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ANKLE INJURY MECHANISMS

and Integrative Medicine Therapies

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ABSTRACT

The purpose of this article is to show the relationship between the mechanism of an ankle injury (inversion, eversion, etc.) and the most likely result of the injury (sprain, fracture, etc.). While there are no absolute rules for positively associating each mechanism of injury with a specific type of injury, this article will provide some guidance for those attempting to prove or disprove the relationship between mechanism and injury type. Furthermore, this article will also illustrate common Integrative Medicine treatments for patients with ankle injuries, including acupuncture and homeopathic remedies.

SCOPE OF PAPER

A preliminary examination of the anatomy of the ankle, as well as the *kinematics* that the structures of the ankle generate, will precede a discussion of types of injuries to the ankle. Following will be a discussion of the relationship between the type of injury and the mechanism of injury, from both an anatomical point of view and by example. Finally, we will discuss common integrative medicine treatments which patients with ankle injuries might undergo as part of their "whole body" treatment.

ANKLE ANATOMY

The ankle is formed by the *distal* tibia, distal fibula, talus, and calcaneus (Figure 1). Superficially, the ankle's landmarks are the bony prominences on each side of the ankle, known as the *medial* and *lateral* malleoli, which are the rounded downward projections at the distal ends of the tibia and fibula, respectively (Figure 2). The tibia, or shin bone, is the larger and stronger of the two bones of the leg below the knee and connects the knee to the ankle. The articular surface of the distal end of the tibia is also known as the plafond or pilon. The plafond articulates with the talus; together, they distribute weight bearing throughout the ankle (Small, 2009, p. 314). The fibula, or calf bone, is located on the lateral side of the tibia. The fibula is connected to the tibia both *proximally* and distally. The lower extremity of the fibula projects below the tibia and forms the lateral portion of the talocrural joint. The fibula maintains ankle mortise stability during weight bearing. The talus is the second largest of the tarsal bones. The superior, dome-shaped surface of the body of the talus is known as the trochlea. The calcaneus, or heel bone, meets the talus in two places: at the *posterior* and *anterior* talocalcaneal articulations. The ankle is surrounded by the articular capsule, which is attached to the borders of the articular surfaces of the malleoli proximally and to the distal articular surface of the talus distally (Norkus & Floyd, 2001, p. 69).

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LEARNING OBJECTIVES:

1. Describe the roles of the various anatomical structures of the ankle.
2. Explain the mechanisms required to injure various anatomical structures of the ankle.
3. Discuss the common practices in complementary and alternative medicine, also known as Integrative Medicine, to treat patients suffering from various ankle injuries.

KEYWORDS: ankle sprain, ankle fracture, Integrative Medicine, acupuncture, homeopathy

TARGET AUDIENCE: upper-level college and graduate students, physical therapists, physicians, health insurance industry professionals

PROGRAM LEVEL: Intermediate

DISCLOSURES: The author has nothing to disclose.

PREREQUISITES: intermediate knowledge of anatomy, mathematics and/or physics, physical sciences

PRACTICE GAP: understanding the mechanisms of injuries, valuable to those who treat injuries

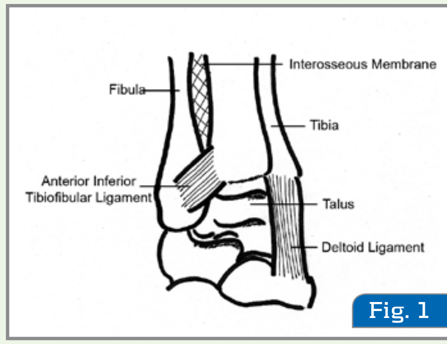


Fig. 1

Bony anatomy of the ankle (anterior view)

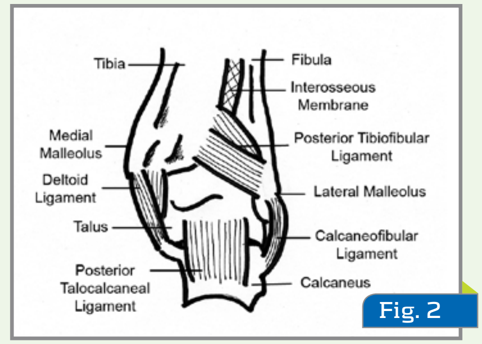


Fig. 2

Bony anatomy of the ankle (posterior view)

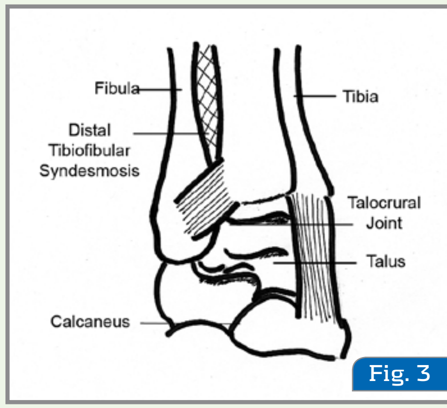


Fig. 3

Joints of the ankle (anterior view)

