THE TREATMENT OF UNSTABLE ANKLE FRACTURES

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In Portsmouth early open reduction and secure internal fixation is the treatment of choice for unstable ankle fractures. It ensures accurate reduction and rigid fixation, and eliminates the need for plaster. This permits better treatment of the soft tissues immediately after operation. With early mobilisation a quick functional recovery is achieved. We consider that this fixation is best achieved by two screws (Figs. 1 and 2): one lag screw to hold the medial malleolus accurately in place and another long intramedullary screw to hold corrected the shift, tilt, twist and telescoping of the fibula. With an intact tibio-fibular ligament and a fibula restored to normal length, reattachment of the posterior malleolus is not often needed. We believe that fixation in this manner is more secure than it is with wires or nails and that open operation is much easier than treatment in plaster. It must be the aim of treatment that if internal fixation is done it must be so secure that external fixation with plaster is not needed.

Over the last ten years the total number of ankle fractures treated in the Orthopaedic Department in Portsmouth was 2,323. Of these, 348 (15 per cent) were treated by open operation: 298 (85 per cent) were available to follow-up.

Those patients treated during the first two years of the study were the subject of a previous review (Denham 1964).

CLASSIFICATION OF ANKLE FRACTURES

The classification of Ashhurst and Bromer (1922), subsequently used by other authors (Bonnin 1950, Watson-Jones 1955), is used in this series. A first degree fracture shows no radiological displacement of the talus. In a second degree injury the talus is shifted or tilted sideways, and in a third degree fracture the talus is also displaced upwards.

![Fig. 1](image1.png)

![Fig. 2](image2.png)

**Fig. 1**—A fractured ankle before reduction. **Fig. 2**—After reduction and internal fixation with the screws.
Lateral rotation fractures can be further subdivided depending upon whether the foot was supinated or pronated at the time of injury (Lauge-Hansen 1950, 1952). This experimental and clinical work has shown that with increasing rotation each component of an ankle injury predictably follows the next in a set sequence. Two key factors, which may have to be established by examination under anaesthesia, are the presence of diastasis of the inferior tibio-fibular joint and the integrity of the medial ligament of the ankle. Diastasis may have occurred in a pronation fracture but this may not be obvious in the radiograph. Complete rupture of the medial ligament of the ankle with instability of the joint may also be present in a patient whose radiograph appears normal.

SELECTION OF FRACTURES FOR OPERATION

Most ankle fractures (85 per cent) are stable and only require simple conservative measures for pain and swelling. This treatment is followed by gentle restoration to full function. In this series all second and third degree fractures were treated by operation. Most first degree abduction fractures with avulsion of the medial malleolus also required operation, for, although spontaneous reduction may seem to occur, a flap of periosteum is usually trapped between the fragments. This may cause non-union with persistent disability and pain. Compound fractures were usually treated by debridement, reduction and internal fixation. Ruptured collateral ligaments were not explored or sutured. When the interosseous ligament has been broken the mortice must always be stabilised for at least four months.

TREATMENT BEFORE OPERATION

Early operation should be done before severe swelling of the soft tissues occurs. Table I shows that 81 per cent of the ankles were operated upon within the first thirty-six hours. Twenty-eight fractures when first seen were so severely displaced that the overlying skin was endangered from pressure necrosis. These were immediately reduced and splinted under general anaesthesia or heavy sedation. As soon as it was convenient to do so the fractures were stabilised by operation. Seven compound fractures were fixed internally and antibiotic cover was used for a week. Chemotherapy has not been used as a routine for closed fractures.

<table>
<thead>
<tr>
<th>Days</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>The same</td>
<td>177</td>
</tr>
<tr>
<td>The next</td>
<td>68</td>
</tr>
<tr>
<td>Third</td>
<td>13</td>
</tr>
<tr>
<td>Fourth</td>
<td>14</td>
</tr>
<tr>
<td>Fifth and over</td>
<td>26</td>
</tr>
</tbody>
</table>

THE OPERATION

Under general anaesthesia the leg is gently washed with enema soap and carefully shaved with an electric razor. An above-knee tourniquet is used. A sandbag placed under the hip rotates the leg inwards and allows access to the lateral malleolus. When it is placed under the opposite hip, outward rotation displays the medial malleolus. Straight longitudinal
incisions are used. The fracture, the anterior and posterior malleolar borders, and the tips of the malleoli are exposed by dissection. 

