Indications

Although recent studies have discussed the use of revision total ankle arthroplasty (TAA) to manage failed initial TAA, arthrodesis remains the standard method used to salvage failed ankle arthroplasty. Typically, considerable osteolysis exists about the implant that may result in the formation of a large bony defect that must be managed with bone grafting. Occasionally, these bony defects are a result of sepsis after TAA. The authors of this chapter prefer to perform arthrodesis using an intramedullary (IM) rod with proximal dynamic locking hole. In the setting of infection, a two-stage procedure is performed. First, an antibiotic cement spacer is placed and the patient receives intravenous antibiotic treatment for 6 weeks which arthrodesis is performed using an IM rod.

Contraindications

Active sepsis is the primary contraindication to salvage arthrodesis of a failed TAA. Bone graft should not be placed at the arthrodesis site in patients with active sepsis because of the risk for recurrent infection. An internal fixation device should not be used either. However, the authors of this chapter do use an IM rod after clearance of the infection.

Alternative Treatments

Brace treatment can be attempted prior to salvage arthrodesis; however, if osteolysis becomes worse or a patient becomes considerably symptomatic, conversion to arthrodesis should proceed before more bone is lost. Although other fixation devices such as a blade plate or single or dual plating system are available, the authors of this chapter prefer to use a load-sharing IM rod because it is easier for the patient as there is no need for long-term use of an external fixator and because this construct has had success in the limited number of patients treated in this manner. In patients recently treated for sepsis, an external fixator such as a fine-wire fixator may be used because it avoids placement of a foreign body at the infected site, thereby minimizing the risk of recurrent or persistent infection.

Results

The results of arthrodesis after failed ankle arthroplasty are summarized in Table 1. Arthrodesis after failed arthroplasty has a relatively high success rate and generally results in a plantigrade, stable leg on which the patient can walk. However, because of the large bony defect that must be filled and the biologically compromised environment in the setting of failed ankle arthroplasty, the nonunion rate is higher in these patients than in patients with uncomplicated arthrodesis. Many surgeons use allograft or iliac crest autograft to fill the bony defect.

Techniques

Setup/Exposure

• The patient is placed supine on the surgical table.
• A bump is placed under the ipsilateral hip to orient the foot perpendicular to the ground.

Instruments/Equipment/Implants Required

• Standard orthopaedic instruments including osteotomes and curets are used to remove the loose prosthetic components and surrounding fibrous membrane. In general, the prosthesis is relatively easy to remove because of the presence of osteolysis.
Degenerative Conditions of the Ankle

Table 1  Results of Arthrodesis After Failed Ankle Arthroplasty

<table>
<thead>
<tr>
<th>Author(s) (Year)</th>
<th>No. of Patients</th>
<th>Procedure or Approach</th>
<th>Mean Patient Age in Years (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stauffer (1982)</td>
<td>23</td>
<td>6 prosthesis reinsertions, 17 conversions to arthrodesis</td>
<td>NA</td>
</tr>
<tr>
<td>Groth and Fitch (1987)</td>
<td>19</td>
<td>Revision TAA, ankle arthrodesis, or lesser soft-tissue work</td>
<td>58 (22–75)</td>
</tr>
<tr>
<td>Kitaoka (1991)</td>
<td>10</td>
<td>Various fixation methods</td>
<td>48.6 (33–61)</td>
</tr>
<tr>
<td>Kitaoka and Romness</td>
<td>36 (38 ankles)</td>
<td>Various fixation methods</td>
<td>56.8 (27–87)</td>
</tr>
<tr>
<td>Kotnis et al (2006)</td>
<td>16</td>
<td>Salvage with arthrodesis or revision TAR</td>
<td>63 (51–74)</td>
</tr>
<tr>
<td>Culpan et al (2007)</td>
<td>16</td>
<td>Tricortical autograft, oriented vertically with maintenance of the malleoli</td>
<td>54 (24–78)</td>
</tr>
<tr>
<td>Schill (2007)</td>
<td>15</td>
<td>Revision to arthrodesis. A retrograde locking nail was used to stabilize the TTC arthrodesis.</td>
<td>56 (46–76)</td>
</tr>
<tr>
<td>Carlsson (2008)</td>
<td>3</td>
<td>TTC arthrodesis using a titanium cage with graft</td>
<td>49 (28–71)</td>
</tr>
<tr>
<td>Doets and Zürcher (2010)</td>
<td>18</td>
<td>7 tibiotalar arthrodeses, 11 TTC arthrodeses</td>
<td>55 (27–76)</td>
</tr>
<tr>
<td>Berkowitz et al (2011)</td>
<td>24 (12 per group)</td>
<td>Ankle arthrodesis (group 1) or TTC arthrodesis (group 2)</td>
<td>Group 1: 58 (40.2–82) Group 2: 65.3 (42.7–80)</td>
</tr>
<tr>
<td>Bonnin et al (2011)</td>
<td>96</td>
<td>6 fusion, 18 revision arthroplasty</td>
<td>57 (26–81)</td>
</tr>
</tbody>
</table>

NA = not available, TAA = total ankle arthroplasty, TAR = total ankle replacement, TTC = tibiotalocalcaneal.

a Mean time between TAR and arthrodesis.
b Mean time between arthroplasty and revision.

- A retrograde IM nailing system of the surgeon’s choice should be available for fixation (Figure 1).