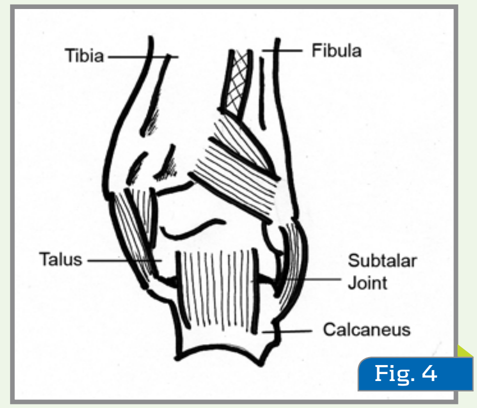


Fig. 4

Joints of the ankle (posterior view)

THE ANKLE IS COMPRISED OF THREE JOINTS: THE TALOCRURAL JOINT, THE SUBTALAR JOINT, AND THE DISTAL TIBIOFIBULAR SYNDESMOSIS

Joints of the Ankle

The ankle is comprised of three joints: the talocrural joint, the subtalar joint, and the distal tibiofibular syndesmosis (Figures 3 and 4). The talocrural joint, also known as the tibiotalar joint or the mortise joint, is a uniaxial, modified-hinge joint formed by the medial malleolus of the tibia, the lateral malleolus of the fibula, and the talus. The tibial plafond articulates with the trochlea. The convex shape of the trochlea allows it to fit snugly into the concave plafond, which stabilizes the ankle mortise, the fork-like structure of the malleoli (Norkus et al., 2001, p. 68). This is important because the ankle bears more weight per unit area than any other joint in the body (Morrison & Kaminski, 2007, p. 135). The medial malleolus articulates with the medial aspect of the trochlea, and the lateral malleolus articulates with the lateral aspect of the trochlea. The talocrural joint allows for *dorsiflexion* and *plantarflexion* of the ankle. The normal range of motion (ROM) for the ankle joint is 30 degrees of dorsiflexion and 45 degrees of plantarflexion. Normal gait requires only 10 degrees of dorsiflexion and 20 degrees of plantarflexion (Small, 2009, p. 315). During dorsiflexion, the wider anterior portion of the talus occupies much of the mortise as it wedges itself between the medial and lateral malleoli; this is considered the safest ankle position due to the increased joint stability created by the increased contact of the articular sufaces of the talocrural joint.

The subtalar joint lies just inferior to the talocrural joint. The subtalar joint is a gliding joint, where the posterior aspect of the talus articulates with the superior aspect of the calcaneus. The anterior subtalar joint is formed by the head of the talus, the anterior-superior facets, the sustentaculum tali of the calcaneus, and the concave proximal surface of the tarsal navicular. The posterior subtalar joint is formed by the inferior posterior facet of the talus and the superior posterior facet of the calcaneus. The anterior and posterior subtalar joints behave like a single ball-and-socket joint. The subtalar joint averages a 42-degree upward tilt and a 23-degree medial angulation, allowing for *inversion* and *eversion* of the ankle (Fong, Chan, Yung, & Chan, 2009, p. 3).

The distal tibiofibular syndesmosis is a syndesmotic joint formed by the joining of the distal fibula and tibia by the anterior and posterior tibiofibular ligaments and the interosseous membrane (Molinari, Stolley, & Amendola, 2009). The distal tibiofibular syndesmosis allows for limited translation and rotation during dorsiflextion and plantarflexion, accommodating for the asymmetric talus (Fong et al., 2009, p. 3).

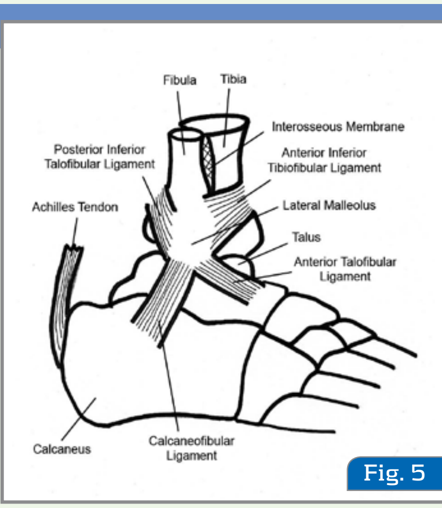


Fig. 5

Ligaments of the ankle (lateral view)

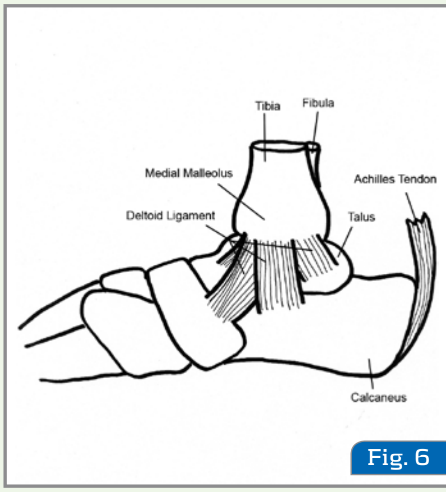


Fig. 6

Ligaments of the ankle (medial view)

