Persistently Painful Sprained Ankle

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Abstract

Chronic discomfort sufficient to limit activity may affect 20% to 40% of patients after an ankle sprain. These patients complain of vague and diffuse pain, most often localized to the lateral and/or anterolateral aspect of the ankle. They may also complain of a giving-way sensation, swelling, stiffness, and locking and crepitation. Examination may show tenderness, swelling, and reduced range of motion, especially in dorsiflexion. Ankle instability is sometimes demonstrable. Severe cases exhibit discoloration, glossy skin, and temperature changes suggestive of reflex sympathetic dystrophy. Incomplete rehabilitation is the most common cause of chronic pain. Other common problems are intra-articular lesions (e.g., osteochondral and meniscoid lesions), chronic instability, undetected syndesmotic or deltoid sprains, chronic tendon degeneration, stress fractures, and, in rare cases, congenital lesions and tumors. Reflex sympathetic dystrophy occurs occasionally, even after minor trauma. With correct diagnosis and appropriate treatment, it is often possible to restore acceptable ankle function

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Ankle injuries are very common. Approximately one sprain occurs per 10,000 persons each day, which means 27,000 ankle ligament injuries every day in the United States alone. In spite of this high incidence, there is a great variation in the treatment methods employed. Today there is consensus that functional treatment, including early mobilization and weight-bearing with the protection of a brace, is efficacious.[1] Most patients are able to return to normal activity within 4 to 8 weeks. However, as many as 20% to 40% of patients are reported to have residual pain sufficient to limit or alter their activity after a severe grade 3 sprain.[2] In some cases, these symptoms persist for months or even years after the initial injury.[3] These cases constitute a diagnostic and therapeutic problem for the clinician.

Evaluation and Diagnosis

The clinical picture varies according to the underlying disorder. The first steps toward correct diagnosis are taking a good history and carrying out an adequate physical examination. A typical patient usually complains of vague and diffuse ankle pain, which is often localizable to the lateral and/or the anterolateral part of the ankle. This pain may be of such intensity that it limits walking capacity and participation in sports. The patient may also complain of a feeling of giving way, difficulties when walking on uneven ground, swelling, stiffness, and sometimes locking and crepitation.

Physical therapy often has been tried, but the patient may have had so much pain that it had to be discontinued. Sometimes, the patient limits weight-bearing and even reinstitutes the use of crutches. Immobilization and casting may also have been tried. Despite these measures, the pain may continuously worsen, leaving the patient caught in a vicious circle. At this stage the patient is very frustrated and seeks advice from one doctor after another, trying to find a solution to the problem.

The physical examination may show localized tenderness over the lateral ligaments and sometimes over the anteroinferior aspect of the tibiofibular ligament (i.e., the syndesmosis) and the anterior part of the deltoid ligament; however, the tenderness is sometimes nonspecific. If swelling is present, it is diffuse, involving the anterolateral and/or the lateral aspect of the ankle as well as the sinus tarsi. Increased instability, evidenced by positive anterior drawer and talar tilt test results, is fairly common. Range of motion, especially dorsiflexion, is limited in most cases. There is also poor flexibility of the Achilles tendon and atrophy of the calf muscles. There may be discol-

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oration and glossiness of the skin, with temperature changes indicating chronic edema or reflex sympathetic dystrophy.[3]

The differential diagnosis of persistent pain after an ankle sprain includes incomplete rehabilitation, intra-articular injuries, chronic instability, subtalar sprain, syndesmosis sprain, impingement problems, sinus tarsi syndrome, chronic tendon disorders, stress fractures, nerve injuries, reflex sympathetic dystrophy, tumors, and, in children, undetected traumatic epiphyseal injuries.

The clinical history and plain radiographs usually make it possible to identify most chronic problems. If the diagnosis remains unclear, other modalities may be useful (Fig. 1). Stress x-ray studies can be used to verify and evaluate the extent of chronic instability. A bone scan is often valuable in detecting bone lesions. Computed tomography (CT) and magnetic resonance (MR) imaging are unnecessary in most cases. Tomography and CT can be useful in evaluating the location and extent of osteochondral lesions and the location of loose bodies. If indicated, MR imaging is valuable in evaluating the soft tissues, especially the tendons.

Incomplete Rehabilitation

Inadequate rehabilitation most often occurs after a grade 3 ligamentous injury. Many athletes return to sports before they are fully rehabilitated and often incur a reinjury or an additional injury. Examination demonstrates loss of range of motion, such as limited dorsiflexion or a plantar flexion contracture. Atrophy of the lower-leg muscles is common. Ankle motion may be painful, and stiffness is common, although the radiographs are normal.