The medial malleolus—Interposed bone fragments and haematoma together with inturned periosteum are removed. Excision of a narrow strip of periosteum on either side of the fracture line and exposure of the anterior and posterior margins of the bone helps anatomical reduction to be obtained. Two bone hooks in the distal fragment hold this position while the medial malleolus is drilled and while the cancellous bone screw, 4 to 7 centimetres long, is inserted. The lateral malleolus is now displayed with the fibular fracture. After removing interposed soft tissue the fracture is pulled out to length with bone hooks inserted into the distal fragment. When accurately reduced the fracture is held by bone forceps. The fibular fragment is drilled longitudinally and a screw, 10 to 15 centimetres long, passes from the tip of the malleolus up the medullary cavity to hold reduction and to maintain normal length. 

The posterior malleolus usually remains attached to the fibula by the posterior tibio-fibular ligament. If the fibula is pulled out to length accurate reduction of the posterior malleolar fragment can usually be obtained. In this series only three posterior malleoli were reduced by open operation and held by local fixation. In two of these cases stiffness followed this treatment. 

Diastasis is often associated with a high fibular fracture. Intramedullary screw fixation of the fibula does not stabilise the inferior tibio-fibular joint and subsequent widening of the mortice could still occur. An oblique lag screw which passes across the inferior tibio-fibular joint while the talus is in the neutral position is used to hold the diastasis after accurate reduction of the fibular fracture has been achieved. This screw is usually removed after four months.

In a few patients a fragmented medial malleolus was held with Kirschner wires. Occasionally a circumferential wire was used in long oblique fibular fractures to prevent rotation after intramedullary screwing.

AFTER-CARE

Wool and a crepe bandage are applied. A plaster backslab is used to hold the foot plantigrade for the first twenty-four hours. This splint is then removed and mobilisation of the joints is encouraged by the physiotherapist. On the fourth day the size of the dressing is

<table>
<thead>
<tr>
<th>TABLE II</th>
</tr>
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<tbody>
<tr>
<td><strong>TIME IN HOSPITAL</strong></td>
</tr>
<tr>
<td><strong>Weeks</strong></td>
</tr>
<tr>
<td>2 or less</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5 or over</td>
</tr>
</tbody>
</table>

55 per cent returned home within 2 weeks and 81 per cent within 3 weeks.

Reduction. The sutures are removed on the tenth day. The soft tissues are supported by a crepe bandage and the patient is allowed to walk partially weight bearing with elbow crutches. Over 80 per cent of our patients were discharged within three weeks of injury with at least two-thirds of the normal ankle movements (Table II). Out-patient physiotherapy or plaster was rarely needed. Screws were not removed as a routine except in young patients who were actively engaged in sport or in those cases where there was local pain or tenderness.

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### TABLE III
**Interval: Operation to Review**

<table>
<thead>
<tr>
<th>Years</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 and 2</td>
<td>87</td>
</tr>
<tr>
<td>3 and 4</td>
<td>88</td>
</tr>
<tr>
<td>5 and 6</td>
<td>38</td>
</tr>
<tr>
<td>7 and 8</td>
<td>29</td>
</tr>
<tr>
<td>9 and 10</td>
<td>56</td>
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</tbody>
</table>

### TABLE IV
**Age on Admission**

<table>
<thead>
<tr>
<th>Age in years</th>
<th>Patients</th>
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<tbody>
<tr>
<td>20 and under</td>
<td>29</td>
</tr>
<tr>
<td>21-30</td>
<td>31</td>
</tr>
<tr>
<td>31-40</td>
<td>27</td>
</tr>
<tr>
<td>41-50</td>
<td>51</td>
</tr>
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<td>51-60</td>
<td>55</td>
</tr>
<tr>
<td>61-70</td>
<td>52</td>
</tr>
<tr>
<td>71 and over</td>
<td>53</td>
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### TABLE V
**Degree of Displacement**