GLOSSARY

ARNHEIM & PRENTICE, 1993; DOX, MELLONI, & EISNER, 1993; KAPIT ET AL., 1993

ABDUCTION:	Movement of away from the midline of the body.
ADDUCTION:	Movement of toward the midline of the body.
ANTERIOR:	Before or in front of.
DISTAL:	Farthest from a center, from the midline, or from the trunk.
DORSIFLEXION:	Movement of the superior surface of the foot toward the leg.
EVERSION:	Outward turning of the sole of the foot.
EXTERNAL ROTATION:	Rotation away from the midline of the body.
INTERNAL ROTATION:	Rotation toward the midline of the body.
INVERSION:	Inward turning of the sole of the foot.
KINEMATICS:	The science of motion of the parts of the body.
LATERAL:	Located on the side; farther from the midline.
MECHANISM:	The manner in which an effect is produced.
MEDIAL:	Relating to the middle; near the median plane.
PLANTARFLEXION:	Movement of the forefoot away from the leg.
POSTERIOR:	Located behind a structure; relating to the back or dorsal side.
PRONATION:	Within the ankle, a combination of calcaneal eversion, foot abduction, and dorsiflexion.
PROXIMAL:	Nearest to the point of reference.
SUPINATION:	Within the ankle, a combination of calcaneal inversion, foot adduction, and plantarflexion.

Ligaments of the Ankle Joint

The talocrural joint is supported by the anterior talofibular ligament, the posterior talofibular ligament, the calcaneofibular ligament at the lateral aspect (Figure 5), and the deltoid ligament at the medial aspect of the ankle (Figure 6). The anterior talofibular ligament originates from the anterior-inferior border of the fibula and inserts into the neck of the talus. It prevents anterior displacement and *internal rotation* of the talus during plantarflexion. It has the lowest ultimate load, approximately 138.9 N, and is the weakest of the lateral ligaments, making it the most susceptible to lateral ankle sprains (Fong et al., 2009, p. 3). The posterior talofibular ligament also connects the talus and the tibia and provides stability to the posterior aspect of the lateral ankle. The calcaneofibular ligament connects the calcaneus and the lateral malleolus and limits ankle inversion. It is the strongest lateral ankle ligament. Injury to the calcaneofibular ligament occurs when the ankle is dorsiflexed and an inversion force is applied. The deltoid ligament is a flat, triangularly shaped ligament found on the medial aspect of the ankle. The deltoid ligament has both a deep and a superficial portion. It is comprised of the anterior tibiotalar, the posterior tibiotalar, the tibiocalcaneal, and the tibionavicular bands. The deltoid ligament is considered to be the strongest ankle ligament. During plantarflexion, it prevents excessive eversion and resists talar *external rotation*. Injury to the deltoid ligament is uncommon and occurs due to excessive eversion (Norkus et al., 2001, p. 69; Small, 2009, p. 314).

The subtalar joint is supported by the deep ligaments, the peripheral ligaments, and the retinacula, which stabilize the subtalar joint and form a barrier between the anterior and posterior joint capsules. The three lateral ligaments also prevent excessive inversion and lateral talar tilt at the subtalar joint (Fong et al., 2009, p. 3; Norkus et al., 2001, p. 69).

The anterior and posterior tibiofibular ligaments, along with the interosseous membrane, form a stable roof for the mortise of the talocrural joint and hold the tibia and fibula together (Figures 5 and 6). These syndesmotic ligaments resist axial and rotational forces against the ankle. The interosseous membrane also prevents posterolateral bowing of the fibula during weight bearing. If the tibia's articulation with the talus is shifted at all, the weight distribution on the talus can be altered, which may lead to early onset arthritis (Fong et al., 2009, p. 3; Molinari et al., 2009, p. 130; Norkus et al., 2001, p. 69; Small, 2009, p. 314).

TABLE 1[15,22] [MUSCLES OF THE ANKLE]

INSERTION OF TENDON	MUSCLE	ACTION
BEHIND THE MALLEOLI	Peroneus longus	Plantarflexion, eversion
	Peroneus brevis	Plantarflexion, eversion
	Gastrocnemius-Soleus complex	Plantarflexion
	Flexor Hallucis longus	Plantarflexion
	Flexor Digitorum longus	Plantarflexion
	Tibialis posterior	Plantarflexion, inversion
ANTERIOR TO THE MALLEOLI	Tibialis anterior	Dorsiflexion, inversion
	Extensor Hallucis longus	Dorsiflexion, inversion
	Extensor Digitorum longus	Dorsiflexion
	Peroneus tertius	Dorsiflexion, eversion

Muscular Control of Ankle Motion

The following muscles have tendons which pass behind the malleoli and act as ankle flexors: Peroneus longus, Peroneus brevis, Gastocnemius-Soleus complex, Flexor Hallucis longus, Flexor Digitorum longux, and Tibialis posterior. The following muscles have tendons which pass anterior to the malleoli and act as ankle dorsiflexiors: Tibialis anterior, Extensor Hallucis Longus, Extensor Digitorum Longus, and Peroneus tertius (Martini & Bartholomew, 2000, p. 204-206; Patton, K.T., & Thibodeau, G.A., 2000, p. 228-229). [Please refer to Table #1 and Figures 7, 8, and 9.]

