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Original Article

Epidemiology of Genu Varum Patients In Dr. Soetomo General Academic Hospital Surabaya 2010-2018: A Retrospective Study

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ABSTRACT

Background: Genu varum is a condition where the legs bend inward, resembling the letter "O," leading to gait disturbances and other lower-limb deformities. Data on genu varum, particularly regarding its prevention, is still lacking. This study aimed to identify the epidemiological characteristics of patients with genu varum to improve prevention, management, and prognosis, and to provide data for future research.
Methods: This descriptive study employed a retrospective research design. Total sampling was used, including all genu varum patients from the Department of Orthopedics and Traumatology database at Dr. Soetomo General Academic Hospital Surabaya between 2010 and 2018. Data was collected from medical records and patient home visits.
Results: Thirty-one patients were included in the study, with 21 males (68%) and 10 females (32%). The mean age of the patients was 4.3 years, with an average age at first complaint of 1.8 years. The average birth weight was 3.49 kg, and the average body mass index was 26.3. Langenskiold stage distribution was as follows: I (3%), II (70%), III (3%), IV (8%), V (3%), and VI (13%). Eighteen patients (58%) had bilateral Blount disease, seven (23%) had unilateral Blount disease, and six (20%) had physiological genu varum. Eighteen patients underwent conservative treatment, and 13 underwent operative treatment.
Conclusion: Blount disease is the most common cause of genu varum at Dr. Soetomo General Academic Hospital, particularly in the infantile group. The majority of patients were male and received conservative treatment.

Keywords: Blount disease; Epidemiology; Genu varum; Human and medicine

INTRODUCTION

Genu varum, or bowleg, is a condition in which the legs bend inward, resembling the letter "O." This typically occurs in infants and toddlers younger than two years. It is important to determine whether this abnormality falls within physiological limits or indicates Blount disease. Blount disease, first described in 1937, is a growth disorder of the medial portion of the proximal tibia, specifically the epiphysis and metaphysis.[1,2] This disease is generally associated with the varus angulation and internal rotation of the tibia in the metaphyseal area. Although the primary pathology presents as tibia vara, other lower limb multiplanar deformities may exist, including genu varum, genu procurvatum (anterior angulation), internal rotation, and limb shortening.[3–6] These deformities can lead to gait disturbances, lower limb-length discrepancy, and premature knee osteoarthritis.[7]

Globally, the prevalence of early-onset Blount disease has been estimated at 1 in 1,200 live births in North America, particularly the Caribbean. The typical patient is an overweight child of Black African, African-American, or

Afro-Caribbean descent.[8] Disease onset is before three years of age. A study in Iran with 4,689 primary school students reported that genu varum was found in 0.09% of four-year-old children.[9]

Clinical classification can be differentiated based on the limb deformities that develop before and after four years of age. Thompson and Carter further classified late-onset Blount disease as juvenile type (onset at 4–10 years of age) and adolescent type (onset after 10 years of age).[10,11] Blount disease can affect children in infancy and can be classified into two types based on the age of first presentation: early-onset (infantile) and late-onset (adolescent). Langenskiold described there as being six stages of progressive radiographic changes in the epiphyses and proximal tibial metaphysis of children with early-onset Blount disease. With an increasing age and higher Langenskiold grades (V and VI), irreversible physeal changes with permanent inhibition of the medial portion of the tibial growth plate may occur.[12,13]

In physiological genu varum, the varus deformity will typically decrease when observed in patients aged 2–3.5 years. Generally, the knee is slightly valgus at the age of 3.5 years, according to the Salenius graph and Vanka.[14] Management of genu varum can include observation, bracing, or surgery. Bracing is usually used for children younger than four years. Surgical options include osteotomy and epiphysiodesis.[7,15] However, there are gaps in the data on genu varum that hinder effective prevention strategies. This study aimed to determine the epidemiology of patients with genu varum at Dr. Soetomo General Academic Hospital Surabaya to improve prevention, management, and prognosis, and to serve as a foundation for future research on genu varum.

