Tibiocalcaneal fusion for avascular necrosis of the talus

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Between 1994 and 1999, we treated six patients with avascular necrosis of the talus by excision of the necrotic body of the talus and tibiocalcaneal fusion using an Ilizarov frame. This was combined with corticotomy and a lengthening procedure. Shortening was corrected in all patients except two, who were over 60 years of age.

All patients had previous operations which had failed. All achieved solid bony fusion, with five out of six having either a good or an excellent result.

We conclude that this is an effective reconstructive technique which gives a good functional result.

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It is not possible to predict with certainty the degree of avascular necrosis which may occur after a fracture of the talus, or the severity of symptoms which will result from such an injury. Immediately after the fracture every attempt should be made to preserve the talus. If avascular necrosis occurs the results are usually disabling. We could find no published review of the types of surgery carried out at this stage. The surgical options include talectomy, tibiotalar arthrodesis, pantalar arthrodesis, tibiocalcaneal arthrodesis, or below-knee amputation. All of these procedures produce long-term problems.

Tibiocalcaneal fusion, as described by Reckling,¹ gives the best functional result, but at the expense of shortening. We have used a modification of his technique, using an Ilizarov frame to compress the arthrodesis while, at the same time, lengthening the leg at an upper tibial corticotomy. For patients over the age of 60 years we have accepted the shortening produced by the surgery and not

attempted to lengthen the leg because this extra surgical procedure increases the complications.

Patients and Methods

Between 1994 and 1999 we carried out six unilateral tibiocalcaneal fusions for avascular necrosis of the talus, using a modification of the method originally described by Reckling.¹ This was combined in patients below the age of 60 years with a proximal tibial corticotomy and callotasis distraction to correct the shortening which resulted from the talar resection.

Trauma was the cause of the avascular necrosis in five patients; the sixth had a failed primary ankle arthrodesis complicated by avascular necrosis of the talus (Table I). Their mean age was 45 years (27 to 67), and the mean number of previous operative procedures for each ankle was five (1 to 16). The mean delay from the initial injury to the time of operation for tibiocalcaneal fusion was 56 months (2 to 231).

The distal fibula was excised using a lateral incision and the peronei and extensor digitorum longus divided in a Z fashion between sutures. A medial incision allowed the necrotic body of the talus to be excised and the ankle to be dislocated medially to expose the distal tibia. Cuts were made with an oscillating saw in transverse and coronal planes as shown by the dotted line in Figure 1, with resection to healthy bleeding bone. The cut surfaces between the tibia and calcaneus were apposed so that the foot was in neutral dorsiflexion. If the head of the talus was viable, the neck was divided in the coronal plane to allow apposition with the anterior tibial cut, with the foot held in 10° of external rotation. This preserved the talonavicular joint. When the head was avascular the whole of the talus was resected. This produced a gap anteriorly and a pseudarthrosis between the front of the tibia and the navicular bone.

An Ilizarov frame was constructed to hold the foot with olive wires passing through the calcaneus and the metatarsals. The distal and proximal areas of the tibia were each held by olive wires tensioned to Ilizarov rings. The foot was held in 90° of dorsiflexion and 10° of external rotation in relation to the tibia. Compression was then applied across the site of the arthrodesis in both the transverse and coronal planes (Fig. 2).

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Table I. Details of the six patients who had tibiocalcaneal fusion for avascular necrosis of the talus

Case	Age (yr)	Gender	Initial diagnosis*	Previous treatment	Initial event to application of frame (mth)	Duration of frame (mth)	Length gain (mm)	Follow-up (mth)
1	47	F	RTA crush injury Open Hawkins III# Dislocation talus	16 previous operations including a failed ankle fusion and talectomy	231	8 initially, off for 7, developed varus, reappplied 7 total 15	38	40
2	27	F	RTA crush injury Closed Hawkins III# Dislocation talus	Operative reduction Sequestrectomy and ankle fusion with screws Revision ankle fusion with IM nail and third ankle fusion with removal of nail and bone grafting	44	14	42	29
3	35	M	RTA Closed Hawkins III# Dislocation talus	Operative reduction and screw fixation	23	11	36	13
4	30	F	RTA Open Gustilo III Hawkins III# dislocation talus	Operative reduction	2	6	25	49
5	67	M	Fusion for OA ankle, progressed to nonunion with AVN and collapse of talus	Fusion with graft and screws	20	10		41
6	61	F	Bimalleolar ankle# ORIF. Became infected Attempted ankle fusion Nonunion with persisting infection AVN talus	ORIF ankle ROM† for infection Ankle fusion with nail Debridement and insertion gentamicin beads	17	8		19

* RTA, road-traffic accident; OA, osteoarthritis; AVN, avascular necrosis; ORIF, open reduction and internal fixation

† removal of metal

Fig. 1

Diagram showing the resection margins to allow tibiocalcaneal fusion for avascular necrosis of the talus.

