



# Connections

An Integrated Approach  
to Treating Knee Injuries, Part 2

BY ART RIGGS



# A

fter introducing the importance of a holistic view of knee rehabilitation in order to restore proper gait, the previous article (November/December 2008, page 52) ended with our fingers deep in the iliotibial (IT) band. The demonstrated techniques (Treatments 1–4) began with more superficial work that is appropriate soon after injury or surgery, and progressed to tools for returning flexion mobility. We now turn our attention to treatment strategies to improve full extension to the knee and to a more detailed explanation of the complexities of gait, including techniques to deal with the compensatory reactions in the feet and hips that occur after injury.

## TREATMENT 5: RETURNING NORMAL EXTENSION

Because of the impossibility of normal gait without full knee extension, I feel that this is the primary goal for proper rehabilitation after injury or surgery. Of course, tight fascia and muscles, particularly the hamstrings, will prevent full extension, but the therapist should also be skilled in working with the deeper restrictions in the joint itself by using mobilization techniques (shown later) to work with the knee joint. Let's begin with some of the major muscles that contract after trauma and prevent the knee from straightening.

### WORKING WITH POPLITEUS AND PLANTARIS

*Cautionary note: you may feel a fairly strong pulse from the popliteal artery, but don't let this deter you. Just be sure to use the usual precautionary techniques to distinguish the muscle tissue from the artery and be precise in your work.*

Since these are relatively weak flexors of the knee compared to the hamstrings, popliteus and plantaris are often neglected in conventional therapy. Their role in preventing full knee extension is less one of strong muscular resistance than of being agitators delegating responsibility to stronger muscles that do the dirty work of preventing knee extension. The body always reacts to pain as a strong dictate of movement, and both these muscles can be sensitive or painful when stretched if they shorten after injury. At the first sign of pain in popliteus and plantaris, they send inhibitory reflexes to the quadriceps to prevent them from contracting to straighten the knee. They also recruit their allies, the hamstrings, to strongly contract and prevent the knee from straightening. Reducing irritation to these small muscles and lengthening them is a first step in proper functioning of the larger muscle groups.



Although most of the examples in this article recommend working with muscles in a stretched position to effect a release, working in a sensitive area like the posterior knee is best done with enough flexion to allow easy entry through superficial layers and have popliteus and plantaris relaxed so they are not irritable. As you relax and lengthen them with your work, slowly extend the knee by using a small bolster to restrain their stretch receptors to feel safe with more extension. Once these muscles relax, the primary flexors and extensors of the knee can begin to work properly without neurological interference from popliteus and plantaris.

Usually popliteus and plantaris are shortened as a protective mechanism rather than from adhesions. Therefore, strokes in a distal direction are most effective to train them to relax and lengthen. Use very soft fingers to sink through superficial tissue to find the tight muscles and very slowly stroke distally, with an intention of simply relaxing and stretching an irritable muscle. The texture and depth of popliteus and plantaris are similar to what it feels like to work on the scalenes in the anterior neck, so use the same principles. While working on these muscles, it is also a good time to begin stretching the more superficial fascia in the posterior knee.

### WORKING WITH THE HAMSTRINGS

These are the most important muscles to relax and stretch to allow extension. The hamstrings will have learned to contract anytime the knee approaches the painful angle of straightening. Not only must you release any fibrous restrictions, but you must also train these muscles (and to a much lesser extent, the gastrocnemius, which also crosses the joint and is a minor flexor) to relax into a lengthened position. In the prone position, refrain from using a bolster under the ankle so the leg can straighten.

Hamstring work is almost always beneficial for injured knees, but remember that if the knee is still inflamed and extension is painful in the joint, then it is a natural reflex for these muscles to be short and tight. If the joint is painful in movement, or structural barriers such as adhesions are present, then the hamstrings will naturally contract to protect the knee. Extensive work with the hamstrings will always be helpful, but permanent lengthening will only take place after the joint heals. This will sometimes take several weeks or even months, so follow-up visits over an extended period of time are helpful to incrementally lengthen the muscles. Joint mobilization techniques (shown later) will be very helpful in freeing the joint so the hamstrings will not contract for protection.



Photos and illustrations courtesy of Art Riggs, with thanks to model Joanne King.



