DETERMINATION OF SUBPUBIC ANGLE IN EGYPTIAN POPULATION

BY

Saly Y. Abd-El-hameed, Aml A. Mohamed and Hayam Z. Thabet

Department of Forensic Medicine and Clinical Toxicology,

Faculty of Medicine, Assiut University

ABSTRACT

Identification of sex in human skeletal remains is an important component and frequently the starting point of many forensic anthropological investigations. Skeletal biologists had recognized that each population group requires its own specific standards for accurate determination of sex. The pelvis is probably the most accurate bone from which sex can be determined. The subpubic angles show more definitive sex difference indicating the presence of interpopulation variations. This study was carried out to document regional and racial variability of these angles among Egyptians and comparing them with different population groups previously documented. The subpubic angle was measured in the antero-posterior radiographs of 400 adult Egyptians of known sex. The data was analysed using SPSS version 11 for statistical analysis. The results showed that the angles for males ranged from 66 to 126 degrees with a mean ± SD (102.31 ± 12.50) and for females from 96 to 191 degrees with a mean ± SD (143.28 ±15.82). The angles were significantly wider in females than males (P < 0.05). Using the demarking point method, 74% of Egyptian males and 86.5% of Egyptian females could be accurately sexed. In conclusion the subpubic angle is an anthropological characteristic of the Egyptian population that could be considerably used for sex determination with a high degree of accuracy.

Key Words: *Sex, Egyptians, Subpubic Angle, Demarking Point.*

INTRODUCTION

Sex determination of unknown skeletal material is one of the most vital determinations made by forensic anthropologists (Patriquin et al., 2005). It is widely recognized that skeletal characteristics vary among populations, thus each population should have specific standards to optimize the accuracy of identification (Iscan, 2005). Numerous studies had focused on the differences, both osteometric and morphological, between the sexes of a particular racial phenotype and population (Steyn and Iscan, 1998).

Original attempts to determine the sex were made for those bones of the pelvis and the skull with the idea that they are the best indicators of the gender. It is thought that, to some extent, the shape of the pelvis may correlate with that of the

skull since the skull must pass through the pelvis during the birth process (Iscan, 1983). The pelvis is probably the most accurate bone from which sex is determined, according to Krogman and Iscan (1986) 95% sexing accuracy can be expected if it is complete. The subpubic angle, ventral arc and composite arc showed correct sexing in over 98% of cases (Duric et al., 2005). This angle can be measured from skeletal specimens, and radiological pelvimetry and studies have shown no significant differences between both methods of measurement (Tague, 1989).

The literatures contain conclusive evidence that significant metric and morphologic biological differences exist among the three major racial phenotypes, Caucasoid, Mongoloid and Negroid. Moreover, a great deal of variation also exists at the population level, necessitating group specific standards (Brace, 1995).

Egypt is unique geographically, as it is located centrally to the three continents of Africa, Europe and Asia. Throughout history, the Greeks, Romans, Arabs, Turks, French and British have all ruled Egypt and mixed with its people, such that modern Egypt now is an amalgam of all these legacies. As regard to allelic frequencies Egyptians resemble Caucasians (Hamdy et al., 2002). Further research is needed to develop population specific osteological standards for Africa, central and south East Asia and Pacific region populations. In addition, there will be an increased interest in the study of living people (Iscan, 1998).

Because of the clear heterogeneity and genetic admixture in the Egyptian population, this study was done to develop group specific standards of sex identification for this population.

MATERIAL AND METHODS

The study investigated 400 anteroposterior radiographs of the pelvis comprising 200 males and 200 females aged from 17 to 80 years from the Department of Urology-Assiut University hospital. The radiographs were chosen normal, showed no underlying bone disease or fracture, and were taken for other urological diseases, which did not affect the intact pelvic bones. Furthermore, only radiographs with complete alignment at the inferior margins of the pubic bones at the pubic symphysis were measured because determination of misalignment is best made at the inferior margins (Lusted and Keats, 1978).

