Surgical Treatment of the Unstable Ankle

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Abstract

Symptomatic ankle instability will develop in as many as 20% of patients after inversion sprain of the lateral ankle ligaments. Although most patients may be successfully treated with a rehabilitative exercise program and bracing, some will continue to sustain recurrent ankle sprains with activities of daily living, work on uneven terrain, or sports. The anterior talofibular ligament and the calcaneofibular ligament are the primary stabilizers of the lateral ankle, and surgical procedures should be aimed at restoring the normal function of these ligaments. Preoperative stress radiographs should be obtained to determine the degree of laxity and to differentiate between subtalar joint and ankle joint instability. Numerous surgical techniques have been described to correct ankle instability, most with an 80% to 90% success rate. Reconstructions using tendon grafts may restrict normal ankle and subtalar joint motion, depending on the placement of the graft. Direct repair of the anterior talofibular and calcaneofibular ligaments with shortening and reattachment to the fibula has a success rate similar to that for augmented reconstruction and avoids the increased morbidity associated with tendon graft procedures. Patients with severe laxity or with weak or deficient tissue for direct repair may require an augmented reconstruction. Osteotomy may be required in addition to ligament reconstruction in patients with severe ankle or hindfoot varus alignment, in order to prevent failure of the repair. Patients with paralysis or weakness of the peroneal musculature may require a nonanatomic procedure that limits subtalar motion.

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Ankle sprains are among the most common musculoskeletal injuries, accounting for as many as 40% of all athletic injuries. In a recent study,[1] the overall incidence of sprains in the general population was found to be 7 per 1,000 person-years. The vast majority of these injuries are lateral ligament sprains, resulting from inversion of the plantar-flexed foot. Surgical management of acute ankle sprains is rarely, if ever, indicated. Initial management should include rest, ice, compression, and elevation (the "RICE" regimen). Early controlled motion with use of a functional brace, allowing limited dorsiflexion and plantar flexion while preventing inversion, is superior to casting or surgical repair of the ligaments.[2]

While most patients treated nonoperatively will do well, as many as 20% of patients will experience symptoms of functional instability, with recurrent inversion sprains, pain, and difficulty walking on uneven ground.[3] Many of these patients will become less symptomatic with a supervised rehabilitation program aimed at improving proprioception and strengthening of the peroneal muscles. In addition, bracing is very effective in improving functional symptoms of instability, thus reducing the need for surgical reconstruction.

Patients who continue to sustain multiple recurrent inversion sprains despite a program of rehabilitation and bracing are candidates for surgical reconstruction of the lateral ankle ligaments. Many surgical procedures for the unstable ankle have been described. These vary greatly in their effect on ankle and subtalar joint mechanics. Although most of these reconstructions have been reported to be effective in reducing symptoms of instability, the surgeon should choose a procedure that restores the anatomy and normal mechanics whenever possible.

Anatomy

Inversion of the plantar-flexed foot produces a spectrum of injuries to the lateral ligamentous structures. Anatomically, disruption starts with the anterolateral joint capsule and progresses to the anterior talofibular ligament (ATFL) and the calcaneofibular ligament (CFL)

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sequentially, depending on the severity of the injury. Since the CFL is a stabilizer to both the ankle and the subtalar joints, injury to this ligament will result in increased subtalar laxity in addition to ankle instability.

To restore normal ankle and subtalar mechanics, the surgeon must be aware of the anatomic location and orientation of the lateral ankle ligaments (Fig. 1). In a cadaver study, Burks and Morgan[4] reviewed the anatomy and established landmarks that enable the surgeon to accurately restore and orient the ATFL and the CFL. There is a considerable degree of anatomic variation, however, and the surgeon should use these values as general guidelines. Burks and Morgan found that the ATFL originates on the fibula 1 cm from the tip of the lateral malleolus. The ligament averages 7.2 mm in width and inserts into the talus just distal to the articular surface 18 mm proximal to the subtalar joint. The ligament is contiguous with the joint capsule, rather than being a distinct structure, and is not easily defined in patients who have sustained many previous sprains. The CFL originates on the fibula adjacent to the ATFL approximately 8 mm proximal to the tip of the fibula and courses posteriorly and distally to the calcaneus. The angle at which the ligament lies in relation to the fibula is somewhat variable, averaging 133 degrees (range, 113 to 150 degrees) with the ankle in plantigrade position. The ligament lies deep to the peroneal tendons; although contiguous with the joint capsule, it is a relatively distinct structure and is easily identified. The CFL inserts onto the calcaneus 13 mm distal to the subtalar joint.

Because the fibular origins of the ATFL and the CFL lie within 3 to 4 mm of each other, they are occasionally avulsed together from the fibula with a fragment of bone as the result of severe inversion injury. Although this fragment has been called an “os subfibulare,” it is the result of trauma, and is not a congenital variant.

