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Greater sciatic notch in sex differentiation in Nigerian skeletal samples

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Summary
A total of 150 X-ray films (A-P view) of the pelvis of adult (90 male and 60 female) Nigerians were used to measure the width, depth, posterior segment, total and posterior angles of the greater sciatic notch. Index 1 was calculated by dividing the greatest depth OC by the greatest width AB and multiplying by 100. Index 2 was calculated by diving the posterior segment OB by the greatest width (AB) and multiplying by 100. These indices were used to study the sex differences in the hip bones of these Nigerians. Demarking points of these parameters and indices were worked out to determine sex. The width, depth, total angle and index 1 were insignificant in sex determination. Posterior angle and index 2 were found to be the most useful assigning sex to 74.5% of the male and 90% of the female bones.

Keywords: *Greater sciatic notch, sex differentiation, posterior angel.*

Résumé
Un total de 150 films de rayon x (vue A-P) du bassier du Nigerian adulte (90 homme et 60 femmes) e ete utilize pour mesurer la largeur, profondeur, segment posterieur, total et angles posterieurs du grand entaille sciatique. L'index 1 a ete calcule et divisant la plus grade profondeur OC par la plus grande largeur AB en multipliant par 100. L'index 2 a ete calcule en divisant le segment posterieur OB par la plus grande largeur (AB) en multipiant par 100. Les indices ont ete utilises pour studier la difference du sexe da les os du la hanche de ce Nigerians. Les points remarquables de ces parameters et indices ont ete elabores pour dterminers le sexe. La largeur profounder, angle total et l'index 1 ont ete insignifcants dan la determination du seze. L'angle postereur et l'index 2 s'averent etre les parametres les plus utilises dans la determination du sexe a 74.5% des os males et 90% des os females.

Introduction

The study of the greater sciatic notch is of importance to the anthropologist where the skeletal remains are of historic, prehistoric and paleontological origin. This study is also of practical importance to the obstetrician as regards parturition. The capacity of the pelvic inlet influences labour and is related to the width of the sciatic notch and the configuration of the apex.

Only human beings have a well-developed sciatic notch compared to other primates [1]. Although sex differences are present in foetal life [2], these differences are not manifested until after puberty. Howells and Hotllings [3] and Young and Ince [4] found that the greater sciatic notch was larger in females than in males. This, however, has no statistical correlation with the sub-pubic angle.

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The greater sciatic notch has been studied in Australian aborigines [5], the English and Dutch [6], Indians [7], Belgians and French [8] and the Bantu and Bushmen [9]. The absence of comparative data on the greater sciatic notch in the Nigerian population necessitated the present study.

Materials and methods

One hundred and fifty pelves of known sexes were studied from X-ray films collected from the Departments of Radiology and Anatomy of the College of Medical Sciences and the Medical Centre, University of Calabar. Of these, 90 were male and the remaining 60 were female. The films were taken from a standard distance of 92cm with the feet directed slightly medially. Only films of the anteroposterior (A.P.) view were used. All films belonged to adults between the age of 18 and 85. They were free from pathological changes.

The X-ray films were placed on the horizontal surface of an illuminator and the outline of the shape of the greater sciatic notch was traced on a sheet of paper. From the outline, the following measurements were taken according to the method described by Singh and Potturi [7]. Figure 1 shows the diagrammatic representation of the greater sciatic notch and the measurements.

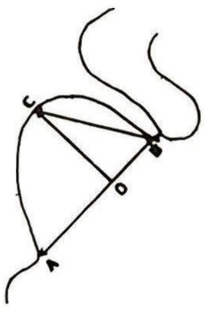

FIGURE 1 Diagramatic representation of the greater sciatic notch

AB Greatest width
OC Greatest depth
OB Posterior segment
AĈB Total angle
BĈO Posterior angle

Fig. 1

1. Greater width (AB): The tip of the ischial spine was taken as the anterior point (A) of the width while the tubercle of the piriformis was taken as the posterior point (B).
2. Greater depth (OC): This was determined between the baseline (AB) and the deepest point (C) on the sciatic notch. It is the perpendicular line drawn to meet the line (AB) at O.
3. Posterior segment (OB): This is the segment of the baseline (AB).
4. Index 1 was calculated as $\frac{\text{greatest depth (OC)} \times 100}{\text{greatest width (AB)}}$

5. Index 2 was calculated as $\frac{\text{Posterior Segment (OB)} \times 100}{\text{greatest width (AB)}}$
6. Total angle (ACB): After construction of the outline of the shape of the triangle ABC and the depth OC, angle ABC denoted the total angle.
7 Posterior angle (BCO): Angle BCO denoted the posterior angle of the greater sciatic notch.

