

Tendons 101

You have been noticing for some time now that when you lift heavy the front of your knees hurt or one of your elbows hurts while benching. Maybe it's not the knees or elbows, it's your shoulders when you do overhead presses. At some point this pain might take you to the doctor for treatment and the diagnosis is tendonitis. We've all heard the term but what does it really mean? And most importantly, how do you get rid of it?

THE BASICS

When talking about tendons, the first thing that you need to know is that a tendon connects a muscle to a bone and the function of the tendon is to transmit force from the muscle to the bone. This makes the bone move. For example, the biceps contracts, transmits force to the biceps tendon which attaches to one of the forearm bones called the radius and you end up performing a biceps curl. But transmitting too much force or small amounts of force thousands of times can lead to overuse and an injury called tendonitis. (Gross, 1992) The last four letters of that word gives you a clue to the condition; "itis" means inflammation and therefore we're talking about an inflamed tendon.

Now, you need to realize that a tendon isn't just some simple sort of rope that goes from a muscle to a bone. Tendons are actually quite complex and even have structures and contractile properties that are similar to that of muscle.

The components of a tendon are water, cells, fibers, and ground substance. The cells of the tendon are called fibroblasts and are responsible for the production of fibers and ground substance. The ground substance is made up of protein molecules, fluids, and metabolites which fill the space between the cells and fibers. (Gelberman, 1988) Fibroblasts are located between the bundles of fibers. The blood vessels and nerves that supply the tendon lie along the outer surfaces of the tendon. In general the vascular supply of a tendon is sparse, and some areas of the tendon may be relatively avascular. Tendon nutrition also may be accomplished through passive

diffusion from synovial fluid. (Gelberman,1988) Nearly all the tendon fibers are oriented longitudinally along the line of tensile stress imposed by muscle contraction. The interface between the tendon and the muscle consists of an inter-twining between the terminal membrane of each muscle and collagen fiber from the muscle's tendon. This interface between these tissues can be a site of stress concentration and potential failure (microtearing) if there is an abrupt transition in the mechanical properties of the two tissues. (Gelberman, 1988) At the tendon-bone interface the transition from tendon to bone occurs within a very short distance (1mm). Over this small distance there is a gradual change in mechanical properties from less stiff to more stiff tissue.

MORE ON ITIS

As you can see, tendons are fairly complex structures that have a very important job to do. It would be a bit simplistic to just say that if you lift too heavy or do lots of reps you can injure a tendon. The contributing factors are actually a bit more involved than just that. Age and vascularity of the area are important to consider when talking about tendonitis. As people age, the tendons lose some of their elasticity and ability to glide as smoothly as they used to. (Gross, 1992) The cause of the age related changes may be due to changes in the blood vessels that supply nutrition to the tendons. Another contributing factor is the frequency of loading the tendon, and you have four factors to consider, therefore overuse itself isn't really that straightforward an issue either.

The most common type of overuse is a specific movement pattern performed repetitively. (Gross, 1992) Examples would be throwing a baseball, cycling, running, etc. Of course this also includes the thousands of reps you do of certain exercises such as squatting, benching, curling, and so on. Because you do these movements so often, there may not be enough time for the tendon's structures to adjust and repair themselves, and the cumulative effect is microtrauma and pain.

A second factor that can cause tendonitis is a single stressor that's high enough in magnitude to cause some structural damage to a tendon and that initial injury is sustained by other activities that normally might not be of concern. (Gross, 1992) One example is

the lifter who may strain his shoulder performing a one rep max on the bench, and he continues to perform his normal shoulder routine although he feels some discomfort in his shoulder. What happened is that he strained one of the tendons in his shoulder and by continuing with his work, he's never allowing the tendon to fully heal. And the downward spiral continues to a point where you end up with chronic tendonitis.

A third factor that can lead to tendonitis is walking or running on uneven terrain. (Gross, 1992) Athletes that continuously run on one side of the same road can place unequal stresses on their legs and, as an example, cause more stress on one of the Achilles tendons and other tendons of the foot.

The fourth factor contributing to overuse type injury can include an improperly fitted tennis racquet, an improperly adjusted seat on a bicycle, or gym machines that don't match your bodies dimensions. (Gross, 1992) Most athletes have one or more of these factors involved when they develop tendonitis, and knowledge about what's contributing to the overuse is one of the first things to know on the road to recovery.

A TENDON'S COURSE

Usually the events leading up to an injury will fall into one of the four previously described categories and you'll typically experience an immediate and sharp pain. You'll end up feeling pain during passive stretching of the area and/or when you actively contract the involved muscle. But sometimes you can have referred pain from the inflamed tendon area. For example, athletes with tendonitis of the shoulder (supraspinatus tendonitis) can have pain that extends as far down as their elbow.

The first step you might take is to back off for a few days. You then resume your training and pain is experienced again. This cycle of rest and then resumption of activity can continue for months and the condition gradually turns into a chronic situation. What you need to consider is that healing tissue is weaker than uninjured tissue. So on one hand, your injured tendon does require rehabilitation type work so that rest for extended periods of time may not provide the controlled loading stimulus necessary for maturation of the healing tissue. On the other hand, if you follow rest with resumption of repetitive loading activities similar to what you were doing prior to injury, you're increasing the risk of damaging the weakened tissue farther.

