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Reforming the Knee

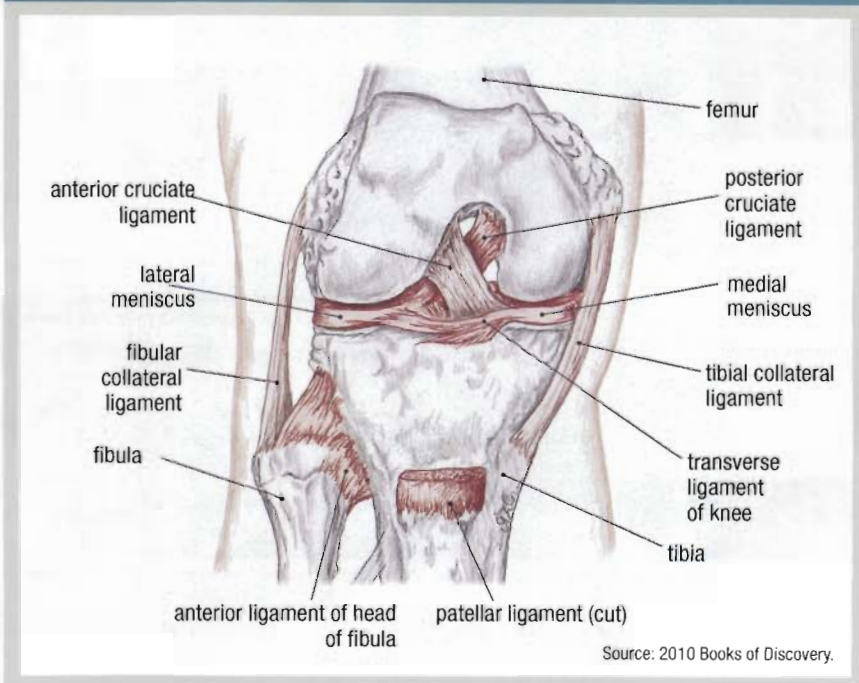
Pilates training principles to optimize knee function.

If one of your Pilates clients developed knee problems and her doctor said the client needed to strengthen the muscles around the knee, would you know what to do? What if a client were diagnosed with patellofemoral dysfunction or were recovering from an anterior cruciate ligament tear? How would you design a Pilates reformer program to help the client heal and return to full function? The reformer is a great, multipurpose tool for improving function, correcting alignment and muscular imbalances and helping the body recover from injury. In this column we will review key principles for working with common knee problems and identify a number of reformer exercises that can optimize knee function.

How the Knee Works

Working intelligently with the knee begins with understanding how it is *designed* to work; what common conditions limit its optimum function; and which strategies will correct those conditions.

Figure 1. The Knee



Source: 2010 Books of Discovery.

The Bones

The knee is a hinge joint comprising three bones: the **femur**, the **tibia** and the **patella**. The primary movements of the knee are flexion and extension, along with slight medial and lateral rotation of the tibia on the femur. The knee joint lacks intrinsic stability, so it relies on ligaments and muscles for support (see Figure 1).

The Ligaments

The ligaments of the knee keep the femur and the tibia attached. The ligaments provide stability in the anterior-posterior plane and in the lateral plane, but they are vulnerable to damage when the knee is twisted or when it is hit from any angle. The knee has four primary ligaments:

- The **anterior cruciate ligament** keeps the tibia from sliding forward on the femur.
- The **posterior cruciate ligament** keeps the tibia from sliding backward on the femur.
- The **medial collateral ligament** keeps the tibia and the femur from separating along the medial joint line.
- The **lateral collateral ligament** keeps the tibia and the femur from separating along the lateral joint line.

The Muscles

The muscles around the knee create movement and support the joint. Balance in the musculature is essential for smooth functioning of the knee and for preventing overuse injuries. Several muscle groups affect the knee:

- The primary knee extensor, and one of the strongest muscle groups in the body, is the **quadriceps**. It consists of the **vastus medialis**, **intermedius** and **lateralis**, plus the **rectus femoris**. Balanced development of this muscle group helps protect the patella from wear and tear, which can lead to patellofemoral dysfunction or chondromalacia patella.
- The knee flexors are the **hamstrings**—both lateral (**biceps femoris**) and medial (**semimembranosus** and **semitendinosus**)—and the **gastrocnemius**, **popliteus**, **sartorius** and **gracilis**. The hamstrings support the back of the knee and align the femur on the tibia. The medial hamstrings medially rotate the tibia, and the lateral hamstrings laterally rotate the tibia. The quadriceps and the

hamstrings work together to provide power for jumping, running, biking and getting out of a chair.