MATERIALS AND METHODS

Study Design

This was a descriptive study. The research employed a retrospective design.

Ethical Clearance

Ethical clearance (No. 1223/KEPK/V/2019) was obtained from the Research Commission of Dr. Soetomo General Academic Hospital Surabaya.

Setting

The study was conducted at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia, in March 2018.

Study Population and Sampling

The target population was comprised of all genu varum patients treated at the hospital from 2010 to 2018. A total sampling technique was used to recruit genu varum patients identified through the Department of Orthopedics and Traumatology database, medical records, and patient home visits.

Data Source

This study used secondary data from the pediatric division database within the Department of Orthopedics and Traumatology at Dr. Soetomo General Academic Hospital Surabaya. This database stores data on the genu varum patients from polyclinics, the emergency department, and orthopedic and traumatology inpatient units discussed in pediatric division meetings.

Data Collection

Patient data included demographics, medical history, clinical examinations, and radiological findings. The following information was collected: sex, age at first presentation, age at walking onset, age at initial complaint, delivery method, birth weight, body mass index, medial distal angle (MDA) of the right and left knee, Langenskiold type, genu varum classification, and treatment.

Inclusion and Exclusion Criteria

All data was screened according to the exclusion and inclusion criteria. Inclusion criteria: Genu varum patients listed in the pediatric

Table 1. Comparison of type variables of genu varum patients.

Patient Characteristics	Variable Type	Number of Patients
Sex	Male	21 (68%)
	Female	10 (32%)
Age at first arrival	Less than 2 years	12 (39%)
	2-5 years	11 (36%)
	5-10 years	6 (19%)
	More than 10 years	2 (6%)
Age for the onset of walking	Less than 12 months	11 (35%)
	More than 12 months	20 (65%)
Early age of complaint	Less than a year	17 (57%)
	1-3 years	9 (30%)
	More than 3 years	4 (13%)
Birth methods of delivery	Spontaneous	22 (69%)
	Caesarean	10 (31%)
Birth weight	2.5-3.5 kg	22 (71%)
	3.5-4.5 kg	7 (23%)
	More than 4.5 kg	2 (6%)
Body mass index	Obesity	13 (44%)
	Overweight	3 (10%)
	Normal weight	13 (43%)
	Underweight	1(3%)
MDA of the right knee	Less than equal to 10^{o}	(32%)
	11-25^{o}	(45%)
	More than 25^{o}	(23%)
MDA of the left knee	Less than equal to 10^{o}	(29%)
	11-25^{o}	(48%)
	More than 25^{o}	(23%)
Langenskiold type	I	2 (3%)
	II	43 (70%)
	III	2 (3%)
	IV	5 (8%)
	V	2 (3%)
	VI	8 (13%)
Genu varum	Bilateral Blount	18 (58%)
	Unilateral Blount	7 (23%)
	Genu varum physiology	6 (19%)
Treatment of the patient	Conservative	18 (58%)
	Operative	13 (42%)