Tendons of the Ankle

The Achilles tendon is the most notable tendon of the ankle joint. The Achilles tendon is a large tendon, running from the heel to the calf, shared by the gastrocnemius and the soleus muscles, and it connects both muscles (as well as a third, vestigial muscle called the plantaris muscle) to the posterior calcaneus (Figures 5 and 6). The attachment of the gastrocnemius and soleus muscles to the calcaneus allows for plantarflexion of the ankle. The Achilles tendon is a strong, nonelastic, fibrous tissue that can absorb large forces associated with running, upwards of six to eight times the body's weight (Dubin, 2005, p. 39).

Bursae of the Ankle

A bursa is a sac containing a viscid fluid that helps to reduce friction between moving parts. Bursae are usually found over bony prominences and beneath tendons. The bursae with the most clinical significance are the retrocalcaneal bursa, located between the Achilles tendon insertion site and the calcaneus, and the retroachilles bursa, located between the Achilles tendon and the skin (Aldridge, 2004, p. 334). Injury to the bursae of the ankle is common, and may be concurrent with another injury to the ankle.

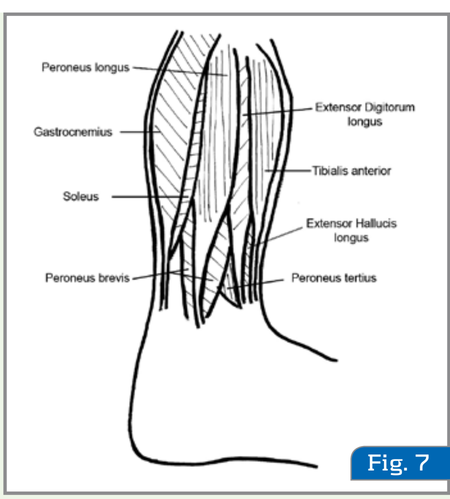


Fig. 7

Muscles of the ankle (lateral view)

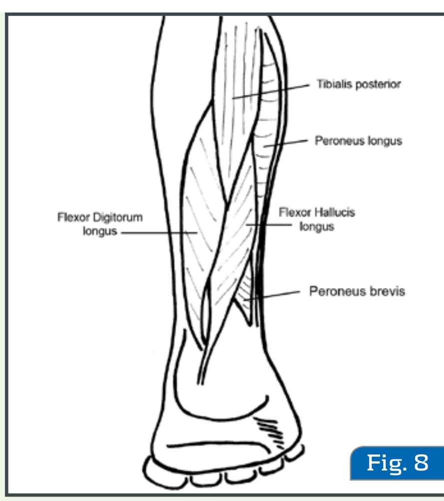


Fig. 8

Muscles of the ankle (posterior view)

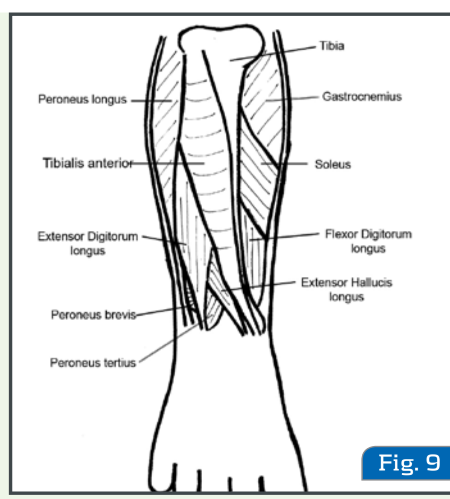


Fig. 9

Muscles of the ankle (anterior view)

TABLE 2 [MECHANISMS & EXAMPLES OF ANKLE INJURIES]

INJURY	MECHANISM OF INJURY	EXAMPLES OF HOW INJURY OCCURS
Lateral Ankle Sprain	inversion and plantarflexion	"twisted ankle"
Medial Ankle Sprain	eversion	landing on the inside of the foot after jumping
High (Syndesmotic) Ankle Sprain	external rotation and hyperdorsiflexion	a blow to the lateral leg while the foot is planted, falling forward onto a planted foot
Unimalleolar Fracture	supination-adduction, supination-external rotation, pronation-abduction, and pronation-external rotation	falling onto the top of the foot
Bimalleolar Fracture	supination-adduction, supination-external rotation, pronation-abduction, and pronation-external rotation	falling onto the outside of the foot while the foot is planted (pronation-abduction)
Trimalleolar Fracture	supination-adduction, supination-external rotation, pronation-abduction, and pronation-external rotation	excessive rotational force while the foot is planted
Ankle Arthritis	posttraumatic degenerative joint disease; may also be osteoarthritic, rheumatoid, or septic in nature	prior trauma, age
Tendonitis	tight gastrocnemius and soleus muscles, overpronation of the subtalar joint, degeneration	overuse of the calf muscles, abnormal stress on the ankle, age
Bursitis	irritation of the area of the Achilles tendon insertion at the posterior calcaneus	ill-fitting footwear

