Acquired genu recurvatum in a skeletally immature patient treated by physeal distraction: A case report

Silvia Pierantoni,[1] Marco Corradin,[2] Roberto Schiavon,[1] Valentina Luppi,[2] Andrea Micaglio[2]

[1]Orthopedics Department, Alto Vicentino Hospital, Santorso; [2]Pediatric Orthopedics Department, Policlinic Abano Terme, Italy

Abstract

The proximal tibia physis' anterior growth arrest is the cause of the uncommon condition known as acquired genu recurvatum, which can also be congenital, idiopathic, or secondary to trauma, infections, cerebrovascular accidents, or neuromuscular diseases. In order to avoid the reported drawbacks that could complicate osteotomies—incomplete correction, patella infera, knee pain or stiffness, and the requirement to remove plate metalwork—physeal distraction and callotasis with external fixation has been suggested. We present the case of a 14-year-old boy who had a 5 cm difference in limb length, with the right leg being shorter, and a right knee that was 30° recurved with flexion restriction beyond 40°. The correction was made in 50 days, and the external fixator was removed in 92 days after we performed a physeal distraction with an axial EF (ST.A.R., Citieffe) through an anterior physeal osteotomy just proximal to the tuberosity in conjunction with simultaneous asymmetrical tibial and femoral contralateral epiphysiodesys. The patient returned to playing football within 8 months despite the persistence of a 3 cm leg length discrepancy and had a symmetric full range of motion of the knee without any complications or persistent pain. The correction of genu recurvatum in adolescents may be achieved safely and effectively through physeal distraction with an axial external fixator.

Correspondence: Silvia Pierantoni, Pediatric Orthopedics Department, Policlinic Abano Terme, Piazza Cristoforo Colombo 1, 35031, Abano Terme (Padova), Italy.
E-mail: silvia.piera87@gmail.com

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Introduction

Acquired genu recurvatum as a result of anterior growth arrest of the proximal tibia physis is a rare condition, and it has been defined as symptomatic hyperextension of the knee beyond 5°. The most common symptoms associated with this deformity include pain, weakness, instability, Leg-Length Discrepancy (LLD), decreased Range Of Motion (ROM), and gait's disturbance.[1,2] Patella alta, impairment of the quadriceps mechanism and stretching with laxity of the posterior capsuloligamentous structure of the knee may also occur. Genu recurvatum can be congenital or acquired secondary to trauma, cerebrovascular accident, infection, neuromuscular diseases like polio, and physeal arrest. Several etiological factors have been reported as a cause of premature closure of the proximal physis of the tibia: Osgood-Schlatter's disease, avulsion of the tibial tubercle, tibial tubercle transfer, prolonged immobilization or traction, local pressure on the tibial tuberosity from casts or braces, traction wire too close to the tibial tuberosity, femoral and tibial fractures (including Salter-Harris type V fracture), as well as a complication following epiphysiodesis.[1,3,4] However, in some cases the etiology remains unknown and repetitive trauma or chronic overloading on the knee during sports activities might be a factor of growth arrest in reported cases.[1,2] Dejour *et al.* described 3 primary types of genu recurvatum: osseous, ligamentous, and combined.[5] Restoration of the deformity can be achieved either by gradual correction through external fixation or by acute correction with bony osteotomies, such as opening wedge osteotomy above the tibial tuberosity, opening wedge osteotomy below tibial tuberosity, and closing wedge osteotomy. Complications of osteotomies include incomplete correction, patella infera, knee pain or stiffness and the need to remove plate metalwork.[2] Physeal distraction and callotasis with the use of external fixator has been proposed to overcome these disadvantages.[1] In our

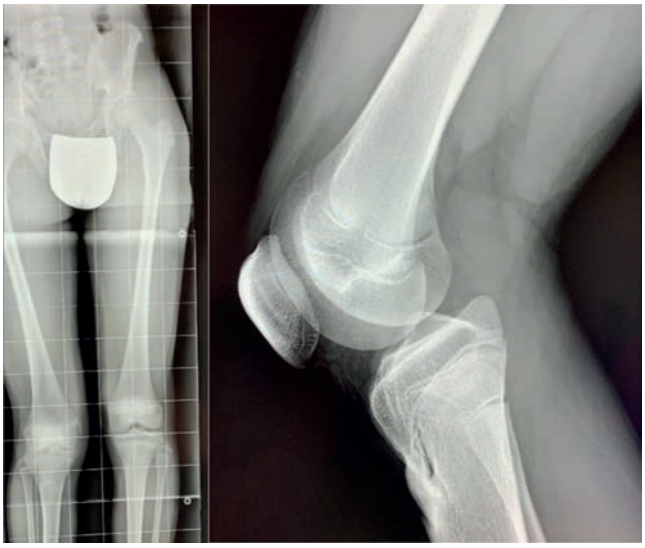

Figure 1. AP and lateral radiographs show genu recurvatum with anterior tibial slope, and limb length discrepancy.