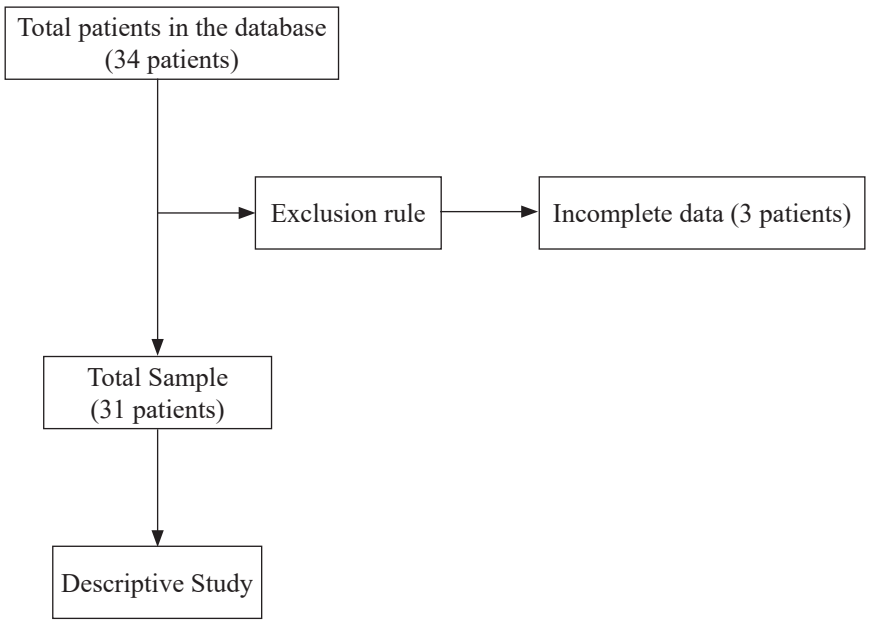

Figure 1. Data processing flow.

division database. Exclusion criteria: Patients with incomplete clinical or radiological examination data and patients who could not be evaluated (Figure 1).

RESULTS

Of the 34 patients with complaints of inward crooked legs (genu varum) during this study, 3 were excluded due to a lack of radiological examination data. A total of 31 patients (21 males and 10 females) met the inclusion criteria. As shown in Table 1, the mean age of the patients was 4.3 ± 3.3 years (range, 1.3–11 years). The age distribution was as follows: 0–2 years, 12 patients (39%); 2–5 years, 11 patients (36%); 5–10 years, 6 patients (19%); and >10 years, 2 patients (6%).

The patients' main complaint was an inward bending of the legs (genu varum). On average, this was first noticed at the age of 1.9 ± 1.8 years (range, 0.8–8 years). The youngest patient was 9 months old, and the oldest was 8 years old. The age distribution at the time of initial complaint was as follows: <1 year, 17 patients (57%); 1–3 years, 9 patients (30%); and >3 years, 4 patients (13%). One patient had a family member with the same complaint; this patient was the fifth of five siblings, and the fourth sibling had a history of bowlegs but did not seek treatment due to their older age and lack of symptoms. This patient's growth and development history was normal, meeting developmental milestones. The mean age at which the patients started walking was 1 ± 0.2 years (range, 0.7–1.5 years). The age distribution at walking onset was as follows: <12 months, 11 patients (35%) and >12 months, 20 patients (65%).

The mean gestational age was 37.4 ± 1.4 weeks (range, 34–41 weeks), with spontaneous vaginal delivery in 22 patients (69%) and cesarean delivery in 10 patients (31%). The mean birth weight was 3.5 ± 0.6 kg (range, 2.5–5 kg). The birth weight distribution was as follows: 2.5–3.5 kg, 22 patients (71%); 3.5–4.5 kg, 7 patients (23%); and >4.5 kg, 2 patients (6%).

Body mass index (BMI) was calculated using weight and height measurements from each patient. The mean BMI was 26.4 ± 5.3 (range, 17.5–40.2). The BMI distribution was as follows: obese, 13 patients (44%); overweight, 3 patients (10%); normal weight, 13 patients (43%); and underweight, 1 patient (3%).

