A technique of fusion for failed total replacement of the ankle

TIBIO-ALLOGRAFT-CALCANEAL FUSION WITH A LOCKED RETROGRADE INTRAMEDULLARY NAIL

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Salvage of a failed total ankle replacement is technically challenging and although a revision procedure may be desirable, a large amount of bone loss or infection may preclude this. Arthrodesis can be difficult to achieve and is usually associated with considerable shortening of the limb.

We describe a technique for restoring talar height using an allograft from the femoral head compressed by an intramedullary nail. Three patients with aseptic loosening were treated successfully by this method with excellent symptomatic relief at a mean follow-up of 32 months (13 to 50).

Total ankle replacement can fail for a variety of reasons such as loosening and subsidence, malleolar impingement, malalignment, deep sepsis, extrusion of cement, dislocation, soft-tissue imbalance and problems with wound healing. Salvage may be achieved by a revision procedure, arthrodesis or transfibular amputation. Revision may not be appropriate if the loss of bone is substantial or infection is present. Arthrodesis provides a stable, pain-free platform on which to bear weight and delivers a more predictable outcome, but can present technical difficulties, problems with union and leg-length discrepancy. This is especially true if the talus is unsalvageable after debridement.

In order to overcome these problems we have used bulk allograft from the femoral head to replace the remnant of the talus. This was pre-drilled centrally and compressed with a locked intramedullary nail. This technique restores the height of the ankle without the need for distraction osteogenesis, avoiding the complications and protracted timescale of fine-wire or external fixation. It obviates the need for autologous donor bone and addresses potential problems in the joints of the midfoot. It is, however, only suitable for patients with aseptic loosening of an ankle replacement.

Patients and Methods
We describe three patients in whom Buechel Pappas Total Ankle Replacements (Endotech Inc., South Orange, New Jersey) had been removed because of aseptic loosening (Table I). Their mean age at arthrodesis was 66 years (46 to 86) and the mean time since ankle replacement was 12 years (9 to 19). The replacement had been performed for post-traumatic joint destruction in one and osteoarthritis in two. One patient had already had their original total ankle replacement revised.

Operative technique and aftercare. The joint is exposed through a lateral approach after turning down the fibula. The implants are removed and a thorough debridement is carried out, removing all cement and fibrous and necrotic tissue until healthy viable bone is exposed. This may also involve the excision of the talus down to the calcaneum. The degree of bone loss is assessed and an appropriately-sized cylindrical block of allograft femoral head is fashioned so that the correct height of the ankle may be restored. The allograft is predrilled to the diameter of the chosen nail to allow its passage and subsequent compression using an ankle salvage arthrodesis nail (Biomet Inc, Warsaw, Indiana) (Fig. 1). Slight distraction of the ankle allows the allograft to be placed so that the nail can be introduced and compressed. The medial malleolus is retained to stabilise the graft if possible. Additional cancellous bone may be harvested from the ipsilateral femoral condyle. The graft is compressed and the nail then locked proximally and distally. Finally, a plaster boot is applied and weight-bearing is protected for 12 weeks.

Each patient was followed up at intervals of three months. Radiological evidence of union was confirmed by the presence of trabeculae crossing the arthrodesis.
Results
By 12 weeks all three patients were comfortable, fully weight-bearing without plaster with no significant complications. There has been no radiological evidence of avascular collapse to date. Figure 2 shows an example of the radiological findings. The mean time to radiological union was three months (3 to 3.5). At the latest review at a mean of 32 months (13 to 50), all patients are free of symptoms.

