TIBIAL DEFECT DUE TO ACUTE HAEMATOGENOUS OSTEOMYELITIS

TREATMENT AND RESULTS IN TWENTY-ONE CHILDREN

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The management of twenty-one children with a defect of the tibial shaft due to acute haematogenous osteomyelitis is described. Half the defects were due to removal of the sequestrum before the involucrum had formed. Only four patients, all under ten years of age, had spontaneous regeneration of the shaft. Eleven children had a posterior tibiofibular graft and six had a transfer of the ipsilateral fibular diaphysis. The results of operation were superior to those of spontaneous regeneration. All the grafts united and the children returned home to lead normal lives. Shortening was only a problem when growth plates or adjacent joints had been damaged. We now leave the sequestrum for up to one year after the onset of infection. If the involucrum fails to form we reconstruct the tibia as soon as possible after sequestrectomy.

Acute, haematogenous osteomyelitis is associated particularly with poverty, overcrowding and poor nutrition, and is still a destructive and crippling disease in many parts of the world (Rida and Eid 1974). The infection may extend through the entire length of a long bone and destroy all or part of it. The sequestrum will maintain the length and alignment of the limb while the periosteum lays down new bone around it, but if the development of this involucrum is incomplete, or the sequestrum is removed too soon, a defect will be created. When the defect is in the tibia instability will result whether the child walks or not. The proximal tibiofibular joint may subluxate or dislocate, the fibula bend and hypertrophy and deformities subsequently develop at the knee, ankle and foot (Figs. 1 and 2). If the tibial growth plates have been injured by the infection, altered growth rates of the tibia and fibula may produce similar deformities and shortening.

This paper describes the clinical features of twenty-one patients treated at the Orthopaedic Centre, Tunis, between 1965 and 1976. Each had a defect in the tibial shaft after acute, haematogenous osteomyelitis.

PATIENTS AND METHODS

There were fourteen boys and seven girls who were between two and twelve years of age at the onset of the disease. In the fifteen patients for whom information was available the sequestrum was removed less than one year after the start of the disease, and in two-thirds of these it was removed within the first three months. On radiographs the defect measured from 0.5 centimetres to 14 centimetres, with an average of 4 centimetres. The tibial remnants were often mere bony spicules, too long, thin and fragile to be useful in reconstructive surgery. The defect for practical purposes was then considerably greater. In fifteen children the head of the fibula was subluxated or dislocated.

Fig. 1
Radiographs of the right tibia, knee and ankle of a nine-year-old boy two years after the onset of acute osteomyelitis of the tibia and septic arthritis of the ankle.

Fig. 2

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Spontaneous regeneration of the shaft occurred in only four children (Group I). Group II consisted of seventeen patients who had reconstructive operations. Eleven had a posterior tibiofibular graft with cancellous bone from the iliac crest and in six children the fibula from the same side was divided proximally and distally and transferred to the tibia.

There were two girls and two boys in Group I, and they were between two and ten years of age when they developed osteomyelitis. After sequestrectomy they were treated with serial long leg casts and antibiotics were continued as long as there were signs of active infection. The youngest patients were fully weight-bearing without external support seven and nine months after sequestrectomy. One had concurrent septic arthritis of the ankle and subtalar joints with destruction of the distal tibial growth plate on the same side. Five years after total diaphysectomy, at the age of seven, he already had 4.5 centimetres of shortening and fibrous ankylosis of the ankle and subtalar joints, with the foot fixed in 25 degrees of supination. The other child had a normal leg seven years after the onset of the infection.

One of the older patients had two fractures of the regenerating shaft and another had a pseudarthrosis which eventually united with pronounced angulation (Figs. 3 to 7). Both patients had premature closure of the tibial growth plates.

Thirteen boys and four girls had surgical reconstruction of the tibia (Group II). Four of them had other skeletal septic foci and seven had premature closure of one or both tibial growth plates. None of these seventeen patients showed radiological evidence of bone forming across the gap. Reconstructive surgery was usually delayed after sequestrectomy to allow sinuses to close but in two patients a discharge was still present at operation. The sinuses closed shortly afterwards. Antibiotics were given to all patients for ten to fourteen days during and after the operation.

