LATERAL ANKLE INJURIES

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Introduction

Numerous studies have been performed evaluating the biomechanics, anatomy, diagnosis, and treatment of lateral ankle sprains. The purpose of this presentation is to review the current concepts of conservative management and contrast those modalities with surgical intervention.

Anatomy

The three ligaments of the lateral aspect of the ankle are known as the anterior talofibular, calcaneofibular and posterior talofibular ligaments (Fig. 1). These ligaments act as static stabilizers to limit excessive inversion of the ankle joint when stressed. The peroneal muscles provide functional stability to the ankle joint complex.

Biomechanics

Lateral ankle ligament injuries are responsible for approximately 85% of all ankle sprains (1). Ligamentous rupture results from inversion and supination of a static foot in association with external rotation of the tibia on that foot. A considerable degree of torque arises resulting in transmission of force in a predictable sequence. Classically the first structures to tear are the anterolateral ankle joint capsule followed by the anterior talofibular, calcaneofibular and posterior talofibular ligaments. Early thought indicated the anterior talofibular ligament ruptured with the ankle in plantar flexion and the calcaneofibular with the ankle in neutral, however, Dias demonstrated the anterior talofibular ligament is the first ligament to be torn regardless of the ankle joint position (2).

Fig. 1. Anatomical position of three lateral ankle ligaments.

Diagnosis

A variety of diagnostic modalities exist for lateral ankle sprains. These include standard radiographs, stress radiographs (inversion stress and anterior drawer) arthrography, and recently Nuclear Magnetic Resonance imaging. Controversy exists as to the modality of choice as numerous studies have been published presenting the advantages and disadvantages of each modality (3-5). An in-depth discussion of diagnosis will not be presented other than to describe our technique at Doctors Hospital.

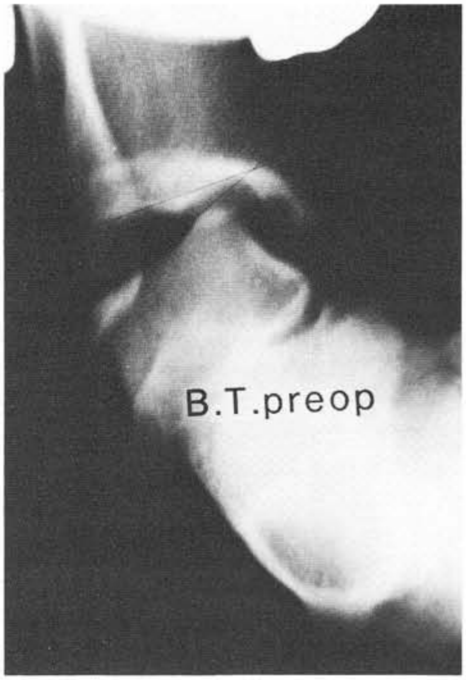
Upon presentation a thorough clinical examination is performed to assess each individual ligament, the base of the fifth metatarsal, the peroneal tendons (subluxating peroneals) as well as the proximal fibula (Maisonneuve fracture). Stress inversion and anterior-drawer radiographic studies are then performed (Fig. 2). Local intra-articular injection or peroneal nerve block at the neck of the fibula may be performed to achieve some anesthesia, however, if views are performed within hours of the injury, anesthesia may not be necessary.

Once a diagnosis of ankle sprain has been determined, a standard classification system is utilized: Grade 1, mild stretch of the ligament without instability; Grade 2, moderate, incomplete tear of the ligament with mild instability and Grade 3, complete tear and severe instability.

Treatment

Immediate care of ankle ligament injuries involves reduction of edema, control of soft-tissue bleeding, and stabilization of injured ligaments. Rest, ice, compression, and elevation should be instituted. Numerous studies have indicated oral anti-inflammatory agents may reduce the pain and swelling although no reduction in healing time has been reported (6, 7). However other investigators have reported statistically insignificant analgesia and reduction of edema when non-steroidal agents are compared with placebo (8, 9).

A



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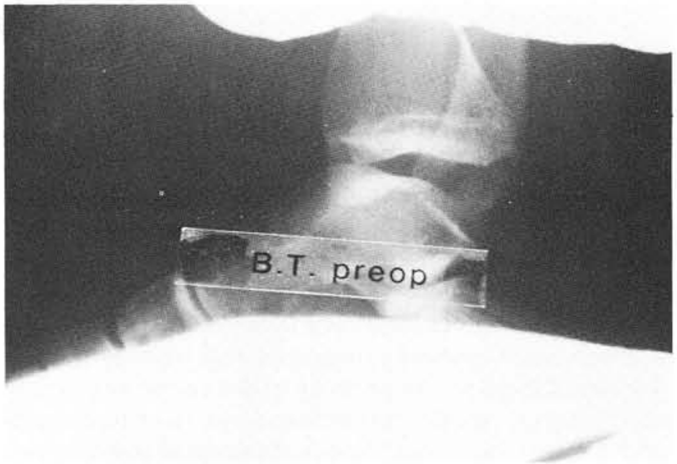

Fig. 2. A. Stress inversion demonstrating significant talar tilt. **B.** Anterior drawing demonstrating anterior displacement of talus from the ankle mortise.

