Original Article

The Morphometric Analysis of the Male Cadaveric Native Knees of the Ethnic Igbos of South East Nigeria and its Implication in Total Knee Replacement

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Abstract

Background: In spite of its consideration as a very successful procedure nearly all total knee replacement (TKR) prostheses were designed based on the parameters of male 4,Western, and primarily white native knees. Mismatch between prosthesis and bone surface or malposition can lead to poor outcome of TKR. **Aim:** To determine the parameters of the native knee of the ethnic Igbos of South East Nigeria, determine any correlations amongst them ,compare the values with that of other populations and discuss its implication in total knee replacement. **Materials and Method:** The study was carried out on male adult cadavers with normal knees found at the museum of the Department of Anatomy University of Nigeria and all cadavers whose knees were deformed or had any pathological condition were excluded from the study. There were 60 knees from 30 male cadavers. Measurements were taken independently from the distal femur and proximal tibia with a method with the aid of a Vernier sliding calipers. **Results:** The determined values of the parameters of the cadaveric knees in centimeters are as follows: FLAP: M=7.10,SD=.44, FMAP: M=6.83,SD=.42, FML:M=7.78,SD=.40, FAR: M=1.10,SD=.06, TLAP:M=4.65,SD=.23, TMAP:M=5.17,SD=.27, TML: M=7.88,SD=.29, TAR:M=1.53. SD=.06. **Conclusion:** The normal values of the knee parameters of the native knee of the ethnic Igbos of the South Eastern Nigeria has been established and these should be taken into consideration by medical engineers during component design and arthroplasty surgeon during total knee replacement. There are correlations between these parameters that could be useful as a decision making tool during TKR and finally, the differences between these parameters and that of ethnic Western and Asian populations should be noted by implant manufacturers and arthroplasty surgeons.

Keywords: *Cadeveric knee morphometry, Ethnic Igbos, South East Nigeria, total knee replacement*

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Introduction

The burden of osteoarthritis (OA) and its management using total knee replacement (TKR) have continued to increase nationally and globally following increased life expectancy.[1,2] Many authors have reported that patients with knee arthritis who have had TKR have had their pain relieved with improve function and enhanced quality of life.[3] In spite of its consideration as a very successful procedure nearly all TKR prostheses were designed based on the parameters of male,[4] Western, and primarily white native knees.[5,6] Mismatch between prosthesis and bone surface or malposition can lead to poor outcome of TKR. During TKR great efforts are made to ensure proper component

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alignment and sizing in other to avoid overhang or under sizing of the prosthesis which may result in a number of severe complications including survivorship. Bonnin *et al*.[7] have demonstrated that tibia prosthesis overhang may result in the residual pain while Stulberg *et al*.[8] demonstrated a close association between sinking and under sizing of femoral prosthesis with high possibility of revisions.

Authors who have carried out studies based primarily on ethnicity have demonstrated variations among the ethnic group of Western and East Asian populations.[9-11] This study had raised three questions for determination. First, what are the normal values of the knee parameters of the native knee of the ethnic Igbos of the South Eastern Nigeria. Second, are there any correlations between these parameters? Third, are there any differences between these parameters and that of ethnic Western and Asian populations? The study has further hypothesized that there are no correlations between these parameters and that there are no differences in the native knees values of the ethnic Igbos and that of Western and Asian populations. Therefore, the purpose of this study is to determine the parameters of the native knee of the ethnic Igbos of South East Nigeria, determine any correlations among them, compare the values with that of other populations and discuss its implication in total knee replacement.

Materials and Method

The study was carried out on male adult cadavers with normal knees found at the museum of the Department of Anatomy University of Nigeria and all cadavers whose knees were deformed or had any pathological condition were excluded from the study. There were 60 knees from 30 male cadavers. Ethical approval obtained from the ethics committe October 25 2019.

A para-patella longitudinal incision about 15 cm long [Figure 1] was made three finger breadth proximal to the patella extending down to a finger breadth medial to the tibia tubercle and the knee exposed by deeper dissections along the same incisional line separating the junction between the rectus femoris and vastus medialis proximally. The cadaver knees were flexed and soft tissues dissected away to expose the articular surfaces of the distal femur and the proximal tibia.

Measurements were taken independently from the distal femur and proximal tibia with a method reported by Kwak *et al*.[12] with the aid of a Vernier sliding calipers, as shown in Figures 2-6.

