Ankle Anatomy for the Arthroscopist. Part II: Role of the Ankle Ligaments in Soft Tissue Impingement

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Injury to the ankle ligaments is one of the leading sports injuries. Lesions affecting the ankle are more frequent in sports such as basketball (45%), handball (25%), and soccer (31%) [1]. Nevertheless, there are relatively few published studies centering on these ligaments compared with other joints such as the cruciate ligaments of the knee.

Together with the joint capsule and the retinacula, the ankle ligaments are important static stabilizers. In the lateral and medial areas of the joint, they are grouped into two large ligamentous complexes under the names lateral collateral ligament (LCL) and medial collateral ligament (MCL) or deltoid ligament.

The most common mechanism of injury to the ankle ligaments is inversion of the foot. This mechanism affects 75% [2] to over 90% [3] of the cases involving the LCL, and particularly one of its elements, the anterior talofibular ligament. Injury to the MCL is much less frequent, accounting for about 15% of all ligamentous lesions [4]. MCL injury rarely occurs alone; it is more often associated with other ligamentous injuries or with fractures. Syndesmotic injuries occur in 1% to 18% [5] of patients who have an ankle sprain and are more common in collision sports.
Following an ankle sprain, 10% to 50% of patients present with some kind of chronic pain. The most frequent cause of chronic pain after an ankle sprain is known as soft tissue impingement syndrome [1], and the primary etiology of this condition is injury to the ligamentous structures. Therefore, an understanding of the anatomy and biomechanics of the ligamentous complexes is essential for diagnosis and adequate treatment of this condition.

To simplify the description of the ankle ligaments, this article is divided into two sections: (1) the ligaments that join the distal epiphyses of the bones of the leg (tibia and fibula): the ligaments of the distal tibiofibular syndesmosis; and (2) the ligaments that join the tibia and fibula to the skeletal structure of the foot: the LCL and MCL.

**Ligaments that join the distal epiphyses of the tibia and fibula**

The distal epiphyses of the tibia and fibula are firmly joined by ligaments that make up a moveable joint system encompassing the talus, thus forming the talocrural joint. The articular surfaces of the tibia and the fibula form a triangular configuration with a proximal base. The surface provided by the fibula and the tibia, called the tibial and fibular notch, respectively, is rough in the proximal region because it is the insertion site for one of the syndesmotic ligaments (the interosseous tibiofibular ligament), which is simply the continuation of the interosseous membrane at this level. Distal to the insertion site of this ligament, the remaining anterior surface corresponds to the tibiofibular synovial recess of the ankle joint, and at the posterior surface, there is a small bundle of adipose tissue called the fatty synovial fringe (Fig. 1). The synovial fringe lowers or rises during ankle movements, retracting in dorsiflexion to rise and to position itself between the tibia and fibula and descending in plantar flexion toward the ankle joint [6]. This structure has been implicated as a cause of chronic pain following ankle sprain in the condition known as anterolateral soft tissue impingement [7] or, more specifically, syndesmotic impingement [8,9].

As can be deduced from the previous description, the distal tibiofibular joint has no articular cartilage. It is a syndesmotic articulation that allows the tibia/fibula as a whole to adapt to the varying width of the upper articular surface of the talus by slight ascending and medial rotation movements of the fibula during extreme dorsiflexion (maximum width) and by inverse movements during plantar flexion (minimum width) [10].

Three ligaments join the distal tibial and fibular epiphyses: the anterior or anteroinferior tibiofibular ligament, the posterior or posteroinferior tibiofibular ligament, and the interosseous tibiofibular ligament. The inferior segment of the interosseous membrane also helps stabilize the tibiofibular syndesmosis.

Most anatomy books provide only a brief description of these ligaments. The related clinical studies also fail to describe them in detail, with the investigators mainly citing information found in other articles or anatomy books. There are also problems related to the terms used for the ligaments. For example, the
official book of anatomic terminology [11] omits the interosseous tibiofibular ligament, as do many of the anatomy books the authors consulted. A similar problem is seen with the terms used for the other two syndesmotic ligaments that stabilize the proximal epiphyses of the tibia and fibula: the anterior and posterior tibiofibular ligaments [12], and the posterior tibiofibular ligament has been given a variety of names (see the Posterior or Posteroinferior Tibiofibular Ligament section).

