Anterior Ankle Impingement Syndromes

Hilary R. Umans, M.D.[1,2] and Luiz Cerezal, M.D.[3]

ABSTRACT

Ankle impingement syndromes are painful conditions that may complicate ankle trauma and are characterized by chronic, progressive pain, swelling, and limitation of movement. These disorders are subclassified according to anatomical location about the tibiotalar joint. This article reviews the various forms of anterior ankle impingement, detailing the unique clinical features, anatomical considerations, pathoetiology, and imaging findings for each.

KEYWORDS: Anterior ankle impingement, anterolateral ankle impingement, anteromedial ankle impingement, MR arthrography, MRI

ANTERIOR ANKLE IMPINGEMENT SYNDROMES

Ankle impingement syndromes are chronic, painful conditions due to friction of joint tissues, precipitated and exacerbated by altered ankle joint biomechanics.[1] All forms of ankle impingement are considered to be a clinical diagnosis of exclusion, with symptoms that mimic a variety of many more common disorders, including osteochondral fracture, mechanical instability, peroneal tendon rupture, subluxation or tenosynovitis, and sinus tarsi syndrome. There is a misperception that imaging offers little advantage over history and physical examination in establishing the proper diagnosis of ankle impingement.[2] This misperception is reinforced by the fact that most radiologists are unfamiliar with the clinical entity and imaging findings. As a result, the radiologist's role in diagnosis of ankle impingement has been limited. Through understanding the relevant anatomy, clinical symptoms and pathogenesis of these chronic, painful syndromes, the radiologist should be able play a more active role in guiding optimal imaging to establish a timely diagnosis, and permit prompt, appropriate treatment of ankle impingement.

Anterior ankle impingement syndromes include three forms. These are, in descending order of frequency, anterior impingement, anterolateral impingement, and anteromedial impingement.

ANTERIOR ANKLE IMPINGEMENT

Osseous impingement due to the formation of anterior tibiotalar spurs is a common cause of chronic ankle pain among athletes. In one series, up to 60% of professional soccer players were found to have anterior tibiotalar osteophytes. Morris originally described this condition and coined the term "athlete's ankle" in 1943.[3] Renamed "footballer's ankle" by McMurray in 1950,[4] this condition is currently termed anteromedial ankle impingement. Less commonly, anterior impingement may occur in ballet dancers, due to repetitive exaggerated ankle dorsiflexion in the plié or demi-plié position.[5]

Clinical Symptoms and Physical Findings

Affected individuals present with pain, stiffness, swelling, and limitation of ankle dorsiflexion.[5,6] Symptoms are exacerbated by athletic activity. Anterior ankle and

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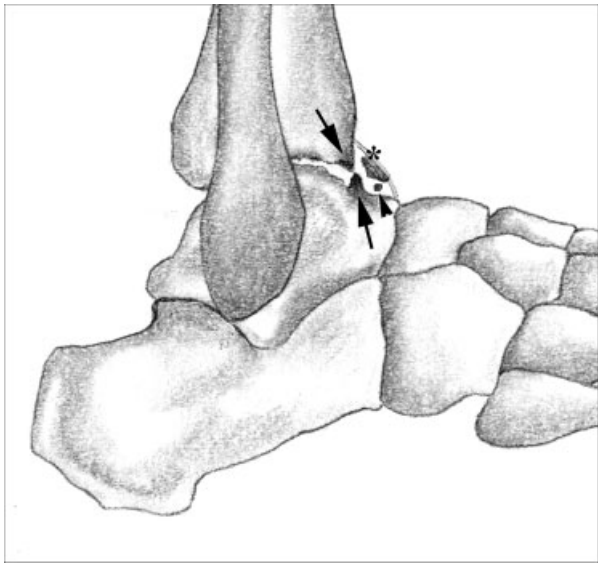

Figure 1 Diagrammatic representation of anterior impingement syndrome in the lateral projection illustrates characteristic findings of anterior ankle impingement including chondral fraying, anterior tibial and talar osteophytes (arrows), synovitis in anterior capsular recess (asterisk), modest reduction of joint space, and osteochondral loose bodies (arrowhead). Reprinted with permission from Cerezal et al.[1]

midfoot pain may radiate to the lateral malleolus. Pain is often more diffuse initially, localizing to the anterior ankle joint over time. On physical examination, there may be a palpable exostosis at the talar neck. Pain is exacerbated on dorsiflexion and relieved with plantarflexion of the ankle joint.