Eleven patients had a posterior tibiofibular graft. These children had a straight fibula, the proximal tibiofibular joint had been reduced if previously dislocated, and the tibial remnants were sufficiently large to accept a graft, none being shorter than 5 centimetres. At operation a posterolateral approach (Harmon 1945) exposed the interosseous membrane and adjacent bone. The posterior surface of the tibial metaphyses and the medial surface of the upper and lower ends of the fibula were then decorticated and cancellous bone from the iliac crest was packed between these sites (Figs. 8 to 12). In three patients the tibia was fixed to the fibula by Kirschner wires and in one patient screws were used. This approach avoided the poor skin over the anterior surface of the tibia and did not disturb the region of the tibial defect.

Six patients had a transfer of the diaphysis of the ipsilateral fibula. They had either a short tibial...
metaphysial remnant of less than 5 centimetres or a fixed axial deformity of the leg due to an irreducible dislocation of the fibular head or to bowing of the fibula. If the metaphysis was too small it could not accept a tibiofibular graft and dissection of the proximal tibial vessels and nerve was hazardous, whilst fixed deformity could not be corrected without an osteotomy of the fibula. In the initial patient the operation was performed in two stages as described by Huntington (1905), but in the others a one-stage procedure was used (Figs. 13 to 18). Through proximal and distal incisions the lateral popliteal nerve was retracted and the fibula divided. The
muscle attachments of the fibula were left as intact as possible and the periosteum was incised vertically to preserve its continuity. The muscles of the anterior compartment were freed from the interosseous membrane and the fibular shaft transferred to bridge the tibial defect. Two anterior incisions were used to cut grooves in the proximal and distal tibial metaphysis to accommodate the fibular shaft which was usually fixed with screws or Kirschner wires.

In both methods the leg was aligned after skin closure and an above-knee plaster-of-Paris cast applied.

**COMPLICATIONS**

Two patients had a lateral popliteal nerve palsy after fibular transfer but recovered within one and five months respectively. Four patients had a recurrence of the tibial infection which cleared after drainage and antibiotics and one had an infection of the pin track. Most of the grafts united within four months and the patients were fully weight-bearing without external support three to four months later, but one patient with a posterior graft had delayed union. Another child, with no upper tibial metaphysis, had the transferred fibula inserted into the proximal tibial epiphysis. This took fifteen months to unite.

**RESULTS**

The average time of follow-up after reconstructive surgery was three years, when every child was leading a normal life. Seven of the ten patients with normal growth plates had legs of equal length, two had shortening of 1 centimetre or less and one had an overgrowth of 1 centimetre. Both patients with fused ankles and destruction of the distal tibial growth plates had an epiphysiodesis of the opposite tibia. Three patients with premature closure of both tibial growth plates had 1.5 to 2 centimetres of shortening. A child with one growth plate destroyed and partial excision of the calcaneum had 4.5 centimetres of shortening at seven years of age. Apart from the patients with septic arthritis, mobility of the knee and ankle was virtually normal, but two children had lost 50 per cent of subtalar movement and a third had fibrous ankylosis of this joint. The two patients with septic arthritis of the ankle had spontaneous fusion in 5 degrees and 15 degrees of varus. Three children had tibia vara of 5 degrees or less, but two others were of 10 degrees and 15 degrees, the latter due to partial closure of the proximal tibial growth plate. In two of these children the distal tibial epiphysis had remodelled and the ankle was parallel with the knee. Two children had 10 degrees of tibia recurvata.

Radiographs of each patient showed that the fibula had hypertrophied far beyond its original size, and that it was almost the same width as the normal tibia (Figs. 9 and 18). In five patients who had a fibular transfer the intact periosteal sleeve at the distal fibular osteotomy site had produced a tibiofibular synostosis, thus stabilising the lateral malleolus, and in one patient the fibula had completely reformed. The lateral malleolus maintained its normal relationship with the ankle in all these children.

