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Sequential Management of Three-Dimensional Knee Deformity in Blount's Disease: A Case Report and Review of the Literature

Khalifa Ababacar Faye[1], Mouhamadou Moustapha Niane[1,2], Djanlo Leo Fréderic[3], Faty Balla Lo[4], Alioune Badara Gueye[1,3], Yacine Sock[1], Charles Valerie Alain Kinkpe[1,3]

[1]Order of Malta Hospital Centre of Dakar, Dakar, Senegal
[2]Iba Der Thiam University of Thies, Thies, Senegal
[3]Cheikh Anta Diop University of Dakar, Dakar, Senegal
[4]Pikine National Hospital Centre, Dakar, Senegal
Email: ababacarortho@gmail.com

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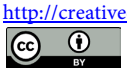

Abstract

The authors report the case of a 13-year-old female patient with no reported medical history who presented with juvenile tibia vara and three-dimensional knee deformity requiring multiple surgeries for complete correction. The aim is to show the importance of long-term follow-up for these complex deformities, where a single operation is often insufficient due to recurrence and undercorrection.

Keywords

Blount's disease, Osteotomy, Sequential

1. Introduction

Tibia vara (TV) or Blount's disease is a growth abnormality of the medial part of the physis and proximal tibial epiphysis, resulting in a three-dimensional deformity of the lower limb, the main axial abnormality being progressive genu varum [1]. It occurs mainly in children during growth and presents in two main clinical forms: the infantile form, which appears before the age of 4, and the juvenile/adolescent form, which begins after the age of 10 [2]. Several techniques have been described in the literature, but none have been unanimously accepted, particularly for advanced cases in which residual deformities and recurrences are common. Some authors recommend a multi-stage approach to address these complications and achieve complete anatomical correction and joint stability. We report a case

of very advanced Blount's disease in a 13-year-old adolescent girl who underwent sequential, long-term treatment. The aim is to demonstrate the role of this therapeutic approach in the management of advanced and complex cases of Blount's disease.

2. Case Presentation

Clinical and Radiological Study (Figures 1-4)

The patient is a 13-year-old schoolgirl with no reported medical history who was referred for consultation due to a deformity of the left knee noticed while learning to walk. The deformity progressed gradually, with a tendency to worsen, leading to a limp when walking.

Figure 1. Clinical image showing varus deformity and internal rotation (frontal view).

Figure 2. 90˚ angulation of the knee in the supine position.

The physical examination revealed:

- Significant lameness
- Three-dimensional deformation of the knee with a 90˚ varus, internal tibial torsion, and recurvatum.
- Uneven length of the lower limbs by approximately 4 cm.
- Protrusion of the head of the fibula externally.
- Full knee mobility.
- There were no neurological disorders in the left lower limb.

The diagnosis of Blount disease classified as stage VI of Langenskiöld with significant collapse of the medial tibial plateau was made after radiological investigations.

In summary, this is a 13-year-old girl with no reported medical history who presents with adolescent-onset Blount disease classified as stage VI on the Langenskiöld scale.

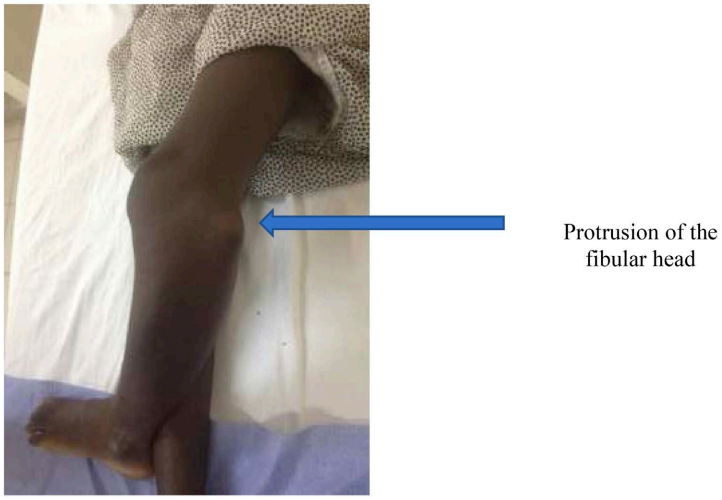

Figure 3. Protrusion of the fibular head (profile view).

