44 Osteochondral lesions of the ankle

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44.1 Introduction

Injuries to the articular surface of the talar dome in the ankle joint are commonly called osteochondral lesions of the talus (OLT). Other terms that refer to the same general process are osteochondral defects (OCD), osteochondritis dissecans, and transchondral fracture. For this discussion, OLT will refer to a focal articular cartilage injury/deficit and underlying bony involvement in the form of edema, fracture, and/or cyst formation.

44.2 Anatomy

The talus articulates with the tibia (tibial plafond and medial malleolus) and fibula (lateral malleolus) to form the ankle joint. The talar dome is trapezoidal in shape (broader anteriorly) and articulates with the tibial plafond, while the medial and lateral talar facets articulate with the respective malleoli. The talus has no muscular or tendinous attachments and receives much of its blood supply through its neck via branches of the dorsalis pedis and peroneal arteries. Additionally, the posterior tibial artery provides a branch to the medial aspect of the talus through the artery of the tarsal canal. Therefore, blood supply to the talar dome is supplied by this retrograde flow. OLTs have an intrinsic difficulty healing spontaneously due to the avascularity of articular cartilage and the inherent inability of healthy chondrocytes to migrate to areas of injury.

44.3 Biomechanics
OLTs can occur from a single traumatic event or repeated microtrauma (e.g., chronic instability). In the case of an inversion sprain with the foot in dorsiflexion, the lateral talar dome impacts the fibula compressing the cartilage and potentially injuring the underlying bone. With the foot in plantar flexion, an inversion-external rotation injury can cause the posterior tibial plafond to shear off a posteromedial fragment of the talar dome. Biomechanical experiments have demonstrated that central/posteromedial and anterolateral areas of the talus are those with the highest load under valgus/varus and pronation/supination stress. A singular significant traumatic event is more closely related to the deep medial lesion, whereas recurrent instability is more closely related to the wafer-like lateral lesion.\(^1\)

### 44.4 Clinical Presentation

The talus is the third most common location of osteochondral lesions behind the knee and the elbow. Patients typically present after a traumatic injury to the ankle (85%) and complain of prolonged pain, swelling, catching, stiffness, and/or instability. Severe mechanical symptoms such as catching and grinding may indicate a severe OLT and possibly a loose body. A loose body can disrupt normal joint motion secondary to displacement of the fragment and can lead to arthrosis over time. Chronic ankle pain and stiffness without improvement from standard conservative measures should increase the suspicion for OLT.

### 44.5 Pathogenesis

OLTs are comprised of both hyaline articular cartilage and its underlying subchondral bone. With regard to traumatic lesions, compressive and rotational forces crush the subchondral bone and crush/shear the cartilage. Berndt and Harty found that 57% of talar dome lesions were located medially and 43% laterally.\(^2\) Additional studies have reported that nearly all lateral lesions are related to ankle trauma, whereas only 70% of medial lesions can be linked to traumatic injury. MRI studies have demonstrated that medial lesions tend to be deeper and more well defined, while lateral lesions are more superficial and less discrete in location. Raikin et al reviewed 428 MRIs of patients with OLTs and charted the frequency of location based on a 3 x 3 grid.\(^3\) They found that the mid (equator from anterior to posterior) medial talar dome was most frequently involved (53%), followed by the mid lateral talar dome (26%). The authors suggested that higher contact pressures at the equator of the talar dome increase the likelihood of development of an OLT.\(^3\)

### 44.6 Classification (Staging)

Classification systems for OLTs are based on imaging modality.

Berndt and Harty’s original classification is based on plain radiography (Figure 1).\(^2\) Loomer et al added a stage V to this system.\(^4\)

- Stage I: Subchondral compression (fracture)
- Stage II: Partial detachment of osteochondral fragment
- Stage III: Completely detached fragment without displacement from fracture bed
- Stage IV: Detached and displaced fragment
- Stage V: Subchondral cyst present
The X-ray on the right represents a Berndt and Harty type IV on the medial talar shoulder.

