Osteochondral Lesions of the Talar Dome

Series Editor:
Robert T. Trousdale, MD
Associate Professor of Orthopaedic Surgery, Mayo Graduate School of Medicine, Consultant, Department of Orthopaedic Surgery, Mayo Clinic, Rochester, MN

Contributing Authors:
Diane L. Dahm, MD
Associate Professor of Orthopaedic Surgery, Mayo Graduate School of Medicine, Consultant, Department of Orthopaedic Surgery, Mayo Clinic, Rochester, MN

James Manzanares, MD
Fellow in Pediatric Orthopaedics, Nemours Children’s Clinic, Jacksonville, FL

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I. INTRODUCTION

Osteochondral lesions of the talar dome are a relatively common cause of ankle pain and disability, and they are often missed in the routine evaluation following ankle injury. Alexander Munro was the first person to describe osteochondral loose bodies of the ankle joint in 1956. Since that time, terminology used in describing these lesions has included osteochondral fracture, which implies traumatic origin, and osteochondritis dissecans, which generally implies ischemic origin. For the purposes of this review, the term “osteochondral lesion” will be used to describe any acute or chronic injury involving the articular surface of the talar dome.

II. ANATOMY OF THE TALUS

A. The talus has 3 parts: the body, neck, and head.
B. 60% of the talus is covered by articular cartilage.
C. The superior surface of the talar body is wider anteriorly than posteriorly and articulates with the distal surface of the tibia. Otherwise known as the talar dome, the superior surface of the talar body is the most common site for osteochondral lesions in the ankle joint.
D. Blood supply (Figure 1)
   1. The posterior tibial artery gives rise to the artery of the tarsal canal, and this artery provides the main blood supply to the talar body, supplying one half to two thirds of the body’s middle section.
   2. The deltoid branches of the posterior tibial artery supply the medial one third of the talar body.
   3. Branches of the artery of the sinus tarsi supply the lateral one eighth to one quarter of the talar body.

III. ETIOLOGY

A. Ischemia
   1. Ischemic necrosis of subchondral bone may lead to separation of an osteochondral fragment.
   2. Environmental factors such as alcohol abuse and steroid use as well as hereditary and endocrine factors may play a role in the development of lesions in the absence of trauma.
   3. Ischemic etiology is thought to be more common in medial talar dome lesions.

B. Trauma
   1. Isolated incidents of macrotrauma or cumulative microtrauma are now thought to be responsible for most osteochondral talar dome lesions. In a review of more than 500 osteochondral talar dome lesions, Flick and Gould found that 98% of lateral lesions and 70% of...
medial lesions were associated with a history of trauma.\(^4\)

2. **Lateral lesions.** These lesions are generally thought to be true osteochondral fractures and are almost always associated with an acute traumatic episode.\(^4\) The mechanism of injury in lateral lesions is generally an inversion force to a dorsiflexed foot with internal rotation of the tibia, causing impaction of the talus against the articular surface of the fibula.\(^5\)

3. **Medial lesions.** These may be traumatic or atraumatic in origin. The mechanism of injury typically is a force through a plantar flexed foot with external rotation at the tibia, causing impaction of the articular surface of the tibia against the superomedial ridge of the talus.\(^4\)

### V. EVALUATION

A. An algorithm of an approach to evaluation of suspected talar dome lesions is shown in Figure 2.

B. **Clinical presentation**
   1. Patients often present with history of inversion injury to the ankle or “ankle sprain.”
   2. Symptoms may be intermittent, vague, and increased with weight bearing.
   3. Chronic symptoms of stiffness, swelling, catching, clicking, locking, and giving way may occur.

C. **Physical examination**
   1. Examination may reveal localized tenderness, decreased range of motion, crepitus, and swelling, although no signs are pathognomonic for osteochondral talar dome lesions.
   2. Lateral lesions are painful with direct palpation, particularly with the ankle held in plantar flexion.
3. With medial lesions, there may be tenderness anteriorly with the ankle in plantar flexion or posteromedially with the ankle in dorsiflexion.

4. Lateral ligamentous laxity may coexist with osteochondral talar dome lesions.

D. Imaging

1. Plain radiographs (Figure 3)
   a. Anteroposterior, lateral, and mortise views of the symptomatic and asymptomatic opposite ankle should be performed.
      1) Anteroposterior and mortise views in both plantar and dorsiflexion may increase the sensitivity of the radiograph examination.
      2) Anteroposterior radiograph in plantar flexion may increase visualization of the medial talar dome.
      3) Mortise view in dorsiflexion may increase visualization of the lateral talar dome.

   b. Stress radiographs should be considered if ligamentous laxity is suspected.