All linear measurements were made in millimetres on the outline of the shape of the notch in paper. For every parameter, the mean and standard deviation (SD) was calculated and the range noted. Demarking points were worked out according to the method of Jit and Singh [10]. The points were calculated by adding to or subtracting from the mean three times the standard deviation. This applied accurately to 99.75% of the population in this region and identified sex with almost 100% accuracy. The percentage of bones identified by each marking point in both sexes was calculated.

Results

Total angle of greater sciatic notch: The total angle of the greater sciatic notch in the female pelves was observed to be significantly greater than that in the male bones ($p \leq 0.001$). This angle in the female hip bone varied from 68 to 102^0 with a mean of 82.7 ± 8.0 (Table 2), while in the male bones, it varied from 50 to 80^0 with a mean of 65.4 ± 6.9. Since the total angle in the male bones was not greater than 80^0, any hip bone with a total angle of the greater sciatic notch more than 80^0 (identification point) could be assigned with confidence to the female sex.

Table 1: Measurements and indices of the greater sciatic notch of Nigerians (Male)

Measure-ments and Indices	No	Mean	S.D	Range	ID.P	% ID	D.P	% Beyond D.P
Total angle	180	65.44	6.86	50.80	68	64	58.65	22
Width	180	46.85	4.89	38-58	-	-	33.28	0
Depth	180	29.47	3.57	22-36	-	-	36.61	0
Length OB	180	6.03	2.96	-2-+14	-	-	6.45	51.5
Posterior angle	180	13.77	3.43	4-24	-	-	17.11	74.5
Index 1	180	63.52	8.47	39.29-80	-	-	77.88	6.5
Index 2	180	13.49	5.99	-3.50-+30.44	-	-	14.89	64.5

$P < 0.001$
All linear measurements in mm.
S.D. = Standard deviation
ID.P = Identification
D.P. = Demarking Point.

Table 2: Measurements and indices of the greater sciatic notch of Nigerians (Female)

Measure-ments and Indices	No	Mean	S.D	Range	ID.P	% ID	D.P	% Beyond D.P
Total angle	120	82.65	8.00	68-102	80	62.57	86.15	35.5
Width	120	50.01	5.58	41-65	-	-	61.52	3
Depth	120	26.28	3.23	18-32	-	-	19.72	2
Length OB	120	16.38	3.31	9-26	-	-	14.90	86.5
Posterior angle	120	31.47	4.81	19-45	-	-	24.01	90
Index 1	120	52.85	8.35	35.88-70.73	-	-	38.11	2.5
Index 2	120	32.61	5.82	20.20	-	-	31.47	6.5

$P < 0.001$
All linear measurements in mm.
S.D. = Standard deviation
ID.P = Identification point
D.P. = Demarking point

In the same way, the lowest total angle in the female hip bones 68^0 acted as an identification limit for the male hip bones. With these identification points, sex could be correctly assigned in 64% of male and 62.5% of female bones. However, in cases where the hip bones had a total angle between the identification points (68 and 80^0), sex could not be assigned.

Width of greater sciatic notch: It was found, as shown in Table 2, that the greater sciatic notch was significantly wider in female than in male ($P \leq 0.001$). The mean value for male bones was 46.9 mm ± 4.9, while the mean value for female bones was 50.0 mm ± 5.6.

Depth of greater sciatic notch: The depth of the greater sciatic notch was observed to be higher in the male than in the female. The range in the male varied from 22 to 36 mm with an average of 29.5 ± 3.6 mm (Table 1). For the female bones, the range was from 10 to 32 mm with an average of 26.3 ± 3.2 mm (Table 2).

Posterior segment: The segment or length OB of the width of the greater sciatic notch was found to be significantly higher in the female than in the male bones ($P \leq 0.001$). The mean value for the male bones was 6.0 ± 3.0 mm while for the female bones it was 16.4 ± 3.3 mm (Tables 1 and 2).

Posterior angle: Tables 1 and 2 show the posterior angle of the greater sciatic notch to be significantly higher in females than in males. It varies from 19 to 45^0 with an average of 31.5 ± 4.8^0 in the female bones and from 4 to 24^0 with an average of 13.8 ± 3.4^0 in the male bones.

Index 1 and 2: Index 1 of the greater sciatic notch was observed to be significantly greater in the female, while index 2 was found to be significantly greater in the female than in the male bones.

Discussion

Sexual differences: Derry [11], Letterman [12], Davivongs [5], Singh and Potturi [7] observed that the greater sciatic notch is wider in female than in male. Male notches were found to be deeper. However, Davivongs [5] reported that the notch is deeper and wider in female Australian aborigines than in the male.