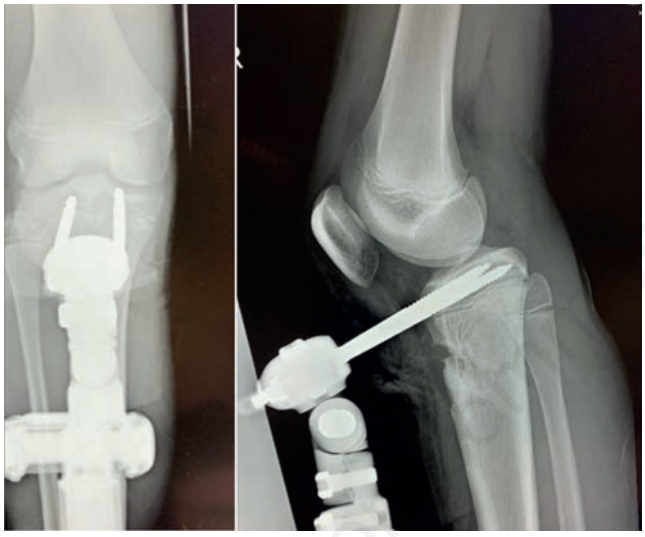

Figure 2. Postoperative radiographs with axial external fixator allowing physeal distraction.

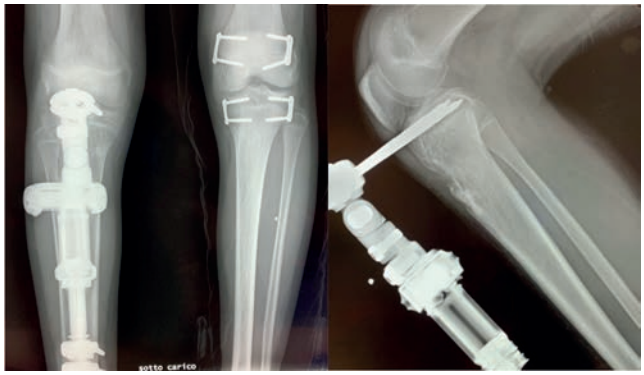

Figure 3. Radiographs show complete correction of the deformity at 3 months of follow-up.

work, we described a case of an idiopathic genu recurvatum in skeletally immature patient treated by physeal distraction through an axial External Fixator (EF) device.

Case report

A 14-year-old boy presented with limb-length discrepancy and right knee hyperextented. Knee pain was associated with sports activity (the boy was a football player). He had no history of trauma except for a bike fall 1-year previously, or recall any changes in his sporting activity in the previous period. Clinical examination of the right knee revealed 30° of recurvatum. No joint line tenderness, patello-femoral abnormalities, or ligamentous instability were noted. Knee ROM was limited in the last 40° of flexion compared to the normal side. The right lower limb was 5 cm shorter compared the contralateral one. Radiographs showed a 20° of anterior slope in the right tibial plateau versus 6° posterior slope in the contralateral knee. The recurvatum was purely osseous. The Posterior Distal Femoral Angle (PDFA) of 90°, while Posterior Proximal Tibial Angle (PPTA) was 67° comparing with 85° on the left side. Medial proximal tibial angle (MPTA) was 92°. Radiographs also showed a LLD of 4.7 cm (Figure 1). MRI showed no epiphyseal bar.

We performed a physeal distraction with an axial EF (ST.A.R., Citieffe) through an anterior physeal osteotomy just proximal to the tuberosity, leaving the posterior tibial cortex intact. The EF was stabilized with 2 screws at the epiphysis and 3 screws at the diaphysis (Figure 2). Intraoperatively, the tibial tendon was found thickened. In order to correct the LLD, we decided to performed an epiphysiodesis of both femur and tibia on the left knee.

Four days after the index procedure, distraction was started at 0.6 (2 x 0.3) mm/day at the anterior cortical margin. Partial weight bearing was allowed and the full range of knee motion maintained. The time required for anatomical correction was 50 days. The time of fixation was 92 days (Figure 3). Follow-up radiographs revealed correction of the genu recurvatum, but a persistence of LLD of 3 cm. At final follow-up of 8 months, the patient had returned to playing football and had symmetric full range of motion of the knee without pain (Figure 4).