<table>
<thead>
<tr>
<th>Type</th>
<th>Degree</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First</td>
<td>Second</td>
</tr>
<tr>
<td>Lateral rotation in supination</td>
<td>17</td>
<td>69</td>
</tr>
<tr>
<td>Lateral rotation in pronation</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Abduction</td>
<td>32</td>
<td>50</td>
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<tr>
<td>Adduction</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Vertical</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>61</td>
<td>144</td>
</tr>
</tbody>
</table>

### TABLE VI
**Duration of Plaster after Operation**

<table>
<thead>
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<th>Weeks</th>
<th>Patients</th>
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<tbody>
<tr>
<td>No plaster</td>
<td>207</td>
</tr>
<tr>
<td>3 or less</td>
<td>28</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>7</td>
<td>14</td>
</tr>
</tbody>
</table>

### TABLE VII
**Time to Return to Normal Work**

<table>
<thead>
<tr>
<th>Months</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 or less</td>
<td>215</td>
</tr>
<tr>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>7 or more</td>
<td>13</td>
</tr>
<tr>
<td>Retired</td>
<td>27</td>
</tr>
</tbody>
</table>
CLINICAL MATERIAL

Between January 1959 and May 1969 a total of 2,323 ankle fractures were seen and treated by the accident service of the Portsmouth Group of Hospitals. This study is based on the analysis of 298 patients who were operated upon for unstable fractures during this time. Table III shows the post-operative interval and Table IV the patient's age at the time of admission.

Seven patients with compound fractures were operated upon. In one ankle this was severe. In two it was moderate and in four cases skin damage was not extensive. Early operation, wound excision and antibiotics were helpful in preventing infection. Nine patients had fractures in other limbs as well as the broken ankle. Table V shows the distribution of fractures and the degree of displacement within individual groups. Twenty-four patients underwent internal fixation following the failure of closed treatment in plaster. The longest delay in this series was eleven weeks.

RESULTS

No patient died as a result of operation. No limb was lost and in this series there has been no need to arthrode a ankle joint. Post-operative infection occurred in eight patients. Minor wound infections in five of these cases responded to antibiotics alone. In two cases healing occurred with antibiotic therapy after the screws had been removed. One case of severe infection occurred: osteomyelitis, septic arthritis and sinus formation resulted in painful ankylosis with stiffness which involved the subtalar joint; the final result was poor. Necrosis of a skin edge occurred only twice with longitudinal incisions. Healing took place in both cases without skin grafting. Deep vein thrombosis on the side of the operation was detected clinically on five occasions. It responded to anticoagulant therapy and caused no serious complications. Inadequate fixation with subsequent displacement occurred in four cases, and a second operation had to be done. In one of these patients, who suffered from severe osteoporosis, the screws were removed and a plaster splint accepted as adequate treatment. Clinical and radiological union occurred in all but three patients, in whom the medial malleolus failed to unite; one patient had osteoporotic bones and in the other two fixation was technically poor. On discharge two-thirds or more of the normal range of ankle movement had usually returned; the remaining movement was regained with exercises at home.

Internal fixation was secure enough to dispense with plaster in 69 per cent of patients (Table VI). Delayed plaster, applied after a few weeks when a good range of movement had already been obtained, was used in some patients who for various reasons needed support for early walking. When the plaster was finally removed ankle movements returned rapidly. Table VII shows that 72 per cent had returned to work within three months. The overall results are shown in Table VIII. With both abduction and adduction fractures over 85 per cent were virtually normal at follow-up examination. Vertical force injuries always involved the articular surfaces, and resulted in stiffness of ankle and subtalar joints and a 25 per cent chance of developing post-traumatic arthritis. A large percentage of the poor results followed lateral rotation fractures in pronation. Fortunately most rotation fractures occur with the foot in supination at the time of injury. This does not cause diastasis, accurate reduction is easily obtained, and the prognosis is similar to abduction and adduction fractures. With the foot pronated an unstable lateral rotation fracture with diastasis occurs. The latter type of fracture was not always diagnosed in this series, and sometimes the fixation was inadequate; in future, results will be improved by correct diagnosis and proper fixation.