To prevent this problem, adequate acute treatment of ankle ligament injuries is important. A recent review by Kannus and Renström[1] included an extensive evaluation of all 12 prospective randomized studies in the literature in which cast immobilization, strapping with early mobilization, and surgery followed by casting were compared as treatment techniques for grade 3 ankle sprains. The authors concluded that functional treatment should be the method of choice for complete rupture of the lateral ankle ligaments.[1] Initial treatment should include a short period of ankle protection by brace, bandage, or tape and early mobilization and weight-bearing. Rehabilitation exercises are the most important step in the treatment process, with

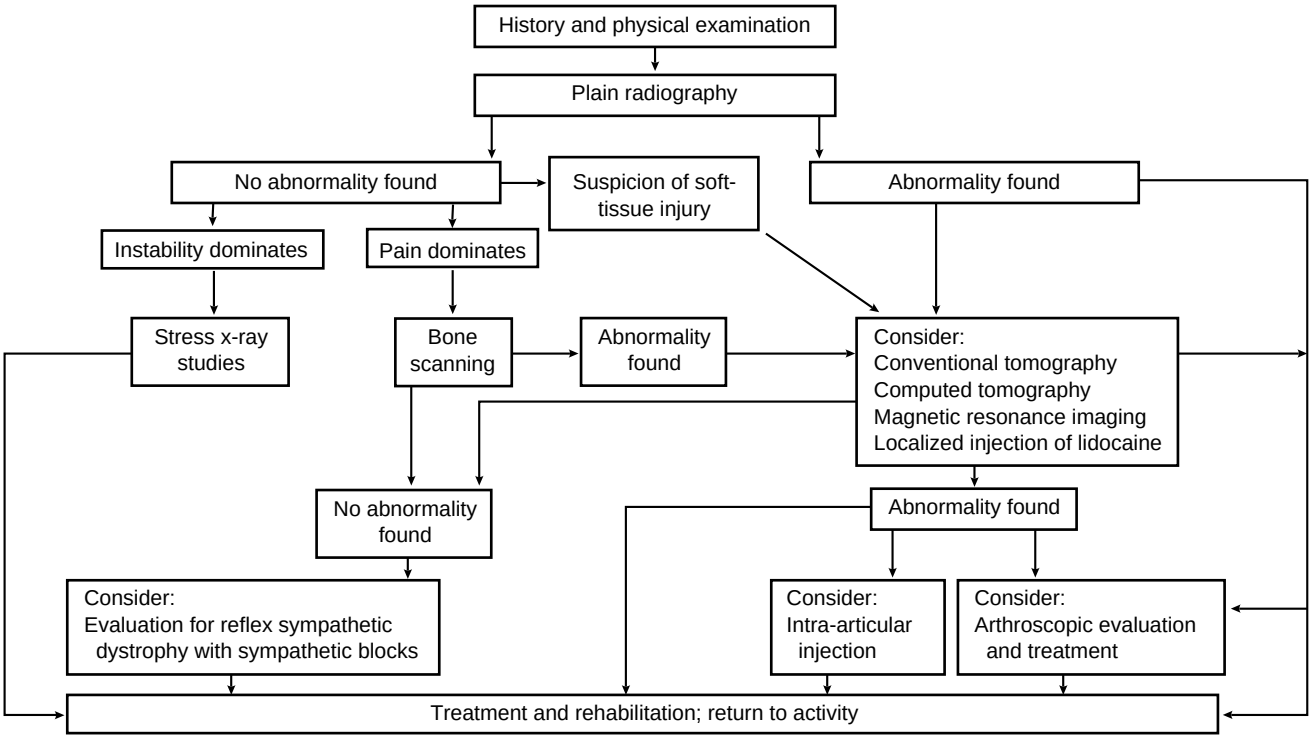

Fig. 1 Management algorithm for chronic ankle pain.

the goal of reestablishing ankle range of motion, muscle strength, and neuromuscular control. Emphasis should be placed on strength training of the peroneal muscles, the anterior and posterior muscles, and the intrinsic muscles of the foot. Proprioceptive training on an ankle tilt board should be combined with increasing agility and sports skills training. If functional treatment of an acute injury fails, surgery may be necessary.

Immobilization with a lower-leg cast for a couple of weeks is still a very common treatment procedure in the United States. However, immobilization will result in weakening of all tissues, as well as atrophy of the muscles and limitation of motion. "Post-cast syndrome" may occur, and the end result can be reflex sympathetic dystrophy.[3]

Inadequate rehabilitation syndrome can be prevented by scrupulously continuing rehabilitation until the patient has achieved full range of motion, strength, and ability to walk and run. Full rehabilitation often requires careful supervision and monitoring by an experienced physical therapist. Compliance by the patient is an essential requirement for success.

If the syndrome does occur, treatment is reinstitution of the rehabilitation program. This treatment is usually successful.

Chronic Ankle Instability

Etiology and Diagnosis

Recurring ankle injury is common.[4] Forty-eight percent of patients have recurrent sprains, and 26% report frequent sprains. Eighty-one percent will experience recurrent sprains if mechanical instability is documented radiographically.[5]

Certain sports create particular risks. Soccer players with previous injuries are about two to three times more likely to sustain another ankle injury than those without any history of injury. Recurrent multiple sprains are reported by 80% of high-school varsity basketball players.

Ankle instability can be characterized as mechanical or functional. Mechanical instability is characterized by ankle mobility beyond the physiologic range of motion, which is identified on the basis of a positive anterior drawer and/or talar tilt test.[6] However, the criteria for mechanical instability are variable. Most agree that mechanical instability is present when (1) there is more than 10 mm of anterior translation on one side or the side-to-side difference is over 3 mm and/or (2) the talar tilt is more than 9 degrees on one side or the side-to-side difference is more than 3 degrees.[7] However, pure mechanical instability of the ankle is rarely the sole reason for the development of late symptoms.

