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Skeletal Ligaments

Joseph Bernstein, M.D., and
Samuel D. Hodge, Jr., Esq.

Editor's Note: The The body contains a number of soft tissues that connect and support the structures of the body. These include the ligaments, which connect bone to bone; and tendons, which anchor muscle into bone on the opposite side of a joint. The job of a muscle is to provide movement, whereas fascia is the protective covering for the muscles. Together, these structures allow a person to walk, raise the shoulder, and stand up straight. This chapter focuses on the ligaments, with special attention to those in the knee, shoulder, and ankle because these ligaments are particularly susceptible to trauma. Likewise, the concepts taken from these three examples can be applied to almost all of the other joints in the body.

INTRODUCTION • Ligaments are fibrous tissues that connect bone to bone. Like ropes, ligaments are injured when they have been pulled too hard. (Like ropes, they can be cut—lacerated—but that is rarely seen.) Ligaments, like ropes, are not injured when they are struck. A classic example of a ligament injury is when a basketball player lands on another player's foot and twists an ankle. Here, the ligaments on the outside of the ankle will stretch and then ultimately may tear.

As with many medical terms, the word "ligament" has a foundation in Latin. The Latin root is *ligare*, meaning to tie or bind. The word ligature (and, interestingly, religion) comes from the root as well. It is no surprise; therefore, that ligaments are fibrous tissues that connect bone to bone. Figure 4-1 gives an example of the ligaments in the knee that demonstrates how the bones are held together by these soft tissue structures.

There are dozens of ligaments in the body, and almost every joint down to the tip of the little finger has at least two of these structures. Ligaments are short, elastic bands of fibers composed of collagen (protein) bundles. They have cells for maintaining the bundles, and some blood vessels. Nerve fibers are found in these bundles, which play an important role in proprioception—the ability

to know where the limbs are in space, even without looking at them. When a ligament is injured, this sense can be lost temporarily, causing in the case of an ankle injury, for example, a subtle clumsiness that may be reported as a feeling of instability.

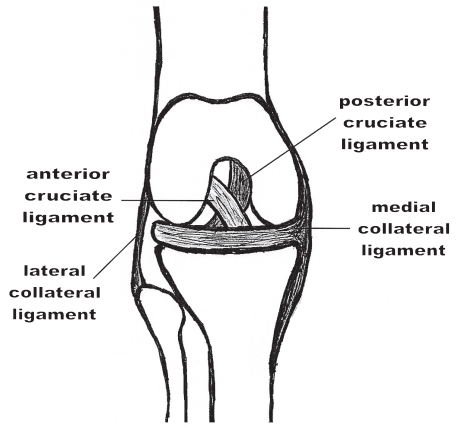

Figure 4-1

INJURIES TO THE LIGAMENTS • Damage to a ligament is called a *sprain*. Sprains are graded according to the amount of joint instability produced. (By way of reference, a *strain* refers to an injury to a tendon or muscle. It is unfortunate that the phrase "sprain and strain" has entered common usage to denote a non-specific soft tissue injury, as these words have discrete meanings.) A grade 1 sprain is an intrasubstance injury to the ligament producing pain but no clinical instability. In other words, the "rope" feels intact to the examiner. A grade 2 sprain represents a partial tear, and the joint may gap open when stressed but otherwise remains stable. A grade 3 sprain refers to a complete tear of the ligament that produces instability (see Fig. 4-2). Paradoxically, it is often the least painful of the three types.

The prognosis for recovery following a grade 1 sprain is excellent. Because the ligament is still intact, normal joint mechanics are maintained; post-traumatic arthritis is therefore *not* a concern. Additionally, grade 1 sprains can be expected to heal. The prognosis after grade 2 and 3 sprains is variable: some patients bounce back as if never injured, and others note lingering complaints.

The effects of a ligament sprain can be placed broadly in three categories:

• An injury to the ligament itself (the primary injury)

Grade III Sprain of a Ligament

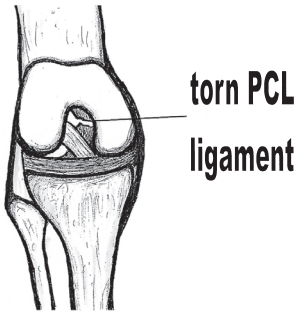

Figure 4-2

• An injury that may occur to surrounding joint tissues by the force of the injury (so-called secondary injuries)

• The ongoing damage to the joint from altered biomechanics (future injuries)

For example, an ankle sprain can cause pain, swelling, and possible functional instability. The ankle injury also may cause subluxation of the bone–a partial dislocation–leading to a collision of the dome of the talus or topmost foot bone with the shin bone. This can damage the cartilage surfaces. This would be a secondary injury. In addition, if there is chronic laxity of the ankle ligaments, this lack of stability may upset the normal biomechanics of the ankle leading to post-traumatic arthrosis. This would be a future injury. This injury happens by the same mechanism by which a car tire is damaged if its lug nuts are not properly tightened: the loading forces are not evenly distributed, and focal stress builds up, causing damage.

