# CONTENTS

# VIDEO CONTENTS

# SECTION 2

# Sport Syndromes

2

# Impingement Syndromes of the Ankle

*Michel A. Taylor, Annunziato Amendola*

OUTLINE



## INTRODUCTION

Impingement is derived from the Latin verb *impingere*, meaning "to force against," where an anatomic structure becomes entrapped causing pain, bony and soft tissue injury, decreased range of motion, and dysfunction.[1–3] When impingement occurs, one bone repetitively strikes another, which over time can stimulate the deep layer of the periosteum to form osteophytes that further exacerbate the impingement and alter the normal mechanics of the ankle joint. Osseous or bony impingement most commonly occurs following spur formation along the anterior margin of the distal tibia and talus or as a result of a prominent posterolateral talar process—the os trigonum (OT). Soft tissue impingement usually results from scarring and fibrosis associated with synovial, capsular, or ligamentous injury and most often occurs in the anterolateral gutter, the medial ankle, or in the region of the syndesmosis.[4] Conservative treatment such as activity modification and retraining should be aimed at breaking this repetitive cycle in order to decrease the inflammation and provide relief. However, the sporting limitations are often limiting, and if conservative management fails, surgery is usually indicated.

## GENERAL TECHNIQUE TIPS FOR OSTEOPHYTE REMOVAL

1. Obtain adequate exposure and visualization prior to attempting removal, to ensure complete excision
2. Careful placement of skin incisions in order to avoid painful neuromas and hypersensitive scars.
3. The surgeon should be meticulous with osteophyte removal. Care should be taken to remove all of the impinging osteophyte. Intraoperative fluoroscopy can be utilized to confirm complete removal.

Studies have shown that preoperative computed tomography (CT) scan may improve the characterization of the osteophytes and lead to more complete removal at the time of surgery.[5]

### The Ankle

In order to understand and appropriately manage ankle impingement conditions, one must first understand the anatomy of the ankle joint. The talus articulates inferiorly with the os calcis, and the talar axis is in line with the first web space of the foot, while the axis of the os calcis is in line with the fourth web space (Fig. 2.1). In dorsiflexion, bony impingement occurs anteromedially between the neck of the talus and the anterior lip of the tibia. In plantarflexion, bony impingement occurs posterolaterally between the os calcis and the posterior lip of the tibia. Therefore, anteromedial and posterolateral impingement is usually bony in nature while anterolateral and posteromedial impingement is usually a soft tissue condition. Impingement conditions are most commonly seen in the anterior ankle; however, they can also occur in all quadrants of the ankle joint, including anterior, lateral, posterior, and medial.

### Anterior (Medial, Central, Lateral) Impingement

#### Anteromedial Impingement

Anterior ankle impingement is relatively common in the athlete. Repetitive forced dorsiflexion can lead to frequent impaction injuries as the talar neck and hypertrophied synovial tissue impinge on the anterior lip of the tibia leading to the formation of osteophytes over time.[6] Recurrent supination injuries in the form of inversion ankle sprains, seen in chronic ankle instability, can also cause inflammation and hypertrophic changes of the synovium between the talus and tibia.[7] If the instability is not addressed, synovitis and scar tissue will accumulate most commonly in the anterolateral gutter leading

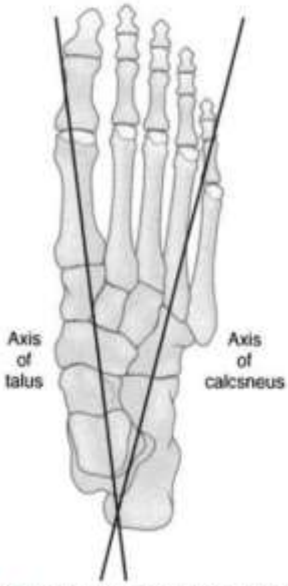


**Fig. 2.1** Axis of talus versus axis of os calcis.


**Fig. 2.2** Lateral impingement and stress fracture.

**Fig. 2.3** Oblique stress fracture.

to pain, swelling, continued impingement and lateral column overload, and stress fractures (Figs 2.2, 2.3). Anteromedial ankle impingement occurs when the anterior portion of the medial malleolus impinges against a spur on the medial shoulder of the talus. The medial joint spurs form following injuries to the deltoid ligamentous complex. In addition, the anterior tibiotalar ligament becomes thickened and can impinge on the anteromedial corner of the talus. Patients typically complain of anteromedial joint line pain, which is aggravated by walking and running as well as planting and pivoting during sporting activities. They also report medial clicking and limited, painful dorsiflexion. Patients often have anteromedial ankle swelling and pain over the anterior aspect of the deltoid ligament, and the spur can often be palpated on physical exam. Anterior osteophytes are often seen on standard lateral weight-bearing plain x-rays. The "plié view," which is a lateral weight-bearing view in maximal dorsiflexion, can be useful to demonstrate anterior impingement. With regards to the anteromedial talar and tibial bone spurs, plain anteroposterior and lateral radiographs can often miss these osteophytes. Studies have shown that spurs over 7 mm in size can be missed in these locations due to projectional issues and the relative positions of the lateral talar neck and body and anterolateral tibia.[8] An oblique anteromedial impingement view (AMI) can be obtained by plantar-flexing the foot and externally rotating the leg to 30 degrees with the x-ray beam tilted 45 degrees cranial. This view has been shown to be especially useful in detecting anteromedial bone spurs.[8] During arthroscopy, the anteromedial ankle should be adequately visualized and inspected for the presence of an impingement spur, which should be debrided when present. Holding the ankle in dorsiflexion will help with visualization and any required debridement.

