SHORT REPORT

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Morphometry of the greater sciatic notch on remains of male Byzantine skeletons from Nicea

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Summary

It is well known that there are metric and nonmetric variations in the expression of sexual dimorphism between racial phenotypes and populations. The creation of skeletal anthropometric measurements of different populations is useful for both comparisons with similar studies and for improving the identification of 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. 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 26 adult male coxae of Byzantine skeletons (13th century) excavated at Nicea in Turkey. The results for the right and left greater sciatic notch were found to be AB: 46.00 mm (± 7.16) and 46.92 mm (± 5.93); OC: 25.23 mm (± 6.62) and 28.07 mm (± 4.78); OB: 20.30 mm (± 7.83) and 20.61 mm (± 5.25); Index I: 55.51 (± 15.83) and 61.02 (± 14.26); and Index II: 43.28 (± 11.35) and 44.67 (± 12.98), respectively. In conclusion, this study provides quantification of the features of the greater sciatic notch in the os coxae of late Byzantine period (13th century) skeletons that should be of value in forensic and archaeological analyses, especially when dealing with fragmentary remains.

Key words: Coxae – Greater sciatic notch – Late Byzantine period – Morphometric analysis

Introduction

There are metric and nonmetric differences in skeletal components among populations and these variations are related to genetic and environmental factors (geography, diet, life style…). 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. Correct sex identification of the human skeleton is important in bioarcheological and forensic practice (Bruzek, 2002).

Current opinion regards the hip bone (os coxae) as providing the highest accuracy levels for sex determination. Different techniques are used for the visual evaluation of traits of the hip bone (Phenice, 1969; Ferembach et al., 1980; Iscan and Derrick, 1984; Novotny, 1986; MacLaughlin and Bruce, 1990; Bruzek, 2002). The results of these methods have been inconsistent, since accuracy levels ranging from 59% to 96% are reported (Bruzek, 2002). However,

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although it is generally accepted that these methods provide satisfactory accuracy only a few studies have tested their reliability in known-sex samples and, surprisingly, the results are often ignored.

The greater sciatic notch is one of the sexually dimorphic traits of the hip bone and commonly used to determine sex in unknown individuals. Metric assessment of the greater sciatic notch has been carried out in several studies and has been evaluated for sex identification (Palfrey, 1974; Singh and Potturi, 1978; Dibennardo and Taylor, 1983; Kayalioglu et al., 1995; Akpan et al., 1998; Patriquin et al., 2002, 2003, 2005; Steyn et al., 2004). Different results related to the role of the features of the greater sciatic in sex determination were obtained in those studies. Based on these results, it appears that knowledge of specific standards of sexually dimorphic traits is necessary to improve the identification of human skeletal remains. Accordingly, studies addressing different populations may be of value for establishing standards of skeletal dimorphic traits.

The aim of this study is to report measurements of the greater sciatic notch of adult individuals of known sex from Late Byzantine (13th AD) skeletons and the racial characteristics of a single archaeological population.

Material and Methods

A total of 26 adult male coxae (they were not related to the same individuals) excavated from a Byzantine (13th century) burial site near Iznik (Nicea) Turkey were studied. They were derived from adult male skeletons (sexed by pelvic and cranial morphology) with healthy teeth, and mean age at death was calculated as approximately 35 years based on the morphology of the symphysial surface of the pubis and the degree of closure of the cranial structures (Ozbek, 1984). These individuals were thought to have been killed during a battle since evidence of traumatic injuries was observed on most of the skeletons. Only complete coxae were included in the study and the measurements were carried out by I. Ari.

Measurements were taken with the help of a stainless steel caliper. 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 (Singh and Potturi, 1978; Milne, 1990; Kayalioglu et al., 1995).

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 (Figure 1).

The following parameters of the greater sciatic notch were considered:

1. Maximal width (AB): The distance between the piriform tubercle and the tip of the ischial spine.
2. Maximal depth (OC): Perpendicular to the width.
3. (OB): Posterior segment of the width.
4. Index I: Maximal depth (OC) x 100 / Maximal width (AB)
5. Index II: Posterior segment of the width (OB) x 100 / Maximal width (AB)

These parameters were obtained from the available literature.