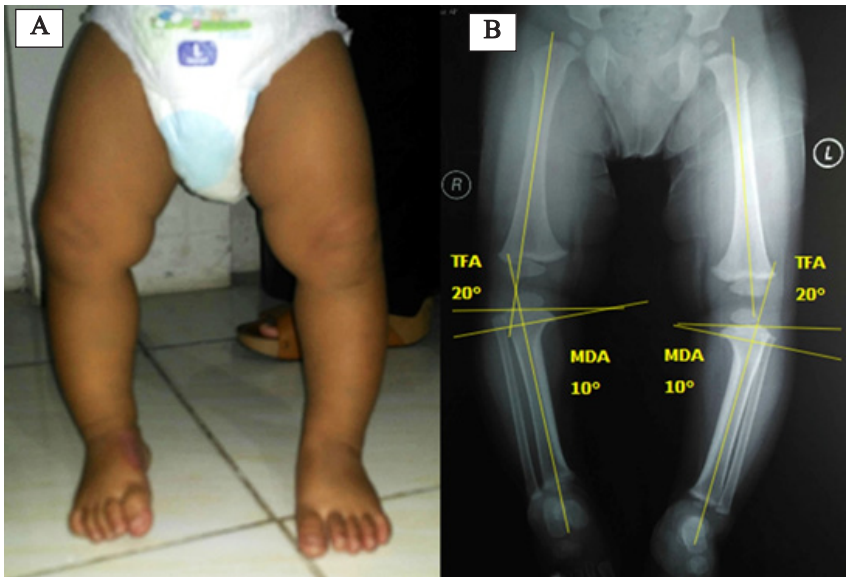

Figure 2. (A) Clinical photograph and (B) standing anteroposterior radiograph of a 16-month-old male patient with bilateral early-onset Blount disease treated conservatively.

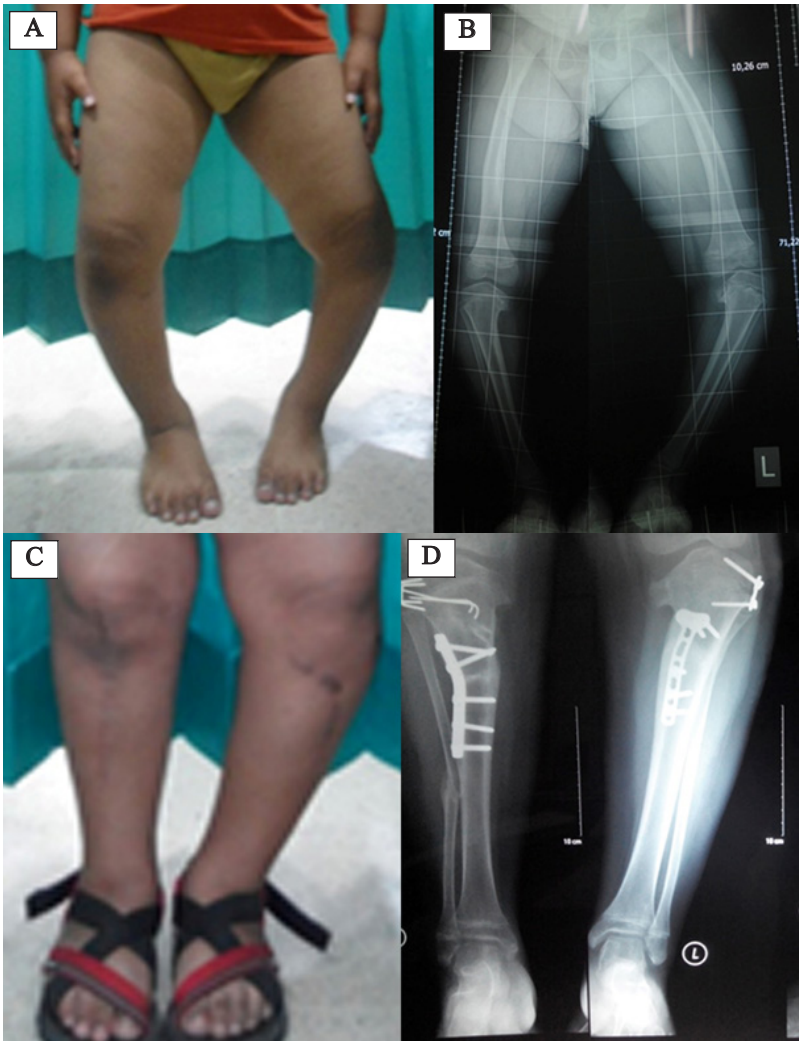

Figure3. An 8-year-old male patient with bilateral early-onset Blount disease (more pronounced bowing on the left side) managed with operative treatment. (A) Pre-operative clinical photograph. (B) Pre-operative radiograph. Outcome after the restoration of limb alignment with a double osteotomy of the proximal tibia, including de-rotation and elevation of the osteotomy physis.

