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Quadriceps Injuries

By Ben E. Benjamin

Muscles in the anterior thigh are commonly injured. The quadriceps muscles are strong, but when they are fatigued you might be subject to sudden microtears in the muscle fibers. There is pain around the knee when the distal tendon is affected, and there can also be significant pain at the anterior portion of the hip when the proximal end is injured. But a pain in the anterior thigh with activity usually means a muscle tear has occurred.

THE QUADRICEPS GROUP

The word *quadriceps* refers to the large, strong, four-headed muscle that is the primary extensor of the knee. In most people, it is, in fact, the strongest muscle group in the human body. It is subdivided into four discrete sections, which have their own individual names.

The rectus femoris is the most superficial quadriceps muscle, and it covers the middle of the thigh as well as the majority of the other three quadriceps muscles. It begins at the anterior inferior iliac spine (AIIS), which is a little protrusion of bone that lies an inch or so inferior to the anterior superior iliac spine (ASIS). The rectus femoris is the only quadriceps muscle that crosses two joints: both the hip and the knee. That means it has two functions: flexion of the hip and extension of the knee. The rectus femoris is critical when walking and running, because it helps swing the thigh forward for each new step. However, it is generally considered one of the weakest muscles in the quadriceps group.

The vastus intermedius is located just beneath the rectus femoris, and between the vastus lateralis and vastus medialis. This muscle cannot be seen without removing the rectus femoris. It is partly attached to the vastus medialis, and the two work in unison during extension of the knee.

The vastus medialis lies deep to the rectus femoris on the medial side of the thigh, and it originates on the body of the femur, attaching distally to the medial aspect of the patellar tendon. The primary function of this muscle is to straighten the knee during the final five degrees of extension. Atrophy of this muscle usually occurs when the person has experienced an injury that causes pain upon full-knee extension. For example, a torn meniscus in the knee often makes it impossible to fully straighten the knee; therefore, this muscle usually atrophies after a few months from lack of use.

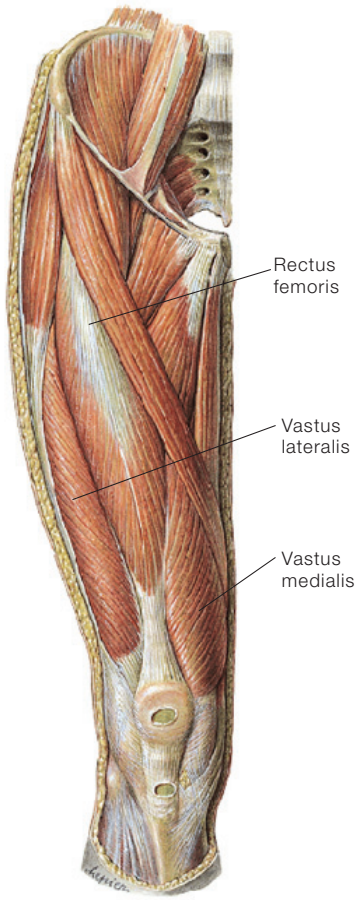
The fourth quadriceps section, the vastus lateralis, is on the lateral side of the vastus intermedius and covers most of the lateral thigh. The lateralis is the largest and strongest part of the quadriceps group. It has multiple attachments to the greater trochanter, gluteal tuberosity, linea aspera, gluteus maximus, and biceps femoris, among others, which makes it structurally strong and less vulnerable to injury. All four quadriceps muscles work in concert to extend the knee, and they are prime movers in walking, running, jumping, and squatting.

WHY DOES INJURY OCCUR?

Any quadriceps injury is a real nemesis for athletes, dancers, or hikers. Injury frequently occurs when the thigh muscles begin to fatigue and the stress on the thigh increases. This often happens near the end of a run, intense athletic match, race, or walk, or when leaning backward while kneeling on both knees (as might occur in yoga or dance class). The site of injury can be anywhere from the top of the thigh where the rectus femoris tendon attaches to the AIIS, or anywhere along the muscle belly. If the pain is present at the front of the hip, it could be the hip joint, or the sartorius tendon, that is injured. If pain is lower down in the anterior thigh, injury could be in the muscles themselves, or it could be a referred pain from the low back.

The muscle-tendon unit that is most commonly injured is the rectus femoris. This muscle is the longest and weakest muscle of the four that comprise the quadriceps—it is the one that helps you lift the thigh to flex at the hip, as well as extend the knee. The other three quadriceps muscles primarily help you straighten the knee. If you see someone limping because of pain, it is usually because of an injury to the rectus femoris tendon or an inflammation in the hip joint.

Damage to the rectus femoris tendon is one of the injuries that results from incorrect stretching of the front thighs. When we stretch, we want to elongate the muscle fibers. We do not want to stretch the tendons, which weakens the fibers and makes them more vulnerable to injuries. Because



Sobotta: *Atlas der Anatomie des Menschen* @ Elsevier GmbH, Urban & Fischer Verlag Munich.

For a video demonstration of proper squat and lunge techniques, visit www.benbenjamin.com/Squats and www.benbenjamin.com/Lunges.