COMMON ANKLE INJURIES

Common ankle injuries include, but are not limited to, ankle sprains, ankle fracture, arthritis, tendonitis, and bursitis. Please refer to Table #2: Mechanisms & Examples of Ankle Injuries.

Ankle Sprains

Ankle sprains are the most common type of ankle injuries. Sprains occur as a result of the stretching or tearing of any of the ligaments surrounding the joints. Sprains are typically classified as a grade I, II, or III sprain. A grade I sprain is considered to be a mild sprain, involving stretching or inflammation of a ligament; a grade III sprain, on the other hand, is a complete tear of a ligament. At this stage, the patient's ankle will suffer a complete loss of function and motion, as well as mechanical instability (Ardizzone & Valmassy, 2005, p. 65; Wolfe, Uhl, Mattacola, & McCluskey, 2001, p. 93). The three types of ankle sprains are lateral, medial, and high (syndesmotic).

Lateral Sprains

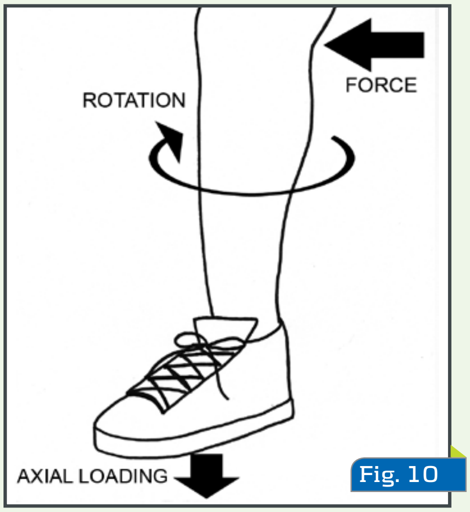
Lateral ankle sprains are the most common. The anatomy and biomechanics of the ankle puts the lateral ankle at the highest risk to sustain inversion injuries; in fact, 85% of ankle sprains are caused by an inversion mechanism (Morrison et al., 2007, p. 135). Lateral sprains often occur from an inversion (or *supination*) force applied to a foot in plantarflexion. For example, the common "twisted ankle," in which the foot rolls inward and the patient lands on the outside of the foot, is a lateral sprain. The anterior talofibular ligament is injured first and, if the force is great enough, the calcaneofibular ligament follows (Small, 2009, p. 316).

Medial Sprains

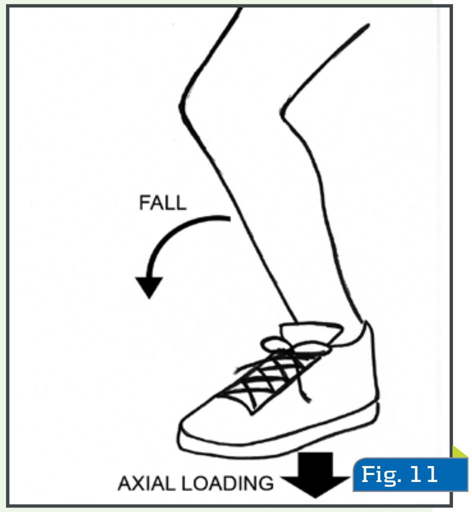
Medial ankle sprains, which are rare, occur when the deltoid ligament is injured during excessive eversion. The foot rolls outward, and the patient lands on the inside of the foot. Because the lateral malleolus extends further distally than the medial malleolus, the ankle has a smaller range of eversion than inversion, which accounts for the more common occurrence of lateral ankle sprains. Deltoid ligament tears are typically associated with ankle fractures (Lynch, 2002, p. 410).

High ankle Sprains

High ankle sprains, or syndesmotic sprains, are far less common than either lateral or medial sprains, accounting for only 1 to 11% of ankle sprains (Small, 2009, p. 317). High ankle sprains manifest themselves in the separation of the tibia and the fibula, or the widening of the ankle mortise. External rotation and hyperdorsiflexion are the most common causes of high ankle sprains. External rotation causes injury to the tibiofibular ligaments, allowing the tibia and fibula to separate; hyperdorsiflexion causes the wide anterior portion of the talus to push the malleoli apart. High sprains are common in collision sports including football, hockey, and soccer, as well as in skiing. A blow to the lateral leg while the foot is planted, or



Mechanism of a high ankle sprain: a blow to the lateral leg while the foot is planted



Mechanism of a high ankle sprain: falling forward onto a planted foot

a ski that sticks in the snow while turning, can result in external rotation (Figure 10). Hyperdorsiflexion can occur when a hockey player's skate is forced into the boards, or when a runner comes to a sudden stop with the foot planted and falls forward (Figure 11) (Molinari et al., 2009, p. 132; Norkus et al., 2001, p. 71-72).

