Ankle arthrodesis for failed total ankle replacement

P. Hopgood, R. Kumar, P. L. R. Wood

From Wrightington Hospital, Wigan, England

Between 1999 and 2005, 23 failed total ankle replacements were converted to arthrodeses. Three surgical techniques were used: tibiotalar arthrodesis with screw fixation, tibiotalocalcaneal arthrodesis with screw fixation, and tibiotalocalcaneal arthrodesis with an intramedullary nail. As experience was gained, the benefits and problems became apparent. Successful bony union was seen in 17 of the 23 ankles. The complication rate was higher in ankles where the loosening had caused extensive destruction of the body of the talus, usually in rheumatoid arthritis. In this situation we recommend tibiotalocalcaneal arthrodesis with an intramedullary nail. This technique can also be used when there is severe arthritic change in the subtalar joint. Arthrodesis of the tibiotalar joint alone using compression screws was generally possible in osteoarthritis because the destruction of the body of the talus was less extensive. Tibiotalocalcaneal arthrodesis fusion with compression screws has not been successful in our experience.

The improvement in outcomes of the mobile-bearing design of total ankle replacement (TAR) compared with those achieved with earlier designs has led to a resurgence of interest in replacement as an alternative to arthrodesis in some patients. However, TAR can fail because of infection, mechanical failure or aseptic loosening. Aseptic loosening may be associated with extensive bone loss, especially when the bone is osteoporotic, as is frequently the case in rheumatoid arthritis (RA) (Fig. 1). The shape of the talus, in particular the absence of a shaft, means that there is very little bone available for fixation of a revision component following a failed ankle replacement.

Nevertheless, some surgeons advocate conversion to another replacement. In 1982 Stauffer had poor results with the reinsertion of prosthetic components and recommended fusion using an iliac crest bone block and an external compression device. Other surgeons have described various techniques of fusion using either internal or external fixation. We describe our experience with tibiotalar and tibiotalocalcaneal arthrodesis using internal fixation for the management of failed TAR in patients with RA or osteoarthritis (OA).

Patients and Methods

Between 1999 and 2005 the senior author (PLRW) performed 23 arthrodeses in 22 patients (13 men, nine women) who had a failed TAR. Their mean age was 62 years (30 to 76). The underlying diagnosis was OA in 12 cases and RA in 11. In the OA group there were eight Scandinavian total ankle replacements (STAR) (Waldemar Link, Hamburg, Germany) and four Buechel Pappas (BP) prostheses (Endotec Inc., South Orange, New Jersey). In the RA group there were seven STAR, two BP and two other designs (the Liverpool and Imperial College London Hospital) that are now obsolete.

Operative technique. The joints were exposed through the previous anterior incision. The implants were removed and the joints cleared of fibrous tissue and necrotic material until healthy, viable bone was exposed. In some cases the bone loss was so extensive that this initial debridement led to opening of the subtalar joint. The tibia and talus were brought into contact with each other, albeit sometimes only over a small area such as the neck of the talus to the anterior tibia, or the medial malleolus to the calcaneum. With this technique, shortening was inevitable, but with one exception, total excision of the malleoli was avoided in order to preserve rotational stability. The entrapment of soft tissue between the bone ends was avoided. Any healthy, resected fragments of bone were packed into the resulting cavity and, in addition, bone graft from the iliac crest was used in six cases and a synthetic...
calcium sulphate preparation and/or calcium triphosphate (Stimulan, Allograft-R Biocomposite; Biocomposites Ltd., Keele, United Kingdom) in eight. An interposition bulk allograft such as the femoral head was not used as it was considered that bony union would be more likely to occur if direct apposition of healthy bone could be achieved.

**Method of fixation.** The amount of talar bone which had survived the process of loosening was assessed from the pre-operative radiographs. In the earlier cases, at operation we found that the extent of bone loss had sometimes been underestimated. Severe arthritic change or ankylosis of the subtalar joint was considered to be an indication for tibiotalocalcaneal arthrodesis (Fig. 2). Cannulated titanium screws 6.5 mm in diameter (ACE, DePuy, Warsaw, Indiana) were used for tibiotalar fusion. Screws were also used early in the series as a method of fixing the tibia to the calcaneum in a tibiotalocalcaneal arthrodesis if the subtalar joint was ankylosed. Increasing experience led us to abandon this in favour of an intramedullary nail. After operation the patients were placed in a below-knee cast or a rigid orthopaedic walker boot for a mean of 15 weeks (10 to 26).