All linear measurements were in millimeters for each parameter. An independent samples t-test was used to compare left and right groups. It was accepted that the confidence interval of the difference was to be 95% and p values of 0.05 or higher were not significant. The SPSS ver. 11.0. program was used for descriptive analysis and the independent samples t-test.

Results

The results for the right greater sciatic notch were as follows: maximal width (AB): 46.00 mm (± 7.16); maximal depth (OC): 25.23 mm (± 6.62); width of the posterior segment (OB): 20.30 mm (± 7.83); Index I: 55.51 (± 15.83); and Index II: 43.28 (± 11.35), respectively (Table 1). The results for the left greater sciatic notch were; maximal width (AB): 46.92 mm (± 5.93); maximal depth (OC): 28.07 mm (± 4.78); width of the posterior segment (OB): 20.61 mm (± 5.25); Index I: 61.02 (± 14.26); and Index II: 44.67 (± 12.98) (Table 1).

These results were then compared for side differences and no noticeable difference was found between the left and right coxae ($p>0.05$).

Discussion

The morphology (maximal width, maximal depth, and posterior segment width) of the greater sciatic notch has been used in different studies addressing different populations for sex determination. Bruzek (2002) stated that the precision of sex determination using the morphology of the greater sciatic notch to describe the shape of the greater sciatic notch corresponds directly to an estimation of the discriminatory power (varying by around 70%) of this trait. Jovanovic et al. (1968) tested the reliability of the greater sciatic notch in sex determination on deformed ossa coxae and concluded that patho-

Table 1.- Measurements of the greater sciatic notch on the right and left male coxae from the late Byzantine period. (AB: maximal width; OC: maximal depth; OB: posterior segment of the width; Index I: OC x 100 / AB; Index II: OB x 100 / AB).

	Side	n	Mean	SD	p
AB	right	13	46.00	7.16	p>0.05
	left	13	46.92	5.93	
OC	right	13	25.23	6.62	p>0.05
	left	13	28.07	4.78	
OB	right	13	20.30	7.83	p>0.05
	left	13	20.61	5.25	
Index I	right	13	55.51	15.83	p>0.05
	left	13	61.02	14.26	
Index II	right	13	43.28	11.35	p>0.05
	left	13	44.67	12.98	

logical changes and abnormalities deforming the pelvis do not affect the greater sciatic notch in either sex and reported that this feature is still a reliable indicator in these conditions. Palfrey (1974) studied west African skeletons of known sex and found highly significant differences between the sexes regarding the width and posterior segment width of the greater sciatic notch, except for the depth of the greater sciatic notch. Singh and Potturi (1978) reported that the width and depth of the greater sciatic notch are useless criteria for sex identification but also that the width of the posterior segment and Index II successfully assigned sex to a high percentage of hip bones (95-97%). Dibennardo and Taylor (1983) 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 females in both races. Kayalioglu et al. (1995) analyzed the adult coxae of unknown sex from the skeletal collection at their department and found the maximal width, maximal depth and posterior width of the greater sciatic notch to be 36.71 mm, 24.96 mm, 7.14 mm, 70.87 and 17.32 for males, respectively. They reported that the maximum width was not a good parameter,