Functional instability was first described by Freeman et al[8] and is signaled by a subjective feeling of the ankle giving way during physical activity or during simple everyday routines after a sprain. Frequent ankle sprains are associated with recurrent pain and swelling. Tropp[9] described functional instability as mobility beyond voluntary control; however, the physiologic range of motion is not necessarily exceeded. The diagnosis of functional instability is made primarily on the basis of a history of frequent and recurrent giving way, which is often associated with difficulty in walking on uneven ground.

The physical examination may show evidence of mechanical instability, but this finding is not necessary to make the diagnosis. Functional instability is frequently associated with muscle weakness and atrophy, but this is often subtle. The incidence of functional instability after ankle sprains has been reported to range from 15% to 60% and seems to be independent of the degree of severity of the initial injury.

The etiology of functional instability is complex, with important roles for several types of factors, among them neural (proprioception, reflexes, and muscular reaction time), muscular (strength, power, and endurance), and mechanical (lateral ligamentous laxity). Other possible factors have also been considered, such as adhesion formation leading to decreased mobility of the ankle, especially in dorsiflexion; peroneal muscle weakness; and tibiofibular sprain.

An ankle sprain may be followed by a combination of sequelae, including mechanical instability, muscle atrophy, and functional instability.[9] The magnitude of disability correlates best with how many of these sequelae are present. The association between functional and mechanical instability remains unclear. Repeated sprains caused by functional instability may later result in mechanical instability.[8] Mechanical and functional instability may be sequential, but the two do not always occur together. Functional instability is prevalent in 81% of patients with mechanical instability and in 41% of patients with mechanical stability.[4] To describe these differences, Mann et al coined the term "stable instability" to refer to functional instability without mechanical instability. With continuing recurrent sprains, the two instabilities tend to become coexistent. Chronic lateral ankle instability syndrome is most commonly a combination of mechanical and functional instability, regardless of the clinical manifestation.

Chronic ankle instability is often characterized by repeated episodes of giving way with asymptomatic

periods between episodes. In contrast, patients with other causes for chronic ankle pain usually experience a constant aching discomfort in the ankle, although symptoms may wax and wane. This difference in history can often be an important key to the correct diagnosis.

Conservative Treatment

The treatment of instability of the ankle follows the principles of functional rehabilitation after acute injuries. Proprioceptive and muscle training is important. Tilt-board exercises should also be used, often for as long as 10 weeks.[9] Ankle braces are increasingly used to provide external stabilization.[6]

Surgical Treatment

Chronic ankle instability is characterized by pain, giving-way episodes, and positive stress test results that have not improved in response to conservative treatment. Isolated mechanical instability without giving-way episodes is not in itself an indication for surgery. Rather, it is the combination of mechanical and functional instability that is the most commonly reported indication for surgery.[6,7,10] It should be emphasized that repeated episodes of giving way do not seem to predispose to degenerative arthritis in the ankle. The main reason for surgery is that the patient is not willing to accept the discomfort that follows the recurrent giving-way episodes. The decision to carry out surgery is made on the basis of the history and clinical examination findings. Stress radiographs can sometimes be of value.

There are more than 50 procedures or modifications of procedures for managing chronic ankle instability. Peters et al[7] have classified these operative treatments (Table 1). Surgical procedures can be divided into nonanatomic reconstructions, in which another structure or material is substituted for the injured ligament, and anatomic reconstructions, in which the injured ligament is repaired secondarily with or without augmentation. With the anatomic techniques, usually both the anterior talofibular ligament and the calcaneofibular ligament are reconstructed, whereas with the nonanatomic techniques (with the exception of the Chrisman-Snook procedure), only the anterior talofibular ligament is reconstructed.

Table 1
Classification of Operative Treatments for Chronic Ankle Ligament Injury

- Nonanatomic reconstruction
  - Endogenous
    - Peroneal tendon
      - Watson-Jones
      - Evans
      - Chrisman-Snook
    - Other
      - Plantaris
      - Partial Achilles tendon
      - Free autogenous graft
  - Exogenous
    - Carbon fiber
    - Bovine xenograft
- Anatomic repair
  - Direct suture
  - Imbrication and repair to bone
  - Local tissue augmentation

Nonanatomic reconstruction

The most widely used nonanatomic reconstruction today is the Chrisman-Snook modification of the Elmslie procedure,[11] which uses half of the peroneus brevis tendon to reconstruct both the anterior talofibular ligament and the calcaneofibular ligament (Fig. 2). Chrisman and Snook reported good or excellent results in 90% of their patients; however, restricted inversion was found in all patients, and restricted dorsiflexion occurred in approximately 20%.[11] In a biomechanical cadaver analysis of nonanatomic reconstructions, it was found that ligamentous isometricity was lacking and that normal biomechanics was not restored.

