Curr Rev Musculoskelet Med (2012) 5:145–150
DOI 10.1007/s12178-012-9117-z

FOOT AND ANKLE (DE BONASIA AND P PHISITKUL, SECTION EDITORS)

# Update on anterior ankle impingement

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Published online: 9 March 2012


**Abstract** Anterior ankle impingement results from an impingement of the ankle joint by a soft tissue or osteophyte formation at the anterior aspect of the distal tibia and talar neck. It often occurs secondary to direct trauma (impaction force) or repetitive ankle dorsiflexion (repetitive impaction and traction force). Chronic ankle pain, swelling, and limitation of ankle dorsiflexion are common complaints. Imaging is valuable for diagnosis of the bony impingement but not for the soft tissue impingement, which is based on clinical findings. MR imaging and MR arthrography are helpful in doubtful diagnoses and the identification of associated injuries. Recommended methods for initial management include rest, physical therapy, and shoe modification. If nonoperative treatment fails, arthroscopic bony or soft tissue debridement both offer significant symptomatic relief with long-term positive outcomes in cases that have no significant arthritic change, associated ligament laxity, and chondral lesion.

**Keywords** Ankle · Impingement · Bony · Soft Tissue · Anterior · Ankle Pain · Chronic · Sport · Arthroscopy · Foot and Ankle · Musculoskeletal

## Introduction

Anterior ankle impingement is one of the most common orthopaedic disorders in the foot and ankle, though the incidence in the general population is unknown. Although anterior ankle impingement is recognizable as spur formation along the anterior margin of the distal tibia, the entrapment of the soft tissue, scarring, or fibrosis also often occurs in the anterior part of the ankle following ankle ligament injury [1•]. Anterior ankle impingement is very common in athletes who sustain repetitive ankle dorsiflexion such as football players, soccer players, ballet dancers, gymnasts, and runners [2–6, 7•, 8].

The first aim of this review is to provide readers with an overview of what is currently known in etiologies, classifications, and investigations. The second aim is to give an evolution of treatment strategies in non-operative and operative managements. The advances in the surgical technique will be discussed as well as the long-term results.

## Etiologies

Anterior bony impingement of the ankle is the osteophytic impingement of the anterior rim of the tibia and the sulcus of the talus. It may be related to ankle instability or a forceful dorsiflexion injury of the ankle joint [9]. Repetitive force can result in impaction-related microtrauma of the anterior chondral margin of the tibiotalar joint. Over time, attempted repair with fibrosis and fibrocartilage proliferation leads to formation of osteophytes [10] that may cause contact between opposing bone or entrap soft tissue with consequent anterior joint space narrowing [11•, 12]. Osteophytes often increase in size and may eventually break off into the joint, forming a loose body [10, 13]. Tibial and talar osteophytes are located in the joint and away from the capsular attachment. This occurrence is contrary to Morris and McMurray's theory hypothesizing that a repetitive traction injury of the anterior joint capsule in extreme plantar flexion force (capsule-ligament traction) serves as the cause of an exostosis [14•, 15].

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Soft tissue impingement is a consequence of supination injuries. The recurrent inversion ankle sprain creates chronic inflammation and hypertrophic changes of the synovial tissue between the talus and the anterior tibia [16]. An accumulation of synovitis and scar tissue is entrapped in the anterolateral gutter of the ankle usually following inversion injuries. The patient will have swelling after activity and limited ankle dorsiflexion and supination as well [12, 17, 18].

Bassett's ligament, a thickened distal fascicle of the anterior inferior tibiofibular ligament (AITFL) that extends distally on the lateral malleolus, is believed to be an independent accessory ligament and the cause of anterolateral soft tissue impingement when the ankle is plantar flexed [19]. Bassett's ligament can impinge with the talar dome in ankle dorsiflexion [19, 20]. In addition, the posttraumatic ankle ligament hyperlaxity from an anterior talofibular ligament tear results in anterior extrusion of the talar dome with ankle dorsiflexion. The articular cartilage quality is generally poor at the area of fascicle contact (Fig. 1) [21].