Although this may be the most important muscular work you do to return normal function to the knee, it is relatively simple work without fancy tricks. Have your client slide down so that both feet are hanging off the table; compare the injured knee with the healthy knee to determine normal extension. In this case, the right knee doesn't allow full extension, so the right heel is about an inch higher than the left. Use your fingers, knuckles, or forearms to slowly stroke distally while visualizing grabbing and stretching the hamstrings.

You should continue your intention of lengthening the posterior compartment below the knee to the gastrocnemius and soleus. Note the dorsiflexion of the ankle to provide stretch.



Not all your work with the hamstrings will be to educate them to lengthen. There may be significant thickening and adhesions in different depths of the muscles or surrounding fascia that need detailed release. Anchor

and stretch using precise pressure at fibrosed areas. Visualize that you are placing all of your intention on a knot in a rubber band. Anchor with proximal oblique pressure at adhesions when the knee is flexed, and then slowly lower the ankle to extend the knee and focus the stretch at your anchor.

*Cautionary note: if your client is recovering from anterior cruciate repair, the surgeon may prefer that the knee does not reach full extension. It is advisable to check with the doctor for guidelines about the limits of extension. This caution should also apply to the use of joint mobilization techniques shown in the next section.*

#### TREATMENT 6: KNEE JOINT MOBILIZATION TECHNIQUES

The largest paradigm shift in my bodywork protocol occurred after I had been practicing for almost 10 years. I took a spinal mechanics class and began working with joints, not only in the spine, but virtually anywhere on the body. I hope new therapists won't wait as long as I did.

With the knee, we are primarily working to improve extension, flexion, and a bit of rotation between the femur and the tibia. Anatomists agree that the knee joint is the most complicated in the body, but some relatively simple joint mobilization techniques can be practiced safely and effectively even if you are new to this concept. Although it is tempting to look at the joint as a simple hinge, in reality, when moving from extension to flexion and back, the tibia must slide anterior and posterior and rotate relative to the femur. After knee injury or surgery, tightening muscles that surround the knee can contract and compress the joint from all sides, impeding the articulation of the bones. If normal movement between the tibia and femur is not returned within a reasonable period of time, then adhesions form deep in the joint and can permanently restrict joint mobility. Since most therapists are apprised of ways to

stretch the knee into flexion, we will concentrate on extension and rotation.

*Cautionary note: if there is any possibility of torn ligaments or meniscus, these techniques are not appropriate unless you have permission from an orthopedist. However, these are very beneficial after surgery, when inflammation has subsided.*

#### ANTERIOR AND POSTERIOR SHEAR OF THE TIBIA AND FEMUR

Straightening the knee to full extension requires that there is freedom for the tibia to glide back and forth on the femur (shear) rather than just straightening like a simple hinge. Soon after injury, adhesions begin to form, and even the slightest limitation can impact gait. Most therapists are trained to work on the knee when it's supported by a bolster, but this practice prevents extending the joint into its structural barriers to release them. Early in the recovery process, you may work in supine position with the extended leg just resting on the table as you gain your client's confidence. But as you begin making progress, place a bolster under the ankle or calf so the knee is suspended in space ("bridging") as demonstrated in the photo below.



Remember to place your intention deep in the joint, and that unlike simply stretching the knee into extension as you would if the client was prone, you are applying posterior pressure directly down toward the table and visualizing sliding the tibia and femur in opposite directions.

Mobilization can be applied in two ways. First, you can use relatively quick pulsations of pressure with about two pounds of force, repeating the pulsations for a minute or more. It is crucial to move the joint all the way until end-range resistance is felt. This is helpful in overriding conscious soft tissue holding patterns and begins to free up the joint as the bones slide back and forth. Secondly, you can apply a bit more steady pressure downward, being careful that your client is not uncomfortable. Sustain the pressure for a minute or two, waiting for a feeling of softening in the joint and a sense that the bones are sliding past each other.

In the first photo, I am putting pressure on the femur so that it is sliding posterior relative to the tibia. Conversely, by placing your hands below the knee on the tibia, you are now sliding the tibia posterior relative to the femur. As you become adept at these procedures, you can expand your effectiveness by experimenting to either compress or traction the joint as you apply anterior/posterior shearing pressure. The key to the success with this and most joint mobilization techniques is to apply enough force to mobilize the joint, but not so much force that your client has pain or is fighting against you.

