Chapter 10
The Ankle

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Functional Anatomy

Figures 10.1, 10.2, 10.3, and 10.4 illustrate the surface anatomy of the ankle joint. Osseous anatomy of the ankle includes the tibia which is the medial malleolus, the fibula which is the lateral malleolus, and the talus which articulates in the ankle mortise. The tibia sees 80 % of the weight-bearing stresses in the lower extremity. The syndesmosis is the articulation between the tibia and fibula at the ankle. It consists of four ligaments: the anterior tibiofibular, the posterior tibiofibular, the transverse, and the interosseous. The lateral ankle ligamentous support is provided by the anterior talofibular ligament, calcaneofibular ligament, and posterior talofibular ligament. Medially there are the superficial and deep deltoid ligaments.

Red Flags

1. *Very young* (*prepubescent*) *or elderly patients*. It is unusual for prepubescent children to have ankle sprains. One must consider a fracture that may involve the growth plate (physis) in these situations. This is because the physis is weaker than the ligaments about the ankle. These fractures, also called Salter-Harris fractures, can be quite serious, as poor healing can have implications for future bone growth. The *Ottawa Ankle Rules* (Table 10.1), a set of rules that help decide

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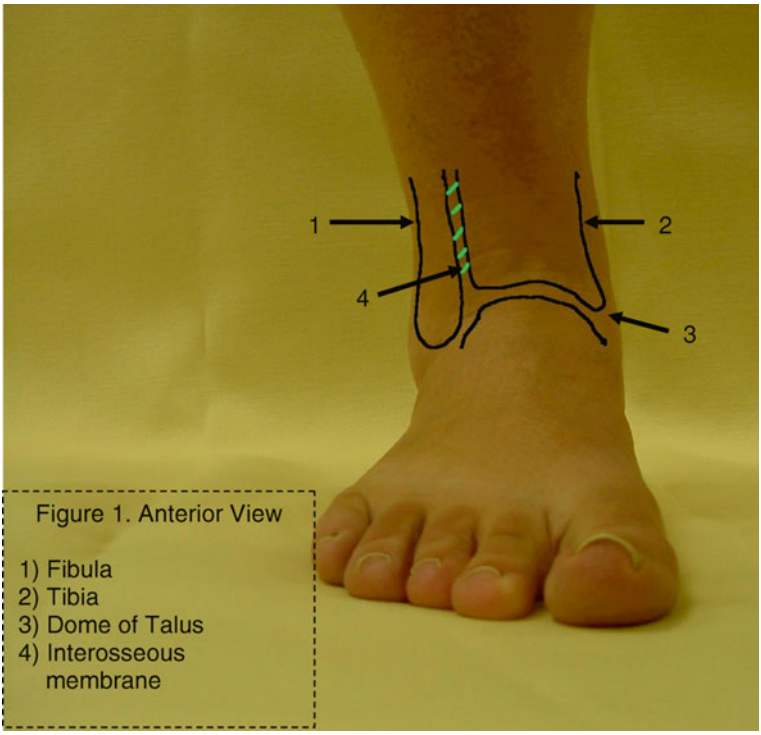