**DISCUSSION**

At least fifteen of our twenty-one patients had undergone surgical sequestrectomy, nine performed less than three months after the onset of the infection. None of the children over ten and only four of the eighteen younger children had complete, spontaneous reformation of the shaft. The new bone which appeared in the two older children was of poor quality and it was two and three years respectively before the tibiae were able to bear weight unaided. Spontaneous regeneration rarely occurs in young children once the defect is established (Bosworth 1933; Bosworth et al. 1966). Cushing (1899), Nichols (1904) and Pheister (1915) favoured very early sequestrectomy, within two months of the acute illness, but Ollier (1867), Platt (1928), Ferrand et al. (1966), Griffiths (1968) and Huckstep (1968) advised a more conservative approach, leaving the dead shaft in place to support the soft tissues while the involucrum was forming. We believe that the sequestrum should be left undisturbed, whenever possible, for six months to a year after the beginning of the illness. Further development of the involucrum is then unlikely and sequestrectomy should then be performed followed by reconstructive surgery as soon as the sinuses have closed or the drainage has become insignificant.

Two operations, with various modifications, have been devised to replace the tibia with the fibula from the same leg. The posterior tibiofibular graft (Girdlestone and Foley 1933; Milch 1950; Stulz and Folschveiller 1961; McMaster and Hohl 1965) is relatively easy to perform, does not disturb the focus of infection, and leaves the fibula intact to act as a strut, thus giving the leg stability. When this procedure is contra-indicated the ipsilateral fibular shaft may be used to bridge the defect.

Hahn (1884) advocated transplantation of the upper end of the fibular shaft into the proximal tibial remnant. However, transfer of only the upper end of the fibula caused a valgus deformity of the leg and subsequent deformity of the foot. Huntington (1905) advised transfer of the distal fibula also, using a two-stage procedure to ensure continued vascularisation of the graft and allow its survival in the infected and poorly vascularised, fibrotic scar tissue filling the tibial defect (Moulonguet 1929; Carroll 1938). When both ends of the fibula are transferred at the same time, much of the muscle mass and periosteum may strip from the fibular shaft leaving a free, cortical strut graft. With care this may be avoided, and we prefer a one-stage procedure.

Removal of the fibular diaphysis from a young child may cause progressive valgus deformity of the ankle (Langenskiöld 1967; Willets 1972; Hsu et al. 1972, 1974). Stone (1907) therefore modified the Hahn-
Huntington operation and created a distal tibiofibular synostosis by splitting the lower 10 centimetres of the fibular shaft longitudinally and implanting only the medial part into the distal tibia. Barbet (1911) advocated the creation of both proximal and distal synostoses, but Langenskiöld (1967) thought that a single, distal synostosis would suffice. Hsu et al. (1974) advised grafting the fibular pseudarthrosis itself so that the entire fibular shaft was reconstructed. We did not section the periosteal sleeve around the fibula completely but retained its continuity with the transposed shaft. In five patients radiographs showed that bone had formed at this site bridging the fibular diaphysis and tibial metaphysis and stabilising the lateral malleolus, preventing proximal migration (Figs. 17 and 18). The sixth patient had spontaneous regeneration of the fibular shaft. None of these patients developed a valgus deformity of the ankle. Scranton, McMaster and Kelly (1976) have shown that during weight-bearing the fibula is pulled downwards and medially, thus supporting and stabilising the talus and deepening the ankle mortice. They described three patients with post-traumatic distal tibiofibular synostosis who experienced pain relieved by resection of the bony bridge. None of our patients had any symptoms which could be related to the synostosis.

After reconstructive operations five of our seventeen children had varus deformities of the tibia although only two were greater than 5 degrees. In order to correct the varus angulation at operation and prevent later progressive deformity due to continued fibular growth, Ferrand et al. (1966) transposed the ipsilateral fibular shaft, added a long cortical graft from the opposite tibia, and stabilised the leg with an intramedullary rod introduced through the sole of the foot. Such procedures are unnecessary if the tibia is reconstituted as soon as possible after sequestrectomy, before the fibula starts to bend and the leg to shorten through dislocation and proximal migration of the fibular head. Pins and screws may become infected and loose, creating problems in realignment of the leg after operation. We prefer not to use them unless the tibial fragments or the fibular graft are very unstable.

This review was conducted while two of the authors (J. V. F. and B. N.) were Senior Medical Officers with CARE/ MEDICO in Tunisia. The subject formed, in part, the doctoral thesis of one of the authors (M. Z.).

REFERENCES


