DOME FRACTURE OF THE TALUS
A Report of Ten Cases

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The dome of the talus is the part that articulates with the ankle mortice formed by the lower articular surfaces of tibia and fibula. A fracture of this part of the talus may be called a dome fracture. Such fractures are not common and the significance of the original radiographic appearance is not always appreciated. Definitive treatment is therefore often unnecessarily delayed; this has been true in our cases as well as in most published series. For this reason we think it is worth reporting a consecutive series of ten cases at Glasgow Royal Infirmary between September 1969 and March 1972. The total number of cases of fracture and dislocation of the ankle over this period was 1,282.

Alexander Monro first reported loose cartilaginous bodies in the knee joint in 1737 and ascribed them to trauma, but it was 1932 before Rendu reported an intra-articular fracture of the talus. In 1943 Watson-Jones noted eight chip fractures of the talus among ninety-seven cases of fracture and fracture-dislocation of the talus and navicular. Of twenty-nine cases of fracture of the talus reported by Kleiger in 1948, six affected the dome. In 1952 Coltart reviewed the statistics of the Royal Air Force from 1940 to 1945 recording 25,000 fractures of all bones. Among 4,000 fractures of the ankle and foot were fifty-six chip fractures of the talus. Marks (1952), Rödén, Tillegård and Unander-Scharin (1954) and Nisbet (1954) reported fractures of the dome, and Cameron (1956) reported a medial lesion which healed with prolonged rest and would seem to have been a dome fracture.

Berndt and Harty (1959) in an authoritative article reported twenty-four cases and found another 190 in the literature. They investigated the mechanism of injury and produced some experimental evidence in support of their theory that all dome fractures are caused by an inversion injury of the ankle. Lateral dome fractures, they say, are caused by inversion and dorsiflexion and affect the anterior part of the dome; medial fractures are due to plantar flexion of the ankle, slight anterior displacement of tibia upon talus, inversion of the ankle, and lateral rotation of tibia upon talus. By this latter mechanism it is the more posterior part of the dome that fractures, and radiographs may require to be taken in plantar flexion.

Berndt and Harty were the first to classify dome fractures according to site and also to stage them according to displacement: Stage I—a small area of compression of subchondral bone; Stage II—a partially detached osteochondral fragment; Stage III—a completely detached osteochondral fragment remaining in place; and Stage IV—a displaced osteochondral fragment. Most writers now agree with their views. Since they wrote in 1959, dome fractures of the talus have been reported by Rosenberg (1965), by Davidson, Steele, Mackenzie and Penny (1967) and by Gustilo and Gordon (1968).

CASE REPORTS

Case 1—A girl aged thirteen fell from a height of four feet on September 2, 1969, and twisted her left ankle. There was swelling and tenderness over the lateral malleolus and she was treated as a case of sprain. When seen at the Infirmary on October 24, 1969, radiographs showed a lateral dome fracture with the fragment upside down (Fig. 1). At operation a week later, the fragment was replaced and found to be stable with the ankle in the neutral position; it was too small for internal fixation. The ankle was immobilised in plaster for eight weeks. Although she remained symptomless, a radiograph taken in June 1971 (Fig. 2) suggested that the fragment was ununited, and in an attempt to minimise
Case 1. Figure 1—The radiograph showing the inverted fragment. Figure 2—The radiograph two years later showing non-union of the replaced fragment.

Case 1—Histological section of the fragment showing living bone cells (compare Fig. 12). (Haematoxylin and eosin, ×120.)

Case 2. Figure 4—The radiograph showing an undisplaced fracture. Figure 5—The radiograph two years later.
degenerative change the ankle was re-explored twenty-two months after the injury. There were some fibrillary changes of the articular cartilage of the talus and of the undersurface of the tibia adjacent to the fracture. The fragment was relatively mobile, being attached only by some fibrous tissue; it was therefore excised. The loose fragment measured 15·10·5 millimetres. Histological examination showed bone covered by cartilage with no evidence of avascular necrosis (Fig. 3).

Progress was satisfactory and when last seen on October 21, 1971, she had regained full movement and was completely symptomless. The radiograph, however, still showed marked irregularity of the articular surface and the prognosis must therefore be guarded.

Case 2—A young man aged seventeen twisted his right ankle on October 26, 1969. On examination there was acute tenderness over the lateral ligament and radiographs showed an undisplaced fracture of the medial dome of the talus (Fig. 4). A plaster cast for eight weeks was followed by elastic support and partial weight-bearing for two weeks. Ten weeks after the injury he had no symptoms and radiographs showed the fracture uniting. When last seen in January 1972 he was again symptomless; ankle movements were full apart from slight loss of dorsiflexion. Radiographs showed the fracture well healed but two small calcified bodies were seen at the tip of the medial malleolus (Fig. 5).