- The hip muscles, including the **hip abductors**, **adductors** and **external rotators**, assist in creating femur alignment and in tracking the knee in a straight line during walking, running and biking.
- The lower-leg muscles, including the **gastrocnemius**, **soleus**, **peroneals**, **anterior and posterior tibialis** and **toe flexors and extensors**, work to align the foot so that ground forces move up to the knee in a balanced way.

When all of these muscles work together in harmony, our knees can keep us moving for a lifetime without trouble.

General Training Principles for the Knee

When observing a client with knee problems, there are four key areas to assess:

Leg Alignment. Look for genu varum, or bowlegs; genu valgum, or knock-knees; internally rotated femurs; externally rotated femurs; tibial torsion; and pronation or supination of the feet. While many of these conditions are based on the structure of the bones, with practice many clients can learn to improve, if not fully correct, their alignment. Misalignments directly affect how muscles fire and where stress lands on joints, and even small corrections can often have a profound effect on how your client moves.

Flexibility. Particularly tight muscles around the knee or hip will lead to misalignments and less than optimum movement patterns. Once you have identified your client's tight areas, you can correct them through movement or stretching—or refer the client to a manual therapist. Tight quadriceps muscles place stress on the patella and the patellar tendon, while tight external rotators create lateral stress on the knee, and tight adductors create medial knee stress. Hamstring tightness, if extreme, can limit full extension of the knee. Tightness of the iliotibial band (IT band) leads to lateral tracking of the patella, which increases stress on the knee.

Strength. Balanced strength between the hamstrings and the quadriceps, and specifically between the medial and lateral hamstrings and the vastus medialis and vastus lateralis of the quadriceps, are keys to knee health and longevity.



Working With Ligament Tears

If a client complains of a torn ligament in the knee, you should aim to strengthen the appropriate muscles in order to compensate for the loss of ligamentous support.

- For anterior cruciate ligament sprains and tears, focus on hamstring strength.
- For posterior cruciate ligament sprains and tears, focus on quadriceps strength.
- For medial collateral ligament sprains and tears, focus on medial chain strength, including the vastus medialis, gracilis, sartorius and medial hamstrings.

Gait Patterns. Observing a client as he walks, runs or rides a bike demonstrates the client's habitual movement patterns. Correcting deviations in these patterns as much as possible will help balance the forces on the knee and on the entire lower body.

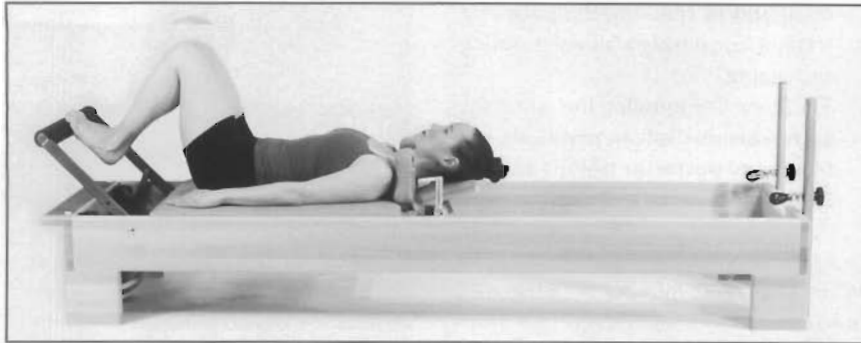
Reforming the Knee

The reformer is a great environment for working on all of the issues outlined above, including leg alignment, flexibility, strength and gait. Let's see how a few key exercises can be used to balance the knee.

Footwork

Footwork is the perfect exercise for improving strength and alignment of the whole lower body from feet to hips. You can increase or decrease resistance and range of motion to allow almost anyone to perform knee flexion and extension safely. Through skillful cuing, you can direct your client's effort toward the quadriceps or the hamstrings; correct leg alignment at the hip, knee and ankle; and increase joint mobility. Single-leg footwork allows you to focus on the specific patterns of an injured leg or the nondominant leg to help it become stronger. >>

Setup: two to four springs, foot bar up. Lie supine on reformer with feet on foot bar. Press carriage back by extending knees. Maintain alignment from hip to knee to ankle. Foot position variations on the bar: heels, toes, V-feet, feet wide and single foot.