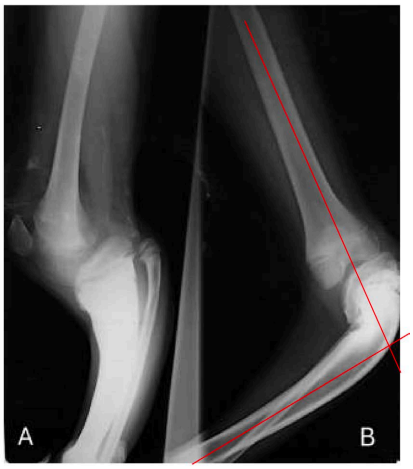

Figure 4. Preoperative X-rays of the knee in profile (A) and frontal view (B) showing Blount's disease.

3. Management

Surgical management was indicated for the patient. It was performed in three stages.

3.1. First Stage

This consisted of a tibial valgus osteotomy by external subtraction combined with a tibial plateau lift (Figure 5). The aim of this procedure was to enable plantigrade weight-bearing.

A fibular osteotomy was performed first. Stabilisation was achieved using three pins. A circular crural cast completed the stabilisation. No procedure was performed on the tibial physis. The postoperative course was uneventful and the cast was removed on day 45.

Seven months after surgery (Figure 6), the patient was able to walk independently with a limp on the left side. There was varus deformity (40˚) and recurvatum of the knee. Mobility of the left knee was preserved.

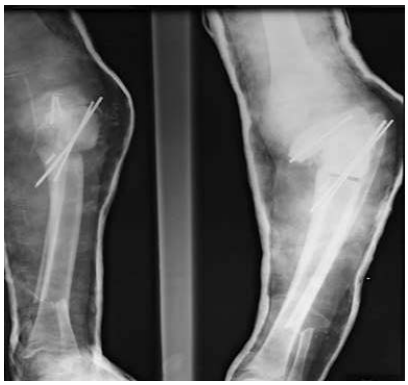

Figure 5. Post-operative image of tibial osteotomy with internal tibial plateau elevation, with persistent tibial varus.

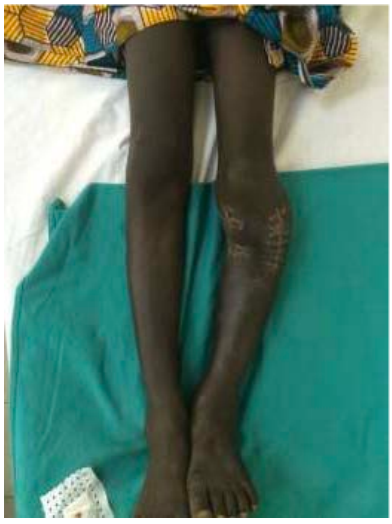

Figure 6. Seven months post-op with persistent varus and ILMI.

3.2. Second Stage of Surgery

Due to the presence of residual varus and recurvatum of the proximal tibia 1 year and 8 months after the first surgery, we planned a second procedure consisting of an external tibial valgus osteotomy. Stabilization was achieved using a Blount staple, reinforced with a circular leg and foot cast. At the time of this second stage, the patient was 15 years old.

The outcome was marked by radiological consolidation (Figure 7). Clinically, the limb was well aligned in the frontal plane, and there was a 4 cm difference in lower limb length (Figure 8).

