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Collodiaphysial Angle in South-Southern Nigerians

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ABSTRACT

The collodiaphysial angle is the angle between the axes of the femoral neck and its shaft. This angle was investigated in South-Southern Nigerians using 177 unilateral anterior posterior radiographs of the hip in subjects aged between 18 and 70 years with the standard technique of the Singh and Singh (1975).

The angle ranged from 100°-155° with a mean of 137.330 and standard deviation of 7.57° for males; and 121°149°, mean of 135.43° and standard deviation of 7.05° for females respectively with significant differences between males and females in both groups ($p < 0.05$). This study documents for the first time the collodiaphysial angle of South-Southern Nigerians and further confirms that the angle is wider in males than females.

Keywords: Collodiaphyseal angle, Nigerians.

The collodiaphysial (neck-shaft angle of the femur is the angle made by the axis of its neck and the axis of its shaft-this angulation of the femoral neck is one of the modifications of the erect posture of humans (Kate, 1967). This angle has evolved as a result of multifactorial heredity, intrauterine position during fetal development, and mechanical forces and is reported to be an important factor for hip stability and normal walking (Gulan et al, 2000).

Various workers (Parson, 1914; Walmsley, 1915; Ingals, 1924; Hashimoto, 1938; Townsley, 1944; Lofgren, 1956; Felts, 1958; Keats et al, 1966; Singh et al, 1975) have studied this angle in different population groups, and their findings differ according to race, sex, and age. However, Katel and Singh and Singh (1975) emphasized that the angle shows regional variation and is generally lower in the female because of her wider pelvis and shorter femur. Moreover, the angle decreases from a mean of 150° at birth to a mean of 120° at the end of growth. More recently, the angel was shown to be a predictor of hip fracture in men and women (Alonso et al, 2000). A few African studies (Singh et al, 1986; Igbigbi, et al, 1997). Have confirmed variations of various parameters of the human femur in different regions of the world (Parsons, 1914; Ingals, 1924; Singh et al 1975). Sex based dimorphism, which also was found in the African studies series so far documented, not only is of interest to the anthropologist but also is useful in the sexing of an individual from skeletal remains a matter of great importance in medico-legal cases(Singh et al 1975).

Despite the importance of and extensive literature about this angle, no reports from the South-Southern Nigeria are available. We conducted the study reported here to fill this knowledge gap and to generate baseline data of the collodiaphysial angle in this region to assist orthopaedic surgeons in managing fractures of the neck of the femur and malformations involving the area of coax valga and coax vara deformation.

MATERIALS AND METHODS

We used unilateral anteroposterior (AP) radiographs to measure the collodiaphysial angle of the hip in 177 indigenous black Nigerian 101 males and 76 females 18 to 70 years old. The angle was measured in 86 right hips and 91 left hips. The radiographs, which were obtained from the archieves of Baptist Medical Centre Eku, Delta State, Nigeria, had been taken to investigate some musculoskeletal problems in the limb, and we selected those that proved normal. In addition only radiographs made in the AP projection with the central ray perpendicular to the plane of the film passing through a point 1-inch bellow the centre of the inguinal ligament were used. The radiologist also ascertained that each radiograph was taken from the standard distance of 92cm with the feet directed a little medially. Each radiograph was placed on a radiograph viewer for measurement of the collodiaphysial angle (figure 1). We used a goniometer, a ruler, vernier caliper and a China-graph pencil to assess the radiograph, and we measured each angle twice to ensure accuracy. Observations agreed on the precise definition of the landmarks to be used.

1. Axis of the neck. We used vernier calipers to measure the maximum and minimum diameters of the head of he femur, and we noticed two mid axes (a,b Figure). We drew a line joining these midaxes; this line marked the axis of neck of the femur.
2. Axis of he shaft of the shaft of the femur. We

determined this axis by measuring the transverse diameters of the femur at the points below the lesser trochanter and away from its distal end, and we noted two midaxes (c, d figure). We drew a line joining these midaxes; this line marked the axis of the femoral shaft.

3. Collodiaphysial angle (neck shaft angle). This angle formed by the intersection of axes "ab" and "cd" backward (aod; fugure), is the collodiaphysial angle. We measured this angle and recorded the measurement on the radiograph.