**Patient review.** Between January 2004 and July 2005 all the patients who had undergone an arthrodesis were seen in a review clinic. The American Orthopedic Foot and Ankle Society (AOFAS) hindfoot score was used to assess function and pain. Union was ascertained clinically by the absence of detectable movement at the level of the arthrodesis, and radiologically by the presence of trabeculae crossing the level of the arthrodesis. This was not necessarily over the total area, remnants of the joint line usually remained visible.

**Results**

The mean follow-up was 29 months (12 to 60). The mean period from the original arthroplasty to arthrodesis was 41 months (13 to 92). Loosening of the components was found in all cases. In 15 ankles it was associated with a recurrent varus or valgus deformity, also described as ‘edge loading’. In one ankle the loosening was associated with a broken tibial implant (Endotec Buechel Pappas).

Table I shows the union achieved by procedure and by diagnosis. Fusion was obtained in 17 of the 23 ankles in a mean time of 15 weeks (10 to 26). Five of the six failures were in patients with RA.

**Tibiotalar arthrodesis with compression screws.** There were eight patients, all with OA, who had a tibiotalar screw fixation which went on to satisfactory union (Fig. 3). This method was not used in patients with RA because the body of the talus had been extensively destroyed and the subtalar joint was either ankylosed or severely arthritic.

---

*Fig. 1*

Intra-operative radiograph showing the extent of bone loss in a 75-year-old woman with rheumatoid arthritis where aseptic loosening occurred 85 months after Scandinavian total ankle replacement.
Aseptic loosening of a Scandinavian total ankle replacement, with subtalar ankylosis in a 55-year-old woman 60 months after replacement. This was treated by intramedullary nailing to give a sound tibiotalocalcaneal arthrodesis.
Aseptic loosening two years after Buechel Pappas ankle replacement for osteoarthritis in a 73-year-old woman. Sound union was achieved using compression screws and synthetic bone substitute to fill the void.
Tibiotalocalcaneal arthrodesis using compression screws. Screws were used to perform tibiotalocalcaneal arthrodesis in five patients, four with RA and one with OA. The results in this group were poor. Only the patient with OA went on to a successful bony union. Two patients, aged 64 and 73 years, respectively, developed a fibrous union with sound soft-tissue healing (Fig. 4); they had very little pain and were able to walk short distances in surgical footwear. They did not wish to undergo further surgery because they had no restrictions in mobility over and above those imposed by their generalised rheumatoid disease. One frail patient with severe RA had nonunion and failure of primary soft-tissue healing. The wound reduced in size over a period of six months, leaving a small sinus which required daily dressings. He was then able to walk indoors, but his general condition made further surgery inadvisable. The most serious outcome occurred in the one ankle where the lateral malleolus was totally excised in the belief that it would assist in obtaining good, bony apposition and serve as a bone graft. The wound healed satisfactorily but nonunion occurred and the absence of a lateral malleolus resulted in the ankle being grossly unstable. Infection developed after a further, unsuccessful operation, leaving the patient with a flail ankle and a discharging sinus. There was also loss of length of 4 cm. The symptoms could not be controlled with a surgical boot and calliper, and so a below-knee amputation was carried out. The patient rehabilitated extremely well and could walk comfortably, wearing an artificial limb, without needing sticks.

Tibiotalocalcaneal arthrodesis using an intramedullary nail. A total of ten patients (seven with RA and three with OA) were treated with a tibiotalocalcaneal nail. The voids were filled with a combination of local bone in all ankles, an iliac crest bone graft in six, calcium sulphate in eight, and calcium triphosphate in one. Proximal locking screws in the tibia were not used because preservation of the malleolus gave rotational stability. Eight of the ten patients achieved satisfactory union. Two patients, one aged 71 years with OA, and a second aged 55 years with RA, developed a fibrous union with which they were satisfied because they had very minor symptoms and wore normal footwear. These two, and one other, required removal of the nail because it was prominent and caused discomfort in the sole of the foot.