Anatomy

This relatively common form of ankle impingement is characterized by the formation of beak-like bone spurs located at the anterior rim of the tibial plafond and the apposed articular margin of the anterior talus (Fig. 1), proximal to the talar neck, well within the joint capsule.[1] These spurs, which are closely approximated in ankle dorsiflexion, can mechanically limit range of motion and may entrap and inflame intervening soft tissues.

Pathophysiology

Two mechanisms of injury are proposed for the etiology of anterior impingement spurs. The first suggests that repetitive hyperplantarflexion of the foot produces strain at the anterior capsular attachments, inducing the formation of traction osteophytes. In a biomechanical study of ball-kicking action on the formation of anterior impingement spurs, Tol et al determined that ball-to-foot impact induces excessive plantar flexion and anterior capsular strain in 39% of cases under experimental conditions.[6] Nevertheless, the hyperplantarflexion mechanism has been largely discredited because the majority of spurs found at arthroscopy are situated in an intra-articular location at the anterior tibiotalar articular margin, ~5 to 8 mm distant to the capsular attachments.[7]

It is now commonly accepted that anterior impingement occurs due to repeated stress in ankle dorsiflexion. Repetitive impaction at the anterior cartilaginous rim along the non-weightbearing margin of the ankle joint likely results in a combination of chondral injury, trabecular microfracture, or periosteal hemorrhage.[7] These traumatic lesions heal with bone proliferation, without concomitant degenerative cartilage space narrowing.

Imaging

A standard lateral ankle radiograph can demonstrate impingement spurs at the anterior rim of the tibial plafond and apposed margin of the talar neck (Fig. 2). A lateral radiograph obtained in maximal dorsiflexion may illustrate the approximation of the impingement spurs and help quantify the degree of mechanical limitation. Note, however, that standard lateral radiographs may fail to detect or might underestimate the size of impingement spurs. Tol et al reported a substantial improvement in the sensitivity and specificity for radiographic detection of anterior impingement spurs by using an additional "anteromedial impingement" view.[8] Projectional limitations inherent to conventional

Figure 2 A 25-year-old male professional soccer player with anterior impingement syndrome. Lateral radiograph obtained in dorsiflexion demonstrates close approximation of anterior tibial and talar osteophytes (arrow), mechanically limiting ankle dorsiflexion. Reprinted with permission of Dr. Antonio Cruz, Santander, Spain.