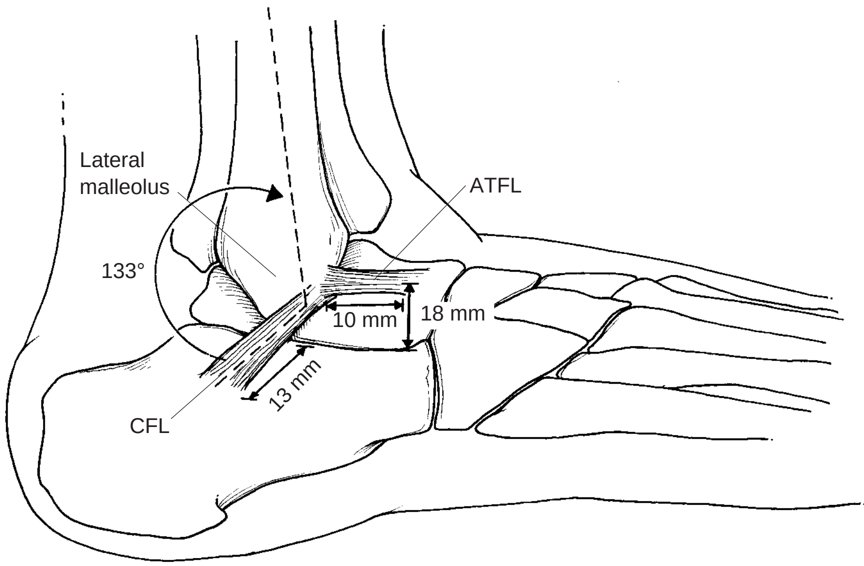


Fig. 1 The critical anatomy of the lateral ankle ligaments.

The posterior talofibular ligament (PTFL) originates on the posteromedial aspect of the distal fibula and is directed posteriorly to the talus. The PTFL is rarely injured as the result of inversion, except in the case of complete dislocation of the ankle, and therefore does not require reconstruction.

The lateral talocalcaneal ligament (LTCL) is a variable structure, which may be contiguous with the inferior border of the ATFL and the CFL or may be distinctly separate as it courses across the subtalar joint between the calcaneus and the body of the talus. When developed, the LTCL limits subtalar motion.

Biomechanics

Normal total range of motion at the tibiotalar joint is approximately 70 degrees—from 20 degrees of dorsiflexion to 50 degrees of plantar flexion. In dorsiflexion, the broad articular surface of the talar dome fits tightly within the ankle mortise. As the ankle is plantar-flexed, the articular surface of the talus narrows, rendering the ankle less stable. The articular surface of the talus is cone shaped, with the apex medial, so that the lateral talus projects anteriorly as the ankle is plantar-flexed, rendering it more susceptible to inversion injury. Normal subtalar joint motion is approximately 20 degrees when measured as inversion from a maximally everted position.[5] Care must be exercised when choosing a reconstructive procedure not to excessively limit ankle and subtalar joint motion.

The peroneal muscles are dynamic stabilizers of the ankle and subtalar joints. Eversion strength is essential in preventing recurrent inversion sprains and maintaining functional stability. Although portions of these tendons may be used in reconstructive procedures, it is preferable to preserve the dynamic function of these muscles whenever possible.

The ATFL and the CFL work in a synchronous fashion to prevent inversion of the talus throughout dorsiflexion and plantar flexion of the ankle. Because of the orientation of the two ligaments, strain in the ATFL increases progressively as the ankle is plantar-flexed during inversion; strain in the CFL is greatest when the ankle is inverted in dorsiflexion. Biomechanical and strain studies have shown that the ATFL is the primary restraint to inversion of the ankle throughout dorsiflexion and plantar flexion.[6,7] In a cadaver study, Rasmussen[8] was unable to create an isolated tear in the CFL; the ATFL was always torn as well. This study supports the clinical observations of Broström[9] in 60 surgical cases, where he found that the ATFL was torn in all patients. The CFL was injured as well in 16 patients, but there were no isolated tears of the CFL.

The CFL not only stabilizes the ankle joint but also is important in stabilizing the subtalar joint while allowing rotational motion along its longitudinal axis. Because tearing of the CFL will render the subtalar joint unstable, it should also be restored when reconstructing the lateral ankle ligaments. Precise orientation of the reconstructed CFL is essential to prevent restriction of ankle and subtalar joint motion.

The LTCL, when it exists as a distinct and separate structure, also limits subtalar inversion. In severe ankle sprains, the LTCL may be torn in addition to the ATFL and the CFL. Direct repair or reconstruction of this ligament is frequently not possible because of a lack of substance; therefore, indirect techniques utilizing tendon grafts may be required to control excess subtalar motion.

The normal valgus alignment of the hindfoot also contributes to the intrinsic stability of the ankle. Ligament reconstruction in patients with an unstable ankle and a varus hindfoot may fail due to the severe inversion forces created by mechanical malalignment. Correction of mechanical varus alignment (with a calcaneal osteotomy) may be required in these patients. Rarely, varus alignment at the tibiotalar joint may predispose a patient to inversion ankle injuries; in this circumstance, distal tibial osteotomy may be required before ligamentous reconstruction will be successful.