2. Technetium-99m bone scan
   a. Increased uptake in the area of a talar dome lesion is demonstrated; hyperemia is present in the blood pool phase.
   b. Sensitivity increases if the scan is performed after 48 hours from injury.
   c. Bone scan is often used in the subacute setting when plain radiographs are negative.
   d. Because bone scan has low specificity, further investigation with computed tomography (CT) or magnetic resonance imaging (MRI) is generally warranted.

3. Computed tomography scan (Figure 4)
   a. CT is the most effective method for evaluating the osseous anatomy of talar dome lesions.
   b. Coronal and axial views should be obtained.

4. With medial lesions, there may be tenderness anteriorly with the ankle in plantar flexion or posteromedially with the ankle in dorsiflexion.

4. Lateral ligamentous laxity may coexist with osteochondral talar dome lesions.

Figure 2. Evaluation for suspected talar dome lesions. CT = computed tomography; MRI = magnetic resonance imaging; OCL = osteochondral lesion.
4. **Magnetic resonance imaging** (Figure 5)
   a. MRI is most sensitive for detecting early nondisplaced lesions.
   b. It provides detail sufficient to image other lesions that may be responsible for the patient’s symptoms, such as tendon and ligament injury or soft tissue impingement lesions.

E. **Arthroscopy** (Figure 6)
   1. This procedure is the most reliable method for determining the status of the articular cartilage and the degree of displacement of the osteochondral talar dome lesion.
   2. It allows for definitive diagnosis and treatment in most cases of osteochondral talar dome lesions refractory to nonoperative management.
VI. CLASSIFICATION

A. **Radiographic** (Berndt and Harty)\(^5\) *(Figure 7)*
   1. Stage I: small subchondral compression fracture
   2. Stage II: partial avulsion of a fragment
   3. Stage III: complete avulsion of a fragment without displacement
   4. Stage IV: avulsed fragment displaced within the joint

B. **Computed tomography classification** (Ferkel)\(^8\)
   1. Stage I: cystic lesion within the dome of the talus, intact roof on all views
   2. Stage IIA: cystic lesion with communication to talar dome surface
   3. Stage IIB: open articular surface lesion with overlapping undisplaced fragment
   4. Stage III: undisplaced lesion with lucency
   5. Stage IV: displaced fragment

C. **Magnetic resonance imaging classification** (Anderson)\(^9\)
   1. Stage I: subchondral trabecular compression; plain radiographs normal but positive bone scan, marrow edema on MRI
   2. Stage IIA: formation of subchondral cyst
   3. Stage IIB: incomplete separation of fragment
   4. Stage III: unattached, undisplaced fragment with presence of synovial fluid around fragment
   5. Stage IV: displaced fragment

D. **Arthroscopic classification**
   1. Ferkel classification\(^10\)
Table 1. Staging System for Classifying Osteochondral Lesions of the Talus

<table>
<thead>
<tr>
<th>Stage</th>
<th>Arthroscopic</th>
<th>Magnetic Resonance Imaging</th>
<th>Radiographic (Berndt and Harty)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Irregularity and softening of articular cartilage, no definable fragment</td>
<td>Thickening of articular cartilage and low signal changes</td>
<td>Compression lesion, no visible fragment</td>
</tr>
<tr>
<td>II</td>
<td>Articular cartilage breached, definable fragment, not displaceable</td>
<td>Articular cartilage breached, low signal rim behind fragment indicating fibrous attachment</td>
<td>Fragment attached</td>
</tr>
<tr>
<td>III</td>
<td>Articular cartilage breached, definable fragment, displaceable but attached by some overlying articular cartilage</td>
<td>Articular cartilage breached, high signal changes behind fragment indicating synovial fluid between fragment and underlying subchondral bone</td>
<td>Nondisplaced fragment without attachment</td>
</tr>
<tr>
<td>IV</td>
<td>Loose body</td>
<td>Loose body</td>
<td>Displaced fragment</td>
</tr>
</tbody>
</table>


VII. TREATMENT OPTIONS

A. General
1. Indications for treatment of osteochondral talar dome lesions are somewhat controversial.
2. Generally, treatment should be based on patient symptoms, taking into account size, location, displacement, and chronicity of the lesion, as well as patient age.
3. Radiographic appearance does not necessarily correlate with clinical outcome following treatment.6
4. No long-term natural history studies exist for untreated osteochondral talar dome lesions.