#### MOBILIZING ROTATION OF THE TIBIA AND THE FEMUR

When the knee moves, the tibia actually rotates upon the femur, rotating externally as the knee extends and internally as the knee flexes. If rotation is impaired, then flexion and extension are impaired. The rotation is subtle, but important to work with.



As you flex the knee by helping your client bring her knee to her chest, place steady pressure to rotate the tibia internally. When you reach the end range of comfortable flexion, stay in this position and continue to exert gentle internal rotational force while waiting for softening of resistance.

Reverse the process as you pull the leg back into full extension by rotating the tibia externally through the range of motion. Of course it can even be more helpful to perform this technique while also stretching tight fascia or muscles, but your primary intention is to be rotating the tibia around the femur.



This technique works well if your client has large or heavy legs or you feel unstable on the table. It has the added advantages of stabilizing the femur during movement and of the natural gravity of the lower leg placing traction on the joint while you work. As you have your client flex her knee, rotate the tibia medially, and then reverse the rotational direction to external as the knee is extended. Remember that the most release will happen at the end range of movement, so hold a sustained pressure at this range of motion for up to a minute.

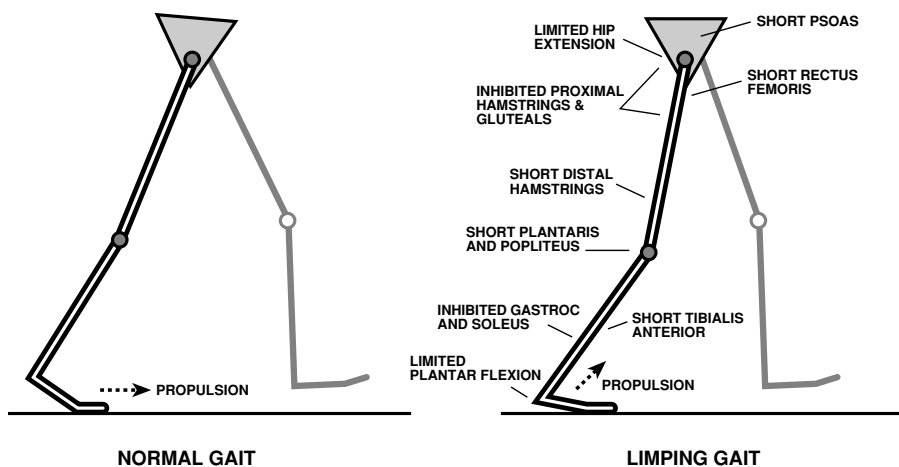
#### UNDERSTANDING MOVEMENT PATTERNS

The treatment suggestions that we have covered so far should provide considerable benefit for your clients who have knee problems and anyone looking for better movement and freedom of the entire leg. As mentioned earlier, a great many people have sustained injuries that persist in compensatory patterns of movement that have been ingrained for decades. A holistic treatment plan that deals with the complicated relationship between the feet, ankles, knees, and hips will be a great boon to your practice and will provide better movement for all your clients, not just with those injuries.

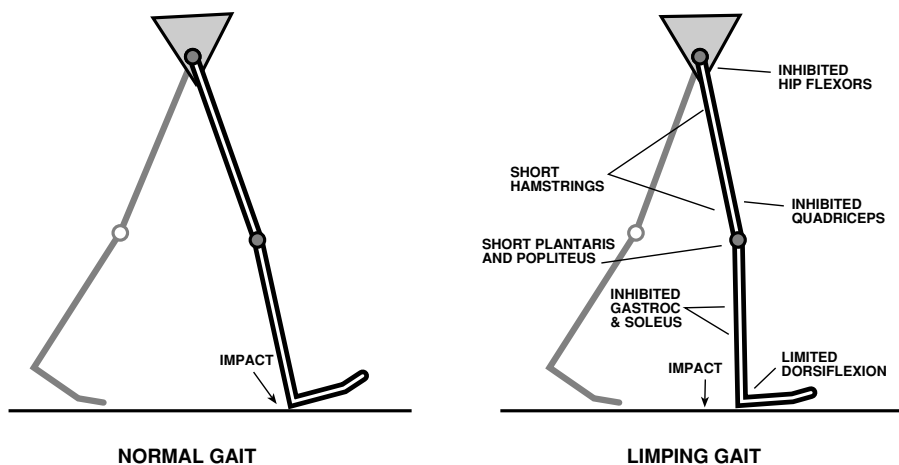
In the previous article we provided a chart of the muscular and joint compensations when the knee isn't able to extend. Now, let's revisit the chart in more detail to discuss the basic kinesiology of walking gait at

