Corrective Strategies for Knee Impairments

**OBJECTIVES**

Upon completion of this chapter, you will be able to:

- Understand basic functional anatomy for the knee complex.
- Understand the mechanisms for common knee injuries.
- Determine common risk factors that can lead to knee injuries.
- Incorporate a systematic assessment and corrective exercise strategy for knee impairments.

**INTRODUCTION**

Lower-extremity injuries account for more than 50% of injuries in college (1) and high school athletes (2), and among lower-extremity injuries, the knee is one of the most commonly injured regions of the body. Researchers have estimated health-care costs to be approximately $2.5 billion annually for anterior cruciate ligament (ACL) injuries (3). To prevent these injuries from occurring and allow for individuals to maintain healthy and physically active lifestyles, it is important to understand the anatomy, causes, and most appropriate corrective exercise strategies for prevention and management. This chapter will review each of these components as they relate to the knee.

**REVIEW OF KNEE FUNCTIONAL ANATOMY**

The knee is a part of a kinetic chain that is greatly affected by the linked segments from the proximal and distal joints. The foot and ankle and the lumbo-pelvic-hip complex (LPHC) play a major role in knee impairment, as the structures that help to form the ankle and hip joints make up the knee joint. This region is a prime example of how alterations in other joints within the human movement system can dramatically affect the movement and increase the stress and injury capacity of another joint, which leads to knee impairments.
Bones and Joints

Looking at the knee region specifically (Figure 13-1), the tibia and femur make up the tibiofemoral joint, and the patella and femur make up the patellofemoral joint. The fibula is also noted as it is the attachment site of the biceps femoris, which crosses and affects the knee.

Proximally, the femur and the pelvis make up the iliofemoral joint, and the sacrum and pelvis make up the sacroiliac joint (Figure 13-2). Collectively, these structures anchor the proximal myofascial tissues. These bones and joints are of importance in corrective exercise because they will also have a functional impact on the arthrokinematics of the knee.

Distally, the tibia and fibula help form the talocrural (ankle) joint (Figure 13-3). Collectively, these structures anchor the distal myofascial tissues of the knee. These bones and joints are of importance in corrective exercise because they will also have a functional impact on the arthrokinematics of the knee.

Muscles

There are a number of muscles in the lower leg and lumbo-pelvic-hip complex whose function may be related to the knee (Table 13-1). It is important to restore and maintain normal range of motion and strength, and eliminate any muscle inhibition, to ensure joints are operating optimally. See chapter two for a detailed review of the location and function of these muscles.

Table 13.1 KEY MUSCLES ASSOCIATED WITH THE KNEE

- Gastrocnemius/soleus
- Adductor complex
- Medial and lateral hamstring complex

- Tensor fascia latae/IT-band
- Quadiceps
- Gluteus medius and maximus
COMMON KNEE INJURIES AND ASSOCIATED MOVEMENT DEFICIENCIES

Patellar Tendinopathy (Jumper’s Knee)

Patellar tendinopathy is a common overuse injury (Figure 13-4). It occurs when an individual places repeated stress on the patellar tendon. The stress results in tiny tears in the tendon, which may cause necrotic degenerative change or inflammation in the tendon and pain.

Patellar tendinopathy is an injury common with, but not limited to, athletes, particularly those participating in jumping sports such as basketball (4–8), volleyball (7–10), or long jumping (7,10). Risk factors for patellar tendinopathy include the following (4,10–12):

- Knee valgus and varus
- An increased Q-angle
- Poor quadriceps and hamstring complex flexibility
- Poor eccentric deceleration capabilities
- Overtraining and playing on hard surfaces

Iliotibial Band (IT-Band) Syndrome (Runner’s Knee)

Iliotibial band syndrome (ITBS) is the result of inflammation and irritation of the distal portion of the iliotibial tendon as it rubs against the lateral femoral condyle (Figure 13-5), or less commonly, the greater trochanter of the hip, causing a greater trochanteric bursitis. Inflammation and irritation of the iliotibial band (ITB) may occur because of a lack of flexibility of the tensor fascia latae (TFL), which can result in an increase in tension on the ITB during the stance phase of running.