A: Femoral Measurements: The three femoral morphologic end points were measured as follows

1. Femoral medial lateral width at the condyle (FML): This was referenced by the femoral epicondyle axis, that was defined as the most salient point between the medial and lateral attachment on the femoral condyle Figure 2
2. Femoral lateral anterior posterior dimension (FLAP): This was defined as the distance from the most anterior point on the femur lateral condyle to the posterior condylar line-This is the longest dimensions of the lateral condyle in the anterior posterior dimension Figure 3
3. Femoral medial anterior posterior dimension (FMAP): This was defined as the distance from the most anterior point on the femur medial condyle to the posterior condylar line-This is the longest dimensions of the medial condyle in the anterior posterior dimension Figure 4

B. The three tibia morphologic end points were measured without resection of the tibia surface as follows:

1. Tibia medial lateral dimension (TML): This was measured as the maximum length between the medial and lateral plateau, parallel to the axis of the femoral condyle Figure 5
2. Tibia lateral anterior posterior dimension (TLAP): This is the length from the most anterior point on the lateral tibia plateau to the most posterior point Figure 6
3. Tibia lateral anterior posterior dimension (TMAP): This is the length from the most anterior point on the medial tibia plateau to the most posterior point Figure 7

Test-retest reliability

To assess the testretest reliability some of the cadaveric knees were measured on two occasions within 5 days and the reliability of the repeated measures was evaluated using scatter plots and correlation coefficient.

Figure 1: Knee incision providing access to the cadaveric knee

Table 1: Descriptive statistics-parameters of the cadaveric knees of ethnic Igbos

	n	Range	Minimum	Maximum	Mean	Std. Deviation
Femoral lateral condyle anterior posterior (FLAP) in cm	60	1.9	5.8	7.7	7.10	0.44
Femoral medial anterior posterior (FMAP) in cm	60	1.7	5.6	7.3	6.83	0.42
Femoral Mediolateral (FML) in cm	60	1.5	7.0	8.5	7.78	0.40
Femoral aspect ratio (FAR) in cm	60	0.23	1.0	1.3	1.10	0.06
Tibia lateral anterior posterior (TLAP) in cm	60	0.8	4.3	5.1	4.65	0.23
Tibia medial anterior posterior (TMAP) in cm	60	0.9	4.7	5.6	5.17	0.27
Tibia mediolateral (TML) in cm	60	1.2	7.2	8.4	7.88	0.29
Tibia aspect ratio (TAR) in cm	60	0.3	1.4	1.7	1.53	0.06

Figure 2: Femoral Medial Lateral Dimensions (FML) Measurements

Figure 3: Femoral Lateral Anterior Posterior (FLAP) measurements

Figure 4: Femoral Medial Anterior Posterior (FMAP) Measurements

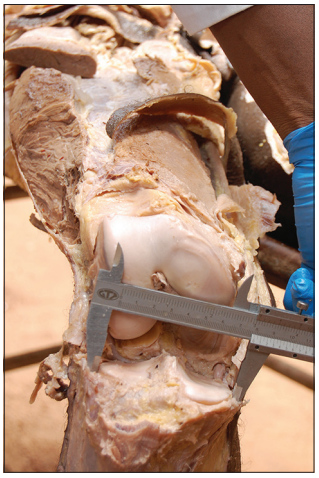

Figure 5: Tibial Medial Lateral (TML) Measurements

Statistical analysis

We used the IBM SPSS package (IBM Corp., IBM SPSS Statistics for Windows, Version 25.0, Armonk, NY, USA), developed by International Business Machines Corporation (IBM) to analyze our data. Descriptive statistics were calculated for all variables of interest. Continuous measures were summarized as means and standard deviations. The *P* values for comparing means of continuous variables were determined after selecting a level of significance ($\alpha = 0.05$). A one sample *t*-test was used for comparison with parameters of White, Black, East Asian and Indian populations. The Pearson correlation coefficient was used to determine correlation between the knee parameters.