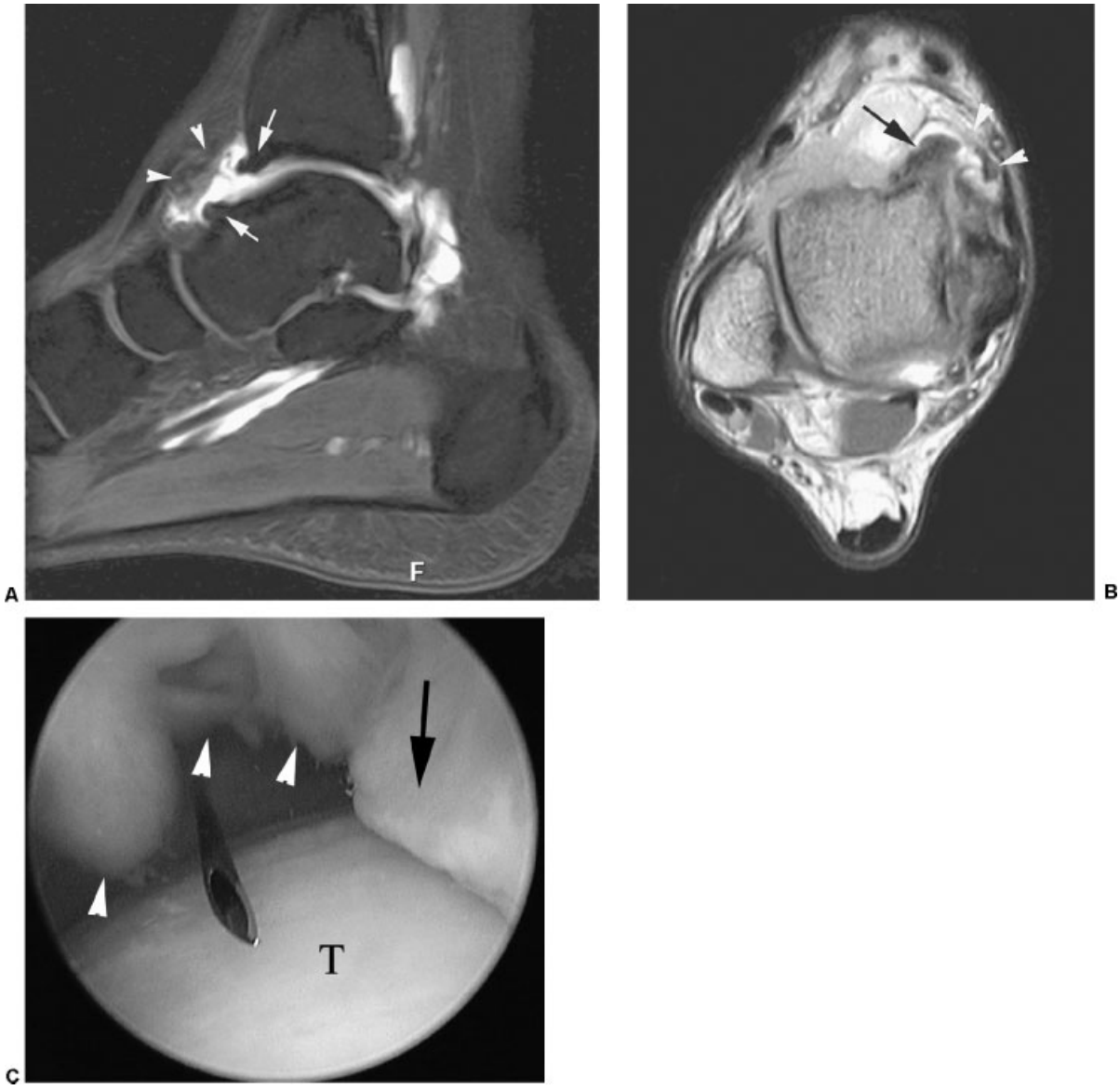

Figure 3 A 28-year-old male professional soccer player with anterior impingement syndrome. (A) Sagittal fat-suppressed T1-weighted spin-echo magnetic resonance (MR) arthrogram of right ankle demonstrate anterior tibial and talar osteophytes ("kissing lesion") (arrows) and an irregular soft tissue mass in the anterior capsular recess (arrowheads). (B) Axial T1-weighted spin-echo MR arthrogram shows anterior talar spur (arrow), with capsular thickening and fibrosis in anterior capsular recess (arrowheads). (C) Arthroscopic image reveals anterior tibial osteophyte (arrow) and anterior capsular recess synovitis (arrowheads). T, talus. Reprinted with permission of Dr. Antonio Cruz, Santander, Spain.

radiography are negated by either computed tomography (CT) with sagittal plane reformatted images or by sagittal plane magnetic resonance (MR) imaging. MRI further permits visualization of bone marrow edema and synovitis in the anterior capsular recess, which may accompany the osseous spurs[9] (Figs. 3, 4).

ANTEROLATERAL IMPINGEMENT

Clinical Symptoms and Physical Findings

Patients present with anterolateral ankle tenderness, swelling, and pain exacerbated by single-leg squatting, ankle eversion, or forced dorsiflexion.[10] Ankle instability and peroneal tendon subluxation may mimic symptoms of anterolateral impingement and must be excluded. Despite a lack of true mechanical ligamentous instability, patients may report a subjective sense of ankle instability; this "functional instability" is caused by entrapment of soft tissues at the anterolateral ankle.[11] A relatively small subset of cases, caused by entrapment of the distal fascicle of the anterior inferior tibiofibular ligament, may present uniquely with a popping sensation or even an audible pop elicited by ankle dorsiflexion and eversion.[12]

Figure 4 A 25-year-old male professional soccer player with anterior impingement syndrome. Sagittal T1-weighted spin-echo magnetic resonance arthrogram of right ankle shows anterior tibial and talar osteophytes (arrows) and a sulcus (divot sign) in the talar neck (arrowhead). Reprinted with permission of Dr. Antonio Cruz, Santander, Spain.