Iliotibial band syndrome (ITBS) typically is caused by overuse. The injury is most commonly reported in runners as a result of abnormal gait or running biomechanics (13–17), although other athletes (e.g., cyclists, tennis players) also may be affected. Weakness of muscle groups in the kinetic chain may also result in the development of ITBS. Weakness in the hip abductor muscles, such as the gluteus medius, may result in synergistic dominance of the TFL (increasing frontal plane instability). This in turn may lead to increased tension of the ITB and thus increased friction on the tissue, with inflammation being the end result.
Patellofemoral Syndrome

One of the most commonly accepted causes of patellofemoral syndrome (PFS) is abnormal tracking of the patella within the femoral trochlea (Figure 13-6). When the patella is not properly aligned within the femoral trochlea, the stress per unit area on the patellar cartilage increases owing to a smaller contact area between the patella and the trochlea (4). Abnormal tracking of the patella may be attributable to static (i.e., increased Q-angle) or dynamic lower-extremity malalignment (i.e., increased femoral rotation, adduction, and knee valgus), altered muscle activation of surrounding knee musculature, decreased strength of the hip musculature, or various combinations (5–8).

Anterior Cruciate Ligament (ACL) Injury

Beyond the common injuries indicated that are more chronic in onset, recent studies also indicate that altered lower-extremity neuromusculoskeletal control imbalances can increase the risk of acute injuries such as ACL ruptures (Figure 13-7) (9–12). Specifically, peak landing forces were significantly predicted by valgus torques at the knee, women demonstrated decreased relative knee flexor torque during landing compared with men, and women had greater side-to-side differences in normalized hamstring complex peak torque (13). Insufficient neuromusculoskeletal control of lower limb biomechanics, particularly frontal plane control of the knee joint, leads to high-risk patterns in female athletes during execution of common, albeit potentially hazardous, movements (12). These sex differences are evident during landing and cutting in soccer and basketball athletes (14,15). Female athletes also have significant differences between their dominant and nondominant sides in maximum valgus knee angle (14,15).
These differences in valgus measures (ligament dominance) and limb-to-limb asymmetries (leg dominance) reflect neuromusculoskeletal control deficits that may be indicative of decreased dynamic knee joint control in female athletes (14).

Subsequent studies systematically evaluated more proximal neuromusculoskeletal control deficits at the hip and trunk to help determine potential contributing mechanisms to high-risk knee mechanics during landing (16,17). When performing single-leg landing tasks, female athletes demonstrated increased trunk flexion and lateral tilt range of motion. In addition to greater knee abduction angles, female athletes had increased hip frontal plane excursion compared with men during both types of landings (18). The increased hip adduction motion seen in the frontal plane during athletic activities likely contributes to the dynamic valgus knee position that may place the athlete at increased risk of knee injury (17–20).

(Text continues on page 288)
CHAPTER 13

STATIC POSTURE

A key static postural distortion syndrome to look for to determine potential movement dysfunction at the knee is the pronation distortion syndrome. As mentioned in chapter five, this is characterized as possessing flat feet with knee valgus (tibial and femoral adduction and internal rotation). This position of the knee can place excessive stress on the muscles and connective tissue associated with the joint during dynamic movement.

Pronation Distortion Syndrome

TRANSITIONAL MOVEMENT ASSESSMENTS

When performing the overhead squat, the key movement compensations to look for with knee dysfunction includes the knee moving inward (knee valgus) or outward (knee varus).

The knee moving inward during the overhead squat (excessive compensatory pronation) may be indicative of calf, TFL/IT-band, and adductor tightness as well as anterior tibialis, posterior tibialis, and/or gluteus medius and gluteus maximus weakness. Because this compensation could be a result of lower leg and/or hip dysfunction, using the modified version of the overhead squat with the heels elevated would be warranted to determine whether the primary cause is coming from the lower leg or from the hip. As described in chapter six, if the compensation improves with the heels elevated (putting the gastrocnemius and soleus in “slack”), then the primary focus may be at the hip (weakness). If the compensation does not improve with the heels elevated, then the primary area to address may be the foot and ankle complex or the foot and ankle complex and hip in combination. Performing further assessments can help isolate the target area(s).

If the knees move outward during an overhead squat assessment, this may be indicative of tightness in the lateral gastrocnemius/soleus, piriformis, and biceps femoris (externally rotates the tibia and femur) and weakness of the adductors and medial hamstring complex (adducts and internally rotates the femur and tibia).
The single-leg squat is also an important transitional assessment to perform to assess potential injury risks at the knee joint. Having to squat on one leg may show dysfunction not evident when squatting on two feet. Like the overhead squat, the key compensation to look for when performing the single-leg squat is whether the knee moves inward.