Diagnostic Techniques

A history of recurrent inversion injuries can usually be obtained from the patient. Patients with posttraumatic degenerative changes in the ankle joint will occasionally complain of "giving way," which is actually due to pain rather than instability. Since an ankle brace will eliminate recurrent sprains in nearly all cases, another diagnosis should be sought when there is no improvement with bracing. Other causes of ankle pain, which may be confused or associated with ankle instability, include osteochondral lesions of the talus and longitudinal tears of the peroneal tendons.

The physical examination should include an evaluation of standing mechanical alignment of the lower extremity and an assessment of gait, with particular attention paid to hindfoot alignment. Many patients with recurrent inversion sprains will have sustained injury to branches of the superficial peroneal nerve and may demonstrate altered sensation or sensitivity in the anterolateral foot. Palpable tenderness posterior to the lateral malleolus may be indicative of injury to the peroneal tendons. Crepitus and pain with passive ankle motion may indicate significant articular cartilage injury. Active ankle and subtalar motion are assessed and compared with those in the opposite ankle, along with a manual assessment of inversion and eversion strength.

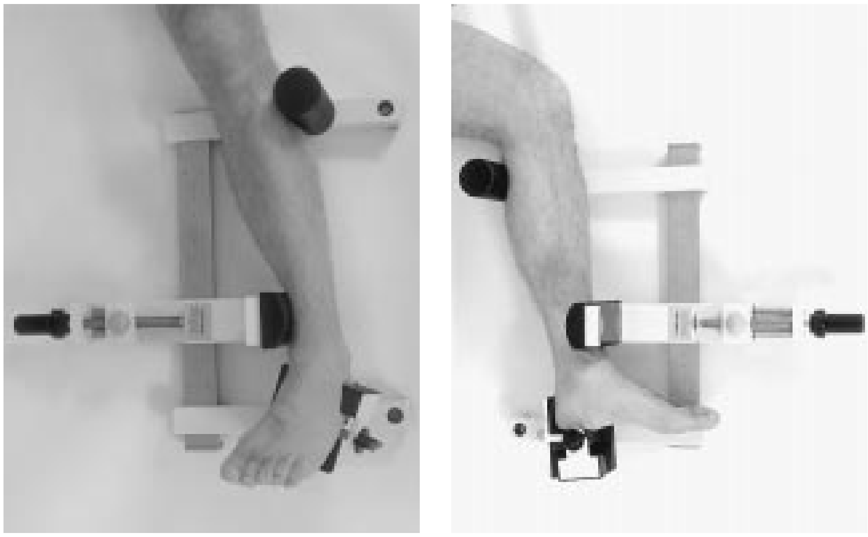
The anterior drawer sign and talar tilt are assessed with the patient in the sitting position and the knee in flexion. During anterior drawer testing, the ankle is allowed to plantar-flex slightly, and an anterolateral rotatory force is applied to the heel. The talus will rotate anterolaterally as it slides forward due to the intact deltoid ligament; it will not displace forward if it is not allowed to rotate. Due to the congruence of the ankle joint, the ankle should be stressed in slight plantar flexion to relax the calf muscles and decrease compressive forces across the joint.

Talar tilt is difficult to assess clinically due to motion in the subtalar joint. With the ankle in slight plantar flexion, the hindfoot and midfoot should be inverted as a unit, with the forefoot not allowed to rotate medially. In a thin person, the examiner may be able to palpate a sulcus at the anterolateral ankle joint and perceive motion between the tibia and the talus with inversion stress. Subtalar motion may be estimated by inverting the calcaneus with the ankle in dorsiflexion. The calcaneus will shift medially in relation to the talus in patients with severe subtalar instability.

Combined motion of the ankle and subtalar joints is estimated clinically by measuring the angle between the hindfoot and the leg during maximal inversion stress. Assessment may be facilitated by positioning the patient prone. This measurement should be used only as a rough estimate, because of the rotatory nature of subtalar motion.

Radiographic Evaluation

Standard radiographs should include lateral and mortise views. Posttraumatic changes such as an-



A B

Fig. 2 The Telos device may be used to consistently measure talar tilt **(A)** and anterior talar translation **(B)**. (Reproduced with permission from Colville MR: Reconstruction of the lateral ankle ligaments. *Instr Course Lect* 1995;44:341-348.)

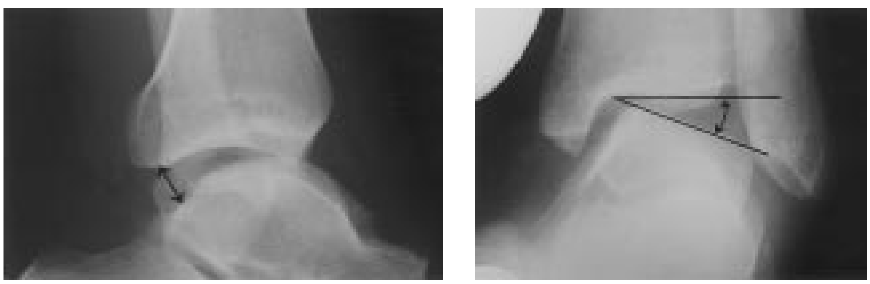
terior tibial marginal osteophytes, talar exostoses, osteochondral lesions of the talus, and os subfibulare lesions should be identified and addressed at the time of surgery.