Another form of anterior impingement was described by Amendola et al., as cam-type impingement of the ankle, similar to the impingement that has previously been described in the femoral neck. This form of impingement occurs when the sagittal contour of the talar dome forms a non-circular arc with anterior talar flattening and creates pathologic contact with the anterior aspect of the tibial plafond with the ankle in dorsiflexion (Fig. 2.4). On lateral weight-bearing foot x-rays, the cam ratio is measured by drawing a line under the lateral process of the talus parallel to a line drawn along the navicular, cuneiform, and metatarsal bones. From this line, the widest and narrowest portions of the talus are measured distal to the apex of the talar dome (Fig. 2.5). The cam ratio is then determined by dividing the narrowest point by the widest. The $\alpha$-angle is determined for both the medial and lateral talar domes. A circle is drawn to match the curvature of the tibial plafond. This circle is then overlayed with the curvature of the talar domes. The $\alpha$-angle is positive when the radius of the talar dome exceeds the radius of the circle anteriorly. The authors found that the medial dome was most prominent and anterior in cases of impingement. The authors also found that cam-type ankles were associated

**Fig. 2.4** CAM lesion. From Amendola N, Drew N, Vaseenon T, Femino J, Tochigi Y, Phisitkul P. CAM-type impingement in the ankle. *Iowa Orthop J*. 2012;32:1-8.


**Fig. 2.5** CAM measurement. From Amendola N, Drew N, Vaseenon T, Femino J, Tochigi Y, Phisitkul P. CAM-type impingement in the ankle. *Iowa Orthop J*. 2012;32:1-8.

with higher cam ratios and positive α sign when compared to control ankles. The authors suggest that if unrecognized and untreated, cam-type impingement, like femoroacetabular impingement, can lead to recurrence as well as degenerative arthritic changes.[9]

### Anterocentral Impingement

Anterocentral impingement is the classic location when describing anterior ankle impingement. The locations of the spurs have been described in four typical patterns:

1. Spurs found primarily on the lip of the tibia. This type is ideal for arthroscopic management. Under direct vision, the impinging lip of the distal tibia can be easily removed with a burr or thin osteotome. The osteophyte is removed while holding the ankle in maximal dorsiflexion while using an osteotome with blunt edges to avoid damaging the dome of the talus.[10]

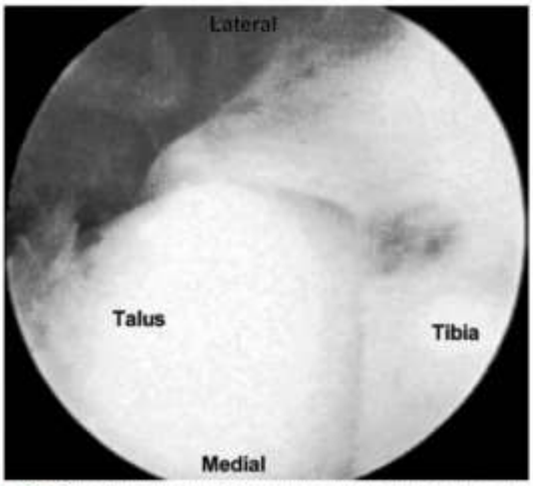


**Fig. 2.6** Basset's ligament. (Arthroscopic view seen from the medial portal.)

2. Spurs found primarily on the talus. This pattern of impingement is more difficult to treat with only an arthroscopic technique. The osteophytes are typically found within the capsular insertion on the talar neck, and it becomes necessary to strip the capsule distally in order to visualize the pathology. In addition, the osteophytes are easily missed, and therefore intraoperative imaging may be needed to ensure adequate removal.
3. Spurs are present on both the lip of the tibia *and* the talar neck. This pattern is also associated with loose bodies that have broken off the osteophytes. This pattern is common and the most technically challenging. Surgical management often involves arthroscopy with an associated mini arthrotomy.
4. Multiple anterior osteophytes are present secondary to advanced ankle osteoarthritis. The benefit of arthroscopic debridement in these cases is questionable and should probably not be performed.

### Anterolateral Ankle Impingement

Anterolateral ankle impingement is usually secondary to soft tissue impingement, as the tibia and talus do not come together in this location. Impingement in this location is usually a result of one of two pathological conditions: Bassett's Ligament and synovial impingement.

***Bassett's Ligament.*** Bassett's ligament is an abnormal thickened distal fascicle of the anterior tibiofibular ligament (AITFL). Rather than being a distal component of the AITFL, Bassett's ligament represents a separate ligament that is separated by a fibrofatty septum[11] and extends distally on the lateral malleolus. It can lead to impingement of the lateral shoulder of the talus when the ankle is plantarflexed (Fig. 2.6).[12] Patients typically present with anterior ankle pain and a remote history of an ankle sprain. Physical exam findings include anterolateral talar dome and AITFL point tenderness exacerbated with ankle eversion and dorsiflexion. The ankle is usually found to be stable on physical exam. Treatment is usually nonoperative and should be attempted for approximately 6 months prior to considering any kind of surgical intervention. The surgical management of this condition involves the surgical excision of the ligament and has been associated with good to excellent results.