Each radiograph was placed on X-ray film viewer, and the subpubic angle was that formed by the inferior border of the 2 pubic bones joining the symphysis pubis. A point was chosen at the inferior midline of the interpubic disc (appears transparent

in the film), and two tangential lines were drawn at the inferior borders of the pubic rami intersecting at an angle at the chosen point. Protractor was placed over the intersection of these two lines, and the inferior angle measured (Fig. 1). Each angle was measured twice by the same person to ensure accuracy. The average of the two measurements was used. Age and sex of the subject together with the angles measured were recorded on the radiograph jacket.

Statistical analysis:

The results were analyzed with SPSS version 11, and compared with previous studies in Ugandan population (Igbigbi and Igbigbi, 2003), Malawians population (Msamati et al., 2005), Amerindians population, and black and white Americans population (Igbigbi and Igbigbi, 2003). Two-sample t tests were used to compare each pair of studies for males and for females separately. Sidak's adjustment for multiple comparisons was used. The difference is significant at 5% (*) and 1% (**) levels respectively.

Sex was determined by using the demarking point method of Singh and Potturi (1978). This method involved calculating the maximum and minimum limits of the range of the subpubic angle by using the formula mean $\pm$ 2 standard deviation (SD). The demarking point for males was the minimum calculated range for females, while for females it was the maximum calculated range for males. Subpubic angles below the male identification values identified as male pubic bones, while those below the female identification values identified as of females.

To test the accuracy of the method 100 radiographs of the pelvis were randomly selected with unknown sex not a part of the original study. The subpubic angle was measured in the same way and sex was identified by applying the demarking point which was concluded for the Egyptians in this study.

RESULTS

Table (1) presents the range, mean, demarking point of subpubic angles and accuracy rate % of sex identification in the studied Egyptian sample.

The subpubic angles range from 66° to 126° in Egyptian males and from 96° to 191° in Egyptian females. The calculated range (mean $\pm$ 2 SD) of Egyptian males and females is 77.31°- 127.31° and 111.64°-174.92° respectively. Using the demarking point calculated from the mean $\pm$ 2 SD, sex can be identified in the Egyptian population. The Egyptian males can be identified to have subpubic angles less than 111.64° and the Egyptian females have subpubic angles more than 127.31°. The accuracy rate of sex determination is 74 % for deter-

mination of males and 86.5% for determination of females.

Table (2) shows the mean of the subpubic angles in both sexes of Egyptian population. Females have wider angles than males (143.28° ± 15.82 and 102.31°± 12.50 respectively). The subpubic angles show significant differences between both sexes ($P < 0.05$). The overall angle for the population was 122.79°.

Table (3) presents the range, mean, demarking point and accuracy rate of subpubic angles in Ugandans and Malawians subjects previously studied with similar methods (Igbigbi and Igbigbi, 2003; Msamati et al., 2005)

The mean ± SD values in Ugandan and Malawians of males and females (93.86° ± 21.12, 116.11°± 17.79, 99.16° ± 15.73 and 129.07°± 14.19 respectively) were lower than those of both sexes in Egyptians. Ugandan and Malawians females had significantly wider subpubic angles than males ($P < 0.05$).

Using the demarking point calculated from the mean ± 2 SD, sex was identified in the Ugandan population as males if the subpubic angle was below 80.53° and as female if above 136.10°. In Malawians males had subpubic angle below 99.95° and females above 130.62°. Sex could be accurately assigned to 31.82 % in Ugandans males and 10.53 % of Ugandans females and 67.12% of Malawian males and 63.02 % of Malawian females were accurately sexed.

Table (4) shows the mean of subpubic angles in different population groups. The race was assigned from the overall mean for each racial group; Amerindians, Black race (Ugandans, Malawians and black Americans) and white Americans. The overall mean of subpubic angles were used for race determination as follows: subpubic angles of more than 76.05° to less than 80.25° indicated white Americans, more than 80.25° to less than 98.21° indicated Amerindians and more than 98.21° indicated black race.

Table (5) represents the racial variability in Egyptians compared to other races (Ugandans, Malawians, Amerindians and white and black Americans). Comparing the Egyptians, versus (vs.) other populations there are significant differences between the pairs both in males and females.