Numerous authors have reported the anterior tibiotalar ligament as one of the causes of anterior soft tissue impingement of the ankle. It is regularly present in the normal ankle joint and consists of collagen and neural structure. The main ligament, or a part of it, can impinge the talar neck in ankle plantarflexion, which leads to inflammation, hypertrophy, and entrapment in the joint [22–24].

## Classification

Two classification systems are widely used in anterior ankle impingement. Scranton and McDermott developed one of these systems and based it on the degree of spur formation [25]. Types I and II describe tibial osteophytes equal to or greater than 3 mm, respectively. A Type III osteophyte is located at the dorsal aspect of the talus, while a Type IV classification describes arthritis osteophytes. The second classification system, from Van Dijk, is based on appearance of osteophytes and joint space narrowing of the ankle from plain radiography [15]. Grades 0 and I both indicate no manifestation of osteoarthritis. While grade 0 signifies a normal joint or subchondral sclerosis, grade I denotes osteophytes without joint space narrowing. Grade II represents a joint space narrowing with or without osteophytes. Grade III describes (sub) total disappearance/deformation of the joint space. After arthroscopic bony spur removal, patient satisfaction was excellent or good in 82 % for grade 0/I and 50 % for grade II, though patient satisfaction was low in grade III impingement [11•]. Therefore, the prognostic factor for the outcome of surgery is the degree of osteoarthritic change.

## Clinical evaluation

The typical symptom of the anterior ankle impingement is chronic anterior ankle pain with a history of recurrent ankle sprains. The ankle is limited in dorsiflexion motion and swollen after activity [26], and tenderness and thickening of the synovium on palpation are detected at the anterior ankle [27]. The bony impingement is commonly found over the anteromedial aspect while the symptoms of soft tissue impingement are on the anterolateral aspect of the ankle. Also, the dorsiflexion impingement sign is commonly positive [28]. Moreover, functional or structural ankle instability that may be a cause of impingement syndrome must be considered [29].

## Imaging

Based on clinical findings, imaging is valuable for diagnosis of the bony impingement but not for the soft tissue impingement [7•]. The osteophytes are usually seen from the standard lateral weight-bearing X-ray. The plié view—the lateral weight-bearing view with ankle in maximal dorsiflexion—demonstrates anterior impingement [8]. In addition, the anteromedial impingement (AMI) view is a special oblique view of the foot that can clearly demonstrate the anteromedial bony impingement at the talus [30]. A combination of lateral weight-bearing and AMI views increases the sensitivity to detect osteophytes up to 85 % on the tibia and 73 % on the talus [31]. Plain radiography is also helpful in evaluating other causes of pain including stress fracture, osteochondral lesion, and arthritis.

Ultrasound is accurate in diagnosing soft tissue impingement lesions within the anterolateral aspect of the ankle and

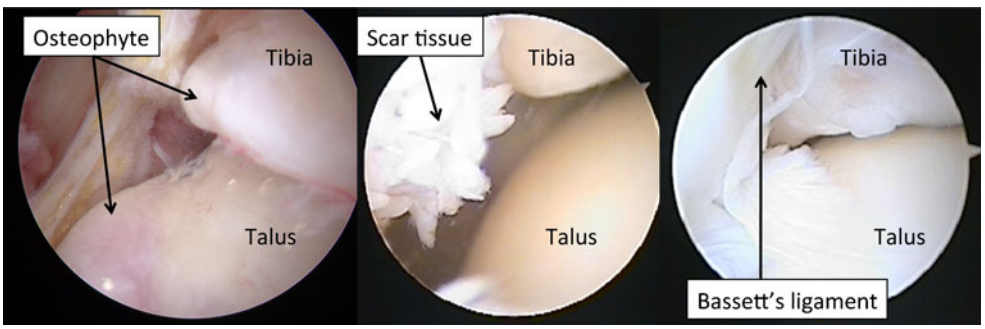


**Fig. 1** Common causes of anterior ankle impingement from left to right: tibial and talar bony impingement, soft tissue impingement and Bassett's ligament (the distal fascicle of anterior inferior tibiofibular ligament)

can evaluate associated ligament injuries and differentiate the disease from bony impingement. Synovitic lesions in excess of 10 mm are associated with impingement symptoms [32].