# GAIT ANALYSIS

## TOE OFF



## HEEL STRIKE



toe off and heel strike with more attention to the feet, ankle, and hips.

### TOE OFF

This is the important stage of walking that propels the body forward. With limited knee extension, the stride is shortened, approximating the “mincing” steps of very elderly people. (I find that working for better knee extension is always greatly appreciated

by my older clients.) If the foot is not far enough behind the body, it loses its power to propel the body forward and energy is expended in lifting the body up, instead of forward. The foot ceases to flex at the toe joints (transverse arch) and become immobile, causing the plantar fascia to shorten. The ankle remains in a neutral position rather than plantar flexing

to push off, so the tibialis anterior becomes short and the gastrocnemius and soleus become weakened.

As previously mentioned, since the knee won't extend, the hamstrings, upper gastrocnemius, plantaris, and popliteus become shortened and will all need lengthening work. But don't forget to work with the superficial fascia, especially behind the knee, to stretch this tissue. Perform joint mobilization to return normal flexion, extension, and rotation of the joint itself.

Many therapists neglect the hip in rehabilitation of the leg. If the leg cannot extend freely to the rear, then rectus femoris and psoas will become short because they don't need to release to allow the hip to extend for a long stride. They also will become fibrous from overwork. Since the leg is not propelled by the foot and ankle to swing forward, rectus femoris and psoas will have to use more energy to lift the leg to overcome inertia. Instead of swinging freely forward, the knee will be lifted at a more vertical angle by the pull of these muscles.

### HEEL STRIKE

If the knee cannot straighten, then the leg is unable to swing forward in front of the body with ease. Instead of landing on the rear of the heel with the ankle slightly dorsiflexed, the foot lands flat at a more vertical angle, preventing the normal rolling motion from heel to toe that dissipates shock. Gastrocnemius and soleus remain short and will need lengthening so the foot can dorsiflex. The ankle will need to be mobilized in both plantar and dorsiflexion to begin working like a smooth hinge.

In addition to being short in the distal portion to prevent knee extension, the hamstrings will also remain tight near the ischeal tuberosity as they prevent a full leg swing forward. It is easy to see how working with the hamstrings is the key to rehabilitation.

## Be sure to become skilled in joint mobilization techniques on the joint itself to help restore proper mechanics.



All of these complex feedback loops occur from the simple restriction to knee extension. Remember the chicken-egg relationship with the joint and the muscles. The lack of proper joint movement will cause the muscles to shorten, but these shortened muscles will solidify improper joint movement if the walking pattern becomes ingrained. Be sure to become skilled in joint mobilization techniques on the joint itself to help restore proper mechanics. The best news is that these techniques work equally well for restoring proper movement patterns after injury to the feet, ankles, and hips.

Although one can understand these kinesiological principles at a cerebral level, by far the best way to understand what is happening in your client's body is to feel the sensations in your own experience by mimicking the limping pattern. What joints aren't moving? What muscles are contracting improperly? If you simply concentrate to prevent your knee from straightening, you will experience the profound compensations from the toes up through the hips as you walk. In classes, I actually have students tape their knees to prevent full knee extension. I also have them experiment with placing a pebble in the forefoot or heel of their shoes. This is an excellent way to feel both the joint and muscular adaptations to pain or discomfort, and will enable a strategy for treatment.

### TREATMENT 7: BALANCING SECONDARY COMPENSATIONS

Now we can move to some techniques to return proper function to secondary areas that respond to knee dysfunction. Work to satellite areas is extremely important because of their tendency to reinforce limping patterns. Until proper function is returned to the primary site of injury, the secondary compensatory patterns will persist. It is perfectly appropriate to work on secondary compensations throughout your treatments because they often cause discomfort as they adapt. However, your primary goal should be to return the primary injury site to health as soon as possible, and then focus on the feet and hips.

