



## ASSOCIATION BETWEEN INTERCONDYLAR/ INTERMALLEOLAR DISTANCES AND TIBIOFEMORAL ANGLES; A CROSS-SECTIONAL STUDY

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### ABSTRACT

**Introduction:** Tibiofemoral angle (TFA) is the angle the femoral axis makes with the axis of the tibia at the knee joint. Intercondylar distance (ICD) is the distance measured in centimeters between the two femoral condyles. The intermalleolar distance (IMD) is the distance between the two medial malleoli. There is a negative correlation between TFA and the ICD and a positive correlation between TFA and the IMD.

**Method:** The study was conducted in kindergarten, primary and post-primary schools in Asaba Nigeria. Clinical measurements of TFA, ICD, and IMD of children 3-17 years were taken. 1775 subjects were assessed. The data was subjected to statistical analysis.

**Results:** The mean TFA in this study was  $-0.160 + 2.650$ . There is a correlation between TFA and ICD/IMD.

**Conclusion:** ICD and IMD correlate with TFA.

**KEYWORDS :** Intercondylar Distance, Intermalleolar Distance, Tibiofemoral Angle.

### BACKGROUND

Tibiofemoral angle (TFA) is the angle the femoral axis makes with the axis of the tibia at the knee joint. It is used to measure the alignment of the lower limb. It serves as a tool for the evaluation of developmental trend of the lower limbs in children. Knowledge of TFA is very crucial for the differential diagnoses of pathological conditions around the knee.

Intercondylar distance (ICD) is the distance measured in centimeters between the two femoral condyles. The intermalleolar distance (IMD) is the distance in centimeters between the two medial malleoli. Both are measured in erect position. The TFA is measured in degrees.

TFA is clinically measured as either varus, neutral or valgus knee. The knee and the axis of the tibia serve as the reference points. Varus is seen when the axis of the tibia is oriented towards the midline and valgus when it is away from the midline. It is neutral when the axis of the tibia is on the midline.

### OBJECTIVES OF THE STUDY

- To determine the normal intercondylar and intermalleolar distances in children and adolescents in Asaba Nigeria.
- To determine relationship between intermalleolar distance and intercondylar distance with TFA.
- To ascertain whether there is a relationship between intercondylar and intermalleolar distances.

### MATERIALS AND METHODS

The research was conducted in kindergarten, primary and post-primary schools. It was a cross-sectional randomized stratified study conducted among school children between three to seventeen years of both sexes.

Ethical clearances were got from the relevant authorities. Children with skeletal or extra-skeletal disorders such as developmental dislocations of the hip, various skeletal dysplasia, cerebral palsy, neuromuscular disorders, and feet deformities were excluded from the study. Students who had previous surgery or those with a history of trauma were also excluded from the study.

A total of 1775 children were recruited and evaluated for the study. The following instruments used; stadiometer, weighing balance, goniometer, and a meter rule. The TFA was measured using a standard goniometer calibrated in one degree. The ICD and IMD were

measured using a metre tape rule. The children in standing position; both knees in full extension and there was maintenance of parallel gaze. The knees and the ankles were brought together.

The mid axis of the thigh and the centre of the patella were palpated. These served as the reference for the anatomical axis of the femur. The mid axis of the leg, the midpoint of the ankle and the second toe were palpated and noted as the reference of the anatomical axis of the tibia. One arm of the goniometer was placed at the centre of the knee joint at the mid axis of the thigh. The second arm of the goniometer was placed at the centre of the knee and the mid axis of the leg. The angle formed between the anatomical axes of the femur and the tibia (TFA) was then taken. The TFA was taken as varus when the axis of the tibia was oriented towards the midline, valgus when it was away from the midline and zero when it was on the midline.

Conventionally, the varus angle was given negative (-) values while valgus angle was given positive (+) values. The Tibiofemoral Angle, Intercondylar and Intermalleolar distances were all measured by the researcher so as to prevent inter-observer errors. The whole data was then entered into a preformat for statistical analysis.

### STATISTICAL ANALYSIS

Statistical analysis was conducted using IBM SPSS version 20.0 for Windows. A paired t-test was used to assess differences between the right and left TFAs of the subjects.

The Average TFA (ATFA) was computed as the representative of both right and left TFA. Correlations between the TFA, IMD, and ICD with age, weight, and standing height measurements were studied by performing Pearson's correlation test. A P-value of less than 0.01 was considered to be statistically significant.

