International Journal of Contemporary Pediatrics
Ganavi R. Int J Contemp Pediatr. 2016 May;3(2):687-691
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291
DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20161068

Clinical Perspective

Bow legs and knock knees: is it physiological or pathological?

Ramagopal Ganavi*

Department of Paediatrics, Chettinad Hospital and Research Institute, Kelambakkam, Chennai, Tamil Nadu, India

Received: 10 February 2016
Revised: 11 February 2016
Accepted: 16 March 2016

***Correspondence:**
Dr. Ramagopal Ganavi,
E-mail: ggganavi10@gmail.com

ABSTRACT

Knock knees and bow legs are commonly seen pediatric orthopedic problem, as the child grows the knee undergoes sequential changes in the axial development from varus to valgus. Differences in appearance of foot and position of foot while the child is walking as noticed by parents most often reflect variations of normal physiological development. As parents are not aware of normal growth and development of lower-extremity, and desire for normal alignment in their children, they are very much concern and motivated to seek medical advice. Many children are referred unnecessary to orthopedician for treatment of physiological genu varum and genu valgus which is unnecessary and may turn out to be sometimes harmful also. Most parents are happy to be reassured that this children deformity is with normal limits and will disappear. For this the physician should be aware of when to consider as physiological and pathological for which he has to take a detailed history of the problem, perform a detailed examination to rule out pathological causes. So, this article helps us to know when to consider physiological and rule out pathological so as to avoid unnecessary interventions for the child.

Keywords: Genu, Varum, Valgum

INTRODUCTION

Most of the parents bring their little ones for the complaints of bow legs or knock knees, which is just variation of normal growth and development and it resolves on its own as the child grows.

Whether it is pathological or physiological, the differentiation has to be made by taking detailed history, careful examination and certain measurements that include the intercondylar distance, intermalleolar distance and tibio femoral angle assessment.

The anxious parents have to be explained and reassured as treatment is usually not required in most of the cases and is reserved only for those with proven pathological deformity.

Terminology [1]

Varum*:* Term used to describe angulation of a bone or within a bone towards the midline.

Genu means knee, so genu varum indicates bowlegs.

Valgum: Term used to describe angulation of a bone distal to a joint or in a part of a bone away from the midline. Genu valgum indicates knock-knees.

Intercondylar & Intermalleolar distance

In bow legs, we measure intercondylar distance, which indicates the degree of genu varum and is the distance between the medial femoral condyles when the lower extremities are positioned with the medial malleoli touching.

In knock knees, we measure intermalleolar distance that indicates the degree of genu valgum and is the distance between the medial malleoli with the medial femoral condyles touching.

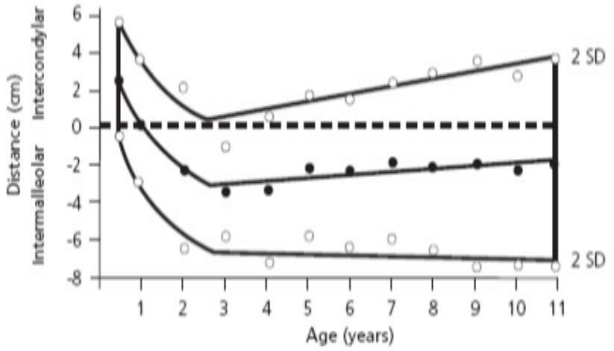

Figure 1: Standard values of intercondylar and intermalleolar distances in a study of 196 white children. Standard values are solid dots; circles are two standard deviations.

Figure 2: Physiological bowlegs and knock-knees. These siblings show the sequence with the toddler with bowlegs and the older sister with mild knock-knees.