Anatomic reconstruction

Broström[4] found that it was possible to repair chronic ankle ligament injuries by direct suture even many

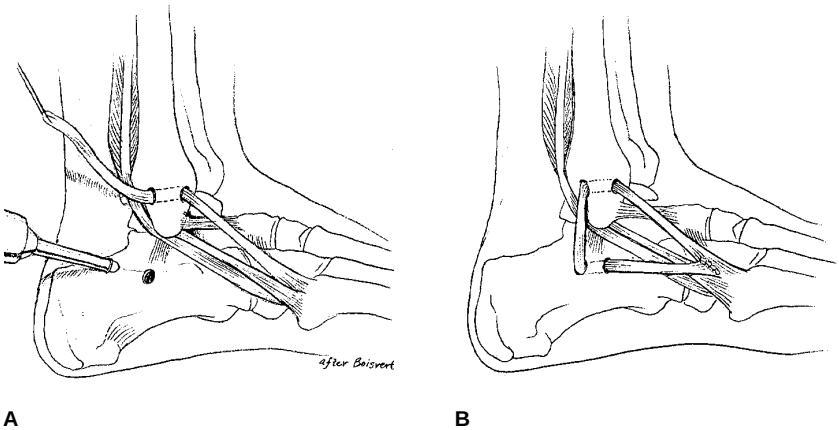

Fig. 2 Nonanatomic reconstruction of chronic ankle ligament insufficiency according to Chrisman and Snook.[11] **A,** The mobilized half of the peroneus brevis tendon is threaded through the anterior talocalcaneal ligament (held by sutures) and then through a hole in the fibula. **B,** Completed reconstruction.

years after the initial injury if the ligament ends could be found. The combination of imbrication or shortening of the ligaments and reimplantation into bone to achieve a more anatomic reconstruction has been successful[12] (Fig. 3). Gould et al[13] advocated reinforcing the anterior talofibular ligament repair with the extensor retinaculum and reinforcing the calcaneofibular ligament repair with the lateral talocalcaneal ligament.

After an anatomic reconstruction, a posterior splint should be used for 8 to 10 days to allow the wound to heal. Thereafter, a walking boot should be used. The ankle can be taken out of the boot after 2 to 3 weeks to allow movement of the foot in 0 to 20 degrees of plantar flexion. The healing time is 6 weeks, and return to full activity is possible after 10 to 14 weeks.

The results of anatomic reconstruction were reported to be good or excellent in 87% of 152 patients in one study.[12] The small percentage of patients with fair or poor results suffered from residual mechanical instability. Three factors were found to predict poor outcome: (1) a history of 10 years or more of instability prior to surgery, (2) associated ankle osteoarthrosis, and (3) generalized joint hypermobility.

The anatomic technique is considered simple and allows early return to function. It should be the primary choice when surgery is indicated.

A patient with a significant hindfoot varus and ankle instability may also need an osteotomy of the calcaneus because an isolated ankle ligament reconstruction may fail.

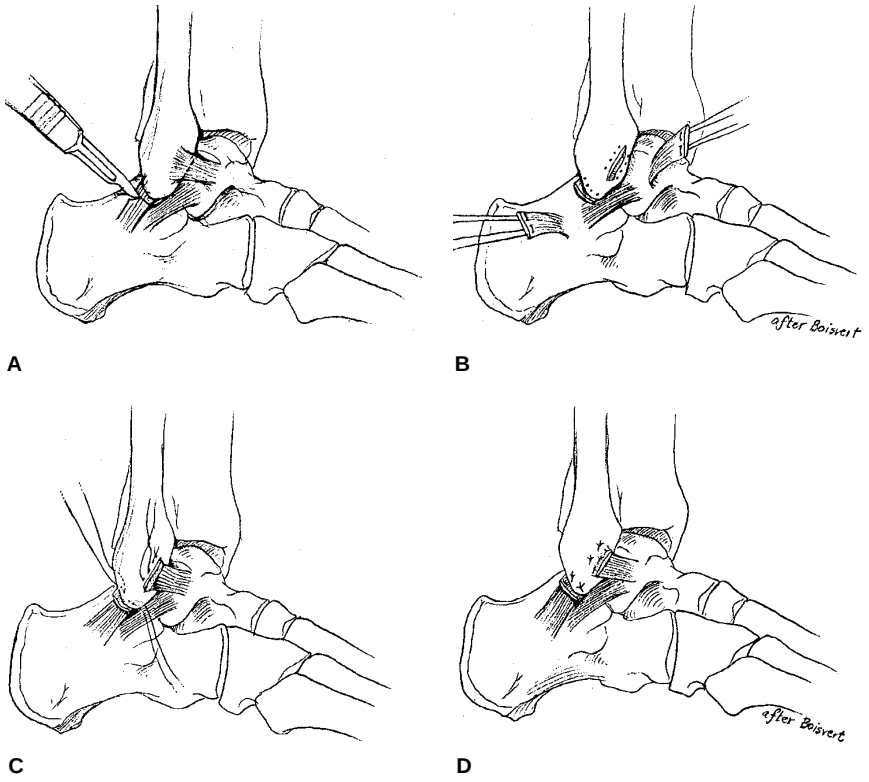

Fig. 3 Anatomic reconstruction of chronic ankle ligament instability according to Peterson.[6] **A,** Elongated ligaments are divided 3 to 5 mm from insertion on the fibula. **B,** Bone surface of the distal end of the fibula is roughened to form a trough to promote ligament healing. Holes are drilled through the distal fibula. **C,** Mattress sutures are used to fix the distal stump of the ligaments and the capsule to the fibula. The sutures are tightened while the foot is held in dorsiflexion and eversion. **D,** The proximal ends of the ligaments are imbricated over the distal portion.

Subtalar Sprain and Instability

The subtalar joint consists of the talocalcaneal and talonavicular joints. The subtalar sprain has remained a mysterious and little known clinical entity. The incidence is unknown, but it is widely accepted that most subtalar ligamentous injuries occur in combination with injuries of the lateral ligament of the ankle. Subtalar instability is estimated to be present in about 10% of patients with lateral instability of the ankle. Using subtalar arthrography, Meyer et al[14] conducted a prospective study of 40 patients who had acute lateral ankle sprain that was documented on stress radiographs. They found that 32 of them also had a significant subtalar sprain associated with leakage of the contrast medium.