DISCUSSION

The most certain way of restoring normal function to a fractured weight-bearing joint is to obtain perfect reduction of the joint surfaces (Lambotte 1907, Lane 1914, Lewis and Graham 1940, Burwell and Charnley 1965, Colton 1971). With meticulous care this can be achieved
by closed manipulation and plaster support (Bonnin, 1950). In most hands (Cox and Laxton, 1952, Mitchell and Fleming, 1959, Cedell and Wisberg, 1962) continued fixation with plaster until union has occurred is difficult because of the changing dimensions of the injured ankle; repeated manipulations, changes of plaster and several general anaesthetics may be needed for success. Furthermore, external splintage with plaster encourages ankle and subtalar joint stiffness.

### TABLE VIII
**RESULTS IN 298 ANKLE FRACTURES**

<table>
<thead>
<tr>
<th>Type of Fracture</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Total</th>
<th>Good (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral rotation in supination</td>
<td>85</td>
<td>40</td>
<td>20</td>
<td>11</td>
<td>156</td>
<td>80:--</td>
</tr>
<tr>
<td>Lateral rotation in pronation</td>
<td>8</td>
<td>1</td>
<td>5</td>
<td>6</td>
<td>20</td>
<td>45</td>
</tr>
<tr>
<td>Abduction</td>
<td>60</td>
<td>12</td>
<td>10</td>
<td>3</td>
<td>85</td>
<td>80:--</td>
</tr>
<tr>
<td>Adduction</td>
<td>18</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>26</td>
<td>80:--</td>
</tr>
<tr>
<td>Vertical</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Anterior</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Shearing</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>172</td>
<td>56</td>
<td>37</td>
<td>33</td>
<td>298</td>
<td></td>
</tr>
</tbody>
</table>


**MOVEMENT** Full 258 (86 per cent). Moderate 28. Poor 12 (in 10 reduction was poor).

**RADIOLOGICAL ASSESSMENT** Good 259 (86 per cent). Fair 22. Poor 17.

**ARThritis** Only 9 out of 39 patients who had malunion were symptom free.

Total patients with arthritis: 26.

- Evidence of osteoarthritis before the accident: 3
- After vertical force fracture: 4
- After poor reduction: 12 (of the latter, 10 were painful)

The alternative of open operation permits accurate reduction under direct vision; the haemarthrosis, bone debris, and interposed soft tissues are removed and reduction is securely held with screws, eliminating the need for plaster and allowing early mobilisation. A full range of movement can often be obtained very quickly with this treatment.

Accurate reduction was achieved in 86 per cent of patients. Treatment in hospital, mostly in the convalescent wards, was usually less than three weeks (81 per cent). Only 13 per cent needed physiotherapy after operation and after discharge from hospital.

Over 80 per cent of patients returned to full duties at work within three months. Many were labourers who did so after severe bimalleolar or trimalleolar fractures. Early recovery of full ankle movement is the essential feature for this prompt return to work (Ellis, 1958). The loss of even a small range of movement is undesirable and in this series a 20-degree loss is classified as a poor result. This was avoided in all but 4 per cent of fractures.

We disagree with fixation of only the medial structures in bimalleolar and trimalleolar fractures (Graft, 1960, Close and Inman, 1962). We think that the fixation which it provides is inadequate to allow mobilisation and weight-bearing without added plaster support.

Those patients with good results in 1964 have not deteriorated when recently reviewed. In this series of 298 patients, which includes the 1964 cases, osteoarthritic changes were found...
radiologically in only six ankles in which the operative reduction had been good. Only two of these patients had significant symptoms. This observation confirms the findings of Wilson and Skilbred (1966). With shift or tilt of the talus 75 per cent of those injured had pain, swelling or stiffness in the ankle joint. A good result can only be expected if reduction of the fracture is good. The degree of the traumatic arthritis is directly proportional to the accuracy of this reduction.

SUMMARY
1. A series of 298 unstable ankle fractures treated during the last ten years is reviewed.
2. Open reduction and rigid fixation with two screws, with early mobilisation after operation and avoidance of plaster, achieved a high percentage of satisfactory results. Accurate reduction diminishes the incidence of traumatic arthritis and pain.

We wish to thank Mr C. M. M. Murray and Mr G. E. Dunkerley for allowing us to examine their cases during this review.

REFERENCES