***Synovial Impingement.*** Synovial impingement or Ferkel's disease is the chronic accumulation and entrapment of scar tissue and synovitis in the anterolateral gutter of the ankle, which is usually preceded by trauma in the form of an inversion injury.[13] The patient typically presents with symptoms similar to Bassett's ligament impingement. Pain with palpation over the anterolateral gutter with the ankle plantarflexed typically reproduces the symptoms. Plain films are usually normal but can be used to rule out other bony pathology. Advanced imaging modalities such as CT scan and conventional magnetic resonance imaging (MRI) have shown moderate sensitivity and specificity but often rely on the experience level of the reader.[14–18] Magnetic resonance (MR) arthrogram, however, has been associated with a sensitivity of 96%, specificity of 100%, and accuracy of 100% in the assessment of anterolateral impingement when clinical signs are present.[19] Like Bassett's ligament, arthroscopic debridement is the surgical treatment of choice after a trial of nonoperative management has failed, with good to excellent results in approximately 94%–96% of patients.[20,21]

Anterolateral ankle pain can also be caused by anterior syndesmosis pathology. Although this is not as a result of true impingement, it can be exacerbated by ankle dorsiflexion as the widened anterior aspect of the talus engages the malleoli and places tension on the anterior tibiofibular ligament. There are three types of anterolateral syndesmosis pathology: a sprain of the syndesmotic ligaments and interosseous membrane, also known as a high ankle sprain; the Tillaux fracture, which is an avulsion fracture of the insertion of the AITFL usually on the distal tibia; and the herniation of synovium into rents in the tibiofibular ligament.

Results of arthroscopic anterior ankle debridement have been reported as good to excellent by numerous authors, with success rates of approximately 67%–88%.[2,13,22,23] A systematic review looking at the results of anterior ankle arthroscopy found good or excellent results in 64%–100% of patients while most studies had outcomes greater than 80%. Improved postoperative outcomes were seen in patients with mostly soft tissue impingement compared to bony impingement.[24] Studies comparing open and arthroscopic debridement for anterior ankle impingement found significant postoperative clinical improvements in both groups with shorter hospital stays seen in the arthroscopic group and earlier return to sports.[10] Multiple studies have consistently found that patients undergoing arthroscopic or open debridement in the presence of arthritic changes have inferior clinical outcomes.[10,23–25]

## Lateral Ankle Impingement

The lateral ankle is complex and the causes of pain and discomfort are varied, therefore obtaining an accurate diagnosis can often be difficult. Symptoms in this area are also often preceded by ankle sprains. The original trauma can often be mild and appear inconsequential at first, such as a first-degree ankle sprain with no residual lateral instability. Other conditions to consider in the evaluation of lateral ankle impingement and pain are:

1. *The "meniscoid" of the ankle* – Thought to be soft tissue trapped between the lateral shoulder of the talus and the lateral malleolus. This lesion was described in four soccer players with a history of frequent ankle sprains who underwent arthroscopic debridement after failing nonoperative treatment.[26] After appropriate rehabilitation, all four had complete resolution of symptoms and returned to competition.
2. *Fracture of the lateral process of the talus*[27] – Can be a source of impingement beneath the lateral malleolus. The fracture is also known as a "snow-boarder's fracture" due to the increased incidence in this particular athletic population. It is often misdiagnosed as an ankle sprain, therefore a high index of suspicion is required. Routine plain radiographs of the foot and ankle can often miss the subtle fracture, and a CT scan is the study of choice. Surgical treatment options range from bony excision to open reduction internal fixation (ORIF), depending on the size of the fragment.[28]
3. *The symptomatic os subfibulare* – An accessory ossicle that was previously asymptomatic can loosen or fracture following an injury and become symptomatic.
4. *Distal fibula avulsion fractures* – The tip of the fibula can often become trapped at the insertion site of the calcaneofibular ligament (CFL) and become symptomatic. If the fragment is small, it can be excised and the stump of the ligament can be sutured to the tip of the lateral malleolus. If it is large, it often can be reattached with a screw or K-wire. Infrequently a similar fracture can occur at the anterior edge of the lateral malleolus at the insertion of the anterior talofibular ligament (ATFL) (Fig. 2.7).
5. *Os Calcis fractures* – Previously healed or malunited fractures of the os calcis can present with lateral ankle pain and subfibular impingement, which is often difficult to differentiate from subtalar joint pain and dysfunction. A small injection of local anesthetic beneath the tip of the lateral malleolus, but not into the subtalar joint, can help elucidate the cause. If there is significant pain relief with local anesthetic, fragment excision may be considered prior to recommending subtalar arthrodesis.
6. *An avulsion fracture of the anterior process of the os calcis*[29] – an avulsion fracture of the origin of the EDB and EHB and not a true impingement syndrome. It can usually be seen on x-ray (Fig. 2.8) and suspected on physical examination by point tenderness over the site exacerbated by pronation-supination of the forefoot. If symptoms persist despite nonoperative treatment, excision of the fragment is warranted (see Fig. 2.8).
7. *Accessory anterolateral talar facet* – The accessory anterolateral talar facet was first described by Sewell in 1904 who found it to be present in 10.2% of cadaveric tali.[30] A case series by Martus et al. described the association between an accessory talar facet and the anterior process of the calcaneus leading to talocalcaneal impingement and symptomatic rigid flatfoot. Patients typically presented around the age of

Fig. 2.7 Fracture of the tip of the fibula trapped under the lateral malleolus.

Fig. 2.8 Fracture of the anterior process of the os calcis.

