ANSWER PLEASE

Fig 1A: AP knee of 4-year-old girl.

Fig 1B: AP knee radiograph of the same patient at 6 years.
Case 1. A 4-year-old girl presented with left genu varum. She walked at age 9 months and had bilateral genu varum which gradually corrected on the right. Her left genu varus deformity progressed from 10° to 20° in 6 months and to 29° by age 6 years, 4 months. On physical examination, she was slightly overweight and stood with her left knee in varus, hyperextension, and medial femoral torsion (Figs 1A-B). Any prolonged physical exertion resulted in lower extremity pain and weakness. Laboratory results: BUN 10, Creatinine 0.9, P04 4.5, Ca+ 8.5, Hemoglobin 14.

Case 2. An 11-year-old obese boy presented with a 6-month history of increasing left knee pain. Although he denied any recent trauma, he had been quite active in contact sports. He did have a significant decrease in his activity in the past 3 months due to increasing pain. On physical examination he stood with a 20° left genu varus deformity (Fig 2) and ambulated slowly with an antalgic gait, but displayed no other joint involvement. Lab results: Bun 12, creatinine 0.9, P04 5.0, Ca + 9.0, hemoglobin 13.9.

Choose one diagnosis and treatment plan for each case.

**Diagnosis:**
- Rickets
- Adolescent Blount’s Disease
- Physiologic genu varum
- Metaphyseal chondrodysplasia
- Infantile tibia vara
- Traumatic epiphyseal disturbance

**Treatment plan:**
- Observation
- Bracing
- Vitamin D and calcium
- Osteotomy
- Epiphysiodesis

(continued on page 1504)
Blount's Disease: Tibia Vara

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Case 1. Diagnosis: Infantile Blount's Disease (answer = 1.e, 2.d). By the first 6 months follow up, the patient's radiographic changes were too advanced to warrant bracing. At the time of surgery, she had a stage IV Langenskiöld lesion and was treated with a proximal tibial closing wedge valgus osteotomy and an oblique proximal one third fibular osteotomy (Fig 3). She went on to heal, correct the varus deformity, and have good early clinical results.

Case 2. Diagnosis: Adolescent Blount’s Disease (answer = 1.b, 2.d). The patient was treated with a proximal tibial reversed dome osteotomy and a proximal fibular osteotomy. He went on to early union with correction of his varus deformity and improvement in gait pattern.

The differential diagnosis of pediatric genu varum includes:

1. Physiologic Genu Varum. This is the normal angular development of the femur and the tibia in a symmetric fashion from birth with 15° of varus to neutral at 24 months to 10° valgus at 36 months and 5° to 6° of valgus by 6 years. The epiphysial plate is normal with an associated thickening of the distal femoral and proximal tibial medullary cortices as well as a medial metaphyseal prominence. Angular correction is usually spontaneous and requires no formal treatment compared to the following disorders.

2. Rickets. Patients present with epiphyseal radiographic changes, low serum phosphorus, and varying degrees of serum calcium and renal function depending on the etiologic type.

3. Traumatic Epiphyseal Disturbance. This is associated with prior damage to the physis and premature closure at the proximal medial femoral or tibial physis.

4. Metaphyseal Chondrodysplasia. These patients are of short stature with multiple metaphyseal deformities. Radiographically, it may appear to be rickets, but clinically, the serum phosphorus and alkaline phosphatase levels are normal.

5. Blount’s Disease (Tibia Vara). This includes the infantile and adolescent types involving varying growth disturbance of the proximal medial tibial epiphysis, physis, and metaphysis. Blount initially described two types of tibia vara, the more common infantile form occurring between age 1 and 3 years and the adolescent type that is not manifested until after age 9 years. The overall incidence for true Blount's disease is uncommon, with less than 500 world cases reported.

The infantile form is associated with obese children of short stature that are early walkers. There is some sporadic familial occurrence, and a higher percentage of cases reported in black children. There is growth disturbance of the proximal medial tibial epiphysis, ossification center of the physis, and the metaphysis. Histologically, it appears as areas of dense hypertrophied resting cartilage cells and areas of cellular fibrous cartilage. The etiology is still unclear, but increased pressure on the medial aspect of the tibia does enhance the radiographic deformity.

The diagnosis is made radiographically after age 2 years and the earliest findings include a metaphyseal-diaphyseal angle greater than 11°. The more characteristic radiographic changes occur later, as detailed below. The child presents with gradual bowing of the tibia, internal tibial torsion, genu recurvatum, increased knee ligamentous laxity, and hypoplasia of the posterior medial tibial plateau. The infantile form is more severe, usually progressive, bilateral in 80%, and can be staged according to the Langenskiöld classification (Fig 4).