Non-operative management is diverse and generally includes cast immobilization, taping, or cast-brace therapy. Other modalities utilized less frequently will also be discussed.

Cast immobilization is the most frequently utilized therapy by the family practitioner. Four to six weeks of immobilization is the standard and is followed by rehabilitative exercises. Although casting usually provides a successful result several studies indicate disadvantages (10-12). Muscle degeneration, loss of joint proprioception, and prolonged rehabilitation have all been reported (13).

Taping in association with daily hydrotherapy has yielded satisfactory results. Initially 20-30 minutes of ice whirlpool is instituted followed by open tape application for the first 24-72 hours. Contrast hydrotherapy is then begun followed by closed taping on a daily basis. Obviously a controlled environment is necessary with readily accessible physical therapy personnel.

Taping should be performed with the ankle in a maximum amount of dorsiflexion and eversion which can be tolerated. The knee should be flexed to relax the gastrocnemius and assist ankle dorsiflexion. The aim is to immobilize the ankle in a position where the ligament ends are at their closest proximity to each other. If this goal is not achieved, scar tissue will fill the interval resulting in a lengthened ligament and possible chronic instability. Crutches are dispensed and the patient is allowed partial weightbearing. An exercise program is instituted as pain and edema decrease. Taping continues on a daily basis for approximately 6 weeks. Once the patient is able to ambulate without pain or a limp the crutches are discontinued. Strapping techniques offering the most satisfactory results include the Gibney Basket Weave and spica figure-of-eight bandage.

The cast brace system offers early mobilization and weightbearing that daily taping provides without the inconvenience. A plaster or synthetic material is applied above the ankle followed by a synthetic insert to cover the ankle and foot. The distal segment may be hinged to allow range of motion activity. A commercial device is available known as the Air Stirrup. The device limits inversion while maintaining function (14).

There is little difference in end stability between plaster immobilization and taping (15, 16). Tape with early immobilization or cast-brace technique has been preferred over casting since muscle atrophy is reduced, active range of motion is begun and activity is resumed earlier (1).

Other modalities for the treatment of ankle sprains have been reported. Paris and associates described the utilization of the neuroprobe for second degree ankle inversion injuries (17). The neuroprobe is a non-invasive electrical stimulation apparatus which was used to stimulate acupuncture points on the ear and ankle in combination with standard physical therapy. A significant decrease in rehabilitation time was reported in comparison to conventional physical therapy without the neuroprobe.

Brade and Arnold reported on the use of ankle joint aspiration followed by injection of hyaluronidase combined with a local anesthetic (18). The concept of the therapy was to relieve pain and allow early range of motion by aspirating the hematoma and anesthetizing the ankle joint. Hyaluronidase was added to assist tissue perfusion of the Lidocaine and to dissolve areas of hematoma formation. Decreased morbidity and shorter periods of incapacitation were reported by the authors.

Muwanga et al described the use of an elasticized strap with velcro closure tabs (Nottingham Ankle Support) applied in a figure-of-eight method around the ankle joint (19). The study compared this modality to Tubigrip and eversion strapping for treatment of stable inversion injuries. Their results indicated a significant increase in early range of motion in comparison to the other two therapies.

Williamson and associates conducted a randomized, prospective, double blind study comparing ultrasound and physical therapy to physical therapy without ultrasound (20). No significant difference was demonstrated between the two treatment groups implying ultrasound does not hasten recovery following lateral ankle injuries.

Obviously a wide variety of non-operative treatment regimens have been reported. Each modality has its proponents along with its detractors. Those who support surgical management point to prolonged disability following conservative measures.

Staples examined 73 ankles ten years after being treated with cast management (21). He found only 58.8% were asymptomatic at the time of follow-up. In a later study, he examined 27 patients who were treated initially with immediate ligamentous repair and found significantly improved results.

Ruth performed a comparison study between surgical repair and cast immobilization (22). Of 32 surgically repaired ankles examined 2.5 years later all were noted to be stable and 3 presented with only minor symptoms. Of 72 ankles treated with cast immobilization only two-thirds were stable at 2 years post injury with only 30 indicating a 90% or better return of function (22).

