Distal fibular lengthening after premature growth arrest: a case report

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ABSTRACT

Post-traumatic premature closure of the distal fibular growth plate is a rare entity leading to shortening of the lateral malleolus. We report on a 14-year old boy who presented with a 4-year history of worsening, diffuse discomfort and swelling of his left ankle, as well as fibular shortening and talar malreduction. He had sustained a distal tibial fracture 4 years earlier and had been treated with closed reduction. He reported instability of the ankle and difficulty with running. There was 1-cm shortening of the left fibula, 1-cm shortening of the proximal fibula, and slight widening of the medial clear space. Both tibial and fibular growth plates were already closed and the left ankle joint space was slightly narrowed. He was treated with late fibular lengthening and autogenous iliac crest tricortical bone grafting and achieved anatomic restoration of the distal tibiofibular relationship. At one-year follow-up, the ankle-hindfoot score had improved from 69 to 100.

Key words: ankle joint; bone development; growth plate; leg length inequality

INTRODUCTION

Ankle fractures account for approximately 5% of paediatric fractures and 15% of physeal injuries, and occur twice as frequently in boys. The goals of ankle fracture treatment for children are to achieve a satisfactory reduction and avoid physeal arrest so as to minimise the risks of angular deformity, early arthrosis, leg-length inequality, and joint stiffness.

Post-traumatic premature closure of the distal fibular growth plate is rare and results in a shortened lateral malleolus. This can lead to lateral wedging of the distal tibial epiphysis, valgus ankle, and medial ankle instability. Loss of fibular length can cause a dramatic lateral shift in tibiotalar surfaces. Deviation from normal anatomy causes alterations in joint reaction forces and increases shear stress on the articular cartilage of neighbouring joints, which can lead to degenerative arthritis. Surgical lengthening acts to restore normal joint reaction forces and to...
correct the mechanical axis of the limb.

We present a case with premature fibular growth arrest of the distal physis and subsequent shortening of the lateral malleolus after an old distal tibial fracture that was treated with late fibular lengthening and placement of a tricortical iliac autograft.

CASE REPORT

In January 2010, a 14-year-old male soccer player presented to our hospital with a 4-year history of worsening, diffuse discomfort and swelling of his left ankle. Four years earlier, he had sustained a Salter-Harris type-II fracture of his distal tibia during a soccer game (Fig. 1). He had been treated with closed reduction under anaesthesia at another hospital (Fig. 1). A cast had been applied for one month, and the boy had returned to his normal activities.

At the time of presentation to our hospital, he reported instability of the ankle and difficulty with running. He felt that since the fracture his left ankle had been unlike the contralateral ankle. There was no definite tender spot around his left ankle although mild swelling was present. Ankle range of motion was normal and no valgus deformity was present. The preoperative American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot score was 69. Radiographs revealed 1-cm shortening of the left fibula and slight widening of the medial clear space (Fig. 2). Both tibial and fibular growth plates were already closed and the left ankle joint space was slightly narrowed. On the mortise view, disruption of the Shenton line of the ankle and of the curve between the lateral talus and the peroneal groove of the fibula was noted. In addition, there was 1-cm shortening of the proximal fibula (Fig. 3). Joint cartilage was normal and the tibiofibular syndesmosis was intact.

Figure 1  (a) A Salter-Harris type-II distal tibial fracture and a small fragment at the level of the distal fibular physis, and (b) the ankle is treated with closed reduction and casting.

Figure 2  Five years after the initial injury, there is (a) 1-cm shortening of the lateral malleolus and lateral shift of the talus with widening of the medial clear space, (b) disruption of the Shenton line of the ankle and of the curve between the lateral talus and the peroneal groove of the fibula, with the fibular ‘spike’ (arrow) being 1 cm proximal from its anatomic position, (c) slight narrowing of the joint space of the left ankle, and (d) distal migration of the left proximal fibula (arrow).

Figure 3  (a) Coronal and sagittal T2-weighted magnetic resonance images showing normal joint cartilage signal. (b) Axial T2-weighted images showing intact tibiofibular syndesmosis and the well-seated distal fibula in the incisura fibularis.
distal fibula was well seated in the incisura fibularis and no malrotation of the lateral malleolus was noted (Fig. 4).