A patient with chronic subtalar instability usually describes giving-way episodes during activity and has a history of recurrent sprains and/or pain, swelling, and stiffness. There is a feeling of instability, especially when walking on uneven ground. Because the symptoms in subtalar and talocrural instability are similar, patients with a clinically serious recurrent ankle sprain should be carefully evaluated for subtalar instability. Localized tenderness on palpation over the subtalar joint is suggestive of involvement of the subtalar ligaments, but clinical evaluation of subtalar instability is difficult and unreliable. If a major sprain of a

subtalar joint is suspected clinically, the diagnosis can be verified with subtalar arthrography,[14] a subtalar stress view, or stress tomography. Although scientific studies proving the value of CT and MR imaging are not yet available, one or the other may ultimately be established as the best diagnostic modality.

Functional treatment similar to that used for ankle sprains is the treatment of choice. Surgery is occasionally indicated.

Syndesmosis Injuries

Diastasis of the syndesmosis occurs with partial or complete rupture of the syndesmosis ligament complex, including the tibiofibular ligaments and the interosseous membrane. Ten percent of all ankle ligament injuries involve a partial tear of the anterior part of the syndesmosis.[5] Partial tears of the anterior inferior tibiofibular ligament are more common in soccer and football players due to the violent external rotation and plantar flexion trauma of the ankle that is often experienced.

Isolated complete syndesmosis injuries without fracture are rare, and there is relatively little information in the literature about ankle diastasis in the absence of fracture. In a series of more than 400 ankle ligament ruptures,[15] 12 cases (3%) of isolated syndesmosis rupture were identified. These ruptures occurred in various sports, such as skiing, motocross, skating, and soccer and other ball sports. Rupture of the syndesmosis is often associated with rupture of the deltoid ligament. This rupture is partial and often involves the anterior aspect.

The importance of an accurate history to ascertain the mechanism of injury and a careful clinical examination of the patient with acute ankle trauma cannot be stressed enough. The mechanism of injury may be pronation and eversion of the foot combined with internal rotation of the tibia on a fixed foot. Pain and tenderness are located principally on the anterior aspect of the syndesmosis and interosseous membrane and are less sharp in the posterior region of the syndesmosis.[13] Active external rotation of the foot is painful. The patient is usually unable to bear weight on the injured leg.

The squeeze test is considered positive when compression of the tibia against the fibula at the midportion of the calf proximal to the syndesmosis produces pain in the area of the interosseous membrane or its supporting structures. The external rotation test is carried out with the leg hanging and the knee in 90 degrees of flexion. The foot is externally rotated while the tibia is fixed with the other hand. Pain at the syndesmosis during this test is a strong indication of a syndesmosis injury. The Cotton test manually assesses the mediolateral motion of the talus in the ankle mortise. The calcaneus and talus are held with one hand, and the foot is tested for motion in the medial and lateral directions with the tibia fixed. A feeling of side-to-side play when the foot is in neutral position is considered an indication of possible diastasis.

Anteroposterior, lateral, and mortise-view radiographs are needed to exclude fractures and osseous avulsions. Stress radiographs in external rotation, in both dorsiflexion and plantar flexion, can display the diastasis between the tibia and the fibula.[15] Bone scanning is a reliable procedure that can be used to guide initial management when stress radiographs cannot be obtained because of pain or swelling or when radiographs are considered unreliable.

Partial isolated syndesmosis tears should be treated conservatively. Late symptoms may be due to talar impingement by the distal fascicle of the anterior inferior tibiofibular ligament,[16] peroneal nerve palsy, or an initially missed talar-dome fracture.

If the syndesmosis is completely ruptured, the fibula can shorten and rotate externally, leading to ankle joint incongruence and degeneration. A complete tear is managed by suture of the ligament and temporary fixation of the tibia and fibula with a syndesmosis screw or cerclage or Kirschner wires. A walking boot or a brace is used postoperatively for 6 to 8 weeks. Early motion is encouraged, and full weight-bearing is usually allowed by 6 weeks. The syndesmosis screw is usually removed 8 weeks after surgery. Late complications include incongruity of the ankle joint, late arthrosis, and calcification of the interosseous ligament.

Tibiofibular Synostosis

Tibiofibular synostosis can occur after an ankle sprain associated with syndesmosis rupture.[17] The rupture produces a hematoma, which later ossifies, leading to partial or complete ossification of the syndesmosis.

The typical patient is an athlete with a history of an acute or recurrent ankle sprain in whom syndesmosis rupture was not considered. Three to 12 months after the injury, the patient experiences pain during the stance phase and the initiation of the push-off phase of running. The pain occurs because the synostosis impairs the normal tibiofibular motion by preventing fibular descent on weight-bearing and by restricting the normal increase in width of the ankle mortise that occurs on dorsiflexion of the talus. Clinical examination usually reveals restricted dorsiflexion of the ankle. Radiographs show development of the synostosis.

Therapy is aimed at removing the synostosis and restoring normal fibular motion. If the patient is experiencing symptoms, surgical excision and reduction of the diastasis are indicated after the synostosis has matured.