Fig. 2

Diagram showing positioning of the Ilizarov frame.

Fig. 3a

Fig. 3b

Case 2. Radiographs a) before tibio calcaneal fusion and b) immediately after removal of the Ilizarov frame.

A low-energy subperiosteal corticotomy was undertaken through the proximal tibial metaphysis using a Gigli saw. Driving rods were connected to allow callotasis by the standard Ilizarov technique. Distraction started on the tenth postoperative day and proceeded at the rate of 1 mm per day in four incremental steps, until the leg-length discrepancy had been corrected.

The progression of the fusion and regenerated bone was assessed by sequential radiographs. When bony fusion was achieved at the site of the arthrodesis before consolidation the foot-piece was removed. The tibial frame was maintained and the patient mobilised fully weight-bearing to help the new bone to mature. If the tibia was not lengthened, the frame was removed as soon as fusion had been achieved.

After the frame had been removed, the arthrodesis was protected for a further three months in a weight-bearing cast or a removable brace.

The results were graded clinically as excellent, good, fair and poor, according to the grading system of Kitaoka and Patzer² which specifically addresses degenerative changes secondary to avascular necrosis of the talus.

The result was considered excellent if the patient had no pain, or no limitation in daily or recreational activities, did not need to wear a brace or use walking aids, and was able to walk more than one mile. A good result was scored if the patient had only occasional mild pain and limitation in recreational, but not in daily activities, did not need to wear a brace or use a walking aid, and could walk more than one mile. The result was fair if the patient had frequent moderate pain and limitation in both recreational and daily activities, and needed to use a stick, but could walk further than half a mile, and poor if there was severe persistent pain or severe limitation in recreational and daily activities, a

brace, crutches or walking frame were needed and walking was restricted to less than half a mile.

Results

Table I gives a brief summary of the initial injury and previous treatments. Before operation, all patients had avascular necrosis with severe pain. All were functionally rated as poor on the grading system used for the postoperative results. Figure 3a shows a typical preoperative radiograph and Figure 3b a radiograph of the same patient (case 2) immediately after removal of the frame at 14 months.

All progressed to solid fusion, both clinically and radiologically. The frames were removed after a mean period of 10.7 months. Those patients who did not have a corticotomy and lengthening had their frames removed as soon as solid fusion was achieved, after a mean period of nine months. Tibial lengthening delayed removal of the frame until a mean of 11.5 months. Patients were reviewed at a mean of 32 months (13 to 49) after removal of the frame.

The mean length of bone obtained to equalise leg length was 35 mm (25 to 42). This is comparable to Reckling's¹ published figures for the inequality produced by tibio calcaneal fusion without lengthening.

There was a high rate of minor complications. All patients had pin-site infections requiring antibiotics, although none required any wires to be resited. Two patients had considerable problems with breakage of proximal wires; one patient (case 2) required general anaesthesia for resiting of the wires and the other (case 1) for the frame to be extended after bowing of the new bone. In this patient the frame was removed after eight months and complications developed because the new bone had not

consolidated. Over the next seven months she developed a progressive varus deformity of the tibia. A second frame had to be applied and hemicallotasis corrected this angulation. She therefore required a total of 15 months within an Ilizarov frame over a 22-month period.

Only one patient (case 6) had a poor result, with chronic pain after development of a reflex sympathetic dystrophy. Clinically and radiologically, she had a sound fusion, but her symptoms persisted despite treatment in the regional pain clinic.

There was one excellent result; the patient (case 4) was entirely free from pain and had no limitation in activities. The other four patients (cases 1 to 3 and 5) had good results. One of these (case 5) was entirely free from pain after surgery and had unlimited walking distance. He was downgraded to good because he did not have a lengthening procedure and had clinical shortening of 3.8 cm requiring a shoe raise. Another (case 1) had an excellent result from the ankle fusion but was downgraded to good, because of pain in the knee produced by other injuries sustained during the same accident.

