**CASE REPORT**

Early resection of congenital pseudarthrosis of the tibia and successful reconstruction using the Masquelet technique

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Congenital pseudarthrosis of the tibia remains one of the most difficult orthopaedic problems. We describe early excision and the use of the Masquelet technique to reconstruct the bone defect in a child aged 14 months. Consolidation sufficient for complete weight-bearing was achieved by seven weeks. After two and a half years, the child was asymptomatic with a fully reconstructed tibia and no leg-length discrepancy.

The goal of surgical management of congenital pseudarthrosis of the tibia is to obtain and maintain union while minimising deformity. Various techniques have been described, including free vascularised fibular grafting, \(^1\) \(^3\) Ilizarov bone transport, \(^4\) \(^6\) intramedullary fixation \(^7\) \(^9\) and periosteal grafting. \(^10\) The use of recombinant human bone morphogenetic protein-2 (rhBMP-2) has been found to improve the healing time with Ilizarov fixation or the intramedullary rod technique, with earlier consolidation. \(^11\) \(^13\)

Recently, a preliminary study \(^14\) reported that transplantation of autologous bone marrow stromal cells may be a promising strategy.

The Masquelet technique \(^15\) \(^17\) has been described for use in reconstruction of long bones after excision of a septic pseudarthrosis. This procedure has two stages. The first consists of radical resection and the interposition of a cement spacer into the bone defect. Stabilisation is achieved with a plate or by nailing. The second stage is performed six to eight weeks later. The cement is removed, preserving the foreign-body membrane that has developed around the spacer. The cavity is then filled with morcellised corticocancellous autograft and the membrane carefully closed. This prevents resorption of the grafted bone and promotes corticalisation of the graft.

This procedure has been used following resection of tumours in children, \(^18\) and in congenital pseudarthrosis of the tibia, \(^19\) where the reconstruction and autograft were stabilised with a telescopic transplantar rod. Healing was achieved in all three cases.

We describe use of this technique in a case of congenital pseudarthrosis of the tibia. Internal fixation through the distal tibial physis avoided the need to cross the ankle.

Case report

An eight-month-old boy presented with a congenital pseudarthrosis of the right tibia (Fig. 1) that was not secondary to neurofibromatosis. When he was 14 months old the dystrophic area of 6.5 cm was excised and reconstruction using the Masquelet technique was undertaken. The space between bone ends was maintained with a Kirschner (K)-wire passing from the medial malleolus to the proximal tibia, traversing the distal physis. Movement of the ankle joint was not affected. A polymethylmethacrylate cement spacer was placed around the K-wire. The thermal effects of polymerisation were minimised by temporarily protecting the surrounding soft tissues with syringes split along their length. Cement was wrapped around the bone ends to promote decortication in the induced membrane in the second stage. The fibula was not touched (Fig. 2). An above-knee cast was applied for 45 days. The second stage was then undertaken. The membrane surrounding the cement was opened along the length of the spacer and the cement removed in fragments, taking care not to damage the induced membrane. The bone ends were decorticated. The cavity was then filled with a morcellised corticocancellous autograft taken from both posterior iliac crests (Fig. 3). The membrane was then sutured tightly and an above-knee cast applied for 45 days. By then, consolidation of the bone was good enough to allow removal of the cast and for weight-bearing to begin (Fig. 4). After two and a half years the tibia had been fully reconstituted (Fig. 5). The child was asymptomatic and led a normal life, with a full range of movement in the ankle and no leg-length discrepancy.
Discussion
Congenital pseudarthrosis of the tibia is a difficult condition to treat. Vascularised fibular grafting, Ilizarov bone transport and intramedullary nailing are generally considered to be the best ways to achieve and maintain union. However, the vascularised free fibular graft has disadvantages, including the need for prolonged protection from full weight-bearing, excessive residual angulation of the tibia, angulation at the donor site and variability in hypertrophy of the fibula. The procedure requires expertise in both orthopaedic and microvascular surgery. Fixation with an intramedullary rod appears to produce good results, with a healing rate of 86%. However, a refracture rate of 57% has been reported and the time to achieve union is long, being 16 months on average. Intramedullary nailing may also produce complications, such as
residual pseudarthrosis of the tibia, refracture, valgus deformity of the ankle, ankle stiffness and leg-length discrepancy.7,9 Although the Ilizarov technique appears to be safe, with the rate of union of 75%, and a successful correction of additional deformities,21 residual problems requiring secondary reconstructive surgery for refracture and post-operative deformities must be expected.5,6,22 A recent study,10 suggested that use of a periosteal graft with bone grafting, internal nailing and Ilizarov fixation provides the best combination of biological and mechanical properties for healing, and is preferable to any one of these methods in isolation. The periosteal grafting functions as a biological envelope.

The membrane concept prevents resorption of the bone graft and plays an important role in revascularisation and consolidation.15 More recently, Biau et al18 used the technique to reconstruct a defect of 16 cm in the femur following resection of a tumour. Bony union with complete integration of the graft and cortical reconstitution were obtained by one and two years, respectively.

The results of a multicentre study by the European Paediatric Orthopaedic Society,21 indicate a clear correlation between age at surgery and the final outcome, with better results being achieved in the older child. This society recommended that surgery should not be performed on patients under the age of three years, and preferably should be postponed until the age of five.21 In our case, use of the concept of the induced membrane enabled earlier resection and graft at 14 months. The children in Pannier’s original report19 were operated on at a mean age of 20 months. These cases were stabilised by a rod crossing the ankle.

Ankle pain is associated with multiple operations using intramedullary nails in vascularised free fibular grafting,3 and with degenerative changes in the ankle. Both a valgus deformity of the ankle and the passage of an intramedullary rod across the ankle joint cause pain.23,24 Ankle stiffness is a recognised complication after long-term transfixation of the tibiotaral and subtalar joints.7,9,25,26 In order to minimise loss of ankle movement, the K-wire can be removed soon after the pseudarthrosis has healed.7 In our case, stabilisation was achieved with an intramedullary nail passed from the medial malleolus to the proximal tibia through the distal physis. Ankle movement is unrestricted throughout the procedure, which helps to avoid pain and stiffness.

The Masquelet technique is a simple two-stage procedure which avoids vascular fibular grafting from the healthy leg and the complications of external fixation. It should be considered for achieving and maintaining union in the early treatment of congenital pseudarthrosis of the tibia.

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References