Ferkel and Sgaglione developed a classification system based on CT (Figure 2).\(^5\)

- Stage I: Intact roof/cartilage with cystic lesion beneath
- Stage IIA: Cystic lesion with communication to the surface
- Stage IIB: Open surface lesion with overlying fragment
- Stage III: Nondisplaced fragment with lucency underneath
- Stage IV: Displaced fragment

Hepple et al developed an MRI classification (Figure 3).\(^6\)

- Stage I: Articular cartilage injury only
- Stage II A: Cartilage injury with bony fracture and edema (flap, acute)
- Stage II B: Cartilage injury with bony fracture and without bony edema (chronic)
- Stage III: Detached, nondisplaced bony fragment (fluid rim beneath fragment)
- Stage IV: Displaced fragment, uncovered subchondral bone
- Stage V: Subchondral cyst present
Stage IIa MRI

Figure 3. Stage IIa MRI

The Berndt and Harty classification is most classically referred to; however, MRI is the usual modality used to identify the lesion.

Arthroscopic grading systems have also been developed; however, their usefulness depends on correlation to MRI findings, as some deep lesions may be present with intact overlying cartilage. Mintz et al reviewed MRI's of 54 patients who underwent ankle arthroscopy and showed that MRI accurately evaluated the cartilage lesions seen intraoperatively.\(^7\)

Ferkel/Cheng Rating: Arthroscopic Surgical Grade Based on Status of Articular Cartilage

- Grade A: Smooth, intact, but soft or ballotable
- Grade B: Rough surface
- Grade C: Fibrillations/fissures
- Grade D: Flap present or bone exposed
- Grade E: Loose, undisplaced fragment
- Grade F: Displaced fragment

### 44.7 Physical Examination

Ligamentous laxity can be a predisposing factor by allowing the talus to be subjected to abnormal stresses during repeated subluxation events. The ankle should be tested for abnormal anterior drawer and talar tilt to evaluate the ATFL and the CF ligaments respectively. Patients with lateral lesions are generally tender over the anterolateral joint line with the ankle in plantarflexion, while patients with medial lesions are tender over the posteromedial joint line with the ankle in dorsiflexion. Effusions may often be present.

### 44.8 Imaging
Patients with an acute or chronic ankle injury with concerning exam signs should first undergo weight-bearing X-rays (AP, mortise, and lateral views). Plain radiography can be used to detect bony defects in the talar dome; however, this imaging modality will fail to recognize a purely cartilaginous injury and underlying bone edema.

MRI is the most sensitive diagnostic test for OLTs and can be used to identify lesions in bone and cartilage as well as associated ligament injuries. If X-rays are normal and an OLT is suspected, MRI is the next appropriate study. MRI has also been shown to correlate closely with visual findings on arthroscopy. Specifically, MRI will show low intensity signal on T1 images when sclerosis is present in a chronic OLT. A fluid rim of high intensity underneath the OLT on a T2 image suggests an unstable fragment.

CT is frequently helpful in documenting the precise geographic location and can be helpful for operative planning. CT has been shown to be less useful for identifying stage I (purely chondral) lesions when compared with MRI. Spect CT is an evolving modality that may increase the sensitivity for symptomatic OCD (Figure 4).

**Figure 4.** SPECT scan shows uptake in the medial gutter which correlates with pain from tibial origin and not talus. SPECT CT Courtesy of Dr. Murray Penner MD, FRCSC.

### 44.9 Conservative Treatment

Conservative treatment usually consists of immobilization and no weight-bearing for approximately 6 weeks, followed by progressive weight-bearing and physical therapy. This protocol is instituted for Berndt and Harty type I and II lesions and small grade III lesions. Large grade III and any grade IV lesions are generally considered operative candidates. Additionally, grade I and II lesions that fail non-surgical management are also operative candidates. 

Berndt and Harty reported poor outcomes for nonoperative treatment of OLTs in their original article: good in 16%, fair in 9%, and poor in 75%. A systematic review of treatment strategies for OLT by Verhagen et al in 2003 demonstrated only a 45% success rate for nonoperative treatment.

