Scientia Africana, Vol. 12 (No.1), June 2013. Pp51-56
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EVALUATION OF CORTICAL INDEX IN THE FEMUR OF YOUNG ADULTS IN PORT HARCOURT, NIGERIA.

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Received: 06-03-13
Accepted:10-05-13

ABSTRACT

A total of 600 anteroposterior radiographic films of the femur of 600 adult Nigerians (289 males and 311 females) between the ages of 20 and 40 years were used to study the Cortical bone width and index of the femoral shaft. The total bone width and medullary width were measured at the middle third of the femoral shaft using standard procedures. From the above measurements the Cortical bone width and the Cortical index were then calculated. The mean Cortical Index (CI) was found to be 0.54 ± 0.06 for the males and 0.54 ± 0.04 for the females. There was no significant difference between the index of the males and females. This study provides an easy and objective means of diagnosing and assessing osteoporosis but can not be used for gender identification of long bone in anthropological research.

Key words: Femur, Cortical Index, Osteoporosis, Radiograph.

INTRODUCTION

Variations exist in human skeletal measurements among populations and this determines the racial characteristics of the populations. The variations are related to genetic and environmental factors. The femur is the bone of the thigh. It has an outer cortex and an inner medulla like all long bones [Moore and Dally (2004), Agur and Dally (2005)].

Determination of cortical thickness to predict demineralization of the skeleton was first reported by Barnett and Nordin (1960). They measured the thickness of the medial and lateral cortices of the femoral shaft at the thickest part of the cortex. The sum of these two thicknesses was divided by the total shaft diameter at the same level. This ratio they termed Femoral Score, it was a method of assessing osteoporosis radiologically.

Another method to detect osteoporosis was devised by Virtama and Telkkae (1962) which is the Cortical Index. The Cortical Index is the ratio of the cortical thickness to the total diameter of the shaft. They also found a significant correlation between the Cortical Index and the bone density of the Humeri. Other authors

also found the cortical thickness of various bones such as the femur, humerus, radius and the metacarpals as a very effective predictor in assessing osteoporosis [Bloom and Laws (1970), Bloom and Bloom (1980), Meema and Meema (1963), Morgan et al (1967)].

The Cortical Index of long bones decreases significantly after the process of dimeralization of about 10 percent (Virtama and Kallio 1961). Sabatier et al (2000) also stated that the Cortical Index is the best parameter in detecting and monitoring the progress of pathological state of osteoporosis. Osteoporosis especially in the elderly and post menopausal women have been shown to result in higher risk of fractures of the bones involved. [Bengner et al (1988), Kelsey et al (1992), Rose et al (1982)]

The aim of this study is therefore to determine the normal cortical thickness and Cortical Index of the femur on radiographs in Port Harcourt, Nigerians; this will make diagnosing of Osteoporosis much easier in a resource poor setting like Nigeria as prompt measures will be taken appropriately.

MATERIALS AND METHODS

In this study, a convenient sample size of 600 x-ray films of the femur comprising 289 males and 311 females of young adult Nigerians in Port Harcourt, Rivers State were used. Their ages ranged from 20 – 40 years. It is assumed that at this age physiological osteoporosis had not set in.

These radiographs were collected from hospitals in Port Harcourt and they include:-

* Braithwaite Memorial Hospital (BMH), Port Harcourt
* University of Port Harcourt Teaching Hospital
* Teme Hospital, Mile 1 Diobu, Port Harcourt.

All the radiographs were reported normal; they were sorted out from the archieves of the radiology departments of the hospitals. The radiographs were then separated according to gender and measurements as described by Barnett and Nordin (1960) were taken as follows:-

(1) A manual vernier caliper was placed on the middle third of the femoral shaft transversely to obtain the total bone width of the femoral shaft. (A) (Figure 1).

(2) The medullary width (B) was also obtained as in the schematic drawing (Figure 1).

The cortical width was then calculated as the total bone width minus the medullary width. A ratio of the cortical width to the total bone width is the cortical index (CI).

The above process was done for all the radiographs. The mean and standard deviation were then obtained and Test of Significance determined using appropriate Statistical analysis. (Sokal and Rahlf, 1995).

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RESULTS

Table 1: Showing the range of values of the Cortical bone width, frequency and percentage of occurrence of the femur in male and female Nigerians.

	Males		**Females**	
Cortical Width Range (mm)	**Frequency**	**%**	**Frequency**	**%**
5 – 9	8	2.77	12	3.86
10 – 14	62	21.45	62	19.94
15 – 19	156	53.98	160	51.45
20 – 24	58	20.07	71	22.83
25 – 29	5	1.73	6	1.92
	289	**100**	**311**	**100**

Mean Cortical width (Males) 16.8 ± 0.4mm
Mean Cortical width (Females) 16.9 ± 1.2mm

Table 2: Showing the range of values of the Cortical index, frequency and percentage of occurrence of the femur in male and female Nigerians.