Brostrom published the definitive study comparing three methods of treatment with follow-up averaging at 3.8 years (15). Primary surgical repair was performed on 95 patients followed by 3 weeks of immobilization; cast immobilization alone was performed on 82 cases and ankle strapping with early immobilization was the treatment for 104 cases. The most successful results were achieved with primary surgical repair since 97% of those cases treated surgically had no functional instability. The two other methods were satisfactory with functional stability in 80% of those cases casted or strapped.

Primary Repair of the Anterior Talofibular and Calcaneofibular Ligaments

The following procedure is performed typically for primary repair of the lateral ankle injury as well as in the delayed primary repair of the lateral ankle in an effort to stabilize a laterally unstable ankle.

Following acute injury normal anatomy about the ankle is disrupted by profound edema, ecchymosis, and subcutaneous hematoma. Therefore, the exact orientation of several anatomical structures must be defined preoperatively. The fibular malleolus is traced exactly with a skin marking pen. The prospective positions of the calcaneofibular and anterior talofibular ligaments are mapped. The anterior talofibular ligament courses from the distal 1.5 cm of the fibular malleolus extending anteriorly and inserting into the lateral talar neck. The calcaneofibular ligament originates from the distal fibular malleolus and courses posteriorly and inferiorly to its insertion into the lateral body of the calcaneus.

Using these landmarks the skin incision is drawn beginning approximately 2 mm inferior to the tip of the fibular malleolus coursing distally, and superiorly through the sinus tarsi, then curving anteriorly to the lateral extent of the extensor tendons. Care is taken not to begin the surgical incision too far inferiorly beneath the fibular malleolus as surgical dissection will then carry into the lateral aspect of the subtalar joint or the talocalcaneal ligaments.

At the Podiatry Institute this procedure is readily performed under local anesthesia with IV sedation. A hematoma block is routinely employed using a mixture of Marcaine plain and Xylocaine with epinephrine. Similarly, the procedure can be performed in some cases on an outpatient basis and without using a pneumatic thigh tourniquet for hemostasis.

The skin incision is performed along the course as outlined previously. Immediately upon penetration of the superficial fascia in the post-traumatic case, a degree of subcutaneous hematoma is encountered. Care is taken at this point in the dissection process to avoid interruption of two important nerves coursing through the subcutaneous tissue. At the anterior aspect of the incision lies the intermediate dorsal cutaneous nerve and at the posterior aspect of the incision the sural or lateral dorsal cutaneous nerve is found (Fig. 3). Care is taken to retract these structures gently from the operative site.

As the dissection procedes through the remainder of the subcutaneous tissue, the amount of the subcutaneous hematoma begins to be fully appreciated. Dissection is continued through the subcutaneous layer taking care to identify and ligate vascular structures that have been traumatically ruptured.

The next anatomic plane that needs to be thoroughly identified is the deep fascia. The fascia is identified as a distinct fibrous layer specialized posteriorly as the peroneal retinaculum. Not infrequently following the severe inversion injury, the deep fascia including the peroneal retinaculum has been traumatically ruptured. It is of utmost

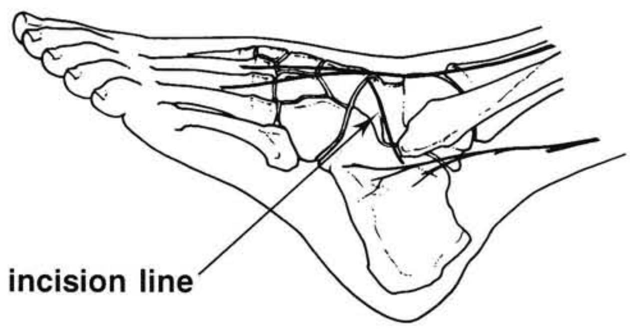

Fig. 3. Incision line runs between intermediate dorsal cutaneous nerve anteriorly and sural nerve posteriorly.

importance to fully visualize the deep fascia as well as to appreciate defects in the retinaculum so that these may be repaired anatomically to minimize potential for subluxation of the peroneal tendons. Alternatively if the fascia remains intact during the original dissection phase it is incised in a curvilinear fashion corresponding to the skin incision.

Following the deep fascial incision the ankle joint capsule is the next anatomical layer encountered. Routinely the ankle capsule has been ruptured at injury, not infrequently across the entire anterior ankle joint. This layer also must be identified to facilitate accurate repair at the time of closure.