Case 3—A man aged forty-one sustained a twisting injury of the left ankle on March 13, 1970, causing pain and swelling. He was treated conservatively. When seen at the Infirmary in March 1972 he complained of occasional attacks of pain over the antero-lateral aspect of the ankle for the previous three months. Clinically there was no abnormality but a radiograph showed an old fracture of the lateral dome of the talus with minimal sclerosis at the site (Fig. 6). Fifteen months after operation full movement of the ankle had been regained and radiographs showed no further change.

Case 4—A boy aged eight attended this hospital on September 24, 1969, with a history of a fall of six feet on to the edge of a concrete slab, injuring the left ankle. A radiograph revealed a large displaced osteochondral fragment in the region of the anterior part of the dome of the talus (Fig. 7). Open reduction was performed a week later. The large fragment broken from the dome was reduced and noted to be stable in full dorsiflexion of the ankle. A below-knee plaster cast was applied with the ankle fully dorsiflexed and retained for six weeks. When last seen in June 1971, twenty-one months after the injury, he had no complaints and full movement of ankle and foot. The radiograph now showed the fracture completely healed (Fig. 8).
Case 5—A man aged thirty-seven suffered an inversion injury of the left ankle on September 8, 1970. At that time there was tenderness, pain and swelling over the lateral malleolus and he was unable to bear weight. A radiograph showed a medial fracture of the dome of the talus (Fig. 9), but the significance of this was not recognised and he was treated by a supporting bandage and crutches.

He appeared again in February 1972 after another twisting injury causing severe pain. The ankle joint was distended and there was tenderness anteriorly, particularly in front of the medial malleolus. A radiograph showed the fracture line still present with a sclerotic margin suggesting non-union (Fig. 10). It was thought that the fragment was probably loose and the ankle was explored the next day. The joint was full of blood and there was some fibrillation of the articular cartilage of the medial dome but no break in its continuity. It was assumed that there was strong fibrous union and the wound was closed. The ankle was immobilised in a below-knee cast for four weeks, with no weight-bearing for a further week.

When last seen in April 1972, nine weeks after the operation, he had no symptoms and a full range of movement.

Case 6—A girl aged fourteen first attended the Casualty Department of this hospital on June 4, 1970, for a twisting injury of the left ankle. A radiograph showed a lateral dome fracture of the left talus (Fig. 11). She was treated conservatively in a plaster cast for eight weeks. However, pain, swelling and instability of the ankle persisted and a radiograph in June 1971, twelve months after the injury, revealed a defect in the lateral dome of the talus but no loose body. In July 1971 the ankle was explored through an antero-lateral approach and an osteochondral loose body measuring 10 by 5 millimetres was found and removed from the outer side of the joint. The defect of the lateral dome...
was covered with firm fibrous tissue. Histological examination of the loose body showed appearances of avascular necrosis of bone with degenerative fraying of the articular cartilage (Fig. 12). She remained non-weight-bearing for three weeks and then gradually resumed normal activities. When last seen in December 1971 she was completely symptomless, with full movement of the ankle and foot and no swelling.

Case 7—A boy aged fifteen attended this hospital on October 16, 1970, with a history of a twisting injury of the right ankle sustained at football a week previously and of a similar injury two years previously. The radiograph showed a defect in the lateral dome of the talus, with three loose bodies lying on the lateral side of the ankle joint in front of the anterior margin of the tibia (Fig. 13). The ankle was explored in February 1971 through an anterolateral approach. Three separate osteochondral fragments were found lying free in the joint and were removed. The lateral part of the dome of the talus was markedly rough from degenerative changes. He made an excellent recovery.

When last seen in June 1971, thirty months after the initial injury and eight months from operation, he had no symptoms and full movement of the ankle. A radiograph showed a defect of the lateral dome (Fig. 14).

Case 8—A man aged twenty-four fell from a height of some twenty feet on February 4, 1971, and twisted his left ankle. Initially he was treated at another hospital as a case of fractured lateral malleolus. When seen at the Infirmary three weeks later a fracture of the lateral dome was found (Fig. 15). In March 1971 the ankle was explored through an anterolateral approach; a large osteochondral fragment with a few small loose fragments was found over the lateral part of the dome of the talus. The small fragments were removed; the large fragment was accurately reduced and fixed with a screw. A long leg plaster was applied and maintained for ten weeks. Radiographs then showed the fracture to be healed but with a slight step in the articular surface.

When seen in September 1971 six months after operation, the patient had no complaint. Dorsiflexion of the ankle was full but plantar flexion was limited by ten degrees. Eversion movement was full and inversion moderately restricted. All movements were completely pain-free. A radiograph showed the fracture soundly healed (Fig. 16).

