Chronic Ankle Instability (Medial and Lateral)

Markus Knupp, MD*, Tamara Horn Lang, PhD, Lukas Zwicky, MSc, Patrick Lötscher, MD, Beat Hintermann, MD

KEYWORDS

• Ankle instability • Ankle sprain • Medial ankle ligaments • Lateral ankle ligaments

KEY POINTS

- Up to 40% of patients with ankle sprains develop symptomatic instability.
- Arthroscopy as a diagnostic adjunct allows functional testing and assessment of the instability pattern (distinction of isolated medial/lateral or combined pathologies).
- Treatment of acute medial injuries and the postoperative protocol of the deltoid ligaments should be more restrictive than for the lateral ankle ligaments.
- The aim of surgical treatment is to restore the anatomy. Tenodesis procedures should be avoided.
- In severely altered conditions of the ligaments, tendon grafts can be used to restore joint stability.

INTRODUCTION

Ankle sprains are among the most common injuries, comprising up to one-third of all sport injuries.[1] A recent study, analyzing the ankle sprains presenting to emergency departments in the United States has shown an incidence of 2.15 per 1000 person-years.[2] Independent of the initial treatment strategy and the number of ligaments involved, up to 40% of the patients suffering from lateral ligament injuries end up having chronic ankle instability (CAI).[3]

Factors that may contribute to the development of CAI are functional and/or anatomic deficiencies. Functional deficiencies may be owing to impaired proprioception,[4] muscular imbalance,[5] or an impaired neuromuscular control, such as a delayed muscular reaction of the joint bridging muscles.[6] Suggested predisposing anatomic factors include hindfoot varus,[7] pathologic ligament laxity,[8] and an osseous configuration of the ankle joint, where the talus is less restrained in the ankle mortise.[9]

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Department of Orthopaedic Surgery, Kantonsspital Baselland, Rheinstrasse 26, Liestal CH-4410, Switzerland
* Corresponding author.
E-mail address: markus.knupp@ksbl.ch

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The aim of this article is to summarize the different entities and various therapy approaches in CAI.

DIAGNOSIS OF CHRONIC ANKLE INSTABILITY

History and Clinical Findings

The diagnosis of CAI is based on the patients' medical history and clinical findings. Patients often complain of experiencing insecurity, instability, and "giving way" on uneven ground, leading to limitations in daily activities and difficulties in sports. Recurrent sprains, pain, tenderness, and at times bruising over the lateral or medial aspect or both of the ankle are common symptoms. Approximately 30% of patients suffering from CAI may be asymptomatic between the events, whereas others may present with chronic lateral and/or medial pain, tenderness, swelling, or "giving way."[10] Clinical tests such as the talar tilt test or anterior drawer test are positive in patients with structural ligament insufficiency, whereas these tests may be negative when only functional ankle instability is present.[11]

Imaging

Plain, weight-bearing, anteroposterior and lateral radiographs of the ankle joint are recommended to exclude fractures and malalignment. If a deformity is present, additional radiographs—dorsoplantar and lateral views of the foot and a hindfoot alignment view—are recommended. Particularly in chronic and recurrent instability, the physician must exclude osseous contributing factors such as frontal plane deformity of the hindfoot (varus/valgus) or forefoot-driven hindfoot deformities (such as the plantar flexed first metatarsal in a cavus foot leading to a hindfoot varus). Further imaging such as MRI may exclude osteochondral lesions and concomitant pathologies of the tendons. Particularly in CAI, comorbidities of the peroneal tendons are frequent. These comorbidities can be detected by MRI with a sensitivity of 84% and a specificity of 75%.[12] However, MRI has been shown to be clearly less reliable in detecting ligamentous deficits than arthroscopic assessment.[13]

Intraoperative Diagnostic Measures

Operative treatment is initiated with the completion of diagnosis using intraoperative fluoroscopy and arthroscopy, with the patient under anesthesia. Clinical tests include the talar tilt in the mortise and the anterior drawer test (**Fig. 1**). Stress views may additionally allow assessing syndesmotic stability.