The six stages are based on the radiographic changes and help to determine treatment timing. In stages I and II, complete restoration is common compared to only possible restoration in stage IV. The radiographic staging cannot be done before age 2 years due to the normal physiologic bowing that exists and lack of radiographic changes before that age. Radiographic changes include: wedging of the tibial medial epiphysis; beaking

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and fragmentation of the proximal tibial medial metaphysis with associated cartilage islands; growth plate widening; and progressive radiolucencies that give the metaphysis a step-cut like appearance.2,4,10

Adolescent Blount’s Disease is the less common form, unilateral in 90% and usually less severe than the infantile form.5 It is often associated with obesity and, frequently, there is some precedent mild trauma or repetitive stresses. No step-like epiphyseal plate deformities can be seen radiographically, and the ossified area of the plate looks normal or slightly flattened. The medial portion of the proximal tibial growth plate is prematurely closed and a bony bar can sometimes be demonstrated by tomography.2,11

Radiographic Angular Measurement. The lower extremity angular deformities may be measured by two methods9,12 (Fig 5A). The tibiofemoral angle is measured between longitudinal lines drawn between the femur and the tibia. The tibiofemoral angle is not as reproducible due to the effect of ligamentous laxity, femoral bowing, and rotation during radiographic positioning. The metaphyseal-diaphyseal angle (MDA) (Fig 5B) is formed by a line drawn across the horizontal plane of the proximal tibial metaphysis and a perpendicular line through the tibial shaft long axis. The MDA is more accurate and not directly affected by femoral bowing or ligamentous laxity upon weightbearing.8,9,12 Sixty percent of the tibia vara deformity evolves around the proximal tibial metaphysis compared to 20% of the deformity in physiologic bowing. In physiologic bowing, the MDA will be less than 11° compared to an MDA of more than 11° that is characteristic of Blount’s disease. The MDA is clinically significant, since it aids in the early diagnosis of tibia vara, its progression, and subsequent decisions on a treatment regimen.9

Treatment

Infantile Tibia vara. A child of age 2 to 3 years with stage I or II disease may be initially observed and subsequently braced for treatment of varus deformity of 15° to 20°.8,11 Good results in up to 83% have been reported with this treatment group.8 The disease progresses most rapidly from ages 3 to 6 years, and close clinical follow up is required. Children with stage III or IV disease over the age of 3 and a varus deformity of more than 5° should be treated with a valgus osteotomy.4,8,10,11 A reversed dome osteotomy of the proximal tibia between the diaphysis and metaphysis is performed along with a lower oblique fibular osteotomy. Care must be taken to avoid the common error of positioning the osteotomy too low or in too much valgus. Best results have been reported with correction of the alignment to within ± 5°.1,8 The position of the cut on the lateral view must also be considered when fashioning the dome to prevent anteroposterior deformities. At final intraoperative positioning of the leg, pedal

Fig 3: Postoperative healed proximal tibial closing wedge valgus osteotomy and oblique fibular osteotomy (case 1).

Fig 4: Six radiographic and age-related stages of tibia vara.
pulses and capillary refilling should be checked to look for kinking or impingement of the anterior tibial artery.\textsuperscript{13} Close postoperative monitoring for potential compartment syndrome is mandatory.\textsuperscript{13} Good results with low recurrence rates have been reported in children less than 8 years of age and best results in those \( \leq 5 \) years of age.\textsuperscript{1,8}

In the older child with stage V or VI involvement, a repeat osteotomy is often required.\textsuperscript{1,8,11} Those with severe medial plateau deformities may require elevation of the plateau and an epiphysodesis of the lateral proximal tibia and fibula with a subsequent reversed dome tibial osteotomy and oblique fibular osteotomy.\textsuperscript{10} For partial proximal medial epiphyseal closures less than one-third of the plate, a bony bar resection may be considered.\textsuperscript{7}

Adolescent Tibia Vara. Early mild angular deformities may be observed. Surgical treatment should be undertaken if there is significant pain or severe deformity. Correction is best achieved with a proximal tibial and fibular osteotomy at off-set levels.\textsuperscript{10,11}

Summary
Infantile tibia vara, although uncommon compared to normal physiologic bowing, is significant due to the resultant progressive deformities if not diagnosed early. The key radiographic finding is medial tibial metaphyseal beaking and fragmentation. Although the etiology is unclear, it appears to be an acquired growth disturbance of the proximal medial tibial epiphysis, ossification center, and metaphysis rather than any type of avascular necrosis. The Langenskiöld six-stage classification is useful for the diagnostic, prognostic, and treatment staging of the disease. The adolescent form is less common and less severe
with only slight irregular thickening of the physis present on radiograph. The MDA appears to be the most reproducible method for measuring angular deformities in both variants of the disease.

Treatment of the infantile stages I or II consists of observation and bracing. Stage III or IV disease in children over age 3 years with more than 5° of varus angulation should be treated with corrective valgus osteotomy. Stages V or VI may require repeated surgical treatment with multiple osteotomies and possible contralateral epiphysiodysis. The adolescent form frequently requires surgery when there is significant physical impairment related to the severe genu varum.

References


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