Ankle Fractures

Ankle fractures are classified as unimalleolar, bimalleolar, or trimalleolar. Unimalleolar fractures involve injuries to either the medial or lateral malleolus. Bimalleolar fractures involve injuries to both the medial and lateral malleoli. A bimalleolar equivalent fracture occurs when the lateral malleolus is fractured and the deltoid ligament is completely ruptured. Trimalleolar fractures involve a combination of both medial and lateral malleollar fractures and either a posterior malleolar or a posterior tibial fracture. Mechanisms of unimalleolar, bimalleolar, and trimalleolar fractures include falling forward on top of the foot, falling onto the outside of the foot while the foot is planted (pronation-abduction), and excessive rotational force while the foot is planted. Pilon fractures (fractures of the articular surface of the distal end of the tibia) are caused by axial loading mechanisms (ie., falling from a considerable height and landing on one's feet).

Ankle fractures are classified using two systems: the Danis-Weber classification and the Lauge-Hansen classification. The Danis-Weber classification system is based on the level of the fibula fracture. Type A fractures occur distal to the joint line or ankle mortise (i.e., fractures below the ankle joint); type B fractures occur at the level of the ankle joint; and type C fractures occur proximal to (or above) the level of the ankle joint. The Lauge-Hansen system is based on the mechanism of injury and pathology: the first part identifies the position of the ankle at the time of injury, and the second part identifies the type of force applied to the ankle. There are four Lauge-Hansen classification groups: supination-*adduction*, supination-external rotation, *pronation-abduction*, and pronation-external rotation (Small, 2009 p. 317-319).

Ankle Arthritis

Arthritis refers to inflammatory joint disease. The presenting symptoms of arthritic joints include pain, swelling, stiffness, redness of the skin about the joint, effusion, deformity, and ankylosis (Rogers, 2011, p. 218). Although the ankle joint is the most commonly injured joint of the human body, symptomatic arthritis of the ankle is nine times less likely than that at the knee and hip, and the ankle joint is rarely affected by osteoarthritis. The most common causes of the degenerative changes of ankle arthritis are traumatic injuries (fractures of the malleoli, tibial plafond, and talus and ostochondral damage of the talar dome) and abnormal ankle mechanics (ankle instability due to chronic lateral ligament laxity) (Thomas & Daniels, 2003, p. 923).

Tendonitis of the Ankle

Tendonitis (tendinitis) is the inflammation of a tendon, and can affect the ankle joint when any of the tendons associated with the ankle joint, including the Achilles tendon, become inflamed. Achilles tendonitis, as well as other Achilles tendon injuries, is common among runner and is caused by overuse, improper training, gait abnormalities, degenerative changes, and improper footwear (Dubin, 2005, p. 39).

Bursitis of the Ankle Joint

Bursitis of the ankle joint is the inflammation of one, or more, of the bursae that surround the ankle joint. The retrocalcaneal bursa and the retroachilles bursa are common sites of inflammation. The most common cause of retrocalcaneal and retroachilles bursitis is ill-fitting footwear that irritates the area of the Achilles tendon insertion at the posterior calcaneus (Aldridge, 2004, p. 334).

Mechanism of Injury vs. Injury Type

There are no absolute rules for positively associating a type of ankle injury with a specific mechanism of injury, and vice versa. For example, a supination-adduction mechanism of injury can result in a unimalleolar, bimalleolar, or trimalleolar fracture, depending on several variables such as the severity and the exact location of the application of the mechanism of injury. Furthermore, an ankle injury may be associated with a secondary injury. A working knowledge of the mechanisms of common ankle injuries, however, can lead one to postulate possible mechanisms for specific ankle injuries.