DISCUSSION

The accurate identification of sex and race in human skeletal remains is pivotal to forensic and physical anthropology (Kerley, 1972; Brooks, 1975), especially because of the escalating crime rate, which have became a worldwide phenomenon. This accuracy requirement stresses the

need to recognize new, cheap, and probably more accurate means of determining sex and race when it is needed (Steyn et al., 1997; Iscan, 1998).

Pelvic dimensions have been shown to be important in forensic medicine; these measurements display individual and racial differences, which have been found to be greater in the inferior aperture than the brim (Williams et al., 1989).

Comparing the mean ± SD of subpubic angles in Egyptian males and females revealed the existence of high significant difference between both sexes ($P < 0.0001$). The same had been observed in previous studies on Ugandans (Igbigbi and Igbigbi, 2003), Malawians (Msamati et al., 2005), Amerindians, white and black Americans (Igbigbi and Igbigbi, 2003). Significant differences in the subpubic angles were also found to exist between the Egyptians compared to all other races in both sexes ($P < 0.05$).

In the present study using the demarking point method, sex could be assigned in the Egyptians as males if the subpubic angles are less than 111.64° with accuracy rate of 74% and identified as females if the angles are more than 127.31° with accuracy rate of 86.5%.

The accuracy rate for sex determination among Egyptians is higher than that recorded among Ugandans and Malawians (31.82% for males, 10.53% for females, 67.12% for males and 63.02% for females respectively) (Igbigbi and Igbigbi, 2003; Msamati et al. 2005). Nwoha (1995) reported that 93% of Nigerian females had subpubic angle above 111.3 degrees and concluded the relevance of the angle in sex determination using the demarking point.

The race was assigned from the overall subpubic angles of the population comparing Egyptians with Amerindians, white Americans (Igbigbi and Igbigbi, 2003) and black race [Ugandans (Igbigbi and Igbigbi, 2003), Malawians (Msamati et al., 2005), and black Americans (Igbigbi and Igbigbi, 2003)].

Egyptians are identified by their subpubic angles ranged from 98.25 to 122.79°. The subpubic angles of more than 76.05 ° to less than 80.25° indicate white Americans, more than 80.25° to less than 98.21° indicate Amerindians and more than 98.21° indicate black race. In comparison with other populations, as anticipated, Egyptians are closest to the neighboring population of black races.

The direction of size difference between the races was consistent, with blacks having wider subpubic angles than whites. The presence of sexual, regional, and racial variability of the subpubic angles could possibly be explained on genetic,

dietary, and environmental factors (Tague, 1992).

Comparing the subpubic angles of both sexes in the Egyptian population with other populations there was a high statistical significant racial variability.

In this study only one parameter (subpubic angle) was used with application of demarking point method giving accuracy rate of 74%- 86.5% for sex identification in males and females respectively. Phenice (1969) stated that attempts to sex an unknown pelvis using one criterion alone could determine sex in 70 % of cases, while using several criteria could give 95% accuracy. In the study done by Singh and Potturi (1978) they found that application of the demarking points of seven parameters of the hip bone also identified sex in 75 to 100% of the cases with 100% accuracy.

In conclusion the subpubic angle in Egyptian population shows a high accuracy rate for sex determination with high racial variability that allows its use in medicolegal identification of sex and race.

Acknowledgement:

We acknowledge Prof. Dr. Alaa Ezzat Professor of Urology for providing us with the X-ray films, Prof. Dr. Afaf M.A. Farghaly Professor of Forensic Medicine and Toxicology and Prof. Dr. Abd el Wahab Dawood Professor of Forensic Medicine and Toxicology for revising the manuscript.

Table (1) : The range, mean, demarking point and accuracy rate of subpubic angles in Egyptian males and females.

Sex	Range	Mean ± SD	Calculated range (Mean ±2 SD)	Demarking point	Accuracy rate of sex determination (%)
Males (n=200)	66° - 126°	102.31±12.50	77.31° - 127.31°	< 111.64°	74%
Females (n=200)	96° - 191°	143.28± 15.82	111.64°-174.92°	> 127.31°	86.5%

Table (2) : Mean subpubic angles in Egyptian males and females.