**Anterior or anteroinferior tibiofibular ligament**

The anterior tibiofibular ligament is the weakest of all the syndesmotic ligaments, and the first to yield when the fibula is turned outward over its longitudinal axis [13]. The ligament originates in the anterior margin of the lateral malleolus and its fibers extend in a proximal and medial direction to the insertion site in the anterior tubercle of the tibia, with increases in the length of the fibers distally. On examination, the ligament is seen to be divided into several fascicles, which gives it a multifascicular morphology (Fig. 2). This multifascicular appearance is probably due to its relationship with the perforating branch of the peroneal artery, which runs along the surface of the ligament and provides small
vessels that penetrate through the interfascicular spaces. The most distal fibers of the ligament at its origin may be confused with those of the anterior talofibular ligament [14–16].

On careful inspection, the most distal fascicle of the anterior tibiofibular ligament appears to be independent from the rest of the structure. It is separated by a septum of fibroadipose tissue and may be slightly deeper than the rest of the ligament. In its oblique course toward insertion in the tibia, the fascicle covers the angle formed by the tibia and fibula and comes into contact with the dorsolateral border of the talus during flexion of the ankle (see Fig. 2; Fig. 3). Knowledge of this configuration is important to understand the anatomic bases for anterolateral soft tissue impingement [16] because abrasion between the distal fascicle of the anterior tibiofibular ligament and the talus may lead to pain.

This relative independence of the distal fascicle from the anterior tibiofibular ligament led investigators such as Nikolopoulos [17] to give it a separate name: the accessory anteroinferior tibiofibular ligament. This term was refuted years later by Bassett and colleagues [15] following an anatomic study of 11 cadaver ankles, which led to its designation as distal fascicle of the anteroinferior tibiofibular ligament. Bassett and colleagues [15] measured the dimensions and the degrees of dorsiflexion needed for the distal fascicle to come into contact with the talus (mean, 12°) and observed that the fascicle has an intracapsular and extrasynovial location, thereby explaining why it can be seen by arthroscopy. These researchers also published a series of seven case studies in which resection of the distal fascicle of the anterior tibiofibular ligament satisfactorily resolved the symptoms of patients who had chronic ankle pain and a history of inversion.

Fig. 2. Anatomic view of the anterior ligaments of the ankle. 1, lateral malleolus; 2, tibia; 3, talus; 4, anterior tibiofibular ligament; 4’, distal fascicle of the anterior tibiofibular ligament; 5, anterior talofibular ligament; 6, calcaneofibular ligament; 7, superficial and deep layers of the MCL; 8, head of the talus.
sprains of the ankle. Thickening of the ligament was seen in all cases; five patients additionally showed abrasion of the joint cartilage in the region where the ligament came into contact with the talus. Bassett and colleagues [15] were the first to mention ligamentous etiology as the cause of impingement in the English literature. Resection of the distal fascicle as a therapeutic approach, whether by open surgery or arthroscopy, does not produce noticeable changes in the stability of the ankle [15,17–19] and may lead to clinical improvement.

Impingement of the distal fascicle of the anterior tibiofibular ligament seems to depend on changes in the ankle mechanics [15]. An injury to the LCL (eg, anterior talofibular ligament) increases anteroposterior laxity of the ankle [20], which in turn results in increased anterior extrusion of the talus and causes the distal fascicle to have greater contact and pressure on the talus [15]. Another factor related to distal fascicle impingement is the level at which the anterior tibiofibular ligament is inserted in the fibula with respect to the joint line. More distal insertion of the ligament could lead to increased contact in the neutral position of the ankle and a higher potential for ligamentous pathology [21]. Subsequent to Bassett and colleagues’ studies, the distal fascicle has been the subject of numerous publications that have provided further definition of the anatomy of this structure and correlations with impingement [12,16,21,22].