THE ANKLE • The ankle is a hinged joint connecting the leg to the foot (see Fig. 4-3). The ankle joint consists of three bones. The tibia is the bone on the inside (medial) part of the lower leg and functions as the main weight-bearing structure of the shin. It also forms the roof or top part of the ankle joint, called the plafond, as well as the inner wall, the medial malleolus. The fibula forms the outer wall, the lateral malleolus. Just proximally

to the ankle joint, the tibia and fibula form an inverted U, in which the talus, the superior aspect of the hindfoot, sits.

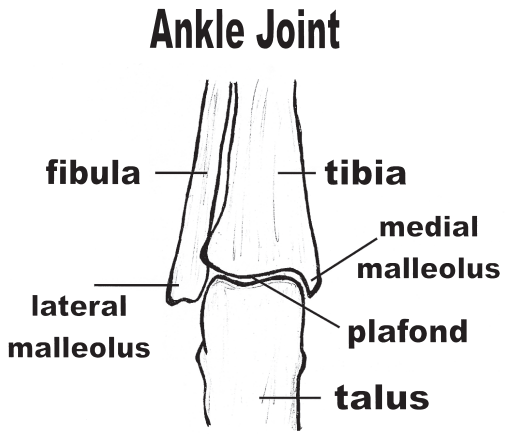

Figure 4-3

Ligaments Of The Ankle

The ankle joint depends on its ligaments for stability and support. The deltoid ligament on the medial side and the lateral collateral ligament complex provide side-to-side stability. Equally important is the syndesmosis, a collection of ligaments that connects the distal tibia to the fibula to create the U shaped mortise. The ankle joint has some inherent stability from the bony configuration between the talus below and the tibia and fibula above. It is also stabilized, to some extent, by the tendons passing across it. The majority of the stabilizing support, however, comes from the ligaments.

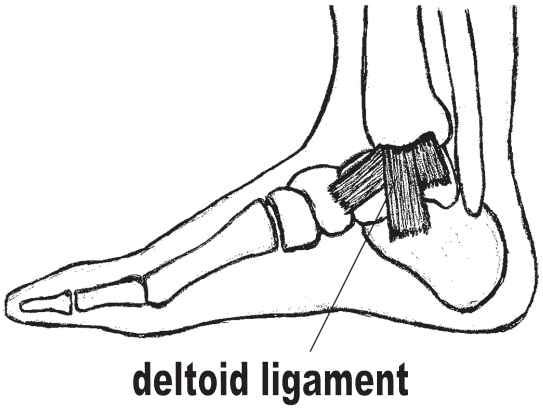

Figure 4-4

On the medial side, the tibia is connected to the talus by a triangular ligament, the deltoid ligament (see Fig. 4-4). This has a deep and superficial component; the deep component is the stronger and more important.

On the lateral side, there are connections between the fibula and the calcaneus, the lower heel bone, as well as the anterior and posterior ligaments connecting the fibula to the talus: these are the anterior talofibular, calcaneofibular, and posterior talofibular ligaments (see Fig. 4-5). This three-prong approach offers greater stability across a wider variety of foot positions. The deltoid ligament resists an outward tilting of the foot, called *eversion*; the lateral ankle ligaments resist *inversion*. It is important to note that ligaments fail (that is, are sprained) only in tension. This occurs when the ligaments are pulled too hard. (This injury does not occur from a direct blow.)