### RESULTS

**Table 1: Age and sex distribution of subjects.**

Age (Yrs.)	Subjects		
	Male	Female	Total
3	55	51	107
4	78	48	126
5	66	55	121
6	65	49	114
7	62	50	112

8	63	73	136
9	54	50	104
10	50	69	119
11	55	77	132
12	44	69	113
13	52	72	124
14	62	53	115
15	47	57	104
16	57	59	116
17	69	63	132
Total	880	895	1775

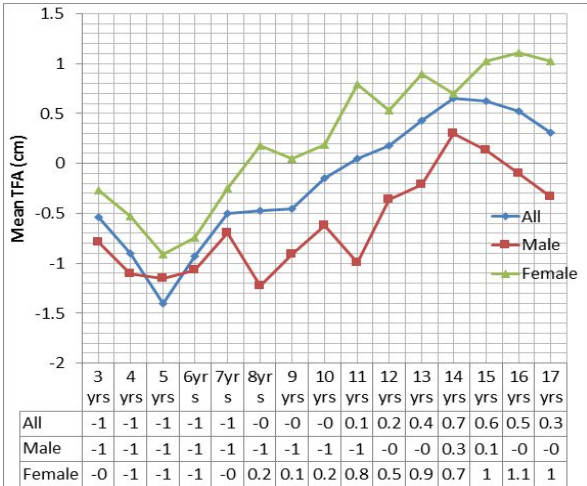


Fig. 1: Mean TFA of the subjects for age and sex

The distributions of the average tibiofemoral angle of the subjects for age and sex are shown in table 1 figure 1.

**INTERCONDYLAR DISTANCE (ICD)**

Table 2: The distribution of intercondylar distance by age and sex

Age (yrs)	Males		Females		Total	
	Mean	SD	Mean	SD	Mean	SD
3	2.52	± 1.39	2.64	± 1.42	2.58	± 1.40
4	3.21	± 1.06	3.22	± 1.52	3.22	± 1.25
5	3.95	± 4.40	3.06	± 1.35	3.55	± 3.39
6	3.25	± 1.47	2.82	± 1.22	3.06	± 1.38
7	3.05	± 1.43	3.42	± 1.22	3.21	± 1.35
8	3.74	± 1.61	2.88	± 1.01	3.28	± 1.39
9	3.90	± 1.59	2.87	± 1.33	3.45	± 1.57
10	3.38	± 1.55	2.65	± 1.69	2.95	± 1.66
11	3.89	± 1.60	2.75	± 1.57	3.22	± 1.67
12	4.43	± 1.77	2.96	± 1.78	3.54	± 1.91
13	3.66	± 1.83	3.33	± 1.77	3.47	± 1.80
14	3.79	± 1.90	3.45	± 1.65	3.63	± 1.79
15	3.97	± 1.91	3.62	± 1.96	3.78	± 1.94
16	3.73	± 2.11	3.21	± 1.96	3.47	± 2.05
17	4.12	± 1.71	3.04	± 1.92	3.60	± 1.89
3-17	3.62	± 2.02	3.06	± 1.61	3.32	± 1.65

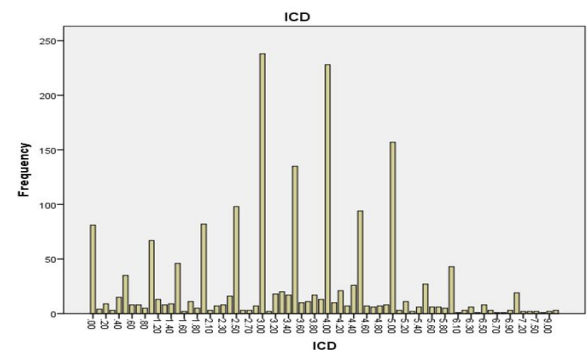


Fig. 2: Distribution of the intercondylar distance (ICD) of the subjects by age and sex



Figure 3: Distribution of the Intercondylar Distance (ICD) of the subjects by Age and Sex

The distributions of the average ICD by age and sex are shown in table 2, figures 2 and 3. The average ICD in this study was  $3.32 \pm 1.65$ cm; with a range of 0 – 10cm. The mean ICD for male subjects is  $3.62 \pm 2.02$  and that of the female subjects  $3.06 \pm 1.62$ .