Other Ligamentous Injuries

Chronic Medial Instability of the Ankle

Although isolated deltoid ligament rupture is theoretically possible, it is uncommon as an isolated event. Widening of the medial clear space suggesting deltoid insufficiency can be associated with an end-stage posterior tibial tendon rupture when the deltoid ligament has been stretched. The underlying injury should be treated. Conservative treatment is usually enough, but occasionally surgery is needed.

Midfoot Sprains

Sprains of the ligaments in the transverse tarsal (midtarsal), intertarsal, and tarsometatarsal joints are poorly defined but can mimic an ankle sprain. The history and symptoms of the two conditions can be similar. A minor sprain is treated symptomatically. Return to sports can take 4 to 6 weeks. A stiff-soled shoe can be helpful. Instability and diastasis may necessitate surgical correction.

Sinus Tarsi Syndrome

Sinus tarsi syndrome is characterized by pain and tenderness over the lateral opening of the sinus tarsi accompanied by a feeling of instability and giving way of the ankle. About 70% of affected patients will have sustained trauma, which usually is a severe inversion sprain of the ankle. If the calcaneofibular ligament is torn, the interosseous talocalcaneal ligament, which occupies the sinus, can be sprained as well. In most cases, the ligaments heal quickly with little posttraumatic disability. However, because of the abundance of synovial tissue in the sinus tarsi area, synovitis may result after an injury.

The diagnosis can be made on the basis of a complaint of pain and tenderness at the sinus tarsi, most often in combination with a feeling of instability. The most characteristic clinical sign is pain on the lateral side of the foot that is increased by firm pressure over the lateral opening of the sinus tarsi. Pain is most severe when the patient is standing or walking on uneven ground. Arthrography or MR imaging may demonstrate a rupture of the talocalcaneal interosseous ligament. At this time, however, the role of MR imaging in the diagnosis of this injury remains uncertain.

The pain can usually be relieved by injections of local anesthetic and corticosteroids into the sinus tarsi. Approximately two thirds of patients respond to injections at weekly intervals.[18] However, the number of injections should be limited because of the small amount of subcutaneous tissue in the area. Exercises, including reeducation of the peroneal and calf muscles, are of value. Excision of the tissue filling the lateral half of the sinus tarsi can give good results if conservative treatment has failed. In refractory cases, a subtalar arthrodesis may be sufficient treatment.

Intra-articular Conditions

Osteochondral Lesions of the Talus

Osteochondral lesions can be sustained during an ankle sprain. Osteochondral injury has been reported to occur in 6.5% of patients who have had an ankle sprain, and some form of chondral injury may occur in as many as 50%.[3]

Pettine and Morrey[19] have described four stages of osteochondral lesions. In stage 1, a compression injury has caused microscopic damage to an area of subchondral bone. Plain radiographs appear normal. In stage 2, there is a partially detached osteochondral fragment, detectable on careful examination of anteroposterior, lateral, and mortise views in ankle flexion and extension. Mortise views in plantar flexion may disclose a posteromedial lesion, and corresponding views in dorsiflexion may disclose an anterolateral lesion. In stage 3, the osteochondral fragment is completely detached but remains in anatomic position. In stage 4, the detached fragment is located elsewhere in the joint.

Another commonly used grading system, that devised by Berndt and Harty,[20] distinguishes two types of transchondral fractures, those caused by avulsion and those caused by compression. Those authors credited trauma as the sole cause of talar osteochondritis dissecans, which they identified with transchondral fracture. This classification is based on the plain-radiographic appearance.

Patients with osteochondral lesions often describe a history of a sprained ankle that includes a popping sensation. The symptoms may be more intense after an inversion injury because of the ligament tear, which masks the pain from an osteochondral lesion. Theoretically, the location of the lesion determines the location of the pain and the tenderness.

If the pain, recurrent swelling, and catching or locking persist, continued investigation is essential. If routine radiographs are normal, bone scanning is usually the next

step, as it is very sensitive to these lesions, although not specific. If further evaluation is indicated, MR imaging, CT, and plain tomography are all means of accurately determining the exact location and extent of a lesion.

Stage 1 and stage 2 lesions often heal well and have a good prognosis. An intra-articular injection of 10 ml of lidocaine may help differentiate the pain caused by these lesions from that due to other causes. If there is relief of pain with the injection, surgery can be considered. Because delayed nonoperative treatment of stage 3 and stage 4 lesions often fails, these lesions are generally treated surgically to prevent further deterioration of the joint. An experienced arthroscopic surgeon may reach these lesions and treat them with debridement and drilling of the lesion bed. Open treatment is occasionally necessary. Postoperative weight-bearing is delayed for 2 to 6 weeks. The results of surgery in patients with late stage 3 and stage 4 lesions have been variable, with good outcomes reported in 40% to 80% of cases. The degree of success depends in part on the interval between injury and surgical treatment. Advanced lesions for which treatment has been delayed for more than 1 year generally have a poor outcome.[19]

Osteochondral Loose Bodies in the Ankle

Loose bodies originating from a stage 4 transchondral fracture of the talus should be suspected in patients with intermittent pain, swelling, and clicking. A few loose bodies may also originate from osteophytes on the anterior distal rim of the tibia or the dorsal neck of the talus; if multiple, they may originate from synovial osteochondromatosis. Purely chondral loose bodies may cause the same problems; in these cases, plain radiographs will appear normal, and the loose bodies can be detected only with arthrography, CT, or MR imaging. Arthroscopy will secure the diagnosis of osteochondral lesions. The treatment is arthroscopic removal of the loose bodies, sometimes with debridement and drilling of the lesion bed.