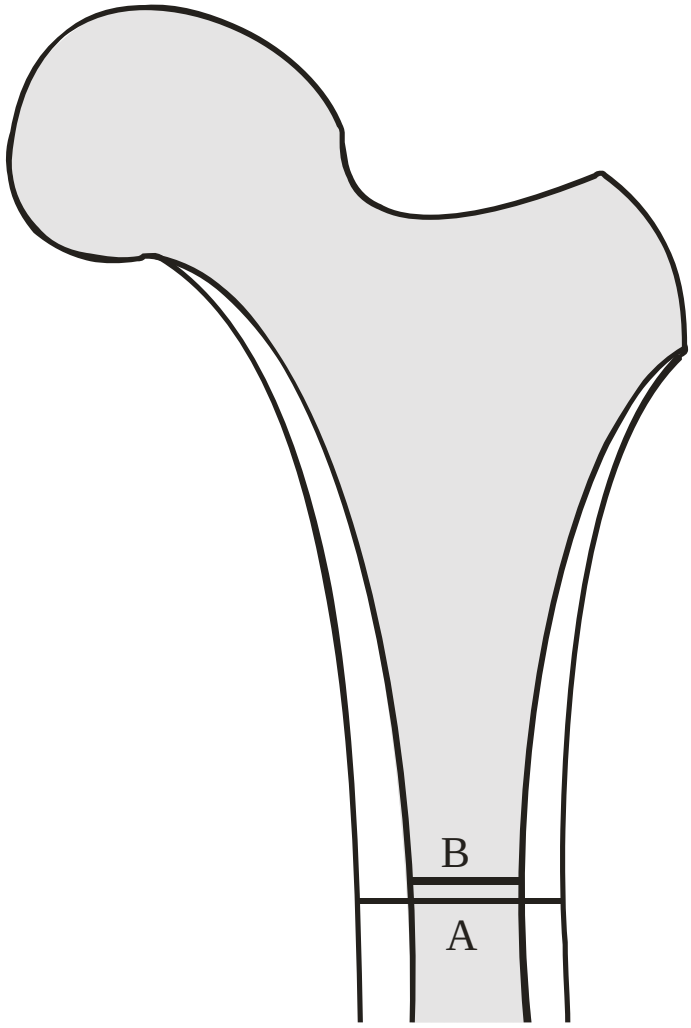
Males		**Females**		
Cortical Index Range (mm)	**Frequency**	**%**	**Frequency**	**%**
0.31 – 0.40	18	6.23	20	6.43
0.41 – 0.50	76	26.30	85	27.33
0.51 – 0.60	124	42.91	129	41.48
0.61 – 0.70	67	23.18	75	24.12
0.71 – 0.80	4	1.38	2	0.64
	289	**100**	**311**	**100**

Mean Cortical Index (Males) 0.54 ± 0.06
Mean Cortical Index (Females) 0.54 ± 0.04
95% Confidence Interval of the Cortical Index = 0.42 - 066

From table 1, about 50% of the studied population had cortical width range from 15 – 19mm. The least in both genders were the ranges of 5 – 9mm (about 3%) and 25 – 29mm (about 2%). The distribution for males was similar to females. There was no statistical difference ($p>0.05$).

From table 2, the Cortical Index was 0.54 for both males and females, about 92% of the study group had Cortical Index between 0.41 – 0.70, however the range from 0.51 – 0.60 comprises about 42% of the total population.

Figure 1: Schematic drawing of the femur



Where A = Medullary width
B = Total bone width
Cortical width = A - B

DISCUSSION

Determination of cortical thickness and subsequently cortical index have been used to predict loss of mineralization since the first report of Barnett and Nordin in 1960. This has made it easier to assess osteoporotic changes in any given bone. The most commonly used are the metacarpals, the femur and the humerus.

The cortical index as defined by Virtama and Telkkae (1962) is even a better indicator and shows significant correlation between the cortical index and bone density. In this study, the mean male cortical thickness was 16.8 ± 0.4mm while

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that of the cortical index was 0.54 ± 0.06. This was almost the same cortical index as in the females - 0.54 ± 0.04 (P>0.05). The cortical thickness in females was 16.9 ± 1.2mm. The total population Confidence Interval was 0.42 – 0.66. This study has been able to determine with a measure of accuracy that Cortical Index less than 0.42 of the femur is highly suspicious of Osteoporosis in Nigerians. In this study, the values of the cortical index of the Nigerian femur was seen to be lower than that of the Finnish subjects. The Finnish cortical index was given as 0.63 (Virtama and Telkkae 1962). In another study of the Americans (Greun 1997) the Cortical Index of the total population was found to be 0.47 (males 0.5 and females 0.47) with a range of 25.8 – 64.8. There was a highly significant correlation between the Cortical Index and the Body Mass Index. The Cortical Index also decreased with older patients. These differences may be due to genetic, nutritional and environmental factors.

The cortical index which decreases significantly in Osteoporosis can be used to assess metabolic turnover and activity of the bone. Yeung et al (2006), Bloom and Laws (1970), Morgan et al (1967). The cortical index has been found to be the best parameter to follow an individual patient during therapy, Virtama and Kalis (1961), Sabatier et al (2000). Severe osteoporosis with thinner cortical bone of the femoral diaphysis (resultant low cortical index) is seen more often in patients with trochanteric fractures, (Maeda et al 2011). Femoral neck fractures are also common in osteoporotic patients especially those with low body mass index, (Guen T 1997). The cortical index can actually be used as a guide for objectively diagnosing osteoporosis in our environment for a quick intervention especially in large scale studies.

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