OSTEOCHONDRAL FRACTURES OF THE TALUS
A LONG-TERM FOLLOW-UP

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Sixty-eight patients with 71 osteochondral fractures of the talus were evaluated an average of 7.5 years after the onset of symptoms to determine which factors influenced the final result. It was found that the type of fracture was the most important; delay in treatment also affected the result adversely. A scheme of treatment for each type of fracture is proposed.

Transchondral fracture, osteochondral fracture, osteo-
chondritis or dome fracture are all terms used to describe
similar lesions of the talus. Although this lesion has been
extensively studied (Berndt and Harty 1959; Mukherjee
and Young 1973; Yvars 1976; Alexander and Lichtman
1980; Canale and Belding 1980; O'Farrell and Costello
1982), several questions of clinical relevance remain
unanswered, such as: does delay in diagnosis or in
operative treatment affect the result; are the results
affected by the type of fracture; do the results deteriorate
with time; and what is the best method of treatment?

Our study was designed to address these questions
and to provide possible answers.

MATERIALS AND METHODS

Eighty patients with 84 osteochondral fractures of the
talus were seen at the Mayo Clinic between 1970 and
1982 (Table I). Of these patients, 68 were followed-up for
at least two years and form the basis of this study. Forty-
ine were evaluated by an interview, a questionnaire, a
physical examination and bilateral anteroposterior,
lateral and mortise radiographs of the ankles; these
patients were followed up for an average of 6.4 years
(range 2 to 21 years). The remaining 19 patients, who
could not return due to distance and work consider-
ations, were evaluated by questionnaire, a personal
interview and a review of their medical charts and
radiographs; these patients were followed up for an
average of 9.9 years (range 2 to 20 years). Thirty-three
patients (49%) had been treated elsewhere before being

Table I. Site of the lesion in 80 patients with 84 osteochondral fractures of
the talus

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of lesions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males (n = 50)</td>
</tr>
<tr>
<td>Medial</td>
<td>23</td>
</tr>
<tr>
<td>Lateral</td>
<td>28</td>
</tr>
<tr>
<td>Posterior</td>
<td>1</td>
</tr>
<tr>
<td>Anterior</td>
<td>-</td>
</tr>
<tr>
<td>Midline</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>52</td>
</tr>
</tbody>
</table>

seen at the Mayo Clinic; 22 of these had been initially
misdiagnosed and 11 had undergone operation.

Assessment. Subjective data. Information was sought
regarding the patients' general health, the date of onset
of symptoms, whether additional trauma had occurred at
the time of the fracture, if there was any swelling,
limitation of activities or difficulty in wearing shoes, and
whether subsequent treatment had been necessary.

Objective data. Physical examination comprised a gen-
eral musculoskeletal evaluation, a visual gait analysis,
measurements of the range of movement of the ankle and
subtalar joints, testing the muscle strength in the lower

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0301-620X/87/1002 $2.00

Fig. 1

Figure 1 - Numbers and types of lesions in 68 patients with
osteochondral fractures of the talus. Classification after
Berndt and Hardy (1959).
limbs, and evaluating ankle swelling, crepitus and tenderness. Radiographs were examined for joint space congruity, talar dome irregularities and evidence of osteoarthritis. Operative, pathological and radiographic reports and all the charts were reviewed.

All lesions were classified by fracture type (Berndt and Harty 1959) (Figs 1 to 5) and by results which were considered good if the patient was asymptomatic, fair if the patient had symptoms but little limitation of daily activities, or poor if symptoms interfered with or prevented daily activities.

The results for each of these four types of fracture were compared, and the overall results for all types of fracture were evaluated. Results of early operation (less than 12 months from the onset of symptoms) were compared with those after late operation to determine whether delay in diagnosis affected the results.

RESULTS
The average age at injury or onset of symptoms was 26 years (range 12 to 60 years) for men and 23 years (range 11 to 65 years) for women. The site of each talar lesion in the entire group of 80 patients is shown in Table I. Two patients had associated fibular fractures and one a distal tibial fracture; all the fractures were on the same side as the talar dome fracture.