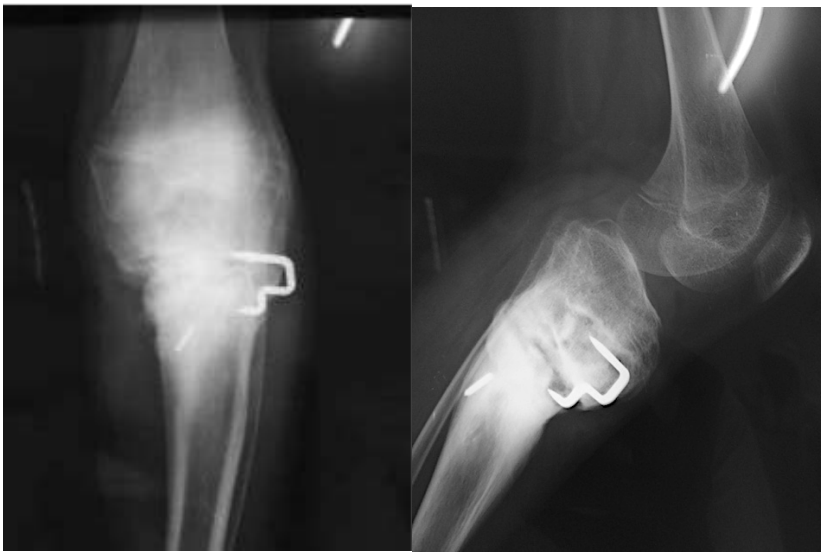

Figure 7. Radiographic check at M7 of the second stage of surgery (note the inversion of the tibial slope).

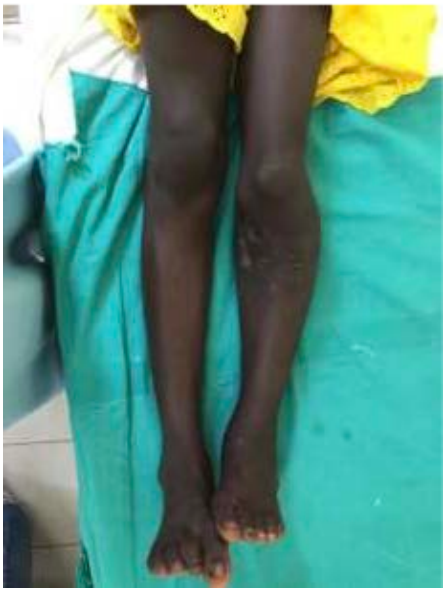

Figure 8. Clinical examination after the second stage of surgery.

3.3. Third Stage of Surgery

The recurrence of knee varus at 7 years and 5 months after the second stage of surgery (Figure 9) led us to plan a third stage of surgery. This consisted of an internal tibial valgus osteotomy with a cortico-cancellous bone graft. Stabilisation was achieved using an Orthofix-type external fixator (Figure 10). At this point, the patient was 21 years old.

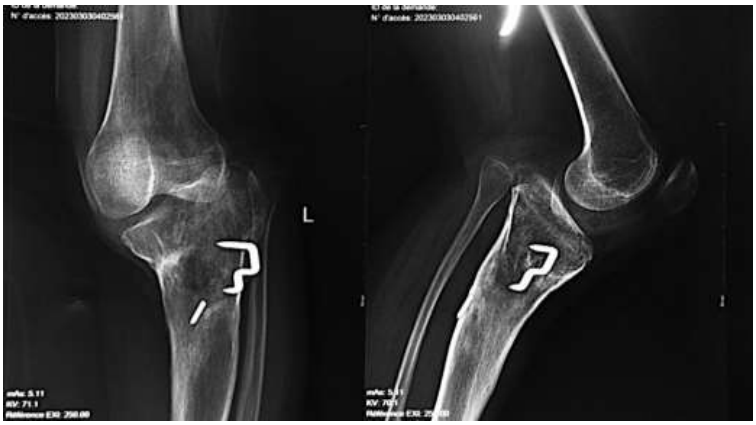

Figure 9. Recurrence of varus at A7M5 post-op.

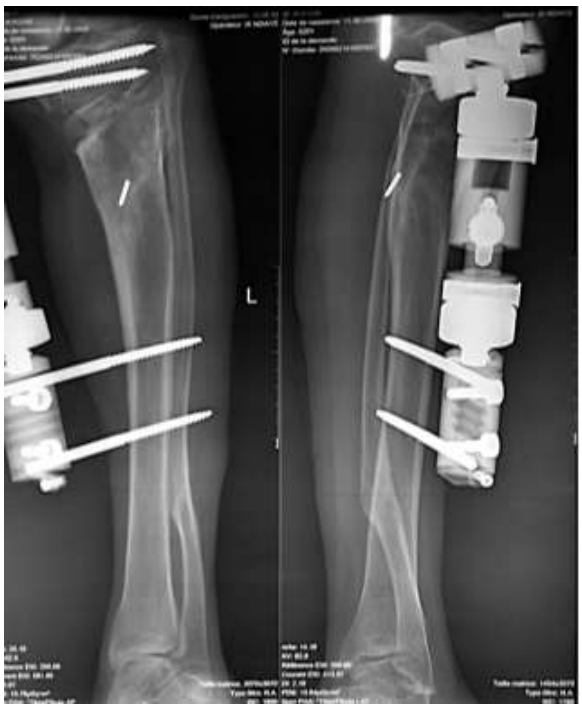

Figure 10. Third surgical stage (internal addition osteotomy + external fixator).