Results

Descriptive statistics-Table 1

The determined values of the parameters of the cadaveric knees in centimeters are as follows: FLAP:

Table 2: Correlations of the parameters of the cadaveric knees of ethnic Igbos

		FML	FLAP	FAR	FMAP	TML	TMAP	TAR	TLAP
FML	Pearson Correlation		.621**	.217	.561**	.847**	.694**	-.167	.251
	Sig. (2-tailed)		0.000	0.096	0.000	0.000	0.000	0.202	0.054
	n	60	60	60	60	60	60	60	60
FLAP	Pearson Correlation	0.621**		−0.628**	0.961**	0.705**	0.341**	0.175	−0.094
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.008	0.181	0.477
	n	60	60	60	60	60	60	60	60
FAR	Pearson Correlation	0.217	−0.628**		−0.639**	−0.060	0.240	−0.374**	0.325*
	Sig. (2-tailed)	0.096	0.000		0.000	0.650	0.065	0.003	0.011
	n	60	60	60	60	60	60	60	60
FMAP	Pearson Correlation	0.561**	0.961**	−0.639**		0.651**	0.397**	0.048	0.014
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.002	0.714	0.915
	n	60	60	60	60	60	60	60	60
TML	Pearson Correlation	0.847**	0.705**	−0.060	0.651**		0.662**	0.020	0.323*
	Sig. (2-tailed)	0.000	0.000	0.650	0.000		0.000	0.880	0.012
	n	60	60	60	60	60	60	60	60
TMAP	Pearson Correlation	0.694**	0.341**	0.240	0.397**	0.662**		−0.735**	0.668**
	Sig. (2-tailed)	0.000	0.008	0.065	0.002	0.000		0.000	0.000
	n	60	60	60	60	60	60	60	60
TAR	Pearson Correlation	−0.167	0.175	−0.374**	0.048	0.020	−0.735**		−0.609**
	Sig. (2-tailed)	0.202	0.181	0.003	0.714	0.880	0.000		0.000
	n	60	60	60	60	60	60	60	60
TLAP	Pearson Correlation	0.251	−0.094	0.325*	0.014	0.323*	0.668**	−0.609**	
	Sig. (2-tailed)	0.054	0.477	0.011	0.915	0.012	0.000	0.000	
	n	60	60	60	60	60	60	60	60

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed)

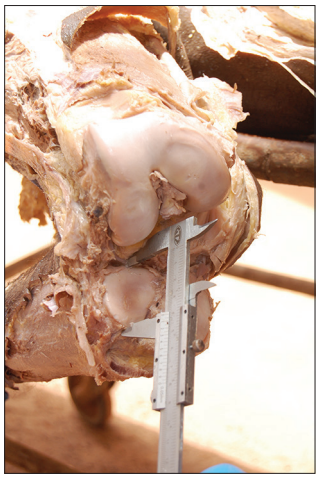

Figure 6: Tibial Lateral Anterior Posterior (TLAP) Measurements

Figure 7: Tibial Medial Anterior Posterior (TMAP) Measurements

M = 7.10, *SD* = 0.44, FMAP: *M* =6.83, *SD* = 0.42, FML: *M* = 7.78, *SD* = 0.40, FAR: *M* = 1.10, *SD* = 0.06, TLAP: *M* = 4.65, *SD* = 0.23, TMAP: *M* = 5.17, *SD* = 0.27, TML: *M* = 7.88, *SD* = 0.29, TAR: *M* = 1.53. *SD* = 0.06.

Correlation of knee parameters of the cadaveric knees of ethnic Igbos- Table 2

Correlation of FML with TML, FLAP, FMAP and TMAP

When the FML dimensions were correlated with the other parameters, the results of the Pearson correlation indicated that there was a strong significant positive association with TML, (r (59) = 0.847, $P < 0.05$), moderate significant positive association with FLAP, (r (59) = 0.621, $P < 0.05$), FMAP, (r (59) = 0.561, $P < 0.05$), and TMAP, (r (59) = 0.694, $P < 0.05$).

Correlation of FLAP with FMAP, FAR, TML, and TMAP

When the FLAP dimensions were correlated with the other parameters and the results of the Pearson correlation indicated that there was a strong significant positive association with FMAP, (r (59)=0.961, $P < 0.05$) and TML (r (59)=0.705, $P < 0.05$), moderate

significant negative association with FAR, (r (59)=0.628, $P < 0.05$), and a weak significant positive association with TMAP, (r (59)=0.341, $P = 008$).