Population group	Sex	Mean±SD	P value	Overall mean angle
Egyptians	**Males** (n=200)	102.31°± 12.50	**<0.0001****	**122.79**°
	Females (n=200)	143.28 °± 15.82		

** Highly significant at P <0.001.

Table (3) : The range, mean, demarking point and accuracy rate of subpubic angles in Ugandans and Malawians subjects previously studied with similar methods (Igbigbi and Igbigbi, 2003; Msamati et al., 2005).

Population groups	Sex	Range	Mean±SD	Calculated range (Mean±2 SD)	Demarking point	Accuracy rate of sex determination (%)
Ugandans (Igbigbi and Igbigbi, 2003)	**Males** (n=110)	50°-140°	93.86 ±21.12	51.62°-136.10°	<80.53	31.82 %
	Females (n=95)	75°-155°	116.11 ±17.79	80.53°-151.69°	>136.10	10.53 %
Malawians (Msamati et al., 2005)	**Males** (n=73)	66°-150°	99.16 ± 15.73	76.79°-130.62°	<99.95	67.12%
	Females (n=46)	86°-174°	129.07± 14.19	99.95°-158.19°	>130.62	63.02%

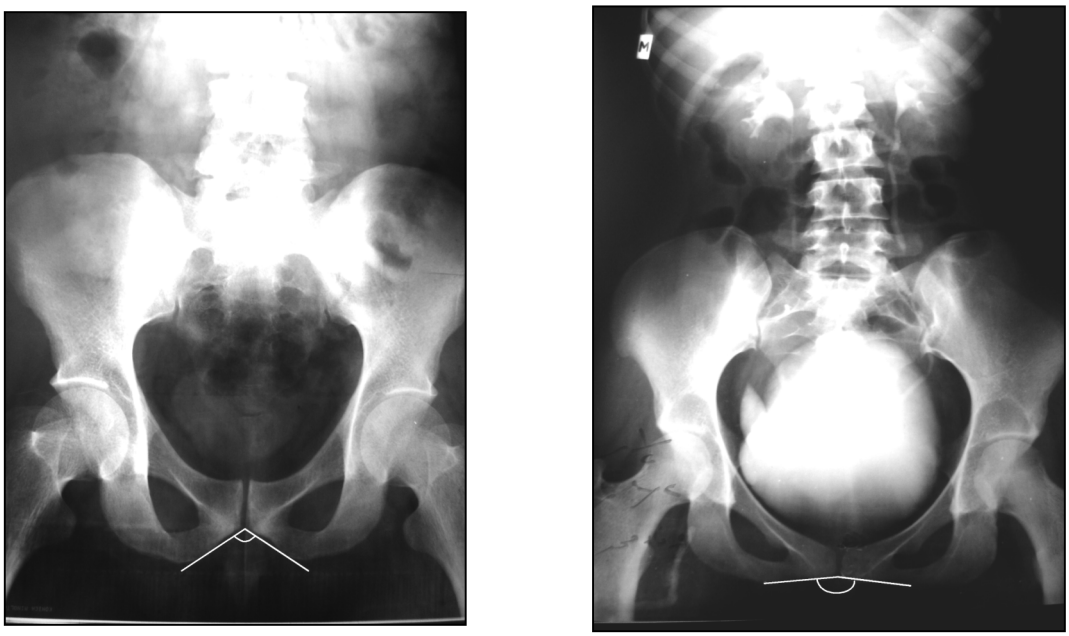
Table (4) : Mean Subpubic Angles in different population groups.

Population groups	Sex	n	Mean±SD	Overall mean angle
Ugandans (Igbigbi and Igbigbi, 2003)	**Males** **Females**	**110** **95**	93.86±21.12 116.11±17.79	**98.21°**
Malawians (Msamati et al., 2005)	**Males** **Females**	**73** **46**	99.16± 15.73 129.07± 14.19	
Black Americans (Igbigbi and Igbigbi, 2003)	**Males** **Females**	**50** **49**	65.8± 8.7 85.2±8.5	
White Americans (Igbigbi and Igbigbi, 2003)	**Males** **Females**	**50** **50**	63.7± 7.8 88.4± 8.5	**76.05°**
Amerindians (Igbigbi and Igbigbi, 2003)	**Males** **Females**	**253** **212**	67.4±8.1 93.1±10.4	**80.25°**

Table (5) : The racial variability in Egyptians compared to other races.