Fig. 10.1 Surface anatomy of the ankle – anterior view

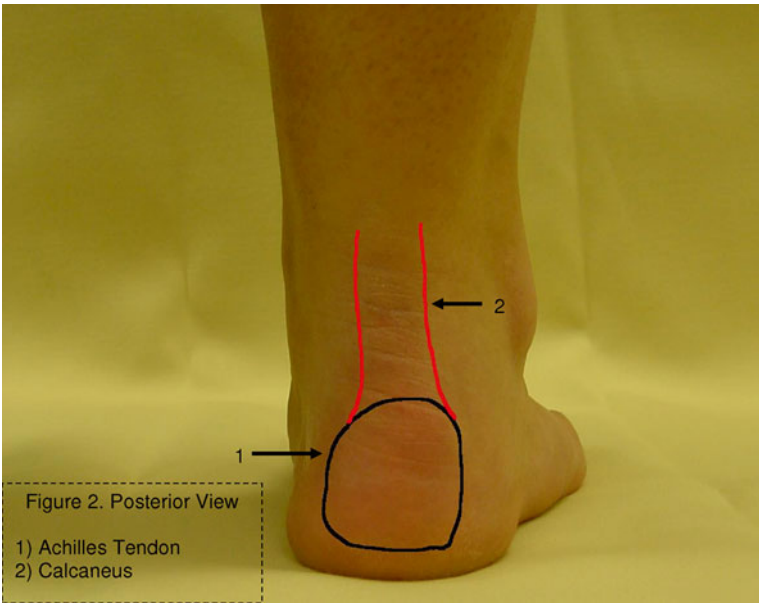

Fig. 10.2 Surface anatomy of the ankle – posterior view

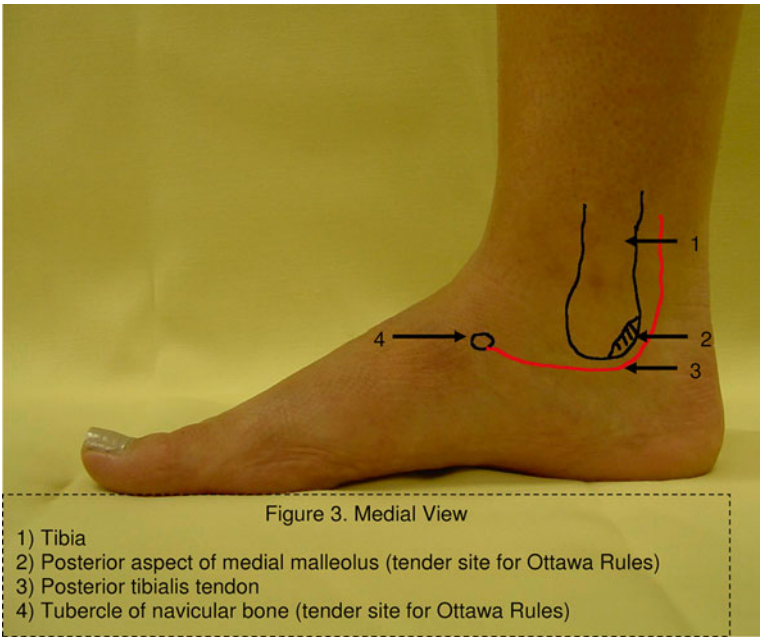

Fig. 10.3 Surface anatomy of the ankle – medial view

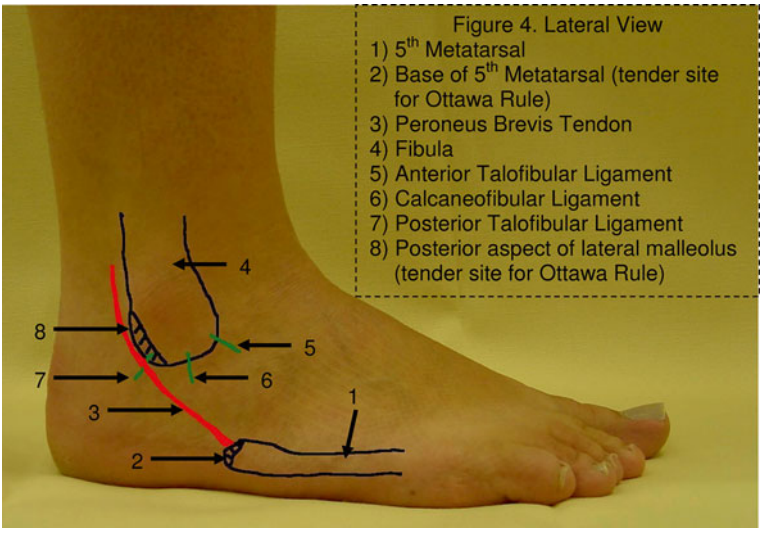

Fig. 10.4 Surface anatomy of the ankle – lateral view

Table 10.1 Ottawa Ankle Rules

For the patient presenting with *malleolar zone* pain:
The patient should be able to take four steps (two loading and two unloading gait cycles)
Palpate the posterior edge of the medial and lateral malleoli for tenderness
Failure of either of these rules mandates a complete *ankle* series of radiographs
For the patient presenting with *midfoot zone* pain:
The patient should be able to take four steps as described above
Palpate the base of the fifth metatarsal and navicular bone for tenderness
Failure of either of these rules mandates a *foot* series of radiographs