B. Nonoperative management
1. This approach consists of cast or brace immobilization and protected weight bearing for 6 to 12 weeks, followed by increasing pain-free range of motion exercises and strengthening along with proprioceptive training.
2. A nonoperative approach is indicated for initial management of stage I and II lateral and medial lesions and stage III medial lesions.13,14
3. Most authors agree that delay in operative treatment resulting from a trial of nonoperative therapy does not adversely affect the results of later surgical management.
However, Pettine and Morrey\textsuperscript{13} found that delaying surgery beyond 1 year had an adverse effect on outcome.\textsuperscript{3,4,13,15}

C. \textbf{Operative management}

1. \textbf{General indications}
   a. Symptomatic lateral stage III lesions and medial stage III lesions that have failed a trial of nonoperative management
   b. Acute or chronic symptomatic stage IV (completely displaced) lesions
   c. Stage III and IV lesions occurring concomitantly with ankle fractures requiring open reduction and internal fixation
   d. Recently, surgical treatment has been advocated for all symptomatic MRI and CT stage III and IV lesions.\textsuperscript{6}

2. \textbf{General surgical techniques}
   a. Open ankle arthrotomy has traditionally been performed for excision of loose bodies, joint debridement, and drilling or abrasion at the site of the osteochondral talar dome lesion.
   b. Distal tibial articular surface grooving and medial or lateral malleolar osteotomy have been used to increase exposure, particularly for more posteriorly located lesions.
   c. Ankle arthroscopy has emerged as an important tool for both diagnosis and treatment of osteochondral talar dome lesions.
      1) A 2.7-mm small-joint arthroscope is typically used in combination with noninvasive distraction techniques.
      2) Arthroscopy allows for excellent visualization of the entire joint surface and results in less morbidity compared with open approaches.
      3) It may be used alone or in combination with percutaneous or open approaches.

3. \textbf{Specific methods}
   a. \textbf{Internal fixation of osteochondral talar dome lesions}
      1) \textbf{Indication}. This method is indicated in younger patients with acute traumatic lesions greater than or equal to 1 cm in diameter.\textsuperscript{3}
      2) The fragment should have adequate attached subchondral bone.
      3) \textbf{Approach}
         a) Internal fixation of posteromedial lesions generally requires a medial malleolar osteotomy for optimal exposure.
         b) Internal fixation of anterolateral lesions may be performed via open anterolateral arthroscopy or arthroscopically assisted percutaneous techniques.

   4) \textbf{Methods of internal fixation}
      a) \textbf{Kirschner wires}
         i) \textbf{Technique}. Wires may be placed retrograde through the sinus tarsi or using a transmalleolar approach.
         ii) \textbf{Advantage}. Arthroscopy is typically not required.
         iii) \textbf{Disadvantages}. Wires must be removed and do not allow for compression.

      b) \textbf{Small compression screws}
         (ie, Herbert screws or similar)
         i) \textbf{Technique}. Open arthroscopy with or without medial malleolar osteotomy is required.
         ii) \textbf{Advantage}. Compression may be achieved.
         iii) \textbf{Disadvantage}. Screws must be removed.

      c) \textbf{Bioabsorbable pins}
         i) \textbf{Technique}. Open arthroscopy with or without medial malleolar osteotomy.
         ii) \textbf{Advantage}. Pin removal is not required.
         iii) \textbf{Disadvantages}. Compression cannot be achieved, and there is a theoretical risk of local reaction or bone resorption with degradation of bioabsorbable implants.

   b. \textbf{Drilling}
      1) \textbf{Indication}. Drilling is indicated when there are nondisplaced lesions with intact overlying articular cartilage. Theoretically, drilling increases vascularization and healing of the osteochondral fragment.
      2) \textbf{Approach}. Medial lesions may be drilled using an antegrade transmalleolar technique or retrograde technique through the sinus tarsi under
arthroscopic guidance. Lateral lesions are typically accessible for drilling via the anterolateral portal or an accessory lateral portal.

3) **Technique.** The general technique involves perforating the lesion with multiple drill holes; a small Kirschner wire (0.062 in) is typically used.

c. **Bone grafting**
   1) **Indications.** Bone grafting is indicated for partially detached lesions with intact articular surface and large subchondral cyst formation.
   2) **Approach.** Transmalleolar and retrograde transtalar approaches have been described.16,17
   3) **Technique.** The involved bone is curetted beneath the articular surface and autogenous cancellous or corticocancellous bone grafting is performed.

d. **Osteochondral fragment excision and debridement**
   1) **Indications.** Excision and debridement is indicated for small acute symptomatic lesions or chronic detached osteochondral lesions.
   2) **Approach.** Excision/debridement may be performed open or arthroscopically.
   3) **Technique.** The loose fragment is excised and then debridement of the bony bed is performed using curetage, burr, drilling, or microfracture.
   a) In theory, penetration of subchondral bone disrupts subchondral blood vessels and encourages formation of fibrocartilaginous repair tissue at the articular surface.18
   b) Long-term results of drilling appear to be superior to results of abrasion.19

4. **Postoperative management.** This should be tailored to the individual patient but in general consists of 6 weeks of no weight bearing, early range of motion, and progression of rehabilitation, including strengthening, proprioceptive training, and plyometric activities.