Four patients (three men and one woman) had more than a single lesion; one of the men had traumatic, lateral Type IV osteochondral fractures of the talus on both sides. Two of the patients with 14- and 20-year histories of severe ankle pain gave no history of trauma; one had a bilateral medial Type I fracture and the other a lateral Type III fracture. One patient had a medial Type III and a lateral Type II lesion on the same talus after falling 50 feet.

Fifty-nine patients (87%) had a history of acute trauma producing symptoms in the ankle; the remaining nine had chronic symptoms but no specific history of trauma (two of these nine had bilateral lesions and seven had medial lesions).

The initial anteroposterior and lateral ankle radiographs were negative in 21 patients (31%); at follow-up, however, mortise radiographs were positive in 16 of these, while tomograms were required to visualise the lesion in the remaining five.

The initial radiographs were positive in 47 (69%) of the cases. Ankle radiographs taken an average of seven years after injury showed no signs of tibiofibular arthritis in 13 of the 22 Type I and II fractures, but the bony defect was still present; it was also seen in 37 of the 46 Type III and IV fractures and, in 21 of this group, mild to moderate articular changes were apparent. Because interim radiographs were not available, the time at which articular changes occurred remains unknown.

Treatment. Non-operative treatment in 38 patients had consisted of applying, for 4 to 8 weeks, adhesive tape, a crêpe bandage, or a below-knee plaster.

Of the 30 patients treated by operation, the fragment was excised in 25 and reattached in five (K-wire fixation was used in three). Bone pegging was also used for one Type III medial fracture and for one Type II lateral fracture. Eight patients required more than one operation (range 2 to 8). Two patients had arthrodesis of the ankle after developing severe osteoarthritis, one five years and the other six years after the initial injury; both patients had had Type IV lesions treated by excision of the fragment after more than two years of symptoms.

Pain. Almost three-quarters of the patients had some ankle pain and almost one-third had pain all the time (Table II). Residual tenderness at the sites of the fracture and the incision were other symptoms.

Table II. Symptoms in 68 patients

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some pain</td>
<td>50</td>
<td>74</td>
</tr>
<tr>
<td>Pain worse after activity</td>
<td>49</td>
<td>73</td>
</tr>
<tr>
<td>Pain all the time</td>
<td>22</td>
<td>32</td>
</tr>
<tr>
<td>Pain limiting activity</td>
<td>35</td>
<td>51</td>
</tr>
<tr>
<td>Inability to run</td>
<td>21</td>
<td>31</td>
</tr>
<tr>
<td>Inability to wear normal shoes</td>
<td>31</td>
<td>45</td>
</tr>
<tr>
<td>Ankle swelling after activity</td>
<td>34</td>
<td>50</td>
</tr>
<tr>
<td>Tenderness at fracture site</td>
<td>40</td>
<td>59</td>
</tr>
<tr>
<td>Tenderness at the site of incision</td>
<td>28</td>
<td>41</td>
</tr>
</tbody>
</table>

Movement. Physical examination revealed that 41% of the patients had normal ankle movement; 59% had a 5° to 10° loss of movement compared with the opposite (normal) ankle. Ninety-two per cent of the patients with diminished movement had decreased dorsiflexion and 38% decreased plantarflexion; nevertheless 86% of the patients walked without a limp. Subtalar movement was normal in 82% of patients but limited in the remainder.
Table III. Results of delayed diagnosis in 22 patients

<table>
<thead>
<tr>
<th>Duration of symptoms before diagnosis</th>
<th>Good</th>
<th>Per cent</th>
<th>Fair</th>
<th>Poor</th>
<th>Good</th>
<th>Per cent</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;1 year (average 3.3 years)</td>
<td>1</td>
<td>11</td>
<td>7</td>
<td>54</td>
<td>1</td>
<td>100</td>
<td>13</td>
<td>100</td>
</tr>
<tr>
<td>&lt;1 year (average 9.5 weeks)</td>
<td>3</td>
<td>33</td>
<td>6</td>
<td>46</td>
<td>2</td>
<td>50</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>56</td>
<td>—</td>
<td>—</td>
<td>3</td>
<td>20</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>9 (4*)</td>
<td>100</td>
<td>13 (7*)</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Number of patients treated by excision of fragment

The power of foot dorsiflexion, plantarflexion, inversion and eversion was normal in 92% of patients; the remaining 8% had loss of strength due to muscle atrophy from lack of use.

