

## Original Research Article

# Clinical measurement of intermalleolar distance in Western Indian population

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### ABSTRACT

**Background:** Angular deformities around the knee are one of the common basis of presentation at orthopaedic clinic and intermalleolar distance (IMD) is an essential anthropometric tool for evaluation of the angular status of the lower limb.

**Methods:** 500 healthy (330 male and 170 female) subjects between 20 to 40 years of age were taken for IMD measurement in standing and supine position by digital vernier caliper.

**Results:** The normal range of IMD in western Indian population in between 32-58 mm. IMD in standing position was 42.47 mm with (95% CI = 40.51 to 44.42 mm) and in supine position was 34.45 mm with (95% CI = 32.78 to 36.13 mm). Mean IMD in male in standing position was 40.01 mm while in female it was 43.74 mm observed. Statically significant difference was observed in posture change and according to age.

**Conclusions:** Significantly higher value in female, in standing position and in higher age group were observed.

**Keywords:** Intermalleolar distance, Standing position, Supine position, Western Indian population

### INTRODUCTION

At any orthopedic clinic, angular malformations around the knee are one of the common presentations. Determining which of these are pathological often cause apprehension in the population, although most of these conditions are commonly benign and self-limiting.

Intermalleolar distance is the distance between the two medial malleoli of the ankles keeping the femoral condyles touching each other and is an important anthropometric tool while assessing the angular status of the lower limb.<sup>1,2</sup> In classifying individuals in a population as having genu valgum (knock-knees), genu varus (bowed legs) or normal limbs, the intermalleolar measurement is commonly used in the orthopaedic practice. The determination of individuals as having valgus or varus deformity assumes significance in recruitment into armed forces and para-military forces.

Lateral femoral neck anteversion coupled with lateral tibial torsion leads to Genu valgum (knock-knee).<sup>3</sup> This structural nonconformity causes abnormal lateral stress on the patella so that legs are bent inward in the upright position. In those instances where both the knees are touching, then ankles also touch. However in a person with knock-knee, the knees typically touch each other but ankles remain separated by a distance. Occurrence of Genu valgum or Knock-knee may be physiological or pathological.<sup>4,5</sup> Physiological genu valgum is often seen in children younger than six years and gets resolved by age six. Pathological genu valgum is seen to occur in adolescent and adults and may be acquired or congenital. Acquired genu valgum may be caused due to infectious diseases like polio, maltreated (or untreated) traumatic injuries of the lower limb. Congenital genu valgum may be due to genetic disorders like Down's syndrome, Marfan syndrome, hereditary multiple exostoses, neurofibromatosis and untreated congenital abnormalities.

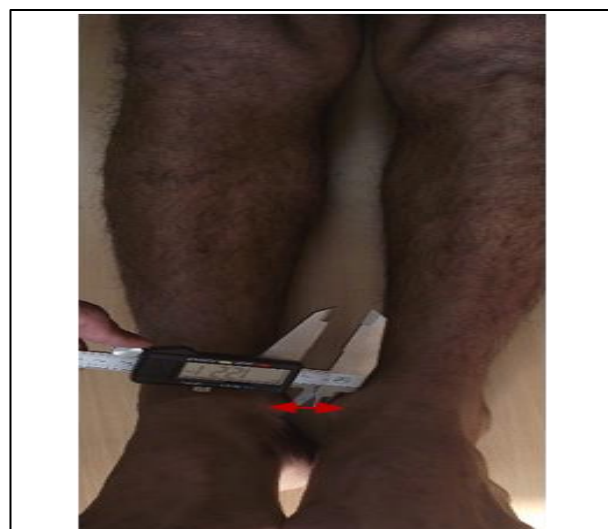
In clinical orthopaedic surgery these measurements are important for correction of varus or valgus deformity by osteotomy. Despite its clinical importance the available literature regarding measurement of IMD and the variation of intermalleolar distances (IMD) in Indian adults is scanty. Most studies that exists in literature are related to normal growth and defining physiological ranges of the knee angle in children. They have attempted to establish standards for certain ethnic/social groups. However, study related to define the normal range in adults in India is very meagre.

The present study was an attempt to formulate a baseline data of intermalleolar distance with respect to age, side and positioning of body among healthy western Indian population with reasonable accuracy.

### METHODS

The study comprised of 500 healthy (330 male and 170 female) subjects between 20 to 40 years of age from various regions of western India. Written informed consent were obtained from all the subjects included in the study. Ethical clearance from Institute Ethics Committee was obtained before undertaking the study. A digital vernier caliper was used to measure the intermalleolar distances. Distance between two approximating medial malleoli of both side was measured as intermalleolar distance in both supine and standing positions (Figure 1). This clinical method to measure IMD is a low-cost method and have the added advantage of not exposing the subject to radiation.<sup>1</sup>

Any person having age less than 20 years and more than 40 years or having any history of joint injuries or musculoskeletal dysfunction of lower limb, any bony deformity in the lower limb, any history of fracture and its surgical intervention in the lower limb and pregnant females were excluded from the study.



**Figure 1: Measurement of intermalleolar distance (IMD) in standing position.**

### Statistical analysis

All subjects were categorized according to particular age groups and gender. Results were statistically analysed and provided the normal range, mean values and standard deviations of the values of intermalleolar distances. In addition, the interrelation between age groups, gender and positioning of body (supine and standing) were evaluated.