What you need to understand is that when a tendon is initially injured it undergoes an inflammatory phase that lasts approximately three days. The area can become warm and swollen as your body sends cells into the area to help clean up the injury site. Ice and anti-inflammatory medication can be very useful during this time. After three days your body begins to lay down collagen fibers in the injured area to help continue the healing process. This phase is known as the proliferation phase and can last about four weeks. (Gelberman, 1988) Now, though collagen fibers are being laid down by the body, they have to undergo some loading to help make the tissue strong again. The analogy often used to describe this remodeling concept is the box of dropped toothpicks. If you drop a box of toothpicks on a table the toothpicks are scattered in a variety of directions. By placing your hand on top of the toothpicks and running your hand back and forth, the toothpicks will start to line up underneath your hand. Stretching and lifting very light weights that only gradually increase is the process that collagen fibers of the tendon must undergo to have the strength of the pre-injured tendon and this process can take up to two months.

HEALING APPROACH

Your first level of intervention should involve the removal of any activity that may result in repetitive loading of the involved tendon. You should avoid other activities that would load the affected tendon repetitively. For example, a lifter who hurts his shoulder lifting weights should certainly discontinue any lifts that bother the shoulder, but he should also avoid other activities such as throwing a baseball or football, possibly swimming, and basically anything that could aggravate the injury.

Your next course of action is to ice the affected area 10-15 minutes three to four times a day and possibly take some anti-inflammatory medication (over the counter, such as Advil or Ibuprofen). Corticosteroid injections have shown to weaken the tendon for two weeks so if you do receive an injection in the area then your training must be extremely light for two weeks. (Kennedy, 1976) There's reported evidence that multiple injections can lead to tendon rupture, so most physicians will inject an area only twice a year but be cautious of any more than that. (Kennedy, 1976) You also need to address any flexibility deficits in the region of the affected

joint. Compare your flexibility of the involved joint to the healthy side. Also look at the joints adjacent to the affected area. For athletes with tennis elbow, as an example, it's very common to have forearm, wrist, and even shoulder tightness compared to the healthy side. Increasing flexibility of the entire extremity can help reduce stress on the injured area. This reduction of stress on the affected area will allow the tendon to heal faster and able to be loaded sooner. All stretches should be held 30 seconds and repeated 2-3 times. The stretches should never be painful and after holding the stretch for 30 seconds you should feel the stretch become less intense. If the stretch becomes **more** intense you are stretching too hard and need to back off. Stretching should be incorporated into your daily lifting routine.

Transverse friction massage is a modality that has been shown to be effective for tendonitis. This is a deep tissue massage in which massage strokes are applied back and forth perpendicular to the longitudinal axis of the tendon. This type of massage tends to release scar tissue from adjacent tissues and has a way to facilitate an increase in local blood flow which can also aid in the healing process. (Curwin, 1984) You should note that adhesions between the tendon and adjacent tissue may be the source of continuous tissue irritation and inflammation and as such prolong the healing process.

A final consideration deals with how you train. The use of eccentrics or negatives to treat chronic tendonitis has found some support. (Komi, 1973) Here's what happens. Eccentric muscle contractions can transmit higher forces through tendon tissue, which can be appropriate *only* during the later stages of chronic tendonitis in an effort to facilitate maturation of a strong tendon. Eccentrics can be added once concentric movements are pain-free. To perform the eccentrics, raise the weight with both extremities and then lower with the involved extremity. If any discomfort is felt the exercise should be stopped and stretching of the affected area should take place. There are no documented studies that have specifically studied the best ways to eccentrically load tendons so in our clinic we start athletes with a weight they can handle for 20 reps and gradually increase their resistance over several workouts. Start with one set and gradually increase to three. If you have questions

about introducing heavy eccentrics into your workout for chronic tendonitis you should seek the advice of a physician, physical therapist, or athletic trainer.

TENDON POWER

Tendons are extremely strong structures that are an essential component to your ability to perform your sport and demonstrate strength and power. However, they can get injured and for the most part it's due to doing too much too often without sufficient rest. If you find one of your tendons acting up, be sure to include a general warm-up to increase overall body blood flow, deep tissue massage to help break up adhesions, a progressive strengthening program for the area (concentric and progress to eccentric), passive non-painful stretching to increase flexibility of the region, and ice to reduce any inflammation that may have been caused by the workout. Armed with more knowledge about tendons in general, you're afforded an excellent opportunity to prevent your injury from becoming a chronic condition.

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[sidebar]

DO I NEED TO SEE A DOC?

The answer is yes if you have any of these complaints:

- Noticeable swelling in the affected area
- Pain worsens during training and prevents completing the session
- Increased soreness in the area longer than one hour after training

[sidebar]

SEARCHING FOR CARE

- Always turn to a sports medicine orthopaedist or physical therapist.
- Do some research and find out who takes care of the local college or professional teams in your area. You deserve care equal to those athletes.
- If referred to a physical therapist – ask the physician to recommend one or ask to see the physical therapist who mostly works with the college or professional teams in the area.
- Visit the American Academy of Orthopaedic Surgeons at www.aaos.org to find an orthopaedist near you, but use the criteria above and also find an orthopaedist that you feel comfortable with.

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