Does delay in diagnosis affect the result? Twenty-two patients who gave a history of trauma immediately before the onset of symptoms were initially misdiagnosed as having a sprained ankle. Radiographs in 21 of these patients were at first considered negative but those taken at follow-up showed 15 lateral fractures, six medial fractures and one posterior fracture. Nine of the patients had had symptoms longer than a year (average 3.3 years) and had had multiple examinations before diagnosis, while the rest had had symptoms for an average of 9.5 weeks before diagnosis. The initial treatment varied from none to applying a bandage, adhesive tape or plaster, depending on the severity of the ligamentous injury. Definitive treatment for these patients was by fragment excision, or plaster for 4 to 8 weeks. The results are given in Table III.

Delay in diagnosis and treatment produced poor results only if the fracture was Type III or Type IV: the fracture type appears to be the most important variable, although a delay in diagnosis also affected the results adversely.

Does delay before operation affect the result? The results of early and late operation are shown in Table IV. Type I or Type II fractures rarely required operation. With the other types, early operation (that is, within one year of the onset of symptoms) generally improved the results, especially for Type IV fractures. The only good or fair results for patients with Type IV fractures occurred in three who had had immediate excision of the fragment and in one treated by the same procedure within a year of symptoms. However, two patients with Type IV fractures who had the fragment excised within a year of symptoms had poor results. Delayed operation or non-operative treatment produced poor or unknown results in the 13 other patients with Type IV fractures. Regardless of the fracture type, results were generally worse if operation was delayed for more than 12 months after the onset of symptoms.

Are the results affected by the fracture type? The results of operative or non-operative treatment of each fracture type are compared in Table V. Overall, the results for the 68 patients were good in 27 (40%), fair in

Table IV. Results of early or late operation in 30 patients*

<table>
<thead>
<tr>
<th>Type of fracture</th>
<th>Early operation</th>
<th>Late operation†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good</td>
<td>Fair</td>
</tr>
<tr>
<td>II</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>III</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>IV</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>IV</td>
<td>7</td>
<td>5</td>
</tr>
</tbody>
</table>

* Two patients had arthrodesis after excision of fragment (Type IV fractures)
† More than one year after the onset of symptoms
‡ Patients whose average duration of symptoms was 3.3 years

14 (21%), poor in 24 (35%) and unknown in three (4%). Of the patients with Type I or II fractures, 82% had good or fair results; of those with Type III or IV fractures, only 48% had good or fair results.

Retreatment of the fracture was attempted in five patients and was successful in two (one lateral Type II and one lateral Type III); the other three later required fragment excision or had a poor result.

Eight patients had had multiple operations and two had been treated by arthrodesis of the ankle; of these 10 patients, eight had poor results, one a fair result, and one result was unknown.

Do the results deteriorate with time? The final results were unrelated to the length of follow-up, the average of which was 7.9 years for the patients with good results, 7.3 years for those with fair results, and 6.7 years for those with poor results. At an average of 7.7 years after definitive treatment, symptoms were unchanged since treatment in 67% of patients, were improving in 15% and were getting worse in 18%.

On the basis of these data, we cannot conclusively say that results deteriorate with time; in most patients, they seem to be stable at about a year after definitive treatment.

DISCUSSION

The cause of osteochondral fractures of the talus is controversial: some patients have unilateral or bilateral lesions with chronic ankle pain but no history of trauma, while others (the majority) are diagnosed after trauma.