Anteroposterior and lateral stress radiographs of the ankle should be obtained to quantify the degree of laxity and confirm the clinical diagnosis of ankle instability. The knee should be flexed, and the ankle should be positioned in slight plantar flexion to relax the gastrocnemius-soleus complex. The ankle must be carefully aligned to obtain true lateral and mortise radiographs so that accurate measurements can be made. Use of a special apparatus, such as the Telos device (Austin & Associates, Fallston, Md), may improve consistency in stress testing by applying known forces to the ankle ligaments (Fig. 2). However, the high degree of variability in laxity in normal ankles makes it difficult to establish strict criteria for ligament reconstruction on the basis of stress measurements alone. In addition, pain and guarding may limit the accuracy of stress tests in nonanesthetized patients. Therefore, the results of stress testing should be used along with other important clinical indicators of functional instability to determine the need for ligament reconstruction. Furthermore, both ankles should be stress-tested for comparison.

Anterior translation is measured on the lateral stress radiograph as the perpendicular distance between the posterior edge of the tibial articular surface and the talus (Fig. 3, A). Anterior translation 5 mm greater than that on the uninvolved side or an absolute value of 9 mm is indicative of instability.[10,11]

Most authors consider a talar tilt angle 5 degrees greater than that on the uninvolved side or an absolute value of 10 degrees to be indicative of pathologic laxity.[10,11] The talar tilt angle is measured on the mortise view as the angle between the talar and tibial articular surfaces (Fig. 3, B). Lateral stress radiographs are more difficult to obtain consistently than mortise views. The talus should be allowed to rotate medially as anterior force is applied so that the deltoid ligament does not prevent anterior translation.

Stress radiographs of the subtalar joint[11,12] are difficult to interpret because of the complex motion at that joint. At present, they are not widely used in the clinical setting. Subtalar stress radiographs are taken with the ankle in dorsiflexion and 30 degrees of internal rotation. The x-ray tube is angled 45 degrees caudocephalad. Medial displace-



A B

Fig. 3 **A,** Anterior translation of the talus is determined on a lateral stress radiograph by measuring the perpendicular distance (between arrows) from the talus to the posterior articular margin of the tibial plafond. **B,** Talar tilt is measured on a stress anteroposterior view obtained with the ankle internally rotated 30 degrees (mortise view). (Reproduced with permission from Colville MR: Reconstruction of the lateral ankle ligaments. *Instr Course Lect* 1995;44:341-348.)

ment of the calcaneus on the talus by more than 5 mm is indicative of pathologic laxity.[13] Increased subtalar laxity should be suspected in patients with a history of recurrent ankle sprains who have normal talar tilt values on stress radiographs; reconstructive procedures in these individuals must limit subtalar motion.[13]

Classification Systems

Classification systems generally have been applied to acute ankle sprains but may be useful in regard to chronic ankle laxity. Acute ligament sprains are classified as grade 1 injuries if the ATFL has sustained a minor injury with no disruption of the ligament and no increased laxity on stress testing. A grade 2 sprain is defined as partial tearing of the ATFL, with increased laxity on anterior drawer stress testing. Complete tears of the ATFL are classified as grade 3 sprains. Inasmuch as the CFL is not torn unless the ATFL is also torn, all ankle sprains involving the CFL are grade 3 sprains. Black et al[14] prefer to classify sprains as either single-ligament (ATFL) or double-ligament (ATFL and CFL) injuries, more clearly defining the status of the CFL.

Although no formal grading system exists for ankles with chronic instability, it is useful to determine the status of the CFL, as it may influence the type of reconstruction performed. Measured talar tilt on stress radiographs may help the surgeon assess the need for CFL reconstruction preoperatively.

Indications for Surgery

Most patients with ankle instability are treated nonoperatively with a rehabilitation program including strengthening of the leg musculature with an emphasis on the peroneal muscles. Proprioceptive exercises have been shown to improve functional stability and are an essential part of the program.[15] In addition, functional ankle bracing and/or taping is almost always successful in preventing recurrent sprains. Most patients who require surgical reconstruction have extreme ankle laxity and have sustained recurrent sprains with activities of daily living. Continuous bracing is not possible for all patients, because of dress shoe requirements at work or skin irritation.

With the exception of ballet dancers and others who require extremes in ankle motion, athletes can usually be treated successfully with rehabilitation and bracing. Occasionally, lateral ankle ligaments may be reconstructed in athletes at the time of arthroscopic or open debridement of osteophytes or other intra-articular ankle lesions.