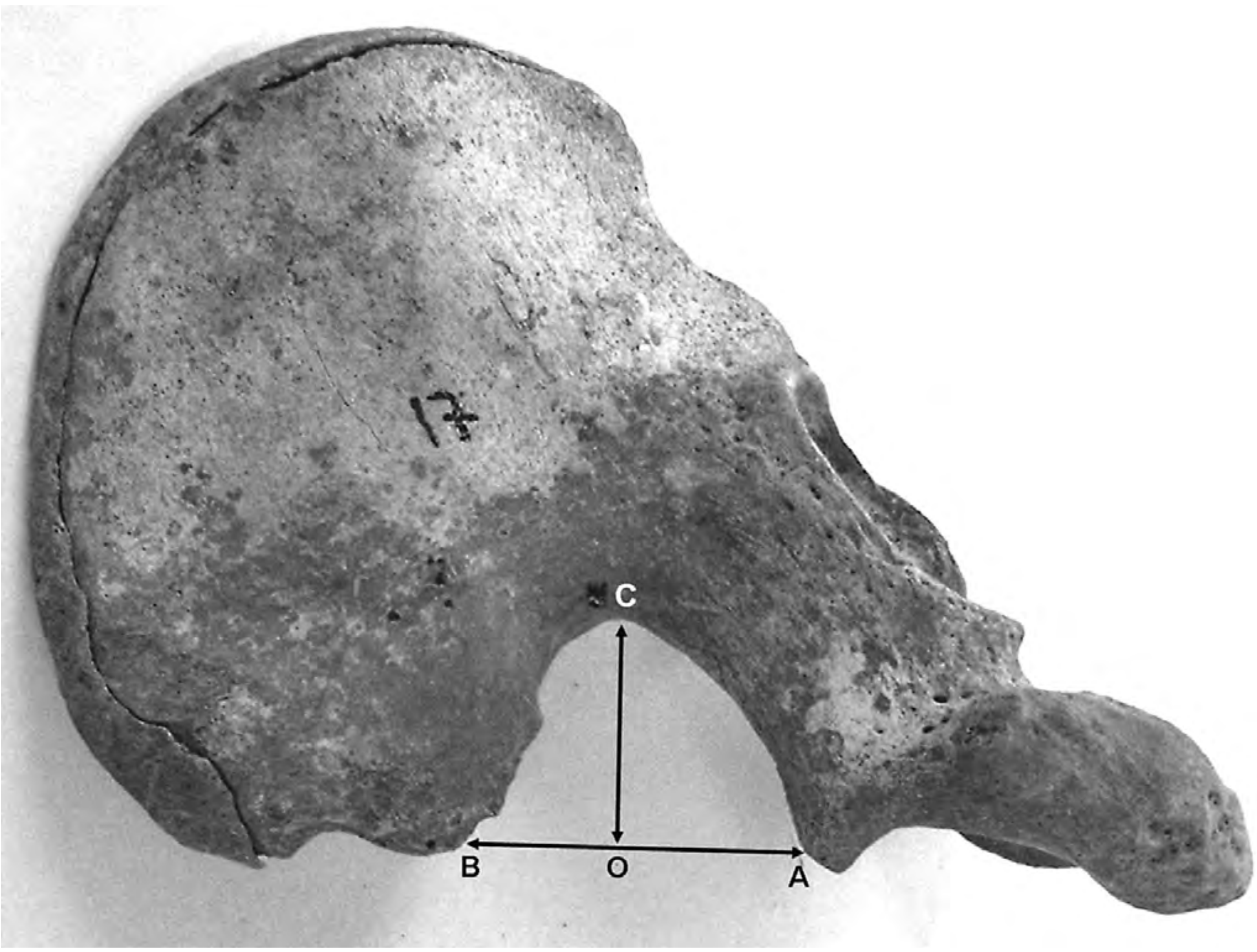

Fig. 1.- The greater sciatic notch and its features on the coxae. [from late Byzantine period (13^{th} AD) remains]. AB: maximal width; OC: maximal depth; OB: the width of the posterior segment.

Table 2.- Distribution of the validity of the features of the greater sciatic notch in sex determination according to different studies (+: valid feature, -: invalid feature). (AB: maximal width; OC: maximal depth; OB: posterior segment of the width; Index I: OC x 100 / AB; Index II: OB x 100 / AB).

Studies	Features of greater sciatic notch				
Author, year, population, n	max. width (AB)	max. depth (OC)	posterior width (OB)	Index I	Index II
Palfrey (1974) West African population n: 64	+	-	+	-	-
Singh and Potturi (1978) Indian population n: 200	-	-	+	-	+
Dibennardo and Taylor (1983) American whites and blacks Population, n: 260	-	+	-	-	-
Kayalioglu et al. (1995) Anatolian population n: 218	-	-	+	-	+
Akpan et al. (1998) Nigerian population n: 150	-	-	-	-	+
Patriquin et al. (2002) South African white and black population, n: 400	+	+	+	-	-
Steyn et al. (2004) South African white and black population, n: 115	+	-	-	-	-