AOFAS scores. The mean AOFAS score at review was 61 (35 to 80). Most of these patients were limited by problems in other joints. This affected their overall mobility and contributed to the low scores. Of the 17 patients who had union, 15 were satisfied, one was somewhat satisfied and one was dissatisfied. Eight had no pain, five mild pain and four moderate pain. In these latter patients clinical examination showed no movement at the site of fusion and the pain appeared to be arising from the mid-tarsal joint. One patient had no restriction of activity, seven had limited recreational activity, five had limited daily activities, and four had severe limitation of all activity. However, the limitations were largely because of coexisting locomotor or general health problems. Six patients found benefit from a raise built into the heel and/or sole of the shoe, and two used an insole incorporating a heel raise. The other patients were offered a raise, but either declined this or abandoned it as they found it unhelpful.

Effect of the design of TAR. There were six revisions of BP prostheses, three tibiotalocalcaneal arthrodeses with a nail and three tibiotalar arthrodeses. All united. The outcomes for the STAR revisions are shown in Table II. The STAR design resurfaces the medial and lateral articular surfaces of the talus, whereas the BP does not. Consequently, the STAR requires the removal of bone from the sides of the talus, whereas with the BP these remain intact. The talar fixation fin of the STAR requires bone to be removed to a greater depth than with the BP. Preservation of more bone at the time of the primary arthroplasty with the BP than with the STAR leaves more of the body of the talus intact and, therefore, increases the likelihood of achieving union should arthrodesis become necessary. Both of the arthrodeses carried out for failure of obsolete designs failed to unite. Both were in patients with RA; one had tibiotalocalcaneal arthrodesis with screws and the other a tibiotalocalcaneal arthrodesis with a nail.

Discussion

Our results illustrate the problems encountered when trying to restore function following failed TAR. Contrary to the views of some authors, we did not find that tibiotalar arthrodesis could be achieved in every case despite the minimal amount of bone resected at the time of ankle replacement. This was true for the STAR and BP mobile-bearing designs as well as the two obsolete fixed-bearing designs which were used. Severe bone loss may develop on the talar side as the component loosens, and this may extend to the subtalar joint.
Severe recurrent deformity in a 73-year-old woman with rheumatoid arthritis. Failure of an attempted tibiotalocalcaneal fusion using screws.
Spirt et al. achieved success with a revision of the replacement when failure was largely because of a poor clinical outcome, and not loosening. The bone loss was presumably not extensive.

In some patients, even when the bone loss did not extend to the subtalar joint, the bony remnant of the talus was insufficient for fixation of a new component, and it would have required the talar component to be fixed to the calcaneum. If this had eventually loosened there would have been loss of bone from the calcaneum, resulting in only a thin shell remaining. Fusion might then have been impossible to achieve and amputation would have remained the only surgical solution. When enough of the talus remains for satisfactory screw fixation, tibiotalar arthrodesis is generally possible. In our experience this was the case with some patients with OA, but rarely for those with RA.

Eight of the ten ankles which had tibiotalocalcaneal arthrodeses with a nail united, but we had extremely poor results when attempting such procedures using screw fixation. An intramedullary nail gives firm fixation both distally and proximally and is our method of choice when tibiotalocalcaneal arthrodesis is indicated. Two recent papers from Sweden recommend tibiotalocalcaneal arthrodesis with a nail in selected patients with RA, and these also show that screw fixation should be avoided in such cases. In these series, 11 of 16 ankles treated with an intramedullary nail united after the first attempt and two after a repeat arthrodesis. Stauffer described 17 ankle arthrodeses following failed replacement, all of which progressed to a solid arthrodesis. He used a modification of the Chuinard and Peterson technique, which involved filling the defect with a corticocancellous bone block and employing a device for external fixation and compression. We have no experience with external fixation in this situation. Gabrion et al. advise external fixation only where there is infection.

If there is sufficient talar bone stock a tibiotalar arthrodesis is usually successful. This is often the case in patients with OA, but if there is significant loss of bone from the talus, or a markedly arthritic subtalar joint, we recommend a tibiotalocalcaneal arthrodesis with an intramedullary nail. Fusion following TAR is not as reliable as primary ankle arthrodesis. It is, therefore, important that guidance regarding the indications for TAR is strictly followed.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References