In the United States, nearly one-half of the patients undergo arthroscopic evaluation before ligament reconstruction.[14] Arthroscopy has been found to be helpful to detect intraarticular damage, such as injuries to the syndesmosis, cartilage, and distal tibiofibular joint.[15–19] Therefore, a majority of the authors recommend arthroscopic evaluation to define the extent and origin of instability (medial/lateral) and to exclude intraarticular damage.[15,20,21]

In a large majority of patients, injury to the ligament is observed at the proximal insertion site. Intraoperatively, a bare area of periosteum on the lateral/medial malleolus, around the region of the detached ligament (the insertion site), is characteristically found. Functional arthroscopic testing includes:

- Axial traction to quantify the opening of the tibiotalar space
- Anterior drawer test to assess the medial and anteromedial instability
- Tilt test (valgus stress) to detect laxity or instability of the medial ligaments
- Tilt test (varus stress) to detect laxity or instability of the lateral ligaments

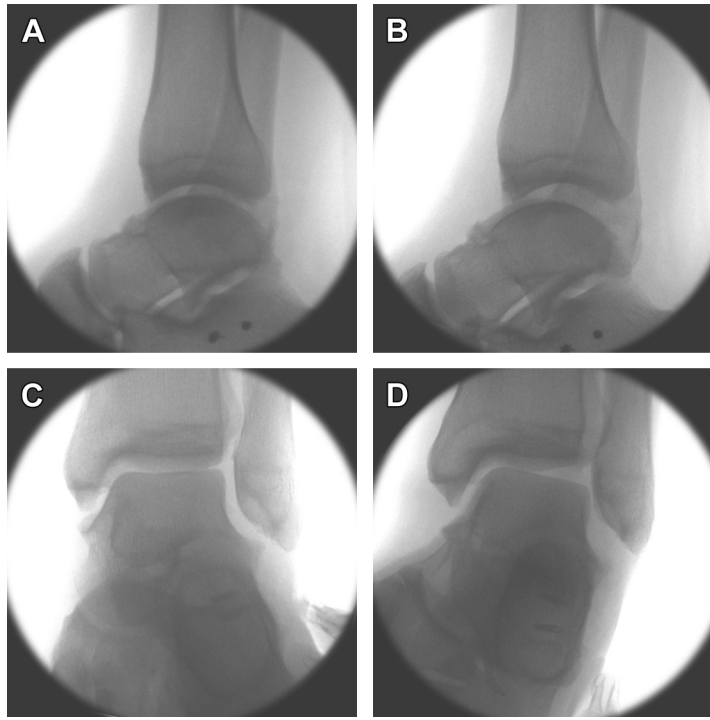

Fig. 1. Intraoperative testing of the drawer test (*A*, *B*) and the talar tilt test (*C*, *D*) in a 34-year-old male patient with combined, recurrent medial instability, 5 years after lateral ligament reconstruction. (*A*, *B*) Positive anterior drawer. (*C*, *D*) Positive talar tilt test. The drawer is positive owing to the injured left anterior talofibular ligament, calcaneofibular ligament, and the superficial deltoid. Valgus tilt is only partially negative owing to the remaining deep deltoid.

Finally, endoscopy of the peroneal and tibialis posterior tendon completes the intraoperative diagnostics.

CHRONIC LATERAL INSTABILITY

Anatomy of the Anterior Talofibular and the Calcaneofibular Ligament

In chronic lateral ankle instability the anterior talofibular ligament (ATFL) and/or the calcaneofibular ligament (CFL) are often altered, leading to joint hypermobility. Depending on the position of the foot, each of these lateral ligaments takes over a stabilizing role of the ankle or subtalar joint. In dorsiflexion, the posterior talofibular ligament is maximally stressed and the CFL is taut, whereas the ATFL is loose. Conversely, in plantarflexion, the ATFL is taut and the CFL and posterior talofibular ligaments are loose.[22]

The ATFL blends with the anterior capsule of the ankle, and spans the anterolateral aspect of the ankle joint (**Fig. 2**). The ligament originates at the anterior edge of the fibula, just lateral to the articular cartilage of the lateral malleolus. The center of attachment lies 10 mm proximal to the tip of the fibula. The insertion on the talus begins directly distal to the articular surface, and the center is 18 mm proximal to the subtalar joint.[23] Precisely owing to the ATFL's insertion and origin, it is the first ligament restricting supination of the foot, and is most frequently injured in ankle sprains.