Ankle pain alone is usually not an indication to reconstruct an unstable ankle. Colville and Grondel[16] found that the 4 patients in their series with significant preoperative pain continued to have pain after augmented reconstruction. Similarly, Barbari et al[17] reported residual pain in 17 of 42 patients after reconstruction with a modified Watson-Jones procedure. However, Harrington[18] correlated degenerative arthritis of the ankle with longstanding lateral ankle instability and noted symptomatic improvement and medial joint-space widening in 14 of 22 patients who underwent reconstruction.

Surgical Techniques

The various types of ankle ligament reconstructions may have vastly different effects on ankle motion and mechanics. An understanding of the differences between reconstructive techniques will allow the surgeon to choose the procedure best suited to each patient's particular problem. Important considerations for surgical planning include extremity alignment, which ligaments require reconstruction, peroneal muscle function, subtalar joint laxity, extent of ligamentous laxity, and previous failure of reconstructive surgery. Most reconstructive procedures involve either direct late repair of the ligaments (with or without augmentation) or indirect stabilization with the use of tendon grafts.

Direct Late Repair

In 1966 Broström[9] reported the results in a series of 60 patients with chronic ankle instability in whom he had performed direct late repair of the lateral ankle ligaments. The torn ends of the ATFL were shortened and repaired directly by midsubstance suturing. In 30% of patients, the CFL also required repair. He reported a success rate of 80% with this technique.

Karlsson et al[19] noted that the ATFL and CFL were usually elongated and scarred rather than disrupted and recommended shortening the ligaments and reattaching them to the fibula at their anatomic origins (Fig. 4). Gould et al[20] described a modification of the Broström technique with repair of the LTCL and reefing of the lateral ankle retinaculum to the fibula in addition to repair of the ATFL and CFL. These modifications limit excessive subtalar motion while maintaining normal anatomic relationships and subtalar joint function (Fig. 5).

Direct late repair has the advantages of restoration of the normal anatomy, preservation of subtalar joint motion, and elimination of the morbidity associated with harvesting of tendon grafts. The major disadvantage is inability to ade-

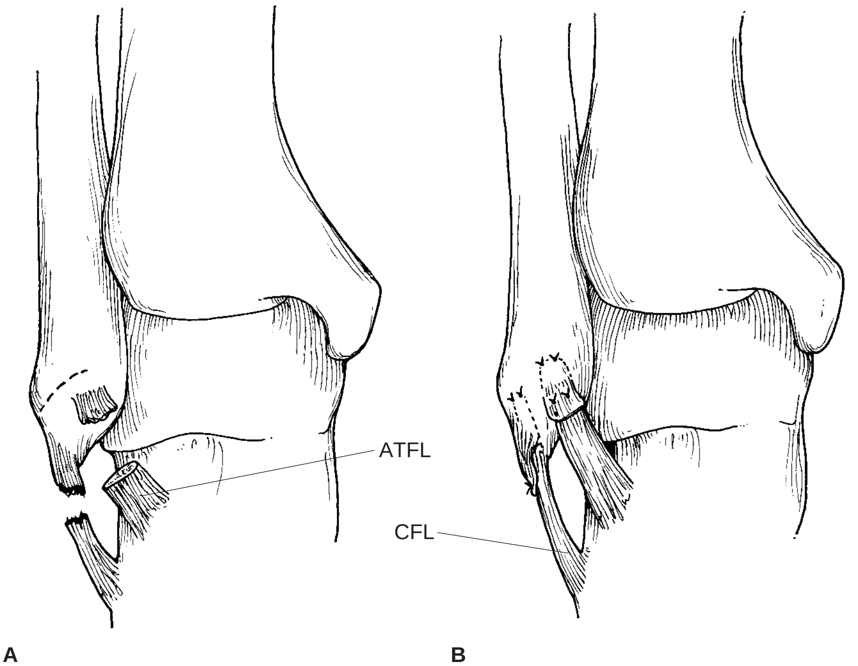


Fig. 4 Karlsson modification of Broström's technique of direct late repair. The ATFL and CFL are shortened **(A)** and attached to the roughened fibula through drill holes **(B)**. The proximal flaps are oversewn to reinforce the repair.

quately stabilize the ankle and/or subtalar joint due to weak or attenuated tissues used in the repair. Karlsson et al[19] found that the failures in their series tended to occur when the CFL was not reconstructed, perhaps because subtalar motion was not adequately controlled. They concluded that relative contraindications to late direct repair were failure of previous ankle ligament repair, increased generalized ligamentous laxity, and long-standing ankle instability of 10 years' duration or more.

Sjølin et al[21] have reported the use of local periosteal flaps turned down from the fibula to augment direct repair (Fig. 6, F). This technique has the advantage of reinforcing weak tissues without the need for extensive dissection or the consequence of donor-site morbidity. The quality, length, and anatomic orientation of the periosteal flaps may be inconsistent.

