Clinical Perspective

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

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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

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 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**

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).

**Natural history**

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 2 years 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.

<table>
<thead>
<tr>
<th>Study</th>
<th>Children [n]</th>
<th>Race</th>
<th>Age [yrs]</th>
<th>Technique</th>
<th>Varus</th>
<th>Valgus</th>
<th>Gender variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathew and Madhuri³</td>
<td>360</td>
<td>South Indian</td>
<td>2 to 18 yrs</td>
<td>Clinical</td>
<td>-</td>
<td>2 yrs</td>
<td>Yes</td>
</tr>
<tr>
<td>Salenius and Vankka²</td>
<td>1279</td>
<td>Caucasian</td>
<td>0 to 16 yrs</td>
<td>Radiological and clinical</td>
<td>&lt;1 yr</td>
<td>18 months to 3 yrs</td>
<td>No</td>
</tr>
<tr>
<td>Yoo et al⁷</td>
<td>452</td>
<td>Korean</td>
<td>0 to 16 yrs</td>
<td>Radiological</td>
<td>&lt;1 yr</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>Heath and Staheli³</td>
<td>196</td>
<td>White</td>
<td>0.5 to 1 yrs</td>
<td>Photographic</td>
<td>6 months</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>Cheng et al¹⁵</td>
<td>2630</td>
<td>Chinese</td>
<td>0 to 12 yrs</td>
<td>Clinical</td>
<td>-</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>Oginni et al²⁵</td>
<td>2036</td>
<td>Nigerian</td>
<td>0 to 12 yrs</td>
<td>Photographic and clinical</td>
<td>0 to 6 months</td>
<td>&gt;23 months</td>
<td>Yes</td>
</tr>
<tr>
<td>Rahman and Badahdah¹¹</td>
<td>300</td>
<td>Saudi</td>
<td>2 to 12 yrs</td>
<td>Clinical</td>
<td>-</td>
<td>2 yrs</td>
<td>Yes</td>
</tr>
<tr>
<td>Cahuzac et al¹²</td>
<td>427</td>
<td>European</td>
<td>10 to 16 yrs</td>
<td>Clinical</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Saini et al¹³</td>
<td>215</td>
<td>Indian</td>
<td>2 to 15 yrs</td>
<td>Clinical</td>
<td>&lt;2 yrs</td>
<td>&gt;2 yrs</td>
<td>Yes</td>
</tr>
<tr>
<td>Arazi et al¹⁴</td>
<td>590</td>
<td>Turkish</td>
<td>3 to 17 yrs</td>
<td>Clinical</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>Omololu et al¹⁵</td>
<td>2166</td>
<td>Nigerian</td>
<td>1 to 10 yrs</td>
<td>Clinical</td>
<td>1 to 3</td>
<td>-</td>
<td>Yes</td>
</tr>
</tbody>
</table>

There are many studies in the literature have shown that physiological bow legs may be present up to 1 ½ to 2 years. 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 approach⁴**

**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 valgum and genu varus.

<table>
<thead>
<tr>
<th>Causes</th>
<th>Genu valgum</th>
<th>Genu varus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congenital</td>
<td>Fibular hemimelia</td>
<td>Tibial hemimelia</td>
</tr>
<tr>
<td>Developmental</td>
<td>Knock knees</td>
<td>Bow legs</td>
</tr>
<tr>
<td>Trauma</td>
<td>Over growth,</td>
<td>Over growth,</td>
</tr>
<tr>
<td></td>
<td>partial physeal</td>
<td>partial physeal</td>
</tr>
<tr>
<td></td>
<td>arrest</td>
<td>arrest</td>
</tr>
<tr>
<td>Dysplasia</td>
<td>Osteochondrodysplasia</td>
<td>Osteochondrodysplasia</td>
</tr>
<tr>
<td>Infection</td>
<td>Growth plate</td>
<td>Growth plate</td>
</tr>
<tr>
<td></td>
<td>injury</td>
<td>injury</td>
</tr>
<tr>
<td>Metabolic</td>
<td>Rickets</td>
<td>Rickets</td>
</tr>
<tr>
<td>Osteopenic</td>
<td>Osteogenesis</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>imperfecta</td>
<td></td>
</tr>
<tr>
<td>Arthritis</td>
<td>Rheumatoid</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>arthritis</td>
<td></td>
</tr>
</tbody>
</table>

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.

• 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.

• 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.

• 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 theibia. A positive value of TFA indicates valgus, while a varus TFA is given a negative value.

Following conditions alerts the physician the possibility of pathological deformity:

• 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.

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REFERENCES


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