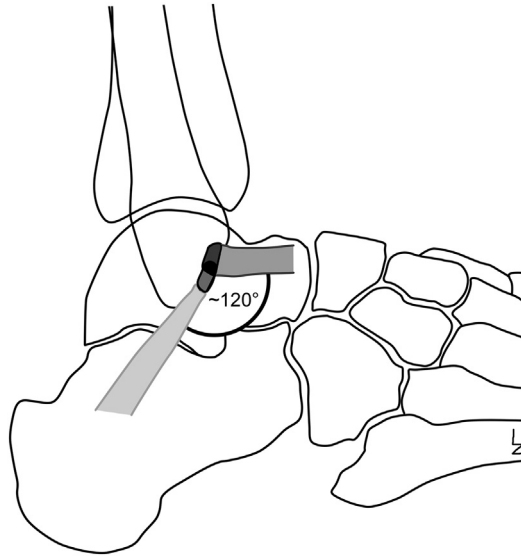

Fig. 2. Anatomy of the right anterior talofibular ligament and the calcaneofibular ligament. The 2 ligaments have overlapping insertion sites at the anterior margin of the distal fibula.

In contrast with popular belief, the CFL does not originate from the apex of the tip of the lateral malleolus (see **Fig. 2**). Its attachment is on the anterior edge of distal fibula, centered 8.5 mm from the distal tip just below the origin of the ATFL. The ligament courses medially, posteriorly, and inferiorly from its fibular origin to the calcaneal insertion. The calcaneal insertion begins 13 mm distal to the subtalar joint with its proximal edge on a line nearly perpendicular to the subtalar joint.[23] The CFL effectively spans the ankle and subtalar joints, which have markedly different axes of rotation.[24–26] Thus, this ligament must be attached so that it does not restrict motion of either joint, whether they move independently or simultaneously. The CFL resists ankle and subtalar joint supination, restricting inversion and internal rotation of the subtalar joint. Strain in the CFL increases with dorsiflexion; when it becomes more vertically orientated, and takes over the role of the lateral collateral ligament of the ankle. Chronic insufficiency of the CFL is combined typically with a pathologic talar tilt test in neutral ankle position.

Operative Treatment

Indications

Patients who fail to become asymptomatic with conservative measures (see also chronic medial instability) are considered for operative treatment. In particular, patients with ongoing instability, recurrent ankle sprains, pain, and limitations in their professional and recreational activities, as well as patients suffering from CAI owing to a nonunited osseous detachment of the lateral ligaments generally benefit from reconstructive surgery. The aims of surgery are to reestablish joint stability and reduce the risk for future ankle sprains, and thereby reduce damage to the cartilage.

Operative stabilization

The operative procedure chosen depends on the extent and the pattern of instability and is usually initiated by diagnostic arthroscopy.

Simple suture technique (Broström) The Broström procedure[10] is the gold standard when anatomic reconstruction of the lateral ankle ligaments is attempted. The goal of anatomic reconstruction is to restore the physiologic anatomy by suturing the ligament itself. If necessary, reconstruction can be reinforced by the extensor retinaculum of the foot[27] or by a periosteal flap of the fibula. Exposure of the lateral ankle ligaments can be achieved through a curved incision from the fibula directed anteriorly or posteriorly. The incision directed posteriorly allows a good exposure of the lateral ligaments; however, it has the disadvantage of not being extendable distally. Therefore, many surgeons prefer the curved incision directed anteriorly toward the base of the fourth metatarsal.

If the preoperative examination of the peroneal tendons resulted in unclear diagnostic findings, it is recommended that the tendons be exposed through the same access to possibly identify and repair existing lesions. Painful accessory ossicles in the area of the lateral ligaments are removed. Unfortunately, this can sometimes lead to considerable soft tissue damage that may greatly complicate ligament reconstruction.[28] Hence, screw fixation of the fragments to the distal fibula should be considered for very large accessory ossicles.

After reconstruction of the ligament, the ATFL and/or the CFL are reattached to the distal fibula using suture anchors or transosseous sutures.[29] If required, the reconstruction can be reinforced using the extensor retinaculum.

Reconstruction with a graft Reinforcement of the lateral ligaments using tendon grafts is done in the absence of sufficient local tissue (or by poor quality/quantity of local tissue) or by revision surgery. When using tendon grafts one distinguishes between anatomic reconstruction and tenodesis (Watson–Jones [1940], Chrisman–Snook [1969],[30] Elmslie [1934][31]). Tenodesis, a nonanatomic reconstruction, leads to nonphysiologic intraarticular pressure peaks, sacrifices a dynamic stabilizer, and causes movement restrictions and should therefore only be used when all other treatment options have failed.[32] When anatomic reconstruction using tendon autograft is aimed for, many surgeons prefer to use the plantaris longus tendon (**Fig. 3**).[33] The tendon is harvested through a separate medial incision and used for reconstruction of the ATFL and the CFL. For this purpose, drill holes are made in the distal fibula, the talar neck, and the lateral wall of the calcaneus; the tendon is weaved subsequently into the lateral aspect of the ankle joint (see **Fig. 3**). Alternatively, the use of the hamstrings[34,35] or bone–tendon–bone grafts[36] have been described in the literature.