Tendon Graft Procedures

Augmented reconstructions with the use of a variety of tissues have been described by Evans, Watson-Jones, and Chrisman and Snook (Fig. 6, A-C). Each procedure involves a tenodesis of the peroneus brevis tendon to control excessive ankle and subtalar joint motion. All of these procedures severely limit subtalar joint motion.[5]

The Evans procedure involves a tenodesis of the peroneus brevis tendon to the fibula, either by directly suturing the tendon to periosteum as originally described by Evans or by securing the tendon to the posterior fibula through a bone tunnel. While ankle dorsiflexion and plantar flexion are minimally restricted with this procedure, anterior translation of the talus is not well controlled, and subtalar motion is restricted.

The Watson-Jones procedure routes the tendon from posterior to anterior through the fibula. The graft is then brought through the neck of the talus and sutured back on itself. The ATFL may be anatomically restored with use of this procedure if the bone tunnels are located properly, successfully controlling anterior translation of the talus but restricting subtalar motion.

The procedure described by Chrisman and Snook uses a split peroneus brevis tendon, thus pre-

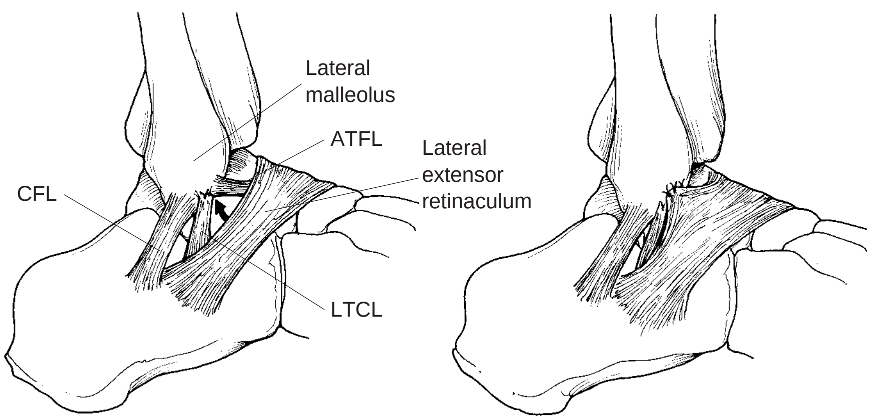


Fig. 5 Gould modification of Broström's technique. The ligament repair is reinforced by suturing the lateral extensor retinaculum and the LTCL to the distal fibula. (The LTCL is variable and may not be reparable.)