Correlation of FAR with FMAP and TAR other parameters

When the FAR dimensions were correlated with the other parameters and the results of the Pearson correlation indicated that there was a moderate significant negative association with FMAP, (r (59)=0.639, $P < 0.05$) and a weak significant negative association with TAR, (r (59)= 0.374, $P = 0.002$).

Correlation of FMAP with TML and TMAP

When the FMAP dimensions were correlated with the other parameters and the results of the Pearson correlation indicated that there was a moderate significant positive association with TML, (r (59)=0.651, $P < 0.05$) and a weak significant positive association with TMAP, (r (59)=0.397, $P = 0.002$).

Correlation of TML with TMAP and TLAP

When the TML dimensions were correlated with the other parameters, the results of the Pearson correlation indicated that there was a moderate significant positive association with TMAP, (r (59)=0.662, $P < 0.05$) and a weak significant positive association with TLAP (r (59)=0.323, $P < 0.012$).

Correlation of TMAP with TAR and TLAP

When the TMAP, dimensions were correlated with the other parameters and the results of the Pearson correlation indicated that there was a strong significant negative association with TAR, (r (59)=−0.735, $P < 0.05$) and a moderate significant positive association with TLAP, (r (59)=0.668, $P < 0.05$).

Correlation of TAR with TLAP

When the TAR dimensions were correlated with the other parameters and the results of the Pearson correlation indicated that there was a moderate significant negative association with TLAP, (r (59)=−0.609, $P < 0.05$).

Correlation of TLAP with TMAP

When the TLAP, dimensions were correlated with the other parameters and the results of the Pearson correlation indicated that there was a moderate significant positive association with TMAP, (r (59)=0.668, $P < 0.05$).

Comparison of the mean FLAP dimensions of the ethnic Igbos with that of White, Black, East Asian and Indian populations-Table 3

A One-Sample Test Mean comparison of Mean

Table 3: One-sample test mean comparison of mean parameters of the cadaveric knees of ethnic Igbos with other ethnic groups for FLAP

Ethnicity	Population Mean	*t*	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference		Cohen's *d*
						Lower	Upper	
White	6.4	12.307	59	0.000	0.6950	0.582	0.808	1.58
Black	6.6	8.766	59	0.000	0.4950	0.382	0.608	1.13
East Asian	6.1	17.620	59	0.000	0.9950	0.882	1.108	2.26
Indian	6.1	17.620	59	0.000	0.9950	0.882	1.108	2.26

FLAP=Femoral lateral condyle anterior posterior in cm. SD=0.44. Mean=7.10. n=60

Table 4: One-sample test mean comparison of mean parameters of the cadaveric knees of ethnic Igbos with other ethnic groups for FMAP

Ethnicity	Population value	*t*	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference		Cohen's *d*
						Lower	Upper	
White	6.5	6.18	59	0.000	0.3317	0.224	0.439	0.79
Black	6.5	6.18	59	0.000	0.3317	0.224	0.439	0.79
East Asian	6.0	15.50	59	0.000	0.8317	0.724	0.939	1.98

Femoral medial condyle anterior posterior (FMAP) dimensions in cm. SD=0.42. Mean=6.83. n=60

Table 5: One-sample test mean comparison of mean parameters of the cadaveric knees of ethnic Igbos with other ethnic groups for FML

Ethnicity	Population mean	*t*	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference		Cohen's *d*
						Lower	Upper	
White	7.9	−2.295	59	0.025	−0.1183	−0.221	−0.015	−0.30
Black	7.1	13.222	59	0.000	0.6817	0.579	0.785	1.70
East Asian	7.6	3.524	59	0.001	0.1817	0.079	0.285	0.45
Indian	7.0	15.161	59	0.000	0.7817	0.679	0.885	1.95

Femoral medial condyle anterior posterior (FML) dimensions in cm. SD=0.40. Mean=7.78. n=60

Parameters of the cadaveric knees of ethnic Igbos with other ethnic groups for FLAP showed t (59)=12.307, P = 0.000 and d = 1.58 for the white population, t (59)=8.766, P = 0.000 and d = 1.13 for the black population, t (59)=17.620, P = 0.000 and d = 2.26 for the East Asian population and t (59)=17.620, P = 0.000 and d = 2.26 for the Indian population.

The FLAP dimensions (M = 7.10, SD.44) for the ethnic Igbos were statistically significant higher than that of the White (M = 6.4), Black (M = 6.6), East Asian (M = 6.1), and Indian populations (M = 6.1). The effect sizes were large.