Fig. 3. Anatomic–arthroscopic correlation showing contact between the talus and the distal fascicle of the anterior tibiofibular ligament. The most distal fascicle of the anterior tibiofibular ligament appears to be independent from the rest of the structure and comes into contact with the dorsolateral border of the talus. 1, lateral malleolus; 2, tibia; 3, talus (beveled triangular region); 3’, dorsal articular surface of the talus; 3”, lateral or malleolar articular surface of the talus; 4, anterior tibiofibular ligament; 4’, distal fascicle of the anterior tibiofibular ligament; 5, anterior talofibular ligament.
Ray and Kriz [22] defined anterior tibiofibular ligament variations and the relationships between this ligament and the talus, which were classified into five types (I–V). The incidence of distal fascicle was 21.7%. According to these investigators, the presence of a separate fascicle is not a requirement for impingement; however, a beveled triangular region in the anterior superolateral border of the talus is common. Akseki and colleagues [21] noted that the cartilage is usually of poorer quality in this area when there is impingement and reported that the incidence of a distal fascicle was approximately 91%. Nikolopoulos [18] observed the presence of a distal fascicle in 82.9% to 91.6% of the cases and continued to call it an accessory ligament. The differences in the reported incidence of this structure could be due considerations related to the strict definition of a separate fascicle.

The authors’ observations in the dissection room have allowed them to identify contact between the distal fascicle and the talus in the neutral position. This finding is frequently observed during ankle arthroscopy, and surgeons should consider it a normal feature [21]. This fact has been reported by other investigators [16,18,22–24], although in cases of anatomic variation or ankle instability, the feature may be pathologic (Fig. 4). Contact decreases with joint

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**Fig. 4.** Anatomic dissection (osteoarticular layer) showing the areas of contact between the talus and the distal fascicle of the anterior tibiofibular ligament, depending on the position of the ankle. (A) Ankle at 90°. 1, lateral malleolus (tip); 2, tibia; 3, dorsal articular surface of the talus; 4, lateral or malleolar articular surface of the talus; 5, neck of the talus; 6, calcaneus; 7, talocrural joint; 8, posterior subtalar joint; 9, anterior tibiofibular ligament; 9\(^9\), distal fascicle of the anterior tibiofibular ligament; 10, anterior talofibular ligament; 11, calcaneofibular ligament; 12, lateral talocalcaneal ligament; 13, tarsal sinus; 14, talocalcaneal interosseous ligament; 15, cervical ligament. (B) Ankle in dorsal flexion.
distraction [21], and this should be taken into account during arthroscopy. Akseki and colleagues [21] observed that section of the anterior talofibular ligament does not alter the contact when the ankle is in neutral position, although important changes are observed when the ankle is in movement, corroborating the theory proposed by Bassett and colleagues [15]. Therefore, ankle instability is one direct factor in anterior tibiofibular ligament pathology.

A diagnosis of this type of ligamentous impingement should be considered in patients who have chronic pain in the anterolateral area of the ankle following a sprain, joint stability, and a normal radiologic study [25]. Kim and Ha [26] considered that isolated impingement by this entity is uncommon, the condition usually being associated with hypertrophic scar tissue of the anterior talofibular ligament.

Posterior or posteroinferior tibiofibular ligament

According to the classic descriptions, the posterior or posteroinferior tibiofibular ligament is formed by two components, one superficial and the other deep [14], although this subdivision is not accepted by all investigators. Based on its position, Nikolopoulos [18] compared this ligament to the anterior tibiofibular ligament and its distal fascicle. The terminology used for this ligament and its components is controversial [12], which is particularly evident in the arthroscopic literature [27].

Superficial component

The superficial component originates at the posterior edge of the lateral malleolus and runs proximally and medially toward the tibia where it inserts in the posterior tubercle. This component would be homologous to the anterior tibiofibular ligament. The term posterior or posteroinferior tibiofibular ligament is usually used to refer to the superficial component.

Deep component

Sarrafian [14] coined the term transverse ligament to refer to the deep component. This structure is cone-shaped, turning on its fibers during its course. It originates in the proximal area of the malleolar fossa and runs toward the tibia, with insertion at the posterior edge of the tibia, immediately posterior to the cartilaginous covering of the inferior tibial articular surface; the fibers may reach the medial malleolus. The transverse ligament extends beyond the osseous margin in the distal direction and comprises a true labrum [14], which is dependent on the inferior articular surface of the tibia. By increasing the size and concavity of the tibial joint surface, the labrum provides talocrural joint stability and prevents posterior talar translation (Fig. 5) [28].