Discussion
The management of a failed total ankle replacement is a difficult problem. The factors that need to be considered include the degree of bone loss, any malalignment, the condition of the soft-tissue envelope, the state of the adjacent joints and the presence or absence of infection. Arthrodesis is the most reliable means of treatment and is preferred to revision. A variety of techniques has been described. In 1992 Kitaoka and Romness gave details of 38 ankles in 36 patients which had been fused after the replacement failed. Of these, 13 had a malleolar resection, 20 an intercalated bone graft using either a modified Chuinard or Campbell technique, and five had a posterior tibiotalocalcaneal fusion. External fixation was used in 36 ankles and internal compression screws in two. Bone graft was used in 32 ankles and union was achieved in 33 (89%). Gabrion et al described the outcome of eight ankles fused after failed joint replacement, seven of which used autograft from the iliac crest. An anterior plate was applied in six. An infected case was treated by external fixation and another by antegrade tibial nailing across the ankle joint. Their overall rate of fusion was 87% (seven of eight). Carlsson, Montgomery and Besjakov described 21 failed ankle replacements salvaged by arthrodesis and external fixation. They achieved fusion in 13 cases (62%) at the first attempt and in four more (19%) after a further procedure. Later, the same authors described another 16 cases of failed replacement.

<table>
<thead>
<tr>
<th>Case</th>
<th>Age at arthrodesis (yrs)</th>
<th>Gender</th>
<th>Indication for ankle replacement</th>
<th>Indication for subsequent ankle fusion</th>
<th>Time since ankle replacement (yrs)</th>
<th>Thickness of the graft (mm)</th>
<th>Time to union (mths)</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>67</td>
<td>M</td>
<td>Osteoarthritis</td>
<td>Aseptic loosening</td>
<td>10</td>
<td>27</td>
<td>3.0</td>
<td>Fatal heart attack four years post-operatively</td>
</tr>
<tr>
<td>2</td>
<td>46</td>
<td>F</td>
<td>Trauma</td>
<td>Aseptic loosening</td>
<td>19</td>
<td>28</td>
<td>3.5</td>
<td>Asymptomatic at 33 months</td>
</tr>
<tr>
<td>3</td>
<td>86</td>
<td>F</td>
<td>Osteoarthritis revision</td>
<td>Aseptic loosening</td>
<td>9</td>
<td>25</td>
<td>3.0</td>
<td>Asymptomatic at 13 months</td>
</tr>
</tbody>
</table>

Table I. Details of the three patients

Fig. 1a
Photographs of a dry bone model showing the technique of arthrodesis.

Fig. 1b
which had been treated by tibiotalocalcaneal fusion with a retrograde intramedullary nail. Of these, 13 (81%) fused, 11 (69%) after a single procedure. They concluded that fusion with intramedullary nailing was preferable to fusion with external fixation. At much the same time three case reports\textsuperscript{7-9} were published which described the successful fusion of four ankles with failed replacements using intramedullary nails. Two required supplementary fibular autograft and two others needed graft from both the fibula and the iliac crest. Recently Hopgood, Kumar and Wood\textsuperscript{10} described the outcome of 23 ankle replacements which had been revised to arthrodeses using three different techniques: tibiotalar fusion with screw fixation, tibiotalocalcaneal fusion with screw fixation and tibiotalocalcaneal fusion with an intramedullary nail. They found high rates of failure with triple fusion when screws were used and recommended abandoning this method in favour of nailing. Based on their experience of 16 patients with a failed ankle replacement in five years, Kotnis et al\textsuperscript{11} published an algorithm for the management of this problem. In the presence of infection they favoured fixation with a circular frame, proximal tibial corticotomy and distraction osteogenesis to correct the discrepancy in leg length. In nine aseptic failures they used a locked intramedullary compression nail and the
distal fibula as graft. In this group, the ankle was clinically fused after a mean of 3.5 months (2.5 to 4.5) and radiologically fused after a mean of eight months (5 to 10).

Tibiotalocalcaneal arthrodesis using a retrograde intramedullary nail is a well-recognised and successful technique, and is particularly useful in salvaging complex disorders of the hind foot.\textsuperscript{12,13} Resection of bone fragments and soft tissue in severe cases can lead to a marked loss of limb length if a calcaneotibial fusion is undertaken. The technique which we describe provides a stable construct with restoration of height thereby improving the function of the midfoot.

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References