whether an ankle and/or foot x-ray is needed, have not been validated for children or the elderly. Therefore, all prepubescent and elderly patients with ankle injuries should have an x-ray.

2. *A red or hot joint*. In the presence of a red or hot joint, the clinician should consider the possibility of infection, neuroarthropathy (Charcot arthropathy), or inflammatory disease.
3. *Atypical pain*. Pain that occurs at rest, pain that wakes the patient out of sleep at night, and bilateral ankle pain are atypical presentations of pain. These symptoms are concerning and may represent a more serious condition, such as a stress fracture, neuropathy, or radicular symptoms from an intervertebral disc herniation. Any patient with pain out of proportion to the clinical findings should be monitored closely or referred for further evaluation.

General Approach to Patient

History is the most important part of evaluating any musculoskeletal condition. The history portion of the exam should include the patient's age, medical history, medication list, and mechanism of injury. It is also important to note location and intensity of pain and if the patient can bear weight.

Evaluation of the ankle begins with inspection. Take note of alignment with the patient in a weight-bearing position. Look for areas of swelling and/or ecchymosis after recent injury. A brief neurovascular examination must be performed on all patients, which includes sensation and palpation of the dorsalis pedis and posterior tibialis pulses. Assessment of the lumbosacral spine may need to be performed as well to rule out a secondary cause to the symptoms or a proximal nerve involvement (see Lumbar Spine chapter). Palpation of the major bony and soft tissue areas will assist the clinician in narrowing down the possible etiologies of pain (see anatomy pictures). Special tests can be performed to determine the status of the soft tissue. To evaluate the ligaments, the anterior drawer test and tibia/fibula squeeze test can be performed. To evaluate the status of the Achilles tendon, the Thompson squeeze test can be performed. Lack of foot plantar flexion with calf compression constitutes a positive Thompson test which is highly correlated with Achilles ruptures.

The Ottawa Ankle Rules are a guideline to determine whether or not a patient with an ankle injury needs further radiographic imaging. When used correctly, these rules have a sensitivity of 98 % for fracture (Bachman). It is important to note that these rules do not apply to the prepubescent and elderly patient (see "RED FLAGS").

Lateral Ankle

The lateral ankle sprain is the most common cause of lateral ankle pain seen in the primary care setting. This injury typically occurs when the foot is plantar flexed and vulnerable to inversion. This will cause damage to the lateral ligament complex of the ankle. The anterior talofibular ligament is most commonly injured. In more severe injuries, the calcaneofibular ligament, which is the strongest of the lateral ligaments, may be injured. Patients with lateral ankle sprains may present to the office in an acute condition, or they may present one to two weeks after the injury if they continue to have problems. They will often have significant swelling and ecchymosis and tenderness to palpation over the involved ligaments and soft tissues.

The Ottawa Ankle Rules, as described above, should be applied to those patients with a lateral ankle sprain for the purposes of decision making regarding the need for an x-ray. However, if there is substantial concern, radiographs are appropriate. The individual ligaments can then be assessed by a few physical examination techniques, but this can be difficult in the acute setting because of patient guarding.