The test provided evidence to reject the null hypothesis.

Comparison of the mean FMAP dimensions of the ethnic Igbos with that of white, black, and East Asian populations-Table 4

The study had hypothesized that the mean value of the FMAP dimensions is not different from that of white, black and East Asian populations and a one sample t test was carried out to test this. The One-Sample Test Mean comparison of Mean Parameters of the cadaveric knees of ethnic Igbos with other ethnic groups for FMAP showed t (59)=6.18, P = 0.000 and d = 0.79 for the white population, t (59)=6.18, P = 0.000 and d = 0.79 for the black population, t (59)=15.50, P = 0.000 and d = 1.98 for the East Asian population. The FMAP dimensions (M = 6.83, SD.42) for the ethnic Igbos were statistically significant higher than that of the White (M = 6.5), Black (M = 6.5), East Asian (M = 6.0). The effect sizes were medium for white and black populations while the effect size for when compared with the East Asian population was large.

The test provided evidence to reject the null hypothesis.

Comparison of the mean FML dimensions of the ethnic Igbos with that of white, black, East Asian populations and Indian populations-Table 5

The study had hypothesized that the mean value of the FML dimensions is not different from that of white, black, East Asian and Indian populations and a one sample t test was carried out to test this hypothesis.

The One-sample test mean comparison of mean parameters of the cadaveric knees of ethnic Igbos with other ethnic groups for FML showed t (59)=−2.30, P = 0.025 and d=−0.30 for the white population, t (59)=13.22, P < 0.05 and d = 1.70 for the black population, t (59)=3.524, P = 0.001 and d = 0.45 for the East Asian population.

The FML dimensions (M = 7.78, SD = 0.40) for the ethnic Igbos were statistically significant lower than that of the White (M = 7.9), but higher than that of Black (M = 7.1), East Asian (M = 7.6). The effect sizes were lower for white and East Asian populations, whereas the effect size was larger when compared with the Black and Indian populations.

The test provided evidence to reject the null hypothesis.

Comparison of the mean FAR dimensions of the ethnic Igbos with that of white and black populations-Table 6

The study had hypothesized that the mean value of the FAR dimensions is not different from that of White and Black populations and a one sample t test was carried out to test this. The One-sample test mean comparison of mean parameters of the cadaveric knees of ethnic Igbos with other White and Black ethnic groups for FAR showed t (59) =−15.783, P < 0.05 and d=−2.02 for the white population and t (59)=−11.867, P < 0.05 and d=−1.52 for the black population. The FAR dimensions (M = 1.10, SD = 0.06) for the ethnic Igbos were statistically significant lower than that of the White (M = 1.2) and Black (M = 1.19). The effect sizes were large.

The test provided evidence to reject the null hypothesis.

Comparison of the mean TLAP dimensions of the ethnic Igbos with that of white, east Asian and Indian populations-Table 7

A One-Sample Test Mean comparison of Mean Parameters of the cadaveric knees of ethnic Igbos with other ethnic groups for TLAP showed t (59)=−1.772, P = 0.082, d=−0.22 for the white population, t (59)=−1.772, P = 0.082, d=−0.22 for the East Asian population and t (59)=15.977, P < 0.05, d = 2.46 for the Indian population.

The TLAP dimension (M = 4.65, SD = 0.23) for the ethnic Igbos was not statistically significant different from that of the White (M = 4.7) and Black (M = 4.7), However, it was statistically significant higher than that of the Indian populations (M = 4.6) with a large effect size.

Table 6: One-sample test mean comparison of mean parameters of the cadaveric knees of ethnic Igbos with other ethnic groups for FAR

Ethnicity	Population Mean	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference		Cohen's d
						Lower	Upper	
White	1.22	−15.783	59	0.000	−0.12093	−0.1363	−0.1056	−2.02
Black	1.19	−11.867	59	0.000	−0.09093	−0.1063	−0.0756	−1.52

Femoral aspect ratio (FAR) dimensions in cm. SD=0.06, Mean=1.10. n=60

The test failed to provide evidence to reject the null hypothesis for the black and white populations but provided evidence to reject it with the Indian population.