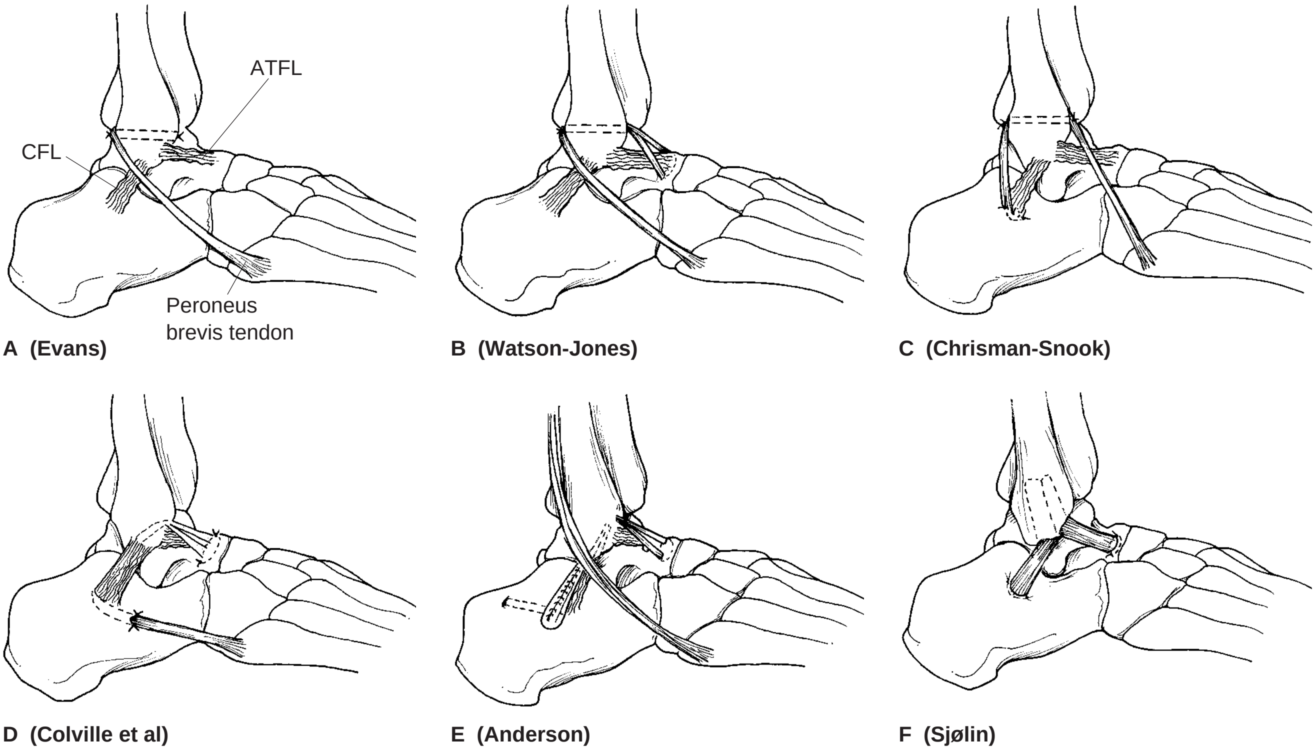


Fig. 6 Augmented reconstructions. **A,** The Evans reconstruction utilizes a tenodesis of the peroneus brevis tendon to the fibula. **B,** The Watson-Jones procedure reconstructs the ATFL in addition to tenodesis of the peroneus brevis tendon. **C,** The Chrisman-Snook procedure uses a split peroneus brevis tendon to reconstruct the ATFL and CFL. **D,** The procedure developed by Colville et al[5] also uses a split peroneus brevis tendon to reconstruct the ATFL and CFL in an anatomic fashion without limiting subtalar motion. **E,** The Anderson procedure utilizes the plantaris tendon to anatomically reconstruct both lateral ligaments without limiting subtalar motion. **F,** The Sjølin technique uses periosteal flaps to augment an anatomic repair.

serving dynamic function in the muscle. The graft is brought from anterior to posterior through the fibula and down to the calcaneus through bone tunnels. This procedure will limit ankle and subtalar motion if performed as originally described. In 1985, Snook et al[22] reported a modification of their procedure in which excessive tightening of the graft is avoided to allow some subtalar motion. In addition, they recommended that the insertion of the graft into the calcaneus be moved posteriorly to more closely approximate the course of the CFL and avoid overrestriction of ankle and subtalar motion. Leach et al[23] described a further modification of the reconstruction, incorporating the anterior limb of the graft into the ATFL to more nearly replicate the orientation of the ATFL.[23]

On the basis of their biomechanical study, Colville et al[5] developed a reconstruction that uses a split peroneus brevis tendon graft, which more closely duplicates the orientation of the ATFL and CFL (Fig. 6, D). The tendon is initially passed through a bone tunnel in the calcaneus and then up through an oblique tunnel in the fibula from posterior to anterior, reproducing the normal alignment of the CFL. The graft is then brought anteriorly through a bone tunnel in the talar neck, reconstructing the ATFL. The posterior limb of the graft is sutured to the lax or torn remainder of the CFL. The ATFL and anterolateral joint capsule are reefed and repaired, and the anterior limb of the graft is sutured to the repaired ATFL. This procedure controls pathologic ankle motion while allowing nearly normal subtalar motion. This reconstruction will limit excessive subtalar laxity only to the extent that reconstruction of the CFL restores normal subtalar motion. Repair of the LTCL or tightening of the lateral extensor retinaculum may be required in some cases.

Anderson[24] reported his results with a technique in which the plantaris tendon is utilized to anatomically reconstruct the CFL and ATFL. The plantaris tendon is harvested through a small incision in the calf with use of a tendon stripper. The graft is then passed through a tunnel in the calcaneus, which emerges at the insertion of the CFL. The tendon is pulled from posterior to anterior through an oblique tunnel in the fibula and anteriorly through a tunnel in the neck of the talus in the orientation of the ATFL (Fig. 6, E). The graft is sutured to the CFL and ATFL to reinforce these ligaments. This reconstruction, if performed correctly, should not limit subtalar motion.

The advantages of augmented reconstructions include increased strength of the repair in patients in whom the ligaments are attenuated. Patients with weak or absent peroneal muscle function and patients with a varus hindfoot may require an augmented nonanatomic reconstruction that limits subtalar motion. In most cases, augmented reconstructions are not necessary, and the surgeon can avoid complications associated with their use by performing an anatomic restoration of the lateral ankle ligaments.

Realignment Procedures

Patients with severe varus deformities of the hindfoot or ankle are at risk for recurrent inversion injuries. Anatomic ligament reconstruction alone may not prevent recurrent ankle sprains if the mechanical forces across the ankle are not corrected. Calcaneal osteotomy may be used to correct a varus hindfoot. Although the technique of calcaneal osteotomy has been well described in the treatment of varus hindfoot deformities, there is little, if any, mention of this technique in regard to the treatment of patients with recurrent ankle sprains. Similarly, patients with severe varus alignment at the tibiotalar joint may require valgus osteotomy of the distal tibia before reconstruction of the lateral ankle ligaments.

Arthroscopy

The role of arthroscopy in ankle joint stabilization procedures is currently limited. Although arthroscopic stapling of the anterolateral capsule has been described,[25] the ATFL is poorly visualized arthroscopically because it is contiguous with the capsule. Arthroscopic reconstruction of the CFL has not yet been reported. Arthroscopic debridement may be used as an adjunct to open ligament reconstruction in patients with osteochondral injury or impingement lesions in areas that are not easily reached through an anterolateral arthrotomy incision.