All patients had some degree of stiffness of the forefoot after the fusion, which caused aching after walking several miles. This did not affect the grading system used. The patients seemed to benefit from using a rigid rocker sole, especially when walking extended distances.

Discussion

The development of avascular necrosis after fracture of the talus is well described. Hawkins³ was the first to classify these injuries according to the degree of displacement and hence the degree of disruption of the vascular supply. He described grades I to III,³ and Canale and Kelly⁴ added a further grade IV. The incidence of avascular necrosis is directly related to the severity of the grade, and occurs in 13% of grade-I, 50% of grade-II and 84% of grade-III fractures.

Most authors suggest early salvage treatment for grade-III and grade-IV fractures, either by talectomy or by fusion.⁴⁻⁷ The extent of this was such that Canale and Kelly⁴ were unable to give any meaningful figures for the rate of avascular necrosis in grade-IV fractures since only two of their patients had not been treated by primary talectomy. In the same paper, after review of the long-term outcome of 71 cases of fractures of the talar neck, they stated that two-thirds of the patients with established avascular necrosis, who had not had a primary talectomy or fusion, required no secondary procedure. Over the last 20 years patients' expectations have increased, and the proportion requesting a secondary procedure now would probably be greater. In the absence of any published literature it is difficult to advocate initial ablative procedures for all such patients, and it is more appropriate to offer surgery to those who are symptomatic later.

Since there is no published review of the results of late

surgery, the choice of treatment has to be extrapolated from the published results of early operation.

All our patients had an unacceptable level of pain and were unable to walk. They therefore required surgical intervention.

Amputation gives the shortest rehabilitation time, and with modern prostheses a good functional result, but it is unacceptable to most patients. There is an emotional attachment to the limb which has been 'saved' by previous surgery. All reconstructive options have long-term problems, functionally, and with secondary deformity.

Talectomy was initially the treatment of choice but can no longer be recommended since it has been shown to give such poor functional results, with pain, shortening and a marked calcaneal foot. Hawkins³ reported no good results after talectomy. All his patients had a limp, considerable loss of ankle and subtalar movement and widening of the hind foot, making shoes difficult to fit. Canale and Kelly⁴ in their review of talar fractures stated that talectomy gave the worst results.

Tibiotalar arthrodesis using a sliding tibial graft was described by Blair.⁵ He claimed that this maintained length, preserved movement at the talonavicular joint, and kept the normal ankle contour, but an unfixed graft, anterior to the weight-bearing axis, is inherently unstable and often leads to a pseudarthrosis. Other authors have modified his technique using fixation. Morris et al,⁷ used a screw to fix the anterior tibial graft and a Steinmann pin to stabilise the tibia over the calcaneus. Lionberger, Bishop and Tullos⁸ osteotomised the tibia obliquely and fixed the tibia to the talar head with a compression screw. Dennis and Tullos,⁶ using the modification of Morris et al,⁷ still report a rate of pseudarthrosis of 28% despite internal fixation. This pattern of reconstruction tends to collapse, and results in shortening and a painful tibiocalcaneal pseudarthrosis.^{4,8}

Tibiocalcaneal arthrodesis produces a biomechanically more stable position, but broadens the hind foot unless the malleoli are resected. Papa and Myerson⁹ stated that patients who had had a tibiocalcaneal arthrodesis were more mobile and had better function than those who had had a pantalar arthrodesis.

Tibiocalcaneal fusion as described by Reckling¹ appears to give the best functional result, but at the expense of shortening. We have modified his technique to have better control of the position of the foot, by compressing the arthrodesis in both the coronal and transverse planes using a circular fixator. The fusion is combined with a tibial lengthening using the same circular frame. Although this prolongs the time within the frame, it gives optimal rates of fusion with minimal residual deformity and with better long-term results. It is a successful way of salvaging these very difficult cases.

Older patients take considerably longer to regenerate new bone. To combine fusion with lengthening in this group would increase the time in an Ilizarov frame by another six or nine months. This would almost certainly

lead to infection at the pin sites as well as being a major inconvenience to the patient. It was considered that 35 mm of shortening was the preferable option for patients over 60 years of age.

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