Radiographic Examination of the Greater Sciatic Notch in Determining the Sex among North Indian Population

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ABSTRACT

Introduction: In forensic and archaeological studies, there is the need for identification of human skeletal remains.The greater sciatic notch is very relevant in identification of sex in human skeletal remains. The features of the greater sciatic notch of the coxae are characteristic and are commonly used to determine sex in unknown individuals.Over the years, different authors had carried various types of measurements on human greater sciatic notch of different sex and races.

Material and method: This study was carried out to determine if indices in the greater sciatic notch can be used in sexing of the hip in North Indian population of Jammu and Kashmir with the help of radiograph and to establish a baseline data for the population.Antero-posterior radiographs of adult pelvis (age range: 25-75 years) were evaluated. The parameters considered are maximum width (AB); maximum depth (OC); the posterior segment (OB), index I and index II of the greater sciatic notch.

Results: Out of all these parameters, width of the notch (p=0.001), depth of the notch (p=0.006), posterior segment width (p= 0.03), index II of notch (p=0.001) were found to be significantly greaterinwomenascomparedwithmen.However whether these radiographic parameters can be used for sex determination needs further studies to quantify the parameters over a larger population and over the bioarchaeological and forensic remains of individuals.

Conclusion: Our results suggest that metric assessment of the features of the greater sciatic notch should be used cautiously in sex determination, particularly in the case of fragmentary forensic or rare archaeological remains.

Keywords: Radiographic Examination, Sex, Greater Sciatic Notch

INTRODUCTION

Virtually every element of the adult human skeleton has been shown to exhibit some degree of sexual dimorphism.[1-3] However, the pelvis, or more precisely,the innominateis generally regarded as the most reliable skeletal indicator of sex.[4-6]

The pelvic bone is an ideal bone for determination of sex because it not only reflects the general differences between the sexes but also the adaptations during child bearing in females. Those authors who have studied this bone in skeletal remains have paid attention either to features relating to its total size or to those of various components, such as its inferior and superior border, the greater sciatic notch, the symphyseal surface, the acetabulum, the obturator foramen, the arcuate line or the distance between defined morphological points on its borders.[7]

Correct sex identification of the human skeleton is important inbioarchaeological and forensic practice.[17] Metric assessment of the greater sciatic notch has been carried out in several studies and has been evaluated for sex identification.[9-11] Different results related to the role of the features of the greater sciatic notch in sex determination were obtained in those studies.

There are metric and nonmetric differences in skeletal components among populations and these variations are related to genetic and environmental factors (geography, diet, lifestyle). Variations in human skeletal features also determine the racial characteristics of the populations. The racial characteristics of populations are linked to the evolutionary differentiation of the human species. Skeletal anthropometric measurements aimed at revealing regional diversity between different populations or within the same population, are beneficial for understanding the temporal evolutionary and developmental progress relevant to our species. Moreover, metric and nonmetric differences between men and women as regards the size and proportions of skeletal components are available, and these differences can be used in the identification of sex.[12-17]

Bruzek[17] stated that in the techniques and evaluations used, the most frequently cited drawbacks for determining the sex of an individual are: 1) the high degree of observer subjectivity, 2) a lack of consistency in the evaluation of traits, and 3) a strong dependence on the results of the previous experience of the observer. Also, Bruzek indicated that it is difficult to admit that the sexual traits of the skeleton may be more

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clearly expressed in one sex than the other. The total degree of sexual dimorphism of any bone is a function of the interaction of the partial dimorphism of certain major regions of the bone. Thus, according to the concept of functional integration, lower levels of sexual dimorphism in a given morpho-functional complex can be functionally compensated by higher levels of dimorphism in another morpho-functional complex. Intersegment size relationships are sex and population-specific. With both genetic and functional components, the existence and degree of trait expression appears to be population-specific.[18-24]

The features of the greater sciatic notch of the innominate bone are commonly used to determine the sex in unknown individuals. In this radiographical study, several measurements of the greater sciatic notch, e.g. width, depth and width of the posterior segment were taken in A–P view and indices I and II were calculated. Inspite of the relevance of indices in the greater sciatic notch in forensic studies, anthropological, obstetrics and gynaecology; there is lack of literatures in North Indian Population. The aim of this study therefore was to determine if indices in the greater sciatic notch can be used in sexing of the hip in North Indian population with the help of radiograph and to establish a baseline data for the population.

MATERIAL AND METHOD

The present study was conducted in the Department of Anatomy,Government Medical College, Jammu using 50 radiographs of pelvis of people belonging to the North Indian population. The radiographs were obtained from the Department of Radiology, Government Medical College, Jammu. Age varied from 25-75 years. Of the 50 radiographs 25 belonged to males and 25 to females.The radiographs were obtained using the standard protocol for analog AP Xray of pelvis with both hips.