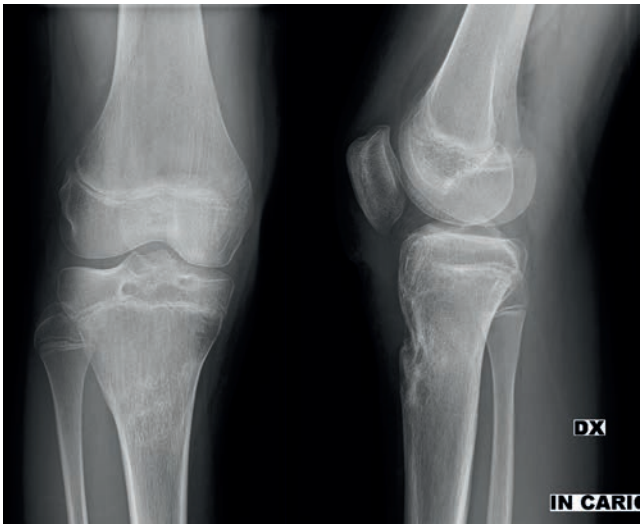

Figure 4. Radiographs show maintenance of correction with restoring of a more posterior tibial slope at the final follow-up (8 months).

Discussion

Several treatment options for correction of genu recurvatum deformity are reported in literature. These include opening wedge osteotomy Proximal to the Tibial Tuberosity (PTO), opening wedge osteotomy distal to the tibial tuberosity, opening wedge osteotomy in combination with the detachment of the tuberosity, closing wedge osteotomy proximal or distal to the tuberosity in association with a fibular osteotomy, and gradual correction using EF by means physeal distraction or callotasis. In a recent review, the anterior opening wedge PTO, with or without postoperative external fixation with progressive distraction, was found to be a reliable surgical treatment for genu recurvatum.[2] However, the various osteotomy and plating techniques used have some potential disadvantages, such as incomplete correction, patella baja, knee pain and stiffness and the need to remove metalwork.[2] It is well-known that an opening wedge PTO can lead to a decrease in patellar height,[6] and a proximalization of the tibial tubercle should be considered at the time of operation. Moreover, there are also complications from bone graft donor site morbidity, even if some evidence in the literature shows that for proximal tibial opening wedge osteotomies of up to 12.5 mm, bone grafting is not necessary at all.[7] In addition, there are often other associated deformities such as genu valgum and LLD as in our case that may not be amenable to be corrected with a single osteotomy. It is reported that physeal distraction and callotasis can overcome these complications, potentially correcting multiplanar deformity, avoiding the morbidity from the donor site for bone grafting and removal of plates.[1,3] Other advantages of these techniques include early weight bearing, the maintenance of a full ROM of the knee, and a potential shorter hospital stay.[1,3] Zazjyalov and Plaksin in 1967 were the first to described the technique of distractional epiphysiolysis to correct LLD by distraction of the growth plate, while De Bastiani *et al.* in 1979 introduced the term of chondrodiatasis to define the controlled and symmetrical distraction of the epiphyseal plate without rupture or fracture.[7] In recent years, the Ilizarov technique with the use of a hexapod frame has gained wide popularity for correcting bone deformity and LLD, with successful outcomes and low risk of complications.[1] Little has been published on physeal distraction or callotasis using an axial EF. Pennig and Baranowski reported a case of an opening wedge callotasis using a hinge type de Bastiani fixator for a recurvatum deformity after femoral and tibial fractures in a 16-years-old boy.[4] The deformity was corrected at a distraction rate of 1 (4 x 0.25) mm/day with a corticotomy just proximal to the patellar tendon insertion, with good results. In our case, we corrected the recurvatum deformity through a proximal physeal distraction with an axial EF. This technique allowed for correction in 55 days, restoring a more posterior tibial slope and ROM, and without affecting the mechanical function of the knee.

Conclusions

Physeal distraction by axial external fixator is a safe and effective technique for genu recurvatum correction in adolescents, and is able to restored the normal sagittal alignment and the knee motion without the disadvantages associated with plating and osteotomy.

References

1. Johnson L, McCammon J, Cooper A. Correction of genu recurvatum deformity using a hexapod frame: a case series and review of the literature. Strategies Trauma Limb Reconstr 2021;16:116-9.
2. Dean RS, Graden NR, Kahat DH, et al. Treatment for symptomatic genu recurvatum. A systematic review. Orthop J Sports Med 2020;8:2325967120944113.
3. Olerud C, Danckwardt-Lilliestm G, Olerud S. Genu recurvatum caused by partial growth arrest of the proximal tibial physis: simultaneous correction and lengthening with physeal distraction. Arch Orthop Trauma Surg 1986;106:64-68.
4. Pennig D, Baranowski D. Genu recurvatum due to partial growth arrest of the proximal tibial physis: correction by callus distraction. Case report. Arch Orthop Trauma Surg 1989;108:119-21.
5. Dejour D, Bonin N, Locatelli E. Tibial antirecurvatum osteotomies. Oper Tech Sports Med 2000;8:67-70.
6. Moroni A, Pezzuto V, Pompili M, et al. Proximal osteotomy of the tibia for the treatment of genu recurvatum in adults. J Bone Jt Surg 1992;74:577-586.
7. De Bastiani G, Aldegheri R, Renzi Brivio L, et al. Limb lengthening by callus distraction (Callotasis). J Pediatr Orthop 1987;7:129-34.