**INTERMALLEOLAR DISTANCE (IMD)**

Table 3: The distribution of intermalleolar distance by age and sex

Age (yrs)	Males		Females		Total	
	Mean	SD	Mean	SD	Mean	SD
3	0.54	± 0.56	0.78	± 0.85	0.66	± 0.72
4	0.41	± 0.39	0.49	± 0.62	0.44	± 0.49
5	0.28	± 0.29	0.41	± 0.56	0.34	± 0.44
6	0.46	± 0.56	0.29	± 0.24	0.39	± 0.46
7	0.29	± 0.27	0.41	± 0.40	0.35	± 0.34
8	0.34	± 0.35	0.27	± 0.22	0.30	± 0.29
9	0.34	± 0.30	0.35	± 0.32	0.35	± 0.31
10	0.46	± 1.45	0.57	± 0.64	0.52	± 0.57
11	0.39	± 0.57	0.62	± 0.79	0.52	± 0.72
12	0.68	± 0.86	0.68	± 1.03	0.68	± 0.96
13	0.56	± 0.63	0.61	± 0.69	0.59	± 0.66
14	0.76	± 0.61	0.86	± 0.76	0.80	± 0.68
15	0.81	± 0.76	0.73	± 0.67	0.77	± 0.71
16	0.94	± 1.10	0.60	± 0.50	0.77	± 0.86
17	0.69	± 0.67	0.78	± 1.03	0.73	± 0.86
3-17	0.52	± 0.61	0.56	± 0.70	0.54	± 0.65

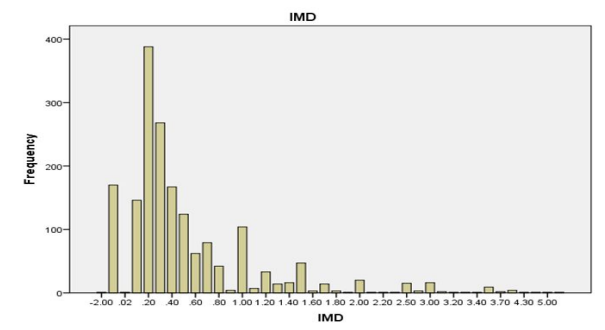
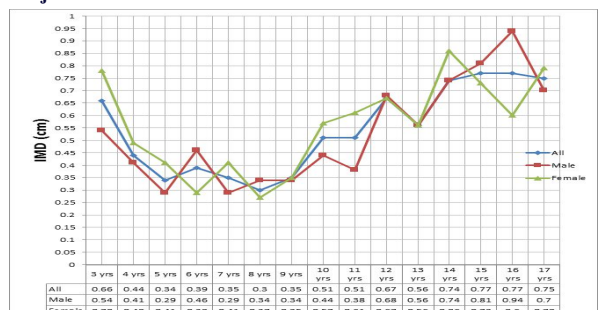


Figure 4: Distribution of the intermalleolar distances of the subjects



### Fig. 5 distributions of the mean IMD by age and sex

The distributions of the mean IMD by age and sex are shown in table 3, figures 4 and 5. The mean IMD in this study was  $0.67 \pm 0.77$ cm: with a range of 0 – 5.8cm. The mean IMD for male subjects is  $0.67 \pm 0.18$  and that of the female subjects  $0.68 \pm 0.10$

### DISCUSSION

The mean TFA in this study was  $-0.16^\circ \pm 2.65^\circ$ , with a range of  $-8.5^\circ$  to  $8.0^\circ$ . The normal range of TFA is defined as mean  $+2SD$ . Intercondylar distance measures the distance between the two femoral condyles while intermalleolar distance estimates the distance between the two medial malleoli. TFA can be estimated indirectly using either the ICD or IMD (Oyewole et al. 2011; Igbigbi et al. 2003; Omololu et al. 2003; Beeson, 1999). In our study, an association between the ICD/IMD and TFA was evaluated.

The research shows that there is a significant negative correlation between TFA and the intercondylar distance (ICD) ( $r = -0.311, p < 0.001$ ). There is also a positive correlation between tibiofemoral angle (TFA) and the intermalleolar distance (IMD) in this study ( $r = 0.115, p < 0.001$ ). There is a negative correlation between the intermalleolar distance and intercondylar distance in this study ( $r = -0.039$ ). This correlation is not statistically significant ( $p = 0.243$ ). The above findings are in conformity with previous works. Therefore, TFA can be estimated using either the ICD or IMD

### CONCLUSION

Tibiofemoral angle measures the alignment of the lower limb. It is a useful tool for the assessment of the knee joint. Tibiofemoral angle can be measured using either the intercondylar distance or the intermalleolar distance.

### CONFLICT OF INTEREST DECLARATION

The authors declare that they have no conflict of interest

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