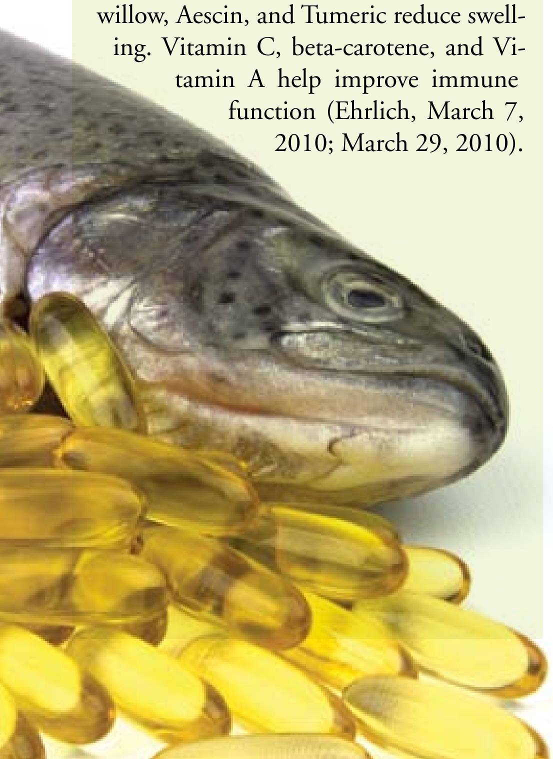
Imagine that a gymnast poorly dismounted from a balance beam, resulting in a trimalleolar fracture of the right ankle, which consisted of a spiral fracture of the distal fibula, an avulsion fracture of the posterior malleolus, and a transverse fracture of the medial malleolus. Trimalleolar fractures typically occur when there is excessive rotational force while the foot is planted. This gymnast's injury can be explained by a supination-external rotation (or supination-lateral rotation) mechanism of injury: when the gymnast landed from her dismount, she rolled her foot inward (supination) as the foot rotated to her right (external rotation). A rupture of the anterior inferior tibiofibular ligament will also be associated with this stage IV supination-external rotation injury (Arimoto & Forrester, 1980, p. 1060

INTEGRATIVE MEDICINE THERAPIES

Integrative medicine is a "whole-person" approach to treating a patient, designed to treat the person and not just the disease (in this case, the ankle injury), by treating the mind, body, and spirit. As every patient is unique, a thorough understanding of the individual patient is essential and can be achieved through diet journals, patient interviews, and lab testing. Most integrative medicine programs combine conventional Western medicine with alternative or complementary treatments and therapy, including herbal medicine, acupuncture, prolotherapy, massage, biofeedback, yoga, and stress reduction techniques. Duke Integrative Medicine's website states that through a partnership between the patient, physician, and a team of clinical experts, integrative medicine also anticipates possible health issues or risks and promotes prevention to minimize them (Duke Integrative Medicine, 2011).

SUPPLEMENTS & HERBS

According to the University of Maryland Medical Center, some nutrients and herbs help restore damaged tissue, reduce swelling, and provide pain relief: Vitamin C, beta-carotene, glucosamine, chondroitin, calcium, and magnesium promote the healing and rebuilding of tissues. Pain relief can be achieved with the use of willow bark, cat's claw, and devil's claw. Bromelain, licorice, white willow, Vitamin E, and essential fatty acids such as fish oil or primrose oil reduce inflammation. White willow, Aescin, and Tumeric reduce swelling. Vitamin C, beta-carotene, and Vitamin A help improve immune function (Ehrlich, March 7, 2010; March 29, 2010).



ACUPUNCTURE

Acupuncture originated in China many centuries ago. Its use spread throughout Asia, and it was introduced to Europe in the 17th century. Acupuncture aims to heal through the stimulation of anatomical points on the body using a variety of techniques. Acupuncture involves penetrating the skin with thin, solid, metallic needles manipulated by the hands or by electrical stimulation. According to the World Health Organiztion (2003), other techniques associated with acupuncture include moxibustion (the burning on or over the skin of selected herbs), laser acupuncture, and acupressure. According to traditional Chinese medicine, acupuncture regulates the flow of qi, or vital energy, through the body, thus keeping the body in a balanced state (National Center for Complementary and Alternative Medicine, 2011). The World Health Organization compiled a review and analysis of controlled clinical trials of acupuncture therapy. The study concluded that acupuncture analgesia works better than a placebo for most kinds of pain, and is highly effective in treating chronically painful conditions. Acupuncture alleviates pain and reduces muscle spasm; for the treatment of sprains, acupuncture can also improve local circulation, thus speeding up the recovery time (World Health Organization, 2003).

HOMEOPATHY

The guiding principle of homeopathy is the principle of similars or "like cures like", in which a disease can be cured by a substance that produces similar symptoms in healthy people. Another important principle of homeopathic treatments is dilution: the lower the dose of the medication, the greater its effectiveness. Most homeopathic remedies are so dilute that no molecules of the healing substance remain; even so, the healing substance has left its imprint or "essence," and it is this essence which cures the disease. Homeopaths treat patients based on their genetic and personal history, body type, and current symptoms; therefore, remedies are individualized to each patient. Homeopathic remedies are derived from natural substances that come from plants, minerals, or animals (National Center for Complementary and Alternative Medicine, 2010). Ehrlich (March 29, 2010), with the University of Maryland Medical Center, lists Arnica (topical or internal), Byronia, Ledum, Rhus toxicodendron, Ruta, and Traumeel as homeopathic remedies for sprains. Ehrlich (March 7, 2010) also lists Byronia, Phytolacca, Rhus toxicodendron, and Rhododendron, as well as injectable homeopathic medications such as Traumeel, as homeopathic rem-

edies for tendonitis. In the treatment of acute injuries, Traumeel, an inflammation regulating drug, is often combined with Spascupreel (for muscle strains) and Lymphomyosot (for tissue swelling) (Barkauskas, 2007, p. 6).