The ATF can be evaluated by using the *anterior drawer sign* with the knee at 90° of flexion and the foot in neutral position. The examiner will pull anteriorly on the heel to evaluate for a solid endpoint. Comparison with the non-injured ankle can be very helpful in determining the extent of injury. The CFL crosses both the ankle and subtalar joints. To test its integrity, the *talar tilt* test has been commonly recommended, but in the setting of an acutely injured ankle, this can be difficult to perform. Another method of assessing the CFL is to perform the anterior drawer sign with the foot in a slightly plantar-flexed position. The posterior talofibular ligament (PTF) is difficult to isolate on examination. Usually, when the PTF is injured, other injuries are present with the most common being fracture of the distal fibula.

A high ankle sprain involves the syndesmosis ligaments between the tibia and fibula and is important to distinguish from a lateral ankle sprain. Syndesmosis injuries are more likely to require surgical stabilization in the acute setting. This injury typically occurs with an external rotation mechanism. History of the injury is very important in determining mechanism and should raise suspicion of syndesmosis injury. The ligaments can be injured alone or in combination with a fracture of the ankle. Tenderness over the anterior ankle mortise and/or pain with *tibia/fibula squeeze test* can indicate an injury to this area. Pain can also be reproduced with passive dorsiflexion and eversion of the foot which stresses the mortise. Pain will usually be more severe than with a typical ankle sprain. Radiographs of the ankle and tibia should be obtained. A syndesmosis injury with a proximal fibula fracture is termed a Maisonneuve injury and is, by definition, unstable.

Most ankle sprains are self-limiting, but decreased morbidity can be obtained by using the PRICE protocol (protect, rest, ice compression, elevation of extremity). Weight bearing as tolerated, with the aid of crutches, may be recommended. A walking boot or cast will help with pain and ambulation in more severe injuries, but prolonged use should be avoided. Application of ice to the area for 20 min per session should be done four times daily during the acute phase. Compression can be obtained several ways such as ACE wrap or compression stocking. Functional bracing becomes important as the patient moves out of the acute phase and increases activity. This can be obtained with a lace up or hinged ankle brace.

Physical therapy, through home exercises or formal setting, and protection of the ankle joint with bracing are needed to prevent the acute injury from becoming recurrent or chronic. Generally 6 weeks is needed to allow the collagen fibers and scar tissue to become strong and resist stresses. Patient's whose pain persists over 90 days should be referred or evaluated with further imaging. If the examiner is comfortable ordering and interpreting it, an MRI of the ankle can be performed. When ordering an MRI, the clinician has the responsibility of sorting out positive findings that may or may not be of any clinical relevance to the patient. For this reason, many primary care clinicians choose to refer these patient's to an appropriate specialist rather than order an MRI themselves.

A patient may present with a history or complaint of a "weak ankle." They may feel the ankle gives out easily or reinjures repeatedly when walking on uneven ground, stepping off of a curb, or playing sports. If the patient does not rehabilitate completely after an initial injury, this increases the patient's risk of chronic ankle problems. This can also indicate a more serious underlying problem and needs to be investigated. Formal physical therapy can be considered with these patients, but a referral to a specialist can also be made at this time.

Peroneal tendon injuries are commonly associated with lateral ankle sprains. The peroneal tendons pass posterior to the lateral malleolus and attach at the foot. The tendons work as lateral ankle stabilizers and will also evert the foot (see Foot chapter). When the foot is plantar flexed slightly, generally less than 15°, the tendons are most vulnerable. As the foot is plantar flexed further, the tendons are locked in posteriorly to the lateral malleolus and are less likely to be injured. Dislocation of the tendon can occur but is more common in athletes. The athlete will complain of a popping or snapping sensation laterally when they walk or run and may be painful. Conservative treatment with casting followed by physical therapy can be attempted in cases of acute peroneal instability; however, with chronic instability of the peroneal, conservative treatment is rarely successful. In this instance referral to a specialist is more appropriate.

Tendinopathy of the peroneals can occur with prolonged or repetitive activities. Commonly affected are those who run on uneven grounds, soccer athletes with their quick side to side motions, and skaters who have poorly fitting skates. The patient will complain of pain laterally, pain with walking or activity which improves with rest, and swelling can be variable. Pain will be reproduced with active and resisted eversion and dorsiflexion of the ankle joint. Conservative treatment is recommended initially with use of ice, taping or bracing of the ankle, lateral heel wedge, and eversion strengthening. If the problem persists and becomes chronic, patients may start to experience popping or snapping and may need referral to a specialist.