Pair of Studies	Difference in Mean	*t*	P
Males			
Egyptians vs Ugandans	-8.45	9.56	0.0000**
Egyptians vs Malawians	-3.11	3.52	0.001**
Egyptians vs black Americans	-36.51	41.31	0.0000**
Egyptians vs white Americans	-38.61	43.69	0.0000**
Egyptians vs Amerindians	-34.91	39.50	0.0000**
Females			
Egyptians vs black Ugandans	-27.17	24.29	0.0000**
Egyptians vs black Malawians	-14.18	12.68	0.0000**
Egyptians vs black Americans	-58.08	51.92	0.0000**
Egyptians vs white Americans	-54.88	49.06	0.0000**
Egyptians vs Amerindians	-50.18	44.86	0.0000**

Vs: versus
** Highly Significant P< 0.001



a) In a male. **b)** In a female.

Fig. (1) : Anteroposterior radiograph of pelvis demonstrates the subpubic angle.

REFERENCES

Brace, C. (1995) : "Region does not mean ''race''- reality versus convention in forensic anthropology". J. Forensic Sci., 40 (2): 171-175.

Brooks, S. T. (1975) : "Human or not? A problem in skeletal identification". J. Forensic Sci., 20(1): 149-153.

Duric, M.; Rakocevic, Z. and Donic, D. (2005) : "The reliability of sex determination of skeletons from forensic context in the Balkans". Forensic Sci. Int., 147 : 159-164.

Hamdy, S. I.; Hiratsuka, M.; Narahara, K.; El-Enany, M.; Moursi, N.; Ahmed, M. S. and Mizugaki, M. (2002) : "Allele and genotype frequencies of polymorphic cytochromes P450 (CYP2C9, CYP2C19, CYP2E1) and dihydropyrimidine dehydrogenase (DPYD) in the Egyptian population". Br. J. Clin. Pharmacol., 53(6): 596-603.

Igbigbi, P. S. and Igbigbi, A. M. (2003) : "Determination of sex and race from the subpubic angle in Ugandan subjects". Am. J Forensic Med. Pathol., 24 : 168-172.

Iscan, M. Y. (1983) : "Assessment of race from the pelvis". Am. J. Phys. Anthropol., 62: 205-208.

Iscan, M. Y. (1998) : "Progress in forensic anthropology: the 20th century". Forensic Sci. Int., 98: 1-8.

Iscan, M. Y. (2005) : "Forensic anthropology of sex and body size". Forensic Sci. Int., 147: 107-112.

Kerley, F. R. (1972) : "Special observations in skeletal identification". J. Forensic Sci., 17 (3): 349-357.

Krogman, W. M. and Iscan, M. Y. (1986) : The Human Skeleton in Forensic Medicine. 2nd edition, Ch. 6, Charles C. Thomas. Springfield, IL, P.P. 208-224.

Lusted, L. B. and Keats, T. E. (1978) : The lower extremity. In: Atlas of Reontgenographic Measurements. Lusted, L.B.; Keats, T.E. (Eds.), 2nd edition, London, England, Yearbook Medical Publishers, P. 165.

Msamati, B. C.; Igbigbi, P. S. and Manda, J. K. (2005) : "The subpubic angle in adult indigenous Malawian subjects". East Afr. Med. J., 82(12): 643-648.

Nwoha, P. U. (1995) : "The anterior dimensions of the pelvis in male and female Nigerians". Afr. J. Med. Sci., 24(4): 329-335.

Patriquin, M. L.; Steyn, M. and Loth, S. R. (2005) : "Metric analysis of sex differ-

ences in South African black and white pelves'. Forensic Sci. Int., 147: 119-127.

Phenice, T. W. (1969) : "A newly developed visual method of sexing the os pubis". Am. J. Phys. Anthropol., 30:297-302.

Singh, S. P. and Potturi, B. R. (1978) : "Greater sciatic notch in sex determination". J. Anat., 125: 619-624.