Impingement Problems

Bone Impingement

This condition, sometimes called "soccer player's ankle," involves osteophytes on the anterior rim of the tibia and soft tissues trapped between the anterior aspect of the tibia and the talus during dorsiflexion of the ankle. These changes are secondary to traction on the joint capsule of the anterior aspect of the ankle when the foot is repeatedly forced into extreme plantar flexion.

Soccer players and dancers most commonly develop these conditions over a period of 10 years or more, as an exostosis gradually enlarges. Pain after activity is the first symptom noted. It starts as a vague discomfort provoked by ankle dorsiflexion, which ultimately becomes sharper and more localized over the anterior aspect of the foot. Anterior tenderness and swelling may appear. Exostoses are visible on routine lateral radiographs. Stress views with the ankle in dorsiflexion can show whether the osteophytes impinge on the ankle bones.

Conservative treatment, consisting of heel lifts, rest, modification of activities, and physical therapy, may be tried first. The only available curative treatment is debridement of the exostosis, which may be done through an arthroscope. Postoperative recommendations include early motion and a return to physical activity after 2 to 3 months.

Soft-Tissue Impingement

An inversion sprain may result in posttraumatic synovitis with synovial thickening and an effusion. The term "meniscoid lesion" has been used to describe entrapment of a mass of hyalinized tissue between the talus and the fibula during ankle motion.[21] A ligamentous origin has been recognized.[2] After an inversion sprain of the ankle, the distal fascicle of the anterior inferior tibiofibular ligament may impinge on the anterolateral aspect of the talus. Meniscoid lesions may also be tears of the anterior talofibular ligament in which the torn fragment becomes interposed between the lateral malleolus and the lateral aspect of the talus. The term "lateral gutter syndrome" has been used to describe this situation. On examination, there is tenderness just anterior to the lateral malleolus and discomfort in dorsiflexion, which often is limited. At times a snapping phenomenon can be elicited when the foot is tested for inversion stability.

The key to a correct diagnosis is awareness of this relatively uncommon lesion. The typical patient is an athlete with a long history of repeated ankle sprains who complains of pain and discomfort in the anterior aspect of the ankle but shows no evidence of mechanical instability and has normal radiographs. A meniscoid lesion should always be considered in this setting; however, this injury can also be present without a history of recurrent ankle sprain. Relief of symptoms after an injection of 10 ml of lidocaine at the point of tenderness will support the diagnosis. Dorsiflexion stretching and a heel wedge may be helpful. Arthroscopic examination confirms the diagnosis, and resection of the lesion seems to be an effective treatment. Return to full

activity is possible in 1 to 2 months.

Arthrosis of the Ankle

The incidence of ankle arthrosis is low compared with that of arthrosis of the hip and knee joints. It is most commonly present after fractures about the ankle, especially when fracture healing occurs in a nonanatomic position. Other predisposing factors include stage 3 and stage 4 osteochondral lesions of the tibia or the talar dome.

The treatment is symptomatic and includes unloading of the joint surfaces and reducing the reactive inflammation with nonsteroidal anti-inflammatory drugs. When catching and locking sensations are present, arthroscopic debridement and removal of loose bodies may be warranted. Ankle arthrodesis is an option if conservative measures fail. The functional disability after an ankle arthrodesis can frequently be well compensated for, especially in a young patient.

Chronic Tendon Injuries

Peroneal Tendon Injuries

A factor that commonly predisposes to peroneal tendon disease is the distortion of local anatomy caused by a fracture of the lateral malleolus or the calcaneus or by an ankle sprain. Peroneal tendon injuries are usually dislocations or subluxations, but ruptures can occur and lead to chronic problems.

Dislocation and subluxation are most commonly seen in skiers, even when good boots with support above the ankle are used. Pain, swelling, and point tenderness are noted posterior and inferior to the lateral malleolus over the tendons and the retinaculum. Resisted eversion of the ankle may produce or provoke subluxation or dislocation of the tendons. This injury has been classified into three grades[21]: grade 1, characterized by retinacular separation of the anterior lip (51% of patients); grade 2, characterized by a tear of the peroneal retinaculum (33%); and grade 3, characterized by avulsion of the lateral malleolus (16%).

Treatment with a cast for 4 to 6 weeks usually is sufficient, but surgery is recommended for active persons. This injury is commonly missed, and chronic pain results. Surgical intervention is recommended in chronic cases, with debridement and repair if needed. The peroneal tendon groove in the fibula is usually deepened, and the retinaculum is reconstructed by duplication and reinsertion to the bone. Return to full activity is usually possible after 3 months.

A longitudinal tear of the peroneal tendon can also cause swelling and tenderness, either local or affecting the entire sheath. A chronic tear is usually treated surgically. A return to full activities is possible in 3 to 6 months, depending on the size and location of the tear.

Posterior Tibial Tendon Injuries

Overuse injuries of the posterior tibial tendon often occur in athletes, especially runners. Running puts biomechanically high demands on the tendon along its course from behind the medial malleolus to its insertion on the navicular bone. The peritenon may be inflamed, and degenerative changes in the tendon may result in chronic tendinitis. Complete tears are rarely seen in younger athletes, but are the most common injury of this tendon in the population over 50 years of age. Hyperpronation is a predisposing factor. Unilateral flatfoot in an adult may indicate a tear.