Case 9—A man aged twenty-three sustained an inversion and plantar flexion injury of the right ankle in a road traffic accident on March 16, 1972. The ankle was grossly swollen, with acute tenderness over the anterolateral and lateral aspects. A radiograph revealed a medial dome fracture of right talus (Fig. 17). He was treated conservatively in a plaster cast. In July 1972 he had no symptoms, ankle movement was only slightly restricted, and the radiograph showed union.

Case 10—A man aged twenty-one sustained an inversion injury of the right ankle on March 24, 1972. The radiograph revealed a lateral dome fracture with minimal displacement (Fig. 18). He was treated conservatively in a plaster cast. By August 1972 ankle movements were full and painless. Radiographs showed union of the fracture.
DISCUSSION

Dome fractures of the talus are not common, and because they arise from inversion injuries the clinical picture may be dominated by the damage to the lateral ligament which is an integral part of the injury. A helpful sign is localised acute tenderness over the front of the ankle joint. Because the fracture involves the articular surface, any irregularity or loose body may lead to arthritic change. Thus Davidson and his colleagues (1967) reported twenty-one cases of dome fracture, five of which led to fusion of the ankle for the relief of disabling symptoms. Early diagnosis and treatment are therefore important. So far nine of the ten patients reported here have no residual symptoms and one has minimal disability, but two are still under treatment (Table I), but it is much too early to know the outcome of any of these ten cases.

Nine out of the ten dome fractures reported here—six lateral and three medial—were caused by an inversion injury of the ankle joint presenting as a sprain of the lateral ligament. The mechanism is probably the same as that described by Berndt and Harty—lateral fractures
by inversion and dorsiflexion, medial fractures by inversion, plantar flexion and rotation. Case 4 was a fracture of the anterior dome, a type of injury not described in the literature. The mechanism of injury in this particular fracture is probably plantar flexion and vertical compression; the anterior edge of the lower articular surface of the tibia fractures the anterior part of the dome and subsequent forward movement of the leg causes its displacement.

**TABLE I**

**ANALYSIS OF TEN CONSECUTIVE CASES OF DOME FRACTURE OF THE TALUS**

<table>
<thead>
<tr>
<th>Case number</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Site</th>
<th>Treatment</th>
<th>Follow-up (months)</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13</td>
<td>Female</td>
<td>Lateral</td>
<td>Removal</td>
<td>29</td>
<td>No symptoms</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>Male</td>
<td>Medial</td>
<td>Conservative</td>
<td>27</td>
<td>No symptoms</td>
</tr>
<tr>
<td>3</td>
<td>41</td>
<td>Male</td>
<td>Lateral</td>
<td>Conservative</td>
<td>24</td>
<td>Minimal symptoms</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>Male</td>
<td>Anterior</td>
<td>Replacement</td>
<td>21</td>
<td>No symptoms</td>
</tr>
<tr>
<td>5</td>
<td>37</td>
<td>Male</td>
<td>Medial</td>
<td>Conservative</td>
<td>19</td>
<td>No symptoms</td>
</tr>
<tr>
<td>6</td>
<td>14</td>
<td>Female</td>
<td>Lateral</td>
<td>Removal</td>
<td>18</td>
<td>No symptoms</td>
</tr>
<tr>
<td>7</td>
<td>15</td>
<td>Male</td>
<td>Lateral</td>
<td>Removal</td>
<td>8</td>
<td>No symptoms</td>
</tr>
<tr>
<td>8</td>
<td>24</td>
<td>Male</td>
<td>Lateral</td>
<td>Replacement</td>
<td>15</td>
<td>No symptoms</td>
</tr>
<tr>
<td>9</td>
<td>23</td>
<td>Male</td>
<td>Medial</td>
<td>Conservative</td>
<td>4</td>
<td>No symptoms</td>
</tr>
<tr>
<td>10</td>
<td>21</td>
<td>Male</td>
<td>Lateral</td>
<td>Conservative</td>
<td>5</td>
<td>No symptoms</td>
</tr>
</tbody>
</table>

**SUMMARY**

1. Ten consecutive fractures of the dome of the talus are reported. Six were lateral, three medial and one anterior.
2. The injury is most commonly seen in the second and third decades of life, and with the exception of the rare anterior dome fracture, results from an inversion injury of the ankle. The possibility of a dome fracture associated with strain of the lateral ligament of the ankle joint should therefore always be borne in mind.
3. Antero-posterior views in neutral and in plantar flexion are helpful in diagnosing medial dome fractures. Lateral fractures are best seen in an antero-posterior view taken in neutral flexion with 10 degrees inward rotation of the limb.
4. A large dome fracture with displacement should be accurately reduced by open operation in order to preserve congruity of the joint surface.
5. A small fracture with no displacement may be treated conservatively until radiographically it appears united.
6. A small fracture with marked displacement is best treated by early excision of the fragment to prevent further damage to the ankle joint.

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**REFERENCES**


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