Comparison of the mean TMAP dimensions of the ethnic Igbos with that of white, East Asian and Indian populations-Table 8

A One-sample test mean comparison of mean parameters of the cadaveric knees of ethnic Igbos with other ethnic groups for TMAP showed t (59)=−3.759, $P < 0.05$, d=−0.49 for the white population, t (59)=−0.940, $P = 0.351$, for the East Asian population and t (59)=1.880, $P = 0.065$, for the Indian population.

The TMAP dimension ($M = 5.17$, SD = 0.27) for the ethnic Igbos was statistically significant different from that of the White ($M = 5.2$) population with a medium effect size. There was no statistically significant difference when compared with that of the East Asian ($M = 5.2$) and Indian ($M = 5.1$) populations.

The test provides evidence to reject the null hypothesis for the white populations but failed to provide evidence to reject it with the East Asian and Indian population.

Comparison of the mean TML dimensions of the ethnic Igbos with that of white, black, East Asian populations and Indian populations-Table 9

The study had hypothesized that the mean value of the TML dimensions is not different from that of white, black, East Asian and Indian populations and a one sample t test was carried out to test this hypothesis.

The One-sample test mean comparison of mean parameters of the cadaveric knees of ethnic Igbos with

Table 7: One-Sample Test Mean comparison of Mean Parameters of the cadaveric knees of ethnic Igbos with other ethnic groups for TLAP

Ethnicity	Population Mean	*t*	df	Sig. (2-tailed)	Mean difference	95% Confidence Interval of the Difference		Cohen's d
						Lower	Upper	
White	4.7	-1.772	59	0.082	-0.0517	-0.110	0.007	-
East Asian	4.7	-1.772	59	0.082	-0.0517	-0.110	0.007	
Indian	4.6	15.977	59	0.000	0.5667	0.496	0.638	2.46

TLAP=Tibia lateral condyle anterior posterior in cm. SD=0.23, Mean=4.65, n=60

Table 8: One-sample test mean comparison of mean parameters of the cadaveric knees of ethnic Igbos with other ethnic groups for tibia medial anterior posterior dimensions (TMAP)

Ethnicity	Population Mean	*t*	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference		Cohen's *d*
						Lower	Upper	
White	5.3	−3.759	59	0.000	−0.1333	−0.204	−0.062	−0.49
East Asian	5.2	−0.940	59	0.351	−0.0333	−0.104	0.038	
Indian	5.1	1.880	59	0.065	0.0667	−0.004	0.138	

TMAP=Tibia Medial condyle anterior posterior in cm. SD=0.27, Mean=5.17, n=60

Table 9: One-sample test mean comparison of mean parameters of the cadaveric knees of ethnic Igbos with other ethnic groups for tibia mediolateral dimensions (TML)

Ethnicity	Population Mean	*t*	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference		Cohen's *d*
						Lower	Upper	
White	7.9	−0.543	59	.589	−0.0200	−0.094	0.054	
Black	8.0	−3.260	59	0.002	−0.1200	−0.194	−0.046	−0.41
East Asian	7.7	4.890	59	0.000	0.1800	0.106	0.254	0.62
Indian	7.7	4.890	59	0.000	0.1800	0.106	0.254	0.62

Tibia mediolateral dimensions=TML. M=7.88. SD=0.29

Table 10: One-sample test mean comparison of mean parameters of the cadaveric knees of ethnic Igbos with other ethnic groups for tibia aspect ratio (TAR)

Ethnicity	Population Mean	*T*	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference		'Cohen's *d*
						Lower	Upper	
White	1.57	−5.442	59	0.000	−0.0425	−0.058	−0.027	−0.71
Black	1.54	−1.601	59	0.115	−0.0125	−0.028	0.003	
East Asian	1.53	−0.321	59	0.750	−0.0025	−0.018	0.013	

Tibial aspect ratio (TAR) dimensions in cm. SD=0.06, Mean=1.53. n=60

other ethnic groups for TML showed t (59)=−0.543, P = 0.589 for the white population, t (59)=−3.260, P = 0.002, d=−0.41 for the black population, t (59)=4.890, $P < 0.05$, d = 0.62 d = 0.45 for the East Asian population and t (59)=4.890, $P < 0.05$, d = 0.62 and d = 0.45 for the Indian population.