At this point, in the usual post-traumatic case, a significant ankle joint hemarthrosis may be expressed. A thorough lavage of the ankle joint is recommended to facilitate visualization of the traumatically disrupted ankle joint anatomy. The peroneal tendons are quite readily retracted posteriorly to facilitate visualization of the calcaneofibular ligament damage (Fig. 4). Anteriorly, the anterior talofibular ligament damage is readily visualized.

One of three separate scenarios of ligamentous disruption must be appreciated. There may exist either a midbody tear of either the calcaneofibular or anterior talofibular ligament. This must be differentiated from the avulsion type injury of either ligament from the fibular malleolar origin or their insertions onto the lateral aspect of the talus or calcaneus respectively. Any small avulsion fracture fragments that may have been generated with the avulsion type injury must be either anatomically repaired if large enough or surgically resected if too small.

Any avulsion fracture fragments if unrepairable are excised. Should either ligament be avulsed from its origin or insertion, it should be replaced primarily by one of several methods. The repair may be as simple as suturing the ligamentous structure back to the periosteal tissue of the fibula, talus or calcaneus as appropriate. Should this not prove feasible, however, the ligaments may be reattached via trephine bone plugs, drill hole reapproximation, or using an AO screw and polyacetal washer as necessary.

Following anatomic repair of both the anterior talofibular and calcaneofibular ligaments (Fig. 5), the ankle capsule is repaired using a 2-0 absorbable over and over suture technique. Again, this repair is also performed with the foot fully dorsiflexed and everted to facilitate postoperative ankle stability. The ankle capsular repair using an absorbable suture tends to cover any of the nonabsorbable suture tags left following repair of the ligamentous structures.

After the capsule has been repaired laterally and anteriorly, the deep fascia is the next structure to be reapproximated. The peroneal retinaculum must be sutured anatomically to preclude postoperative subluxation of the peroneal tendons. The deep fascial repair is routinely performed using a 3-0 absorbable suture in an over and over technique.

Several subcutaneous simple absorbable sutures are then employed for wound support. Superficial fascia closure is performed using 4-0 absorbable running suture. Finally the skin is repaired using a 6-0 subcuticular suture. The incision is supported with skin tapes for 6 weeks. A Jones compression cast is applied for 72 hours postoperatively.

At 3 days postoperatively a dressing change is performed. A synthetic non weight-bearing cast is employed for the following 10 days. Full weightbearing is allowed in the cast from week 2 through week 4. Return to full weight-bearing exercise including aerobic exercise cycling and return to weight training is permitted. At 4 weeks postoperatively the cast is replaced with an Air Stirrup and return to full activity is encouraged.

Six weeks postoperatively all dressings are removed and the patient returns to full function without limitation.

Fig. 4. Retraction of peroneal tendons assists visualization of calcaneo-fibular ligament.

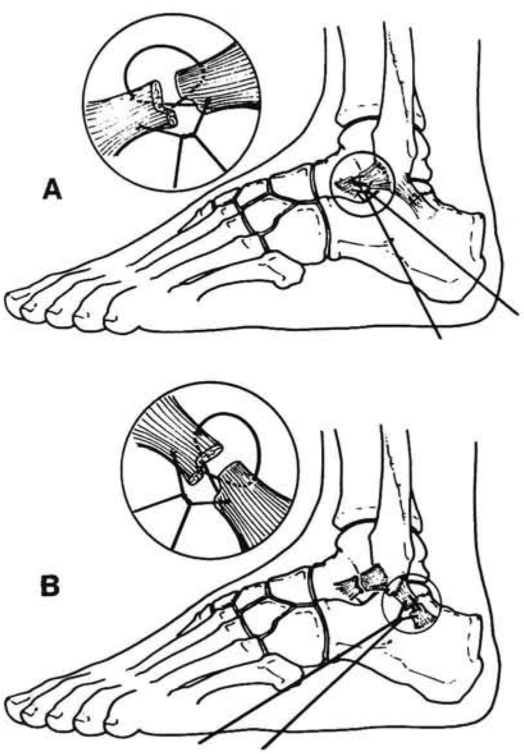

Fig. 5. Anatomical restoration of **A.** Anterior talo-fibular and **B.** Calcaneo-fibular ligament facilitates ankle joint stability and function.

Summary

At the Podiatry Institute we are now following over 150 operative primary ankle ligament repairs. It is our firm impression that the appropriate application of primary lateral ankle ligament repair, operative evacuation of ankle hemarthrosis, and appropriate postoperative management yield a dependably stable postoperative ankle joint mortise. As a rule, patients are fully relieved of post-traumatic symptomatology within the 6 week postoperative period. Return to full preoperative function can be expected within 6 to 8 weeks postoperatively.

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