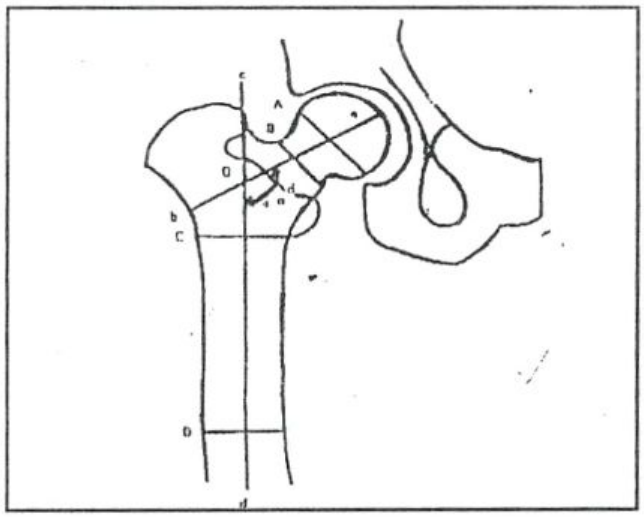

Figure 1: Measurement of the collodiaphyseal angle of the femur. (A) Maximum diameter of the head of the femur (B) Minimum diameter of the neck of the femur. (c) Maximum diameter of the shaft of the femur just below the lesser trochanter. (D) Maximum diameter of the shaft of the femur away from its distal end. Notes: ab indicates the axis of he femoral neck (connecting the midaxes of the neck and head of the femur); cd, the axis of he shaft of the femur (connecting the midaxes c and d); aod, the collodiaphyseal angle (between the axes ab and cd).

The observers agreed to try to avoid influencing subsequent measurement, and lines drawn were erased before the next observer used the film. For each subject, we recorded name, age, hip side, and sex (all as shown on the radiograph jacket), plus the angles measured. We used the SPXX statistical package for the Windows (version 4) to analyze all results.

RESULTS

The tables above show the characteristics of the collodiaphysial angle in Nigerians. For men, table 1, the angle of the right femur ranged from 110^0-115^0 (mean, 138.2°, SD, 8.06°), and the angle for the left femur range from 1230 1510 (mean, 136.88°, SD6.73°); the difference between the angles of the right and left femurs was not significant ($p > .5$). For the women, table 2, the angle of the right femur ranged from 122^0-149^0 (mean, 136.47^0 SD7.08°) the difference between the angles of the right and left femur was not significant ($p > .5$). The difference between the collodiaphysial angles in Nigerian men and women was significant ($p < .001$), with men having a wider angle.

Table 1 Colladiaphysial angles in males

Sex	Sid	N	Range	Max	Min	Mean	Std	Std
Male	L	51	28	151	123	136.88	6.73	0.94
Male	R	50	45	155	110	138.20	8.09	1.14
Male	L&R	101	27	155	110	137.34	7.57	0.75

Table 2 Colladiaphysial angles in females

Sex	Sid	N	Range	Max	Min	Mean	Std	Std
Fm	L	51	28	151	123	136.88	6.73	0.94
Fm	R	50	45	155	110	138.20	8.09	1.14
Fm	L&R	101	27	155	110	137.34	7.57	0.75

DISCUSSION

We have confirmed that the colladiaphysial angle is smaller in women because of heir wider pelvis, larger bicondylar angle, and shorter femora (Singh et al, 1986). Many other workers have established that the collodiaphysial angel is smaller in female subjects (Hashimoto, 1938; Keats et al, 1966; Singh et al, 1986; Igbigbi et al, 1997). As early as 1889, Sir George Humphrey stated that the collodiaphysial angle is smaller in shorter bones than in larger bones and in wider pelvises than in narrower pelvises and hat after puberty, age does not affect this. We have further confirmed that such results are affected by study method-a conclusion first drawn by Pearson and Bell (1919) using skeletal bones and radiographs of the pelvis (Keats and Lusted 1966) adopted this method and drew a similar conclusion). In our study, the collodiaphysial angle ranged from 10^0 - 155^0. As reported elsewhere, the angle in Nigerians ranged from 133^0 to 144^0. A comparison with findings from studies with Ugandans, Malawians and results obtained from India and Europeans by Kate (1967) and Keats (1966) respectively clearly indicate regional and racial variations in the collodiaphysial angles of the human femur.

Also evident in studies of the collodiaphysial angle is dimorphism based on sex. This finding prompted some authors to use the angle for sex determination. Jit and Singh reported that the Demarking point (DP) method is 99.75% accurate in sexing and therefore important in medico-legal cases. In our method however, application of this recommended method did not identify any Nigerian by sex. We believe that other methods (e.g using weight or head diameter of the femur) are better for sexing an individual from

human remains of the femur. In this article we have for the first time, documented the collodiaphysial angle of South-Southern Nigerians and showed that this angle is wider in males than females in this area of study. We have also found evidence of sex-based dimorphism confirming results form other African studies. Although we emphasize the need to use the DP method for sex determination in African subjects we recommended that this method not be used in all cases and certainly not in the Nigerian group sampled here.

Our study is important in that it provides basic anthropometric data for Nigerians useful information in light of recent results showing that collodiaphyseal angle is a predictor of the hip fracture in men and women (2000). In Nigerians, this findings will assist the orthopaedic surgeons managing fractures of the neck of the femur as well as malformations like coax vara and coax valga deformities.

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