-specific activities; for example, landing after a jump to head the ball or after turning in the air to provide a better starting position for the next action. However, the added rotation action makes the exercise more difficult to complete. Safety is paramount. Ensuring control of the body on landing is vital to minimize the risk of injury. Landing off-balance is a risk factor for knee and ankle injuries.

ROMANIAN DEADLIFT



Execution

1. With the barbell on the floor, stand with your feet flat on the floor, shoulder-width apart or slightly less, and toes under the bar and pointed slightly out.
2. Move into a deep squat. With the arms straight, grasp the bar in an overhand grip, palms down. Your back should be flat or slightly arched. Pull your shoulders back and your chest forward.
3. Look forward, and inhale. Pushing through your heels and contracting your quadriceps and gluteals, pull the weight off the floor. Keep your back flat and the bar close. Stand erect, but don't lock your knees. Exhale.
4. Inhale, and slowly lower the bar to the shins. Return to the upright position and

repeat for reps.

Muscles Involved

Primary: Erector spinae, rectus femoris, gluteus maximus, hamstrings (biceps femoris, semitendinosus, semimembranosus)

Secondary: Scapular stabilizers (such as trapezius), rectus abdominis, external oblique, internal oblique, forearm muscles (mostly wrist and finger flexors including flexor carpi radialis and ulnaris, palmaris longus, flexor digitorum superficialis and profundus, and flexor pollicis longus), vastus lateralis, vastus medialis, vastus intermedius

SOCCER FOCUS

The Romanian deadlift is a whole-body exercise found in nearly every training manual across the sporting spectrum. It demands power output from the legs, hips, trunk, and back. If you have never done this lift before, you may think it looks easy, but the use of a barbell increases its complexity by making a smooth motion more difficult. It is a good idea to get some personal instruction to ensure you are doing this lift correctly and safely. Rounding the back during the lift exposes the intervertebral discs to possible herniation, so keep your head up. Looking at the bar leads to a rounded back. Also, do not try to flex the forearms during this lift because it can place unnecessary strain on the biceps. Posture is the key. Don't take any shortcuts with the deadlift. (Note: The single-leg RDL is included as a variation of the toe raise carrying partner exercise in chapter 6.)

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EXERCISE FINDER

THE FIFA WARM-UP

CORE TRAINING

BACKS AND HIPS

LEGS: MUSCLE ISOLATION

SHOULDERS AND NECK

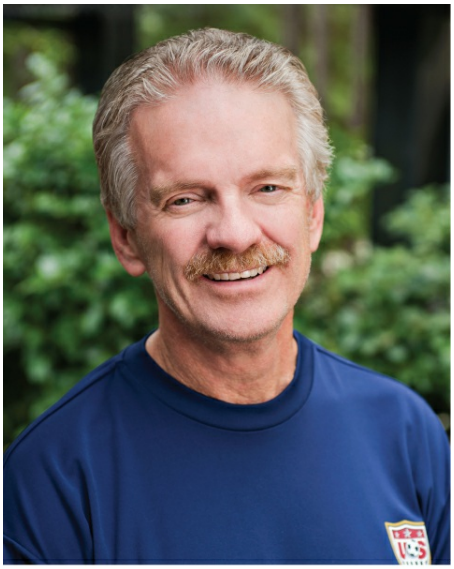
CHEST

ARMS

LEGS: COMPLETE POWER

TOTAL BODY TRAINING FOR SOCCER

ABOUT THE AUTHORS



Peter Mueller

Donald Kirkendall, PhD, received his doctorate in exercise physiology from The Ohio State University and went on to teach human anatomy, physiology, and exercise physiology at the University of Wisconsin at La Crosse and Illinois State University. In 1995 he was recruited to join the sports medicine program at Duke University Medical Center. He went on to join the staff at the University of North Carolina at Chapel Hill (1998-2003). He retired from the Duke Clinical Research Institute in 2015. His research interests focused on sports medicine and physical performance with an emphasis on team sports—especially soccer.

Kirkendall is a member of U.S. Soccer's Medical Advisory Committee, and he was a member of the Fédération Internationale de Football Association (FIFA) Medical Assessment and Research Centre (F-MARC) from 2004 to 2015. He frequently lectured at coaching clinics and to local and national coaching organizations, and he has lectured to audiences in all six of FIFA's confederations.

East Tennessee State

Adam Sayers, PhD, is a faculty member at East Tennessee State University (ETSU) in both the Global Sport Leadership Department and the Department of Sport, Exercise, Recreation, and Kinesiology. Sayers was the head coach of women's soccer at ETSU from 2011 to 2019. In 2018, he became the all-time winningest coach in ETSU history with his 80th win.

Sayers holds the Union of European Football Associations (UEFA) A-level coaching license and the U.S. Soccer Federation (USSF) A-level coaching license and is a sport science staff member with the U.S. youth women's teams, working with the U16, U18, U19, and U20 national teams. Sayers is also certified by the National Strength and Conditioning Association (NSCA) as a Certified Strength and Conditioning Specialist. He has served as a coach educator within the USSF coach education program and with the Tennessee State Soccer Association.

Sayers obtained a PhD in human performance from Middle Tennessee State University in 2006. He has presented his research on various physiological aspects of soccer at national and regional conventions, including the American College of Sports Medicine (ACSM) national meeting and the NSCA National Sport-Specific Training Conference. He has contributed soccer-related articles to peer-reviewed scientific journals as well as coaching journals and websites.