The symptoms include tenderness and swelling along the course of the tendon behind the medial malleolus. Passive pronation and resistive supination of the midfoot may increase the pain. Treatment may include a medially posted orthotic device. In chronic cases, surgical exploration may be appropriate, followed by a procedure that deals with whatever pathologic condition is present, whether it be tenosynovitis, tendinosis, or a tear along the tendon. The possibility of a tendon transfer or a hindfoot fusion (subtalar fusion, triple arthrodesis, or double fusion) should be considered for a chronic injury.

Undetected Fractures

Ankle fractures are often associated with ankle ligament injuries. Fractures may occur in the lateral, medial, and posterior malleolus; the proximal fibula; the lateral and posterior processes of the talus; the anterior process of the calcaneus (calcaneal attachment of the bifurcate ligament); the fifth metatarsal (avulsion at the insertion of the peroneus brevis tendon); and the navicular and other midtarsal bones. Epiphyseal separations are another possibility in children. Plain radiography and CT can be used to confirm the diagnosis. Such fractures can cause long-lasting pain if they are not detected.

Stress Fractures

Stress fractures are common around the ankle and in the distal fibula and tibia and the calcaneus. A stress fracture of the tarsal navicular bone is uncommon in the nonathlete. Such a fracture may result in limited dorsiflexion of the ankle and vague arch pain, which can be transmitted up to the ankle in the active person.

The first symptom is generally an insidious onset of pain, which is initially vague and is usually associated with physical activity. With continued stress, pain increases and becomes more localized, sometimes accompanied by soft-tissue swelling. Clinical examination reveals distinct tenderness over the lesion. The diagnosis can be confirmed with bone scanning and tomography.

Treatment consists primarily of avoidance of the activities that caused the pain. In chronic pain situations, casting or use of a walking boot may be useful. Surgery is rarely necessary. Healing of a properly treated stress fracture usually occurs within 4 to 15 weeks, but may take up to 6 months, depending on the location of the fracture.

Nerve Injuries

Gradual constriction of anatomic structures about a nerve and chronic compression of a nerve against a nonyielding structure may cause nerve entrapment.[22] Nerve injuries can also occur by stretching of the nerve. Nerve entrapment usually causes mixed motor and sensory symptoms, with tenderness over the entrapment point and sometimes pain and hypersensitivity proximal to the nerve compression.

Nerve entrapment can occur in several nerves and cause discomfort around the ankle. Entrapment of the common peroneal nerves is due to compression at the fibular head and neck. Entrapment of the superficial peroneal nerve can occur when it emerges through the fascia at the junction between the medial and distal thirds of the leg. Recurrent ankle sprains that stretch the nerve predispose to this condition. The deep peroneal nerve can be entrapped at the middorsal aspect of the foot. Entrapment of the posterior tibial nerve within the fibro-osseous tunnel behind and distal to the medial malleolus is referred to as tarsal tunnel syndrome. Local sural nerve compression may be associated with recurrent ankle sprains.

There is often local tenderness over an entrapment area, and Tinel's sign is often positive. Injection of 3 to 5 ml of a local anesthetic may relieve the symptoms. If pain recurs, surgical decompression may be required.[22]

Reflex Sympathetic Dystrophy

Posttraumatic reflex sympathetic dystrophy is often associated with a trivial trauma,[23] but nontraumatic causes also exist. An early diagnosis based on an accurate clinical history is important. Pain at rest, pain with active and passive motion, and pain at night are typical symptoms. The pain experienced is worse than would be expected from the trauma involved and persists a long time after the conventional healing period. The discomfort is not localized to the site of the primary trauma and becomes more generalized with time. A psychological component is often present. There is diffuse tenderness, and vascular and trophic changes often develop.

Early radiographic findings of localized osteoporosis or later findings of subperiosteal bone resorption and soft-tissue swelling support the diagnosis. Three-phase technetium bone scanning and sympathetic blocks may also be useful in diagnosis.

Initial treatment includes anti-inflammatory medication and physical therapy on a daily basis at the patient's own rate. If there is only a limited effect at 6 to 8 weeks, lumbar sympathetic blocks may be tried. Surgical sympathectomy can be beneficial.

Tumors

Tumors are rare but may occur in the ankle region. They are most commonly localized in the tarsal bones and the lateral malleolus and are usually benign. If a tumor is present and an ankle sprain occurs, the result may be a pathologic fracture with residual chronic pain.

In patients with chronic ankle pain for which no plausible cause can be identified, plain radiography should be the first study performed. If the findings are normal, bone scanning should be done. A normal bone scan excludes the overwhelming majority of tumors in the foot. Magnetic resonance imaging will reveal most soft-tissue tumors.

Summary

Ankle sprains are very common. Such injuries often entail residual problems. Incomplete rehabilitation is the most common cause of residual problems, but there are many other reasons for chronic pain. It is, therefore, important to conduct a systematic evaluation, including a careful history and examination, so as to reach the correct diagnosis, which is essential to successful management. It is important to gain the patient's confidence, as patients tend to go from doctor to doctor because of the chronicity of the problem. Restoration of the complete range of motion and progression to resistive exercises to restore full strength are the key to recovery.

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