Because of its location and the limited joint surface provided by the lateral malleolus, the transverse ligament comes into contact with the talus. The inden-
The transection of this ligament in the talus results in a triangular surface with a posterior base at the lateral edge of the talar body in its posterior half [14].

On arthroscopic examination through anterior portals, many investigators report that the posterior tibiofibular ligament (superficial component) is readily visualized, but there is some controversy regarding the transverse ligament (deep component). The author and colleagues [27] have shown that only the deep component is visible arthroscopically and that the superficial component cannot be seen, thus helping to clarify previous descriptions of this ligament that may be confusing (Fig. 6).

**Interosseous tibiofibular ligament**

The interosseous tibiofibular ligament is a dense mass of short fibers that, together with adipose tissue and small branching vessels from the peroneal artery,
span the tibia to the fibula. It can be considered a distal continuation of the interosseous membrane at the level of the tibiofibular syndesmosis [6,14].

Ligaments that join the leg bones to the skeletal structure of the foot

The ligaments that join the tibia and fibula to the skeletal structure of the foot have been grouped into two main ligamentous complexes, the LCL and the MCL.

Lateral collateral ligaments

Located on the lateral part of the joint, the LCL comprises three fascicles or ligaments, entirely independent of one another: the anterior talofibular, the calcaneofibular, and the posterior talofibular ligaments.

Anterior talofibular ligament

The anterior talofibular ligament is the most frequently injured ligament of the ankle. This flat, quadrilateral ligament is in close contact with the capsule and is typically composed of two bands separated by an interval that allows pene-
tration of the vascular branches from the perforating peroneal artery and its anastomosis with the lateral malleolar artery; the upper band is larger than the lower one. Occasionally there are three bands [14], although the authors have never observed this morphology in their dissections. Milner and Soames [29] found that the ligament had a single band in 38% of cases, two bands in 50% of cases, and three bands in 12%, in contrast with Sarrafian’s [14] observations. Nevertheless, it is notable that subsequent anatomic studies [30,31] to determine the anatomy and dimensions of the parts of the LCL do not stress this aspect. In a study using MRI to investigate 22 patients who had no history of ankle sprains, Delfaut and colleagues [32] found that the anterior talofibular ligament had a single band in 9% of cases, two bands in 55%, and a striated appearance in 36%. The authors’ dissections have shown that this ligament most commonly has a double-band morphology, as described by Sarrafian [14]. The upper band reaches the origin of the anterior tibiofibular ligament, and the inferior band reaches the origin of the calcaneofibular ligament. In many specimens, these latter ligaments (talofibular and calcaneofibular ligament) are joined by arciform fibers at the malleolar origin (Fig. 7) [14].

In its entirety, the anterior talofibular ligament originates at the anterior margin of the lateral malleolus. From its origin, it runs anteromedially to the insertion

![Fig. 7. Osteoarticular anatomic dissection of the ligaments of the foot and ankle joint. 1, lateral malleolus (tip); 2, tibia; 3, dorsal articular surface of the talus; 4, lateral or malleolar articular surface of the talus; 5, neck of the talus; 6, head of the talus; 7, calcaneus; 8, navicular; 9, cuboid; 10, lateral cuneiform; 11, talocrural joint; 12, posterior subtalar joint; 13, talonavicular joint; 14, calcaneocuboid joint; 15, tarsal sinus; 16, anterior tibiofibular ligament; 16’, distal fascicle of the anterior tibiofibular ligament; 17, anterior talofibular ligament; 18, calcaneofibular ligament; 19, talocalcaneal interosseous ligament; 20, cervical ligament; 21, talonavicular ligament; 22, lateral calcaneocuboid ligament; 23, dorsal cuneonavicular ligament; 24, bifurcate ligament; 25, peroneal tuberele.](image-url)
points at the talus body immediately anterior to the joint surface occupied by the lateral malleolus and consists of two small tubercles visible in osseous anatomic preparations and corresponding to the insertion sites of each of the bands. The ligament is virtually horizontal to the ankle in the neutral position but inclines upward in dorsiflexion and downward in plantar flexion.