Medial Ankle

The tibialis tendons are the most common medial ankle structure that can be injured. *The anterior tibialis tendon* is visualized on the anterior aspect of the ankle with dorsiflexion and inversion of the foot. This tendon can be injured with new athletic activities such as hill running or cycling. The patient may have tenderness at the insertion of the tendon on the medial cuneiform and medial aspect of the base of first metatarsal. The examiner may also note swelling along the course of the tendon. Pain will be reproduced with resisted dorsiflexion and inversion of the ankle. The patient will usually respond to conservative treatment with anti-inflammatories and the use of ice. Eccentric strengthening and stretching is also helpful.

The posterior tibialis tendon runs posterior to the medial malleolus and will insert on the navicular bone. The tendon provides stability of the ankle on the medial aspect but also is integral to the structure of the foot and arch (see Foot chapter). This structure can be injured acutely with a twisting type of injury such as stepping off of a curb or can present as a tendinopathy with gradually worsening medial ankle pain over several weeks. Dysfunction of the posterior tibialis tendon is a leading cause of adult-acquired flatfoot deformity. Swelling and tenderness will be present over the structure (see anatomy). Because this tendon affects the foot as well, evaluation should also include the arch and midfoot and testing with heel raises along with checking for "too many toes sign" (see Foot chapter). If left untreated, the patient can later develop lateral ankle pain due to impingement as the foot goes into valgus position "falling arch." This can be observed when the patient raises onto their toes, and from behind the examiner will note an inward or varus position of the heel.

Treatment with modified activity, ice, anti-inflammatories, and supportive shoe inserts or orthotics for the arch and heel are recommended initially. If symptoms are not improving quickly, the provider should consider referral.

Posterior Ankle

Achilles tendinopathy is a common cause of posterior ankle pain. This problem can affect patients from competitive-level activities to the sedentary. Foot mechanics, poor foot ware, decreased flexibility of the calf muscles, trauma, and exercise on uneven ground increase the risk of developing this problem. The provider may also note swelling of the tendon and crepitus with active motion. Tendinopathy may cause insertional pain located at the calcaneal insertion of the Achilles or can cause non-insertional pain and nodularity several centimeters proximal to the tendon insertion. Conservative treatment initially is recommended which includes activity modification, ice, and heel lifts. Anti-inflammatory medications may provide some relief of symptoms. Stretching exercises that concentrate on eccentric loading are also recommended for treatment.

Rupture of the Achilles tendon can occur. A patient may describe feeling or hearing a pop or a sudden feeling of being kicked in the back of the ankle at the time of the injury. A pitfall for some providers is the patient may still be able to ambulate into the office with a partial tear of the Achilles and can be missed if not evaluated thoroughly. The Thompson test or calf squeeze test is used to evaluate for an Achilles tendon rupture. The patient lies on their stomach on the exam table, lower leg is partially off the end, and the provider squeezes at the mid-calf and should note plantar flexion of the foot. Comparison to the non-injured side will be useful. This test can miss partial tears so it is also important for the provider to palpate along the tendon into the mid-calf for a possible defect. Musculoskeletal ultrasound, if available, is a good tool to identify partial tears. Full tendon ruptures require immediate referral to an orthopedic surgeon for possible repair.

Other causes of posterior ankle pain can range from benign to more serious conditions. Bilateral ankle pain at the insertion of the Achilles tendon can be due to more serious conditions such as a seronegative arthritis, rheumatoid arthritis, or a postinfectious syndrome such as Reiter's syndrome. These patients will describe pain that is more severe first thing in the morning and generally improves through the day. History of patient's symptoms may reveal urinary or inflammatory bowel symptoms. Laboratory testing will generally begin with CBC, CMP, sedimentation rate or CRP, ANA, and rheumatoid factor.

