

# Proximal Tibia Vara is a Hidden Deformity in a Subset of Patients with Congenital Posteromedial Bowing of the Tibia

Jeanne M. Franzone, MD,<sup>1</sup> Philip K. McClure, MD,<sup>2</sup> and John E. Herzenberg, MD, FRCSC<sup>3</sup>

<sup>1</sup>Nemours/Alfred I. duPont Hospital for Children, Wilmington, Delaware, USA; <sup>2</sup>Shriners Hospital, Salt Lake City, Utah, USA;

<sup>3</sup>International Center for Limb Lengthening, Rubin Institute for Advanced Orthopedics, Sinai Hospital, Baltimore, Maryland, USA

## Introduction

- Congenital posteromedial bowing of the tibia is a rare congenital deformity with a posteromedial oblique plane deformity of the distal third of the tibia and fibula with associated shortening and abnormal soft tissues in the distal third of the leg.<sup>1,2</sup>
- The associated calcaneovalgus foot deformity tends to resolve spontaneously or with stretching and casting, and the magnitude of the posteromedial bow tends to gradually decrease with growth.<sup>3-7</sup>
- However, children are often left with residual tibial bow and a leg length discrepancy (LLD) of approximately 2 to 6 cm.<sup>3-7</sup>
- Proximal tibial varus deformity associated with congenital posteromedial bowing of the tibia has not been well described in the literature. This study introduces a potentially overlooked deformity and presents several management options.

## Methods

- A retrospective medical record review was conducted for 18 patients with congenital posteromedial bowing of the tibia treated at one institution since 2007.
- Presence of a proximal tibia varus deformity was determined by measuring the extended leg (EL) radiographs:
  - A line from the center of the femoral head to the center of the distal femur was drawn as the femoral mechanical axis and continued distally through the proximal tibia (Line 1A).
  - A distal tibial line was drawn as an anatomic axis in the distal segment (Line 2).
  - If these two lines did not intersect at the level of the apex of the tibial deformity, suggesting a hidden deformity, a third line was drawn along the anatomic axis of the tibial diaphyseal segment proximal to the bow (Line 3).
  - The intersection of Lines 1 and 3 is the apex of the proximal tibia vara, and the intersection of Lines 2 and 3 is the apex of the posteromedial bow of the tibia in the coronal plane (Figs. 1A, 1C).
  - The intersection of Lines 2 and 3 indicated a proximal tibia varus deformity for the purposes of this review when the angle was greater than 5° as there is an accepted range of 5° for the normal range of the medial proximal tibial angle (MPTA).<sup>8</sup>
- Magnitude of the tibial bow in the sagittal plane was measured using two anatomic lines on a lateral view of the tibia (Fig. 1B).
- Magnitude of the oblique plane deformity was calculated in the Oblique Plane Deformity calculator in the Multiplier App (©Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore).
- The indication for operative management of the congenital posteromedial bow of the tibia most often included symptomatic LLD.<sup>9</sup> Families are counseled that a residual LLD may require additional treatment.