15 with lateral sided ankle and hindfoot pain and symptoms consistent with a rigid flatfoot deformity. The patients were overweight with an average body mass index (BMI) of 34.6, and symptoms had been ongoing for almost 2 years. Lateral radiographs typically showed a broadening of the anterioinferior lateral talar process suggestive of an accessory anterolateral facet. CT scan and MRI were performed and ruled out the presence of a tarsal coalition, confirm the presence of the accessory talar facet, dorsal talar beaking was frequently present, and MRI showed bone marrow edema localized to the anterolateral talar facet and adjacent calcaneus. The authors stipulate that symptoms are caused by the combined effect of increased body mass, subtalar joint eversion in the presence of an accessory talar facet leading to impingement and associated painful flatfoot deformity. In the absence of subtalar arthrosis or an associated coalition, treatment consists of isolated resection of the accessory facet through a sinus tarsi incision with or without gastrocnemius recession, peroneal lengthening and medial displacement calcaneal osteotomy.[31]

8. *Peroneal tendon dysfunction* – although not true impingement, can also cause lateral ankle pain and should always be considered in the differential diagnosis. This can include peroneal tendon subluxation, longitudinal tears,[32] and fractures of the os perineum with retraction of the peroneal tendon (Fig. 2.9).[33]

## Posterior Ankle Impingement

Posterior ankle impingement, also known as talar compression syndrome, os trigonum syndrome, posterior triangle pain, and posterior tibiofibular impingement,[34] is relatively common in athletes such as dancers, gymnasts, soccer players, and skaters who engage in repetitive and forceful ankle plantarflexion. A working knowledge of the anatomy of the posterior ankle and its key structures is important in order to understand and appropriately manage the impingement syndromes found in this area (Tables 2.1 and 2.2). The posterior talar anatomy is the main determining factor underlying posterior ankle impingement. The posterior aspect of the talus has two tubercles: the medial and the lateral tubercles (Fig. 2.10). The lateral tubercle is the origin of the posterior talofibular ligament (PTFL). When the lateral tubercle is large, it is referred to as the posterior process of the talus or Stieda's process. In 7% to 11% of the population, this posterior process is separate from the talus and connected by a fibrous synostosis; in these cases, it is referred to as an OT. The OT is the second most common accessory bone in the foot, behind the accessory navicular or os navicularum. Anatomical variants like these ones in combination with a traumatic injury such as an ankle sprain or repetitive microtraumas as is seen with certain sports can lead to posterior impingement syndrome.

There are also important soft tissue structures of the posterior ankle that can contribute to posterior ankle impingement such as the flexor hallucis longus (FHL) tendon, the posterior ankle ligaments, the joint capsule, and synovium. The FHL tendon passes in a groove on the posterior tibial plafond and through a fibro-osseous tunnel between the medial and lateral posterior tibial tubercles (Fig 2.11). It runs from its proximal origin on the fibula to its insertion on the distal phalanx of the hallux. Chronic tendinitis and dysfunction within this tunnel can produce posterior medial pain.[34–36] The most common sources of posterior ankle impingement pain in the athletic population is trigonal impingement laterally and FHL tendinitis medially.

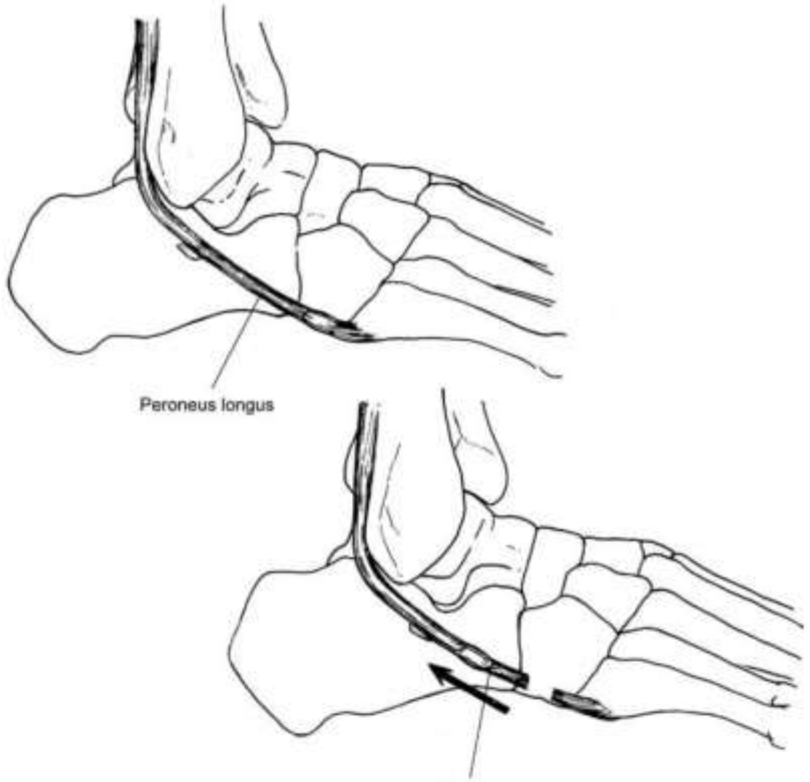


Fig. 2.9 Retraction of the os peroneum (*arrow*), following rupture of the peroneus longus tendon.

**TABLE 2.1 Flexor Hallucis Longus (FHL) Tendonitis Versus Posterior Impingement of the Ankle**

| FHL tendonitis | Posterior impingement |
|---|---|
| Posteromedial | Posterolateral |
| Tenderness over FHL tendon | Tenderness behind fibula |
| Pain or triggering with motion of the hallux | Pain with plantar flexion of the ankle |
| ±Thomasen's sign [28] | Plantar flexion sign |
| Mistaken for PT tendonitis | Mistaken for peroneal tendonitis |

*FHL, flexor hallucis longus; PT, posterior tibial.*

**TABLE 2.2 Medial Versus Lateral Posterior Ankle Pain in Athletes and Dancers**

| Posteromedial | Posterolateral |
|---|---|
| FHL tendinitis | Posterior impingement (OT syndrome) |
| Soleus syndrome | Fx. trigonal process (Shepherd's fracture) |
| PT tendonitis | Peroneal tendonitis |
| Posteromedial fibrous tarsal coalition | Pseudomeniscus syndrome |

*FHL, flexor hallucis longus; Fx., fracture; OT, os trigonum; PT, posterior tibial.*

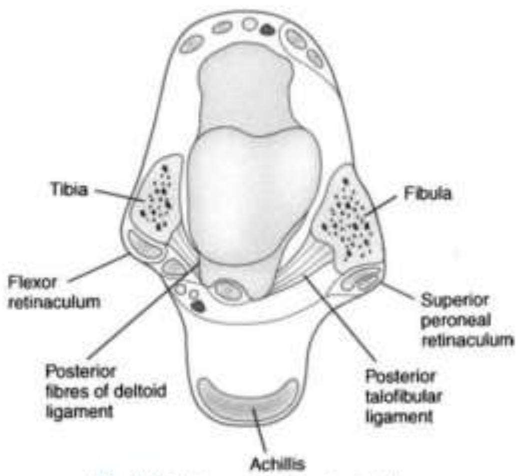


Fig. 2.10 Anatomy of the posterior talus.