Molloy et al reported a maneuver that is highly sensitive and moderately specific for detection of anterolateral synovial impingement.[13] The two-handed maneuver involves grasping the hindfoot with the hand and applying pressure over the lateral ankle gutter with the thumb while ranging the ankle from plantarflexion to maximal dorsiflexion. Hypertrophied synovium in the anterolateral recess is forced into the joint by the examiner's thumb, thereby intensifying pain with impingement of the soft tissue mass between the distal tibia and neck of the talus in dorsiflexion.

Anatomy

The anterolateral recess of the ankle is bounded by the talus and tibia posteromedially, the fibula laterally, and the anterior ankle joint capsule along with the anterior tibiofibular, anterior talofibular, and calcaneofibular ligaments anteriorly.[14] Hypertrophic soft tissues that form within the anterolateral recess in response to relatively minor trauma may cause impingement on the anterolateral ankle joint in dorsiflexion and eversion. Scarring or adhesions may also form between the anterolateral capsular soft tissues and the anterior surface of the fibula.[15]

The syndesmotic ligaments of the ankle joint are comprised of the interosseous ligament, the posterior tibiofibular ligament, and the anterior inferior tibiofibular ligament (AITFL). The AITFL, the weakest of the syndesmotic ligaments, courses obliquely and inferiorly from the distal anterior tibia to the anterior aspect of the lateral malleolus.[12–17] An accessory ligament or distal fascicle of the AITFL may be found with a reported incidence of 21–92%.[17] In a small subset of individuals with clinical symptoms of anterolateral impingement, the AITFL may be hypertrophied, with or without concomitant chondral abrasion at the apposed margin of the talus or the formation of bone spurs.

Pathophysiology

Anterolateral impingement typically complicates relatively minor ankle injury with forced plantar flexion and supination.[14] Anterolateral capsular tearing ensues, without clinically significant mechanical instability. Functional instability, due to resultant post traumatic soft tissue entrapment at the anterolateral ankle, and repetitive microtrauma exacerbate soft tissue hemorrhage, synovial hyperplasia, and scar formation (Figs. 5, 6).[10,14]

The AITFL normally contacts the anterolateral talus in ankle dorsiflexion and eversion.[16] With experimental transection of the anterior talofibular ligament, the normal posterior translation of the talus with respect to the tibial plafond does not occur on ankle dorsiflexion, thereby increasing contact between the talus and the AITFL.[16] As such, it appears that there may be pathological impingement of the AITFL in the

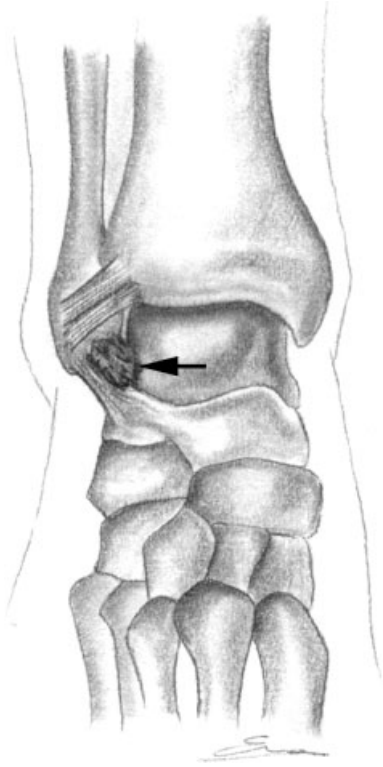

Figure 5 Illustration of the characteristic site of soft tissue impingement lesion in the anterolateral gutter (arrow) in anterolateral impingement syndrome. Reprinted with permission from Cerezal et al.[1]