From the anteroposterior and lateral radiographs of the knee, the metaphyseal-diaphyseal angle (MDA) and tibiofemoral angle (TFA) were measured for both knees. The mean MDA was 19.2° ± 13.1° (range, 2°–60°) for the right leg and 20.2° ± 15° (range, 2°–74°) for the left leg. The mean TFA was 29.8° ± 13.4° (range, 14°–60°) for the right leg and 27.6° ± 14.5° (range, 0°–62°) for the left leg. Blount disease was diagnosed when the MDA was greater than 11°.[16] Figure 2 shows the TFA and MDA measurements for patients who underwent conservative treatment. Blount disease was present in 21 right knees (67%) and 22 left knees (70%), while physiological genu varum was present in 11 right knees (33%) and 8 left knees (30%). According to the Langenskiold classification system, the distribution of disease severity across all knees (n = 36) was as follows: Langenskiold I, 2 knees (3%); Langenskiold II, 24 knees (70%); Langenskiold III, 2 knees (3%); Langenskiold IV, 5 knees (8%); Langenskiold V, 2 knees (3%); and Langenskiold VI, 8 knees (13%).

Eighteen patients (58%) had bilateral Blount disease, 7 patients (23%) had unilateral Blount disease, and 6 patients (19%) had physiological genu varum. Of the 25 patients diagnosed with Blount disease, 8 had late-onset disease, and 17 had early-onset disease. Eighteen patients underwent conservative treatment, and 13 patients underwent surgical treatment. Surgical treatment included realignment osteotomy and epiphysiodesis, while conservative treatment consisted of clinical and radiological observations every 6 months, weight loss management, and knee-foot orthosis bracing. Figure 3 shows an 8-year-old patient with bilateral early-onset Blount disease who underwent surgical treatment with a double osteotomy of the proximal tibia (including osteotomy, derotation, elevation, and physeal osteotomy).

DISCUSSION

The sample for this study was obtained from Dr. Soetomo General Academic Hospital in Surabaya, Indonesia. Patients were referred from as far away as East Nusa Tenggara. Our observations indicated that the patients generally came from city hospitals or health centers and had middle to lower socioeconomic status and limited education,

Males comprised the majority of the study population (68%). Regarding sex and Blount disease type, there were 10 males and 6 females with infantile Blount disease and 8 males with adolescent Blount disease. This contrasts with demographic studies in America and Europe; a meta-analysis by Rivero found that females were more likely to have infantile Blount disease (61%, $p < 0.0001$), while males were more likely to have adolescent Blount disease (71%, $p = 0.0001$).[7] This may be related to obesity data in America, which shows that females under 2 years of age are more likely to be overweight (11.4%) compared to males (5%, $p = 0.03$).[7]

In this study, there was a delay between the initial observation of genu varum and the first hospital visit, averaging approximately 28 weeks (range, 6 months to 7 years). Eighteen patients (58%) had a delay of less than 1 year, while 13 patients (42%) had a delay of more than 1 year. This delay may be due to a lack of understanding about genu varum among the patients' families or limitations in the referral system from primary health facilities to hospitals.[17]

Some studies have suggested that sporadic genetic factors may predispose individuals to Blount disease. Three families have been reported with an inheritance pattern of genu varum or Blount disease from parents to children. Additionally, identical twins with Blount disease whose mother had physiological genu varum have been reported.[7,18,19] In this study, we found only one patient with Blount disease

who had an older sibling with bowlegs who did not receive treatment.

One of the etiological factors for Blount disease is mechanical, specifically excessive weight and early walking onset (<12 months).[20–22] The pathology involves weight-bearing stress, particularly on the medial side of the tibia, which can disrupt growth according to the Heuter-Volkmann law.[23–26] Histopathological examinations have revealed anatomical and functional abnormalities in the chondrocytes and ossification disorders of the epiphyseal plate. In a simulation study of patients with obesity and 10° of genu varum, walking on one foot was sufficient to disrupt physeal growth.[27] In our study, 13 patients (41%) were obese, and 11 (35%) started walking before 12 months of age