## Posterolateral Ankle Impingement

A common cause of posterolateral ankle impingement is from the natural consequence of full weight bearing in maximal plantarflexion of the ankle in the *demi-pointe* or full *pointe* position, especially when an OT is present. In these cases, the

Fig. 2.11 Flexor hallucis longus (FHL) posteromedial scope.

OT is compressed between the posterior lip of the tibia and the superior portion of the os calcis (Fig. 2.12) causing posterolateral ankle impingement and pain. The chronic repetitive impingement events can lead to inflammation of the OT. It can be confirmed on physical examination with patients experiencing point tenderness posterior to the peroneal tendons behind the lateral malleolus, which is exacerbated with forced passive plantarflexion of the ankle known as the "plantar flexion sign." This pattern of impingement can often be mistaken for peroneal tendinitis, which can also occur in association. It is best seen on a lateral view of the ankle *en pointe* or in full plantar flexion (see Fig. 2.12). MRI findings often include bone marrow edema in the posterior talus (Fig. 2.13) or within the OT and/or a prominent posterior calcaneal process or a downward slope to the posterior tibia. It can also be associated with traumatic osteochondral defects of the talus (Fig. 2.14, 2.15). If necessary, the diagnosis can be confirmed by injecting 0.5 ml of a local anesthetic into the posterior soft tissues behind the peroneal tendons. It is important to keep in mind that most people who have an OT are asymptomatic and that posterior impingement syndrome is uncommon in most athletes. Unfortunately, due to the often dramatic appearance of the OT on x-ray, the condition is frequently overdiagnosed by practitioners, who may then recommend surgery unnecessarily.

Treatment of posterolateral impingement syndrome begins with conservative management options such as activity modification, avoiding exacerbating plantarflexed ankle positions, nonsteroidal antiinflammatory drugs (NSAIDs), and physical therapy. In addition, an injection of 0.25 to 0.5 ml of a mixture of a long-acting and a short-acting corticosteroid may provide significant relief of symptoms, and the accuracy of the injection can be improved with sonography.

Although uncommon, if nonoperative treatment has failed and the OT remains symptomatic, surgical excision becomes indicated. If the pathology is isolated to a symptomatic OT with no medial symptomatology, it can be approached posterolaterally in the interval between the FHL and the peroneal tendons while protecting the sural nerve. However, posterolateral impingement is often associated with FHL tendinitis (Video 2.1 "Os Trigonum and FHL"), and in this case,

Fig. 2.12 Posterior impingement on the os trigonum.

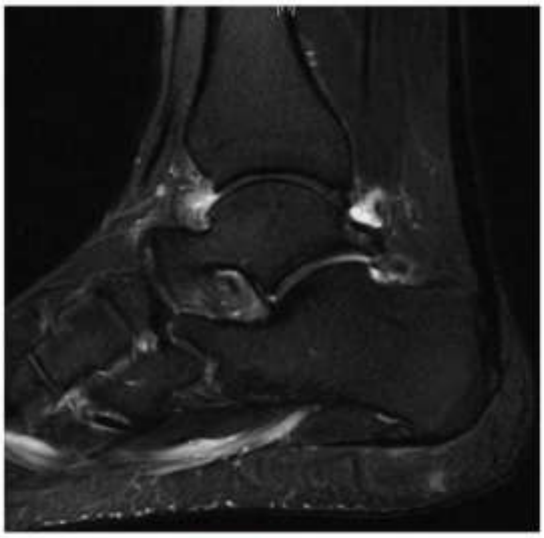

Fig. 2.13 Edema OT.

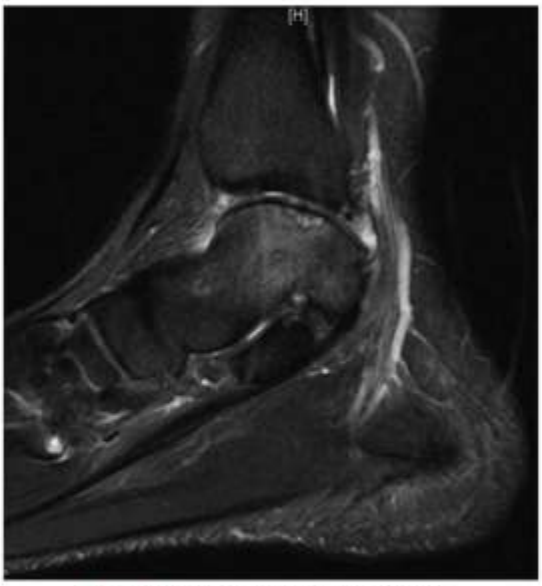

Fig. 2.14 MRI osteochondral defect (OCD) sag.