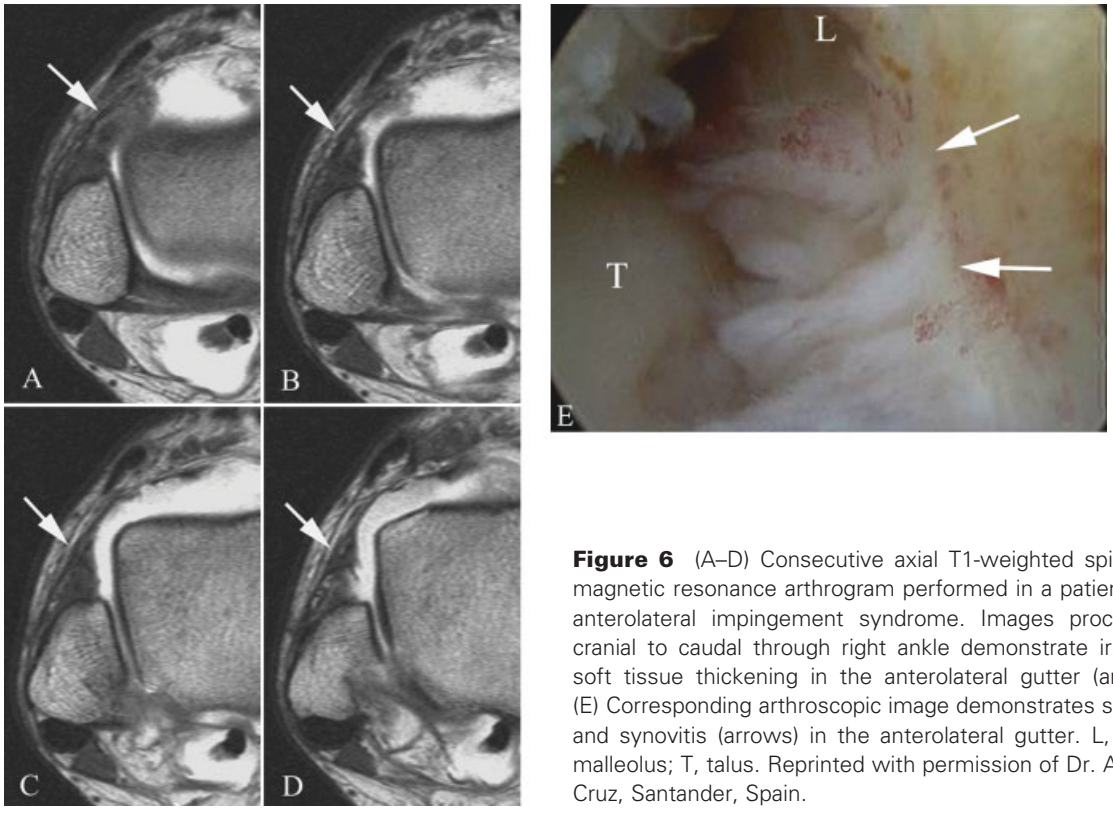

Figure 6 (A–D) Consecutive axial T1-weighted spin-echo magnetic resonance arthrogram performed in a patient with anterolateral impingement syndrome. Images proceeding cranial to caudal through right ankle demonstrate irregular soft tissue thickening in the anterolateral gutter (arrows). (E) Corresponding arthroscopic image demonstrates scarring and synovitis (arrows) in the anterolateral gutter. L, lateral malleolus; T, talus. Reprinted with permission of Dr. Antonio Cruz, Santander, Spain.