**Compensation During Single-Leg Squat, Knee Moves Inward**

**DYNAMIC MOVEMENT ASSESSMENTS**

The tuck jump exercise may be useful to the health and fitness professional for the identification of lower-extremity technical flaws during a plyometric activity (19,21). The tuck jump requires a high level of effort from the individual, which may allow a health and fitness professional to readily identify potential deficits, especially during the first few repetitions when the individual places most of his or her cognitive efforts solely on the performance of this difficult jump (19,21). In addition, the tuck jump exercise may be used to assess improvement in lower-extremity biomechanics as the individual progresses through training (19,21).
The below figure provides the “health and fitness professional friendly” landing assessment tool that the health and fitness professional may use to monitor an individual’s technical performance of the tuck jump before, during, and after training. As reviewed in chapter six, the individual is instructed to perform repeated tuck jumps for 10 seconds, while the health and fitness professional visually grades the outlined criteria (19). To improve the ease of the assessment, a standard two-dimensional camera in the frontal and sagittal planes may be used to assist the health and fitness professional. The individual’s technique should be subjectively graded as either having an apparent deficit (checked) or not. Indicators of flawed techniques should be noted for each individual and should be the focus of feedback during subsequent training sessions (19). The individual’s baseline performance can be compared with repeated assessments performed at the midpoint and conclusion of training protocols to objectively track improvement with jumping and landing technique. Empiric laboratory evidence suggests that individuals who do not improve their scores, or who demonstrate six or more flawed techniques, should be targeted for further technique training (19).

### Tuck Jump Assessment Chart

<table>
<thead>
<tr>
<th>Tuck Jump Assessment</th>
<th>Pre</th>
<th>Mid</th>
<th>Post</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Knee and Thigh Motion</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Lower extremity valgus at landing</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>2. Thighs do not reach parallel (peak of jump)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>3. Thighs do not equal side-to-side (during flight)</td>
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<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td><strong>Foot Position During Landing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Foot placement not shoulder width apart</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td></td>
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<tr>
<td>5. Foot placement not parallel (front to back)</td>
<td>☐</td>
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<td></td>
</tr>
<tr>
<td>6. Foot contact timing not equal</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>7. Excessive landing contact noise</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td><strong>Plyometric Technique</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Pause between jumps</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>9. Technique declines prior to 10 seconds</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>10. Does not land in same footprint (excessive in-flight motion)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
</tbody>
</table>

Total _____ Total _____ Total _____

One specific area that the health and fitness professional should focus on when training to prevent ACL injury risk is the correction of lower-extremity valgus at landing and improvement of side-to-side differences in lower-extremity movements, which are both target deficits to be assessed with the tuck jump assessment tool (12,19). The tuck jump assessment tool can be used to improve these high-risk techniques during an exercise that requires a high effort level from the individual (19). If individuals can improve their neuromusculoskeletal control and biomechanics during this difficult jump and landing sequence, they may gain dynamic neuromusculoskeletal control of the lower extremity and create a learned skill that can be transferred to competitive play (if performing with an athlete) and ultimately reduces their injury risk (12,19).
If an individual does not have the capabilities to perform the tuck jump assessment, a basic gait analysis can also be performed as a dynamic movement assessment, looking for overpronation of the foot and excessive knee valgus.

**RANGE OF MOTION ASSESSMENTS**

Once static and movement assessments are completed, range of motion assessments (chapter seven) can be performed to help identify the specific areas that need to be addressed through inhibitory and lengthening techniques. Key goniometric assessments to determine range of motion deficiencies that may be contributing to knee dysfunction include ankle dorsiflexion (gastrocnemius/soleus) and hip extension (TFL). Hamstring complex flexibility (biceps femoris, semitendinosus, and semimembranosus) may also be assessed by extending the knee when the individual is supine and the hip flexed to 90°. Lastly, hip internal rotation can also be assessed to determine transverse plane extensibility of the biceps femoris, adductor magnus, and piriformis, particularly if the knees move outward during an overhead squat assessment. See chapter seven to view proper execution of these assessments and average range of motion values.

**STRENGTH ASSESSMENTS**

Lastly, manual muscle tests (chapter eight) are suggested to be used to determine possible strength deficits and will help identify specific muscles that need to be activated in the corrective exercise process. Key muscles to test include the medial gastrocnemius, medial hamstring complex, gluteus medius, and gluteus maximus. Medial hamstring complex and adductor weakness may also need to be assessed if the knees move outward during the overhead squat assessment. Weakness of any of these muscles could contribute to knee dysfunction. See chapter eight to view proper execution of these assessments.