All the radiographs were free from pathological changes. In taking these measurements the radiographs were placed on the horizontal surface of an illuminator and the following measurement were taken with the help of a vernier calliper. A marker was used to mark these points for clear visualization. The definitions of the measurements were taken from the literature and were selected on the basis of their being good discriminators in previous studies. These are clearly defined in the available literature.[19,21,25]

The piriform tubercle was taken as the posterior point (B) and the tip of the ischial spine was taken as the anterior point (A) of the width (AB). Maximum depth (OC) was determined between the baseline (AB) and the deepest point (C) of the greater sciatic notch. Also, (OB) was designated as the posterior segment.

The following parameters of the greater sciatic notch were considered:

- **Maximal width (AB):** The distance between the position A and B
- **Maximal depth (OC):** Perpendicular to the width
- **OB:**Posterior segment of the width
- **Index I:** Maximal depth (OC) x100/Maximal width (AB)
- **Index II:** Posterior segment of the width (OB) x100/ Maximal width (AB)

Each variable was measured by the same observer. All linear measurements were in centimeters for each parameter.p value was calculated and value <0.05 was considered statistically significant.Radiographs showing abnormalities were not considered.For each parameter, mean and standard deviation was calculated.

RESULTS

The number of cases and the statistical data related to their age is shown in table 1.The result of the mean, standard deviation and range of all radiographic measurements in the greater sciatic notch in North Indian population are shown in table 2. The mean maximum width (AB) for males and females was 5.54 ± 0.177 and6.33 ± 0.173 (cm). The maximal width which was described in Fig. 1 was sexually dimorphic. The females mean maximal width is significantly higher than that of the males ($p<0.05$)

The mean maximal depth(OC) of males and females in the greater sciatic notch was 2.14 ± 0.066 and 2.411 ± 0.087 (cm). The maximal depth which was described in Fig. 1 was sexually dimorphic. Infemales mean maximal depth (OC) is significantly higher than that of the males ($p<0.05$).

The mean values for posterior segment (OB) of males and females were 2.29±0.125 and 2.92±0.220 (cm). The females had a significantly larger value for posterior segment compared to the males ($p<0.05$).

The mean values of Index I for males and females were 38.69 ±1.722 and 38.002±1.839.The Index was comparable in the two sexes and no significant difference was noted.

The mean values of Index II for males and females were 41.44±2.315 and 46.16±3.681. The females in North Indian

Variable	Male	Female
N	25	25
Mean age	44	48
Minimum age	25	29
Maximum age	75	72

Table-1:Age and sex

S. No.	Variable	Male	Female	P value*
1.	OB	2.29±0.125	2.922±0.22	0.03
2.	OC	2.14±0.066	2.41±.08	0.006
3.	AB	5.54±0.17	6.33±0.17	0.001
4.	Index I	38.69±1.72	38±1.83	0.8
5.	Index II	41.44±2.31	46.16±3.68	0.001

*pvalue<0.05 significant.

Table-2: Comparisons of various parameters of greater sciatic notch in both sexes

population in this study had a significantly higher Index II than the males.

From the observations given in table 2 statistically significant difference between the means of various variables related to sex were seen in OB, OC, AB and index II while index I showed no statistically significant difference.

DISCUSSION

In this study, several measurements of the greater sciatic notch, e.g. width (AB), depth (OC) and width of the posterior segment (OB) were taken and Indices I and II were calculated in 50 adult (25 men and 25 women) pelvic radiographs(A/P view). Out of all these parameters, width of the notch (p=0.001), depth of the notch (p=0.006),posterior segment width (p= 0.03), index II of notch (p=0.001) were found to be significantly greaterinwomenascomparedwithmen (Table2).

It is generally recognized that of all the elements of the human skeleton, the innominate offers the best prospect for the correct identification of the sex of an individual. Unfortunately, the very features of the innominate that exhibit the highest levels of sexual dimor- phism are frequently found to be damaged or missing in exhumed material. The highly dimorphic pubic element of the innominate is especially vulnerable to postmortem damage and decay as it is covered by only a thin fragile shell of cortical bone. The identification of sex from the human skeleton is further complicated by the considerable morphological and metric variation which exists between and within human populations. Criteria for the identification of sex established on one ethnic group are unlikely to be applicable to another group of different ethnic origin. Similarly, criteria appropriate to present populations may not be appropriate for past populations and vice versa. Further, it is important that criteria used/for sex discrimination should be unequivocal and hence as free as possible from subjective bias.[26-29]

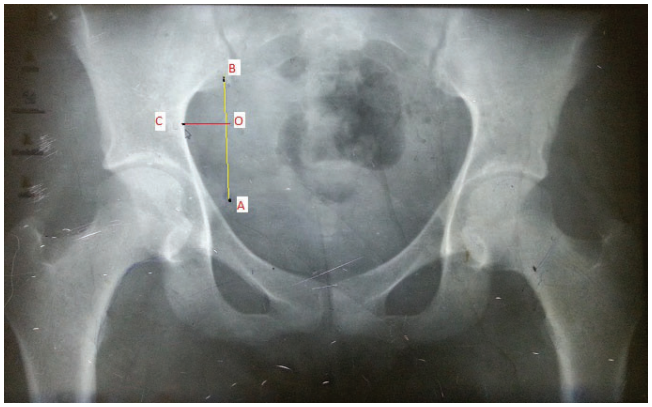

Figure-1: Showing the various measurements of the greater sciatic notch from an antero-posterior radiograph of the pelvis. A is the tip of the ischial spine, B is the piriformis tubercle,C is the deepest point on the sciatic notch. AB is the maximum width,OC is the maximum depth and OB is the posterior segment.