The increasing rates of childhood obesity in the United States pose a significant health challenge. Although Blount disease is considered rare, its incidence may rise with this trend. According to Klyce et al., the etiology of Blount disease is likely to be multifactorial rather than attributable to a single cause.[28] Numerous studies have linked income level and race to childhood obesity. Therefore, understanding the socioeconomic and racial disparities that influence Blount disease is crucial for developing effective prevention strategies from both community and surgical perspectives.[28]

The Langenskiold classification system describes six stages of progressive radiographic changes in early-onset Blount disease. Patients with Langenskiold stage II often experience spontaneous correction, although this can sometimes occur in patients with stage IV as well. It can be challenging to differentiate between physiological tibial varus (which resolves spontaneously) and infantile Blount disease. Bilateral abnormalities are common, especially in early-onset Blount disease.[11] Birch has noted that a limitation of this classification system is that the positioning of the extremity can affect the appearance of the coronal plane on radiographic images.[29] Furthermore, Janoyer et al. reported significant interobserver variability in the interpretation of the six Langenskiold stages and limited relevance to non-white populations in North America and the Caribbean.[8]

Conservative treatment options include observation with repeated clinical and radiographic examinations, or the use of orthoses. Hensinger has reported significant and encouraging results with orthoses in patients aged 2–3.5 years with the early-stage disease (Langenskiold I and II).[30] Risk factors for the failure of brace therapy include obesity, varus thrust, brace treatment for longer than 3 years, bilateral abnormalities, and Langenskiold stage III or higher.[30]

Indications for surgical treatment include failure of conservative treatment to correct varus deformity, progressive disease, age older than 3 years, advanced Langenskiold stage II or III, MDA >14°, and TFA >15°. Osteotomy performed in patients older than 4 years with Langenskiold stages IV, V, or VI tends to have a higher recurrence rate due to decreased healing potential of the physis (growth plate). Surgical treatment involves varus correction and tibial derotation (Langenskiold stages II and III), with overcorrection into 10° of valgus and derotation to achieve a thigh-foot angle of +10°. For varus deformities in Langenskiold stages IV, V, and VI, a double-level osteotomy is performed, including valgus-derotation osteotomy and epiphyseal-metaphyseal elevation osteotomy. Elevation osteotomy (medial plateau elevation) can be achieved through transepiphyseal osteotomy (for closed growth plates) or intra-epiphyseal osteotomy (for open growth plates).[12,31,32] Surgical treatment is generally more effective in patients younger than 4 years.[30] Janoyer et al. found that the recurrence rate after osteotomy increases rapidly after 4 years of age and is highest when an epiphysiodesis bridge is present at the time of

surgery.[8] Osteotomy performed after 4 years of age has a higher recurrence rate due to decreased healing potential of the physis.[8,11] Potential complications of surgery include compartment syndrome, delayed union, nonunion, hardware failure, vascular injury, infection, peroneal nerve palsy, and recurrence.[11]

This study had limitations, including the condition of medical records at the Dr. Soetomo General Academic Hospital Polyclinic. Long-term follow-up data was not reliably archived. Records were kept manually in a status book and stored in a room. Consequently, follow-up status was available for only 17 patients, while 14 patients were lost. Furthermore, some patients did not return for observation every 6 months as requested, reflecting low patient and family compliance. We suggest that future research be conducted over a longer period with larger samples across multiple hospitals to obtain more robust data. Additionally, meticulous documentation is essential for each patient with genu varum, both at the initial examination and during follow-up evaluations, to assess the treatment outcomes. Physicians should provide a thorough education to parents regarding the importance of routine follow-ups.

CONCLUSION

This study found 31 patients with genu varum in Dr. Soetomo General Academic Hospital from 2010 to 2018, including 25 Blount disease patients and 6 patients with physiologist genu varum. The patients consisted of 21 male patients (68%) and 10 female patients (32%). Of the 25 patients with Blount disease based on age, 17 patients were infantile (early-onset) (68%), and 8 patients were adolescent (late-onset) (32%). A total of 13 patients (28%) underwent operative treatment, while 18 patients (72%) underwent conservative treatment. However, the prevalence in general society might be diverse.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

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