Results and Complications

A high success rate has been reported for nearly all ankle reconstructions, regardless of whether they are augmented or nonaugmented, anatomic or nonanatomic. Broström[9] reported successful restoration of functional stability in 51 of 60 patients after late direct repair of the ATFL and CFL. Karlsson et al[19] reported 86% excellent or good results in their series of 152 patients who underwent nonaugmented reconstruction of the lateral ligaments. At follow-up, functional results correlated with the degree of stability achieved. Analysis of the treatment failures led them to the conclusion that the CFL should always be reconstructed in addition to the ATFL, and that an augmented reconstruction should be considered in patients with failed previous ligament repairs, with increased generalized ligamentous laxity, or with ankle instability of 10 years' duration or more.

Thermann et al[13] believe that subtalar and combined ankle and subtalar instabilities are frequently overlooked. They have not found a procedure to anatomically reconstruct the subtalar joint and recommend a tenodesis procedure (Chrisman-Snook) in these cases.

The success rate of augmented reconstructions is also high, perhaps more reliably achieving mechanical stability than repair of the ligaments alone. Snook et al[22] reported failures in 3 of 48 patients in their series. Two of the failures occurred more than 10 years after reconstruction, as the result of a severe inversion injury. Anderson[24] reported no failures in his series of 8 patients who underwent reconstruction with use of the plantaris tendon. Colville and Grondel[16] found no failures in their series of 12 patients who underwent an anatomic augmented reconstruction and found that mechanical stability, as measured on follow-up stress radiographs, was achieved in all 12 cases.

Loss of subtalar inversion as the result of nonanatomic graft placement can be a major cause of morbidity in some patients, particularly those whose occupations require walking on uneven terrain. Subtalar motion and improved function may be successfully restored in these patients by means of a more anatomic reconstruction. Revision frequently does not require a new tendon graft; the local tissues, being thickened and scarred, are often adequate for a direct repair. Pain may be a cause of morbidity in patients with excessive ankle and subtalar stiffness after augmented reconstruction. Snook et al[22] recommended against overtightening of the graft in their procedure to avoid this complication.

Wound complications are more common in procedures that require a long posterolateral incision to harvest the peroneus brevis tendon graft. Scar sensitivity and sural nerve injury leading to neuroma formation are associated with these procedures.[16,22] Milachowski and

Wirth[26] retrospectively reviewed the results in 81 patients who underwent peroneus brevis reconstruction, ligament advancement, and reconstruction with the use of lyophilized gamma-irradiated allograft dura, which was rolled into a band 10 cm long and 5 mm thick and passed through bone tunnels. Both the dural reconstruction and the ligament advancement procedures reconstructed the lateral ligaments in their correct anatomic positions; the peroneus brevis reconstruction was nonanatomic. The authors found that the procedures had similar success rates in terms of achieving mechanical stability. However, the peroneus brevis reconstruction was associated with restricted supination and the highest incidence of late osteoarthritis of the ankle.

Summary

Late reconstruction for lateral ankle instability is successful in approximately 85% of patients regardless of the type of reconstruction performed. Most patients do not require an augmented reconstruction; shortening of the ATFL and CFL and repair to bone are all that is necessary. Arthroscopic debridement of the tibiotalar joint should be considered at the time of open ligament reconstruction in patients with osteochondral lesions that might be difficult to visualize through a lateral ankle arthrotomy.

In patients with extreme ligamentous laxity or pain posterior to the fibula, a posterior longitudinal incision should be used. Unlike the oblique approach advocated by Broström, this approach allows the surgeon to open the peroneal tendon sheath to inspect the tendons and also to convert to an augmented reconstruction if the ATFL and CFL require reinforcement. The ATFL and CFL are divided just distal to their fibular origins, and the anterolateral joint capsule is opened to allow inspection of the ankle joint and debridement if required. The shortened ATFL and CFL are sutured to the fibula at their anatomic origins through drill holes, and the joint capsule is reefed as it is closed.

Most patients also have increased subtalar laxity. In these individuals, the LTCL and the lateral extensor retinaculum are included in the repair, as described by Gould et al.[20] Patients with severe laxity and weak attenuated tissues are treated in a similar fashion, with the addition of a split peroneus brevis tendon graft or periosteal flaps placed anatomically so as not to excessively restrict subtalar motion. The presence of weak peroneal muscle function, limited eversion strength, varus hindfoot, or excessive subtalar laxity should prompt consideration of an augmented procedure that limits subtalar motion, such as the Chrisman-Snook or Watson-Jones procedure. Calcaneal or distal tibial osteotomy is an option for patients with severe mechanical varus alignment.

Postoperatively, the patient is immobilized with the foot in eversion and the ankle in neutral dorsiplantar flexion for 2 weeks. A removable ankle-foot orthosis is then fitted, and an active exercise program to regain motion and strength is begun. Passive inversion stretching is avoided. Six weeks postoperatively, the patient wears a lace-up–style ankle brace for daily activities. Progressive resistive and proprioceptive exercises are continued for the next 3 months. Cutting and pivoting sports can be resumed at 3 months, and the brace is worn for sports for 6 months. Most athletes must continue to use a brace or tape for sports indefinitely.

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