The CT scan can clearly distinguish osteophytes in cases with bony impingement. It is often the preferred method for identification of bony and arthritic changes if plain radiography is inadequate in evaluating these changes in detail [8]. However, for the soft tissue impingement, CT arthrography may provide evidence of impingement including intraarticular oblique linear formation, nodular thickening of the capsule, or irregularity of the edges of the anterolateral groove of the ankle [33].

Conventional MR imaging can accurately detect and localize anterior osteophytes and associated lesions. In addition, MR imaging provides an easy evaluation of any articular cartilage changes, ligamentous injury, and occult bony contusions, and it is also helpful in differentiating extra- from intra-articular causes of ankle impingement. The MR arthrography does not provide much additional information to diagnose bony impingement [34]. However, for the soft tissue impingement, MR arthrography is highly accurate in the assessment with a sensitivity of 96 %, specificity of 100 %, and an accuracy of 100 % when clinical signs of anterolateral impingement are present [35, 36]. T1 and proton density axial MRI images are the most useful sequences in diagnosing anterolateral impingement of the ankle [17, 37]. Moreover, thickened synovium in the anterolateral aspect of the ankle is a consistent finding associated with soft tissue impingement [8].

The Bassett's ligament may appear sometimes on the conventional MRI. Its thickness in the abnormal cases is significantly greater than in the normal cases. However, sensitivity and specificity of MRI using the thickness of the ligament as a sign of abnormality is still limited, so arthroscopy is still the best tool for the dynamic assessment of this entity [20].

## Non-operative treatment

Rest, physical therapy, ankle bracing, shoe modification, and local injection can be included in the first-line management for anterior ankle impingement. An intra-articular corticosteroid injection may be used in cases not responsive to conservative treatments to reduce inflammation. Patients should be treated conservatively after an inversion injury of the ankle, with adequate joint rehabilitation, peroneal strengthening, and muscle balancing before considering operative treatment [38]. Ankle bracing should be considered in those who have had ankle sprains. Varus foot alignment may be controlled with additional orthotics with lateral forefoot posting. The goals of non-operative treatment are reducing the symptoms and preventing the recurrent ankle injury.

## Operative treatment

Operative treatment is performed when all modalities of conservative treatment are unsuccessful. Goals of operative treatment are the removal of the osteophytes to restore the anterior ankle space, preventing the impingement, and reducing the chances of recurring symptoms. The open and arthroscopic methods both have been shown to be effective for bony impingement [2, 10, 18, 25].

## Open debridement

Open anteromedial longitudinal incision can be performed just medial to the tibialis anterior tendon. After incising the dorsal retinacular ligament, dissection is carried down to the ankle capsule. Partial synovectomy is helpful for improved visualization into the joint. The osteophytes on the talar neck and distal tibia are best seen with ankle dorsiflexion. Osteophytes are carefully resected, and damage to both the dorsalis pedis artery and deep peroneal nerve can be easily avoided using an intraarticular retractor. Furthermore, the open anterolateral approach can be used to improve visualization, but with this additional approach, the superficial peroneal nerve injury must be isolated carefully in order to avoid injuries [39].

Open arthrotomy for spur removal has been reported to produce good outcomes [2, 10, 18], and it can be used effectively for removing anterior osteophyte of the ankle, though it is not recommended when an osteochondral defect is associated [8]. Complications are uncommon but include cutaneous nerve entrapment, wound dehiscence, damage of the long extensor tendons, and formation of hypertrophic scar tissue.

## Arthroscopic debridement

Numerous authors have recently reported good to excellent results with arthroscopic debridement [11•, 17, 40]. Success rates of approximately 67 % to 88 % were described for the arthroscopic debridement in different case series, including both bony and soft tissue anterior ankle impingement [41•]. Advantages of the arthroscopic treatment over open arthrotomy include reduced recovery time and earlier return to sports activities [25].