Steyn, M. and Iscan, M. Y. (1998) : "Sexual dimorphism in the crania and mandibles of South African whites". Forensic Sci. Int., 98: 9-16.

Steyn, M.; Meiring, J. H. and Nienaber, W. C. (1997) : "Forensic anthropology in South Africa: a profile of cases from 1993 to 1995 at the Department of Anatomy, University of Pretoria, South Africa". J. Ethnol., 20: 23-26.

Tague, R. G. (1989) : "Variation in pelvic size between male and females". Am. J. Phys. Anthropol., 80:59-71.

Tague, R. G. (1992) : "Sexual dimorphism in the human bony pelvis, with a consideration of the Neanderthal pelvis from Kehara Cave, Israel". Am. J. Phys. Anthropol., 88: 1-21.

Williams, P. L.; Warwick, R.; Dyson, M. and Bannister, L. H. (1989) : Sexual differences in the pelvis. In: Gray's Anatomy. Williams, P.L.; Warwick, R.; Dyson, M.; Bannister, L.H. (Eds.), 37th edition, London", Churchill Livingstone, P.P. 431-444.

تحديد الزاوية السفلى لعظم العانة فى المصريين

المشتركون فى البحث

د. سالى يحيى عبدالحميد د. أمـل علـى محمـد

د. هيام زكريا ثابت

قسم الطب الشـرعى والسموم الإكلينيكية

كلية الطب - جامعـة أسيوط

تحديد الجنس والعرق من البقايا العظمية الآدمية يعتبر جزء مهم ودائماً مايكون نقطة البداية فى الدراسات الطبية الشرعية ودراسات قياسات الجسم البشرى، وقد اتضح من خلال الأبحاث أن كل مجموعة من البشر يحتاجون لتسجيل قياسات خاصة بهم تميزهم عن غيرهم خاصة فى تحديد الجنس.

تعتبر عظام الحوض من العظام الأكثر تحديداً للجنس فى الإنسان والزاوية السفلى لعظم العانة تعتبر الأفضل تميزاً فى تحديد الجنس ولها خصائص تميز سكان المناطق المختلفة عن بعضهم البعض.

أجريت هذه الدراسة لتسجيل وتوثيق الاختلافات العرقية للزاوية السفلى لعظم العانة فى المصريين واستخدامها لتحديد الجنس ومقارنتهم بدراسات سابقة لشعوب أخرى.

فى هذه الدراسة تم قياس الزاوية السفلى لعظم العانة لعدد أربعمائة شخصاً بالغين (مائتين ذكور ومائتين إناث) وذلك من خلال صور أشعة سينية أمامية خلفية لعظام الحوض وتم عمل الدراسات الإحصائية وقياس مائة أشعة سينية أمامية خلفية لعظام الحوض، وتم عمل الدراسات الإحصائية وقياس مائة أشعة أخرى غير معروفة الجنس وتحديد الجنس عن طريق "تحديد النقطة" المحددة من خلال النتائج لقياس نسبة دقة النتائج.

من الدراسة اتضح أن الزاوية السفلى لعظم العانة أوسع فى الإناث عنها فى الذكور ولها دلالة إحصائية فى التمييز بين الذكور والإناث، وقد وجد أن الزاوية تتراوح بين ٦٦-١٢٦ درجة فى الذكور ومتوسط ± الانحراف القياسى ١٠٢,٣١ ± ١٢ر٥ وبين ٩٦-١٩١ درجة فى الإناث والمتوسط ± الانحراف القياسى ١٤٣ر٢٨ ± ١٥ر٨٢. باستخدام طريقة "تحديد النقطة" وجد أنه يمكن تحديد الجنس فى المصريين بنسبة دقة تتراوح بين ٧٤٪ للذكور و٨٦ر٥٪ للإناث، وقد وجد إن هذه النسبة أعلى من الموجودة فى دراسات سابقة والتى أستخدمت نفس الطريقة .

مما سبق نستنتج أن الزاوية السفلى لعظم العانة فى المصريين لها أهمية فى تحديد الجنس بدقة عالية وتميزهم عن شعوب أخرى.