Postoperative Treatment

Postoperative treatment is similar to the treatment advised after an acute ankle sprain. **Table 1** provides an overview of the recommendations according to a Cochrane review.[37]

CHRONIC MEDIAL INSTABILITY

Anatomy of the Deltoid Ligament

The deltoid ligament spreads in a fan-shaped manner over the medial part of the ankle joint, and is an important structure with regard to stability against valgus and rotatory forces. It consists of 6 distinct components: 4 superficial and 2 deep ligaments (**Fig. 4**). The superficial ligaments (tibiospring ligament, tibionavicular ligament, superficial posterior tibiotalar ligament, and tibiocalcaneal ligament) cross the ankle and the subtalar joint, whereas the deep components (deep posterior tibiotalar ligament and anterior tibiotalar ligament) only cross the ankle joint.[38] Owing to the broad insertion of the

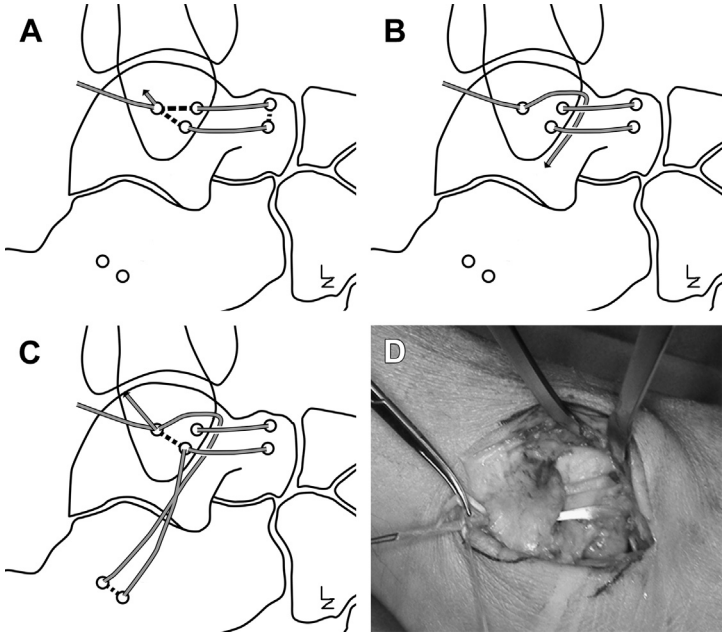

Fig. 3. Anatomic reconstruction of the right anterior talofibular ligament (LFTA) and the calcaneofibular ligament (CFL) using a plantaris tendon graft. (*A*) Reconstruction of the LFTA. (*B*, *C*) Reconstruction of the CFL. (*D*) Intraoperative image of a reconstructed LFTA with a plantaris tendon graft.

superficial deltoid ligament on the spring ligament, this complex also plays an important role in the stabilizing function of the medial ligaments. The superficial layers of the deltoid ligament particularly limit talar abduction, whereas the deep layers limit external rotation. Both deep and superficial layers are equally effective in limiting pronation of the talus.[24]

In contrast with the lateral ligaments, the deltoid ligament is involved significantly in the coupling mechanism between the leg and the foot. This is especially well-illustrated when sectioning the ligaments: sectioning the lateral ligaments does not affect tibial rotation and foot inversion–eversion while sectioning the medial ligaments

Table 1
Treatment after an acute ankle sprain

Weeks	Patient Mobilization	Physiotherapy
1–2	Rest, Ice, Compression and Elevation (RICE) Orthosis Walker	Lymphatic drainage
3–6	Walker Weight bearing as tolerated	ROM max PF/DF 20°/0°/10 No inversion/eversion Proprioceptive training
7–12	Orthosis if needed	Unrestricted ROM, proprioceptive training, coordination training and force

Abbreviations: DF, dorsiflexion; PF, plantarflexion; ROM, range of motion.