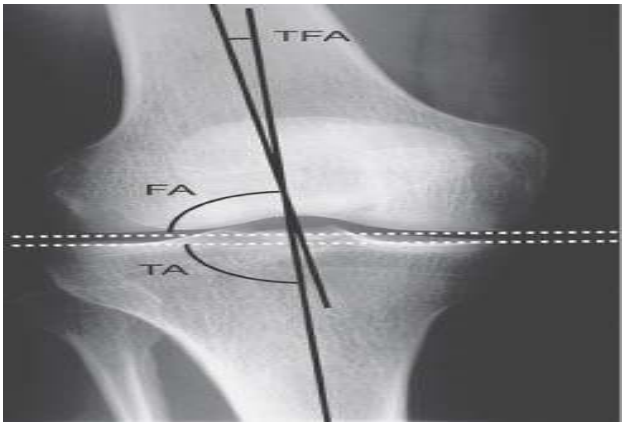

Figure 3: X- ray showing tibiofemoral angle.

Figure 4: Clinical photograph showing the determination of the tibiofemoral angle using customised standardised goniometer.

***Tibio femoral angle*[3]**

Tibio femoral (TFA) angle or knee angle is the angle formed by the mechanical axis of the femur intersecting the mechanical axis of the tibia. When there is a reduction of this angle, it leads to genu varum (bow legs) and an exaggeration of this angle results in genu valgum (knock knees).The physiological development of the TFA from bow legs (varus) in infants to knock knees (valgus) in early childhood is well known.

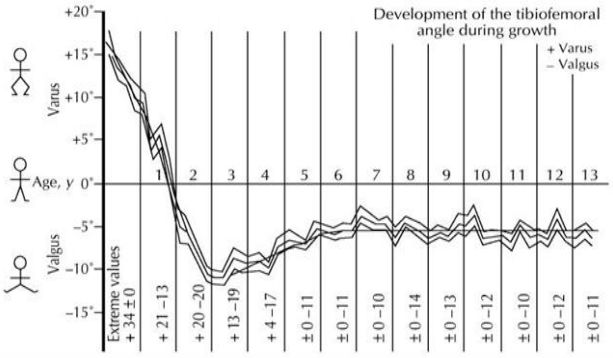

Figure 5: Development of the tibiofemoral angle during growth (0-13 years).[4]

***Natural history*[5]**

Bow legs are as a result of normal intra uterine positioning. In utero, the lower limbs are positioned such that, the hips are flexed, externally rotated, and abducted and the knees are flexed and the legs are internally rotated. This combination of external rotation of the hip along with internal rotation of the leg results in bowed appearance of the lower limbs (varus). This varus position is maximum in new-born (12 to 15°) which becomes neutral at 1 ½ to 2 years.

The knee undergoes sequential physiological changes in its axial alignment from varus to valgus. Bow legs are common up to 2 years of age and gradually progress to knock knee from 2yrs onwards. By 3-4 yrs, maximum valgus is seen and certain amount of knock knees persists throughout the life.

Table 1: Findings of various studies.

Study	Children [n]	Race	Age [yrs]	Technique	Varus	Valgus	Gender variation
Mathew and Madhuri [3]	360	South Indian	2 to 18 yrs	Clinical	-	2 yrs	Yes
Salenius and Vankka[4]	1279	Caucasian	0 to16	Radiological and clinical	<1 yr	18 months to 3 yrs	No
Yoo et al[7]	452	Korean	0 to 16	Radiological	< 1yr	-	No
Heath and Staheli[8]	196	white	0.5 to 1	Photographic	6 months	-	No
Cheng et al[9]	2630	Chinese	0 to 12	Clinical	-	-	No
Oginni et al[10]	2036	Nigerian	0 to 12	Photographic and clinical	0 to 6 months	>23 months	Yes
Rahman and Badahdah[11]	300	Saudi	2 to12	Clinical	-	2 yrs	Yes
Cahuzac et al[12]	427	European	10 to 16	Clinical	-	-	Yes
Saini et al[13]	215	Indian	2 to 15	Clinical	< 2 yrs	>2 yrs	yes
Arazi et al[14]	590	Turkish	3 to 17	Clinical	-	-	Yes
Omololu et al[15]	2166	Nigerian	1 to 10	Clinical	1 to 3	-	Yes

There are many studies in the literature have shown that physiological bow legs may be present up to 1 ½ to 2years. They have studied age group ranging from 0 to 18 years, by using clinical, photographic, radiological methods in different racial population.