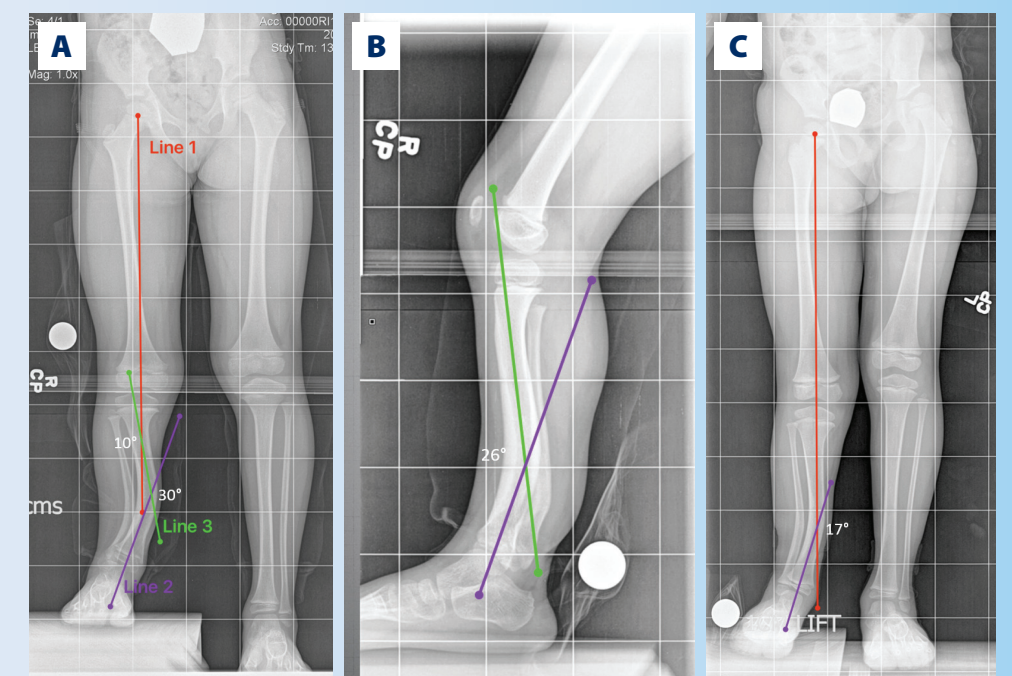


Figure 1. A, Erect anteroposterior (AP) extended leg (EL) radiograph of a 4-year-old girl with a 10° varus deformity (intersection of Lines 1 and 3) in the proximal tibia and a 30° apex medial bow of the tibia (intersection of Lines 2 and 3). B, Lateral view of the tibia and fibula of the same girl in Figure 1A with a 26° apex posterior bow of the tibia. C, Erect AP EL radiograph of a 3-year-old girl with a 17° apex medial bow of the tibial diaphysis without a proximal varus deformity in the proximal tibia.

## Results

- 18 patients were identified who had congenital posteromedial bowing.
- 9 of the 18 patients have not yet been indicated for an operative intervention.
  - None of these patients had a proximal tibia varus deformity.
- 9 (4 boys, 5 girls) of the 18 patients underwent surgery (Table 1):
  - Average age: 6.7 years (1.4–17.5 years)
  - Proximal tibial varus deformity: 3 of the 9 patients
    - Patients 1, 2, and 3 in Table 1 (Figs. 2 and 3)
    - Average LLD: 5.5 cm (standard deviation [SD] 2.6 cm)
    - Average oblique plane posteromedial deformity: 28.9° (SD 9.2°)
  - No proximal tibia varus deformity: 6 of the 9 patients
    - Patients 4–9 in Table 1
    - These patients underwent single-level deformity correction.
    - Average LLD: 3.8 cm (SD 1.2 cm)
    - Average oblique plane posteromedial deformity: 25.3° (SD 10.6°)