In a study conducted by S.C. Okoseimiema and A.I. Udoaka on Nigerian population it was concluded that metric assessment of the features of the greater sciatic notch should not be used in sex determination in South Nigerian population, particularly in the case of fragmentary forensic or rare archaeological remains. In this respect, even anthropometric measurements of the skeletal remains of a single archaeological population should afford valuable information about the features of different populations. Furthermore, the different results obtained for the different populations should be useful for comparisons with similar studies and for improving the identification of human pelvis.[27]

The morphology of the greater sciatic notch has been used in different studies addressing different populations for sex determination and some of these are summarized in Table 3. Akpan et al.[22] used a total of 150 X-ray films (A-P view) of the pelvis of adult (90 male and 60 female) Nigerians to measure the width, depth, posterior segment, total and posterior angles of the greater sciatic notch. They reported that the width, depth of the greater sciatic notch and Index I were insignificant criteria but that Index II was the most useful criterion in sex determination.

Kalsey et al.[28] made an attempt to find the baseline data of various parameters pertaining to the greater sciatic notch of 100 hip bones of known sex (male: female = 80:20) and side (right: left = 50:50), in Punjab, India.They showed that width, posterior segment width and index II of notch were found to be significantly greater in women as compared with men.Kalsey found the notch to be deeper in women of north

Author	Population	Width (AB)	Depth (OC)	Posterior Segment (OB)	Index I	Index II
Palfrey	West Africa	+	-	+	-	-
Singh and Potturi	Varanasi	-	-	+	-	+
Dibennardo and Taylor	American whites and blacks	-	+	-	-	-
Akpan et al.	Nigeria	-	-	-	-	+
Patriquin et al.	South African whites and blacks	+	+	+	-	-
Kalsey et al.	North India (Punjab)	+	-	+	-	+
Alizadeh et al.	Iranian	+	-	+	-	+
Present study	North India(Jammu and Kashmir)	+	+	+	-	+
[+] Statistically significant variable; [-]Statistically insignificant variable						

Table-3: Comparison of variables of greater sciatic notch in different studies

India, however his results were not statistically significant.
Patriquin et al.[23] determined the maximal width, maximal depth and posterior width of the greater sciatic notch in whites and blacks. They reported that the width of the greater sciatic notch is larger in women but deeper in men and that there are significant sex differences among South African men and women and whites and blacks.
Steyn et al.[24] used geometric and morphometric analysis of the greater sciatic notch and reported that this feature may not be so reliable, especially in South African white males.
Palfrey[18] studied West African skeletons of known sex and found highly significant differences between them regarding the width and posterior segment of the greater sciatic notch.
Singh and Potturi[19] reported that the width and depth of the greater sciatic notch are not good criteria for sex identification and also that the width of the posterior segment and Index II successfully assigned sex to a high percentage of innominate bones, especially to the female ones.
Dibennardo and Taylor[20] investigated the adult coxae of American blacks and whites of known sex and found that the depth of the greater sciatic notch was larger in women in both races.
The present study is comparable with the study of Palfrey,-Patriquin et al., Kalsey et al., Alizadeh et al., in case of width and posterior segment being statistically significant for sex determination in addition to index II (except Patriquin etal and Palfrey) while in Singh and Potturi the posterior segment and index II are the sole statistically significant variable.In the present study the depth of the notch has been found to be a valid variable for sex determination which is comparable to studies of Dibennardo and Taylor and Patriquin et al.Kalsey found the notch to be deeper in women of north India, however his results were not statistically significant.
While the accuracy of the measurements of the greater sciatic notch is high, all collections used in these studies are from different populations and one cannot assume the methodology would yield equally high success rates in all of them. Therefore, this study, of data from North Indian collections ensures this technique's applicability to that population.

CONCLUSION

In conclusion, our results suggest that metric assessment of the features of the greater sciatic notch should be used cautiously in sex determination, particularly in the case of fragmentary forensic or rare archaeological remains. In this respect, even anthropometric measurements of the skeletal remains of a single archaeological population should afford valuable information about the features of different populations. Furthermore, the different results obtained for the different populations should be useful for comparisons with similar studies and for improving the identification of human skeletal remains.

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