Ferkel and colleagues [33,34] cited this ligament as another cause of anterolateral soft tissue impingement, indicating that although an injury to this ligament may not be severe enough to cause chronic instability, inadequate treatment could lead to an inflammatory process in the area of the injury, followed by synovitis and the formation of prominent scar tissue. This mass of tissue would occupy the lateral recess of the joint, possibly causing pain and irritation that would lead to the development of additional inflammatory tissue and eventually to chronic pain [33,34]. Chronic progression of this inflammatory tissue, together with remnant scar tissue, would produce the so-called “meniscoid tissue” described by Wolin and colleagues [35].

**Calcaneofibular ligament**

The calcaneofibular ligament is a thick, cordlike ligament that originates at the anterior edge of the lateral malleolus, right below the origin of the lower band of the anterior talofibular ligament, to which it can be joined by arciform fibers. It is important to note that the origin of this ligament does not reach the tip of the malleolus, which remains free from ligamentous insertions, as is observed during ankle arthroscopy. In the neutral position, the ligament courses backward, downward, and medially, and inserts in a small tubercle in the posterior region of the lateral calcaneus, posterior to the peroneal tubercle (see Fig. 7).

This ligament is superficially crossed by the peroneal tendons and sheaths, which can leave a concavity over the ligament; only about 1 cm of the ligament is uncovered [14]. In addition, the calcaneofibular ligament is separated from the subtalar (talocalcaneal) joint by the lateral talocalcaneal ligament, and is further separated from this ligament by adipose tissue. The anatomic variants of the calcaneofibular ligament and their relationship with the lateral talocalcaneal ligament have been the subject of study [36].

The calcaneofibular ligament controls two joints—the talocrural joint and the subtalar joint—unlike the other two elements making up the LCL, which only affect the talocrural. Little attention has been given to this ligament compared with the other ligaments of the LCL, although variants in the orientation of the structure have been studied by Ruth [37]. The calcaneofibular ligament becomes horizontal during extension and vertical in flexion, remaining tense throughout its entire arc of motion. A valgus or varus position of the talus considerably changes the angle formed by the ligament and the longitudinal axis of the fibula. The ligament is relaxed in the valgus position and tense in the varus position, which explains the potential for injury even without dorsiflexion/plantar flexion movement in the ankle.

According to Ferkel and colleagues [34], in cases in which injury to the anterior talofibular ligament is associated with injury to the calcaneofibular
ligament, the latter also contributes to the development of anterolateral soft tissue impingement.

**Posterior talofibular ligament**

The posterior talofibular ligament is a strong, thick, fascicled, trapezoidal ligament in an intracapsular extrasynovial location, found in an almost horizontal plane. It originates on the medial surface of the lateral malleolus in the malleolar fossa and courses toward the posterolateral talus. The fibers of the ligament are inserted along the lateral aspect of the talus on a rough, grooved surface situated along the posteroinferior border of the talar lateral malleolar surface. Other fibers are inserted in the posterior surface of the talus and may reach the lateral talar tubercle, trigonal process, or os trigonum by expansion. Furthermore, the fibers can contribute to forming the tunnel of the flexor hallucis longus tendon. In the posterior view, the overall structure is triangular, with the vertex located laterally and the base situated medially (Fig. 8).