Atypical pain such as pain at rest or pain at night (see red flags) should raise the examiner's suspicion of a more serious cause of posterior ankle pain such as a stress fracture of the calcaneus, neuropathy, or peripheral nerve entrapment. These conditions will require more workup, treatment, and possibly referral. Other causes of posterior ankle pain are described in Table 10.2.

Please refer to Fig. 10.5 for the ankle meaningful use form.

Table 10.2 Other causes of posterior ankle or foot pain

Condition	Location of pain/findings	Typical presentation
Sever's disease (benign)	Tender over calcaneus or insertion of plantar fascia	Prepubescent with heel pain upon awakening or with weight bearing
Haglund's deformity (benign)	"Pump bump" bony prominence at base of Achilles tendon	Middle-aged woman who wears high heels
Peripheral neuropathy (serious)	"Stocking" numbness	Patient's with conditions producing neuropathy (DM, hypothyroidism, alcohol abuse)
Calcaneus stress fracture (serious)	Pain on lateral aspect of calcaneus	History of jump from height, over training, metabolic diseases
Posterior tibialis nerve entrapment (serious)	Tinel's sign (posterior to medial malleolus)	Heel pain at rest, radiates to great toe
Seronegative arthritis (serious)	Tender at insertion of Achilles tendon	Bilateral heel pain, consider Reiter's syndrome

CC: ☐ Right ☐ Left ☐ Both

HPI:
Onset: _____
Mechanism of Injury: _____
Relieving Factors: _____
Exacerbating Factors: _____

PMH: Chronic Medical Conditions: _____

_____

Occupation/Sport /Position: _____

Red Flags:
1. Very young
2. Geriatric
3. Hot joint
4. Atypical pain

Q1. Are there red flags?

Q2. Ottawa Rules
a) 2 gait cycles: can't walk (Need radiographs)
b) Tender base 5th metatarsal or navicular (Foot x-ray)
c) Tender posterior aspect of medial or lateral malleoli (Ankle x-ray)

Q3. How to treat?

a) High grade sprain
- Cotton Test
- Mechanism of Injury

Treat
- PRICE
- Crutches
- Sugar Tong Splint

b) Fracture
- Consult if unstable or mortise

Otherwise, treat
- PRICE
- Crutches
- Sugar Tong Splint

c) Sprain
- PRICE
- Compression Sleeve
- Lace up Brace
- Ace-wrap
- Ambulate with PRICE

Common and Don't Miss Conditions:
- Fracture
- High Grade Sprain
- Subluxation of Peroneal Tendons
- Neuropathy
  - Diabetes
  - Anemia
  - Chronic Alcoholism
- Achilles Tendon Rupture

Fig. 10.5 The ankle meaningful use form

TREAT APPROPRIATELY	Ankle/Foot Pain ..... 719.47 Achilles tendonitis ..... 726.71 Ankle Sprain ..... 845.00 Tendonitis 726.79
TREAT WITH CLOSE FOLLOW-UP (< 1 week f/u)	Unable to bear weight with negative X-ray findings Cellulitis of Foot/Ankle
CALL CONSULTANT THAT DAY	Uncertain X-ray findings Fracture Diagnosis uncertain/perplexing
CONSULT OR REFER	Septic joint Nerve entrapment Fractures, if not comfortable treating Torn Achilles Vascular disease needing surgical treatment

Plan:
- ☐ Xray / Imaging What: _____
- ☐ Laboratory Eval What: _____
- ☐ NSAIDs _____
- ☐ Acetaminophen _____
- ☐ Other
- ☐ PRICE Protocol
- ☐ Physical Therapy

Disposition:
- ☐ Treatment initiated: Follow-up _____ weeks
- ☐ Treatment / Work up Initiated: Follow-up ≤ 1 week _____ days
- ☐ Immediate call to Dr. _____
- ☐ Consultation initiated with Dr. _____
- ☐ Referral to Dr. _____

Fig. 10.5 (continued)

Suggested Readings

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