Table V. Results of operative or non-operative treatment in the 68 patients

<table>
<thead>
<tr>
<th>Type of fracture</th>
<th>Number of patients</th>
<th>Number of operations</th>
<th>With operation</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>II</td>
<td>17</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>11</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>III Medial</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>IV Medial Lateral</td>
<td>20</td>
<td>12</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>IV Medial Lateral</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>IV Medial Lateral</td>
<td>14*</td>
<td>10</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>II</td>
<td>24</td>
<td></td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

* Results in one patient unknown
† Results in two patients treated by operation unknown
The two groups are often radiographically indistinguishable (Rödén, Tillegård and Unander-Scharin 1953–1954). Berndt and Harty (1959) produced medial and lateral fractures experimentally in cadavers and demonstrated that acute trauma can produce a transchondral fracture of the talar dome. Campbell and Ranawat (1966), however, doubted whether most of these lesions were secondary to trauma. Ischaemic necrosis, abnormal patterns of vasculature, congenital factors, and spontaneous necrosis have all been proposed as aetiological factors (McCullough and Venugopal 1979; Naumetz and Schweigel 1980).

In 85% of our patients a single acute traumatic event was the cause. This figure is similar to those of other investigators (Davidson et al. 1967; Mukherjee and Young 1973; Yvars 1976; Alexander and Lichtman 1980; Canale and Belding 1980; Naumetz and Schweigel 1980). On rare occasions congenital factors, repeated minor trauma or spontaneous necrosis may predispose the talus to develop the cyst-like appearance of osteochondritis dissecans observed in other joints, as described by Campbell and Ranawat (1966). Patients with bilateral lesions, usually on the medial aspect of the talus, are probably in this non-traumatic category.

Our current treatment plan for each type of fracture is given in Table VI. It differs slightly from that of Canale and Belding (1980) in that we believe undisplaced Type III fractures should be initially immobilised whether they are medial or lateral.

Our results corroborate earlier findings that the type of fracture and the time of treatment are the most important determinants of good long-term results. A very high percentage of satisfactory results (92%) can be expected from the non-operative treatment of Type I or Type II fractures; early protection of movement may benefit cartilage healing in a Type I fracture, while immobilisation is probably important for a Type II fracture to prevent the partial lesion from extending or displacing further.

Type III and Type IV fractures present the most difficult problems. Our data suggest that any patient with a Type IV fracture with a loose fragment should have early excision; this procedure produced the only satisfactory results we obtained with this type of fracture. Non-operative treatment or excision after 12 months of symptoms was less satisfactory. Type III fractures that remain undisplaced should heal with adequate immobilisation; if displaced, however, they become Type IV fractures and should be treated accordingly.

The site of the fragment also seems to be of prognostic importance. In general, medial Type III fractures have a more favourable prognosis. The lateral lesions more commonly require operation and can usually be approached without the malleolar osteotomy needed for excision of medial lesions. The use of arthroscopy to treat these lesions has been recommended by some authors (Alexander and Lichtman 1980).

### Table VI. Recommended treatment for each type of osteochondral fracture of the talus

<table>
<thead>
<tr>
<th>Type of fracture</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Early protection of ankle movement</td>
</tr>
<tr>
<td>II and III</td>
<td>Plaster immobilisation for 4 to 6 weeks; if symptoms persist, possible excision of fragment within a year</td>
</tr>
<tr>
<td>IV</td>
<td>Immediate excision of fragment followed by early protection of movement</td>
</tr>
</tbody>
</table>

The high percentage of poor results in this series emphasises the importance of recognising these osteochondral fractures and of providing adequate initial treatment, especially for Type III or Type IV fractures. Accurate differentiation of the type of fracture is often very difficult, if not impossible, on plain films. Zinman and Reis (1982) recommended CT scanning and, if the lesion cannot be accurately defined with routine views, we agree.

All patients with an osteochondral fracture of the talus, especially those with Type III or IV fracture, should be cautioned as to the seriousness of their injury.

**Conclusion.** Our data suggest that: 1. Delay in diagnosis can affect results, especially with Type III or Type IV fractures. 2. Excision of the fragment is best reserved for symptomatic Type III and all Type IV fractures, and results are better if the procedure is performed within a year of symptoms. 3. The type of fracture is the major determinant of prognosis and CT scans are helpful in differentiating the fracture types. 4. The results do not appreciably worsen with time.

**REFERENCES**