A case study by Steven Rosenberg, D.P.M., (1998) related his homeopathic treatment of a 45-year-old woman with an ankle sprain. After a physical examination and evaluation of x-rays of the left ankle, Dr. Rosenberg diagnosed this patient with a 1st degree left ankle sprain. He treated the patient with multiple subcutaneous injections of Traumeel to all three ligament sites in the lateral aspect of the ankle. An Unna boot soft immobilization cast was applied to the left ankle to provide stability and compression. The patient was also given Traumeel (anti-inflammatory), Osteoheel (pain relief), and Lymphomyosot (edema relief) tablets to help decrease the pain, inflammation, and swelling, and Traumeel ointment for topical application. The following day, the patient had a less painful ankle that could support her weight. The swelling was decreasing, and she could flex her ankle without pain (p. 280). This case study shows how conventional techniques (application of the Unna boot) in concert with alternative medicine (homeopathic remedies) can effectively relieve the symptoms of ankle injuries.

Prolotherapy

Prolotherapy involves a series of injections of irritants, osmotic shock agents, and/or chemotactic agents designed to stimulate low-grade inflammation in injured tissues, specifically ligaments, tendons, and cartilage, which promotes tissue repair and/or growth.

When tissues, such as ligaments, are injured, the common initial response is inflammation, which stimulates substances carried in blood that produce growth factors in the injured area to promote healing. Ligaments, tendons, and cartilage, however, have poor blood supply and take longer to heal than other tissues; as a result, incomplete healing of these structures is common. Traditional treatments for ligament and tendon injuries include anti-inflammatory medications (ibuprofen and Naprosyn), nonsteroidal anti-inflammatory drugs (NSAIDS), or corticosteroids to relieve pain and/or swelling to provide temporary relief. Gordin (2011) wrote that a study by Dr. Richard Wrenn demonstrated "suppressed fibroblastic reacitons (connective tissue formation) to injury following intramuscular injections of cortisone" (p. 601). Proponents of prolotherapy argue that by suppressing inflammation and/or fibroblast proliferation and collagen formation, these traditional treatments actually suppress the body's natural healing process, and the injured tissues do not fully heal. As a result, many patients suffer from chronic ankle sprains, laxity, or instability due to incomplete healing.

"NUMEROUS STUDIES HAVE DEMONSTRATED THE DEVELOPMENT AND GROWTH OF NEW LIGAMENTOUS TISSUE IN JOINTS THROUGHOUT THE BODY USING PROLOTHERAPY TREATMENT."

According to Alderman (2007), the use of prolotherapy techniques dates back to Ancient Greece and Hippocrates, who used red-hot needle cautery to treat dislocated shoulders, but the term "Prolotherapy" was by George S. Hackett, M.D., in 1956 as "the rehabilitation of an incompetent structure [ligament or tendon] by the generation of new cellular tissue" (p. 10-11). Gordin (2011) states that common proliferant solutions used in prolotherapy treatments include dextrose, glycerin, minerals, sodium morrhuate, autologous growth factors, and other pro-inflammatory compounds. These injected substances irritate the injured ligaments, tendons, or cartilage, which stimulates the formation of collagen (the major component of connective tissue, i.e. ligaments and tendons) via the production of fibroblasts (cells that synthesizes collagen), resulting in tissue growth and repair of injured structures (p. 605-606).

Numerous studies have demonstrated the development and growth of new ligamentous tissue in joints throughout the body using prolotherapy treatment. A case study by Clive Sinoff, M.D., (2010), documented prolotherapy treatment of a 58-year old man with a 20-year-old ankle injury. This gentleman injured both ankles due to a fall off a roof. He had physical therapy for 7 years, underwent arthrodesis of both ankles and the right foot, and utilized therapeutic ultrasound, a TENS unit, and hot foot soaks to only transient, mild relief. Prolotherapy treatments were started in May 2006 and ended in August 2008 (a total of seven sessions over two years). By July 2009, the patient reported minimal pain and no longer needed analgesiscs (p. 487-488).

SUMMARY

Although the anatomy of the ankle is rather complex, a careful examination of the individual components of the ankle makes the entire structure easier to understand. The same process applies to ankle injuries: once the specific functions of the components of the ankle are examined, the mechanisms of injury to those same components become clear. Through this examination of the ankle and its mechanisms of injury, it is easy to see why people suffer ankle injuries when applied forces cause the components of the ankle to exceed their physical limits. Additionally, through Integrative Medicine, treatment of ankle injuries (and symptoms) can be performed in concert with treatment of the whole patient using alternative and complementary techniques.

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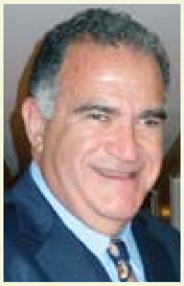

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