Another group of fibers originates at the upper edge of the ligament near its origin and courses in an upward, medial direction to the insertion site at the posterior edge of the tibia. These fibers fuse with the deep component of the posterior tibiofibular ligament (transverse ligament), reaching the posterior surface of the medial malleolus and helping to form the existing labrum in the posterior margin of the tibia. This group of fibers has been given several names

![Fig. 8. Macrophotography of anatomic dissection of the posterior ligaments of the ankle. 1, lateral malleolus; 2, tibia; 3, talus (lateral talar process); 4, posterior tibiofibular ligament, superficial component; 5, transverse ligament or deep component of the posterior tibiofibular ligament; 6, posterior talofibular ligament; 7, posterior intermalleolar ligament (bundles indicated with arrows); 8, calcaneofibular ligament; 9, calcaneus; 10, tunnel for flexor hallucis longus tendon.](image)
(capsular reinforcement bundle [38] or ascending or tibial bundle of the posterior talofibular ligament [6]), although the authors prefer the one proposed by Paturet [39]: posterior intermalleolar ligament. This ligament has been designated the “tibial slip” by Chen [40] and others [41] in several articles on arthroscopy (see Fig. 8; Fig. 9). The ligament is in close proximity to a synovial fold that runs transversally in a posterior recess of the ankle joint (Figs. 10 and 11) [40].

The posterior intermalleolar ligament has been the subject of recent studies because of its involvement in the posterior soft tissue impingement syndrome of the ankle [42,43]. Rosenberg and colleagues [44] observed this ligament in 56% of the dissections they performed and in 19% of patients in an MRI study, attributing the difference in frequency to the limited spatial resolution of MRI. In an MRI study of 23 classical ballet dancers who had symptoms of posterior

Fig. 9. Posterior view of anatomic dissection of the ankle ligaments. Posterior intermalleolar ligament and bundles indicated with arrows. 1, fibula; 2, tibia; 3, lateral talar process; 4, dorsal surface of the calcaneus; 5, posterior talofibular ligament; 6, superficial component of the posterior tibiofibular ligament; 7, transverse ligament or deep component of the posterior tibiofibular ligament; 8, flexor hallucis longus tendon with its retinaculum; 9, flexor digitorum longus tendon; 10, tibialis posterior tendon; 11, medial talar process; 12, calcaneofibular ligament; 13, peroneus brevis tendon; 14, peroneus longus tendon; 15, subtalar joint; 16, calcaneal tendon (cut at the level of insertion).
Fig. 10. Sagittal section of the ankle joint. Photomacrograph shows the relationship between the posterior intermalleolar ligament and the synovial fold. 1, tibia; 2, talus; 3, flexor hallucis longus tendon; 4, talocrural joint; 5, articular capsule (posterior recess); 6, posterior intermalleolar ligament; 7, synovial fold.

Fig. 11. Arthroscopic image of the posterior ligaments of the ankle through the anterior portal showing the constant relationship between the posterior intermalleolar ligament and the synovial fold. 1, plantar articular surface of the tibia; 2, dorsal articular surface of the talus; 3, synovial fringe; 4, transverse ligament or deep component of the posterior tibiofibular ligament; 5, posterior intermalleolar ligament; 6, synovial fold; 7, posterior articular capsule. (Courtesy of Prof. Pier Paolo Mariani, Department of Sports Traumatology, IUSM, University of Motor Sciences, Rome, Italy.)
ankle impingement syndrome, Peace and colleagues [45] detected the posterior intermalleolar ligament in 48% of the cases, a higher incidence than was found by Rosenberg and colleagues [44]. Peace and colleagues [45] ascribed the difference to the possibility that among these patients, the ligament would be more obvious on MRI because of scar thickening and inflammation resulting from repeated trauma. In their anatomic study, Milner and Soames [31] reported the presence of the posterior intermalleolar ligament in 72% of the specimens. Golanó and colleagues [27] identified this ligament in all of their dissections and in the arthroscopic study they performed. In the authors’ opinion, the difference in frequency is probably due to the small size of the posterior intermalleolar ligament (mean, 2.3 mm; range, 1–5 mm) and the fact that it is difficult to dissect. In addition, the ligament may be divided into 2 or 3 different bands (20%) [44], of which none might not achieve bony insertion and become inserted in the joint capsule of the ankle (Fig. 9). After examination by arthroscopy, the division of this structure into bands should not be confused with an injury (Fig. 12).