The TML dimensions (M = 7.88, SD = 0.29) for the ethnic Igbos was not statistically significant different from that of the White (M = 7.9), but was statistically significantly lower than that of Black (M = 8.0) with a weak effect size. It was statistically significant higher than that of East Asian (M = 7.7) and Indian populations (M = 7.7) with moderate effect sizes. The test did not provided evidence to reject the null hypothesis. When compared with the black population but provided evidence for rejection of the null hypothesis when compared with that of East Asian and Indian populations.

Comparison of the mean TAR dimensions of the ethnic Igbos with that of white and black and East Asian populations-Table 10

The study had hypothesized that the mean value of the TAR dimensions is not different from that of White, Black and populations and a one sample t test was carried out to test this. The One-sample test mean comparison of mean parameters of the cadaveric knees of ethnic Igbos with other White, Black, and East Asian ethnic groups for TAR showed t (59)=−5.442, $P < 0.05$ and d=−0.71 for the white population, t (59)=−1.601, P = 0.115 for the black population and showed t (59)=−0.321, P = 0.750 for the East Asian population. The TAR dimensions (M = 1.53, SD.06) for the ethnic Igbos were statistically significant lower than that of the White (M = 1.57) with a moderate effect size while the difference between them and that of Black and East Asians are not statistically significant. The test provided evidence to reject the null hypothesis with the White population and fail to reject with the Black and East Asian populations.

Discussion

TKA has been used to treat disabling OA.[13,14] TKA is a major surgery whose indications and outcome are linked to a lot of variables including proper component sizing.[15]

The study has determined the values of the distal femoral morphology, proximal tibia morphology and the aspect ratios for the native knees of the Igbo population of the South East Nigeria. The importance of these determined values cannot be over emphasized as properly shaped prosthesis constructed based on these determined values can provide the best coverage and avoid soft tissue impingement in the knees of the studied population.

This study showed that the FML dimensions had a strong significant positive association with TML, moderate significant positive association with FLAP, FMAP, and TMAP. This is in contrast with the findings of Mensch and Amstutz[16] who did not demonstrate any correlations in these parameters in their study among the Brazilian populations.

The FLAP dimensions had a strong significant positive association with FMAP and TML, moderate significant negative association with FAR and a weak significant positive association with TMAP. This is in consonance with the findings of Lakati *et al*.[17] who demonstrated a similar correlation of these parameters among the Kenyan population.

This study showed that the FLAP and FMAP dimensions were statistically significantly higher than that of the White, East Asian, and Indian populations with large effect sizes. This should be given due consideration during TKR in patients of Igbo extraction as medical tourism continues to draw huge number of Nigerians towards these continents.[18]

Most of the components used in the Igbo population are designed based on White population knee data and this may indeed lead to a mediolateral component overhang in the studied population. Prosthesis overhanging is more likely to cause soft tissue imbalance, and an abnormal stress distribution in patellofemoral joint. During TKA operation, there may be need to downsize the femoral components to avoid this over hang arising from over sized prosthesis. Sometimes, this may also result in an undesirable complication, such as notching of the anterior cortex which makes the femoral bone loose 40% of its strength and predisposes it to periprosthetic fractures.[19-22]

In the same vein, over-resection of the posterior femoral condyles can result in an imbalance between the flexion and extension gaps.[23]

The geometry of the proximal tibia is considered as an important factor in TKA design and has a direct impact on the biomechanics of tibiofemoral joint.[24]

There was a comparison of the tibial plateau parameters in this study and the TMA*P* values were larger than that of TLAP, which is in consonance with findings of similar studies.[25,26]

A comparison of the parameters obtained from the proximal tibia, with that of Asia–Pacific population including Chinese population did not show any statistically significant difference unlike the findings of some authors,[27] who reported larger size in this population. Our series showed the white had a significantly large size.

A statistically significant difference in aspect ratio was found between White, Black, and East Asian populations in this study. The implication of these findings is that it is necessary to adjust the aspect ratio during components design for achieving a better clinical outcome.

Conclusion

The normal values of the knee parameters of the native knee of the ethnic Igbos of the South Eastern Nigeria has been established and these should be taken into consideration by medical engineers during component design and arthroplasty surgeon during total knee replacement. There are correlations between these parameters that could be useful as a decision making tool during TKR and finally, the differences between these parameters and that of ethnic Western and Asian populations should be noted by implant manufacturers and arthroplasty surgeons.

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Conflicts of interest

There are no conflicts of interest.

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