### RESULTS

Mean age of the study population was 36.99±11.358 years (range 21 to 40 years). Proportion of the cases were more in 21 to 30 years (70.4%) followed by (29.6%) in 31 to 40 years. The male female ratio was 1.94:1 (males were 66% and females were 34%).

**Table 1: Position wise distribution of intermalleolar distance.**

	Position	Mean	Std. error	Std. deviation	95% C.I.	
					lower limit	upper limit
<b>Intermalleolar distance (mm)</b>	Supine	34.45	0.84	18.72	32.78	36.13
<b>Intermalleolar distance (mm)</b>	Standing	42.47	0.98	21.87	40.51	44.42

Intermalleolar distance (in mm) was significantly more in standing position as compared to supine position (42.47±21.87 mm versus 34.45±18.72 mm) (p<0.001 significant) (Table 1).

No significant difference was observed in intermalleolar distance (in mm) in supine position according to age groups but in standing position mean distance was significantly more in higher age (31 to 40 years of age) (Table 2).

**Table 2: Value of intermalleolar (IMD) distance in association with age.**

Age group	IMD (mm) supine	IMD (mm) standing
<b>21 to 30 (N=352)</b>	34.09±18.36	40.51±21.41
<b>31 to 40 (N=148)</b>	35.31±19.59	47.14±22.31
<b>P value LS</b>	0.507NS*	<0.001S*

\*NS- Non significant, S- Significant

In supine position mean Intermalleolar distance was significantly more in female group (Table 3).

**Table 3: Value of intermalleolar (IMD) distance in association with gender.**

Gender	IMD (mm) supine	IMD (mm) standing
Male (N=330)	31.60±18.35	40.01±19.51
Female (N=170)	35.92±18.77	43.74±22.91
P value LS	0.041S*	0.072NS*

\*NS- Non significant, S- Significant

## DISCUSSION

The present study was focused predominantly towards estimating the mean intermalleolar distances in normal adults. Variations in the mean intermalleolar distances between males and females in both cases (standing and supine) were observed on statistical analysis of the data collected. These variations between the male and female groups ( $p=0.041$ ) were statistically significant. The value of IMD observed significantly higher in female may be explained by the wider pelvis present in the female. Positional differences was also observed as value of IMD was significantly higher in standing position as compared to supine. Significantly higher value was also observed in higher age group (31-40 years). Reason for positional changes could not be ascertained and has to be investigated. Reason for age related changes may be due to skeletal changes due to ageing.

Cheng et al reported maximum IMD of 2.8 cm at 3 years which decreased to  $0\pm 3$  cm at 8 years of age.<sup>6</sup> Uttam et al in their study on Indian children, observed the highest mean IMD of 4.5 cm in children aged 5 years, with a minimum mean of 1 cm at the age of 9 years.<sup>7</sup> Omagbemi et al reported mean peak valgus IMD of 2.5 cm at 3 years of age which decreased to 0.7 cm at 8 years of age.<sup>8</sup> Matthew et al reported a maximum IMD of 3.3 cm.<sup>9</sup>

Very few studies on adults are available in literature to compare the present study results. The present study indicates higher intermalleolar distances for females than male which is comparable with the earlier observation of an intermalleolar distance of 4 cm for normal males and 8 cm for normal females reported in a study of normal Europeans.<sup>10</sup> Similar findings were found by Dare et al during their work on adult Amassoma South-South Nigeria people.<sup>11</sup> However Sharrard et al, in his work on Brazillians with the idiopathic type of genu valgum, reported a higher intermalleolar distance amongst males with genu valgum than in the females which might be due to racial differences in the length, shape and thickness of ossified adult bone.<sup>12</sup> But none of studies have reported any positional and age related changes in IMD values. Consequently there is no data accessible to compare.

We agree that only a multi-institutional study from all regions of the country comprising a hefty number of

adults can exactly predict the normal value of IMD in Indian adults. However it is felt that such a large-scale study might not be plausible considering the diverse ethnicity of Indian population and our study, even with its probable restrictions, sensibly symbolizes the highly diverse Indian population. Another limitation of our study could be its dependency on clinical measurements whose consistency and reproducibility merit consideration. However, to obviate this, we ensured that the measurements were taken by two separate examiners who were blinded with respect to each other's measurements during the study. Although precise reproducibility of the data might be queried, we consider that the general trends of the IMD have been well represented in our study.

Intermalleolar distance at different age groups differ and racial disparities are anticipated to be existing. The general practitioner should, therefore, be cognizant of these differences in the indigenous inhabitants to make suitable treatment judgments.

Authors had suggested the use of intermalleolar/intercondylar distances only in the assessment of progress of genu varum/valgum deformity.<sup>6</sup> However, some other authors feel tibiofemoral angle is a more reliable measurement tool.<sup>9,10,13</sup> Generally, it is believed that using the tibiofemoral angle is more reliable and affords better accuracy. Also there is a positive correlation between IMD and the tibiofemoral angle, it is recommended that IMD may be used as a screening tool in large populations like schools to estimate presence or absence of pathologic genu varus or valgus deformity.

## CONCLUSION

The present study is in conformity with observations of previous studies. The present study established that a mean intermalleolar distance of <4 cm for adult males and <6 cm for adult females in this region of western India is to be considered normal. Value greater than these should be considered abnormal and requires careful follow up and evaluation.

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