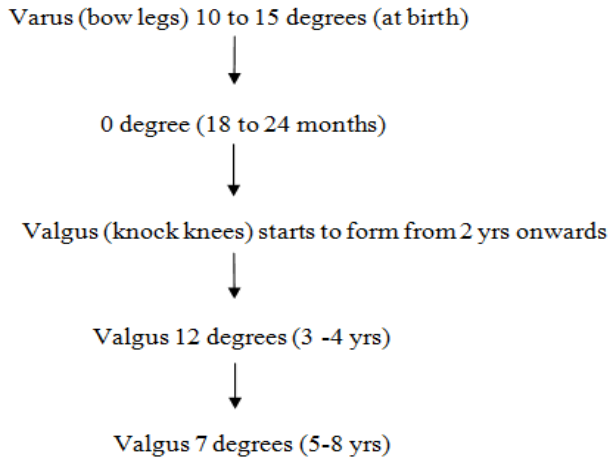

Figure 6: Flow chart of sequential changes.

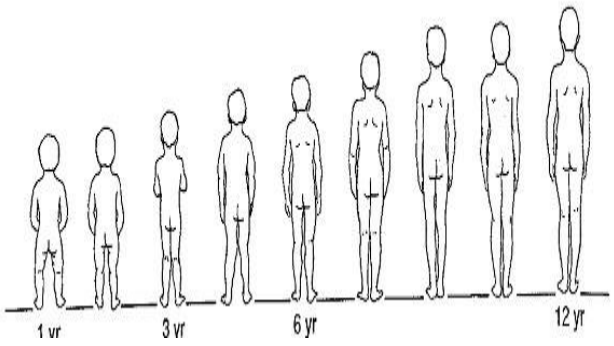

Figure 7: Progression of TFA.[6]

Case approach[1]

History

Detailed history is taken from the parents, regarding the onset, when did they notice, since how long is the problem, when it began. Antenatal, natal and post natal history is taken along with detailed developmental

history. Information regarding similar history among the family members, history of trauma, any pain, limping, tripping, falling and also about sitting habits of the baby like "W" sitting is also enquired.

Examination

Anthropometric measurements like the Height, weight should be taken and plotted on the growth chart and if it is normal for age it rules out pathologic conditions like hypophosphatemic rickets. The back and spine are examined for dimple, tuft of hair, scoliosis, or sinus openings. A detailed neurologic examination should be done for diagnosing any neuromuscular disorders.

Table 2: Differential diagnosis of genu valgus and genu varus.[2]

Causes	Genu valgum	Genu varus
Congenital	Fibular hemimelia	Tibial hemimelia
Developmental	Knock knees	Bow legs
Trauma	Over growth, partial physeal arrest	Over growth, partial physeal arrest
Dysplasia	Osteochondrodysplasia	Osteochondrodysplasia
Infection	Growth plate injury	Growth plate injury
Metabolic	Rickets	Rickets
Osteopenic	Osteogenesis imperfecta	-
Arthritis	Rheumatoid arthritis	-

The lower extremities are to be examined for Trendelenburg's Sign and leg length discrepancy to rule out hip dysplasia. The range of motion of the hips, knees, and ankles should be looked for.

The assessment of bowlegs and knock knees is performed by measuring, intercondylar distance and intermalleolar distance and tibiofemoral angle degree measurement by the use of invasive or non-invasive techniques. The non-invasive includes clinical examination as well as photographic analysis. Invasive Technique includes mainly use of radiography.[3]