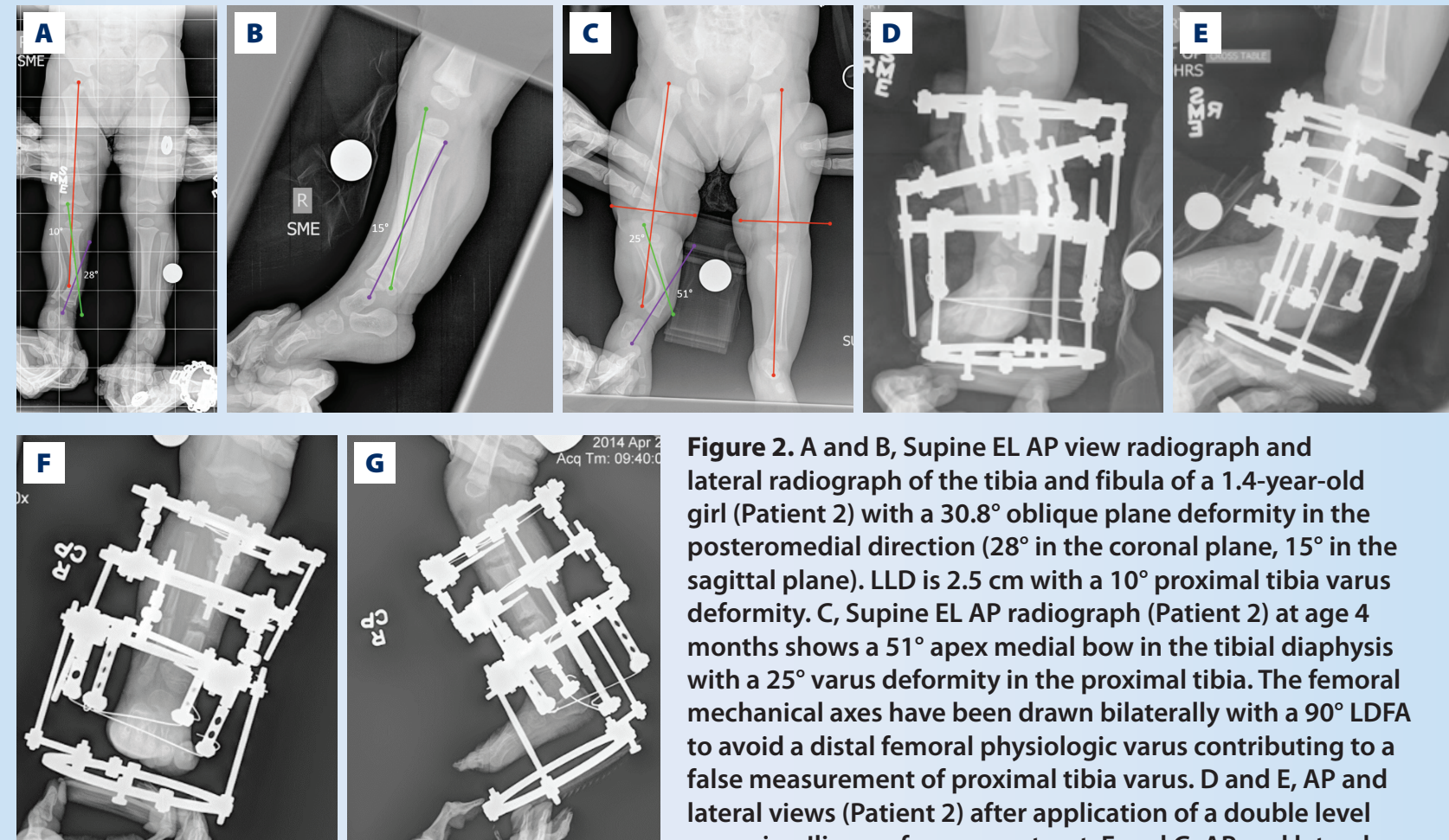


Figure 2. A and B, Supine EL AP view radiograph and lateral radiograph of the tibia and fibula of a 1.4-year-old girl (Patient 2) with a 30.8° oblique plane deformity in the posteromedial direction (28° in the coronal plane, 15° in the sagittal plane). LLD is 2.5 cm with a 10° proximal tibia varus deformity. C, Supine EL AP radiograph (Patient 2) at age 4 months shows a 51° apex medial bow in the tibial diaphysis with a 25° varus deformity in the proximal tibia. The femoral mechanical axes have been drawn bilaterally with a 90° LDFA to avoid a distal femoral physiologic varus contributing to a false measurement of proximal tibia varus. D and E, AP and lateral views (Patient 2) after application of a double level opposing Ilizarov frame construct. F and G, AP and lateral views (Patient 2) after deformity correction.

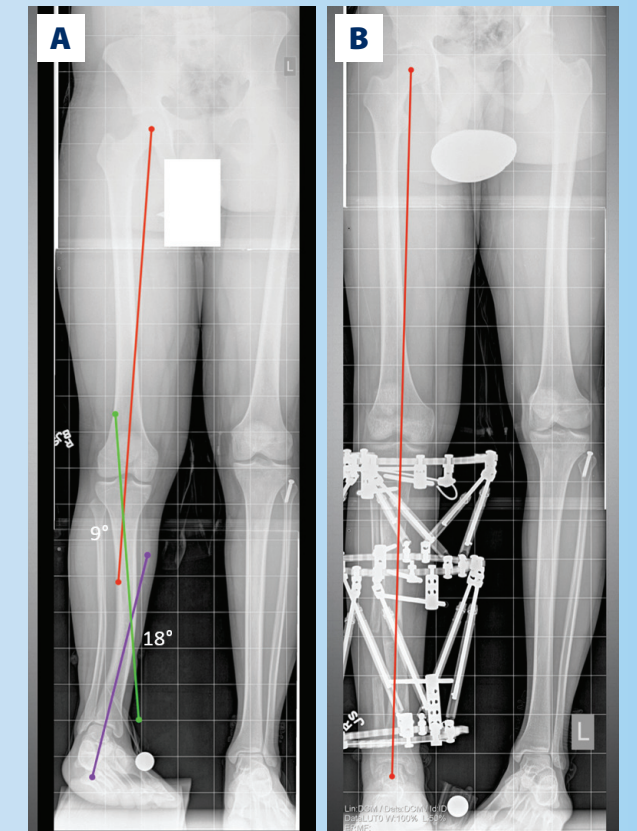


Figure 3. A, Erect AP EL radiograph of Patient 3 (age 17 years) with an oblique plane posteromedial deformity of 18.9° (18° in coronal plane, 6° in sagittal plane), 9° proximal tibia varus deformity, and a 6.9-cm LLD. B, Erect EL AP radiograph (Patient 3) after double level tibial deformity correction with a hexapod external fixator.