**Procedure**
- Typically, the anterior incision from the initial TAA procedure is used to gain access to the joint. However, if the skin of the initial anterior incision is compromised, a lateral transfibular approach may be used to expose the ankle and the subtalar joint (Figure 2, A and B).
- The loose arthroplasty components are explanted, and all of the surrounding membrane is removed using curets. The surgeon should consider sending a sample of the membrane for culture to be evaluated for indolent infection.
- Because insufficient bone remains
in the talus to anchor internal fixation devices (Figure 2, B), the authors of this chapter fuse the subtalar joint. Although it would be ideal to avoid arthrodesis of the subtalar joint, typically it is already stiff and/or arthritic.

An incision is made just anterior to the heel pad, with blunt dissection to the undersurface of the calcaneus. Dissection is done laterally and then medially to minimize the risk of injury to the lateral plantar artery and nerve (Figure 3, A).

A T-handled broach is passed from the plantar aspect of the heel, perpendicular to the plantar aspect of the foot, through the calcaneus, and across the remaining talar body into the tibial IM canal. The broach is then exchanged for a long...
smooth guide pin (Figure 3, B). The usual starting point for the broach is at the junction of the medial and middle thirds of the undersurface of the calcaneus.

• Sequential reaming to the desired implant diameter, usually the largest available within the implant system, is then done. The authors of this chapter do not overream because it may compromise rotational stability during insertion of the IM rod.

• The bony defect is then filled with bone graft. Bone graft options include freeze-dried cancellous chips with or without biologic stimulant, autograft, and femoral head structural allograft. The authors of this chapter prefer freeze-dried cancellous chips because the IM rod provides the structural support necessary as the graft incorporates. Bone morphogenetic protein-2 pads are placed along the margins of the cavitary defect. The authors of this chapter do not use autograft because of the risk of donor site morbidity, nor do they use femoral head structural allografts because they have led to a few instances of delayed settling (Figure 4).

Figure 1  Preoperative AP (A) and lateral (B) radiographs demonstrate an infected, loose total ankle arthroplasty. AP (C) and lateral (D) radiographs demonstrate maintenance of length and alignment after removal of the implant, curettage, and placement of an antibiotic cement spacer. Postoperative AP (E) and lateral (F) radiographs demonstrate solid arthrodesis using an intramedullary rod and allograft cancellous chips mixed with bone morphogenetic protein. G, Postoperative sagittal CT scan taken at 4-month follow-up demonstrates solid incorporation of the allograft.
The appropriate size IM rod is inserted into the plantar aspect of the heel. Lateral fluoroscopic views are used to confirm the appropriate depth of insertion.

Two posterior-to-anterior calcaneal screws are placed under fluoroscopic guidance to confirm the appropriate depth of insertion. AP fluoroscopic live rotational views are obtained to confirm that the screws have passed through the rod (Figure 5).

To allow for compression across both the ankle and the subtalar joints, talar screws are not placed.

The arthrodesis site is manually impacted with a mallet, and a proximal dynamic locking screw is placed through the IM rod from lateral to medial. Placement of the screw in the proximal end of the dynamic slot is confirmed on AP and lateral fluoroscopic views.

Final fluoroscopic views are obtained.

Wound Closure

- The wound is closed in layers using absorbable subcutaneous sutures and nonabsorbable cutaneous sutures.
- Skin tension should not be present during wound closure; to relieve skin tension, the underlying bony prominences should be resected.

Postoperative Regimen

The patient is placed in a posterior splint initially and, at the time of suture removal (approximately 2 weeks after surgery), is placed in a non-weight-bearing short leg cast for a minimum of 2 months. The authors of this chapter routinely obtain a CT scan before initiating weight bearing because of the risk of slow incorporation and delayed union in this complex patient population. As soon as evidence of bone healing is evident, the patient is allowed to progress to weight bearing in a walking cast or boot over a 2- to 3-week period. In general, progression to a tennis shoe or rocker-bottom shoe is permitted approximately 4 months after surgery when the patient can walk comfortably in the boot.

Avoiding Pitfalls and Complications

A common pitfall of this procedure is failure to notice a low-grade infection. The authors of this chapter routinely culture the membrane around the prosthesis and have encountered positive culture postoperatively. The few patients who presented with occult infection received antibiotics for 6 weeks. Infection did not recur in these patients.

If a low-grade infection is discovered at the time of surgery, an attempt is made to maintain the IM rod and the patient on suppressive antibiotics until...
the arthrodesis is established. The rod is removed later.

Nonunion is the most common complication. The authors of this chapter have discontinued the use of femoral head structural allografts in an attempt to minimize this complication. Settling more than 1 year after surgery has been observed and is indicative of delayed union and nonunion even in cases in which the bone appears to be healed both clinically and radiographically.

Figure 4  Preoperative AP (A) and lateral (B) radiographs demonstrate a failed total ankle arthroplasty after previous subtalar arthrodesis. Gross lucencies around the aseptic, loose arthroplasty (arrows) can be seen on both views. Postoperative AP (C) and lateral (D) radiographs demonstrate a femoral head structural allograft and intramedullary (IM) rod fixation after salvage tibiotalocalcaneal arthrodesis. AP (E) and lateral (F) radiographs taken 4 years after femoral head allograft arthrodesis demonstrate settling at the arthrodesis site. At this time, the patient had no pain at the arthrodesis site but did report mild pain at the plantar end of the IM rod.

Figure 5  Intraoperative AP fluoroscopic view shows the two screws disappearing within the intramedullary (IM) rod as the foot is rotated. This indicates that the screws did not pass outside of the IM rod.
Bibliography