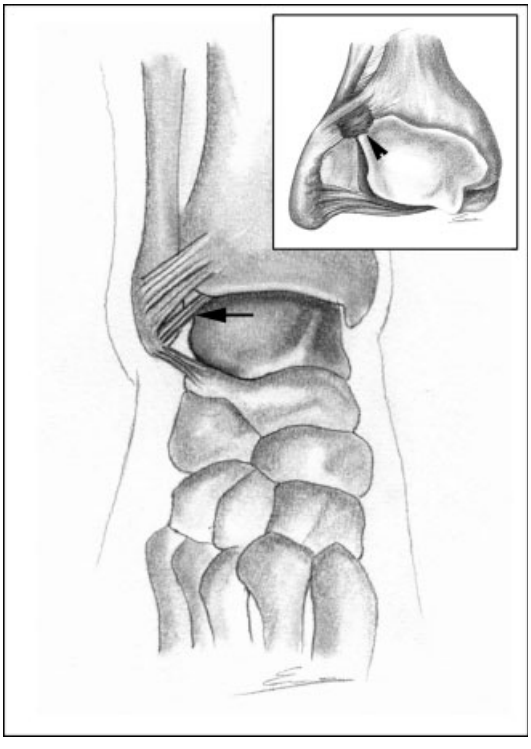

Figure 7 Illustration of Bassett's ligament (accessory fascicle of the anterior tibiofibular ligament) (arrow). The inset depicts anterolateral impingement with hypertrophy of the accessory fascicle of the anterior tibiofibular ligament and focal fibrosis (arrowhead). Reprinted with permission from Cerezal et al.[1]

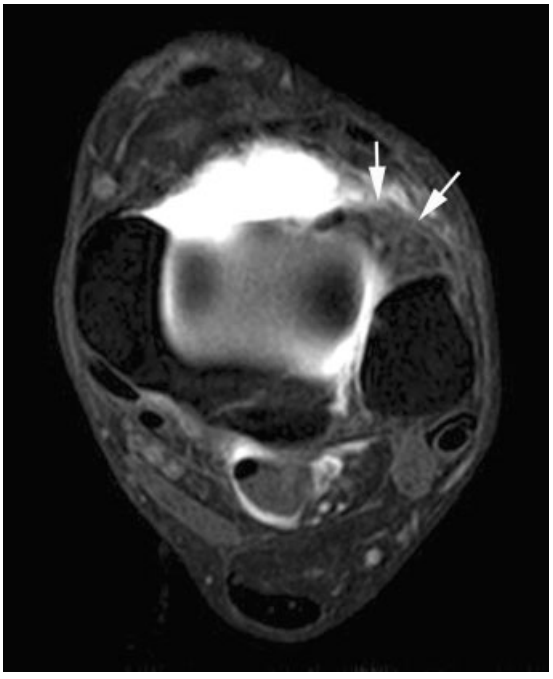

Figure 8 Axial fat-suppressed T1-weighted spin-echo magnetic resonance arthrogram of left ankle in a patient with anterolateral impingement syndrome demonstrates nodular lesion surrounding Bassett's ligament in the superior aspect of the anterolateral gutter (arrows). Reprinted with permission of Dr. Antonio Cruz, Santander, Spain.

context anterolateral ankle instability. With continued entrapment of the AITFL it may become hypertropic, exacerbating symptoms of anterolateral impingement in a small subset of individuals (Figs. 7, 8). There may be associated chondral abrasion at the apposed anterosuperior lateral margin of the talus.[12]

Imaging

Conventional MR imaging offers little advantage over physical examination in the assessment of anterolateral impingement in the absence of significant joint effusion.[10,18,19] Indirect MR arthrography, which takes advantage of contrast diffusion into the joint, offers no advantage in the absence of a native synovial effusion.[20]

Studies evaluating the utility of CT[21] and MR arthrography[1,15] in assessment of anterolateral impingement have demonstrated that the presence of a nodular or irregular deep contour of the anterolateral joint capsule correlates strongly with scarring and synovitis at arthroscopy. Nondistension of the anterolateral recess due to scarring is a highly specific but insensitive sign for anterolateral impingement, which cannot be detected without arthrography. In a series of 13 patients with a clinical diagnosis of anterolateral impingement, Robinson et al found that MR arthrography was 100% accurate for evaluation of soft tissue abnormality, which corresponded to scarring and/or synovitis in the anterolateral recess.[15] Note that a large subset of their control cases, without clinical symptoms of anterolateral impingement, had arthrographic findings of anterolateral scarring and/or synovitis that were confirmed at arthroscopy. Therefore these pathological imaging findings must be correlated with symptoms of anterolateral ankle impingement to be clinically meaningful.