Surgical intervention was indicated taking into account the patient’s need to return to sports activities. Under general anaesthesia, a lateral incision was made over the lateral malleolus with anterior extension to expose the anterior aspect of the tibiofibular joint and the interosseous membrane.11 A separate incision was made over the medial malleolus to remove the intra-articular fibrosis in the medial gutter. A fibular transverse osteotomy was made above the level of syndesmosis, approximately 7 cm proximally from the tip of the lateral malleolus. Abundant scar tissue had developed at the area of the distal tibiofibular syndesmosis preventing the distal advancement of the lateral malleolus, and extended release was performed (Fig. 5). A 1-cm distraction of the osteotomy site was made using a lamina spreader. A tricortical bone graft harvested from the iliac crest, oversized 1 mm compared to the distraction gap, was inserted into the gap. Anatomic reduction between the fibular notch and the incisura fibularis of the tibia was confirmed. Under direct vision through the medial incision, the talus was anatomically repositioned as it was moved in against the tibial plafond and the medial malleolus. Two Kirschner wires were used for temporary fixation. A 10-hole, 3.5-mm, limited-contact dynamic compression plate was contoured and applied, producing moderate compression along the interposed graft (Fig. 5). A syndesmotic screw was placed through the plate for reconstruction of the syndesmosis.

Postoperatively, a short-leg cast was applied for 6 weeks with non-weight-bearing walking, and the patient was allowed partial weight-bearing walking with a CAM-boot for another 6 weeks. The syndesmotic screw was removed under local

Figure 4  (a) Extended debridement of scar tissue at the area of the tibiofibular syndesmosis. The lateral talar articular surface (thin arrow) and the anterior talofibular ligament (thick arrow) can be seen. (b) Fibular osteotomy, tricortical iliac crest bone grafting (arrow), and application of a 10-hole, 3.5-mm, limited-contact dynamic compression plate is shown.

Figure 5  (a) Anatomic restoration of fibular length and the tibiofibular relationship. A broken drill bit is seen at the proximal end of the plate. Follow-up at (b) week 6, (c) month 3, and (d) month 6 show graft incorporation. The syndesmotic screw is removed at 12 weeks.
anaesthesia at 12 weeks (Fig. 6). At the 3-month follow-up, the osteotomy had healed uneventfully. The patient started running again at 5 months. At 7 months and after adequate muscle strengthening, he took part in a soccer game, without any subsequent complaints. At one-year follow-up, the AOFAS score had improved to 100 and the patient had resumed a high level of physical activity.

DISCUSSION

Growth disturbances after ankle fractures in children are frequent. Although noticeable shortening of the fibula may develop, most children have no symptoms or only minor symptoms.12 Some develop ankle pain and instability, especially when the initial injury occurs years before skeletal maturity. Frequent follow-up is needed for early diagnosis and treatment of these deformities.

In normal growth of the ankle joint, there is continuous distal movement of the fibular metaphysis relative to the tibial metaphysis.6 Distal sliding of the fibular shaft can partly compensate for 1 cm of fibular shortening. Thus, if growth arrest occurs more than 2 years before skeletal maturity, distal movement of the fibula will be insufficient to compensate for the shortening, and the talus will tend to displace laterally into a valgus position.6 This is due to both the deficient osseous support and the development of wedging of the distal tibial epiphysis.6

The lateral malleolus plays an important role in lateral buttressing of the talus and load transmission of the ankle. The loss of these functions places increased pressure on the lateral tibial plafond, with subsequent cartilage damage and possible subsidence of the plafond,13-15 which results in progressive ankle valgus deformity and degenerative arthritis. Shortening of the lateral malleolus compromises its biomechanical functions. Causes of lateral malleolus shortening are a malunited fracture, physeal injury, osteochondromatosis, and neuromuscular diseases.5

Corrective osteotomy of the fibula before irreversible degenerative changes occur is necessary.16,17 Anatomic reduction of the distal fibula leads to restoration of the tibiotalar articulation and stability. In cadaveric models of unstable ankle fractures, small fibular displacements lead to significantly increased tibiotalar contact pressures.18 There are different ways to establish fibular length without autologous bone grafting.19,20 We performed a transverse osteotomy above the level of the syndesmosis,11 and the 1-cm gap was filled with a tricortical iliac crest graft which promoted additional stability.21 A 3.5-mm dynamic compression plate was applied to hold the lateral malleolus in its reduced position.11

Unlike malunited ankle fracture with fibular shortening,13 there was no evidence of syndesmosis disruption during the initial injury in our patient. His distal tibiofibular ligaments were intact, with normal signal on magnetic resonance images. In order to move the lateral malleolus distally, the syndesmosis was divided and a 3.5-mm syndesmotic screw was placed through the lateral plate, crossing 3 cortices to prevent diastasis.11,22 It is suggested that the syndesmotic screw be kept for a minimum of 6 months and retrieved if breakage occurs.23 However, some authors recommend removal of the syndesmotic screw after 12 weeks.11,22 The presence of the syndesmotic screw is not a contraindication to weight-bearing.

REFERENCES