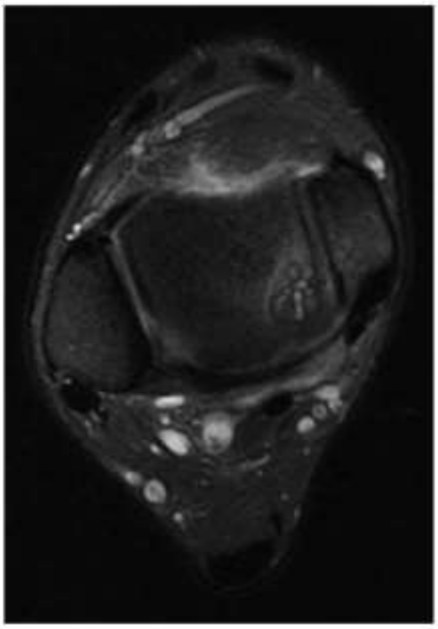
Fig. 2.15 MRI sag axial.

the posteromedial approach is utilized in order to adequately develop and protect the neurovascular bundle and perform a tenolysis of the FHL after excising the adjacent OT. Results of OT resection using a posterolateral approach have shown significant improvement in APFAS scores, with a complication rate of approximately 20% including sural nerve injury, superficial wound infection, and reflex sympathetic dystrophy.[37] Ankle arthroscopy using two posterior portals can also provide excellent visualization of the posterior structures of the ankle and good access to the OT, loose bodies, and FHL tendon sheath.[38]

Posterolateral impingement can also occur following an ankle sprain where the lateral ligamentous structures are disrupted. The resulting instability causes the talus to slide forward and the posterior lip of the tibia to comes to rest on the os calcis. In this case, the treatment is to correct the anterior drawer by reconstructing the lateral ligamentous complex (ex: Brostrum-Gould).[34,39]

A posterior pseudomeniscus or plica in the posterior ankle, with or without an OT, can cause posterior impingement syndrome in the absence of an OT or ligament laxity. Bucket-handle like tears in this structure can cause locking and other mechanical symptoms similar to what is typically seen in the knee.[34]

The differential diagnosis of posterolateral ankle pain can also include acute trauma including fractures of the posterior process of the talus, avulsions of the PTFL, fracture of the trigonal process also known as a Shepherd's fracture or of the os trigonium synchondrosis.

### Posteromedial Ankle Impingement

Bony impingement does not typically occur in the posteromedial ankle as the tibia and talus do not come together. Therefore, posteromedial impingement is mainly due to soft tissue causes. The posteromedial flexor tendons, joint capsule, and tibiotalar ligament are the main contributors of posteromedial impingement. The FHL passes through a fibro-osseous tunnel behind the talus between the medial and lateral tubercles to the level of the sustentaculum tali like a rope through a pulley. As it passes through this pulley, it is easily strained. When this occurs, rather than moving smoothly in the pulley, it begins to bind. This binding causes irritation and swelling. Chronic inflammation and hypertrophy of the musculotendinous unit within this tunnel can lead to a painful stenosing tenosynovitis, analogous to de Quervain disease in the wrist. Tendinitis of the FHL tendon behind the medial malleolus of the ankle is also known as dancer's tendonitis but can also occur in other athletes as well. If a nodule or partial tear is present, triggering of the big toe may occur; this is known as hallux saltans (Fig 2.16). In extreme cases, the tendon may become completely frozen in the sheath, causing pseudo hallux rigidus. Physical exam findings include localized tenderness and swelling over the FHL sheath behind and lateral to the medial malleolus. Palpation of the sheath with active and passive motion of the hallux will mimic the patient's symptoms. Dorsiflexion of the first metatarsophalangeal (MP) joint can be reduced or absent when the ankle is in maximum dorsiflexion and the muscle fibers of the FHL are drawn into the FHL tunnel, producing a functional hallux rigidus (Thomasen's sign). This finding is not always pathological, as it may be present in asymptomatic patients. Usually there is no pain with forced plantarflexion of the ankle. FHL tendinitis is often misdiagnosed as posterior tibial or Achilles tendonitis, and it typically responds to the usual conservative measures such as rest (no pointe work), activity modification, and NSAIDs. Steroid injections should be avoided in this location. In refractory cases that have failed conservative management, surgical release of the fibro-osseous is indicated.

FHL tendinitis usually occurs behind the medial malleolus, but occasionally it can be isolated to the knot of Henry where the flexor digitorum longus (FDL) crosses over the FHL, and

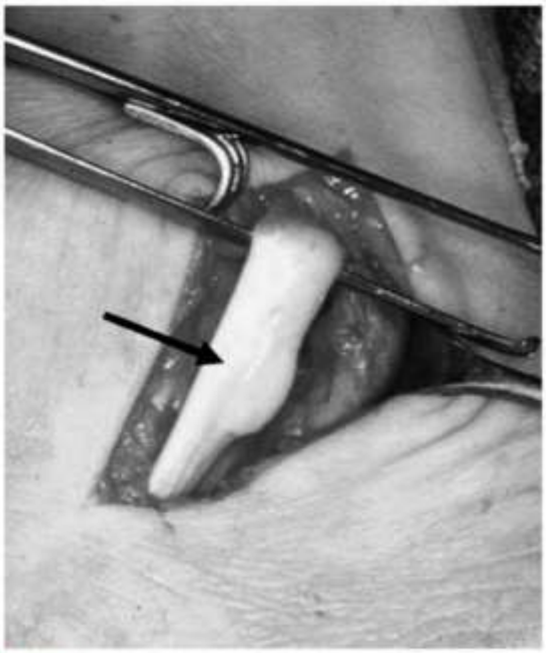

Fig. 2.16 A nodule in the flexor hallucis longus (FHL) tendon causing triggering of the great toe; "hallux saltans."

under the head of the first metatarsal where it passes between the sesamoids. A fibrous subtalar coalition may be present in the posteromedial ankle, mimicking FHL tendinitis or tarsal tunnel syndrome. This condition should be suspected when limited subtalar motion is seen on physical examination.