4. Follow-up and Progress

The post-operative course was marked at 3 months by suppuration of the wound, requiring debridement in the operating theatre.

At the last follow-up at A1 + M2 post-op, she presented (Figure 11):

- Independent walking with slight limping
- A normally aligned limb
- A 2 cm difference in leg length
- Complete healing of the wounds
- No pain

The external fixator was removed 8 months post-operatively (Figure 12).

Figure 11. Complete correction of varus and recurvatum at the last follow-up.

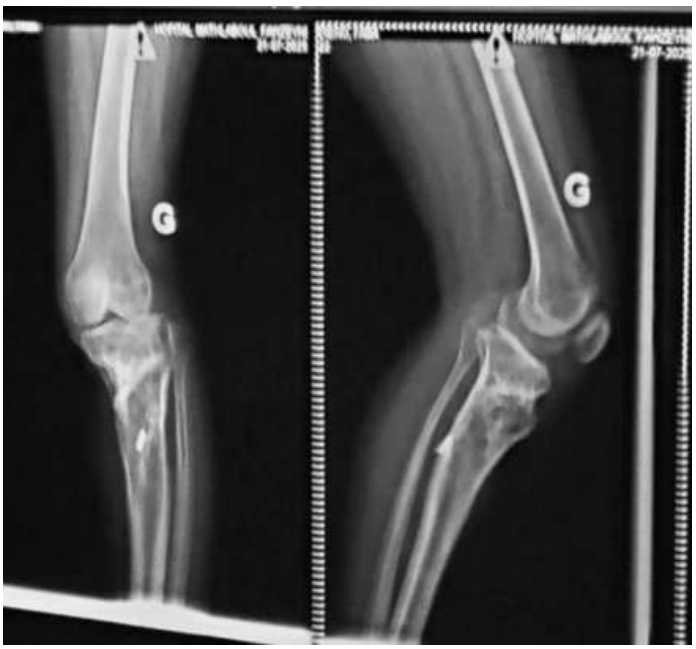

Figure 12. X-ray after removal of the external fixator.

5. Discussion

Blount's disease, or tibia vara, is a rare and progressive osteochondrodysplasia of

the proximal tibial metaphysis, characterized by inhibition of growth of the medial tibial cartilage, resulting in varus deformity of the knee [3]. The case of our patient, aged 13 at the time of her first consultation, is consistent with the adolescent form of Blount's disease, with deformity developing since childhood, reflecting a disease that was not diagnosed early, as can be observed in contexts of limited resources or delayed access to specialist expertise [4].

In our patient, examination of the contralateral knee was normal, suggesting unilateral involvement, which is common in the adolescent form [5].

Imaging revealed Langenskiöld stage VI Blount's disease, with collapse of the medial tibial plateau and irregularity of the growth plate, reflecting advanced and irreversible damage to the medial physis.

Stage VI is rare and occurs mainly in cases diagnosed late or not previously treated. According to Lamont *et al*., less than 5% of patients with juvenile or adolescent Blount's disease have such an advanced form. At this stage, angular and rotational deformities are usually fixed and associated with limb shortening [6].

In our patient, treatment required three successive corrective osteotomies, which illustrates the therapeutic complexity of severe and rigid forms in adolescents. Several surgical techniques have been described in the literature for the treatment of stage VI Blount disease:

- Proximal tibial corrective osteotomy (classic or double-level): proximal tibial osteotomy is often valgus. In stage VI, this option is generally insufficient on its own. Janoyer *et al*. showed that correction was often incomplete [7]. Sabharwal *et al*. recommend a double-level osteotomy [3].
- External fixator (Ilizarov or Taylor spatial frame type): Indicated for severe forms, it allows for three-dimensional correction. Ghoneem *et al*. reported good alignment in 80% of cases [8]. Burghardt and Herzenberg prefer the Taylor spatial frame (TSF) for fine corrections [9].
- Correction in several stages (2- or 3-stage approach): Ferland *et al*. reported a series of 4 cases of stage VI Blount's disease treated in 2 to 3 stages. Dogan *et al*. recommend personalized management. This technique is similar to ours.