Resisted Extension Supine Test.

Resisted Extension Sitting Test.

this weakening is a slow process, a person can overstretch for years before getting this injury. When stretching properly, the pull should be felt in the muscle, not the tendon.

Climbing or hiking down steep hills or mountains, especially where the terrain is gravelly or slippery, can cause the front thigh to contract suddenly to prevent a fall and thus become injured. The mechanics of injury are this: as you start to slip or begin to fall, the quadriceps contract so severely that it causes either a massive tear throughout the muscle, or a tear in the tendon.

In cases where the tear is severe, walking becomes painfully difficult and running becomes impossible. In milder cases, walking feels all right, but lifting the leg straight up in front or doing a single leg lift from a lying-down position is quite painful.

INJURY VERIFICATION TESTS

Resisted Extension Supine

With the client lying supine, stand at the side of the knee. Slip your headward hand under the knee closest to you, placing it on the other thigh just above the knee. Place your footward hand on top of the ankle and grasp it firmly. Now, ask the client to try to straighten the leg as you resist with equal force.

Resisted Extension Off Table (Sitting)

Have the client sit at the edge of the table with the knee at a 90-degree angle. Kneel in front of their knee and place your hands around the anterior ankle. Now, ask the client to try to straighten the leg as you resist with equal force. Use this position as a second test if the first one causes no pain or if the person is very strong and overpowers you.

TREATMENT CHOICES

Friction Therapy

For injuries to the tendon at the top of the thigh, friction therapy is effective. Because this area is commonly very sensitive, and the tendon is deep, the hip and knee must sometimes be bent at a 90-degree angle in order to access the area. First, let me describe how to treat the tenoperiosteal junction, which is the most commonly injured section of the tendon where it attaches to the bone. With the knee bent and the foot on the table, place the tip of your index finger on the ASIS. Now, move your finger inferior about one inch until you are over the AIIS. Ask your client to lift her foot an inch or so off the table so that the muscle will contract. This will help you trace the tendon up to the attachment site. With your finger pressing against the bone, perform the friction motion medially and laterally, applying pressure in one direction only. This treatment can be performed either with the hip flexed

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or with the leg extended on the table. If the treatment needs to be performed on the tendon body, move down a half-inch or so until you find the tender area on the tendon. Then apply friction in this region. If the injury is in the muscle belly itself, identify that area and then perform friction therapy on the muscle. This is often a fairly large area, so it is usually a good idea to use three or four fingers at once while performing the friction treatment.

Exercise Therapy

Both stretching and strength building are important parts of the rehabilitation process. Start out with a warm-up. You can either walk around for 3–4 minutes, or sit on the edge of a table and swing your legs back and forth. Now perform a series of stretches of the quadriceps muscles. A simple way to do this is by lying on your side with a pillow under your head. Bend your knee and take hold of your ankle with your hand, and gently pull your heel toward your buttock. Do this for about 2 seconds and then straighten your leg out again. Now bend your leg and repeat that process 10–15 times. Then roll over to the other side and do the same thing again on the good leg to keep your legs balanced. If that is too easy for you, lie prone, place a few large pillows under your knee, and try doing the same stretch in that position. This places a greater angle of stretch on the anterior thigh.

Now, try some strengthening exercises. This can be as simple as sitting on the edge of the table with a 5- or 10-pound weight strapped around your ankle and extending your leg 15–20 times. Once you are stronger, progress to standing squats and lunges. When you do a squat, keep your legs hip-width apart, and when you bend your knees, keep them over your toes and do not turn inward. You can begin with 10 or 15 squats and then progress by holding a weight in front of your chest while doing the squats. Start out with 10 pounds and progress up as high as you can. If you can do 12 or 15 squats and not feel tired, you do not have enough weight. If you can do 15 squats holding 40–50 pounds, you are pretty strong. Lunges can be done in a similar manner, first with no weight and then holding a 5-,10-, or 20-pound weight as you progress through your lunges.

SUMMARY

Injuries to the quadriceps muscles and tendons are fairly easy to assess and treat. Once you find the injury, first perform friction therapy followed by massage. After a few sessions, start the client on stretching and strength-building exercises. Retest the client every two weeks to monitor their progress. **m&b**

Editor's note: Massage & Bodywork *is dedicated to educating readers within the scope of practice for massage therapy. Essential Skills is based on author Ben E. Benjamin's years of experience and education. The column is meant to add to readers' knowledge, not to dictate their treatment protocols.*

Ben E. Benjamin, PhD, holds a doctorate in education and sports medicine, and is founder of the Muscular Therapy Institute. Benjamin has been in private practice for more than 45 years and has taught extensively across the country on topics including orthopedic massage, Active Isolated Stretching and Strengthening, and ethics. He is the author of *Listen to Your Pain* (Penguin, 2007), *Are You Tense?* (Pantheon, 1978), and *Exercise Without Injury* (MTI, 1979), and coauthor of *The Ethics of Touch* (Sohnen-Moe Associates, 2003). Presently, he is offering continuing education for massage therapists around the world via webinars. He can be contacted at Ben@BenBenjamin.com.