The innominate bone has been recognised as one of the most reliable indicators of sex in adult human skeletons [13]. Several methods have been developed which provide criteria for sex determination in adult skeletal remains using the features of the innominate [14,15,1], but no such precise and confident criteria exist for determination of sex in foetal and intact remains [17]. However, recognisable sex differences have been shown to exist in the foetal and infant skeleton by numerous workers such as Reynold [18, 19], Boucher [20], Black [21] and Weaver [22].

The depth and width of the greater sciatic notch were widely considered to be of great value in sex determination, but this present study and the work of Singh and Potturi [7] found Index 1 to be of little value in the determination of sex. However, the length of the posterior segment, posterior angle and index 2 were found to be very useful parameters in sex determination. The mean values for all these measurements were found to be significantly higher in females ($P < 0.001$). The posterior angle of the greater sciatic notch, a parameter which was not used by most earlier workers, was found to be most useful parameter for sex determination. This is in line with the views of Singh and Potturi [7]. The mean values of the posterior angle in females are more than twice those of the males and showed minimal overlap in their ranges resulting in the identification of 90% of the female bones and 74.5% of male bones using the demarking points (D.P).

Although the percentage of bones classified into sex by identification points were quite high, 64% for males and 62.5% for females from their total angle, these identification points are not very reliable. . For a given region, maximum and minimum limits have to be calculated on the basis of standard deviation by adding and subtracting 3 S.D. to and from the mean value of each parameter which would cover 99.7% of the samples from that region [22]. These limiting points are called demarking points (D.P) and were worked out according to the method of Jit and Singh [10]. From Tables 1 and 2, the percentage of hip bones identified by demarking points of total angel of the greater sciatic notch is much less than the percentage sexed by identification points. Though the percentage of bone identified is less, the demarking points apply accurately to 99.7% of the population in this region.

Thus, for 100% accuracy in identification, only demarking points are reliable. Demarking points for different races and regions should be worked out individually because in a larger population, the mean values of such parameters from these different values and regions show significantly different values [23].

The posterior segment, posterior angle and index 2 have been shown to be good indicators of sex and therefore highlight the importance of the posterior segment of the greater sciatic notch in sex determination.

Racial differences: Tables 3 and 4 show that the various parameters of the greater sciatic notch vary in different races and between selected groups [1]. This differences may also occur within homogenous groups as a result of various conditions such as nutrition and heredity [24, 25], but some of these differences are insignificant, such as in the present study and that of the Australian aborigine Maclauhlin and Bruce [6] showed that the relative size of the notch was a poor indicator of sex in a sample of 2 temporary. distinct European skeletal collections of documented age and sex (English and Dutch). This finding is at variance with the findings of Kelly [26] using the same index for a sample of American whites and American Negroes, and for a sample of archaeologically derived American Indian skeletons. This shows that the relative size of the notch varies not only between sexes, but between sexes, but between groups of differing ethnic and/or temporal origin [20].

Table 3: Average total angle of the greater sciatic notch in different races

Author	Year	Race	Male		Female	
			Right	Left	Right	Left
Singh and Potturi	1978	Indians	65 31⁰	66 15⁰	82 76⁰	83.66⁰
Segebarth-Orban	1980	Belgian and French	70 30⁰		76 70⁰	
Present author		Nigerian	65.44⁰		82 65⁰	

Table 4: Average width of the greater sciatic notch in different races

Author	Year	Race	Male		Female	
Washburn	1948	Bantu	25.1		35.0	
Washburn	1948	Bushman	23.7		34.9	
Davivongs	1963	Australian Aborigine	45.23		50.86	
Singh and Potturi	1976	Indians	Right	Left	Right	Left
			44.30	45.20	48.27	47.40
Segebarth-Orban	1980	Belgian and French	55.90		58.30	
Maclanghlin and Bruce	1968	Dutch	41.78		45.72	
Present Author		Nigerian	46.85		50.01	

Davivongs [5], working on the pelvic girdle of Australisan Aboriganes, reported that the female notches were deeper than the male notches. This is a deviation from what has been obtained in other races and regions and as such can be regarded as a racial difference [27].

It can be seen from Table 4 that the Belgians and French showed the highest mean width of the greater sciatic notch as reported by Segeburth-Orban [8] followed by that of Nigerians in the present study of male and female bones. The bushman's hip bones has the least width as reported by Washburn [9].

In forensic investigations and anthropological studies, it is necessary that these population differences be noted and the origin of the population investigated. Appropriate population specific criteria should then be used in the determination of sex [6] for each race and even for the different regions of a similar population.

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