In our patient, the first stage consisted of an external valgus tibial osteotomy combined with an internal tibial plateau lift. This technique, which has been well described in adolescents, allows for direct angular correction [10] [11]. However, in our patient, persistent residual varus (40˚) and recurvatum were noted, probably due to an insufficient initial assessment of the sagittal component [12].

A new external tibial osteotomy was performed to correct residual abnormalities. The failure of this second attempt, marked by recurrence of varus and recurvatum 7 years and 5 months post-operatively, is consistent with data in the literature on the high frequency of recurrence in advanced stages, especially in the absence of treatment of the aetiopathogenic basis [10] [13]. In addition, initial management without external epiphysiodesis could also explain this recurrence, but this allowed us to minimize the limb length discrepancy.

An internal addition osteotomy with a cortico-cancellous graft stabilized by an

Orthofix-type external fixator was performed during the third stage of surgery. This technique, well described by Paley and others [14] [15], allows for more stable correction with medial support.

In order to better situate our case in the international therapeutic context, we have produced a comparative table of the main surgical treatments described for Langenskiöld stage VI Blount disease (**Table 1**). This table compares the different approaches used in different countries, their clinical results, associated complications, and specific comments on each strategy.

Analysis of these data clearly shows that combined or multi-stage treatments (osteotomy + external fixator + ligament stabilisation) give the best results in stage VI cases, particularly in terms of complete anatomical correction, joint stability, and reduced risk of recurrence. These approaches also allow for gradual adaptation to the patient's biomechanical response.

Our three-stage therapeutic strategy is in line with this modern trend. Unlike isolated osteotomies, which are often insufficient in stage VI [7], or single treatments with fixators, our progressive approach has achieved almost complete correction. These results are consistent with those reported by Ferland *et al.* in their series of patients treated in several stages [16].

Thus, our case study supports current recommendations in the literature that personalised, multimodal, and progressive management is most appropriate for advanced forms of Blount's disease.

Table 1. Comparative table of surgical treatments for stage VI Blount's disease.

Study/Year	Country	Type of treatment	Results	Complications
Ghoneem *et al.* (2000)	Egypt/USA	Ilizarov external fixator	Satisfactory correction in 80% of cases	Infections, pain, joint stiffness
Burghardt & Herzenberg (2010)	USA	Taylor Spatial Frame (TSF)	Good accuracy for complex corrections	Risk of overcorrection or recurrence
Sabharwal (2004)	USA	Double-level osteotomy (femoral + tibial)	Effective angular and rotational correction	Possible delayed healing
Ferland *et al.* (2014)	Canada	Three-step treatment: osteotomy + external fixator + reconstruction	Good alignment and good joint function at 2-year follow-up	Long recovery, possible reoperations
Dogan *et al.* (2013)	Türkiye	Customized osteotomy according to the site of deformity	Clinical and radiological improvement	Risk of recurrence if growth remains
Alman *et al.* (2007)	Canada	Bone correction + ligament reconstruction	Good results in patients with instability	Surgical complexity, longer treatment
Jadeja *et al.* (2015)	India	Reaming + ligament stabilization	Improved stability, partial correction	Outcome depends on age and degree of laxity
Janoyer (2016)	France	Simple valgus osteotomy	Incomplete correction in severe stages	Frequent recurrence

6. Conclusions

Blount's disease is a rare but potentially severe growth disorder that can lead to

significant deformities of the lower limb if not treated early and appropriately. In this paper, we present a clinical case that is particularly indicative of an advanced and complex form of the disease in a 13-year-old adolescent.

These advanced cases represent a major surgical challenge. A multimodal and personalised approach offers the best results. Our three-step strategy, although unplanned, is part of this personalised approach and long-term follow-up for a satisfactory outcome.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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