BY JUSTIN PRICE, MA

The Foot, Ankle and Knee

The first of two articles presenting a structural assessment of the lower kinetic chain.

The lower kinetic chain consists of the foot, ankle, knee and lumbopelvic hip girdle. In the first article of this two-part series, you will learn how to assess the structures of the foot, ankle and knee; how the alignment of these parts affects the alignment of other body parts in the lower kinetic chain; and some possible exercises to help correct deviations.

ANATOMY OF THE FOOT AND ANKLE

The foot and ankle form the foundation for the entire body and act as shock absorbers when the body interacts with a contact surface. They also help the body adapt to terrain via side-to-side movement.

The Foot. The foot consists of three parts: the **hindfoot,** the **midfoot** and the **forefoot.** The hindfoot (talus and heel bone) absorbs shock and displaces it forward and from side to side. The midfoot (comprising the small bones in the foot between the heel and toes) also helps dissipate force from side to side. The forefoot (consisting of the toes) adapts further to the terrain and pushes the foot off for the next step during walking.

The Ankle. The ankle can be divided into two parts: the **true ankle joint** and the **subtalar joint.** The true ankle joint, which lies immediately below the tibia and fibula, functions as a shock absorber. Just below the true ankle joint and above the heel bone is the talus bone, and below that bone is the subtalar joint. This joint helps displace force from side to side.

COMMON DEVIATIONS OF THE FOOT AND ANKLE

The two most common deviations found in the foot and ankle are **overpronation** and **lack of dorsiflexion.**

Pronation, a function of the foot wherein the foot collapses and the heel rolls inward, is necessary to help transfer forces forward and toward the midline of the body. Overpronation, however—wherein the tibia, femur and knee rotate inward along with the heel—causes a disruption in the transfer of force.

Dorsiflexion is also a normal function of the foot and ankle. It involves flexing, or pulling the foot and toes up and back toward the shin to maintain alignment throughout the body. Overpronation limits dorsiflexion, causing the foot to push down and forward (plantarflex) rather than up and back. Limited dorsiflexion impairs all weight-bearing activities from standing to squatting, walking and running.

ANATOMY OF THE KNEE

The primary function of the knee is to link the upper and lower leg by way of a hinge joint. The knee allows a small degree of movement from side to side; however, its main functions are flexion and extension.

The **kneecap (patella)** attaches to the quadriceps above the knee via the quadriceps tendon, and to the tibia below the knee via the patella ligament. Correct alignment of the femur and tibia ensures that the patella moves smoothly during flexion and extension. Between the femur and tibia lie two shock absorbers: the **medial and lateral menisci.** On either side of the knee are two ligaments—the **medial and lateral collateral ligaments,** which give side-to-side support to the knee. Inside the knee between the tibia and femur lie the **anterior cruciate ligament (ACL)** and the **posterior cruciate ligament (PCL),** which help stabilize the knee from front to back.

COMMON DEVIATIONS OF THE KNEE

The two most common deviations found in the knee are **problems with side-to-side alignment** (the side-to-side position of the knee in relation to the femur and tibia) and **tracking problems of the patella during flexion and extension.** These two problems are closely related. If the knee has side-to-side alignment problems, the patella will not move freely over the end of the femur (femoral groove) when the knee bends or straightens, and the joint can become irritated.

ASSESSMENT OF THE FOOT, ANKLE AND KNEE

In order to assess a client for problems with the foot, ankle and knee, you must be able to see these structures clearly. Instruct the client to wear shorts for the

assessment, and make sure he removes his shoes and socks. The assessment process is verbal, visual and hands-on.

Verbal Assessment

A verbal assessment can provide some insight into your client's condition. Ask the following questions:

1. Do you ever experience pain in your feet, ankles or knees?
2. Have you ever been diagnosed with arthritis in the feet, ankles or knees?
3. What is your occupation? How much physical activity do you get? (This helps you gauge the daily stress the joint experiences.)
4. If you are experiencing pain, what aggravates the condition? What makes it feel better? Does the pain coincide with other pains in the body?

Remember to stay within your scope of practice; only a physician can diagnose a medical condition. Rather than attempting to make a diagnosis, use your client's responses to your questions to choose exercises that strengthen or balance weak areas. If the imbalances are severe, avoid exercises that might be contraindicated. For example, if the client's patella does not track effectively, flexing and extending the knee under a load, as during a barbell squat, would be contraindicated. You could address the issue by using exercises to strengthen the gluteals and muscles of the calf and foot, since these muscles help control alignment of the femur and tibia and, subsequently, alignment of the knee.

Visual and Hands-On Assessment: The Foot and Ankle

A visual and hands-on assessment is used to further assess the structures of the body.

General Appearance. With the client standing in front of you, look for any swelling, calluses or irregularities between the two feet and ankles.

Pronation. Check to see if the foot is overpronated, with the arch dropped—or absent—and a bulge of flesh sticking out on the inside of the foot. Most people will be overpronated, and there are a number of strategies you can use to address this imbalance—for example, choosing exercises that strengthen the gluteus maximus (which functions to outwardly rotate the leg), thereby improving alignment of the leg and helping to prevent inward rotation.

Supination. If all the weight appears to be on the outside of the foot, your client probably suffers from oversupination.