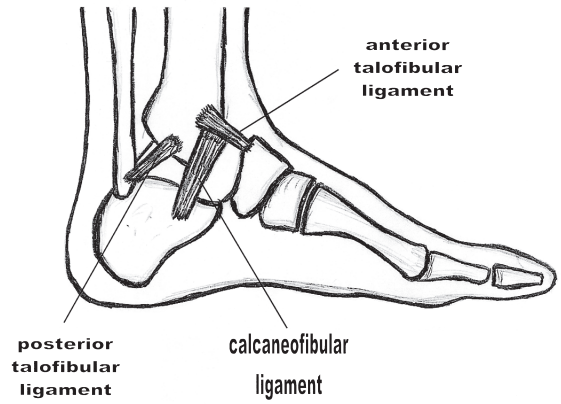

Figure 4-5

The Diagnosis Of An Ankle Sprain

The diagnosis of an ankle sprain is made on the basis of history and physical examination. It is not uncommon for a person to sustain a prior ankle sprain without realizing it. Thus, the demonstration of laxity on physical examination may not speak to an acute injury, and the patient's history is necessary to clarify this causation issue. Likewise, some people have laxity of their connective tissues on a genetic basis and may have a seemingly abnormal examination without any type of an acute event.

In the acute phase, the ligament injury can be detected by swelling and tenderness directly over

the ligament itself and there may be laxity on examination. This degree of laxity is related to the amount of damage to the ligaments themselves. It is also possible, however, for a complete ligament tear to be present in the absence of any laxity because muscle spasms may temporarily splint the joint.

Imaging studies can reveal a ligament sprain. For instance, an abnormal widening of the joint on x-ray suggests a ligament injury and a magnetic resonance imaging scan (MRI) can show an acute ligament tear as well. For the most part, an MRI of the ankle is medically justified in the setting of acute twisting injuries not so much to diagnose the sprain itself (which is clinically apparent), but to see if there are any associated cartilage lesions, typically involving the talar dome.

In a chronic setting, the ankle can be assessed by several maneuvers, including the drawer test. In this test, the foot and shin are stabilized by the hands of the examiner while a yanking motion is applied to the foot in a forward direction. The examiner is able to assess the quality of the endpoint of this maneuver to determine the integrity of the lateral ankle ligaments. The foot may also be turned to the side to stress it for stability, but this is not the best test because there is some normal motion in that direction, even without a sprain, from the subtalar joint located between the talus and the calcaneus (heel bone).

Treatment Of An Ankle Injury

The treatment of ankle sprains centers on "RICE," an acronym for *rest, ice, compression*, and *elevation*. The swelling that is associated with acute sprains is often more disabling than the ligament damage itself. It is common for physicians to see patients who have lost range of motion or functional mobility because of swelling and joint stiffness after even minor sprains. The goal of initial treatment, therefore, is to limit this pathological swelling.

In subacute and chronic phases, treatment of ankle sprains is directed toward functional rehabilitation. This includes range-of-motion therapy, strengthening programs, and exercise to increase proprioception. One of the more disabling features of some ankle sprains is the loss of proprioception, the sense of where the limbs lie in space. Proprioception is mediated, in part, by stretch receptors in the ligament. Until this sense is regained, a person may feel that the leg is unstable even though objective testing indicates that it is not.

Injuries to a ligament from tension can also be associated with compressive injuries to the bone and post-traumatic arthritis from altered joint mechanics. There can be osteochondral injuries to the talar dome as well as to the distal tibia. The causes of persistent ankle pain following an acute ankle injury include the following:

- Inadequate rehabilitation
- Occult injury to bone or cartilage
- Chronic ligamentus instability
- Scar tissue formation (impingement syndrome)
- Peroneal tendon injury

THE KNEE • The knee has been described as two matchsticks held together by rubber bands. This is somewhat hyperbolic, but there is more than a grain of truth to it as well. The knee, more so than any other major joint in the body, is inherently unstable. The femoral condyles are like round balls rolling on the flat surface of the tibial plateau. The knee is formed by the femur on the top and the tibia from below to form a hinged joint that flexes and extends. The patella, or knee cap, sits between the quadriceps muscles and patellar tendon in front of the hinge. The fibula is the lateral (outside) bone in the lower part of the leg that contacts with the tibia but not the femur (see Fig. 4-6).

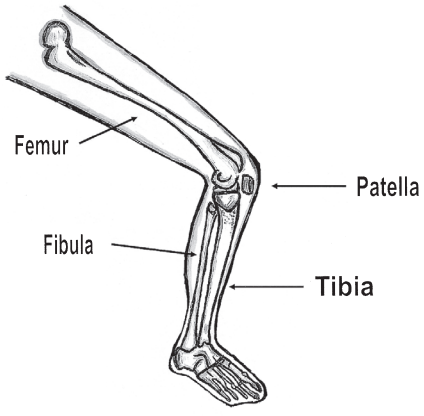

Figure 4-6