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Original Article

Flexion test in the coronal plane deformities of knee

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ABSTRACT

Background/aims: A little information is available in the orthopaedic literature on the clinical bedside assessment of the coronal plane deformities of the knee. We aim to explain the 'knee flexion test' to make it useful for the clinicians and the students learning the art of orthopaedics.

Methods and results: We describe the principle, pre-requisites, fallacy, and modification of the 'knee flexion test' along with the illustrative case description that had genu valgum deformity of the left knee of tibial origin.

Conclusion: The 'knee flexion test' should be a part of clinical bedside assessment of the coronal plane deformities of the knee.

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Coronal plane deformities of the knee are common disorders affecting the lower limb in children and adolescents.¹ The deformity can originate from the distal femur or proximal tibia. Genu valgum usually arises from deformity in the distal femur and genu varum because of deformity in the proximal tibia; however, it may not always be true (Fig. 1a–d). We define the knee flexion test which may be a useful diagnostic tool to determine the origin of deformity. However, this test may lead to erroneous interpretation if not performed accurately. Hence, its detailed basis, possible fallacy, and precautions to

avoid false interpretation have been discussed. The parents of the patient provided written informed consent for print and electronic publication of the figures.

1. Knee flexion test

The patient is laid supine on the examination couch and gradually the knee is flexed passively to 90°. After knee flexion, the deformity is reassessed by observing from the foot

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Fig. 1 – (a) Clinical photograph of the patient showing genu valgum deformity. (b) The deformity disappears on flexing the knee suggesting it to be of femoral origin. However, a note may be made of the external rotation of femur/patella. (c) Plain radiograph and (d) scanogram of the same patient showing the deformity to be of tibial origin.

end of the couch. If the deformity disappears, the cause lies in the lower end of femur and if it persists on knee flexion, it is because of the defect in upper end of tibia.

1.1. The principle

The test is based on the pre-requisite that the posterior femoral condyles are normal. On knee flexion, the normal posterior femoral condyles articulate with the proximal tibia, and therefore, the deformity disappears if it is because of the

femoral component. Similarly, if the cause lies in the upper end of tibia, it is the diseased medial/lateral tibial condyle which articulates with the lower end of femur on any degree of knee flexion and hence the deformity persists.

1.2. Pre-requisites

- (1) The posterior femoral condyles should be normal.
- (2) There should not be any fixed rotation deformity at the hip joint.

1.3. Fallacy

The test is reliable in deformities which arise from lower end of femur. We have observed that even if the cause of deformity lies with the proximal tibia, the deformity may disappear with knee flexion (Fig. 1a and b) and the examiner gets a false impression that the defect lies in lower end of femur (Fig. 1c and d). It occurs because of the faulty technique as shown in Fig. 1. As the knee is flexed, the genu valgum of tibial origin will tend to externally rotate the femur (Fig. 1b) and *vice versa* in genu varum. In this faulty manoeuvre, the attitude of patella and the deformity is masked.

The same can be described with the normal knee flexed at 90°, as it may create an illusion of genu valgum if the femur is rotated internally and *vice versa* genu varum.

1.4. Modification

To avoid such false interpretation, we suggest that an assistant should firmly grasp the femoral condyles while flexing the knee so as to prevent the femoral rotation while the

examiner observes by standing at the foot end of the couch (Fig. 2). However, it may make the test cumbersome and it requires the need for an assistant. As an alternative, the test can be performed in sitting position with the patient at the edge of the table thus locking the femur in neutral rotation (Fig. 3). The attitude of patella should be identical to the normal limb and this serves as auto-check against the wrong technique.

2. Discussion

Coronal plane deformities are the common conditions in children and adolescents that an orthopaedic surgeon is called on to evaluate.² By definition, children with genu valgum or varum have tibiofemoral angles that are outside two standard deviations of the mean.³ Nutritional rickets is the leading cause of coronal plane deformities in children in developing nations, whereas, trauma is probably the leading cause of pathologic genu valgum in developed nations.

There are various clinical tests described to evaluate the severity of deformity like goniometric measurement of the tibiofemoral angle,⁴ measurement of intermalleolar distance,⁴ photographic technique³; however, a method to depict the

Fig. 2 – The deformity is unmasked when femoral rotation is prevented (by an assistant behind the drapes) which is evident from the surface marking of patella.

Fig. 3 – The test performed in the sitting position un masks the deformity as femoral rotation is automatically brought to neutral. This method obviates the need for an assistant.

origin of the deformity has not been described in detail. A single weight-bearing antero-posterior radiograph of the lower extremity including hip, knee and ankle (the so called, scannogram) allows measurement of alignment and assessment of bony or physeal abnormality.² Measurement of tibiofemoral angle (anatomic axis) on these films may reasonably reflect the magnitude of the deformity.^{2,5} However, this angle requires drawing of relative diaphyseal anatomic axis which may be difficult to draw when there is generalised involvement of the long bones.⁶ The access to this facility may not be available with majority of the centres in developing nations and peripheral centres in developed nations. The knee flexion test can be a useful bedside clinical assessment tool in such circumstances to know the predominant femoral/tibial origin of the deformity. Such a clinical bedside investigative tool has not been described, to the best of authors' knowledge, in the international orthopaedic literature.

Over the years, the authors have found the test extremely useful in their clinical practice for depicting the origin of deformity in coronal plane deformities of the knee. It might form a special bedside clinical test which should be included in the initial assessment of the deformity by a trainee/registrar/treating clinician. The findings may later on be correlated with radiological parameters like lateral distal femoral angle (LDFA) or medial proximal tibial angle (MPTA).

Conflicts of interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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