Movement Patterns. While your client is in a neutral foot and ankle position, look at her knees. (See "Finding Neutral Foot and Ankle Position" sidebar.) For most people, the center of the kneecap will be in line with the second toe (its anatomical neutral position). When your client relaxes from neutral, she will likely fall back into an overpronated position, and the tibia and femur will rotate inward with the foot. This rotation will cause the knee to rotate inward and subsequently be out of alignment.

When the knee shifts toward the middle of the body, many people turn the foot outward so the knee can be aligned pointing forward. This compensation places further stress on the foot, as forces no longer pass over all the toes during walking. This can lead to calluses on the inside of the big toe and/or bunions, and can place undue stress on the underside of the foot. Overpronation also causes the foot and toes to move laterally (abduct). Over time, this affects the calf muscle, creating an imbalance in the lower leg and ultimately preventing the foot from dorsiflexing.

Visual and Hands-On Assessment: The Knee

General Appearance. Look for swelling on either side of the knee. Note any irregularities in both a seated and standing position.

Side-to-Side Alignment. Ask your client to stand on one leg and bend the knee of the standing leg to about 20–30 degrees three or four times. Watch the center of the knee. Make a note of any movement either inward or away from the center line of the body.

Patella Tracking During Flexion and Extension. Ask your client to lie supine. Help him bend one leg toward the chest. Place your hand on his kneecap and ask him to bend and straighten the knee. Make a note of whether the kneecap glides smoothly or if there is excessive popping, grinding or crunching.

Movement Patterns. If your client's kneecap moves toward the midline of the body during the assessment for side-to-side alignment, the foot and ankle are probably overpronated as well. This overpronation causes the lower and upper leg to inwardly rotate, which adds further stress to the knee.

finding neutral foot and ankle position

There are small indentations at the base of the ankle just below the ankle bones. Place your thumb on the dimple on the inside of the ankle and your forefinger on the dimple on the outside. When your client rolls the foot and ankle inward (overpronate), you will feel pressure on your thumb. When the foot is rolled outward (oversupinated), you will feel pressure on your forefinger. This pressure is the talus bone moving in the ankle. Coach your client to pronate and supinate until you feel even pressure of the talus bone on both your thumb and forefinger. This is the anatomical neutral position for the foot and ankle. Most people will have to supinate to get to neutral from their usual dysfunctional overpronated position.

EXERCISE CONSIDERATIONS

Full squats, single-leg squats, leg presses, lunges, elliptical training and running all involve ankle and knee flexion. If the foot overpronates during these activities, the knee joint cannot function optimally. Similarly, if the knee moves toward the midline of the body, the foot will overpronate, which will limit dorsiflexion. These structural malalignments can cause foot and leg problems like plantar fasciitis, bunions and shin pain. They can also cause both medial and lateral knee conditions such as iliotibial (IT) band pain, chrondomalacia and ligament irritation. [*Editor's note:* See "The Scoop on Running Injuries" in this issue for more information on IT pain.] Therefore, it is imperative to carefully assess your client's ability to maintain correct form and optimal alignment during complex movements of the ankle, foot, knee and hips. Make sure that the client's foot is in neutral, the patella is in line with the second toe, and the center of the front of the hip is in line with both the patella and the second toe. If there is a deviation, choose exercises that strengthen and balance the supporting structures, and if the deviation is severe, avoid contraindicated exercises, such as squats under a load.

INCORPORATING THE INFORMATION

The process of structural assessment and corrective exercise does not need to be a laborious one. Simply assess structures and think about what muscles might be affected by any deviations. Then incorporate strategies such as stretching and strengthening exercises and myofascial release to address the musculoskeletal imbalances you have identified, while you get on with your regular exercise program. (See "Suggested Exercises" sidebar.)

In the next installment of this series, you will learn how to assess the lumbopelvic hip girdle, how it relates to other structures of the body and some sample exercises to correct or alleviate deviations.

Justin Price, MA, is a corrective exercise specialist, personal trainer and co-owner of The BioMechanics. He is the 2006 IDEA Personal Trainer of the Year and IDEA's national spokesperson on personal training issues.

suggested exercises

These three exercises will help your clients overcome the structural deviations associated with the foot, ankle and knee.

GOLF BALL ROLL

Overpronation leads to wear and tear on the plantar fascia and degeneration of other structures of the foot. The golf ball roll is a myofascial massage technique that can help regenerate the tissue on the underside of the foot.

Each day, roll golf ball along bottom of foot for 30 seconds to 1 minute, focusing on any sore spots.

CALF STRETCH

The lack of dorsiflexion that accompanies overpronation is usually caused in part by tight calf muscles.

In standing position, place one foot behind body and push heel of that foot into ground. To avoid overpronation, maintain neutral position in foot and ankle. Hold for 30 seconds. Perform at least once a day on each side.

SINGLE-LEG STAND

Strengthening the structures of the lower legs and hips helps maintain a neutral foot, ankle and knee position.

Stand on one leg, using balance aid if needed. Rotate tibia and femur of standing leg outward by rolling foot out and raising arch. Feel gluteal muscles contracting and pulling both lower and upper leg outward. Keep pelvis rotated under so that abdominals contract. This will help align leg in hip joint. Perform 2–3 sets of 10–12 reps three times a week.