In the posterior view, the posterior intermalleolar ligament is situated between the transverse ligament and the posterior talofibular ligament and runs obliquely from lateral to medial and from downward to upward (see Figs. 8 and 9). The posterior intermalleolar tenses during dorsiflexion and relaxes during plantar flexion [27]; therefore, trauma that causes forced dorsiflexion of the ankle can be assumed to produce injury to or rupture of this ligament or osteochondral avulsion [46]. Plantar flexion would cause it to relax and become susceptible to trapping between the tibia and the talus, leading to impingement. The possibility of impingement is accentuated by the presence of predisposing factors such as a trigonal process (Stieda process), an os trigonum, or a prominent dorsal process of the os calcis. The clinical relevance of the posterior intermalleolar ligament is manifested in the improvement of symptoms observed among patients treated with debridement of this ligament (Fig. 13) [27,42–44,47,48].

![Fig. 12. (A–C) Arthroscopic images of the posterior ligaments of the ankle through the anteromedial portal showing the fascicles of the posterior intermalleolar ligament from lateral (A) to medial (C). 1, plantar articular surface of the tibia; 2, dorsal articular surface of the talus; 3, synovial fringe; 4, posterior tibiofibular ligament (deep component or transverse ligament); 5, posterior intermalleolar ligament; 6, gap between 4 and 5: intra-articular landmark to establish the posterolateral portal. (Courtesy of Dr. Raúl Puig-Adell, Barcelona, Spain.)](image-url)
Van Dijk’s [49] pioneer work on endoscopic portals has allowed observation of the posterior ligaments in ankle joint injuries. Palpation of these ligaments and neighboring structures has made it possible to identify and treat related pathology in the hindfoot. The use of these portals to treat posterior soft tissue impingement involving injury to the posterior intermalleolar ligament was recently described by Lohrer and Arentz [48].

Medial collateral ligament

The MCL is a strong, broad ligament with a multifascicular appearance that fans out from the medial malleolus toward the navicular, talus, and calcaneus. Because the origins and insertions of the various fascicles or components of the
MCL are contiguous and poorly defined, the anatomic descriptions show several interpretations, with artificial division being common. Most investigators appear to agree that the MCL has two layers: one superficial and one deep \[14,50–52\]. The ligaments that compose the superficial layer cross over two articulations (the ankle and the subtalar joints), whereas those composing the deep layer only cross the ankle joint \[51\]. Nevertheless, this differentiation is not entirely clear (Fig. 14) \[50,53\].

A review of the morphology of the medial malleolus is helpful to understand the origins of the MCL. In the medial view of the malleolus, two areas or segments (colliculi) can be seen, separated by the intercollicular groove, which is about 0.5 to 1 cm in length. The anterior segment or anterior colliculus is about 0.5 cm lower than the posterior segment or posterior colliculus \[14\]. The authors use this nomenclature because the international anatomic terminology \[11\] does not discuss these anatomic details and because it is used by most investigators in their anatomic descriptions.

The most commonly accepted description of the MCL is the one proposed by Milner and Soames \[51\] and later corroborated by Boss and Hintermann \[50\]. Six bands or components have been described for the MCL: three are always present (tibiospring ligament, tibionavicular ligament, and deep posterior

![Fig. 14](image-url). (A) Medial view of the ankle joint ligaments showing their typical fanlike morphology. (B) Frontal section of the ankle joint where the superficial and deep layers of the MCL are separated by a small mass of fatty tissue. 1, tibia; 1', medial malleolus; 2, talus; 2', medial talar process; 3, calcaneus; 3', sustentaculum tali; 4, navicular tuberosity; 5, superficial layer of the MCL; 6, deep layer of the MCL; 7, tibialis posterior tendon; 8, flexor digitorum longus tendon; 9, flexor hallucis longus tendon; 10, peroneus brevis tendon; 11, peroneus longus tendon.
tibiotalar ligament), whereas the presence of the other three may vary (superficial posterior tibiotalar ligament, tibiocalcaneal ligament, and deep anterior tibiotalar ligament) (Table 1).

Most of the MCL is covered by tendons as it extends down the leg to the bony insertions in the foot. The anterior region, in continuation with the joint capsule, is covered by the tendon of the posterior tibial muscle, and the middle and posterior area is covered by the tendons of the posterior tibial and long flexor muscles of the toes. The floor of the fibrosynovial sheaths covering these tendons is frequently composed of fibrocartilaginous tissue that is firmly adhered to the MCL. Precise dissection is needed to separate the fibrous sheath from the MCL. In the posterior region, the MCL continues with the posterior capsule of the ankle joint.