In the management of posteromedial ankle impingement, operative treatment is indicated when conservative therapy has failed. A posterior-based approach can be made on either the medial or lateral side of the Achilles tendon. The lateral approach should be utilized if the patient has isolated posterior impingement without a history of FHL tendinitis or medial-based pathology. However, if the patient presents with posterior impingement and FHL tendinitis with or without an incidental OT, a medial incision should be performed. The medial incision is preferred as it avoids the sural nerve and provides access to the lateral structures while allowing direct access to the posteromedial neurovascular bundle.

## Open Medial Approach—FHL Tenolysis and Excision Os Trigonum

This procedure can be performed with the patient prone or supine with a bump under the contralateral hip in order to provide external rotation of the hip and knee. A well-padded tourniquet is placed around the thigh. A curvilinear incision is made following the neurovascular bundle beginning just above the superior border of the os calcis and ending just posterior to the tip of the medial malleolus (Fig. 2.17A). Blunt dissection is performed and the deep fascia is then divided carefully to avoid damage to the posteromedial neurovascular bundle. The tibial motor branches to the os calcis are more variable in the posterior aspect of the neurovascular bundle, therefore the interval between the medial malleolus and the anterior aspect of the neurovascular bundle should be developed at this point. The bundle can then be taken down off the malleolus by blunt dissection. In this region, there are several small vessels that will need to be ligated and the bundle can then be mobilized and held with a blunt retractor. The surgeon should examine the tibial nerve and artery and note the location where they divide into medial and lateral plantar branches as they leave the tarsal canal. It is not unusual for either the artery or the nerve, or both, to divide above this area, leading to reduplication within the tunnel. There also may be reduplication of the FHL tendon. With the neurovascular bundle retracted posteriorly, the FHL is identified by moving the hallux. The thin fascia overlying the FHL is opened proximally and tenolysed from proximal to distal. Usually the fascial sheath is stenotic and rigid, and the FHL can be seen entering at an acute angle. Care should be taken distally, as the FHL tunnel and the nerve are in close proximity. As the tendon approaches the sustentaculum tali, the fascial sheath becomes exceedingly thin. At this point, the tendon should be inspected for nodules or longitudinal tears and, if such are present, should be carefully debrided or repaired. Following this, the FHL and neurovascular bundle can be retracted posteriorly allowing access to the OT or trigonal process on the lateral side of the FHL tunnel. If the posterior aspect of the talus cannot be visualized, a capsulotomy should be performed. If there is difficulty in visualizing the OT, it helps to identify the superior border of the os calcis and the subtalar joint (by moving the os calcis into adduction and abduction). The subtalar joint is then dissected from medial to lateral, and this will take the surgeon underneath the OT. Once identified, it can be removed by circumferential dissection. Care should be taken to stay on the bone when performing this part of the procedure. This can be somewhat difficult, especially if the OT is large. Once it is removed, the posterior ankle joint should be inspected for bone fragments, loose bodies, soft tissue entrapment, or the large articular facet on the upper surface of the os calcis that often articulates with the OT. If this articulation is large, it may need to be removed with a thin osteotome. The FHL sheath should not be closed. The wound is then irrigated and the ankle is put in plantarflexion to check for any residual impingement. The wound is closed in layers with the ankle in neutral flexion. Full weight bearing with crutches can begin immediately with swimming and physical therapy started at approximately two weeks once the wound has healed. Ankle range of motion is started as early as possible to prevent residual stiffness. If only the tenolysis is performed without excision of the OT, the recovery period is approximately 6 weeks. When the tenolysis is performed with OT excision, the recovery time is approximately 8 to 12 weeks.

## Posterior Ankle and Hindfoot Arthroscopy[38,40,41]

This is our preferred technique to deal with posterior ankle impingement and pathology. The patient is positioned prone and a well-padded tourniquet is placed around the thigh. Although used infrequently, ankle distraction is achieved with a tensioned wired can be placed transversely in the calcaneus, the operative knee is cephalad to the break in the operating