### FREEING THE TOES, TRANSVERSE ARCH, AND PLANTAR FASCIA

With a limping gait, the feet become stiff and inflexible as they land similar to wearing a very stiff-soled shoe that prevents the toes from flexing and providing power on toe off.



Working in the end range of motion is the key to this technique. With soft fingers, bend the toes as far as possible into an upward dorsiflexed extension. With knuckles or fingers patiently work the area of the metatarsal heads with both cross-fiber strokes and in the direction of lengthening of tissue. Broaden your goals to soften the entire planar fascia.



The biomechanics of stretching the foot into dorsiflexion in either the prone or supine position can be difficult when the leg is straight. This technique offers the advantages of using your body weight, being able to exert strong pressure to dorsiflex the ankle, and the use of the broad and comfortable tool of your forearm. This technique is also useful to treat plantar fasciitis.

### IMPROVING ANKLE MOVEMENT



The front of the ankle is surrounded by a fibrous retinaculum that can stiffen the ankle joint like an Ace bandage, limiting both plantar flexion and

dorsiflexion and causing torsion on the ankle. Use your knuckles or the ulnar surface of your forearm to soften and free this tissue. Anchor in one direction and then mobilize the ankle in any opposing direction to improve freedom. This is an excellent technique after ankle sprains or on virtually anyone who wishes easier ankle movement.



## IMPROVING HIP MOBILITY



By flexing the leg with the knee relatively straight, you can place the hamstrings on a nice stretch while releasing any areas, both anchoring and stretching against the stretch. Don't strain yourself by holding the leg with your arm if your client is large. You can have your client help you by pulling her leg toward her chest or even have your client apply the stretch by using a strap over the bottom of her foot.

The rectus femoris and front of the pelvis will become short and tight if your client has been walking with a limp that prevents the leg from freely swinging back into extension. Working in the neutral supine position will soften tissue but not stretch enough to open the area. This position allows you to work easily using your own body weight as you stretch the leg into extension. Support your client's head and neck, and possibly low back, with pillows and have your client pull her opposite leg to her chest to keep the pelvis in a neutral position.

Apply pressure with your other hand to extend the hip and work in the direction of the stretch, using your fingers for superficial tissue and your forearm for deep muscular work on the quadriceps.

This technique is also useful for working with the psoas in a stretch, but do not overextend the hip. If the hip is too extended, it becomes difficult to sink through the superficial tissue in the anterior pelvis to contact the psoas.

## HOLISTIC CONNECTIONS

I hope these articles have given you insight into the interesting interrelationship of the joints of the legs, as well as some specific tools to successfully treat problems, not only to the knees, but to the other joints of the lower extremity. All joints of the leg are inextricably linked together in a complex feedback loop that must be treated in a holistic manner for the best results. Remember, each

client will present unique adaptive mechanisms to injury and the solutions to solving limping problems rarely are simple or lie in only one area. These considerations are what make our work so interesting and rewarding.

A holistic treatment not only includes a broad view of distant joints and compensations, but should consider the whole person you are working with, including the causative factors of an injury (especially with overuse injuries), a client's approach to self-help through home programs of stretching and strengthening, and the associated emotional feelings. Fear, anger, depression, and self-judgment are often associated with injuries. We always treat more than muscle, tendon, and bone. The best therapists' skills are more of an art than a craft, as they provide a hopeful healing environment for their clients with their humanity and contact with the person behind the injury. *m&b*

**6** *Art Riggs is a certified advanced Rolfer who has been practicing and teaching in the San Francisco Bay area and internationally for over more than 20 years. His graduate studies were in exercise physiology at the University of California in Berkeley. He is the author of Deep Tissue Massage: A Visual Guide to Techniques (North Atlantic Books, 2002), now in a second edition and translated into five languages, and the seven-volume companion DVD set. Visit his website at [www.deeptissuemassage.com](http://www.deeptissuemassage.com).*

*Editor's note: Massage & Bodywork magazine is dedicated to educating readers within the scope of practice for massage therapy. This feature was written based on author Art Riggs' years of experience and education. It is meant to add to readers' knowledge, not to dictate their treatment protocols.*