Breakage of an intramedullary rod after bone union in congenital pseudoarthrosis of the tibia: a report of two cases

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ABSTRACT

We report 2 patients with congenital pseudoarthrosis of the tibia who underwent intramedullary Rush rod transfixation through the ankle joint following refracture and nonunion of vascularised fibular grafting 6 and 8 months earlier. After 9 and 5 years, both Rush rods were broken at the level of the ankle joints, while the reconstructed area was solidly united. The growth of the distal tibia increased the distance of the tips of the broken rod and hence the ankle joint motion. The broken tips may damage the articular cartilage and result in valgus deformity of the ankle and limb length discrepancy.

Key words: ankle joint; congenital pseudoarthrosis; fracture fixation, intramedullary; tibia

INTRODUCTION

For congenital pseudoarthrosis of the distal tibia, treatment involves resection of the diseased periosteum and sclerotic bone ends and primary docking of residual gaps with or without bone or periosteal grafting, bone transport, or vascularised fibular grafting, followed by intramedullary rod insertion for stability and bone union and prevention of limb length discrepancy and recurrent fractures. We report 2 patients with congenital pseudarthrosis of the tibia who underwent intramedullary Rush rod transfixation through the ankle joint following refracture and nonunion of vascularised fibular grafting 6 and 8 months earlier. After 9 and 5 years, both Rush rods were broken at the level of the ankle joints, while the reconstructed area was solidly united.

CASE REPORTS

Case 1

In June 1999, a 3-year-old boy with Boyd type-4 congenital pseudoarthrosis of the left tibia underwent reconstruction using the ipsilateral vascularised...
fibular graft. Six months later, the fibular graft hypertrophied and tibialised, but the distal junction refractured, which was treated with retrograde transfixation with a 4-mm diameter Rush rod (Fig. 1). Four months later, solid union was achieved, and unrestricted daily activity without any external brace was allowed. Both proximal and distal tibial growth plates continued to lengthen, and the rod became relatively short. Six years later, the rod was exchanged with a longer one to ensure stability. Proper intramedullary rod fixation of the tibia was planned after adolescence. Three years later, the rod was broken at the ankle joint level, which was noted after an episode of temporary mild pain. One year later, the distal tibia continued to grow and the range of ankle motion was <10°. There was no limb length discrepancy or valgus deformity of the ankle. An ankle-foot orthosis was prescribed to minimise the ankle movement and damage to the articular cartilage.

Case 2
In April 2001, a 5-year-old boy with Boyd type-2 congenital pseudoarthrosis of the right tibia underwent reconstruction using the contralateral vascularised fibular graft. Eight months later, the distal junction showed nonunion, and the patient underwent retrograde transfixation with a 4-mm diameter Rush rod (Fig. 2). Four months later, solid union was achieved, and unrestricted daily activity without any external brace was allowed. Five years later, the rod was broken at the ankle joint level, and the range of ankle motion gradually increased. The rod was not exchanged, and there was no recurrent fracture of the tibia. Three years later, the distal tibia continued to grow and the ankle joint motion increased to near normal. There was no limb length discrepancy despite damage to the focal central physeal over the rod tract. The patient had 20° of valgus ankle deformity and pseudoarthrosis of the distal fibula.

DISCUSSION
Intramedullary rod transfixation through the ankle joint is recommended for congenital pseuadoarthrosis of the distal tibia. The proximal anchor in the Williams rod enables distal tibial growth and ankle joint motion 3 years after transfixation.1 On the contrary, the Rush rod anchor in the calcaneum transfixes the ankle joint permanently until its removal after skeletal maturity. To avoid recurrent fractures, removal of the Rush rod is not recommended.2,3

In a series of 17 cases of congenital pseudoarthrosis of the tibia treated with the Rush rod,4 the rods recede

Figure 1  Patient 1: (a) solid union is achieved 4 months after intramedullary Rush rod transfixation through the ankle joint, (b) the rod is broken at the ankle joint level after 9 years, and (c) one year later the distance of the tips of the broken rod increases because of distal tibial growth.
into distal half of the tibia suggesting growth of the distal tibia. After 2 to 11 years of follow-up, most patients who had initial transfixation before the age of 3 years underwent exchange with longer rods.4

Recurrent fractures of the tibia have been reported in the disease area after transfixation with the William rod, Rush rod, and expandable rod,2–4 and even with protection by an ankle-foot orthosis.2 Recurrent fractures together with breakage of the expandable rod or Rush rod at the pseudoarthrosis site have been reported in cases with unprotected weight bearing.2 In our study, the rods were broken at the ankle joint level after unrestricted daily activities for 9 and 5 years, as the ankle joint became the weakest link in this construct after solid union of the vascularised fibular graft. The broken rod at the ankle joint level increased the range of ankle motion, but the tips of the broken rod could damage the articular cartilage, and thus removal of the rod or application of the ankle-foot orthosis may be needed.1,2

Growth of the distal tibia in the unprotected ankle in the presence of concomitant pseudoarthrosis of the fibula may lead to valgus deformity of the ankle.2 The angulation was not attributable to central physeal damage, which causes limb length discrepancy rather than angular deformity. The valgus ankle can be corrected with medial physeal stapling of the distal tibia, and its recurrence can be prevented by syndesmotic screw fixation.1,2

In an animal model, when >7% of the cross-sectional area of the physis is destroyed, generalised growth arrest and limb length discrepancy may occur.5 A growing physis was strong enough to break the small bone bridge.6 In patients 2, the smallest and largest diameter of the physis were 3.8 and 4.2 cm, respectively. Therefore, the area of the physis was between 11.3 and 13.8 cm². The rod with 0.5 cm diameter had an area of 0.2 cm² and occupied 1.4 to 1.8% of the area of the physis, and did not cause limb length discrepancy. The real proportion at the time of transfixation was unknown. The smooth surface of the rush rod and a single attempt at insertion without violating other plates minimise damage to the growth plate. The presence of a rod in the growth plate for a long duration served as a plug that prevented bone bridge or fibrous tissue formation that might have tethered the lengthening process of the growth plate.

Figure 2  Patient 2: (a) at year 1 solid union is achieved after intramedullary Rush rod transfixation through the ankle joint, (b) at year 5 the rod is broken at the ankle joint level, (c) at year 7 the distance of the tips of the broken rod increases because of distal tibial growth, (d) damage to the focal centre of the growth plate without physeal bar formation leads to distal tibial lengthening and valgus ankle deformity, and (e) the smallest and largest diameters at the physis level are 3.8 and 4.2 cm, respectively, and the rod diameter is 0.5 cm.
REFERENCES