ANTEROMEDIAL IMPINGEMENT

Clinical Symptoms and Physical Findings

This uncommon cause of chronic ankle pain is rarely an isolated condition. As such, symptoms may overlap with and be overshadowed by those of multiligamentous injury and ankle instability. Tenderness at the anteromedial ankle joint line over the anterior tibiotalar fibers of the deltoid ligament is an inconsistent finding.[22,23] Nonspecific symptoms including swelling and painful limitation may worsen with ambulation, athletic activity, and prolonged standing. Clicking or snapping has been reported during sports activity or active dorsiflexion.

Anatomy

Anteromedial ankle impingement may complicate injury to the anterior tibiotalar ligament, the anteromedial joint capsule, or both in combination.[22–24] The deltoid ligament is comprised of five deep and superficial components. The deep deltoid is formed by the anterior and posterior tibiotalar ligaments. From anterior to posterior the superficial layer is formed by the tibionavicular, tibiospring, and tibiocalcaneal ligaments. All components of the deltoid ligament arise from the medial malleolar tip.

Pathophysiology

The precise mechanism of injury in anteromedial ankle impingement is not fully understood. Similar to anterior ankle impingement, both traction and impaction mechanisms have been considered. The first reported case was presumed to have resulted from overpronation (ankle eversion) with a traction injury to the anterior tibiotalar ligament.[22] Subsequent larger surgical series, the largest of which was based on only 11 subjects, were associated with supination (ankle inversion) injury as the primary event.[23] It is theorized that supination injury, with a possible rotational component, may lead to entrapment and tearing of the anteromedial joint capsule.[23,24] The supination mechanism is supported by the fact that concomitant lateral capsuloligamentous

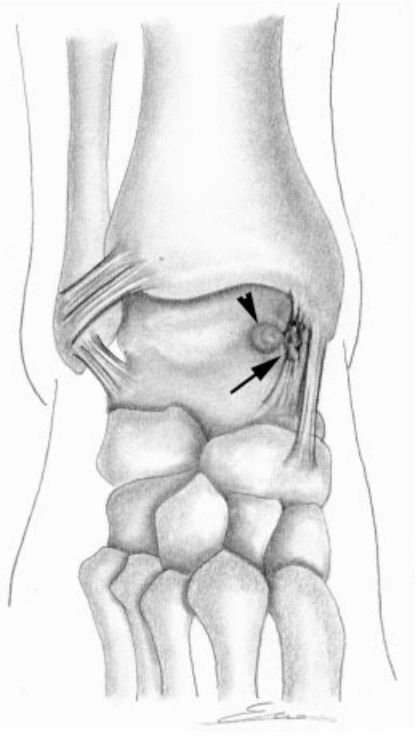

Figure 9 Illustration demonstrates constellation of findings in anteromedial ankle impingement, including a meniscoid lesion (arrow), thickening of the anterior tibiotalar ligament, and chondral damage or anterior medial corner articular surface osteophytes (arrowhead). Reprinted with permission from Cerezal et al.[1]

injury and anteromedial osteochondral lesions are found in the majority of reported cases.

Ankle instability resulting from anteromedial and lateral capsular injury predisposes to repetitive microtrauma. Reactive synovitis and capsular thickening may result in the formation of an anteromedial "meniscoid lesion," first reported by Egol and Parisien.[22] Repetitive anteromedial osteochondral impaction may also induce the formation of anteromedial bone spurs (Fig. 9).

Imaging

Neither radiography nor conventional MRI has proven useful for diagnosis of anteromedial ankle impingement. MR arthrography may demonstrate anteromedial capsular abnormality and irregular soft tissue thickening (Fig. 10).[24] Anteromedial osteophyte formation, associated lateral capsular and ligamentous injury, and tibiotalar chondral or osteochondral lesions may be detected as well.