➤ **SYSTEMATIC CORRECTIVE EXERCISE STRATEGIES FOR KNEE IMPAIRMENTS**

Neuromusculoskeletal control imbalances are often evident in adolescent female athletes, which include ligament dominance (decreased lower-extremity frontal plane stability), quadriceps dominance (decreased relative strength or recruitment of the posterior chain musculature), and leg dominance (limb-to-limb asymmetries in neuromusculoskeletal control or muscle recruitment) (21). To target ligament dominance deficits, the health and fitness professional should instruct the individual to use the knee as a single-plane (sagittal) hinge joint allowing flexion and extension, not valgus and varus motion at the knee (21). The health and fitness professional should also use training movements that will facilitate both identification and correction of unwanted knee motions in the frontal plane. Teaching dynamic control of knee motion in the sagittal plane may be achieved through progressive exercises that challenge the neuromusculoskeletal system (21). To target the deficits described as ligament dominance, the health and fitness professional must first make the individual aware of proper form and technique as well as undesirable and potentially dangerous positions. To achieve this awareness, individuals can be videotaped or placed in front of a mirror to improve their awareness of undesirable medial knee alignments during movement (21). Second, the health and fitness professional must be diligent in providing adequate feedback of correct technical performance to facilitate the desirable neuromusculoskeletal alterations. If inadequate or inappropriate feedback is provided, then the individual may be reinforcing improper techniques with the neuromusculoskeletal training (21).
Before teaching the dynamic movement exercises, individuals should be shown the proper athletic position. The athletic position is a functionally stable position with the knees comfortably flexed, shoulders back, eyes up, feet approximately shoulder-width apart, and the body mass balanced over the balls of the feet. The knees should be over the balls of the feet, and the chest should be over the knees (13,21). This is the individual’s ready position and should be the starting and finishing position for most of the training exercises.

**Athletic Position**

Wall jumps are an example of an integrated dynamic movement exercise that could be used to target ligament dominance deficits. This low-to-moderate intensity jump movement allows the health and fitness professional to begin analysis of the athlete’s degree of valgus or varus motion in the knee (21). During wall jumps, the individual does not go through deep knee flexion angles, with most of the vertical movement provided by active ankle plantar flexion (21). The relatively straight knee makes even slight amounts of medial knee motion easy to identify visually. When medial knee motion is observed, the health and fitness professional should begin to give verbal feedback cues to the individual during this low-to-moderate intensity exercise (21). This feedback allows the athlete to cognitively process the proper knee motion required to perform the exercise. Neuromusculoskeletal control of medial knee motion is critical when landing with knee angles close to full extension, as this is a commonly reported mechanism of injury (22).
Another useful exercise to target the ligament-dominant individual is the tuck jump (as shown earlier in the chapter). Although used as an assessment, the tuck jump can also be used as an exercise that is on the opposite end of the intensity spectrum from the wall jump and requires a high level of effort from the individual. During the tuck jump exercise, the health and fitness professional can quickly identify an individual who may demonstrate abnormal levels of frontal plane knee displacement during jumping and landing because the individual usually devotes minimal attention to technique on the first few repetitions (21). As mentioned earlier, tuck jumps can also be used to assess improvements in lower-extremity biomechanics (19).

The long jump and hold exercise allows the health and fitness professional to assess the individual’s knee motion while he or she progresses through movements in the sagittal plane (21). The achievement of dynamic knee control during tasks performed in all planes of movement is critical to address deficits that may transfer into competitive sports participation or everyday activities. During competition, athletes may display “active valgus,” a position of hip adduction and knee abduction that is the result of muscular contraction rather than ground reaction forces (21). The long jump is a moderate-intensity integrated dynamic movement exercise that can provide another opportunity for the health and fitness professional to assess active valgus and provide feedback on more desirable techniques, which can assist the individual’s cognitive recognition during each jump to perfect technique. When performing the long jump exercise, individuals may demonstrate active valgus when taking off from a jump rather than landing. This movement deficit should be identified and corrected during training. In addition, individuals should
be instructed to hold the landing (stabilize) for 5 seconds, which forces the individual to gain and maintain dynamic knee control for a more prolonged period (21). The prolonged deep hold may facilitate feedback-driven lower-extremity alignment adjustments and ultimately improved frontal plane alignment of the knee.

The 180° jump is an integrated dynamic movement exercise that is incorporated into dynamic movement training to teach dynamic body and lower-extremity control while the body is rotating in the transverse plane. The rotational forces created by the 180° jump must be quickly absorbed and redirected in the opposite direction (21). This movement is important to teach the individual to recognize and control dangerous rotational forces that can improve body awareness and control that will reduce injury risk and also improve measures of performance (13, 21, 23).