Table 1. Demographic Information, Surgical Procedures and Deformity Measurements

Patient	Gender	Laterality	Age on Date of Surgery (yrs)	Surgical Intervention	Additional Procedures	Leg Length Discrepancy (cm)	Proximal Tibial Varus (degrees)	AP Apex Medial Bow (degrees)	Sagittal Apex Posterior Bow (degrees)	Oblique Plane Deformity: Apex Posteromedial (degrees)
1	F	R	4.7	Planned: Single level osteotomy with TSF, proximal tibial lateral hemiepiphyseodesis	–	7	10	30	26	37.1
2	F	R	1.4	Double level Ilizarov tibial correction, fibular osteotomy	–	2.5	10	28	15	30.8
3	M	R	17.5	Double level tibial osteotomy, double level TSF correction, fibular osteotomy, Vulpius, application of TSF to stretch right foot/ankle, prophylactic anterior fasciotomy, proximal and distal syndesmosis stabilization	3.5 years prior: left pan-genu epiphyseodesis	6.9	9	18	6	18.9
4	F	R	3.5	Tibial osteotomy, fibular osteotomy, single level TSF correction, prophylactic anterior fasciotomy	–	3.6	None	17	23	27.6
5	M	R	6.5	Tibial osteotomy, fibular osteotomy, single level TSF correction, prophylactic anterior fasciotomy, Vulpius	–	2.8	None	8	14	16
6	F	L	5.8	Tibial osteotomy, fibular osteotomy, single level TSF correction	–	4.1	None	20	15	24.3
7	M	L	1.4	Tibial osteotomy, fibular osteotomy, single level TSF correction, left peroneal nerve decompression, arthrogram of left knee and left ankle	1 month postop: Fibular osteotomy for premature consolidation; 4.5 months postop: Prophylactic intramedullary rodding at time of frame removal; 5.5 months postop after index surgery: Removal of tibial Rush rod; 7.5 years postop: Left distal tibial medial hemiepiphyseodesis	2.5	None	15	24	27.5
8	M	L	15.3	Left tibia, fibular osteotomy, single level acute correction for FAN with PRECICE, prophylactic anterior fasciotomy, Vulpius, proximal and distal tibiofibular syndesmosis fixation	4.5 years preop: Epiphyseodesis right proximal tibia and fibula	4.1	None	6	12	13.3
9	F	L	4.0	Left tibia, fibular osteotomy, single level TSF correction, prophylactic anterior fasciotomy, Vulpius, decompression of fascial compartment of left flexor hallucis longus muscle belly	6 weeks postop: Fibular osteotomy for premature consolidation, proximal tibiofibular syndesmosis fixation with mid-diaphyseal stirrup wire	5.8	None	32	35	43.2

AP, anteroposterior; F, female; FAN, fixator-assisted nailing; L, left; M, male; postop, postoperative; R, right; TSF, Taylor Spatial Frame.

## Discussion

- Three of the nine patients who underwent surgery had hidden varus deformity of the proximal tibia.
- Two of the three patients with the double level deformity had the double level deformity on their earliest available radiographs and the third patient did not have prior radiographs. Therefore, it is difficult to surmise whether this is a compensatory deformity that develops over time or is present in some children and not others.
- Four patients required lengthening of the posterior soft tissues (Vulpius gastrocnemius recession). It is important to fully assess dorsiflexion intraoperatively based upon the tibiocalcaneal angle of the distal segment of tibia rather than allowing the posterior bow to skew the perceived amount of clinical dorsiflexion, particularly when embarking on a course of lengthening.
- A significant limitation of this study is its small sample size. Congenital posteromedial bowing of the tibia is, however, a rare condition.
- Failure to recognize hidden varus deformity in cases of congenital posteromedial bowing of the tibia could result in residual post-treatment varus mechanical axis deviation.
- Recognizing proximal tibia varus deformity in this group of patients allows the surgeon to consider double level deformity correction.
- This study is not powered to comment on the etiology of the proximal tibia varus deformity or the age at which the deformity will typically appear.
- Performing a double level gradual deformity correction in younger patients with small tibiae can be challenging. We propose proximal tibial lateral hemiepiphyseodesis as an alternative option in skeletally immature patients.

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