Although the description proposed by Milner and Soames [51] has been accepted, the anatomy of this ligament and its elements are still confusing. This confusion is partly because differentiation between the components during dissection is difficult and probably artificial because its origins and insertions are complex and because the nomenclature used still has not been reviewed and accepted by the Federative Committee on Anatomical Terminology [11]. Moreover, the images, sketches, and diagrams shown in the literature are imprecise [50].

Although injury to the MCL is far less common than LCL injury, it too can cause an impingement syndrome. According to the location of the fibrous tissue mass at the level of the medial recess and relative to the medial malleolus, the condition is differentiated into anteromedial soft tissue impingement, as described by Egol and Parisien [54], or posteromedial soft tissue impingement, as described by Liu and Mirzayan [55]. In any case, injury to the deep MCL is implicated in this kind of impingement. Anteromedial soft tissue impingement involves the anterior tibiotalar fascicle [56], whereas in posteromedial soft tissue impingement, the posterior tibiotalar ligament appears to be affected [57].

The mechanism of injury to this ligamentous complex is controversial: some investigators report that the most frequent mechanism is inversion [56,58], whereas others consider that eversion could also be a cause [55,59].

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<th>MCL Components</th>
<th>Milner and Soames [31]</th>
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<td><strong>Superficial layer</strong></td>
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<td>Tibionavicular ligament (major component)</td>
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<td>Tibionavicular fascicle and anterior superficial tibiotalar fascicle</td>
</tr>
<tr>
<td>Superficial tibiotalar ligament (additional band)</td>
<td></td>
<td>Superficial posterior tibiotalar ligament</td>
</tr>
<tr>
<td>Tibiocalcaneal ligament (additional band)</td>
<td></td>
<td>Tibiocalcaneal ligament</td>
</tr>
<tr>
<td><strong>Deep layer</strong></td>
<td></td>
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<tr>
<td>Deep posterior tibiotalar ligament (major component)</td>
<td></td>
<td>Deep posterior tibiotalar ligament</td>
</tr>
<tr>
<td>Anterior deep tibiotalar ligament (additional band)</td>
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<td>Deep anterior tibiotalar ligament</td>
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</tbody>
</table>
Summary

Following an ankle sprain, 10% to 50% of patients suffer some kind of chronic pain, usually caused by soft tissue impingement syndrome. Adequate knowledge of the anatomy of the ankle ligaments and the potential mechanisms for injury is key to understanding the role of these ligaments in the etiopathogenesis of soft tissue impingement syndrome.

Impingement syndromes of the ankle are usually caused by a sprain of some importance that has been treated improperly or inadequately because the patient wants to return to sports activity as soon as possible. The initial mechanism of injury determines the type of lesion sustained by the capsular and ligamentous structures, which can potentially progress to soft tissue impingement.

The mechanism of foot inversion is present in most ankle injuries and is the potential cause of impingement in any area. An inversion sprain can result in injury to the capsule, the LCL, the MCL, or the tibiofibular ligaments. The added influence of plantar flexion or dorsiflexion on the injury mechanism means that the lesion is predominantly anterior or posterior, respectively, and could lead to injury to other structures such as the posterior intermalleolar ligament, the osteochondral region of the neck of the talus, or the anteroinferior margin of the tibia.

The mechanism of foot eversion is more closely associated with injury to the medial capsular and ligamentous elements, although this is not the rule because an inversion sprain can also produce a lesion to these structures. Therefore, medial injury is probably more influenced by the rotating component of the subtalar joint to which the capsule and the MCL are subject.

Soft tissue impingement should be suspected in any case of chronic ankle pain secondary to a sprain. Although most sprains are usually due to inversion and lead to injury of lateral structures, the possibility of lesion to other regions should be considered.

Injury to the ligamentous and capsular structures induces the formation of scar and inflammatory tissue, leading to impingement. Surgical resection of this pathologic soft tissue has proved to be effective from subjective and objective viewpoints.

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References