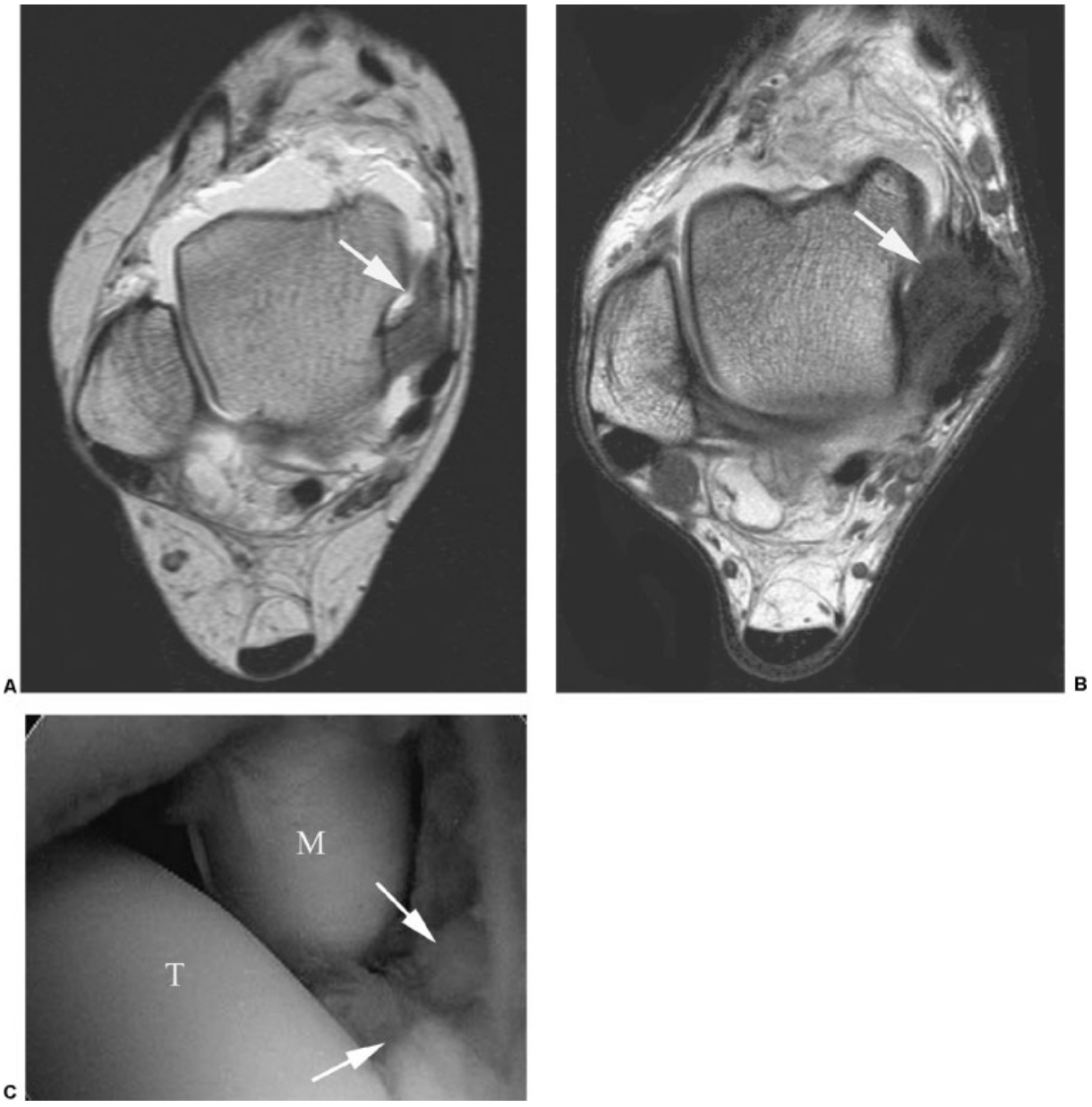

Figure 10 Axial T1-weighted spin-echo magnetic resonance arthrographic images from two different patients demonstrate (A) a normal striated appearance of the deep deltoid ligament on the left (arrow) versus (B) irregular soft tissue thickening in the anteromedial capsular recess and loss of the normal striated appearance of the deep deltoid ligament on the right in a patient with anteromedial impingement syndrome (arrow). (C) Corresponding arthroscopic image demonstrates the anteromedial impingement lesion (arrows). M, medial malleolus; T, talus. Reprinted with permission of Dr. Antonio Cruz, Santander, Spain.

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