- Measurement of the standing inter-condylar distance with the feet placed together is advisable and a distance of up to 6 cm is considered normal beyond this warrants orthopaedic evaluation.[16]
- The intermalleolar distance is measured with the child standing and the knees approximated. A distance of up to 8 cm is considered physiological beyond this is considered pathological and warrants orthopaedic evaluation.[16]
- TFA is measured as follows, where the child is made to stand with the hips and knees in full extension and neutral rotation, with the knees or ankles touching each other. The anterior superior iliac spine (ASIS) is identified and marked with a skin marker pen. The centre of patella is palpated and identified with the aid of concentric circles of increasing diameters and then marked with the pen. The midpoint between the medial and the lateral malleoli is marked as the centre of the ankle with the help of a standardised vernier calliper. Then with the help of goniometer with its hinge placed at the centre of the patella, each axis of the goniometer should be adjusted such that the tip of the proximal limb touched the ASIS and the tip of the distal limb touched the midpoint of the ankle The TFA is measured using the goniometer to the nearest degree. This angle corresponds to the angle suspended by the anatomical axis of the femur with the anatomical axis of the tibia. A positive value of TFA indicates valgus, while a varus TFA is given a negative value.[3]

Following conditions alerts the physician the possibility of pathological deformity:[17]

- Unilateral deformity
- Progressive deformity: e.g.: bow legs get worse after age two years.
- ICD/IMD > 2 standard deviation for the childs age.
- Height of the child is < 25th centile for the age.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Sass P, Hassan G. Lower extremity abnormalities in children. Am Fam Physician. 2003;68(3):461-8.
2. Staheli LT. Practice of pediatric orthopedics, 2001 William & Wilkins publications, Chapter 6 page 80-81.
3. Mathew SE, Madhuri V. Clinical tibiofemoral angle in south Indian children. Bone Joint Res. 2013;2:155-61.
4. Salenius P, Vankka E. The development of the tibiofemoral angle in children. J Bone Joint Surg, 1975;57-A:259-61.
5. Thompson GH. Genu varum, Genu valgum. In: Behrman RE, Kleigman RM, Jenson HB. Eds, Nelson text book of Paediatrics.17th edn, Saunders, phildelphia; 2004:pp 2264-2268.
6. Tolo VT, Wood B, Amaral RS. Pediatric orthopedics in primary care. Baltimore. MD; William & Wilkins; 1993:254.
7. Yoo JH, Choi IH, Cho TJ, Yoo WJ. Development of tibiofemoral angle in Korean children. J Korean Med Sci. 2008;23:714-7.

8. Heath CH, Staheli LT. Normal limits of knee angle in white children: genu varum and genu valgum. J Pediatr Orthop. 1993;13:259-62
9. Cheng JC, Chan PS, Chiang SC, Hui PW. Angular and rotational profile of the lower limb in 2,630 Chinese children. J Pediatr Orthop. 1991;11:154-61.
10. Oginni LM, Badru OS, Sharp CA, Davie MW, Worsfold M. Knee angles and rickets in Nigerian children. J Pediatr Orthop. 2004;24:403-7.
11. Rahman SA, Badahdah WA. Normal development of the tibiofemoral angle in Saudi children from 2 to 12 years of age. World Appl Sci J. 2011;12:1353-61.
12. Cahuzac JP, Vardon D, Sales de Gauzy J. Development of the clinical tibiofemoral angle in normal adolescents: a study of 427 normal subjects from 10 to 16 years of age. J Bone Joint Surg. 1995;77-B:729-32.
13. Saini UC, Bali K, Sheth B, Gahlot N, Gahlot A. Normal development of the knee angle in healthy Indian children: a clinical study of 215 children. J Child Orthop. 2010;4:579-86.
14. Arazi M, Oğün TC, Memik R. Normal development of the tibiofemoral angle in children:a clinical study of 590 normal subjects from 3 to 17 years of age. J Pediatr Orthop. 2001;21:264-7.
15. Omololu B, Tella A, Ogunlade SO. Normal values of knee angle, intercondylar and intermalleolar distances in Nigerian children. West Afr J Med. 2003;22:301-4.
16. Stanley Jones, Sumukh Khandekar, Emmanuel Tolessa Normal Variants of the Lower Limbs in Pediatric Orthopedics International Journal of Clinical Medicine. 2013;4:12-7.
17. Green WB. Genu varum and Genu valgum in children. differential diagnosis and guidelines for evaluation. Compr Ther. 1996;22-9.

Cite this article as: Ganavi R. Bow legs and knock knees: is it physiological or pathological? Int J Contemp Pediatr 2016;3:687-91.