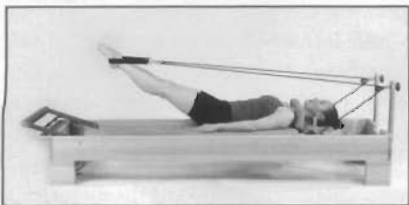
Side-Lying Leg Work

Although not a traditional exercise, this is extremely useful for targeting the abductors and lateral hip while performing knee flexion and extension. By placing the medial or lateral side of the foot on the foot bar, you can also target the medial or lateral side of the leg.

Setup: two to three springs, foot bar up. Lie on side on reformer with top foot on foot bar, legs parallel. Straighten bottom leg parallel to floor. Press carriage back by extending top knee. Maintain alignment from hip to knee to ankle. Foot position variations on foot bar: medial line of foot on foot bar, lateral line of foot on foot bar, top leg turned out.

Feet in Straps

Feet in straps is excellent for developing adductor and hamstring strength in a straight-leg position. For clients with limited knee flexion during recovery from an injury, feet in straps can keep the muscles active until the knees are ready to return to full activity. It is also excellent for working on flexibility of the hamstrings, adductors, abductors and hip flexors.



Setup: one to two springs, foot bar down. Lie supine on reformer with both feet in straps. Maintain pelvic stability as legs move. Exercise variations: hips parallel or externally rotated for any of the following exercises: leg lowers (raising and lowering legs while maintaining pelvic stabil-

ity); circles (large and small, in both directions); scissors (opening and closing legs to target adductors); hamstring stretch (one foot in strap); and adductor stretch (both feet in straps).

Seated Vastus Medialis

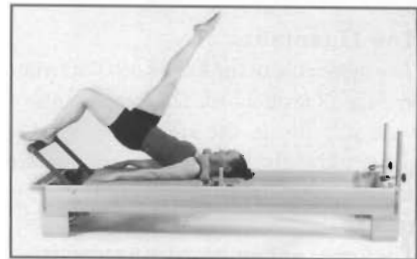
This exercise is specifically designed to strengthen the vastus medialis head of the quadriceps in order to correct lateral patellar tracking. The seated position allows the client to see and feel the vastus medialis engage as she extends the knee. A very common cause of knee discomfort is patellofemoral dysfunction, in which the patella does not track straight in the femur. Over time this can lead to uneven wear on the knee joint. The most common imbalance with this condition is an underactive vastus medialis and tightness in the IT band and vastus lateralis. Releasing the lateral leg with roller work or other myofascial techniques combined with strengthening the vastus medialis provides a fairly easy solution for many knee issues.

Setup: one to two springs, foot bar up. Sit on foot bar with one foot on carriage; place other foot on floor or standing platform for balance. Press carriage out with heel, engaging vastus medialis. Place two fingers on muscle to feel engagement.

Pelvic Lift, or Bridging

The pelvic lift, or bridging, is very effective at strengthening the gluteal muscles and the hamstrings and at stabilizing the back of the knee. Light weight increases hamstring control, while heavier weight supports the torso. Single-leg work is an excellent way to target a weak leg or to

correct alignment in an unusual position. Bridging on the reformer or the mat is a good exercise for assessing tightness in the lateral legs. If a client presses up into bridge and can't keep the legs parallel, tight lateral legs are usually the cause.



Photography courtesy of Balanced Body.

Setup: two to four springs (lighter is harder), foot bar up. Lie supine on reformer with feet on foot bar. Roll pelvis and spine off carriage into bridge position and press carriage back. Bring carriage back in before rolling down. Variations: legs parallel, legs externally rotated, heels on foot bar, toes on foot bar, legs in wide position on foot bar, single leg (shown).

Creating Happy Knees

Through understanding how the knees work and developing balanced strength, flexibility and correct alignment, you can keep your clients moving well for decades. ■

Nora St. John, MS, holds degrees in biology and traditional Chinese medicine. She has taught Pilates for over 20 years and is currently the education program director for Balanced Body®.

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For four more exercises that benefit the knee, please visit www.idealife.com/reforming-the-knee.