### 44.10 Operative Treatment
Goals of operative treatment are to restore the surface anatomy of the talar dome, thereby normalizing joint reactive forces and preventing the progression of arthrosis. The three categories of operative treatment are:

- Primary repair of the OLT
- Stimulation of fibrocartilage healing to fill the defect
- Transplantation of osteochondral tissue to fill the defect

OLTs can be assessed by ankle arthroscopy or by open arthrotomy with or without a medial malleolar osteotomy. A study by Muir and Amendola found that 17% of the medial talar dome and 20% of the lateral talar dome could not be accessed without osteotomy. A well-placed osteotomy will provide complete access in the sagittal plane to the respective side and allow perpendicular access for grafting and repair. An osteotomy is typically required for posteromedial OLTs, whereas lateral lesions usually lie anterior and can be accessed with simple plantar flexion.

Primary repair works best for large OCD lesions with healthy-appearing surface cartilage that is attached to a bone fragment. Fixation to the talus may be obtained with headless screws, K-wires, or absorbable pins. This type of injury is usually seen in acute injuries, and this technique typically fails in chronic lesions with sclerotic borders.

Retrograde drilling is a technique used for stable lesions with an intact chondral surface (Berndt and Harty types I and II). Drilling attempts to bring blood supply to the lesion without disrupting the articular cartilage.

Microfracture stimulates subchondral bleeding and development of a fibrin clot. Debridement of diseased cartilage and subchondral cysts prior to microfracture is of paramount importance. Awls or drills are used after sufficient debridement to perforate the base of the lesion (3-4 mm apart) and bring mesenchymal stem cells, growth factors, and healing proteins to the defect. This fibrin clot heals in the defect and eventually becomes fibrocartilage (type I cartilage), which fills the void but lacks the organized structure of hyaline cartilage (type II cartilage). Fibrocartilage possesses inferior wear characteristics to hyaline cartilage, which has led investigators to develop articular cartilage transplantation.

Restoration of articular cartilage can be achieved by osteochondral autograft or allograft transplantation (OATS, mosaicplasty), autologous chondrocyte implantation (ACI and MACI), and fresh osteochondral allografts (FOCAT).

Osteochondral plugs are cylinders of articular cartilage with underlying bone. They are usually harvested from the femoral condyle or trochlea and placed into the freshly debrided lesion with a press-fit technique (Figure 5). Host donor tissues require a second operative site, but carry no disease transmission risk.
Figure 5. OATS plug on medial talus

The ACI technique implants cultured autologous chondrocytes under a periosteal or synthetic patch to stimulate the growth of hyaline-like cartilage in the defect. MACI utilizes a collagen matrix to deliver the cells without the need for a periosteal patch. These techniques require a previous procedure to harvest the cells and only address the chondral surface of a lesion. Therefore deep lesions are not well suited for this technique.

FOCAT uses an entire fresh talus to contour the allograft to the precise measurements of the OLT (Figure 6). This technique possesses the advantage of recreating the complex surface anatomy of the defect, especially the shoulder of the talus that is not well addressed by the other methods. FOCAT also allows the surgeon to treat large lesions with underlying cysts. Drawbacks are risk of disease transmission and subsidence if the graft fails to incorporate fully.

Fresh bulk talar graft secured to native talus with access through medial malleolar osteotomy

44.11 Controversy
OLTs vary greatly in terms of location, depth, etiology, and response to treatment. A systematic review of 16 studies with 165 patients who underwent excision, curettage, and microfracture of a grade III or worse OLTs produced an 88% rate of successful outcomes. Excision and curettage alone produced a 78% success rate, and excision alone produced a 38% success rate. This has led to microfracture assuming the gold standard role in treatment of OLTs. The inability of this treatment to restore hyaline articular cartilage has opened the door to newer treatment options that attempt to achieve a more durable and/or anatomic repair.

44.12 References