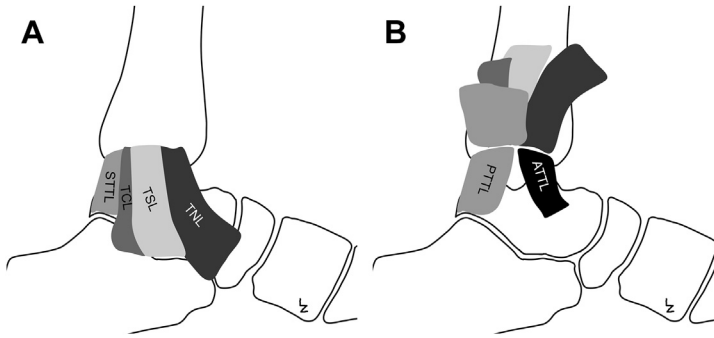

Fig. 4. Medial ligaments. Note that a majority of the ligaments are located posterior to the longitudinal axis of the tibia. (*A*) Shows the superficial part and the superficial posterior tibiotalar ligament of the deltoid and (*B*) Depicts the deep part without the posterior tibiotalar ligament. ATTL, anterior tibiotalar ligament; PTTL, posterior tibiotalar ligament; STTL, superficial posterior tibiotalar ligament; TCL, tibiocalcaneal ligament; TNL, tibionavicular ligament; TSL, tibiospring ligament.

greatly alters the physiologic force transmission pattern of the leg to the foot.[39,40] Therefore, the physiologic gait pattern depends highly on deltoid integrity.

Conservative Treatment

Conservative treatment may include physical therapy, such as muscular strengthening, proprioceptive training, and coordination training. Orthotics with a medial support, bracing, or taping may be used additionally to provide mechanical support and enhance proprioception through skin pressure. If conservative treatment has failed, operative treatment is necessary.

Operative Treatment

A slightly curved incision, 4 to 8 cm in length, is made, starting 1 to 2 cm proximal to the medial malleolar tip and toward the medial aspect of the navicular bone. After the dissection of the fascia, the deltoid ligament and the posterior tibial tendon are exposed. The extent and location of ligament injuries determine the lesion type: (a) injuries at the proximal part of the deltoid (type I lesions), (b) injuries at the intermediate part of the deltoid (type II lesions), and (c) injuries at the distal part of the deltoid and spring ligaments (type III lesions).[41] In type I lesions, the insertion area at the anterior aspect of the medial malleolus is exposed. The insertion area at the anterior border of the medial malleolus is roughened and an anchor is placed 4 to 6 mm above the tip (eg, anterior colliculus) of the medial malleolus. The detached ligament is taken with the suture and the open interval is closed firmly. In type II lesions, the incompetent and typically hypertrophic ligament is divided into 2 flaps. The deep part, which has its origin at the navicular tuberosity, is fixed to the medial malleolus using a bony anchor, as is done when treating a proximal lesion. The superficial part, which has its origin at the medial malleolus, is fixed distally to the superior edge of the navicular tuberosity using another bony anchor. In type III lesions, a bony anchor is used to fix the detached deltoid and spring ligaments to the navicular tuberosity. If the remaining tissue of the spring ligament is of bad quality, the distal part of the posterior tibial tendon is used to augment the ligament reconstruction.[42]

In patients where ankle instability persists and ligament quality is insufficient, direct reconstruction with anchors may not be possible. In these cases, autologous reconstruction using a free tendon graft is the surgical treatment of choice.[43] The graft is

passed through 2 drill holes of 3.2 mm at 2 to 8 mm above the medial malleolar tip and through another dorsoplantar drill hole in the navicular bone. Holding the foot in a neutral position, the graft is fixed with resorbable sutures under slight tension. Attention needs to be paid to reconstruct the tendon in a strict anatomic position and to not overtighten the ligament construct.

Postoperative Treatment

Because the medial ligaments are involved significantly in force transmission from the leg to the foot, the authors tend to be more restrictive in the postoperative rehabilitation. The ankle is usually protected in a weight bearing lower leg cast for 6 weeks. Thereafter physiotherapy is initiated with gradual return to activities. Running is allowed 4 to 6 months after surgery and high-impact sports after 6 to 9 months.

SUMMARY

Up to one-third of the all sport injuries involve a sprained ankle. A large majority of these injuries are successfully treated conservatively. However, up to 40% of these patients report symptoms of CAI, which restrict their daily activities and the ability to return to sports. Once conservative treatment has failed, surgical reconstruction may restore ankle joint stability. Surgery is usually initiated by arthroscopy to assess the instability pattern. The ligaments are reconstructed anatomically and tenodesis procedures should be avoided. If the local soft tissues do not allow direct reconstruction, tendon grafts are used to augment the ligaments. The preferred grafts are the plantaris and the hamstring tendons.

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