Once the individual has been trained to maintain appropriate knee alignment during the jump, land, and hold of the long jump exercise with double-leg stance, the single-leg hop and hold exercise can be incorporated into the training (21). Most noncontact ACL injuries occur when landing or decelerating on a single limb (24). The single-leg hop and hold exercise roughly mimics a mechanism of an ACL injury during competitive play (21). When initiating the single-leg hop and hold exercise, the individual should be instructed to jump only a few inches and land with deep knee flexion. As he or she masters the low-intensity jumps, the distance can be progressively increased, as long as he or she can
continue to maintain deep knee flexion when landing and control unwanted frontal plane motion at the knee (21). Proper progression into the single-leg hop and hold is critical to ensure individual safety during training (21). This point is salient for the health and fitness professional, as ACL injury prevention techniques should not introduce inappropriate risk of injury during training.

The end stages of training targeted toward ligament-dominance deficits is achieved through the use of unanticipated cutting movements. Before teaching unanticipated cutting, individuals should first be able to attain proper athletic position proficiently (21). This ready position is the goal position to achieve before initiating a directional cut. Adding the directional cues to the unanticipated part of training can be as simple as pointing or as sports-specific as using partner mimic or ball retrieval drills (21).

Single-faceted sagittal plane training and conditioning protocols that do not incorporate cutting maneuvers will not provide similar levels of external varus or valgus or rotational loads that are seen during sport-specific cutting maneuvers (21,25). Training programs that incorporate safe levels of varus or valgus stress may induce more muscle-dominant neuromusculoskeletal adaptations (26). Such adaptations may prepare the individual for the multidirectional movement demands that occur during sport competition, which can improve performance and reduce risk of lower-extremity injury (12,13,21,23,27,28). Research has shown that female athletes perform cutting techniques with decreased knee flexion and increased valgus angles (15,21,29). Knee valgus loads can double when performing unanticipated cutting maneuvers similar to those used in sport (21,30). Thus the end point of training designed to reduce ACL loading via valgus torques can be gained through training the athlete to use movement techniques that produce low frontal plane knee loads (26). Recent evidence demonstrates that training which

\[ Continued \text{ on page } 280 \]
incorporates unanticipated movements can reduce knee joint loads and lower-extremity injury risk (12,23,31). Additionally, training individuals to preactivate their musculature before ground contact may facilitate kinematic adjustments, reducing the potential for increased knee loads (21,30,32,33). Training the individual to use safe cutting techniques in unanticipated sport situations or everyday activities may also help impart technique adaptations that will integrate into the athlete’s competitive movements during sport competition or during activities of daily living. If naturally ligament-dominant individuals achieve muscular (sagittal)-dominant movement strategies, their future risk of ACL and other knee injuries will likely be reduced (13,21,28).

It is important to note that not all individuals will have the physical capabilities to perform many of the aforementioned jump task progressions. In this situation, a basic functional movement progression that incorporates total body integration in multiple planes can be used as integrated dynamic movements. This progression could begin with ball squats, then to step-ups, then to lunges, then to single-leg squats (from more stable/less dynamic to more unstable/more dynamic). For each exercise, it will be important to cue the individual to keep the knee(s) in line with the toes and to not allow the knee to move inside or outside of the foot to ensure proper arthrokinematics and neuromuscular control.

### Functional Movement Progressions

<table>
<thead>
<tr>
<th>Squatting</th>
<th>Step-up</th>
<th>Lunging</th>
<th>Single-leg Squatting</th>
</tr>
</thead>
</table>

The following table provides a sample programming strategy using the Corrective Exercise Continuum for knee impairments. The photos illustrate the exercises that can be done for each component of the continuum to help address the issue of knee impairments (knees move inward and knees move outward). Which exercises are used will be dependent on the findings of the assessments and the individual’s physical capabilities (integration exercises).
### SAMPLE CORRECTIVE EXERCISE PROGRAM FOR KNEE IMPAIRMENT