## Arthroscopic resection of osteophytes

A standard supine position with anteromedial and anterolateral arthroscopic portals is used for spur removal. Distraction of the ankle joint is not necessary because

osteophytes are in the anterior compartment. Anterior tibiotalar synovectomy is begun in maximal dorsiflexion to relax the anterior capsule and withdraw the anterior tibial artery, and then intraarticular tibial and talar osteophytes are removed. Mechanical shavers and burrs must be visualized all the time and must not face dorsally towards the neurovascular bundle. Osteophytes should be resected back until the normal cortical bone of the tibia and talus can be seen. Some surgeons recommend extensive capsule release to resect the osteophytes originating from the anterior edge of the distal tibia and talar neck completely [42]. Essential in assessing complete spur removal are both a repeated range of motion examination under arthroscopic visualization and an intraoperative lateral ankle fluoroscopy [7•]. Numerous studies reported excellent results in terms of patient satisfaction, functional scores, and improved ankle range of movement [41•, 42].

## Arthroscopic AITFL resection (Bassett's ligament)

Indications for AITFL resection are 1. contact between the AITFL and the talus in the beginning of plantarflexion-inversion of the ankle, 2. increased contact between the talus and the ligament throughout complete range of motion, with abrasion of the articular cartilage, 3. bending of the fascicle on the anterolateral edge of the talus with dorsiflexion and dorsiflexion-inversion, 4. fascicle inserting onto the distal fibula, close to the origin of the ATFL [1•]. Numerous authors have reported good to excellent results in 89 % to 100 % of the patients with arthroscopic resection at an average follow-up of 3 years [19, 43, 44].

An important surgical technique is a temporary relieving distraction while resecting the AITFL arthroscopically because the AITFL lesion may not be clearly identified while using distraction [45].

## Arthroscopic synovial debridement

Numerous authors reported 84–96 % of good and excellent results for arthroscopic treatment of soft tissue impingement with an average follow-up of 2 years [17, 46–48]. Most patients had significant pain reduction, but only 26 % of them could go back to their previous level in sports [49].

## Post-operative management

A removable boot is used for ambulation and pain control. Patients are allowed to bear weight as tolerated except for cases with concomitant osteochondral lesion repair. The patient must be weaned off the boot after 2 weeks. Physical therapy then begins, with primary goals of range of motion restoration, strengthening, and endurance [6]. Return to sports is allowed after 6 to 8 weeks.

## Prognosis and complications

Based on most literature reviews, prognosis of anterior ankle impingement relates to the staging of osteoarthrosis (OA). Excellent results are obtained with arthroscopic debridement in 100 % of patients without OA. Success rates decline to 77 % in patients with grade I OA and to 53 % in case of grade II OA [14•, 50]. Associated syndesmotic lesions, cartilage damage, and repeated ankle inversion injuries after surgery have negative effects on clinical results during long-term follow-up [51, 52]. Size and location of osteophytes are not related to the outcome and pain score [53]. Ankle dorsiflexion increases 3 to 12 ° on average [11•]. However, in one study, 25 % of patients continued to have pain 2 years after surgery, needing reoperation after failure of conservative treatment [54].

Recurrence of osteophyte projection can occur after debridement. Osteophytes recurred in two-thirds of the ankles with grade I OA, but no correlation was found between the recurrence of osteophytes and the symptoms. There was increased narrowing of the joint space in 47 % of patients with grade II OA [14•].

Complication rates from the arthroscopy are reported to be approximately 9–17 % with difficulties such as neurovascular injury, reflex sympathetic dystrophy, instrument breakage, and painful scars [55, 56•, 57]. The most common complication is injury to cutaneous nerves. Unusual complications such as vascular injury, pseudoaneurysm formation of the dorsalis pedis artery, and extensor hallucis longus tendon rupture following arthroscopic debridement for impingement syndrome have been reported [58–60].

## Conclusion

A history of recurrent inversion injuries and chronic ankle pain combined with a positive dorsiflexion impingement sign are the keys to diagnosing anterior ankle impingement syndrome. Imaging of lateral ankle radiograph and the anteromedial impingement view (AMI) are helpful in diagnosing the bony impingement but not for the soft tissue impingement, which is based on clinical findings. MR arthrography is highly accurate in the assessment of soft tissue impingement. Arthroscopic debridement offers an alternative measure when conservative treatment fails. Adequate bony and soft tissue decompression is important. The best surgical outcomes are obtained in patients with no evidence of arthritis, chronic instability, or associated chondral lesions.

**Disclosure** No conflicts of interest relevant to this article were reported.

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