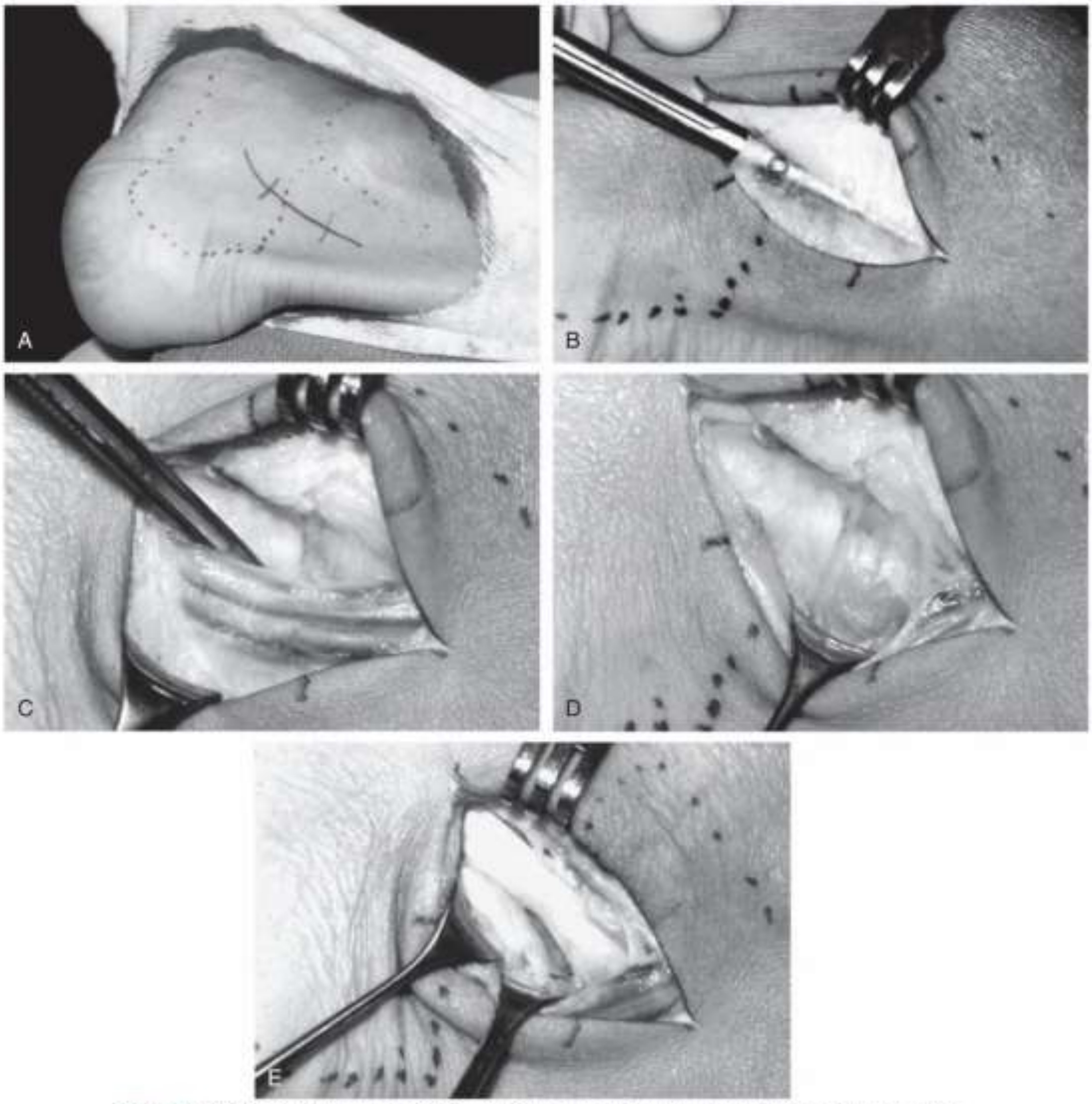

Fig. 2.17 (A) Posteromedial incision. (B) Neurovascular bundle beneath a thin layer of fascia. (C) Neurovascular bundle taken down from the posterior medial malleolus. (D) Posterior tibial nerve protected with a blunt retractor. Underneath lies the flexor hallucis longus (FHL) sheath. (E) FHL sheath opened.

table and the contralateral knee is bent to 90 degrees and secured to a padded post. The foot of the operating table is then lowered allowing access for the mini c-arm. In cases where distraction is not applied, the operative leg is elevated by means of two sterile towel bumps. For intra-articular posterior ankle procedures, the posterolateral portal is first made lateral to the Achilles tendon at the level of the tip of the lateral malleolus (Fig. 2.18). A shallow skin incision is made and blunt dissection is then performed with a straight clamp to avoid injuring the sural nerve. Using fluoroscopic guidance, a blunt trocar is advanced in line with the first web space and toward the posterior process of the talus. Once inside the joint, the trocar is exchanged for a 4.0 mm or 2.7 mm 30 degree arthroscope. At the same level using a similar technique, the working portal is the made just medial to the Achilles tendon. In this case, the blunt trocar is advanced in line with the third web space and aimed medial to the midline.

To gain access to the hindfoot or for extra-articular procedures, blunt dissection is performed through the medial portal in line with the third web space toward the posterior process of the talus. Once the clamp is felt to be resting on bone, it can be exchanged for a 4.0 mm arthroscope, which is directed laterally. A mosquito is then advanced from the lateral portal dissecting toward the tip of the arthroscope. Once

**Fig. 2.18** Dissection with the shaver.

**Fig. 2.19** Os Trigonum and flexor hallucis longus (FHL) adjacent.

**Fig. 2.20** Post ankle scope.

**Fig. 2.21** OCD larger posterior approach.

the mosquito can be seen in the arthroscopic field, it can be exchanged for a 3.5-mm shaver. At this point, careful dissection with the shaver is performed to remove adipose tissue and expand the viewing field (Fig 2.18). Careful debridement can be continued from lateral to medial exposing the posterior tibiofibular ligament, the posterior tibiotalar and subtalar joint capsule, the os trigonum, and finally the flexor hallucis longus tendon (Fig 2.19). Once the impinging lesion or OT is identified, the debridement is made as close to bone as possible (Video 2.2 "Os Trigonum"). The position of the FHL should be confirmed throughout the debridement by moving the great toe. Once the OT has been circumferentially debrided, it can be broken down with a 4-mm burr or detached from the posterior process of the talus and retrieved en bloc with arthroscopic grasper. The adequacy of resection can be confirmed by noting the position of the FHL and by direct observation while plantarflexing the ankle. If an FHL tenolysis is to be performed, the sheath can be released to the level of the sustentaculum staying in the lateral side of the tendon. If any associated osteochondral lesions are present, they can be visualized, debrided (Figs 2.20–2.22), and treated (i.e., microfracture) at this point. Prior to closing, 20 cc of 0.5% Marcaine with epinephrine is injected into each portal and the portals are loosely closed with 3-0 monocryl suture. Postoperatively, patients are placed in a well-padded dressing. Protected weight bearing and range-of-motion exercises are started immediately. At 4–6 weeks, physical therapy should focus on strengthening and proprioceptive exercise, and the patient is permitted to return to sport when full range of motion and strength have returned.