<table>
<thead>
<tr>
<th>Phase</th>
<th>Modality</th>
<th>Muscle(s)/Exercise</th>
<th>Acute Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhibit</td>
<td>SMR</td>
<td>Gastrocnemius/soleus, adductors, TFL/IT-band, biceps femoris [short head] Piriformis (knee moves out during overhead squat)</td>
<td>Hold on tender area for 30 seconds</td>
</tr>
<tr>
<td>Lengthen</td>
<td>Static stretching OR NMS</td>
<td>Gastrocnemius/soleus, adductors, TFL, biceps femoris Piriformis (knee moves out during overhead squat)</td>
<td>30-second hold OR 7–10-second isometric contraction, 30-second hold</td>
</tr>
<tr>
<td>Activate</td>
<td>Positional isometrics AND/OR isolated strengthening</td>
<td>Anterior/posterior tibialis, gluteus medius, gluteus maximus Adductors and medial hamstring complex (knee moves out during overhead squat)</td>
<td>4 reps of increasing intensity 25, 50, 75, 100% OR 10–15 reps with 2-second isometric hold and 4-second eccentric contraction</td>
</tr>
<tr>
<td>Integrate</td>
<td>Integrated dynamic movement</td>
<td>Jumping progression* Functional movement progression: • Ball squats • Step-ups • Lunges • Single-leg squat</td>
<td>10–15 reps under control</td>
</tr>
</tbody>
</table>

*NOTE: Use the functional movement progression if the individual cannot perform jumping progressions.

**KNEE IMPAIRMENT: KNEE MOVES INWARD**

**Step 1: Inhibit**

Key regions to inhibit via foam rolling include the gastrocnemius/soleus, adductors, TFL/IT-band, and the short head of the biceps femoris.

**Self-Myofascial Release**

- Gastrocnemius/soleus
- Adductors

*Continued on page 282*
Section 13: Self-Myofascial Release

Step 2: Lengthen

Key lengthening exercises via static and/or neuromuscular stretches would include the gastrocnemius/soleus, adductors, TFL, and biceps femoris (short head).

Static Stretches

Gastrocnemius/soleus

Adductors

TFL

Biceps femoris (short head)
**Neuromuscular Stretches**

- Gastrocnemius/soleus
- Adductors
- Biceps femoris

**Step 3: Activate** Key activation exercises via isolated strengthening exercises and/or positional isometrics include the anterior tibialis, posterior tibialis, gluteus medius, and gluteus maximus.

**Isolated Strengthening Exercises**

- Anterior tibialis
- Posterior tibialis
- Gluteus medius
- Gluteus maximus

*Continued on page 284*
An integration progression could progress by starting with wall jumps, then progress to tuck jumps, then to long jumps with two feet, then to 180° jumps, then to single-leg hops, then to cutting maneuvers (as shown earlier in the chapter). If the individual cannot perform these tasks, use the functional movement progression also shown earlier in the chapter.
**KNEE IMPAIRMENT: KNEES MOVE OUTWARD**

**Step 1: Inhibit**  
Key regions to inhibit via foam rolling include the gastrocnemius/soleus, piriformis, and biceps femoris (long head).

**Step 2: Lengthen**  
Key lengthening exercises via static and/or neuromuscular stretches would include the gastrocnemius/soleus, piriformis, and biceps femoris (long head).

**Self-Myofascial Release**

- **Gastrocnemius/soleus**
- **Piriformis**
- **Biceps femoris**

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CHAPTER 13

Static Stretches

- Biceps femoris (long head)
- Piriformis
- Gastrocnemius/soleus

Neuromuscular Stretches

- Gastrocnemius/soleus
- Piriformis
- Biceps femoris

Step 3: Activate

Key activation exercises via isolated strengthening exercises and/or positional isometrics include the adductors, medial hamstring complex, and gluteus maximus.
### Isolated Strengthening Exercises

| Adductors | Medial hamstring complex | Gluteus maximus |

### Positional Isometric Techniques

| Adductors | Medial hamstring complex | Gluteus maximus |

### Step 4: Integration Progression

An integration progression used for this compensation could be the same progression used for the compensation of the knee moving inward.
SUMMARY • Lower-extremity injuries account for a majority of the total injuries in both college and high school athletes. Among lower-extremity injuries, the knee is one of the most commonly injured regions of the body. The knee is a part of a kinetic chain that is impacted by the linked segments from the proximal and distal joints. The described integrated assessment process uses four primary assessments of the linked segments from the proximal and distal joints, which include static posture, movement assessments, goniometric measurements, and manual muscle testing. On the basis of the collective information obtained from these assessments, neuromusculoskeletal control deficits are identified for targeted treatments. Use of the outlined corrective exercise strategies for knee impairments provide health and fitness professionals with a systematic approach that can ultimately reduce the risk of knee and lower-extremity injuries while improving performance measures.

References