5. **Treatment of combined osteochondral talar dome lesions and lateral ligament instability**
   a. When an acute osteochondral fracture and lateral ligament instability occur together, surgical treatment of the osteochondral lesion and nonsurgical treatment of the lateral ligament injury is indicated initially. Lateral ligament reconstruction is indicated only if instability symptoms persist.
   b. Chronic osteochondral talar dome lesions in association with chronic lateral ligamentous laxity should be treated in a staged manner if both are sufficiently symptomatic.
      1) The osteochondral lesion is treated initially because early postoperative motion is generally required.
      2) Reconstruction of the lateral ligament is performed as a staged second procedure because a significant period of postoperative immobilization is required.

D. **Results of operative management**
   1. Surgical treatment of stage III and IV lesions yields good early results in 63% to 88% of patients.9,13–15
   2. Patients may improve up to 18 to 24 months postoperatively. Long-term prognosis is still guarded, with symptoms and radiographic evidence of arthrosis often reported.20

3. **Prognostic factors**
   a. **Age.** Patients younger than 25 years exhibit more improvement following surgery than those older than 25 years.21
   b. **Stage of lesion**
      1) Van Buecken demonstrated that (Berndt and Harty) stage II and III lesions have excellent results more often than stage IV lesions.22
      2) Condition of the overlying cartilage (arthroscopic stage) may also affect prognosis; however, evidence for this association is not conclusive.20
   c. **Acuteness of the lesion.** The best surgical results likely occur when there is a delay of less than 12 months from injury to treatment.13,21
   d. Prognostic factors relative to lesion location and patient activity level have not been conclusively defined.

4. **Radiographic appearance of the osteochondral lesion at follow-up.** The presence or absence of radiographic bony healing has not
been found to correlate with clinical results in lesions treated conservatively or surgically.\(^5\),\(^20\),\(^22\)

5. **Arthritis.** Approximately 50% of patients can be expected to develop some evidence of degenerative arthritis regardless of the type of treatment.\(^14\)

**VIII. RECENT ADVANCES IN OPERATIVE MANAGEMENT**

A. **Osteochondral autograft transfer/mosaicplasty** (Figure 8)

1. This technique involves osteochondral cylindrical graft harvest from the ipsilateral knee with transfer into the talar defect using specially designed tube chisels.
2. Excellent early results have been reported for displaced osteochondral talar dome lesions averaging 1 cm\(^2\) in size.\(^23\) However, concerns regarding long-term donor site morbidity remain.\(^24\)

B. **Autologous chondrocyte implantation**

1. This technique involves harvest of autologous chondrocytes and placement of cultured chondrocytes within the osteochondral talar defects in a 2-stage procedure.\(^25\),\(^26\)
2. Autologous chondrocyte transplantation has been studied extensively for lesions of the knee, and early results show some promise for the treatment of displaced osteochondral talar dome lesions.\(^25\),\(^27\)

C. **Periosteal arthroplasty**

1. This technique involves harvest of periosteum from the distal tibia and transplantation to the osteochondral talar dome defect in a single-stage procedure.\(^28\)
2. Early results hold promise for salvage treatment of symptomatic osteochondral talar dome lesions after failure of traditional techniques.

**IX. SUMMARY**

A. Osteochondral lesions of the talar dome are a relatively common cause of ankle pain and disability, and careful clinical and radiographic evaluation is required for accurate diagnosis in the patient presenting with pain following an ankle injury.

B. Once the osteochondral talar dome lesion is identified, further imaging is typically required to determine the exact extent and location of the lesion and to plan appropriate treatment.

C. Treatment should be based on patient symptoms, with specific attention to size, location, displacement, and chronicity of the lesion as well as patient age and activity level.

D. A nonoperative approach is used to treat stage I and II medial and lateral lesions and stage III medial lesions initially; surgical treatment is reserved for those exhibiting persistent symptoms.
E. Symptomatic lateral stage III lesions and all symptomatic stage IV lesions should be treated operatively for best results.

F. Short-term results are generally satisfactory, but long-term prognosis is guarded.

REFERENCES

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