while posterior segment width and Index II were indeed good parameters for sex determination. Akpan et al. (1998) used X-ray films (A-P view) of the pelvis of adult Nigerians to measure the width, depth, and posterior width 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. Patriquin et al. (2002, 2003 and 2005) found the maximal width, maximal depth, and posterior width of the greater sciatic notch to be 43.03 mm (in whites) and 36.96 mm (in blacks); 26.55 mm (in whites) and 22.68 mm (in blacks); 15.56 mm (in whites) and 9.31 mm (in blacks) for males, respectively. They reported that the width of the greater sciatic notch is larger in females, but deeper in males and that there are significant sex differences among both South African males and females and whites and blacks. Steyn et al. (2004) used geometric morphometric analysis of the greater sciatic notch and reported that this feature may not be so reliable, especially in South African white males. Nevertheless, they found that South African black males have a typical narrow shape, and that both black and white females have typical wide notches.

The above studies and our own present a metric assessment of the morphology of the greater sciatic notch and some of the studies question its role as an indicator of sexual dimorphism. According to previous studies there is some incompatibility related to the validity of the features of the greater sciatic notch in sex determination (Table 2). This incompatibility may be related to anthropometric differences among populations, the statistical analysis preferred in the different studies, and the ability of the observer.

Bruzek (2002) 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 (2002) indicated that it is difficult to admit that the sexual traits of the skeleton may be more 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 (Haun, 2000; Bruzek, 2002).

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 useful for comparisons with similar studies and for improving the identification of human skeletal remains.

References

Akpan TB, Igiri AO and Singh SP (1998). Greater sciatic notch in sex differentiation in Nigerian skeletal samples. *Afr J Med Med Sci,* 27: 43-46.

Bruzek J (2002). A method for visual determination of sex, using the human hip bone. *Am J Phys Anthropol,* 117: 157-168.

Dibennardo R and Taylor J (1983). Multiple discriminant function analysis of sex and race in the postcranial skeleton. *Am J Phys Anthropol,* 61: 305-314.

Ferembach D, Schwidetzky I and Stlonkal M (1980). Recommendations for age and sex diagnoses of skeletons. *J Hum Evol,* 9: 517-549.

Haun SJ (2000). Brief communication: a study of the predictive accuracy of mandibular ramus flexure as a singular morphologic indicator of sex in an archaeological sample. *Am J Phys Anthropol,* 111: 429-432.

Iscan MY and Derrick K (1984). Determination of sex from the sacroiliac joint: a visual assessment tecnique. *Florida Sci,* 47: 94-98.

Jovanovic S, Zivanovic S and Lotric N (1968). The upper part of the greater sciatic notch in sex determination of pathologically deformed hip bones. *Acta Anat,* 69: 229-238.

Kayalioglu G, Ozturk L and Varol T (1995). Morphometry of the incisura ischiadica major. *Med J Ege Univ*, 5: 77-80.

MacLaughlin SM and Bruce MF (1990). The accuracy of sex identification in European skeletal remains using the Phenice characters. *J Forensic Sci,* 35: 1384-1392.

Milne N (1990). Sexing of human os coxae. *J Anat,* 172: 221-226.

Novotny V (1986). Sex determination of the pelvic bone: a system approach. *Anthropologie,* 24: 197-206.

Ozbek M (1984). Roma Açikhava tiyatrosundan (Iznik) çikartilan Bizans iskeletleri. *Hacettepe Üniv Edebiyat Fak Derg,* 2: 81-89.

Palfrey AJ (1974). Proceedings: The sciatic notch in male and female innominate bones. *J Anat,* 118: 382.

Patriquin ML, Steyn M and Loth SR (2002). Metric assessment of race from the pelvis in South Africans. *Forensic Sci Int,* 127: 104-113.

Patriquin ML, Loth SR and Steyn M (2003). Sexually dimorphic pelvic morphology in South African whites and blacks. *Homo,* 53: 255-262.

Patriquin ML, Steyn M and Loth SR (2005). Metric analysis of sex differences in South African black and white pelves. *Forensic Sci Int,* 147: 119-127.

Phenice TW (1969). A newly developed visual methods of sexing the os pubis. *Am J Phys Anthropol,* 30: 297-301.

Singh S and Potturi BR (1978). Greater sciatic notch in sex determination. *J Anat,* 125: 619-624.

Steyn M, Pretorius E and Hutten L (2004). Geometric morphometric analysis of the greater sciatic notch in South Africans. *Homo,* 54: 197-206.